The AIRCRAFT YEAR BOOK *For 1951*

TERRESA SMITH

The
AIRCRAFT YEAR BOOK

1951


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THE
AIRCRAFT YEAR BOOK
1951

Official Publication

of

THE AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC.

Thirty-third Annual Edition

Editors

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The contents of the 1951 Aircraft Year Book represent the work of some of the best editorial talent in the aviation industry. Only through the generous collaboration of company public relatons officials, aviation writers volunteering their services from the sidelines, or aircraft executives for the moment more interested in documenting aviation history than in making it, has this edition been possible. In sum, the 1951 Aircraft Year Book represents the combined editorial talent of the industry, and we are as grateful for their aid and advice as we are lacking in space to list all the names of those who have made the book possible. We should, however, like to take this occasion to express our special gratitude to the patient cooperation and helpful criticism of the Year Book Editorial Board of the Public Relations Advisory Committee of the Aircraft Industries Association, who gave much valuable time in suggesting the handling of the material. The Committee included Mr. Paul Fisher, Director of Public Relations, United Aircraft Corp.; Mr. George Hammond, Executive Vice President, Carl Byoir Associates; and Mr. Ed Ryan, Director of Public Relations, North American Aviation. Coordinating the work of the Committee was Mr. Avery M. McBee, Director of Public Relations of the Aircraft Industries Association. We are also especially grateful to Burt English, AIA; Max Karant, AOPA; Charles E. Planck, CAA; Edward E. Slattery, CAB; Terresa Smith, AIA; Elmer Thompson, ATA; and Arthur Renstrom, Library of Congress.

THE EDITORS

Foreword

The most important feature of America's rearmament program in 1951 was the effort applied to the rebuilding of America's air power and that of our allies. Almost half of the money appropriated by Congress in the past two years for the procurement of "hard goods" for the military services has been earmarked for the production of aircraft and aircraft equipment.

The 1951 edition of the Aircraft Year Book recounts in detail air power achievements during the past full year of partial mobilization. At the time, it highlights the critical problems faced in the course of the expansion of our military forces—problems which may well continue to confront us as we approach peak production levels in the year ahead.

Military aircraft production schedules in 1951 have not been met. There are many reasons for this failure. The original schedules admittedly were overly optimistic. Shortages of machine tools seriously interfered with production, especially in the engine and component fields. These shortages in turn delayed deliveries of finished fly-away aircraft.

Materials shortages contributing to production slippages were experienced in varying degrees of severity with a gradual improvement during the year as greater emphasis was accorded the military programs.

All these difficulties of course stem from the fact that we have been trying to superimpose a multibillion dollar defense program upon a booming civilian economy. This is certainly a worthy objective but it is obvious that we cannot now have everything that we desire. The ascendancy of the military program must reflect a corresponding decrease in the civilian program until the products of new productive capacity become available.

In addition to reporting on the problems of aircraft production, the 1951 Aircraft Year Book provides, as it has in the past, a report on the activities of the military services, covering the expansion of our Air Force, Naval Air Arm, Marine Air and Army Aviation, with special emphasis on their achievements in the Korean War. It also contains a full report on our commercial airlines, which established new records of safety and service to the American public, as well as many other features covering a wide range of aviation interests.

Building and maintaining airpower is a costly, long term job. In no other field is qualitative superiority so essential. In no other field does obsolescence occur so rapidly. On our national determination to build such forces, and on the nation's ability to produce the planes and provide the trained men required to make this force effective, may well depend the future security of the United States. We must have a well informed public to obtain and sustain this national determination and effort.

Historically the objective of the Aircraft Year Book has been to provide in a comprehensive, readable fashion, a report to the American public on the status of its airpower. It has reported the facts as they are, and it continues its factual presentation in this issue. It is a pleasure for the Aircraft Industries Association, representing the aircraft manufacturing industry, to officially sponsor this 33rd edition of the Aircraft Year Book.

I am confident that the year book will be a worthy addition to any aviation library, and a reference work of value to students and writers on aviation matters.

D. C. RAMSEY, *President,*
The Aircraft Industries Association of America, Inc.

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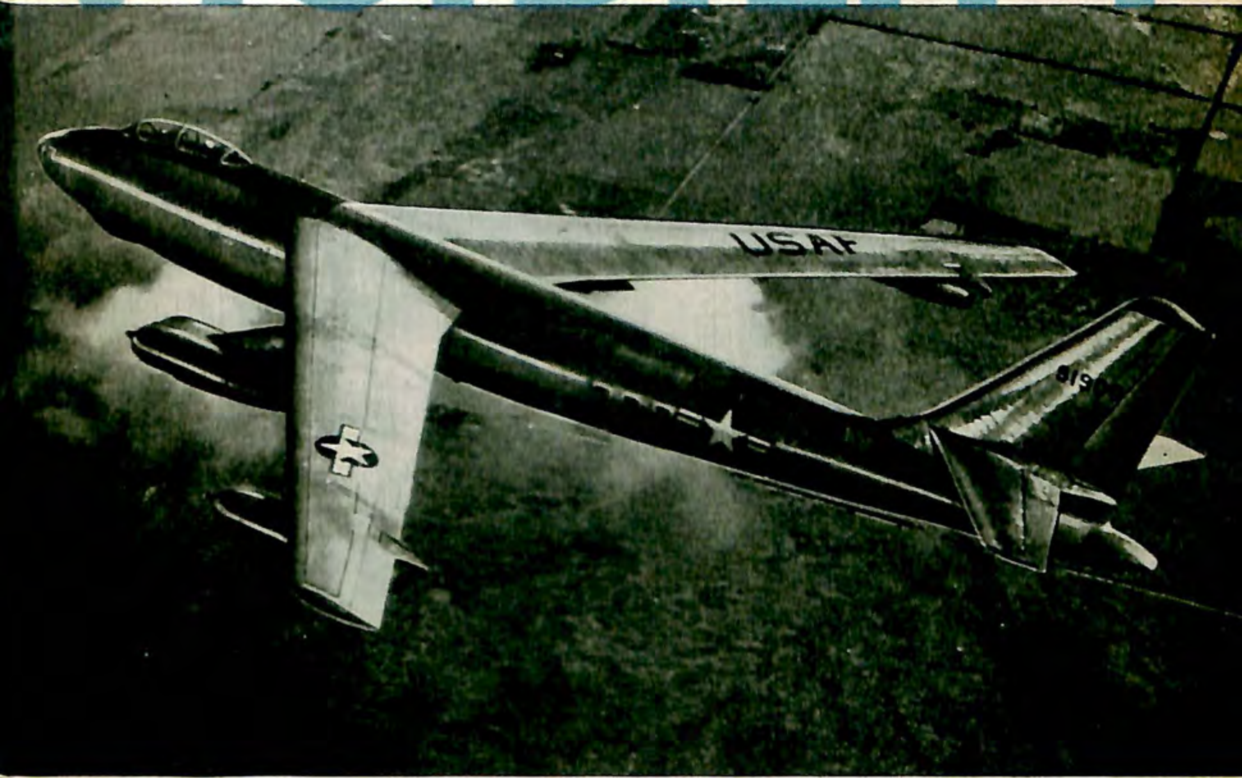

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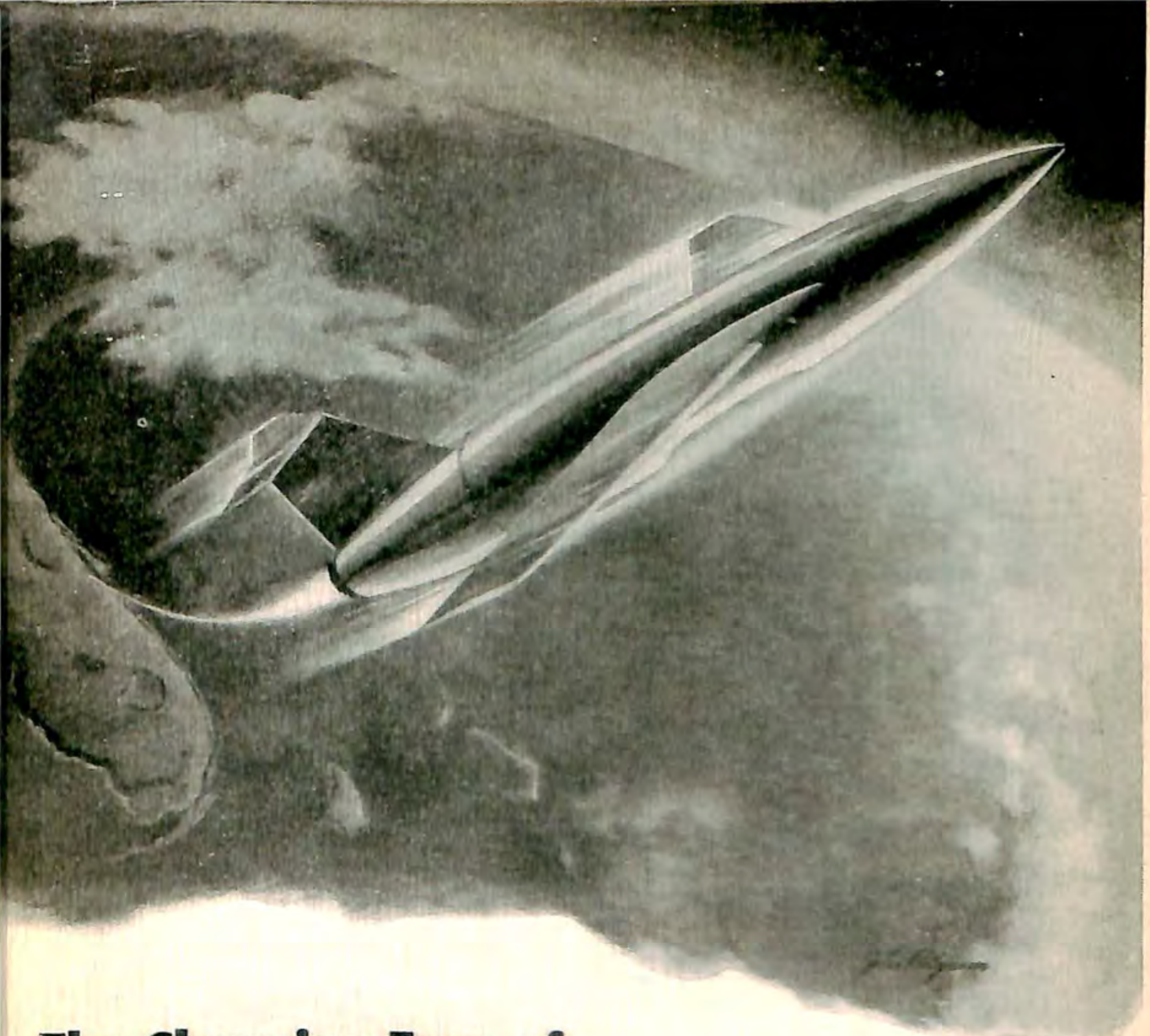

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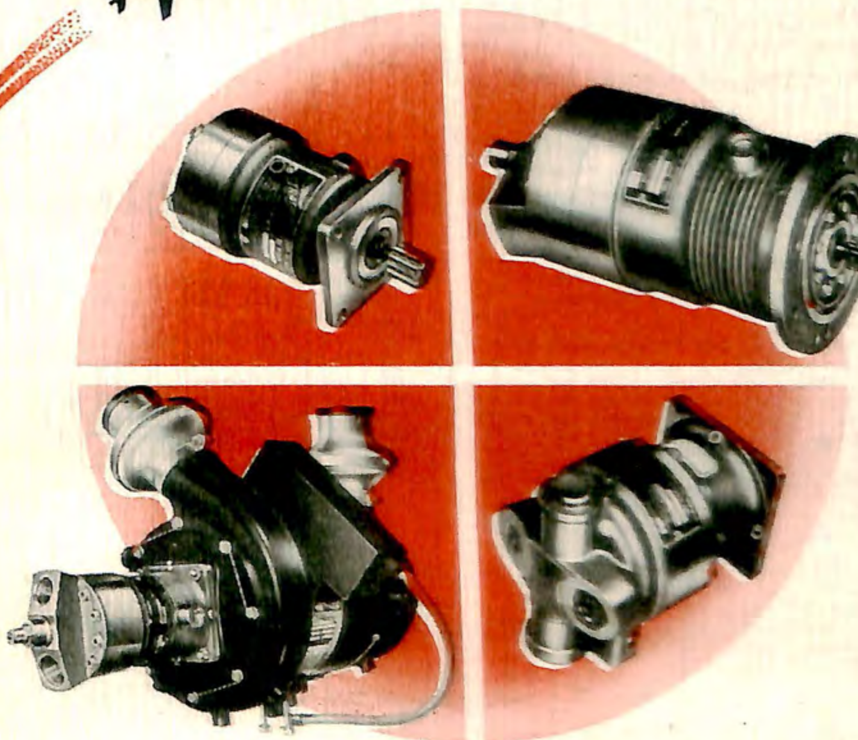

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Contractions. 5th ed. June 1, 1951. Office of Federal Airways, Communications Division. Washington, U. S. Govt. Print. Off. 50p. $.30

ROTOR AIRCRAFT

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KEYES, LUCILE SHEPPARD. Federal Control of Entry into Air Transportation. Cambridge, Mass., Harvard University Press. 405p. Harvard Economic Studies, vol. 90) $6.00

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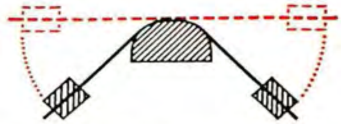

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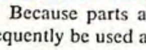

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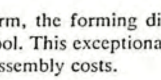

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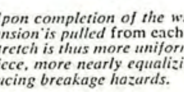

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SUMMARY STATISTICS

The following statistics are as nearly up-to-date as was practicable at the time the Year Book went to press. Wherever possible, last-minute, 1951 figures were included in the main text of the book, and may be found under appropriate chapter headings.

The Editors

AVERAGE WEEKLY HOURS IN THE AIRCRAFT, ENGINE, PROPELLER, AND PARTS INDUSTRY

(Source: Bureau of Labor Statistics)

Year and Month	Aircraft and Parts	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1948	41.0	41.1	40.0	39.7	41.0
1949	40.6	40.5	40.7	41.0	40.4
1950	41.6	41.4	42.1	42.4	41.7
1951					
January	43.7	43.2	45.1	45.3	44.8
February	43.3	42.7	45.3	46.3	44.1
March	43.9	43.5	45.7	46.3	44.2
Aprinl	44.0	43.5	46.0	46.9	44.1
May	43.9	43.3	46.2	46.0	43.9
June	43.8[a]	43.3	46.3[a]	47.3[a]	43.5[a]
July	43.7	43.5	45.7[a]	48.1[a]	42.5[a]
August	43.5	43.6	45.0	47.5	42.6
AVERAGE WEEKLY EARNINGS					
1948	61.21	60.21	63.40	62.13	63.59
1949	63.62	62.69	65.24	66.83	65.08
1950	68.39	67.15	71.40	73.90	70.81
1951					
January	76.78	74.52	82.94	87.11	80.06
February	75.86	73.49	83.49	90.01	78.10
March	77.35	75.04	86.19	90.42	79.34
April	77.13	74.43	86.80	90.38	79.25
May	77.22	74.69	86.67	87.68	78.45
June	77.31	75.00	88.06[a]	90.77[a]	77.43[a]
July	77.57[a]	76.13	86.56[a]	92.11[a]	75.86[a]
August	77.47	76.56	85.01	90.49	76.08
AVERAGE HOURLY EARNINGS					
1948	1.493	1.465	1.550	1.563	1.551
1949	1.567	1.548	1.603	1.630	1.611
1950	1.644	1.622	1.696	1.743	1.698
1951					
January	1.757	1.725	1.839	1.923	1.787
February	1,752	1,721	1.843	1.944	1.775
March	1.762	1.725	1.836	1.953	1.795
April	1.753	1.711	1.887	1.927	1.797
May	1.759	1.725	1.876	1.906	1.787
June	1.756[a]	1,732	1.902[a]	1.919	1.780[a]
July	1.775[a]	1.750	1.894[a]	1.915[a]	1.785[a]
August	1.781	1.756	1.889	1.905	1.786

[a]Revised.

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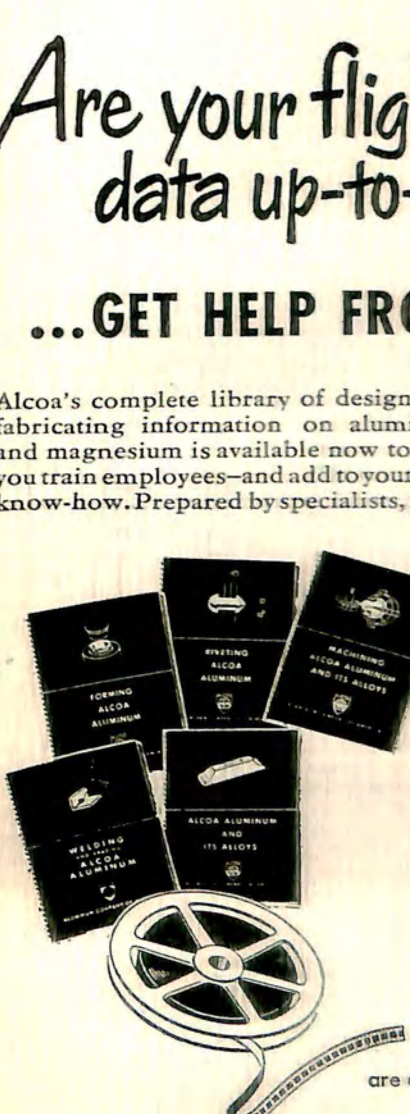

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CIVIL AIRPLANE OUTPUT

By Power and Types

(Source: Aircraft Industries Association)

1936-1951

	1936	1937	1938	1939	1940	1941	1945
Total	1,637	2,289	1,823	3,715	6,785	6,844	2,047
				By number of engines			
Single-engine	1,526	2,171	1,770	3,613	6,562	6,629	1,946
Multi-engine	111	118	53	102	167	165	101
Unclassified	0	0	0	0	56	50	0
				By horsepower			
50 hp. and under	772	1,393	1,350	1,686	490	7	0
51-70 hp.	109	44	23	1,349	4,529	4,303	1,828
71-100 hp.	122	183	61	311	935	1,805	105
101-165 hp.	171	193	149	120	211	206	13
166-225 hp.	75	47	16	9	318	309	0
226-300 hp.	214	199	122	86	37	15	0
301-600 hp.	109	142	54	76	72	31	28
601-1,800 hp.	65	88	48	78	137	118	63
	0	0	0	0	0	0	10
Unclassified	....	0	0	0	56	50	0
				By types			
Landplanes:							
1-2-place	....	1,668	1,487	3,118	5,527	6,060	1,929
3-5-place	....	460	258	465	1,031	573	17
6-20-place	....	48	26	21	8	3	63
21-place and over	....	57	17	55	132	112	10
Seaplanes	....	41	26	51	18	16	0
Amphibians	....	15	10	5	3	30	28
Unclassified	0	0	0	0	66	50	0

1946-1949[1]

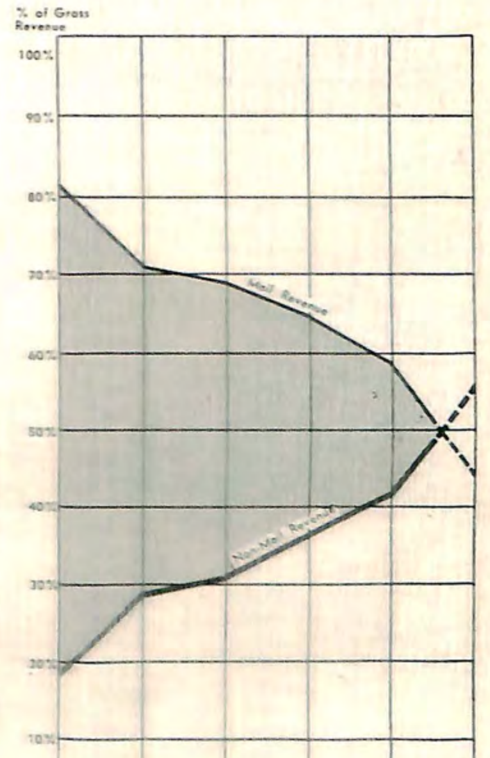
	1946	1947	1948	1949	1950
Total Civil	35,001	15,617	7,302	3,545	3,520
Personal	34,568	15,339	7,039	3,379	3,391
Transport	433	278	263	166	129
By Place:					
2-place	30,766	7,273	3,302	996	1,029
3- to 5-place	3,802	8,066	3,737	2,383	2,362
Over 5-place	433	278	263	166	129
By Horsepower:[2]					
1-74	20,659	2,372	2,990 (1-74 and 75-79)	930 (1-74 and 75-79)	597 (1-74 and 75-79)
75-79	9,122	4,690			
100-399	4,736	8,246	4,026	2,440	2,789
400-3,999	345	129	286 (400-3,999 and 4,000 and over)	174 (400-3,999 and 4,000 and over)	134 (400-3,999 and 4,000 and over)
4,000 and over	139	180			

[1]Exports excluded 1936-1941; no civil production during 1942-44; exports included 1945-50.
[2]Total rated horsepower of all engines.

LOCAL SERVICE AIRLINES

1951 was the most important year in the history of local service airline development.

The FLIGHT Magazine chart at right reveals that local service mail and non-mail revenue has reached a balance with anticipated trend showing non-mail revenues will exceed mail payments for the first time.



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FLIGHT

MAGAZINE

1901 McKINNEY AVE.

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U.S. AIRCRAFT PRODUCTION
1909-1950

(Source: Bureau of Census, Facts for Industry, Series M42A)

Year	Total	U.S. Military	Others
1909	1	1	0
1910	[1]	[1]	[1]
1911	11	11	[1]
1912	45	16	29
1913	43	14	29
1914	49	15	34
1915	178	26	152
1916	411	142	269
1917	2,148	2,013	135
1918	14,020	13,991	29
1919	780	682	98
1920	328	256	72
1921	437	389	48
1922	263	226	37
1923	743	687	56
1924	377	317	60
1925	789	445	344
1926	1,186	478	708
1927	1,995	609	1,386
1928	4,346	847	3,499
1929	6,193	779	5,414
1930	3,437	836	2,601
1931	2,800	853	1,947
1932	1,396	500	896
1933	1,324	331	993
1934	1,615	393	1,222
1935	1,710	336	1,374
1936	3,010	858	2,152
1937	3,773	858	2,915
1938	3,623	925	2,698
1939	5,856	921	4,935
1940	12,804	6,019[3]	6,785
1941	26,277[2]	19,433[3]	6,844
1942	47,836[2]	47,836[3]	[4]
1943	85,898[2]	85,898[3]	[4]
1944	96,318[2]	96,318[3]	[4]
1945	49,761[2]	47,714[3]	2,047
1946	36,670	1,669	35,001
1947	17,737	2,100	15,617
1948	[5]	[5]	7,302
1949	[5]	[5]	3,545
1950	[5]	[5]	3,520

[1]Unknown

[2]Includes U.S.-financed aircraft made in Canada

[3]Includes Lend-Lease military aircraft

[4]Military production only

[5]Figures not available

UNITED STATES AIRCRAFT EXPORTS

Number and Value

(Source: Aircraft Industries Association)

Year[1]	Aircraft exported[2] Number	Aircraft exported[2] Value	Value of all aeronautical exports[3]
1913	29	$81,750	$107,552
1914	34	188,924	226,149
1915	152	958,019	1,541,446
1916	269	2,158,395	7,002,005
1917	135	1,001,542	4,135,445
1918	20	206,120	9,084,097
1919	85	777,900	13,166,907
1920	65	598,274	1,152,649
1921	48	314,940	472,548
1922	37	156,630	494,930
1923	48	309,051	433,558
1924	59	412,738	798,273
1925	80	511,282	783,659
1926	50	303,149	1,027,210
1927	63	848,568	1,903,560
1928	162	1,759,653	3,664,723
1929	348	5,484,600	9,125,345
1930	321	4,819,669	8,818,110
1931	140	1,812,809	4,867,687
1932	280	4,358,967	7,946,533
1933	406	5,391,493	9,180,328
1934	490	8,195,484	17,662,938
1935	333	6,598,515	14,290,843
1936	527	11,601,893	23,143,203
1937	628	21,076,170	39,404,469
1938	875	37,977,324	68,227,689
1939	1,220	67,112,736	117,807,212
1940	3,522	196,260,556	311,871,473
1941	6,011	422,763,907	626,929,352
1942	10,448	879,994,628	1,357,345,366
1943	13,865	1,215,848,135	2,142,611,494
1944	16,544	1,589,800,893	2,825,927,362
1945	7,599	663,128,543	1,148,851,587
1946	2,302	65,257,749	115,320,235
1947	3,125	74,476,912	172,189,502
1948	2,259	66,354,000	153,629,000
1949[4]	1,264	37,388,553	128,782,420
1950[5]	759	44,292,222	44,490,900

[1]1913-18, fiscal years; 1919-49, calendar years. Data for the second half of 1918 is included with calendar year 1919.

[2]Exclusive of gliders and barrage balloons.

[3]Total value of aircraft, engines, parts, etc. 1913-21 include values of aircraft and aircraft parts. Prior to 1922, engine values were not reported separately, but were probably included with either "other" internal combustion engines or with "parts" of aircraft. Values for parachutes and their parts have been included only since 1932.

[4]For security reasons the 1949 figures do not include exports after April on military and cargo aircraft and engines of 400 hp and over. Actual total is believed to at least equal 1948 exports.

[5]For security reasons the 1950 figures do not include military, cargo and used transport aircraft, engines of 400 hp and over, propellers, instruments nor any other parts or accessories. The actual total was certainly more than 1948 exports.


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CONSOLIDATED VULTEE
CURTISS-WRIGHT
DOUGLAS
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MARTIN
McDONNELL
REPUBLIC
ZENITH PLASTICS CO.
GARDENA, CALIFORNIA
R.P.*
REINFORCED FIBERGLAS PLASTICS

AIRPORTS AND LANDING FIELDS

1926-1950

(Source: Civil Aeronautics Administration)

Calendar Year	Total	Commercial	Municipal	CAA intermediate	All others
1926	[1]	[1]	[1]	92	[1]
1927	1,036	263	240	134	399[2]
1928	1,364	365	368	210	421[2]
1929	1,550	495	453	285	317[2]
1930	1,782	564	550	354	314[2]
1931	2,093	829	780	404	80
1932	2,117	869	777	352	119
1933	2,188	938	827	265	158
1934	2,297	872	980	259	186
1935	2,368	822	1,041	291	214
1936	2,342	774	1,037	296	235
1937	2,299	727	1,053	283	236
1938	2,374	760	1,092	267	255
1939	2,280	801	963	266	250
1940	2,331	860	1,031	289	151
1941	2,484	930	1,086	283	185
1942	2,809	1,069	1,129	273	338
1943	2,769	801	914	240	814
1944	3,427	1,027	1,067	229	1,104
1945	4,026	1,509	1,220	216	1,081
1946	4,490	1,930	1,424	201	935
1947	5,759	2,849	1,818	178	914
1948	6,414	2,989	2,050	161	1,214
1949	6,484	2,585	2,200	139	1,560
1950	6,403	2,329	2,272	76	1,726

[1]Not available.

[2]Include auxiliary marked fields, later classified as to ownership, commercial or municipal.

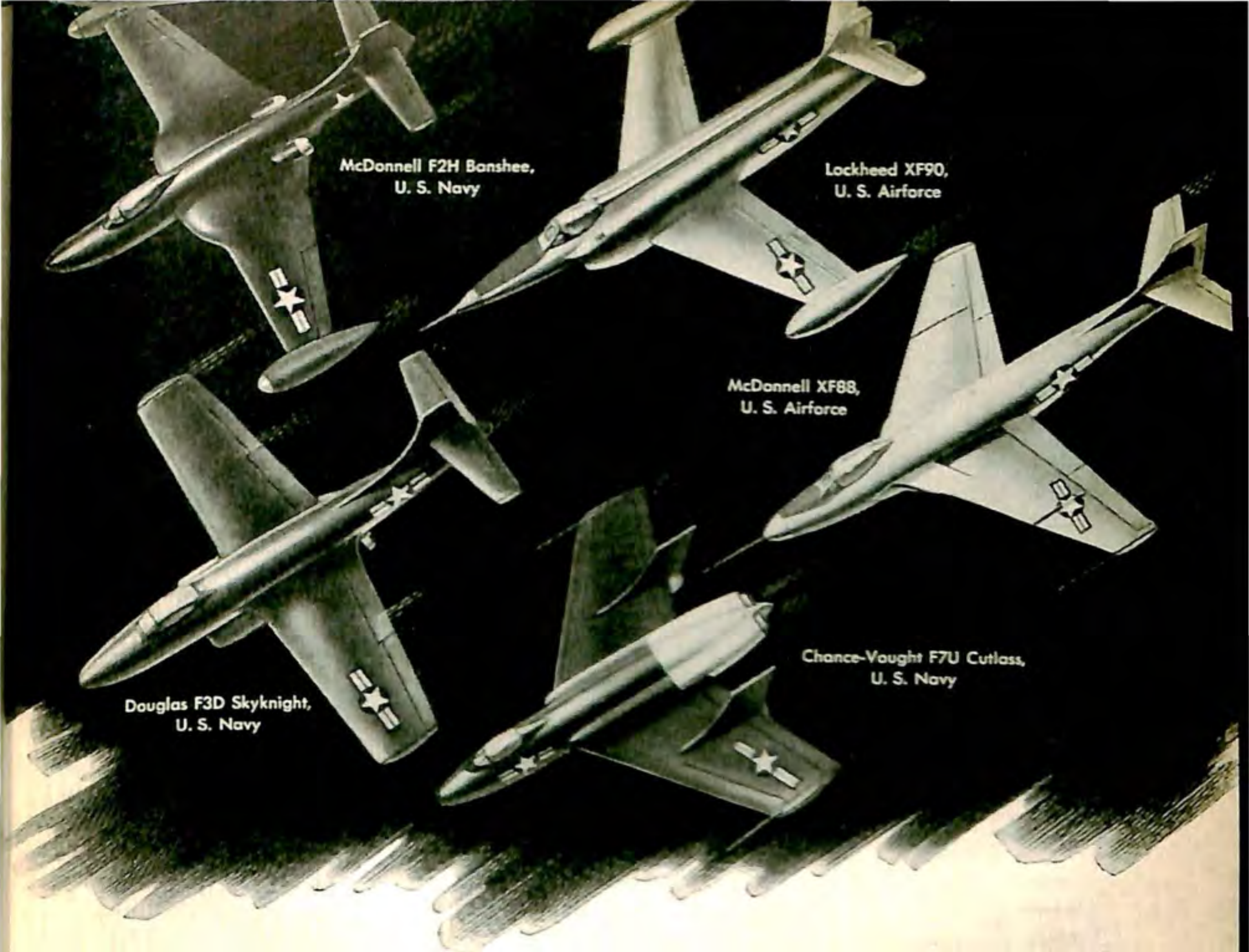
ALLOCATIONS AND APPROPRIATIONS FOR AERONAUTICS, U. S. ARMY

1899	Langley experiments.	$25,000
1900	Langley experiments.	25,000
1908	Baldwin dirigible, revoked and later applied toward payment for Wright plane.	25,000
1909	Herring & Scott airplanes. Later for Wright plane.	21,000
1910	Wright plane.	9,000
1912	Signal Service of Army.	125,000
1913	Signal Service of Army.	100,000
1914	Signal Service of Army.	125,000
1915	Signal Service of Army.	50,000
		$505,000

AVERAGE SPEED
(Miles Per Hour)

Domestic Scheduled Air Carriers
(Source: CAA Statistical Handbook)

Year	Average speed (miles per hour)
1944	155.6
1945	155.4
1946	160.2
1947	168.2
1948	171.9
1949	179
1950	181.2



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AVIATION
GAS TURBINES

TOTAL EMPLOYMENT IN PRIME CONTRACTING AIRPLANE ENGINE AND PROPELLER PLANTS[1]

By Years and Months

(Source: Aircraft Industries Association)

1949	Total	Airframe	Engine	Propellers
January	214,599	166,506	39,846	8,247
February	215,708	167,282	40,221	8,205
March	218,290	168,210	40,761	8,319
April	219,185	169,310	41,500	8,375
May	219,449	168,287	41,656	8,506
June	217,404	167,441	41,180	8,783
July	220,524	171,315	40,703	8,506
August	213,623	171,070	35,676	6,877
September	218,291	168,533	41,244	8,514
October	215,214	165,695	40,991	8,528
November	212,279	163,343	40,569	8,367
December	211,483	163,145	39,961	8,377
1950				
January	211,746	163,531	39,837	8,378
February	211,097	162,741	40,035	8,321
March	211,459	162,846	40,272	8,341
April	213,751	165,009	40,472	8,270
May	214,261	165,286	40,687	8,288
June	216,470	166,787	41,425	8,258
July	219,461	169,275	41,886	8,300
August	230,641	180,304	42,169	8,168
September	239,948	191,784	39,410	8,754
October	255,233	200,729	45,499	9,005
November	269,416	211,864	48,274	9,278
December	282,218	222,091	50,638	9,489
1951	....	230,155	53,106	....
January	....	280,155	53,106	....
February	....	251,632	56,434	....
March	....	263,931	58,610	....
April	....	273,122	60,837	....
May	....	282,326	63,409	....
June	....	298,128	66,503	....
July	....	312,863	68,914	....
August	....	322,068	71,293	

[1]As of week ending nearest middle of month.

U. S. CIVIL AIRCRAFT

By States

(Source: Civil Aeronautics Administration)

State	Number of civil aircraft[1] Jan. 1, 1950	Jan. 1, 1951	State	Number of civil aircraft[1] Jan. 1, 1950	Jan. 1, 1951
TOTAL	92,622	92,809	Montana	1,098	1,113
			Nebraska	1,794	1,863
Alabama	924	907	Nevada	384	401
Arizona	1,170	1,156	New Hampshire	288	278
Arkansas	1,192	1,218	New Jersey	1,682	1,772
California	10,594	10,298	New Mexico	744	769
Colorado	1,265	1,363	New York	4,472	4,386
Connecticut	699	643	North Carolina	1,714	1,694
Delaware	277	302	North Dakota	1,235	1,293
District of Columbia	533	548	Ohio	4,144	4,267
Florida	2,548	2,256	Oklahoma	2,284	2,212
Georgia	1,264	1,212	Oregon	1,809	1,803
Idaho	873	917	Pennsylvania	4,063	4,104
Illinois	4,829	4,909	Rhode Island	198	211
Indiana	2,733	2,753	South Carolina	705	678
Iowa	2,447	2,451	South Dakota	979	1,034
Kansas	2,795	2,797	Tennessee	1,106	1,024
Kentucky	821	799	Texas	6,983	6,998
Louisiana	1,066	1,145	Utah	519	535
Maine	650	632	Vermont	201	168
Maryland	810	862	Virginia	1,390	1,363
Massachusetts	1,398	1,412	Washington	2,229	2,224
Michigan	4.249	4,172	West Virginia	670	655
Minnesota	2,112	2,146	Wisconsin	2,125	2,098
Mississippi	690	728	Wyoming	525	532
Missouri	2,140	2,116	Outside U. S. A.	1,202	1,292

[1]Includes gliders.

CIVIL AIRCRAFT PRODUCTION

Number of Units

(Source: Aircraft Industries Association)

Month	1947	1948	1949	1950	1951
January	2,166	462	160	167	255
February	1,914	461	257	225	239
March	1,785	578	400	326	272
April	2,039	766	456	329	247
May	1,646	812	474	377	248
June	1,193	959	439	369	216
July	998	920	301	321	207
August	929	700	272	354	171
September	1,028	590	284	301	184
October	802	502	228	204	......
November	615	317	158	242	......
December	502	235	116	305	......
TOTAL	15,617	7,302	3.545	3,520	......

QUARTERLY BACKLOG OF ORDERS BY AIRCRAFT, AIRCRAFT ENGINE, AND PROPELLER COMPANIES

First Quarter 1948—Second Quarter 1950

(In millions of dollars)

(Source: Bureau of the Census, Series M42D)

Product	Mar. 31, 1948	Dec. 31, 1948	Mar. 31, 1949	Dec. 31, 1949	Mar. 31, 1950	June 30, 1950
TOTAL	$2,108	$3,104	$2,989	$3,010	$2,903	$2,988
Complete aircraft and parts	1,463	2,094	1,992	2,013	1,862	1,908
For United States military	1,280	1,962	1,868	1,913	1,743	1,774
Other	183	132	124	100	119	134
Aircraft engines and parts	488	786	783	749	761	786
For United States military	455	759	745	710	727	757
Other	33	27	38	39	34	29
Aircraft propellers and parts	84	103	101	91	97	100
For United States military	71	96	96	85	92	96
Other	13	7	5	6	5	4
Other products and services	73	121	113	157	183	194
Complete aircraft and aircraft propeller companies	49	121	57	92	125	147
Aircraft engine companies	24		56	65	58	47

COMPLETE AIRCRAFT SHIPMENTS

Airframe Weight[a]

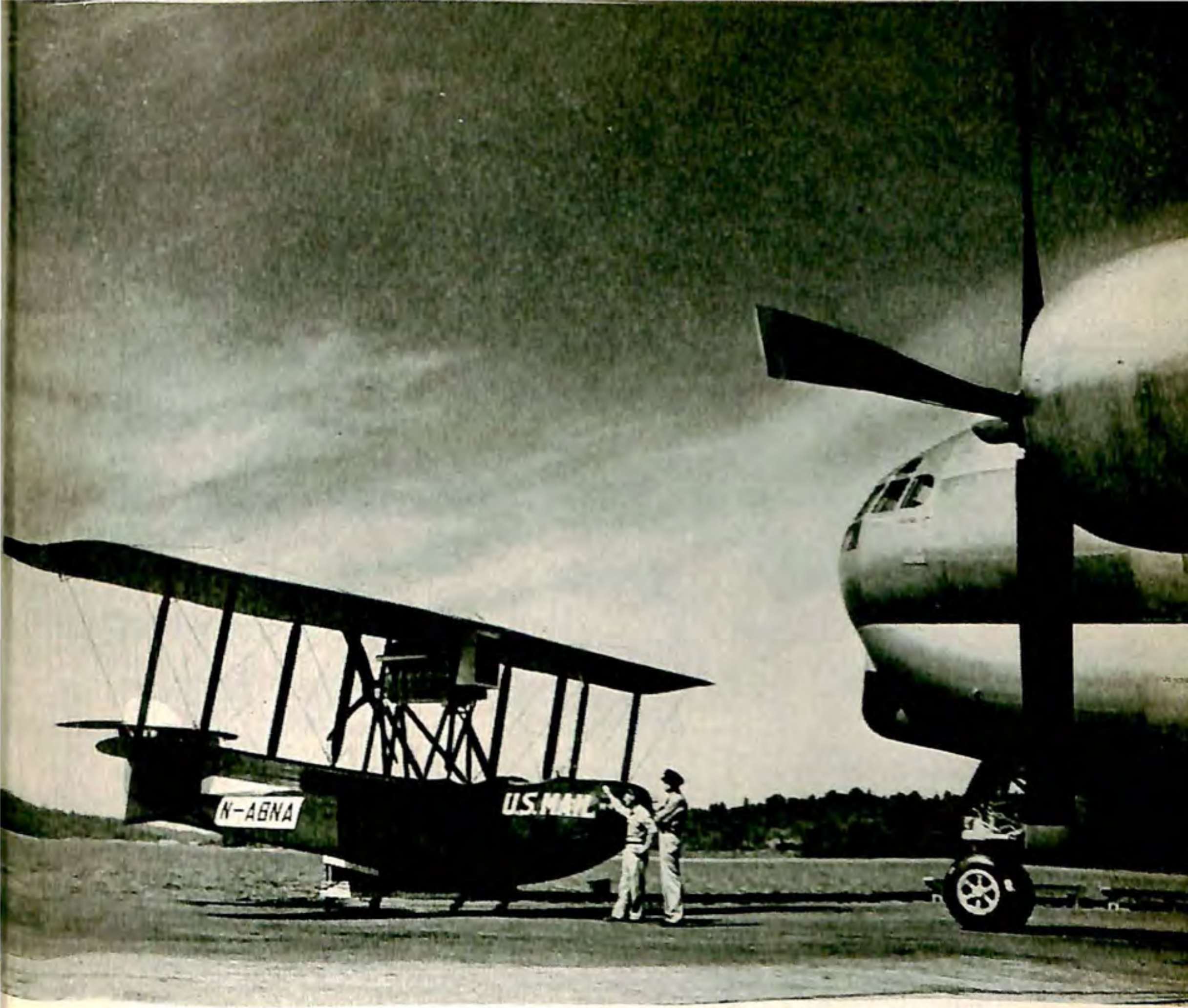
(In thousands of pounds)

	Total	U. S. Military	Civil
1941	....	81,422.0	....
1942	....	275,949.0	....
1943	....	654,657.0	....
1944	....	962,406.0	....
1945	....	540,531.0	....
1946	38,394.4	12,879.0	25,515.4
1947	29,255.4	11,402.0	17,853.4
1948	35,263.5	25,181.0	10,082.5
1949	36,537.3	29,792.9	6,744.4
1950	N.A.	N.A.	5,960.7
1951 (9 mos.)	N.A.	N.A.	3,737.7

[a]Excludes spares.

N.A.—Not available.

Source: 1941-1945, CAA "U. S. Military Aircraft Acceptances, 1940-1945, Aircraft, Engine and Propeller Production."
1946-1951, Bureau of the Census, Facts for Industry, Series M42A.


N-ABNA

NUMBER OF ENGINES PRODUCED
1917-1951

	Total	Military	Civil
1917-1919	N.A.	44,453	N.A.
1930	3,766	1,841	1,925
1931	3,776	1,800	1,976
1932	1,896	1,085	813
1933	1,980	860	1,120
1934	2,736	688	2,048
1935	2,965	991	1,974
1936	4,237	1,804	2,433
1937	6,084	1,989	4,095
1938	N.A.	N.A.	N.A.
1939	11,172	N.A.	N.A.
1940[a]	N.A.	22,667	N.A.
1941[a]	N.A.	58,181	N.A.
1942[a]	N.A.	138,089	N.A.
1943[a]	N.A.	227,116	N.A.
1944[a]	N.A.	256,911	N.A.
1945[a]	N.A.	109,650	N.A.
1946	43,407	2,585[b]	40,822
1947	21,178	4,808	16,370
1948	N.A.	N.A.	9,039
1949	N.A.	N.A.	3,982
1950	N.A.	N.A.	4,314
1951 (9 mos.)	N.A.	N.A.	3,512

[a]Excludes aircraft engines produced for other than aircraft use.
[b]Excludes experimental engines, engines classified by the armed forces as secret or confidential, engines for non-man-carrying, pilotless aircraft, jet assist mechanisms.
Source: 1917-1947—AIA Aircraft Year Book, 1948, P. xxl.
1948-1949—Bureau of Census Facts for Industry Series M42A.

PRODUCTION OF AIRCRAFT ENGINES
HORSEPOWER (in thousands)

	Total	Military	Civil
1941	N.A.	44,930.0[a]	N.A.
1942	N.A.	147,535.0[a]	N.A.
1943	N.A.	262,282.0[a]	N.A.
1944	N.A.	368,050.0[a, b]	N.A.
1945	N.A.	184,187.0[a, c]	N.A.
1946	N.A.	9,152.5[d]	N.A.
1947	22,217.4	17,069.7[d]	5,147.7
1948	24,832.3	22,033.4[d]	2,798.9
1949	46,743.3	45,511.8[d]	1,231.5
1950	N.A.	N.A.	1,645.4
1951 (9 mos.)	N.A.	N.A.	1,623.7

[a]Excludes aircraft engines produced for other than aircraft use.
[b]Excludes 238,000 pounds of thrust for jet engines produced.
[c]Excludes 4,151,000 pounds of thrust for jet engines produced.
[d]Includes jet engine pounds of thrust converted to horsepower.
Sources: 1941-48—CAA Statistical Handbook 1949.
1949-51 Bureau of Census Facts for Industry Series M42A.

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Airline Statistics

AIRLINE REVENUE PASSENGER MILES

U. S. Domestic Air Carriers By Months
(Source: Air Transport Association)

	Millions of Passenger Miles							
Month	1943	1944	1945	1946	1947	1948	1949	1950
January	99,302	141,133	200,819	331,714	380,757	401,214	429,935	481,428
February	109,132	124,688	182,869	331,965	372,276	356,859	432,226	479,650
March	122,839	142,258	240,474	406,403	493,864	440,106	533,548	568,162
April	131,727	154,627	246,418	461,703	526,188	483,233	577,852	636,440
May	132,274	180,616	277,213	512,625	563,771	539,431	608,302	684,940
June	140,057	193,322	295,402	562,722	546,685	588,677	676,842	784,870
July	149,556	211,570	320,154	569,875	543,541	561,075	640,718	746,463
August	156,615	227,986	332,014	624,481	611,838	569,583	627,127	775,238
September	154,008	225,476	315,895	611,961	609,756	549,539	634,088	741,777
October	155,472	239,082	339,687	557,223	578,889	534,758	608,837	757,721
November	144,536	217,068	314,704	468,734	435,083	452,441	504,939	639,826
December	136,924	204,792	296,805	507,643	441,231	486,355	478,164	705,953
Total	1,632,442	2,262,618	3,362,454	5,947,049	6,103,879	5,963,271	6,752,578	8,002,468

AIR CARRIER OPERATING EXPENSES

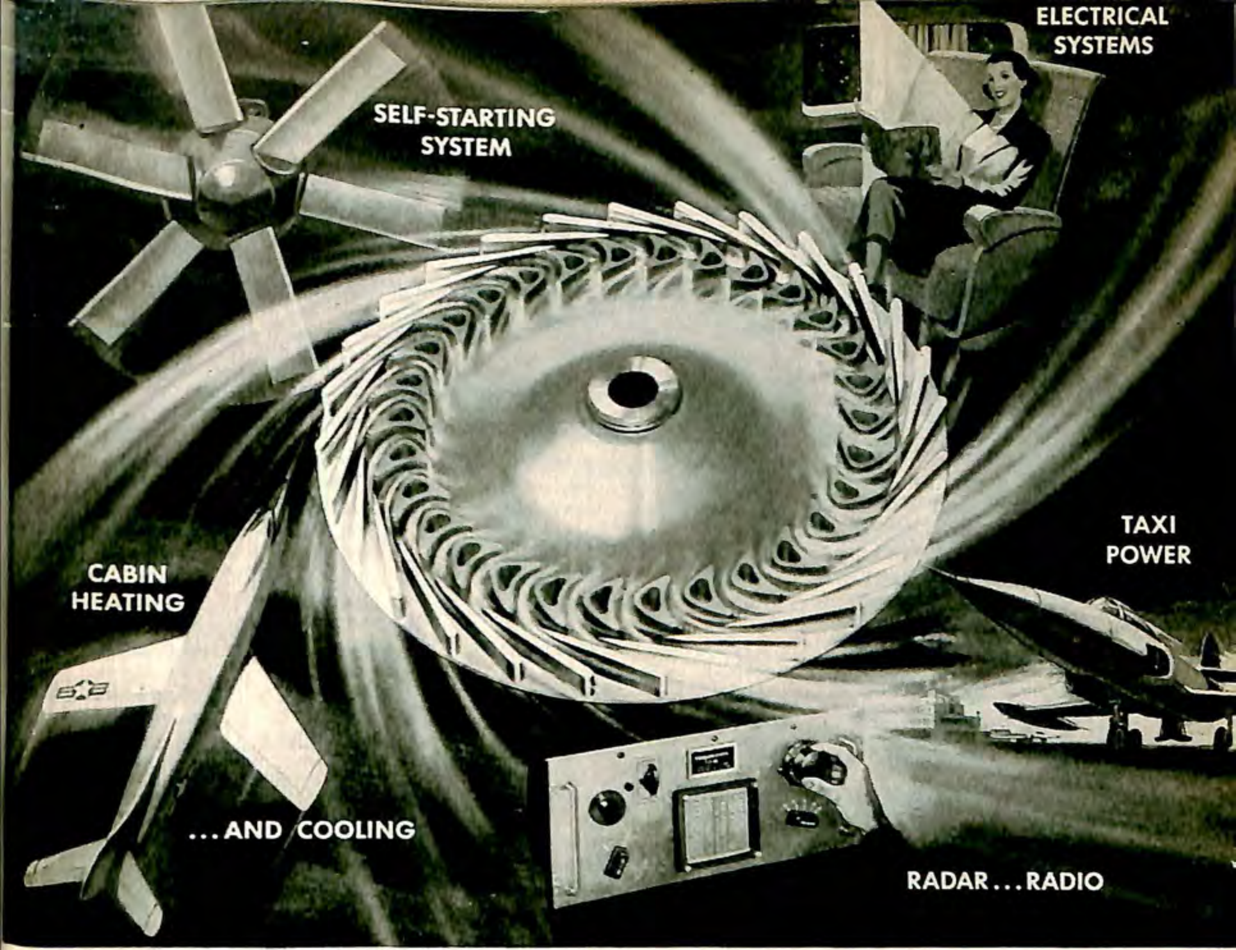
Domestic
(Source: Air Transport Association)

Year	Aircraft Operating Expenses	% of Total	Ground and Indirect Expenses	% of Total	Total Operating Expense
1940	$35,178,395	49.62	$35,028,420	49.41	$70,896,615
1941	44,932,205	49.97	44,986,928	50.03	89,919,133
1942	36,392,090	43.14	47,974,400	56.86	84,366,489
1943	34,613,411	36.22	60,949,609	63.78	95,563,020
1944	45,150,125	36.26	79,371,967	63.74	124,522,092
1945	69,222,625	38,32	111,403,704	61.68	180,626,329
1946	129,645,346	40.24	192,573,836	59.76	322,219,182
1947	169,164,673	43.80	217,034,447	56.20	386,199,120
1948	199,990,706	46.33	231,643,571	53.67	431,634,277
1949	223,193,168	48.34	238,539,727	51.66	461,732,895
1950	228,503,346	48.18	245,797,635	51.82	474,300,981

BREAKDOWN OF DIRECT AIRCRAFT OPERATING EXPENSES

	Flying Operations	% of Total	Direct Maintenance Flight Equip.	% of Total	Depreciation Flight Equip.	% of Total
1940	$22,092,628	31.17	$7,495,998	10.57	$5,589,769	7.88
1941	27,391,837	30.46	9,789,797	10.89	7,750,571	8.62
1942	21,865,924	25.92	8,664,436	10.27	5,861,730	6.95
1943	20,739,121	21.70	9,132,260	9.56	4,742,030	4.96
1944	28,238,316	22.68	11,892,963	9.55	5,018,846	4.03
1945	43,421,033	24.04	16,392,654	9.07	9,408,938	5.21
1946	70,805,391	21.98	33,272,916	10.33	25,567,039	7.93
1947	88,839,885	23.00	42,902,710	11.11	37,422,078	9.69
1948	109,636,528	25.40	49,034,659	11.36	41,319,519	9.57
1949	127,397,922	27.59	54,028,364	11.70	41,766,882	9.05
1950	131,086,952	27.64	55,768,177	11.76	41,648,217	8.78

Includes Trunks, Local Service and Territorial



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PASSENGER MILES, MAIL, EXPRESS AND FREIGHT TON-MILES

U. S. Domestic and American Flag Carriers

(Source: Air Transport Association)

Year	Total Passenger Miles (000)	Passenger Load Factor	Air Mail Ton Miles	Express Ton Miles	Freight Ton Miles
			DOMESTIC[1]:		
1938	479,844	50.43%	7,449,250	2,182,420	....
1939	682,904	56.20	8,610,727	2,713,099	....
1940	1,052,156	57.90	10,117,858	3,476.224	....
1941	1,384,733	59.13	13,118,014	5,258,551	....
1942	1,417,526	72.21	21,166,024	11,901,793	....
1943	1,634,135	88.00	36,068,309	15,636,811	....
1944	2,264,495	89.38	51,145,402	17,702,932	....
1945	3,362,456	88.12	65,100,133	22,196,852	1,350,048
1946	5,947,956	78.71	32,962,122	23,788,392	14,822,325
1947	6,103,879	65.12	33,089,696	28,766,659	35,911,554
1948	5,981,603	57.59	37,925,396	30,092,833	71,283,727
1949	6,744,425	57.78	41,418,156	27,773,669	95,057,219
1950	8,002,792	61.25	47,008,947	37,279,035	114,072,045
			INTERNATIONAL:		
1946	1,100,741	70.85	6,141,461	15,030,431	60,037
1947	1,810,045	61.90	12,755,998	30,786,465	2,109,948
1948	1,888,947	57.37	17,202,868	41,581,133	4,011,668
1949	2,053,980	56.67	19,365,769	49,443,623	6,714,414
1950	2,206,423	59.66	21,188,090	44,501,521	16,049,809

[1] Includes Trunks, Local Service and Territorial Carriers.

U. S. AIR CARRIER OPERATING REVENUES

Domestic and International

(Source: Air Transport Association)

Year	Passenger Revenues	% of Total	Mail Revenues	% of Total	Express & Freight	% of Total	Other Revenues	% of Total	Total Revenues
					DOMESTIC:				
1940	$53,308,172	69.35	$20,090,123	26.14	$2,077,726	2.70	$1,387,622	1.81	$76,863,643
1941	69,791,338	71.72	22,696,351	23.32	2,919,003	3.00	1,904,442	1.96	97,311,134
1942	74,757,776	69.13	23,446,588	21.68	6,968,357	6.44	2,975,188	2.75	108,147,909
1943	87,481,456	71.06	24,212,580	19.67	8,381,539	6.81	3,029,390	2.46	123,104,965
1944	116,440,690	72.36	33,317,399	20.70	8,306,288	5.16	2,863,848	1.78	160,928,225
1945	166,519,923	77.59	33,557,040	15.63	10,835,140	5.05	3,694,562	1.73	214,606,665
1946	275,593,712	86.88	21,953,759	6.92	13,620,295	4.29	6,037,245	1.91	317,205,011
1947	308,575,954	84.58	29,444,746	8.07	19,377,949	5.31	7,440,928	2.04	364,839,577
1948	343,289,730	79.05	59,309,343	13.66	24,372,395	5.61	7,323,916	1.68	434,295,384
1949	385,509,049	78.69	68,569,538	13.99	26,928,631	5.50	8,923,223	1.82	489,930,441
1950	443,852,000	79.66	63,772,233	11.45	35,109,399	6.30	14,428,708	2.59	557,162,340
	Domestic Lines include Trunks, Territorial and Local Service.								
					INTERNATIONAL:				
1946	91,416,767	62.29	25,060,600	17.09	11,413,268	7.77	18,863,467	12.85	146,754,102
1947	140,652,113	67.29	32,299,890	15.45	17,526,276	8.39	18,531,252	8.87	209,009,531
1948	151,337,705	60.72	57,331,556	23.00	20,808,679	8.35	19,756,259	7.93	249,234,199
1949	158,479,705	57.81	75,197,073	27.43	22,126,830	8.07	18,350,930	6.69	274,154,538
1950	156,427,209	58.85	68,348,283	25.71	20,620,858	7.75	20,448,009	7.69	265,844,359

AIRLINE PERSONNEL

Domestic and International

(Source: Air Transport Association)

DOMESTIC

Year	Pilots and Copilots	Pursers, Stewards, Steward-esses	Other Flight Personnel	Meteor-ologists and Dis-patchers	Mechanics	Other Hangar and Field Personnel	Ticket Agts., Reserva-tionists and Office Employees	All Others	Total
1940	1,939	914	18	193	4,054	1,880	5,855	1,131	15,984
1941	2,217	1,028	19	220	4,423	2,224	7,807	1,285	19,223
1942	2,194	753	112	1,581	9,348	2,969	7,717	2,236	26,910
1943	2,125	845	8	1,685	8,271	3,356	10,973	2,391	29,654
1944	2,879	1,322	11	1,870	7,136,	3,509	12,201	2,270	31,198
1945	4,967	2,075	108	2,613	10,844	7,012	19,241	3,453	50,313
1946	5,712	3,342	98	3,577	16,107	10,307	24,626	5,413	69,182
1947	5,030	3,061	181	2,619	15,372	8,407	21,980	2,348	58,998
1948	5,307	3,038	312	2,612	16,428	9,222	21,396	2,101	60,416
1949	5,101	3,168	642	2,688	14,212	9,393	16,391	7,478	59,075
1950	5,385	3,201	687	2,635	14,015	9,310	16,872	7,642	59,745
					INTERNATIONAL				
1940	340	122	15	......	1,359	2,397	1,834	......	6,067
1941	447	182	30	......	1,966	2,707	1,903	......	7,235
1942	952	378	129	29	3,534	4,415	3,366	......	12,803
1943	207	147	322	511	2,140	1,835	1,859	2,604	9,625
1944	466	194	266	631	2,827	2,239	3,033	1,753	11,409
1945	930	411	938	864	5,099	2,435	4,663	2,628	17,968
1946	1,508	1,079	1,405	1,454	7,269	2,463	6,961	5,233	27,372
1947	1,603	1,016	1,152	1,211	5,774	3,201	10,679	1,518	26,154
1948	1,620	1,105	1,203	1,042	5,345	2,362	9,608	1,441	23,726
1949	1,475	1,065	954	870	3,168	2,174	3,476	4,092	17,274
1950	1,598	937	934	1,108	3,123	2,573	3,758	3,884	17,912

AIR MAIL, MILES AND PAYMENTS

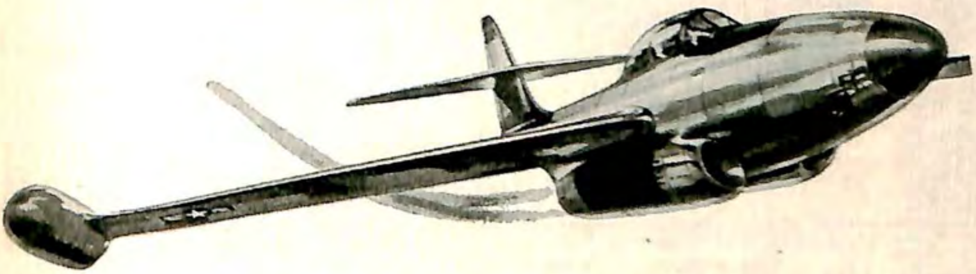
Domestic and International

(Source: Air Transport Association)

	Domestic					International	
Fiscal Year Ending June 30	Pay-ments Per Plane Mile	Pounds Miles per Route Mile	Revenue Plane Miles Flown	Route Miles Air Mail Service	Thousands of Pound Miles Performed	Plane Miles Flown	Pay-ments Per Plane Mile
1940	.33	492.09	59,236,453	37,943	18,671,366	5,907,124.0	2.10
1941	.27	513.58	75,689,939	43,411	22,294,962	8,238,348.6	1.65
1942	.26	703.77	89,307,567	44,623	31,404,256	8,858,293.9	1.61
1943	.26	1,246.96	88,963,296	45,304	56,492,340	15,633,482.9	.36
1944	.26	1,709.30	107,650,804	49,482	84,579,690	19,485,788.5	.17
1945	.21	2,162.03	166,576,371	56,849	122,908,962	24,275,760.0	.25
1946	.13	1,772.01	221,724,860	57,377	101,672,776	40,659,256.0	.37
1947	.09	658.59	314,505,965	102,454	67,475,414	71,065,926.0	.44
1948	.15	520.53	321,661,655	130,093	67,716,848	91,439,534.0	.50
1949	.19	531.27	331,245,576	155,314	82,513,520	97,459,137.0	.62
1950	.19	530.59	339,160,155	158,977	84,350,874	87,809,537.0	.69

High signs for 89's

The fine morale and high caliber of Northrop personnel have been responsible for many production feats in the company's history.



During World War II it was the P-61 Black Widow. Today it's the deadly Scorpion F-89—fast, heavily armed, electronic-search equipped—the standard all-weather interceptor of the USAF.

Northrop Aircraft Inc., Hawthorne, California

5A7

PIONEER BUILDERS OF NIGHT AND ALL-WEATHER FIGHTERS

NUMBER OF PLANES, SEATS AND PASSENGER MILES

Domestic Airlines

(Source: Air Transport Association)

Year	Number of Planes	Average Available Seats	Total Passengers Carried	Route Miles	Revenue Miles in Pass. Service
1938	260	13.91	1,197,100	34,879	68,398,327
1939	276	14.66	1,734,762	36,654	82,914,085
1940	369	16.54	2,802,781	44,643	109,871,044
1941	370	17.54	3,848,882	46,453	133,497,688
1942	186	17.90	3,129,421	49,297	109,648,081
1943	204	18.33	3,035,755	54,502	101,324,297
1944	288	18.97	4,045,965	62,937	133,532,043
1945	418	19.68	6,576,252	66,466	193,862,859
1946	659	25.25	12,213,445	84,358	299,306,989
1947	737	29.93	12,890,208	110,144	313,143,020
1948	779	32.37	13,168,105	155,541	320,834,753
1949	771	33.20	15,080,704	116,371	333,200,258
1950	796	35.86	17,346,913	130,806	348,670,303

1946 through 1949 include combined figures of domestic, local and territorial.

SCHEDULED AIR PASSENGER FATALITIES

U. S. Domestic and International Carriers

(Source: Air Transport Association)

	Domestic Carriers		International Carriers	
Year	No. of Fatalities	Fatalities Per 100 Mill. Pass. Miles	No. of Fatalities	Fatalities Per 100 Mill. Pass. Miles
1933	8	4.61		
1934	17	9.05		
1935	15	4.78		
1936	44	10.10		
1937	40	8.39		
1938	25	4.48	7	13.2
1939	9	1.20	10	12.8
1940	35	3.05	0	0.0
1941	35	2.35	2	1.2
1942	55	3.71	0	0.0
1943	22	1.34	10	3.9
1944	48	2.12	17	5.3
1945	76	2.23	17	3.7
1946	75	1.24	40	3.6
1947	199	3.21	20	1.0
1948	83	1.30	20	1.0
1949	93	1.30	0	0.0
1950	96	1.10	48	2.1

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatalities per 100,000,000 Passenger Miles

(Source: Air Transport Association)

	1942	1943	1944	1945	1946	1947	1948	1949	1950
Domestic Scheduled Air Lines									
Fatalities	55	22	48	76	75	199	83	93	96
Rate	3.71	1.34	2.12	2.23	1.24	3.21	1.30	1.30	1.10
Buses									
Fatalities	....	....	....	120	140	1.40	120	120	100
Rate	.23	.22	.22	.17	.19	.21	.18	.20	.17
Intercity Railroads									
Fatalities	110	262	2.49	142	116	74	52	32	184
Rate	.17	.31	.26	.16	.18	.16	.13	.09	.58
Pass. Autos & Taxicabs									
Fatalities	....	....	....	12,900	15,400	15,300	15,200	15,300	17,600
Rate	2.7	2.7	2.9	2.9	2.5	2.3	2.1	2.1	2.2

ASSETS AND LIABILITIES

Domestic Trunk Airlines 1945-1950

(Source: Air Transport Association)

	1945	1946	1947	1948	1949	1950
Current Assets	$148,083,458	$152,381,835	$132,484,512	$171,859,726	$175,472,186	$204,018,828
Flight Equipment—Net	41,210,236	117,884,329	173,886,500	188,351,172	188,619,849	201,630,303
Other Op. Property	14,757,141	30,593,828	52,855,302	59,963,595	61,476,977	58,149,892
Non-Operating Property	644,708	2,832,701	2,789,790	5,779,353	2,704,375	1,117,230
Other Assets	44,007,796	83,407,794	72,561,452	58,286,768	58,668,273	77,624,812
Total Assets	248,703,339	387,100,487	434,577,556	484,240,614	486,941,660	542,541,065
Current Liabilities	73,412,182	105,659,559	81,829,236	99,836,921	98,428,787	130,111,887
Long Term Debt	24,246,632	89,837,933	154,513,026	167,403,669	148,017,443	135,842,945
Capital Stock	52,195,930	92,896,915	126,621,702	121,312,622	123,710,057	123,467,063
Capital Surplus	32,919,664	46,989,967	41,929,868	53,428,648	56,289,876	57,499,411
Earned Surplus	55,497,640	37,599,404	7,675,418	12,952,554	35,285,887	64,365,672
Operating Reserves	505,977	1,139,325	1,591,145	2,387,158	3,635,427	3,970,701
Other Liabilities	9,925,314	12,977,384	20,417,161	26,919,042	21,574,183	27,283,386
Net Worth & Liabilities	$248,703,339	$387,100,487	$434,517,556	$484,240,614	$486,941,660	$542,541,065

"UMBRELLAS"

...FOR A RAINY DAY!

"Umbrellas" represent one of the first lines of a complete national defense system!

Above these hundreds of silken parachutes fly Fairchild planes...the best equipped "to-do-the-job" aircraft in the skies.

Fairchild leadership in the development of tactical airplanes is now playing a vital part in the vast production mobilization program. Like the airborne trooper, the C-82 Packet, the C-119 Improved Cargo and Troop Transport and the C-120 Detachable Fuselage Transport are parts of the United States Armed Forces Team.

Only this type of coordination between air and ground units could have given the word "Airlift" to our vocabulary. Whether it is generators for the lights of Berlin, trucks, guns or highly trained paratroopers for Korea—Fairchild Airplanes are ready, willing and able to deliver the goods...no matter what sort of weather lies ahead.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD *Aircraft Division*
HAGERSTOWN, MARYLAND

Fairchild Aircraft Division, Chicago, Ill., Fairchild Engine, Guided Missiles and Stratos Divisions, Farmingdale, N. Y.

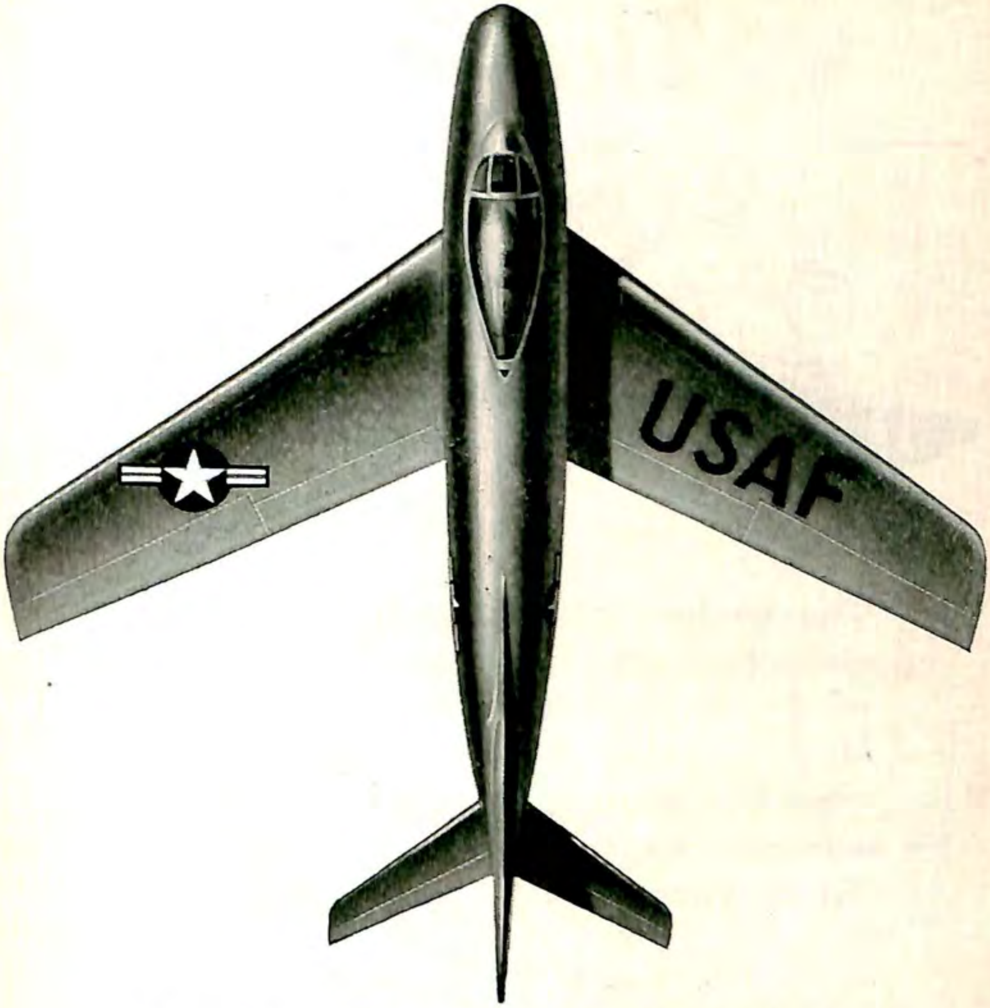
PLANES IN USE

Domestic Airlines

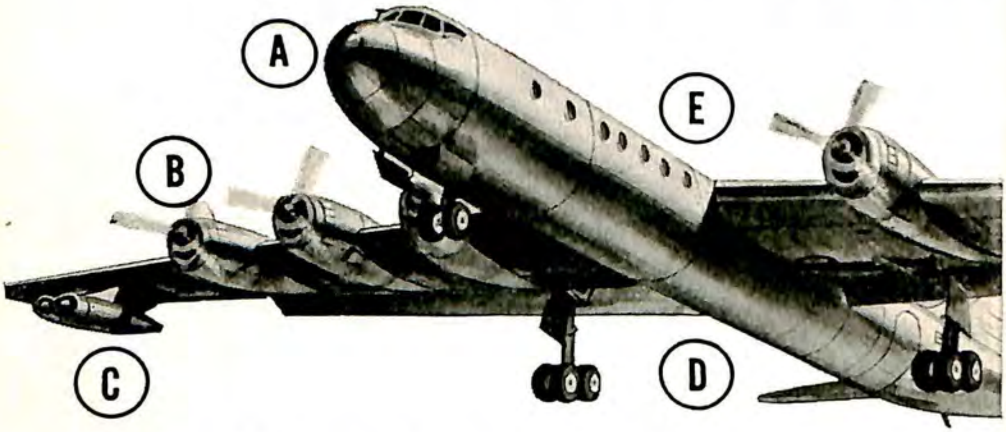
(Source: Air Transport Association)

		1941		1942		1943		1944		1945	
Aircraft	No. of Engines	No. Planes	Miles Per Day	No. Planes	Miles Per Day	No. Planes	Miles Per Day	No. Planes	Miles Per Day	No. Planes	Miles Per Day
Beechcraft	2	......	......	1.0	325	2.0	437	1.2	323	0.8	66
Boeing											
247-D	2	29.3	458	11.3	521	......	......	......	......	......	......
SA-307B	4	5.0	1,596	0.8	1,230	1.0	248	......	......	3.6	2,094
377	4	......	......	......	......	......	......	......	......	......	......
Convair 240	2	......	......	......	......	......	......	......	......	......	......
Douglas											
DC-2	2	16.9	650	5.6	668	......	......	......	......	......	......
DC-3	2	214.6	1,174	178.0	1,424	161.8	1,671	205.6	1,814	314.3	1,756
DST	2	44.8	1,526	16.5	1,584	......	......	......	......	......	......
DC-4	4	......	......	......	......	......	......	......	......	......	......
DC-6	4	......	......	......	......	......	......	......	......	......	......
Lockheed											
Electra	2	21.5	527	6.6	559	......	......	......	......	1.3	727
Lodestar	2	13.7	829	10.9	1,152	11.5	1,392	14.3	1,719	17.7	1,545
Constellation	4	......	......	......	......	......	......	......	......	......	......
Sikorsky S-38	2	5.8	281	4.0	151	3.0	210	2.8	240	2.0	184
Stinson											
Single Motor	1	8.8	262	9.3	326	9.3	379	10.6	377	10.9	404
Tri-Motor	3	......	......	......	......	4.4	151	4.0	148	4.0	61
Waco	1	......	......	0.4	228	0.3	337	......	......	......	......
Martin 202	2	......	......	......	......	......	......	......	......	......	......
Curtiss C-46	2	......	......	......	......	......	......	......	......	......	......

		1946		1947		1948		1949		1950	
Beechcraft	2	0.4	502	5.3	721	6.4	648	......	......	......	......
Boeing											
247-D	2	1.0	607	4.0	654	0.6	818	......	......	......	......
SA-307B	4	5.0	1,695	5.0	1,344	5.0	1,362	5.0	1,365	5.0	656
377	4	......	......	......	......	......	......	10.0	410	10.0	1,283
Convair 240	2	......	......	......	......	16.2	899	93.0	853	103.0	940
Douglas											
DC-2	2	......	......	......	......	......	......	......	......	......	......
DC-3	2	426.6	1,638	446.7	1,303	442.4	1,190	398.0	1,077	388.0	972
DST	2	......	......	......	......	......	......	......	......	......	......
DC-4	4	85.8	1,758	149.6	1,546	150.8	1,318	160.0	958	150.0	1,324
DC-6	4	......	......	21.1	1,462	54.4	1,864	104.0	1,655	111.0	1,751
Lockheed											
Electra	2	3.0	587	......	......	3.9	591	......	......	......	......
Lodestar	2	16.7	1,285	11.5	1,086	12.0	335	11.0	975	11.0	969
Constellation	4	6.6	1,190	21.3	1,742	32.0	2,067	55.0	1,596	83.0	1,264
Sikorsky S-38	2	0.1	100	......	......	......	......	......	......	......	......
Stinson											
Single Motor	1	11.0	445	7.8	420	7.0	447	......	......	......	......
Tri-Motor	3	......	......	......	......	......	......	......	......	......	......
Waco	1	......	......	......	......	......	......	......	......	......	......
Martin 202	2	......	......	2.0	782	17.6	859	24.0	1,255	33.0	954
Curtiss C-46	2	......	......	......	......	0.2	802	2.0	224	......	......


USAF

This is Bendix



The airplane illustrated is a composite since, obviously, no single plane carries all of the Bendix equipment on these pages. However, many Bendix products fly with every U. S. fighting plane and are used extensively on commercial, executive and private planes as well.

(A)

Radio Noise Filters
Switches
Flow Equalizers
Vacuum Operated Instruments
Filters for Aircraft Heaters (Auxiliary, Engine, Cabin)
Pneumatic System Filters
Dynamotors
Blower Motors
Band-Change Motors
Booster Dynamotors
Actuator Motors
Special Inverters
Aircraft Interphone Systems
Radar
Radio Transmitters
Radio Receivers

Radio Communication Systems
Electronic Navigational Equipment
Automatic Radio Compass
VHF Omni-Directional Range Equipment
Automatic Pilot and Flight Path Control Equipment
Autosyn* and Magnesyn* Remote Indicating Systems For
Fuel Flow • Fuel Pressure • Hydraulic Pressure • Liquid Level • Manifold Pressure • Oil Pressure • Position • Temperature • Torque Pressure • Water Pressure
Fuel Flow Totalizing Systems

Manifold Pressure Gauges
Electric Tachometer Systems
Warning Units
Accelerometers
Airspeed Indicators
Attitude Horizon Indicators
Driftmeters
Dual Radio and Magnetic Compass Indicators
Gyro Flux Gate* Compasses
Gyro Horizon Indicators
Magnetic Compasses
Rate of Climb Indicators
Turn and Bank Indicators
ODR Components
Sextants
Control Panels

in Aviation

BENDIX AVIATION CORPORATION

B

Bendix* Starter Drives
Magnetos
Ignition Harnesses
Booster Coils
Igniter Plugs
Ignition Analyzer
Low and High Tension Ignition Systems for Reciprocating Engines
Radio Shielding Harnesses
Hydraulic—Line Type Filters
Reservoir—Line Type Filters
Vent—Line Type Filters
Fuel System Filters
De-Icing System Filters

Alternators
Fault Protection Systems
Generators
Inverters
Line Relays
Overvoltage Protectors
Reverse Current Cutouts
Voltage Booster Dynamotors
Voltage Regulators
Power Failure Indicators
Engine Starting Equipment, including Booster Coils • Induction Vibrators • Relay Switches • Starters

Automatic Engine Power Controls
Automatic Engine Boost Controls
Propeller Governor Controls
Supercharger Regulator Controls
Injection and float type carburetors
Direct injection fuel systems, including Distributing Pumps • Regulator Units • Injector Nozzles • Fuel Supply Pumps
Speed-Density Fuel Metering Systems for Jet and Reciprocating Engines
Water Injection Systems

C

Ignition Systems for Jet and Turbine Engines
Igniter Plugs for Jet and Turbine Engines
Jet Engine Starters and Generators
Speed-Density Fuel Metering Systems
Duplex Nozzles
Fuel Metering Systems for Starting Conditions
Fuel Flow Dividers
Fuel Supply Pumps

D

Brake Lining
Hydraulic Actuating Cylinders
Power Brake Valves
Shock Absorbing Struts
Shoe and Segmented Rotor Type Brakes
Wheels
Master Cylinders
Hydraulic Brake Control Valves

E

Electrical Connectors
Small Electric Actuators
4-Way Hydraulic Valves
Hydraulic Accumulators
Hydraulic Hand Pumps

Position Light Flashers
Pressure Control Valves
Electric Timing Devices
Hydraulic Equipment, including Pumps • Valves

Air Pressurization and Ice Elimination Equipment, including Electronic and Mechanical De-Icer System Timers • Oil Separators • Pumps • Valves • Pressurization and Control Units

ADDITIONAL AVIATION PRODUCTS

Beacons
Telemetering Equipment
Missile Guidance Systems
Micro-Wave Equipment
V. H. F. Ground Direction Finders
G. C. A. Ground Controlled Approach Radar
Long Range Search and Surveillance Radar
G. C. A. Ground Controlled Approach System
Actuators—linear and rotary

Differential Pressure Switches
Oxygen Regulators
Gear Boxes
Flexible Drive Shafts
Special Purpose Electron Tubes, including Amplifier Tubes • Counter Tubes • Gas Filled Control Tubes • Klystron Tubes • Rectifier Tubes • Spark Caps • Temperature Tubes • Voltage Regulator Tubes

Precision Components for Servomechanism and Computing Equipment, including Autosyn Synchros—(transmitters, receivers, differentials, control transformers and resolvers) • Amplifiers • Low Inertia Motors • Servos • Transformers • Gyros • Rate Generators
For Guided Missiles—Specialized fuel metering and control systems
Aircraft Gun Chargers Switches • Controls

BENDIX IN THE WEATHER FIELD

In addition to the products listed above, Bendix makes many meteorological instruments which are the source of much of the weather data governing flight schedules for all types of planes.

*REGISTERED TRADEMARK OF THE BENDIX AVIATION CORPORATION

AVERAGE PASSENGER FARES AND TRIPS

Domestic and International

(Source: Air Transport Association)

	Average Passenger Fare Per Mile		Average Trip Per Passenger		Airline Percentage of First Class Travel Market
	Domestic	International	Domestic	International	
1933	6.1 cts.	....	348	315	....
1934	5.9 cts.	....	399	351	....
1935	5.7 cts.	....	415	381	....
1936	5.7 cts.	....	421	414	....
1937	5.6 cts.	....	418	416	....
1938	5.18 cts.	8.33 cts.	401	487	....
1939	5.10 cts.	8.57 cts.	394	557	....
1940	5.07 cts.	8.83 cts.	375	614	12.36
1941	5.04 cts.	8.61 cts.	360	713	13.01
1942	5.28 cts.	8.85 cts.	452	880	7.30
1943	5.27 cts.	7.92 cts.	541	874	6.06
1944	5.35 cts.	7.82 cts.	538	910	7.26
1945	4.95 cts.	8.67 cts.	511	942	11.11
1946	4.63 cts.	8.31 cts.	487	1,057	22.69
1947	5.06 cts.	7.77 cts.	474	1,332	33.40
1948	5.76 cts.	8.01 cts.	453	1,376	35.30
1949	5.76 cts.	7.72 cts.	477	1,351	41.91
1950	5.50 cts.	7.00 cts.	461	1,324	46.49

NUMBER OF PLANES, PASSENGERS AND MILES

International Carriers

(Source: Air Transport Association)

Year	Number of Planes	Passengers Carried[1]	Route Miles	Revenue Plane Miles	Revenue Ton Miles (000)
1933	86	74,394	19,404	5,857,163	....
1934	99	96,804	22,192	7,539,106	....
1935	101	111,296	31,261	7,949,547	....
1936	94	87,723	31,990	6,904,246	....
1937	92	112,324	31,979	7,909,158	....
1938	73	109,265	34,968	7,042,503	....
1939	84	129,028	43,455	7,607,474	....
1940	68	162,617	53,322	9,651,733	....
1941	83	228,524	....	14,410,358	....
1942	68	269,345	....	18,681,059	....
1943	70	279,402	27,211	18,457,864	34,352
1944	70	341,496	29,708	22,272,638	39,705
1945	97	475,558	38,885	32,608,704	60,019
1946	147	1,041,283	66,419	59,375,572	136,771
1947	154	1,359,712	178,768	86,481,082	238,439
1948	175	1,372,749	177,905	98,053,441	265,428
1949	193	1,520,067	203,678	104,525,884	297,178
1950	208	1,676,540	n.a.	93,820,208	319,674

[1]1933-1937 includes revenue and non-revenue passengers.
From 1938 only revenue passengers shown.

CHAPTER ONE

The Industry

MORE DEMANDS for air power than have ever before been made short of war combined with competing peace-time production to make 1951 one of the most superlative years, from backlogs to headaches, ever experienced by the U. S. aircraft industry.

A score of aircraft manufacturers began the year with modest orders and ended it with backlogs of more than a billion dollars. But they also faced 1952 with what could be pessimistically regarded as insurmountable problems, chiefly to do with shortages. These were bordering on the acute in the raw material, engine, and accessories field, skilled employees and housing, and machine tools. All were aggravated by competing civilian production needs.

The situation was summarized as this goes to press by Admiral Harold R. Boyer, chairman of the Aircraft Production Board of the Defense Production Administration:

"We are not going to produce as many aircraft as we had hoped," he states. Shortages of metals and of aircraft engines, which have been slowed in turn by machine tool shortages, are responsible."

To these facts must be added others. Looking back on 1951 with the observation that it was a year of tooling up, Admiral DeWitt C. Ramsey, President of the Aircraft Industries Association, said late in the year:

"Manpower is also a major threat to the aircraft production program. At year-end, 1951, more than 600,000 workers are engaged in the manufacture of aircraft and their components. They are being added at a rate of some 10,000 per month. But the present high level of employment in civilian industries, plus accompanying shortages in housing, has made it very difficult to obtain the needed skilled employees. Manpower flow to defense industries is also retarded by the choice of skilled workers to remain in peace-time enterprises on the theory that they will be more secure for the long pull."

Offsetting these headaches were numerous favorable factors of which the backlogs were symbolic. Demands for all types of aircraft were at a new peacetime high. The helicopter, which in 1950 made headlines, in 1951 proved itself a permanent flying unit of unlimited usefulness. Airline traffic reached new highs, jet aircraft pointed the way to a new air world in peace or war, new craft shattered records clear across the board, and the wind tunnels and laboratories harvested bumper crops to advance aeronautics and allied fields, especially electronics. So great were the potential needs for planes and equipment that, once again and more than ever in a peace-time economy, aviation became everybody's business.

How that business went forward among the airframe manufacturers and some of the typical subcontractors, is told in detail in the following reports.

Aircooled Motors, Inc.

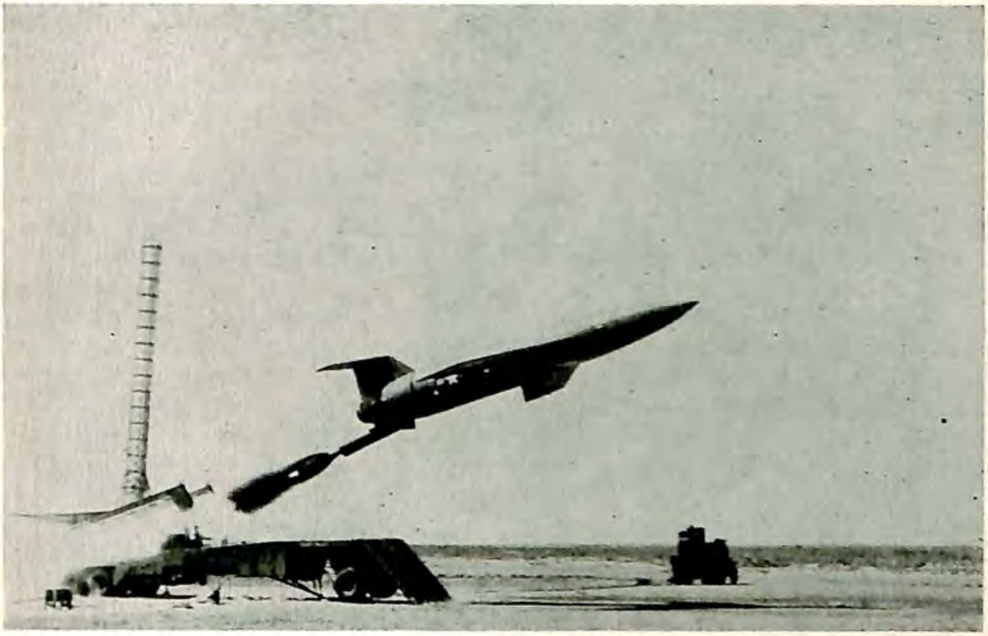
The 1951 boom in helicopters led to large-order demands at Aircooled Motors, Inc., makers of Franklin engines. Production was heaviest on helicopter engines of 178, 200 and 245 hp. There were also substantial orders for 165 hp aircraft engines, as well as subcontracting work.

Several notable achievements were made with the helicopter engines. Inter-City Airlines of Montreal, Canada, developed a 165-hp helicopter which got a CAA type certificate—the first Canadian helicopter to gain certification. The same engine was installed in the McCulloch MC4, and further development of this basic ship is in progress using a 200 hp Franklin. The 165 hp is also being used by Seibel Helicopters in developing a low-cost military and commercial ship. Bell Aircraft and Hiller Helicopters continued with development work and production using Franklin 178 and 200 hp verticals. The Sikorsky S-52, which during the year got its certificate and set world speed records for a helicopter of that type, is also Franklin-powered.

The 165 hp Franklin continued to find application in fixed-wing aircraft, notably the Temco T-35 trainer and in the development of the Continental, Inc., Airphibian roadable plane, which also won a CAA certificate in 1951.

Engineering activities of the company included further development of the basic 200 and 245 hp engines, as well as concentrated design and test work on a supercharged version of the O-425 model engines.

Additional work was conducted under Air Force contracts during the year, but cannot be detailed owing to security.



Martin Matador (B-61)

AiResearch Manufacturing Company

AiResearch Manufacturing Company of Los Angeles, California, a division of the Garrett Corporation, continued in 1951 to play its outstanding role in the following aircraft accessory fields: Air valves, cabin pressure controls, superchargers, air conditioning (turbine refrigeration), electrical-electronics products, heat transfer equipment, temperature controls, gas turbines, and pneumatic systems.

As a result, AiResearch today is supplying some kind of accessories to 99 percent of the military aircraft, and complete air conditioning and pressurization systems to most of the high-altitude commercial transports, including the three latest aircraft in this category, the Martin 4-0-4, the Lockheed Super Constellation and the Convair 340.

The newest division of the Garrett Corporation, the AiResearch Manufacturing Company of Arizona, at Sky Harbor Airport, Phoenix, has added an additional 100,000 square feet of production area, swelling the company's total working area to half a million square feet.

AiResearch products are supplied individually or grouped together into entire systems. Currently in production are some sixty different cabin pressure controls. This includes fifteen types of regulators, covering the requirements of every type of aircraft, as well as scores of air valves. All of this equipment is subjected to exhaustive tests under simulated altitude and climatic conditions.

The cockpit cooling problem in high-speed aircraft resulted in an air expansion cooling turbine so powerful, although in some models it is no larger than a man's hand, that it can make a searing 600°F. blast of air eject snow within 2/10 of a second.

Now producing nine basic types of air turbines, ranging in air flow from 7 to 100 pounds per minute, each of these basic types is manufactured to meet requirements of specific aircraft, both military and commercial.

In order to provide for cabin cooling and ventilation when a plane is on the ground, AiResearch has developed a gas turbine compressor which sends its compressed air power to a refrigerator unit, thereby air conditioning the cockpit when the plane engines are idle. This application of the GTC gas turbine compressor is presently being installed on the YB-366 and RB-36D, and the air starter used in conjunction with the GTC compressor is currently in use on many jet and reciprocating aircraft.

Currently, AiResearch is building over 300 different AC and DC motor-driven electric actuators, and, in addition, many other AC and DC motors for use in thermostatic temperature sensing controls, computers, electric and electronic flap control systems, electronic regulators, electro-hydraulic power units, brushless alternators, ammunition boosters, and radio noise filters.

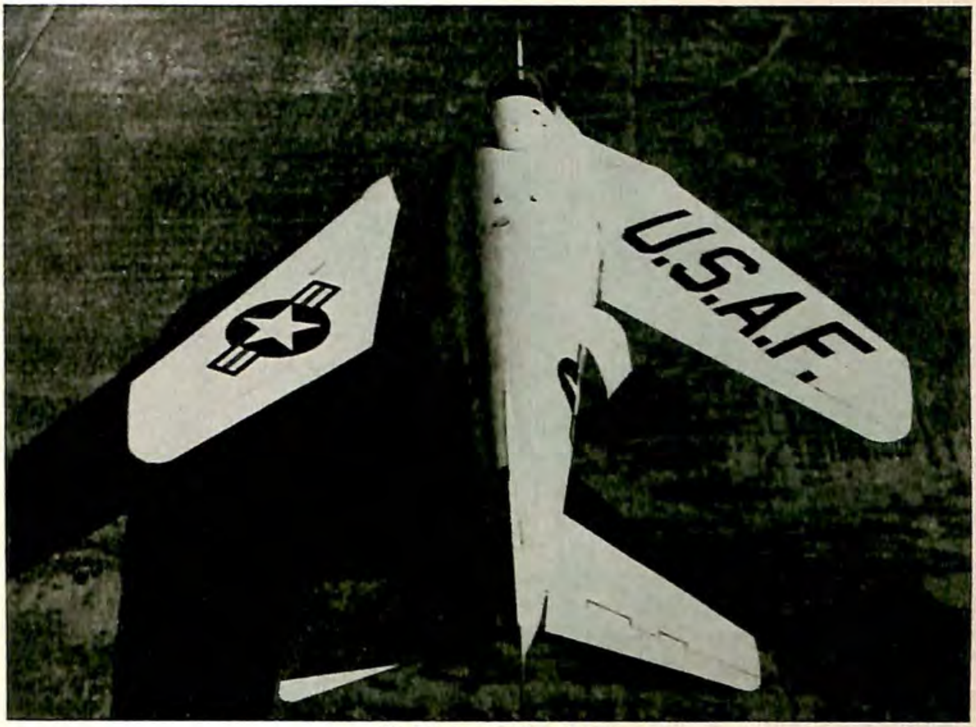
AC motors of 115 volts, 400 cycle, range in output from four-thousandths hp. to three hp. DC motors range in output from five ten-thousandths hp. to 15 hp. Special motors such as the 15 hp., 208 volt motor also have been designed and produced. All AC motors employ a self-contained magnetic-type brake of AiResearch design which requires no additional coils or wiring. AiResearch motors pass military specification No. AN-M-40.

In 1951, AiResearch engineers concentrated on design changes in actuators to improve operating characteristics under extreme conditions. Operating temperatures were lowered to —90°F. In improving resistance against corrosion, some are hermetically sealed, and can operate under water, fuel, or oil.

Following the production of the instant-action electronic temperature regulator in 1949, a new miniature electronic control, incorporating a "fail safe" circuit devised for remote positioning control, was announced in 1950, and produced in volume during 1951. About the size of a three-inch cube and weighing less than two pounds, it is suitable for carburetor and cabin air temperature control, anti-icing and cabin pressure control.

An electronic synchronizer was developed for the complete synchronization of actuators operating under varying and different load conditions. Capable of synchronizing actuators of different characteristics, such as linear and torque actuators, because it synchronizes percentage of stroke instead of distance of stroke, it is particularly applicable for synchronizing aircraft control surfaces. Failing, the sychronizer leaves the circuit immediately, and thus fails "safe."

Electronic components now in production are adaptable in many types



Bell Aircraft's X-5

of analog computers which may be constructed to perform special calculations of widely varying natures. These remote-positioning, synchronizing and computing controls are expected to have important industrial applications in the future.

Leading the list of AiResearch temperature control units is the electronic temperature regulator utilized in many military and commerical aircraft. It weighs only four and one-half pounds, fits in a space less than a six-inch cube, and can be utilized in systems which require sensitive temperature regulation, such as cabin temperature control, oil, fuel and engine temperature regulation, or anti-icing systems.

New applications on modern jet engines are the electrical inlet screen retraction system located in the air-intake section of the jet engine and the inlet guide vane control system located at the entrance to the compressor on the jet engine.

For many applications using DC motors, integral radio interference elimination filters are incorporated when required.

In order to meet the demands of the military aircraft armament program, AiResearch entered the field of electric ammunition boosters in 1948. Extensive qualification tests were run to determine the durability of the AiResearch designed and developed ammunition booster. The results of the tests performed at Wright Field won official AMC approval and production was started on units for the .50 calibre machine guns on the North American F-86D. At the present time, ammunition boosters for various tanks and planes are in full-scale production. In addition, boosters of larger size are currently being developed.

AiResearch oil-to-fuel type of oil coolers for jet aircraft are now being supplied to major aircraft manufacturers and installed as aircraft engine accessories. Many of these coolers are in the form of a section of an annulus and, in effect, conform to the engine configuration, thus utilizing the smallest and most convenient package space.

A recent development in AiResearch's list of available oil coolers is the design of a tube bundle or core which is removable from the outer shell. This new design makes it possible to clean and flush the tube bundle completely on the oil side.

In much of the air-to-air heat exchanger equipment, AiResearch has found it expedient to use various degrees of tube flattening and dimpling in order to achieve a condition of air turbulence, and in turn gain additional heat transfer for the same surface area.

AiResearch continued its large volume production on the regular line of air-to-oil coolers for reciprocating engines.

One of AiResearch's latest contributions to our national defense program is the Air Force Ground Heater, designated GH4-1. With the ever-threatening possibility that our enemies may attack through the Arctic regions, AiResearch began to design and develop a heater that would emit a maximum amount of heat in the shortest possible time.

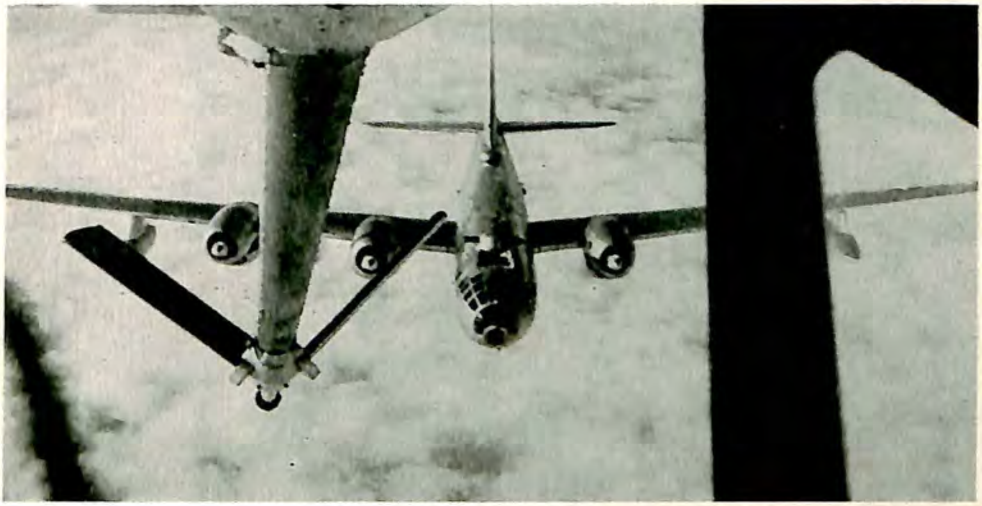
The ground heater, which is now in production, emits 4,000,000 BTU per hour, and heats air from minus 65°F to 280°F in one (1) second—(345° temperature rise). Air leaving the heater is perfectly clean and free of combustion gases and has a velocity of approximately 40 miles per hour. The heater uses a gas turbine as the power unit and can be transported from one place to another on a plane, sled, jeep or truck.

Further work was done on pneumatic auxiliary power system in the Convair P5Y-1 turboprop flying boat developed in 1950. The AiResearch pneumatic system will maintain heat, light, radio communication, and all necessary accessory activity without operation of the main turbine engines during advanced base operations when aircraft self-sufficiency is essential. It also provides the pilot of jet aircraft with a push-button automatic self-starter.

During the past eight years AiResearch has been working on the problem of providing an auxiliary power source to modern high performance aircraft, and after extensive research and development, the low pressure pneumatic power system has been selected as the most satisfactory solution.

Low pressure systems (0-50 lb. per square inch and temperature up to 2000°F) are best suited to aircraft applications where a continuous high power demand is required.

Several aircraft types now flying, and many projected designs, employ



A Boeing B-50 and its tanker

AiResearch airborne, pneumatic systems as the major source of auxiliary power.

The main engines of a gas turbine powered aircraft provide a convenient source of power for operation of air or gas turbine driven devices. The air may be bled from the main engine compressor during its operation. However, in order to meet ground power requirements and to supplement main engine output during an emergency or special flight condition (low main engine output), an auxiliary power source is desirable.

AiResearch components for pneumatic power systems include an air turbine starter, designed for main gas engine starting, and an outstanding example of how light-weight turbo machinery may be adapted to perform the manifold tasks required of accessory systems. An example is the ATS 35 series of starter, which uses gas turbine compressor bleed air and produces 35 hp. The weight is 16.5 lbs. The AiResearch air turbine motor uses main engine bleed air to produce a 150 hp overload rating with a normal rating of 70 horsepower. This unit weighs only 57 pounds and can be used to drive alternators, generators, and pumps.

The company's gas turbine motor is built to use the bleed and burn principle and embodies several advanced design features. Horsepower range 125 and up. The AiResearch gas turbine compressor is of the simple bleed type—a completely packaged auxiliary power plant with integral cooling, oil and automatic control systems. It requires only fuel and electricity from the airplane. It is designed as an airborne auxiliary unit to supply compressed air on the ground or in flight for main engine starting, generation of electrical power, heating, refrigeration, anti-icing and other auxiliary functions.

Pneumatic power is the only feasible single power source for supplying energy for all such major auxiliary loads in the aircraft as main engine starting, power for generation of electricity, and air conditioning. The integrated system consists of an air turbine starter, an air turbine motor or gas turbine motor for driving accessories, an air cycle refrigeration unit, cockpit ducting controls, and bleed-off type gas turbine compressor. The gas turbine may be installed in the airplane or used as a ground unit with a flexible duct to a quick-disconnect fitting in the airplane skin.

AiResearch has, for the past year, been developing auxiliary power units which furnish the electrical and hydraulic power for guided missiles.

In order to prove the principle that a solid-propellent-operated turbine in conjunction with a generator and hydraulic pump is a sound engineering approach to the problem of auxiliary power, AiResearch has spent many months of testing under simulated missile operating conditions. Test units were subjected to shock and vibration up to 60 g's, high and low temperature operation, and other extreme environmental conditions likely to be encountered in the transportation, handling, and firing of missiles. The results of these tests were successful and production units are now underway.

An outstanding phase of the auxiliary power supply program has been the development of an induction alternator. This unit, which uses no brushes or slip rings and is thus free of radio noise and altitude problems, appears to offer an ideal solution to missile electrical power. Once this alternator has been installed, it is instantly ready for service and requires no maintenance or further attention of any kind. This alternator has high reliability with the most rugged type of electrical-machine construction known coupled with complete absence of electrial rubbing contact surfaces.

AiResearch has developed, within the past year, a new approach to cabin pressurization. Heretofore the control mechanism for the regulator has been integral with the outflow valve itself. However, it has been found that several advantages can be realized by mounting the outflow values remotely from the control head. Therefore, a control head incorporating all isobaric, differential, and ratio gas expansion functions, capable of controlling more than one auxiliary outflow valve, has been successfully produced. It is "universal" in the sense that it can meet any specified pressure schedule and, in addition, has good inter-changeability and maintenance features.

Under the direction of Vice-President of Engineering, W. R. Ramsaur, the following list of key engineering personnel have made possible the developments in their specific fields during the past year:

S. K. Anderson, assistant chief engineer, heat transfer and cabin pressure equipment; R. W. Jensen, project engineer—cabin pressurization equipment, heat transfer—ground heater; J. E. Chapman, assistant chief engineer, electrical and electronics equipment: Homer J. Wood, assistant chief engineer, gas turbines and compressors; W. T. von der Nuell, project engineer, gas turbines and compressors; Charles Drexel, project engineer, guided missiles, and L. S. King, chief preliminary design engineering.

Northrop Scorpion interceptors

Allison Division
General Motors Corporation

Two parallel events during the early part of 1951 led the 1951 year's news at Allison Division, General Motors Corporation.

In March, the 10,000th Allison jet engine came off the production line. At the same time came announcement of the new Allison J35-A-23 (now the J71) Super-Jet engine.

The J71, an "all-weather" engine, has de-icing features, automatic retractable air inlet screens, and a "cannular" combustion section, featuring one outer combustion chamber and ten individual inner cans. These inner cans are capable of field replacement, adding to the simplicity of maintenance. The new engine has sixteen axial stages of compression, 3-stage turbine, an over-all length of 172 inches and a diameter of only 37 inches. Fuel economy has been improved substantially in the J71 and first experimental installation is scheduled for the YB-47C USAF Boeing Stratojet. Due to the substantial increase in power compared with the six jet engines now in the B-47, only four of the new engines will be required.

Experience in the air paid off handsomely in 1951, for the J33 engine was officially allowed 500 hours plus extensions between major overhauls. In addition, for the first time in the history of jet engines, an Allison J35 engine completed 1000 hours of operation without a major overhaul. The honor of winding up the 1000 hour tour of duty in an F-84 Thunderjet, that made this engineering history, went to Lt. Col. Walter G. Benz, Jr. commanding officer of the 82nd Fighter-Interceptor Squadron at Hamilton Field, Hamilton Air Force Base, Cal.

Allison jet engines now have accumulated over 1,000,000 hours of flight time, many of which have been flown in combat. Five fighters, during 1951, were in service in the Korean theater, powered by three different types of Allison engines. The USAF F-80 Lockheed Shooting Star, F-94 Lockheed all-weather interceptor, and Navy F9F Grumman Panther are powered by the J33 type jet engine. The J35 is in the USAF F-84 Republic Thunderjet. Also in an outstanding ground support job were the USAF F-82 North American Twin-Mustang, the last operational Air Force fighters to have reciprocating power plants, the liquid-cooled Allison V1710.

Since the announcement of the Allison T38 and T40 turbo-prop in 1950, design and performance have been considerably improved. Figures are restricted. Flight hours are being accumulated on the Allison Turbo-Liner with excellent results, and this first U. S. turbine-powered transport, purchased last year by Allison for experimental tests, is paving the way for turbine transportation of tomorrow in the U. S.

Hours have also been accumulated by Allison T40 turbo-prop engines in the Navy XP5Y Convair Flying Boat and the Navy A2D Douglas Skyshark.

Production contracts received as a result of the successful tests with these planes has given Allison a first production order for turbo-prop engines, followed by other military contracts for Allison turbo-props in three additional types of transport aircraft.

The USAF XC-130 Lockheed four-engine medium cargo plane is the first military transport ever designed around turbo-prop power. Also to be powered by Allison turbo-prop engines are the new Navy-sponsored R6D which is a modified configuration of the world-famous Douglas DC-6A Liftmaster and the Navy R7O, the new turbine version of the Lockheed Super-Constellation.

The Air Forces' only two all-weather combat planes in production, the F-94 Lockheed all-weather interceptor and Northrop F-89A Scorpion are powered by the Allison J33 and J 35 engines with afterburner.

During the year a new model J35 series engine, designated the J35-A-29, went into production. It powers the F-84G Republic Thunderjet. This new fighter is fully equipped for mid-air refueling by tanker planes, has longer range, faster climb, and provides for easier maintenance. The engine delivers 5,600 pounds of thrust, 10 percent more than previous models.

Allison has been active since its inception in the Mutual Defense Assistance Program.

After World War II, the company started on a program to diversify its activities, and as a result is engaged in the manufacture of parts for General Motors diesel locomotives, heavy-duty transmissions for General Patton M-46 and Walker Bulldog tanks and heavy-duty trucks and off-the-road equipment, sleeve type precision bearings for reciprocating aircraft engines, diesel locomotives and other high powered equipment. Activities in each of these divisions have increased to the extent that it became necessary in 1951 to devise a new plan of operation. Where previously all operations were directed by a central management, each operation now has its own manager who is fully responsible for the activity. As part of this reorganization R. M. Critchfield was brought in as assistant general manager from Delco-Remy Division where he served as factory manager.

A new administration building of 100,000 square feet was started during 1951, and when completed early in 1952 will release over 70,000 square feet of present office space to the manufacturing program of Allison Plant No. 3.

During the year, Allison increased its number of employees from 8,500 to 15,500 and is still headed sharply upward in employment and production. There are now seven plants located in Indianapolis, totalling over four and one-half million square feet.

Research engineering and manufacturing programs, it is anticipated, will reach a peak in 1953.

Anderson, Greenwood and Company

Having won an approved type certificate late in 1950 on its AG-14 two-place, pusher-type, all-metal personal plane, Anderson, Greenwood and Company completed five of these craft in 1951, then had to halt production owing to short supplies caused by the defense effort.

Since the company is headed by engineers who worked for the Boeing Airplane Company in Seattle during World War II, defense engineering contracts were sought. One was signed with Consolidated Vultee Aircraft Corporation, San Diego, resulting in expansion of engineering activities to the point that more space had to be leased at Municipal Airport, Houston, Tex. Shops are still maintained at Sam Houston Airport, site of design, development and fabrication work on the AG-14 pusher.

Beech Aircraft Corporation

During fiscal 1951 (October 1, 1950 through September 30, 1951) Beech made good its promise to "continue as long as possible" building commercial aircraft transportation by delivering a total of 396 Beechcraft Bonanzas and 58 Beechcraft Model 18 twin-engine executive transports, compared to 405 and 22 respectively for these two models during the comparable 1950 period. Top production news came early in January, when Beech unveiled the new Model C35 Bonanza, designed especially for business and executive use.

Indicative of accelerated military production activities was the company's fiscal-year total sales report of more than $32-million, as compared with $16,532,900 total sales for the fiscal-year ending September 30, 1950. Total backlog of business late in 1950 was reported as over $50-million. The new end-of-1951 backlog figure was well in excess of $180-million.

Throughout 1951, Beech each quarter reported a steady gain in production, closing its fiscal-year with another record of profitable operation as a manufacturer of military and commercial aircraft. Total production, since the first four-place Bonanza was delivered in the spring of 1947, passed the 3,000 mark before the year ended. A grand total of more than 625 commercial units of the larger Model 18 twin-engine eight-place executive transports have been manufactured since V-J Day.

In April, Beech Aircraft announced that bonafide customer-orders with deposits were then on hand for more than a year's production of the new Beechcraft Model 50 Twin-Bonanza, first flown on November 15, 1949, and certificated by CAA on May 25, 1951. By May of 1951, Beechcraft's commercial production of this new six-place twin-engine model was reported sold out, with the company's program set up to build at least 100 of these executive transports before the end of 1952, defense shortages permitting.

First deliveries of the new medium-range Twin-Bonanza were made in August and September—one to the Lycoming-Spencer Division of AVCO Manufacturing Corp., for extensive use in research of the Lycoming engines being used; and two to Carco Airservice, the "atomic airline" operating between Albuquerque and Los Alamos, New Mexico.

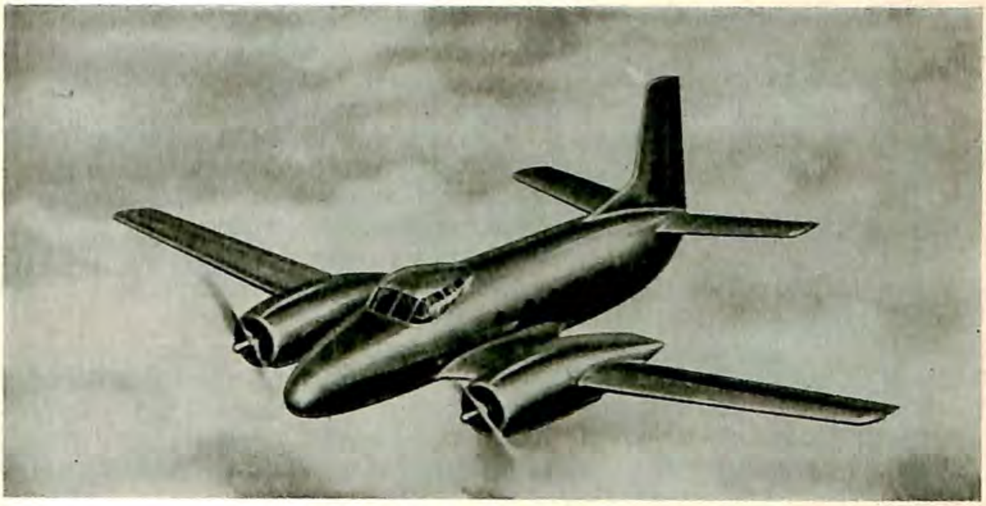
Military-wise 1951 was a year of production and expansion.

At the 1950 year-end, Beechcraft's employment had grown to 4,400 from a June pre-Korea total of 2,300. In November of 1951, the employment total was reported at more than 8,500.

At the 1950 year-end, Beechcraft's peace-time production facilities of approximately 974,000 square feet of floor area had been supplemented with the leasing and activation of the Herington (Kan.) Air Base, a former World War II B-29 Modification Center. In November, 1951, the total plant facilities floor space, owned and leased by Beech, had jumped to approximately 1,624,000 square feet. This greatly increased production facilities total includes that major portion of the existing facilities of the Liberal (Kan.) Air Base leased in October 1951 for military aircraft production activities as a second Beech satellite plant, in accordance with Beechcraft's policy of restricting the expansion of its own buildings to an absolute minimum, and to also help reduce the burdens of defense expansion on the city facilities of Wichita.

Much of the Company's military production continued to remain undisclosed during 1951. While it is known that the Company has been engaged quite actively in the manufacture of special types of auxiliary wingtip fuel tanks for tactical aircraft, security regulations bar production totals or details. A pilot quantity of three T-34's was delivered to the U. S. Air Force in August, 1950, and during 1951 were on loan to the U. S. Army ground forces for evaluation as armed tactical liaison aircraft to fill the dual front-line mission of long-range artillery spotting and light ground-support.

The company in April, 1951, also announced the award of a contract from the Royal Canadian Air Force for an undisclosed quantity of new military versions of the Beechcraft Model 18 twin-engine trainer-transport model.



Beech's T-36, USAF trainer-transport

During the year there was an acceleration of the activity of Beechcraft's special production lines at work for the past four years on the special modification and rebuild contracts for the U. S. military forces' fleets of World War II Beechcraft twin-engine trainer-transports. Another modernization program was arranged late in 1951 with the Canadian Government for RCAF Beechcrafts.

Biggest military news of the year came in July with assignment of USAF T-36 production to the Beech Wichita facilities. The Air Force announced that military production on this plane would give steady employment through 1953 for Beech Wichita employees.

The twin-engine USAF T-36A advanced trainer-transport will have a speed of over 300 mph, a service ceiling of approximately 34,000 feet, and a combat radius of over 650 miles. Production has also been assigned to Canadair Limited, Montreal. All other data are classified.

Mrs. O. A. Beech, widow of Walter H. Beech, who died November 29, 1950, became president of the company on December 14, 1950.

Bell Aircraft Corporation

Diversity of production and controlled expansion keynoted Bell Aircraft's accelerated defense development and production program in 1951.

Employment neared 12,000 mark; floor space, either in use or nearing the end of construction, totalled 2,225,000 square feet; the value of unfilled orders was almost $400,000,000. Sales in the first six months were practically equal to the dollar total for the entire twelves months of 1950.

Bell's total production output was devoted to military needs. However, in conformity with government directives, diversification was an aim almost as important as increased production.

In its dual capacity of prime contractor and subcontractor, the company is engaged in more than thirty-five different projects for almost every branch of the military services.

As prime contractor its production includes helicopters, guided missiles, rocket motors, high speed, high altitude research aircraft, radio-controlled bombs and electronics units. An intensified program of research and development is progressing in the fields of aeronautics and electronics and progress is steady in the development of a convertiplane.

As subcontractor, Bell's contributions to the defense effort include the production of jet engine nacelles, electronics equipment and rocket motor components.

To avoid increasing floor space and employment in the same ratio as total production and sales, it was arranged, so far as possible, to have parts and sub-assemblies made by responsible manufacturing organizations with facilities and equipment of their own. The success of this program is reflected by a comparison of World War II and present figures for peak backlog, space, and employment.

The World War II figures show that Bell's maximum backlog was approximately $500,000,000; floor space was more than 8,300,000 square feet; and employment peaked at the 55,000 mark. Quick analysis of these figures makes it evident that the company has currently on its books almost 80 percent of its World World II backlog although it has 75 percent less floor space and 80 percent fewer employees.

Bell's Wheatfield Plant, location of the company's executive offices, adjoins the Niagara Falls Airport, contains 1,164,000 square feet and will be devoted to the manufacture of guided missiles, rocket motors, radio-controlled bombs, and electronics equipment. It is the home of the series of specialized research aircraft which are following in the scientific flight pattern of the famed Bell X-1.

Bell is also operating the Northland Plant in Buffalo—114,000 square feet; the Kenmore Plant, Town of Tonawanda—402,000 square feet; the Fort Worth (Texas) Plant No. 1—152,000 square feet; the Fort Worth Plant No. 2—42,000 square feet; and the Bell Test Center, Modeltown, N. Y.—20,000 square feet. A new Helicopter Division Plant will provide an additional 200,000 square feet in Fort Worth. Other space is being acquired as the need arises.

The Northland Plant purchased primarily to provide storage space and to relieve congested conditions in the Wheatfield Plant, is also harboring some factory operations.

The Kenmore Avenue Plant, constructed by the government for the Curtiss Airplane Division during World War II, was acquired for needed fabrication and assembly areas and to house the Helicopter Division during the time the Fort Worth Plant was being constructed. When the Helicopter Division completes its move to Fort Worth, the Kenmore Plant will be devoted to the manufacture of jet engine nacelles for B-36 and B-47 bombers and other products.

The Texas facilities have been assigned to the development and construction of helicopters and jet engine nacelles.

To expedite buying materials for guided missiles, radio-controlled bombs, helicopters, and jet engine nacelles a Department of Outside Production was established and placed under the direction of 1st Vice President, Ray Whitman. Contracts for materials and sub-assemblies totaling more than $51,000,000 have been let to approximately 500 suppliers in half the 48 states.

In the field of experimental high-performance aircraft, Bell continued advances. Planes include the Bell X-1 No. 3, the third of the original rocket-powered X-1 series; slightly modified successor aircraft—the X-1A, the X-1B, and the X-1D. The X-1 3 and the X-1D, however, were destroyed in accidents while at the Edwards Air Force Base in Cal. The X-1, X-2 and X-5 give the company the distinction of having design and development contracts for 3 of the 5 so-called "X" aircraft contracts let by the Air Force.

A top aviation event in 1951 occurred when the Bell X-5 began its flight tests. The craft, first to feature wings capable of sweeping backward or forward in flight, was successfully put through its airborne paces at Edwards Air Force Base, Cal., beginning in June.

Unlike the rocket powered X-1, the X-5 is jet propelled and is capable of sustained flights over a longer period of time. It takes off from the ground under its own power instead of being launched from a "mother" aircraft.

The X-5 will be used as a flying laboratory by the National Advisory Committee for Aeronautics to investigate aerodynamic effects of changing the degree of wing sweepback during flight. The sweptback X-5 has all the advantages of conventional wing aircraft in takeoff and climb, maneuvering, and endurance and is also capable of very high speeds.

Viewed in profile, the X-5 has a "flying guppy" configuration which results from mounting its Allison J-35-A-17 turbo-jet engine under the cockpit rather than behind the pilot. The X-5's power-plant extends through the second and third quarter of the ship's length, the tail-pipe protruding beneath the fuselage and not from the rear of the plane.

The X-5 is the product of three years of research and development by the Air Force, NACA and Bell Aircraft engineers. It is 33 feet, four inches long and measures 12 feet in height from ground to fin tip. Wing span is 32 feet nine inches and weight is approximately 10,000 pounds. A slender spear-like boom, extending an additional eight feet from the nose, houses yaw-measuring devices and a pitot tube used in registering indicated air speed.

The needle-nosed X-5 is enameled white, in contrast with the orange-tinted "international yellow" of the revolutionary Bell X-1, now enshrined in the Smithsonian Institution.

A major development in designing the X-5 was the achievement by Bell engineers of a mechanism for changing wing sweep-back in flight, while simultaneously compensating for the resulting shift of the center of gravity.

Each wing has a specially designed fairing to insure that its leading edge presents a smooth airfoil regardless of sweep-back angle. The leading edges of the wings are fitted with slats which comprise an integral part of their upper surface when not extended. When extended they increase aerodynamic lift, appreciably reducing stalling speed.

Two dive brakes are located in the sides of the fuselage forward of the cockpit. They are metal "doors" which can be opened hydraulically until they are at nearly right angles to the fuselage. Protruding, they provide rapid deceleration.

The axial flow turbo-jet engine develops a 4900-pound thrust, and the X-5 is designed to yield valuable transonic data.

The X-5's air inlet duct extends straight from the nose to the front of the engine. This design holds air-duct loss to a minimum, scooping greater quantities of air at high altitudes where the decreased oxygen content of the atmosphere lowers jet engine performance.

Jean L. (Skip) Ziegler, Bell's Chief of Flight Test, was the first to fly the X-5, making approximately twenty flights to complete the initial evaluation tests. Brigadier General Albert Boyd, commanding officer of Edwards Air Force Base, was the first Air Force officer and the first person other than Ziegler to fly the craft.

Preliminary flight tests of the Bell X-2 were also scheduled to take place at Muroc. The Air Force has not released any newer details of the X-2 other than that the ship will be rocket-powered, have swept wings, and be constructed partly of stainless steel.

Since the end of World War II, guided missiles have advanced from the status of research and development projects to the point that production in quantity is being prepared for.

Bell is engaged in guided missile work for the Navy (BuOrd and BuAer), and for the Army (Ordnance and Chemical Corps). Air-to-air, air-to-ground, and ground-to-ground missiles are the types included in prime contracts, but investigations are being conducted in the ground-to-air missile study. One missile has reached such an advanced stage of development that the company is building equipment for training Air Force personnel in handling it.

To meet its new assignments, Bell's engineering department was greatly expanded until it now has the greatest number of employees in company history. Engineering personnel represent 20 percent of the company's total employment, a high ratio which will remain constant.

For every engineering hour behind such airplanes as the Kingcobra and the Airacobra, more than 100 engineering manhours are required for guided missiles. Of the total Bell engineering manhours in 1951, nearly three quarters were expended in the fields of guided missiles and rocket motors.

Bell's guided missile program under prime contracts from the Air Force and the Navy include air-to-surface, air-to-air, and surface-to-surface

COUNTEROFFENSE

I want to make it entirely clear that in my opinion it is not right for this country to have anything less than the most devastating air counteroffensive of which we are capable. We must not be misled by improvements in other parts of our air job, such as the tactical air, to lose sight of the fact that the thing we are trying to do, in the event that unhappily we should be attacked, is to strike at the very heart of this attack and to see to it that the attack is stopped at the earliest possible moment. Nothing other than the strategic air can do this.

—THOMAS K. FINLETTER
Secretary of Air Force

missiles. The company is also experimenting with the surface-to-air type. In addition to prime contracts, the company is assisting in the missile programs of other companies by supplying products of its design and manufacture, such as proportional control systems and major components for rocket motors.

The electronics section of the engineering department is also engaged in the development and construction of components which are expected to contribute importantly to the missile programs of other contractors.

In Canada, the Ontario Hydroelectric Power Commission has streamlined its methods of power-line survey through use of Bell helicopters.

Although military requirements for service and spare parts are increasingly heavy, the company is doing everything possible to provide operators of Bell helicopters with the spare parts and equipment necessary for flight and ground maintenance.

Bell was selected to receive the 1951 National American Legion Award "for having the most outstanding record for employment of physically-handicapped veterans of any employers in New York State." At the time of the award, Bell had 10,500 employees, of whom 9,123 were men. A total of 4,113, or 46 percent, were veterans and 943, or 23 percent were disabled.

Field testing in the missile field is being conducted at Holloman Air Force Base in New Mexico and at the Naval Ordnance Testing Station at Inyokern, Cal.

Under government contract a wide variety of other type research is being conducted, such as: an aerodynamic flutter research project, to correlate theoretical analysis with actual results; an evaluation of aerodynamic temperature rise; a project involving swivel joints for fluids under high pressures and high flows; and an evaluation of a type of aircraft rocket.

To further the study of vibration effects on aircraft and guided missile components, Bell engineers designed and developed a vibration test tower, 40 feet high and 15 feet square, which simulates aircraft or missile flight path variations, and physical vibration and oscillation experienced by supersonic craft can be duplicated.

The tower is capable of subjecting parts and components weighing up to 3,000 pounds to vibration frequencies of from one to 15 cycles per second within a vibration amplitude of five feet.

Future possibilities of the tower include the study of vibration effects on entire missiles and aircraft sections, both for Bell and for other industries which may request use of the Bell facility.

During the year the Air Force revealed the use of the radio-controlled Tarzon bomb in Korea to destroy targets of massive construction. This device provided greater accuracy and greater economy in time, men and planes than free-falling bombs. Destruction of installations included bridges, factories, dams, and power plants above the 38th parallel and as far north as the Manchurian border.

The Tarzon is a 12,000 pound, 21-foot long bomb which can be remotely controlled by radio and directed to its target by the bombardier in the airplane from which it is dropped. Although it is not a guided missile in the accepted sense of the term, its controllability insures far greater accuracy than can be achieved with conventional, free-fall bombs.

Its enormous destructive power can therefore be delivered to a major target without resort to the "near saturation" type of attack which requires the use of many bomber aircraft. Since Tarzon's accuracy makes it possible to assign one bomber and one bomb to a target, additional bombers and crews are freed for other missions.

The Tarzon, which has a maximum diameter of 54 inches, is carried aloft in the bomb bay of heavy bombardment aircraft of the B-29, B-50 and B-36 types. An octagonal ring on its tail contains rudders, elevators and ailerons which perform in the same manner as conventional aircraft controls. They can be actuated by the bombardier who uses a flare mechanism and special bomb sight for tracking, and radio signals to guide the bomb. Extreme accuracy can be attained because compensation may be made for errors which develop at launching or which develop because of atmospheric conditions encountered during descent.

Another structural feature of the Tarzon is the lift ring which is fitted about the center of gravity of the warhead. The ring serves as the wings of the bomb when its flight course is altered.

To streamline its helicopter production, Bell has given full autonomy to its Helicopter Division, physically separated the division from the parent plant at Buffalo, N. Y., and moved it to temporary quarters at Tonawanda, N. Y., and at Fort Worth, Tex.

A new Helicopter Division plant is being readied near the latter city and was scheduled to be in full operation early 1952. The plant, which contains more than 200,000 square feet, was constructed at an estimated cost of about $3,000,000 with equipment requirements at an equal expenditure.

Meanwhile, helicopter production went on at Bell's Kenmore Plant, constructed for the Curtiss Airplane Division during World War II, with over 400,000 square feet of production and office space.

The Helicopter Division plant in the Fort Worth-Dallas area will be a completely independent facility. Within it, all phases of helicopter engi-

HELICOPTER EVACUATION

First Lieut. Joseph L. Bowler, Army helicopter pilot in Korea, holds the official record for all services in the evacuation of wounded, a total of 806 rescues in 10 months time. During the first ten months of 1951 a total of only 12 Army helicopters carried 4,800 wounded soldiers from the battle lines to positions of safety and medical care. Bowler gained fame for his development of a technique for administering blood plasma to wounded while enroute in the helicopter. He has already won the Distinguished Flying Cross and the Air Medal for his work in Korea.

neering and flight research—including design, development and long range research will be carried on in order to speed the fabrication and assembly of the constantly improving 'copters.

Bell is engaged in producing several helicopters at present—the H-13D for the Army Field Forces; the HTL-4 for the Navy and Marine Corps; the YH-12 for the Air Force, the XH-15 for the Air Force; the XHSL-1 for the Navy; and the basic commercial model 47D-1. Practically none of the last named group were produced in 1951 because the company's entire output of military craft was assigned to meet the requirements of the Armed Forces.

This applies particularly to the H-13D (Army and Air Force) and the HTL-4 (Navy and Marine), three-place, 200 hp helicopters which, when equipped with litter platforms, carry as many as five persons.

The X flight HTL-4's and H-13D's, airlifted directly from factory to Korea in transport aircraft, went into action in January and by the end of October had evacuated over 6,500 casualties. The H-13D, extremely maneuverable and equipped with skid-type landing gear, was particularly outstanding. Skid gear, constructed of steel pipe, weighs less than half standard wheel-type gear.

In January, the Army equipped its Second and Fourth Detachments with four H-13D helicopters each. By June, the eight pilots of the two units had rescued 1,518 wounded from front lines, an average of almost 200 per pilot.

To streamline helicopter rescues, the Army Field Forces assigned their three operational detachments to the direct command of the Surgeon General of the United States. Each detachment is attached to a Mobile Army Surgical Hospital, usually abbreviated to MASH.

The MASH, one of the great developments in the field of military medicine, is designed primarily to act as "trouble shooter" in the treatment of casualties classified as non-transportable patients. Each hospital is fully equipped to care for the more serious chest, head, stomach and other injuries which require an extraordinary degree of surgical care.

A MASH is able to set up its tent-city hospitals within a few flying minutes of the front lines. Normal complement of each hospital unit is 12 surgeons, 14 nurses, and 96 medics. Their skill, quickly made available to the wounded through helicopter evacuation from the battlefield, has reduced the mortality rate to less than 2 percent, the lowest ever achieved in the history of warfare, according to Major General George E. Armstrong, surgeon general of the Army.

The YH-12, a much larger helicopter, is being built for the Air Force. It can carry eight fully equipped soldiers, or ten passengers, or six patients on litters in addition to a doctor, nurse, or medical attendant. Model YH-12 has strong peacetime potentials for passenger, mail and cargo transportation such as the operation contemplated by commercial helicopter operators for New York City.

The tandem-rotored XHSL-1 marks Bell Aircraft's first departure from its familiar single-rotor configuration, characteristic of all Bell models from the first experimental helicopter in 1942 to the present production models. Basic Bell rotor system principles will be retained however, particularly the rigid two-bladed rotors and the patented automatic stabilizing device. The fore and aft rotors,which are interconnected, can be folded to allow compact stowing of the 'copter aboard an aircraft carrier or other type of ship. The XHSL-1 has a quadricycle landing gear and employs horizontal stabilizers and fins similar to those of fixed wing aircraft.

Bell is also developing a convertiplane for the Army and the Air Force. This craft combines the takeoff and landing characteristics of the helicopter with the speed and range of the fixed wing aircraft.

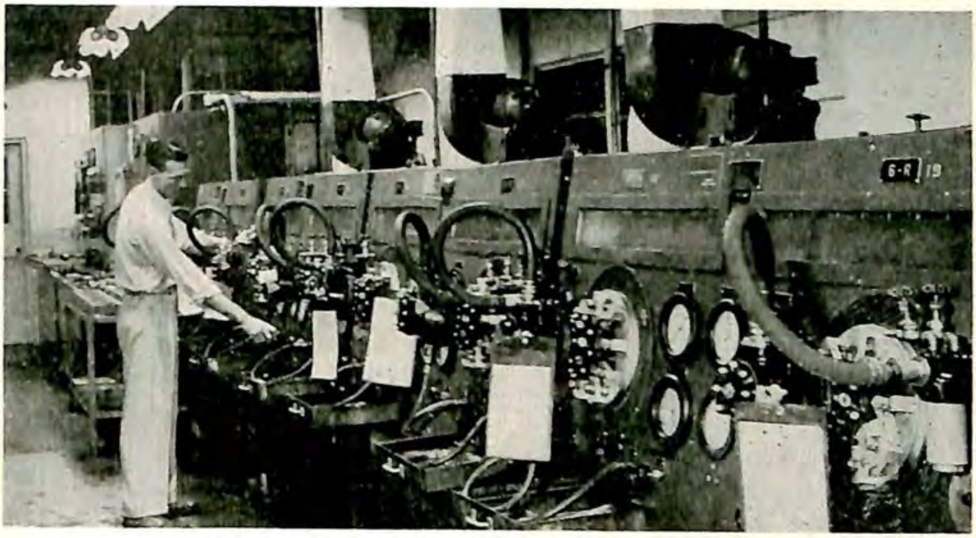
The convertiplane contract is one of three awarded in a competition. All branches of the military agree that if a sound and proven convertiplane design results from this three-way development, production potentials are very great.

In their second year of operation, the six Bell model 47-D1 helicopters of the Helicopter Air Service Incorporated, passed the 10,000-hour mark of accident-free flight on scheduled air mail service in Chicago. The six craft flew the equivalent of twenty trips around the globe while operating within a 50-mile radius in the Chicago area.

Since beginning the Chicago air mail operation, H.A.S. completed more than 95 percent of all scheduled flights regardless of weather conditions. In the two years of operation, more than 10,000 landings were made on the heliport atop the roof of the Chicago Post Office. Weight of the mail carried was considerably in excess of 4,500,000 pounds.

Commercial operators of Bell helicopters in this country and foreign countries found continued demand for the services of their agile craft. The five Bell model 47-D1 helicopters of the Okanagan Air Service, Ltd., Vancouver, logged their 2,000th hour of accident-free flight while transporting 2,000,000 pounds of tools and camp equipment for construction of a dam high in the British Columbia Mountains.

Petroleum Bell-Helicopter Services, Inc., performed extensive geophysical operations in the oil-rich but marshy areas of southern Louisiana. Equipped with pontoons, the Petroleum Bell 47-D1 helicopters moved seismic crews and equipment to shot hole sites in marshes and swamps. Marsh buggies, previously used for the purpose, were often limited to a speed of three miles per day.



Bendix direct fuel injection pumps under test

Bendix Aviation Corporation

Bendix Aviation Corporation expanded its defense and aviation electronics activities clear across the board in 1951. Eclipse-Pioneer at Teterboro, N. J., the Bendix Products division at South Bend, Ind., Bendix Radio division at Towson, Md., and the Scintilla Magneto division at Sidney, N. Y., plus branches new and old elsewhere—all increased production facilities and production totals.

Typical of the other three divisions Eclipse-Pioneer had a marked increase in output, and a vast expansion of manufacturing facilities. The Pioneer-Central division, in Davenport, Ia., and the Utica Division in Utica, N. Y., were added to the growing family of Bendix divisions to provide additional space and facilities needed to meet the continually increasing demands for the aircraft instrument and accessory products.

Division's engineering, research and development forces continued in their efforts to improve design and performance characteristics of current equipment for aircraft coming off the production line, and to develop new devices and systems for high performance aircraft coming off the drawing boards.

Typical of such activity was the successful flight testing of a single lever engine power control system which served to maintain proper relationship of manifold pressure, engine R.P.M. and turbo supercharger for constant horsepower output up to critical engine altitude. Controlled through a single lever by the pilot, it not only lightened the human load by eliminating individual adjustment of up to as many as twelve separate levers, but also provided for maximum engine performance by automatically adjusting each power setting for optimum efficiency.

With the continual addition of electrical equipment to the modern airplane, ever increasing demands were placed on the electrical systems. Eclipse-Pioneer developed AC and DC systems and components helped to alleviate this problem. Electronically trimmed carbon pile voltage regulators provided improved regulating characteristics and fail-safe features. Fault protective systems which sensed low current ground faults and effected instantaneous removal of faults from the electrical system, were placed in quantity production for installation on some of the latest production aircraft.

New components for aircraft ground power supplies were developed and placed under test. These components included 30 volt DC 500 ampere and 1000 ampere generators as well as the associated constant voltage and current controls. Additional power supply developments included a line of AN standard inverters of 5000 VA, 2500 VA and 750 VA ratings: a self-excited 15 KW alternator, and a 300 watt carbon pile voltage regulator for 115 volt DC systems.

A completely self-contained airborne starter was also developed. Packing a 380-hp wallop, the self starter needed but 3½ seconds to bring jet engines to starting speed. Other jet engine starting equipment developed or produced during the year included a quick-disconnect electric starter and a 500 ampere starter-generator with 100-hp starting capacity (including required ground control equipment).

Greatly improved design of the flexible drive shaft opened up a variety of new applications which were expected to solve difficulties formerly encountered in the use of older type flexible couplings.

Significant advances were also made in the field of aircraft instruments. For example, a C-5B directional gyro and a J-8 attitude horizon were placed in quantity production. The C-5B is an hermetically sealed, self-contained unit featuring an extremely low drift rate. The J-8 design incorporated complete freedom on both pitch and bank axes and provided accurate indications of attitude for any maneuver encountered in modern high speed flight. In addition, a new form of attitude presentation, which could be included in conventional gyro flight instruments such as the J-8, was developed and was being considered as standard by both the Air Force and the Navy. This presentation provided the pilot with an accurate quantitative indication of the pitch attitude of his aircraft. Such an indication had many tactical usages, but was of prime significance in jet aircraft landing approaches.

Continued progress in the field of gyros, saw development completed and production started on an all-purpose vertical gyro reference which combined the merits of accuracy, lengthy service life and compact design. The unit was to be used primarily for radar antenna stabilization but had many allied applications.

With the increased utility of gyro instruments, large volume production to rigid performance specifications necessitated new gyro production

STANDARD BOMBS

Air Forces of the United States, Canada and the United Kingdom have standardized on four bombs: 10,000-lb. high-performance bomb; 3,000-lb. high-performance bomb; 1,000-lb. special low-drag bomb carried externally on jet fighters and bombers and 750-lb. general purpose bomb.

techniques. One of the major problems was overcome when Eclipse-Pioneer, in conjunction with a number of ball bearing manufacturers, developed a new series of ball bearings designed specifically to meet the rigid tolerances of gyro instruments. In other aspects of mass gyro production, innovations were made in the overall problems of tooling, inspection, testing and general manufacture to insure that high production schedules at high quality level would be maintained.

To enable flight crews to operate successfully in the rarefied atmosphere and low pressure of high altitude flight, the division's oxygen lab provided a variety of breathing apparatus that included high altitude bailout equipment designed for mounting on the body of the user or on the ejection seat, and a general purpose oxygen regulator for ordinary and emergency use. Liquid oxygen converters, conserving weight and space vitally needed for the installation of other operational equipment, were placed in production.

Entry into the field of ground and airborne radar antenna production was announced with the design of several antenna units which incorporated the latest techniques of weight saving employed in the division's overall program. Other results of the division's effort toward miniaturization and general reduction of size and weight showed up in such products as a small, simple, manifold type de-icer system for use in fighter aircraft; a flat-type fuel flow transmitter weighing approximately 40 percent of its predecessor; airborne computers of compact design, made up of a number of plug-in card-type subassemblies to facilitate maintenance and trouble shooting; a complete line of "pygmy" Autosyn synchros for general purpose servomechanism applications, and a number of miniature and sub-miniature low inertia motors and rate generators.

Assisting in the solution of problems encountered in high-speed flight, a new servoed airspeed and mach number system was placed at the disposal of aircraft design engineers. The system consisted of a computer and an indicator and was designed to furnish sensivtive, accurate, and reliable service at extreme altitudes.

The division received a large order for automatic landing approach equipment, to be used in conjunction with the renowned PB-10 automatic pilot, in the complete United Air Lines DC-6 and DC-6B fleet. Indicative of continued effort in this field was the division's decision to establish a computer center for the solution of auto-pilot design problems. Installation plans were completed and an order placed for an electronic analogue computer which would enable design engineers to solve, in a fraction of the time formerly required, the complex equations involved in the design of automatic pilots for aircraft of the future.

Considerable expansion also took place in the division's specialized line of reliable vacuum tubes, which were designed for rugged applications, where freedom from early failures, long average service life, and uniform operating characteristics are extremely important. Critical tests such as extended run-in periods under various overload, vibration, and shock conditions, were instituted, in an effort to eliminate tubes with defects that might have led to failure under actual operating conditions.

Aircraft engine fuel metering engineering and manufacturing facilities underwent wide expansion during the year at the Bendix Products division, South Bend.

Early in the year the Bendix Aviation Corporation purchased a plant at Hamilton, O., consisting of three buildings and a steam and hydroelectric power plant. This added about 160,000 square feet of floor space which is now used to manufacture fuel metering equipment, supplementing that built in South Bend.

A smaller plant was purchased in Mishawaka, Ind., and two new buildings have been built at the South Bend plant, one containing 48,000 square feet and the other 20,060 square feet. The new construction will add considerably to Bendix fuel metering production facilities.

Twelve hundred square feet has been added to the engine test laboratory to provide an additional engine cell for testing fuel metering devices.

A cold temperature room, large enough to house a 280 gallon fuel tank and pumping equipment, proved valuable during the year in testing fuel metering equipment. This equipment is capable of sustaining high fuel pressure at as much as 16,000 lbs. per hour at temperatures ranging from 250°F to -67°F or colder. Temperature changes can range from 70°F to -70°F within one hour, while the holding time is for a minimum of 122 hours. New methods of putting even higher temperatures on units will aid in thermo-couple development.

Other new laboratory installations include the humidity test, explosion proof and sand and dust equipment which further qualification testing. Recently an electric vibrator capable of 500 cycles per second has been added which will handle complete control units.

Bendix engineers have concentrated on problems arising from the presence of dirt and water in fuel. Fuel controls and supply pumps have been redesigned to take into consideration the presence of a certain amount of dirt and foreign matter that is present in most fuels.

Water in fuel presents a new problem. When given a churning action the emulsion resulting creates a heat problem in localized areas in the pumps which might score fine surfaces and cause an ultimate seizure.

These problems have resulted in tests of new programs of various metals and plating methods, and a new program of dirt and dust control has been inaugurated which extends not only to the units produced but also to the production areas of the plant.

The Bendix electronic group has developed a universal control for engine testing which provides a new technique for finding engine requirements. Its major advantage is that accurate data of a high order, otherwise difficult to obtain, is instantly available. This equipment has found favor and has been used by several engine companies.

Fuel metering equipment in production includes float and injection type carburetors for light and heavy aircraft, water injection equipment, direct fuel injection systems for military and civilian transport planes, automatic starting and fuel metering systems for turbojet and turboprop engines, fuel supply pumps for jet and turboprop engines, turboprop controls and fuel metering and telemetering devices for the military guided missile program.

Advantages of water injection for increased power in emergencies and for the suppression of detonation are well known. The Bendix equipment as supplied for use on piston-type engines works automatically in connection with the carburetor.

The use of water injection has been broadened to include units suitable for jets.

The Stromberg direct fuel injection system is being produced for engines of the B-29 bomber, the B-36 and the Lockheed Constellation. The operation of the system is effectively automatic, changing the amount of fuel to suit the requirements for different engine loads and for varying air temperatures at changing altitudes.

The latest addition to the line of direct fuel injection systems was designed for use on the 28-cylinder Pratt & Whitney R-4360C reciprocating engine. This system consists of a master control, a 28-cylinder pump and a high pressue fuel line arrangement of a unique design, all combined in one unit which fastens on the engine similar to a carburetor, the fuel nozzels and fuel supply pumps.

Bendix fuel metering jet controls and automatic starting systems are on planes in daily combat over the battlefields of Korea.

The Bendix fuel control is of the all-speed governor type. A barometric adjustment of fuel pressure across the governor valve simplifies the governing function. Using the diaphram pressure method of metering, servo-valves are eliminated. This speeds up the response of fuel feed to throttle movement.

Maximum and minimum fuel feeds are predetermined. Rich, hot charges are avoided during accelerations and both high power blow outs and idle die outs are eliminated. Compressor stall is avoided and engine life is prolonged.

The jet aircraft pilot need only to move the throttle lever and the engine is automatically controlled within the operating limits, regardless of the rate of throttle opening or closing and at any altitude within the range of the aircraft.

Hot engine starts are eliminated, since the Bendix starting system feeds fuel to the two burners having spark plugs. On ignition, these operate alone until a predetermined pressure or temperature is obtained. Fuel is then turned on in the other burners while the flame travels to them progressively, smoothly, and without extreme temperatures.

The newest addition to this steadily growing line is control equipment for the Wright Sapphire engine. Another product is the new turboprop control.

A complete line of fuel supply pumps for jet and turbojet engines was introduced by Bendix during the year. The JP-A3 and the JP-C1 are being manufactured for the Pratt and Whitney J-42 and J-48 engines. This, a modification of the British Lucas pump, is of the high pressure, variable stroke, plunger type.

The 9F-A1 plunger pump, which is being built for a new Allison engine, is of the 9-plunger type. It has a fuel delivery of from 12,500 to 15,000 pound per hour.

Bendix continues to be a leader in the field in the development and manufacture of a wide variety of aircraft struts, wheels and brakes.

Landing gear components include shock absorbing struts, wheels and brakes for light and heavy aircraft, hydraulic valves and allied devices which are used on all types of military and civilian aircraft.

During the past year new techniques in drop testing have also been developed in using the refrigerated equipment which is installed in the landing gear drop test laboratory. Here tests are conducted on the largest struts produced in this country at temperatures as low as —65°F.

At present all Bendix struts consist essentially of two telescoping chambers made of high grade steel. Both air and fluid are used in the strut to produce controlled resistance to taxiing, take-off and landing loads. Nearly all strut designs incorporate a rebounding snub device. Taxiing loads are carried mainly on compressed air in the upper chamber of the strut.

Bendix landing gear shock struts are used on the Boeing Stratojet, or B-47, the B-50 Super Fortress, Republic F-84, the Grumman F9F Panther, the Consolidated Vultee Convair Liner 240, and the B-36 bomber.

Trends in the development of shock absorbing struts, wheels and brakes point toward the use of new materials, new wheel designs and more efficient brake lining materials.

Now in production are many sizes of new high pressure aircraft wheels. Brakes include the conventional shoe types and the segmented rotor brake which is currently being built in sizes up to 24 inches.

Wheel and brake installations include the Lockheed Constellation, the Convair B-36, the North American F-86, the Fairchild C-119 revised Packet, the Grumman SA-16A and the Grumman AF-2s aircraft.

An outstanding development is the Bendix shock absorbing wheel. Engineers have been working for some time to simplify the wheel and brake combination by eliminating extra parts.

A new high pressure wheel has been developed which uses roller bear-

ARMY AVIATION

Army aviation is not organized as a separate branch of the Army but, instead, is distributed throughout the combat and combat support elements as integral parts of those elements. Army light fixed-wing aircraft and helicopters are used in a variety of fashions in the field for reconnaissance, transportation of senior officers between units for personal supervision of these units in action, for emergency wire laying and local messenger and courier service. They have performed valuable service in emergency evacuation of casualties, traffic control and similar activities. New uses for these aircraft are continually being developed as their full potentialities are realized through actual experience. One criterion for their employment is their ability to operate from hastily prepared air strips, open road spaces and in the case of helicopters from any cleared surface large enough to accommodate the aircraft. The reports from all echelons of our forces in Korea continually emphasize the importance of these aircraft in their operations.

—ROBERT A. LOVETT
Secretary of Defense

ings in a race nearly as large as the circumference of the wheel. This permits the shock absorbing unit and a greatly simplified brake to be built inside the wheel.

The transfer of heat generated in aircraft brake action points up the limitations of brake linings. Bendix is conducting research work on many types of organic and inorganic materials. Bendix products division has purchased a standard B-25 without armament for landing gear division field tests on landing gear, shock struts, wheels and brakes.

At the Bendix radio division, Towson, Md., the new Bendix TA-18, high power airborne VHF transmitter, came in for some improvements during 1951. Heretofore, providing only 180 channels, the transmitter has been redesigned, in anticipation of the assignment of additional frequencies, to provide a total of 360. By rotating a pair of concentric knobs, this set provides for the selection of any one of the 360 channels in 3 seconds.

The TA-18 transmitter retains a crystal-saver circuit which permits crystal control of all 360 channels with the use of only 38 crystals. The compact single package transmitter weighs only 43 pounds. The additional channel availablity is further insurance against obsolence of this equipment for many years to come.

Bendix Radio continued, in 1951, large quantity production of equipment for the NA-3 omni-directional range navigation system for commercial, private and military aircraft use. The omni-mag indicator, an instantaneous orientation device, used in conjunction with the NA-3 system, provides the pilot with comprehensive course information which approaches picture flying, in that it shows the pilot the direction he is flying as well as the direction he should fly to reach the desired destination.

A new version of the basic receiving equipment (the MN-85D receiver) of the Bendix NA-3 system was developed and production started during the year. The changes, involving simplifying circuits and greater accessibility of components, are designed for easier servicing of the equipment. In addition the weight of the receiver has been reduced by approximately six pounds and the entire unit now weighs only 28 pounds. The original feature of crystal control of 280 channels by the use of only 34 crystals has been retained. However, a highly simplified electro-mechanical selector has been introduced. This will provide crystal control of all 280 channels with a frequency stability of 0.01 percent and with the original 0.7 megacycle band width being preserved.

A new device is the Bendix amspeaker. This is a combination amplifier and loud speaker designed primarily for use in the aircraft cockpit. One of these is mounted near the pilot and one near the co-pilot or other crew members. The advantage of the amspeaker lies in its easy installation and service—the amplifier for operation of the loudspeaker is constructed within the case of the loudspeaker itself.

Because modern aircraft must carry a vast amount of electronic equipment in relatively small cockpit space, Bendix has worked intensively on miniaturizing components. An amplifier, no larger than a package of cigarettes and weighing less than two ounces, has been developed to replace a conventional two-pound amplifier. Its potential lower cost is indicated by the fact that it contains only 35 parts as compared with some 240 parts in average amplifiers. Because of its simplicity, it forecasts longer life and greater reliability and has the further advantage that it is expendable from a service standpoint.

While originally developed for radar equipment, applications are expected in microwave relay systems, electronic control devices, mobile radios, aircraft electronic equipment, communication and television. Its use in these fields should reduce space and weight, cut manufacturing costs, and as an expendable unit greatly simplify maintenance.

Bendix completed and delivered to the Belgian Air Force, during 1951, mobile GCA equipment for installatin at Coxyde Airport. In addition work has continued on the GCA equipment which is being manufactured for the Civil Aeronautics Administration. The original order has been expanded to include equipment for 34 major airports and consists of 15 precision approach radar systems and 19 airport surveillance radar systems.

Bendix Radio has also been engaged, during the past year, in extensive work in the development and manufacture of military search radar, airborne radar, and guided missiles.

To provide additional facilities for increased military production, Bendix has added 15,000 square feet of floor space at Towson. In addition the former BOAC hangar at Harbor Field, comprising 65,000 square feet, and the former Allied Aviation Plant at Dundalk, Md., with space totaling 80,000 square feet have been leased.

In order to provide training for military personnel and civilian field engineers in the maintenance of radar, the Bendix School for Electronics was established in 1951. The school is housed in the hangars at Pimlico Airport, formerly Curtiss-Wright Airport, comprising 38,000 square feet.

Technical developments at the Scintilla magneto division at Sidney,

N. Y., increased in scope and application during the year. Perhaps the greatest achievement since the end of World War II is the development of an entirely new method of producing an electric spark. All previous ignition systems have employed high voltage to break down the gaps between the igniter plug electrodes. Even the highly efficient Bendix low tension systems require transformers near the spark plugs to increase the voltage to a value that will jump the gap in the plugs.

The production of a spark without the use of high voltage is accomplished by an ionizing device built in the nose of the spark plug. Since the device is basically a resistance in parallel with the spark plug gap, it follows that the plug is virtually foul-proof. Carbon or lead formations merely act as additional ionizing agents.

At present this new type of ignition is in production only for jet engines and, for this application, is designated the "TLN." Its availability for ground vehicles can be expected in the near future.

The TCN type of ignition, which was brought out for the first jet engines, received considerable improvement during the past year, chiefly to reduce weight and size. The TCN has spark characteristics somewhat similar to the TLN except that the TCN uses high voltage to ionize the spark plug gap in order that a low voltage—high energy discharge can follow.

The field of jet ignition, although claiming the major part of the development program at Bendix Scintilla, is certainly not the only one in which significant progress has been made. The Bendix ignition analyzer, for example, has been brought to a high stage of perfection.

The analyzer is a specially designed oscilloscope which has been used in some form or other in the Scintilla laboratories for many years to study and analyze all forms of ignition operation. Several years ago it was adapted for field use. The latest model is easily portable, quickly set up, and not at all difficult to interpret. It can be tied to the engine for timing purposes by any one of several methods and possesses a high degree of flexibility.

Many new and important improvements in conventional ignition were also brought out during the past year. The Bendix low tension systems have not received such wide acceptance that they must be included in the conventional class. Steady advances have been made in this type to further increase reliability and reduce weight.

This type is characterized by the use of low voltage throughout the system except for a short path between the spark plug and a small transformer located as close as practicable to the plug. Bendix low tension is free from high altitude troubles and virtually all other problems associated with the production and transmission of high voltages. Perhaps even more important, however, is the fact that the design of the circuit is such that it is possible to reduce the time of spark discharge some 35 percent, resulting in a decrease in spark plug erosion of some 65 percnt. Curiously, this is accomplished with an actual increase in spark effectiveness and Bendix low tension has the ability to fire spark plugs fouled badly enough to cause missing with high tension ignition.

Bendix high tension magnetos have come in for their share of attention also. Some types have been put in production which are so pressure-tight and waterproof that they can operate for long periods of time under a considerable depth of water.

During the past year, a new electro-magnetic design was perfected for the Bendix Model K magneto which increases the output 25 percent without sacrificing other characteristics.

The field of electrical connectors is one of the fastest growing in the Bendix family. Each year sees many new types, particularly for electrical, vibration, and sealing work. Some idea of the importance of these electrical connectors can be obtained from the fact that the average bomber uses approximately 2500 connectors of all sizes.

The problem of filters to eliminate radio interference is a perennial one. Some of those made by the Scintilla mangeto division are separate units; many others are sub-assemblies and are installed in ignition units.

The design of improved starting devices—boosters for magneto-equipped engines—received considerable attention from Scintilla engineers during the past year. Higher output and better reliability has been the design goal for these units. Since these two characteristics are diametrically opposed, this program presented a number of interesting and complex problems.

Another activity at the Scintilla Division was in the field of ceramics. Many Scintilla products require ceramic parts, often of intricate shape and always of close tolerances and high quality. The entire ceramic output is used in other Scintilla products.

One of the chief uses for ceramic parts is in the building of Bendix igniter plugs for jet engines. The severe operating requirements for this equipment require the highest degree of quality control and the greatest attention to design details.

Along with Bendix ignition systems has gone the development of a large variety of switches.

Another product of the Scintilla magneto division is a complete line of diesel fuel injection equipment. This equipment is used over much of the world on diesel engines covering a wide range of types and sizes from railroad locomotives to farm tractors. The combination of a differential nozzle valve and separate spray tip affords highly satisfactory operation and eliminates any sticking of the needle valve due to excessive temperatures.

The most significant recent aircraft filter development at the Bendix purifiers division includes filters for aviation fuel, high pressure hydraulic fluids, and water demulsification.

The Bendix-Skinner aviation fuel filter is a basic unit of air base ground equipment and is designed to remove water and other contaminants efficiently from fuel prior to flight refueling.

These filters are usually installed in the pumping compartment of refueler trucks and trailers.

Until recently the micronic pleated filter elements used in filters of this type were discarded after they became inoperative due to dirt loading. This meant that a large supply of filter elements had to be kept on hand or in storage close to where the filters are used. Replacing a set of filter elements required that the truck or trailer be taken out of operation. To replace a set of elements in both filters took two skilled mechanics the better part of a day.

Bendix-Skinner new type of micronic pleated filter element has extended useful life ten times before replacement becomes necessary. With this filter element it is possible to backwash the filter element whenever it becomes too dirty for satisfactory operation. This cleaning can be done by unskilled labor and without removing or disassembling any components. The turning of a few valves cleans the filter elements by forcing the fuel through the elements in the reverse direction.

In addition to extending the life of the elements tenfold the new construction uses fewer metal parts and provides a filter element capable of withstanding 150 PSI pressure differential.

As operating pressure for aircraft hydraulic systems increased from 1500 PSI to 3000 PSI, a set of filters from ½ to 12 G.P.M. had to be developed. One of the critical requirements was that the filters had to withstand 100,000 impulse cycles from 0-4500 PSI. This in effect meant that the filters had to be constructed to withstand a 15,000-20,000 PSI static burst pressure. By selecting suitable materials and manufacturing processes, Bendix was able to bring out this Hi-pressure filter line with approximately the same envelope size and weight as the 1500 PSI series.

As the size of aircraft increases, larger fuel capacities are required. The B-36 for instance has fuel capacity of several tank cars. To refuel one of these with a conventional positive displacement pump refueler would take many hours. To reduce this time centrifugal pumps up to 600 G.P.M. capacity had to be installed on the refuelers. One of the disadvantages of the centrifugal pump is that it mixes any water present in the fuel to a stable milky emulsion.

The U. S. Navy has a similar problem. For refueling aircraft carrier based planes, large 1200 G.P.M. centrifugal pumps are used to pump the fuel from the carrier storage tanks to the flight deck. In order to prevent explosion hazard due to accumulation of vapors in the tanks, as fuel is removed, sea water is forced into the tanks to keep them always full. Especially in rough sea the salt water becomes mixed with the aviation fuel. As the 1200 G.P.M. centrifugal pump forces this mixture to the flight deck, the action of the pump mixes it into a stable emulsion. To separate this emulsion at flowrates of 1200 gallons a minute is a difficult problem and a special filter is required.

Bendix-Skinner accomplishes this water demulsification by forcing the mixture through a bed consisting of thousands of square feet of surface of glass fibres and subsequently through special filters which separate water droplets and prevent any harmful particles from passing into the outlet side of the filter.

Boeing Airplane Company

Tooling for perhaps the most complex production job ever faced by modern industry was the prime task of Boeing Airplane Company in 1951. To success in this effort was added the concurrent development of such new airplanes as the XB-52, the TB-50D Superfortress and the multi-purpose KC-97E Stratofreighter, and continued research in almost every aeronautical field.

Size of the job can be indicated by the company's backlog at year's end—more than one billion dollars. For security reasons, no hint can be given of the numbers of airplanes on order or the number delivered under these contracts.

Example of Boeing manufacturing expansion is the production job in progress on the B-47 Stratojet. The beginning of the year saw this airplane in initial production stages at Boeing's Wichita (Kan.) Division where just under 15,000 persons were employed. Under normal circumstances this would be considered a major production effort (fewer than 10,000 worked there at the outbreak of the Korean War) but increased emphasis placed on the B-47 by the Air Force dictated still more B-47's were needed.

By the end of 1951 the 3,227,275 square feet Wichita plant was operating with more than 25,000 employees and is still expanding. In addition it is distributing approximately 45 percent of its work among nearly 100 subcontractors and has developed a program in which an additional 1,400 firms participate as parts suppliers.

Last April the Air Force announced that Douglas Aircraft Company at Tulsa, Okla., and Lockheed Aircraft Corporation, at Marietta, Ga., would reactivate World War II bomber plants to complement Boeing's B-47 production.

At Seattle, the company's headquarters and production site for the huge new XB-52, and at nearby Renton, Wash., where the company is building KC-97E Stratofreighters and TB-50 Superfortresses, production and research activity has kept pace. Employment has risen by 5,000—to more than 28,000—since the first of the year. Engineers now are in excess of 3,400, a figure higher than at any other period in the company's history including World War II. More are needed.

To accommodate the new production goals the company set aside some $10,000,000 for new machinery and expansion of its facilities in the Seattle area during the year—this in addition to $7,500,000 set aside last year for the same purpose. Planning calls for construction of a large hangar on King County Airport, (Boeing Field), a substantial addition to the company's principal engineering building, and a jig erection building. Already in progress is a $1,500,000 expansion, authorized last year, of the company's wind tunnel to permit testing at supersonic speeds.

Subcontracting is an important factor in the company's Seattle area operations also. More than 37 percent of the cost of airplanes now under production at Seattle is being diverted to subcontractors, while almost 10

Sweptwings, Boeing B-47 and Republic F-86

percent more goes to suppliers of parts and other finished items.

Climax late in the year at Boeing was reached when the first of two eight-jet experimental XB-52 heavy bombers was rolled from the company's main Seattle factory.

Even before the huge new bomber first emerged from the factory, a large tooling, materiel and subcontracting program had been put in motion for its production sisterships—the unborn B-52A's. For the second time in less than a decade Boeing had been asked by the Air Force to begin production of a new bomber before its prototype had flown.

Boeing's new KC-97E which also made its debut this year, became the ninth model in the C-97 Stratofreighter series. The new airplane combines the troop, cargo and hospital capabilities of its predecessors with a convertibility feature which enables it to serve as a Flying Boom aerial refueling system tanker as well.

The 350-mile-an-hour KC-97E is identical in outward appearance to the C-97A's and C's which preceded it in production. Principal difference is inclusion on the new "K" model of all fixtures necessary to transform the airplane into a tanker. This is accomplished by a unique "packaging" system of Flying Boom equipment enabling simple installation of the boom and its accessories.

The Boom's controls and operator's station are assembled into a single package which can be attached beneath the Stratofreighter's fuselage in the same space normally occupied by the airplane's large rear clam-shell loading doors.

During the conversion process, after the cargo doors have been removed, auxiliary fuel pumps and tanks are swung into place on the upper cargo deck by means of the airplane's self-contained power hoist. After installation, (also by power hoist) of the boom package itself, interconnection of all fuel and electrical lines is made through permanent fixtures installed on the airplane in space not normally used for cargo.

With tanker equipment removed, the KC-97E can carry the same loads as its sister Stratofreighters—up to 134 fully-equipped troops, 34 tons of cargo, or 79 litter patients, their medical attendants and supplies.

The other aerial refueling tanker designed for Flying Boom operations is a modification of Boeing's World War II B-29 Superfortress and is designated the KB-29P. Delivery of these airplanes began in September, 1950, at the Boeing-operated government aircraft plant at Renton, Wash., and was completed in ten months.

As early as last August these airplanes had completed more than 8,000 aerial refueling contacts during Air Force operations and flights conducted by Boeing test crews. They resulted in the transferal of more than 750,000 gallons of airplane fuel. Among the airplanes refueled in these flights and by KC-97E's were Boeing B-47 Stratojets and B-50D Superfortresses, the North American RB-45C Tornado reconnaissance bomber and F-86 Sabre jet fighter and a newer version of the Republic F-84 Thunderjet fighter.

Also unveiled by Boeing during 1951 was a "Flying Schoolhouse" version of the B-50 Superfortress, designated TB-50D and in use as a navigator-bombardier trainer by the Air Force Air Training Command. The new airplane is used to train "triple threat" crewmen who serve as combined bombardier-navigator-radar operators on high-speed jet bombers.

Manufacture of production type TB-50 Superfortresses was moved from Boeing's main Seattle plant to Renton during the year to make room for B-52 production.

Associated closely with these major airplane projects, and generally derived from them, is the work on Boeing's non-aircraft products project. Located at Seattle's original and smallest Boeing plant—Plant One—the project made significant advances this past year in a wide field of aircraft-related products.

Perhaps the most well known of these is Boeing's lightweight gas turbine engine which in 1950 was test-installed as the power plant for a 10-ton motor truck. Early this year Boeing received a production contract from the U. S. Navy's Bureau of Ships for an undisclosed number of the new engines to drive generators supplying electric power for new minesweepers. The gas turbine also is used as the experimental power plant for a 24-foot Navy personnel boat.

Chief advantage of the engine is its low ratio of size and weight to power output. Weighing only 200 pounds, the 175-horsepower engine can be operated equally well on gasoline and kerosene, or on light or heavy fuel oil.

Late in the year one of Boeing's turbines—designated XT-50—was installed in a Kaman K-225 helicopter for evaluation by the U. S. Navy.

Another of the non-aircraft products for which a number of orders were received during the year was Boeing's electronic analog computer.

TRANS-ATLANTIC FLIGHT

Few airplane flights in history have been so well documented as the 3400-mile trans-Atlantic trip of the Boeing Stratocruiser "Canopus" of British Overseas Airways Corp. carrying Princess Elizabeth and the Duke of Edinburgh on the first leg of their North American tour in October, 1951.

It was attended, before, during and after, by big headlines and big pictures in the press. Yet in a strictly aeronautical sense, it constituted no milestone.

Historically, the 3400-mile journey of Princess Elizabeth and the Duke of Edinburgh, from London to Montreal, will be known for its role in tightening the ties of an Empire. As a flight, it was in most respects routine. It was planned and carried out much like all trans-Atlantic flights of British Overseas Airways Corporation's Boeing Stratocruisers.

The Stratocruiser "Canopus" was spic, span and waiting when the royal party arrived at London Airport the night of October 7. The glare of many floodlights pushed back the fog, painting the scene with an air of unreality, like a movie set. Precisely at 11:44 the royal cars pulled up beneath the tip of the 'Cruisers port wing.

At this point there occurred one of those rare and intimate glimpses which show that, basically, royal families are little different from ordinary families.

As with many a young couple leaving on a trip, mother and sister came along to bid the royal couple goodbye. Also on hand to see them off were hundreds of well-wishers, in the background, and an official party led by Lord Ogmore, minister of civil aviation, and Sir Miles Thomas, chairman of BOAC. Queen Elizabeth and Princess Margaret boarded the plane for final farewells. They remained aboard a quarter of an hour, during which the Queen spoke to every member of the 'Cruiser's proud crew.

Then, as the engines roared and the plane began to roll toward the runway, Princess and Duke were visible at a porthole, waving. The Queen, like any mother, blew them a kiss as the plane moved off into the mist.

It was not the year's best night for flying. The ground fog thickened by the minute. As the plane eased up the field, it was quickly lost to the watchers' sight. Even though she could no longer see it, the Queen remained until the "Canopus" was airborne at exactly 12:30.

The trans-Atlantic flight itself was uneventful, with BOAC's bearded master pilot, Capt. O. P. Jones, taking his ship to 24,000 feet, where clear weather lay above the clouds. Briefly, the plane touched at Gander, Newfoundland. It made its final stop on wind-swept Dorval Airport, sixteen miles out of Montreal, from where the visiting royalty transferred to rail for their thirty-one day tour of Canada.

To the already-luxurious Stratocruiser, little more luxury was added fo the flight. The luxury compartment was converted into dressing rooms. The forward main compartment was curtained off for sleeping. Elsewhere, four seats came out to make room for a wardrobe.

The alterations would be removed when the "Canopus" returned to regular service, but this flight would nonetheless leave its mark on the airplane. For many a passenger in the future, this plane will represent something very special.

The computers are similar to ten which previously were built by the company for its own use in solving motion problems in its aerodynamics, mechanical equipment, power plant, structures and acoustics-electrical laboratories.

Most recent Boeing non-aircraft development is a new anti-fouling spark plug announced in September, but which has not been placed on the market.

Fundamentally the plug's advantage lies in its use of a special pre-combustion chamber recessed in its structure which protects the electrodes and other critical parts. Tests have shown the new principle works equally well in airplane engines, automobiles and outboard motors.

Another Boeing non-aircraft product is a new type high power line suspension clamp designed to prevent corona, an electrical leakage from cross-country lines. Designed last year, the clamp was accepted by the Bonneville Power Administration and ordered in an 18,000-unit quantity. A contract for an additional 12,000 of the clamps was signed in August for immediate delivery.

Research and development work on guided missiles has received the attention of Boeing engineers since 1945 and valuable experience has been gained through laboratory studies and from numerous test vehicles which have been fabricated and flown. Under government contract, the company expanded its activities in the field during the year.

Boeing research work, however, is not confined strictly to the type which produces missiles, better aerodynamic designs and electronics. Much time has been spent and continues in the field of making factory fabrication, assembly and production flow more efficient.

Typical of this is Boeing's work in the new field of optical jig alignment, a system which saves valuable time in the basic setup operation of the forms around which airplane sections are assembled.

Formerly these forms, or jigs, were aligned by standard transit and level procedures which involve, as a rule, two transits, a level, three light extensions, six people and at least four hours' time. Very close tolerance accuracy by this system always is questionable because no two operators get the same reading from a scale held in view of a transit or level.

Two men using one set of instruments can accomplish the same job with far greater accuracy using Boeing's development of the optical system which combines both transit and level in one more powerful instrument mounted directly on the jig.

Development of the system stemmed originally from a British system of aligning ocean vessel propeller shafts. It was "discovered" by the Air Force and suggested to airplane manufacturers in this country as an idea worth developing.

Net earnings at the end of Boeing's third quarter lagged behind the $8,210,252 reported for the first nine months of 1950. Boeing President William M. Allen attributed this reduction principally to a lower rate similar figure for 1950—$4,055,198 for the period ending Sept. 30, 1951 of profit on government business, higher income and excess profits taxes and to transition during 1951 of the company's largest airplane contract to a type on which income is not recorded until the airplanes are delivered. Under the old contract, a proportionate share of the fee could be recorded as income while the work was being performed.

He forecast that Boeing net earnings for 1951 would be below those of 1950 because of higher income taxes, the excess profits tax, amortization over a five-year period of facilities procured under Certificates of Necessity and a lower rate of allowable profit on government business.

Early in the year Boeing announced the election of four new members to its board of directors. They are William G. Reed, chairman of the board of Simpson Logging Company and a member of the board of Rayonier Inc.; J. P. Weyerhaeuser, Jr., president of Weyerhaeuser Timber Company; Edward C. Wells, Boeing vice president—engineering, and John O. Yeasting, Boeing vice president—controller.

C. B. Gracey, formerly Boeing factory service manager, was elected to the newly-created post of vice president—operations at the company's April board of directors' meeting.

Cessna Aircraft Company

Keeping pace with the expanding requirements of the Armed Forces and civilian market, Cessna Aircraft Company more than doubled its employment, increased production and enlarged factory space at all three plants during 1951, its fortieth year in aviation.

Top news at Cessna is their backlog of business which will carry them well into their 1953 fiscal year on the basis of current contract schedules.

The largest portion of the backlog is for military defense production with commercial airplanes and hydraulics participating to a smaller degree.

Cessna has a prime contract to build over 2000 Cessna all-metal L-19's. The original contract was awarded in the spring of 1950. Additional orders amount to an increase of over 500 percent.

Subcontracts, including substantial orders from Boeing Airplane Company, represent the largest part of the current backlog. The Boeing contract is for Stratojet bomber tail assemblies. As completed these assemblies are delivered across the airport to Boeing's Wichita plant where the B-47 is in production.

Cessna's backlog took a recent jump when additional orders amounting to over $8,000,000 were received from the Lockheed Aircraft Company of Burbank, Cal. This, the second large order from Lockheed, representing a 100 percent increase in Lockheed contract work, is for empennage and aft fuselage sections of the Lockheed F-94 jet intercepter and T-33 jet-powered trainer. Lockheed work is being done at Cessna's Prospect plant.

General Motors Corporation called on Cessna to build major component parts for the new Republic F-84F swept-wing jet fighter. This work will be completed in Cessna's newly expanded Hutchinson, Kan., plant.

Commercial airplanes continue to be manufactured by Cessna for its world-wide market. Cessna 170's are being manufactured at the rate of two a day for commercial use, while the majority of 190 series, designated LC-126C, are being delivered to the Army Field Forces for liaison work.

Hydraulics participated in the broad advance with a backlog of over $1,750,000. Deliveries are currently being made to large farm implement companies, such as John Deere, J. I. Case, and Minneapolis-Moline.

To cover the handling of these large defense contracts, Cessna enlarged its facilities at all three plants, resulting in an over-all addition of 47 percent more floor space and an expenditure for fixed assets of over $2,500,000.

Highlight of the year was Cessna's flight test in August of their Model 308, a four-place liaison airplane, powered by a 375 hp Lycoming engine and equipped with a Hamilton Standard propeller. It has a pay load of over 1,000 pounds for a range of over 800 miles. Outstanding features of this new observation reconnaissance airplane are the wide tread Cessna safety landing gear found on all current model Cessnas, the high lift flaps, all-metal construction, over-all rugged durability, and excellent visibility. The airplane is designed to operate in and out of unprepared landing fields.

Chance Vought Aircraft Division
United Aircraft Corporation

An advanced version of the F7U Cutlass, the F7U-3, moved from Chance Vought Aircraft's production lines in late 1951 along with a new model of the F4U Corsair—the AU-1 close support airplane for the U. S. Navy.

Chance Vought also received a contract for a second modification of the Corsair, the F4U-7, to be manufactured for the French government under the Mutual Defense Assistance Program.

With the initial order of F7U-1's completed, and a grueling program of testing behind it, the Navy placed a substantial order for a new Cutlass that embodies many of the features of the original airplane, including two vertical tails and no horizontal tail surfaces. Slats in the leading edge of the wings, as in the F7U-1, have been substituted for flaps. Both longitudinal and lateral control is obtained through the use of ailavators. Controls are operated by hydraulic boost.

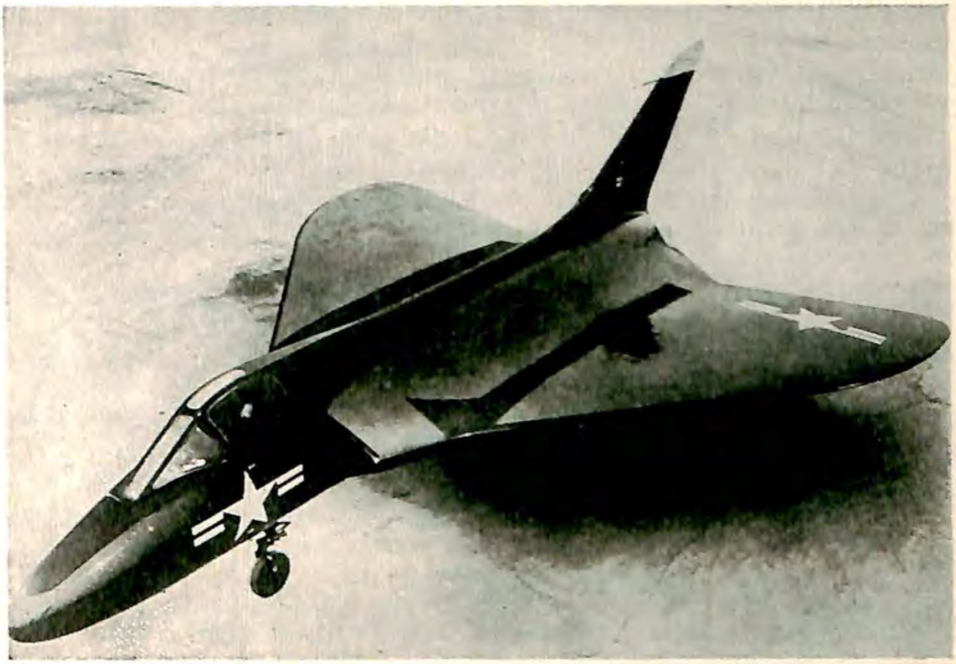
Carrier test landings were conducted with the Cutlass on the USS Midway during August, following up a test program that began in June, 1950, at the Naval Air Test Center, Patuxent River, Md.

The fighting in Korea resulted in a Navy request to produce a Corsair for close ground support of troops. This airplane, the AU-1, followed the last of the F4U-5N Corsairs down the production line. The prototype was flown in September.

The AU-1 is little different in outward appearance from the F4U-5. The powerplant has been changed, with the AU-1 using a single stage Pratt & Whitney R-2800-83WA engine. The F4U-5 is powered by a two-stage R-2800-32 Pratt & Whitney Aircraft engine. Both airplanes use Hamilton Standard propellers.

The F4U-7, powered by a Pratt & Whitney Aircraft R-2800-18W two-stage, two-speed engine and a Hamilton Standard propeller, carries a heavier armor and armament load than earlier versions of the Corsair.

Throughout the year, Chance Vought's Corsairs, mostly F4U-4's, made Marine and Navy air fighting history in Korea. De-icing boots were installed on the Corsair, designated the F4U-5NL, by the Navy.



Douglas Aircraft's Skyray (XF4D)

Performance data and armament are restricted on the F4U-5, the AU-1 and the F4U-7. The F4U-4, however, is armed with four 20 mm. rapid firing cannon. It can pour 3,000 rounds of shells in a minute of firing and at the same time fire eight 5-inch rockets carried under the wings. For special occasions it may be armed with the Tiny Tim, an 11.75 rocket weighing more than 1,500 pounds and used against tanks or heavily fortified positions. Each Corsair can carry two of the armor piercing missiles or, depending on the mission, comparable napalm bombs. Two 150-gallon external tanks can be attached to increase the range.

Chance Vought's guided-missile program, centered at Edwards Air Force Base, Cal., still is clothed in a tight security cover. Performance, armament and range of the F7U-3 are also confidential.

Chase Aircraft Company

The year 1951 was one of major expansion and achievement by the Chase Aircraft Company.

Notable date was April 21, 1951, when the Chase XC-123A jet-powered transport flew for the first time at Trenton, N. J.

Although originally designed as a glider, the plane's airframe is identical for the powered version, and had already performed with piston engines under the designation of C-123, which flew for the first time in October, 1949. The Air Force then ordered the glider returned to Trenton for installation of four GE J-47 engines in twin pods.

Performance figures for the XC-123A have not been released on the grounds of military security, but, compare favorably with speeds and altitudes previously attained by jet planes. The new jet transport has taken off after a ground run of as little as 600 feet.

In June, 1951, the Air Force announced a contract to Chase for C-123 production, and this commenced immediately. Kaiser-Frazer Corporation subcontracted a great deal of component assembly as well as final assembly of the planes at Kaiser-Frazer's Willow Run, Mich., plant. Chase set up production lines in West Trenton, N. J., for component assembly. The company is performing all production engineering work in the West Trenton plant and in the New York Engineering Office, which was opened in the summer of 1951. Deliveries are expected from both Trenton and Willow Run by spring of 1952.

Chase Aircraft Company sold 49 percent of its stock to the Henry J. Kaiser interests on May 11, and a Board of Directors reorganization followed with Edgar F. Kaiser, President of the Kaiser-Frazer Corporation, assuming the presidency of Chase. Michael Stroukoff, Chase founder, became vice president and chief engineer. J. X. Cousins, who had been Chase treasurer and comptroller, and William F. Sauers, who had been secretary, remained in those capacities. Henry J. Kaiser was elected chairman of the board. Michael Miller, vice president of the Kaiser-Frazer Corporation, was elected vice president of Chase. Other directors included Eugene E. Trefethan, Jr., executive vice president of Kaiser Industries and Franklin S. Wood, a New York lawyer.

By spring, 1951, Chase had concluded limited production of the C-122C assault transport and had delivered a total of ten of these craft to the Air Force, and later in the year, at Exercise Southern Pine in North Carolina, the Air Force employed them in numbers for the first time. The 16th Troop Carrier Squadron (Assault) which had been equipped with the C-122's, delivered troops and equipment to forward combat areas. These C-122's landed in the drop zones, minutes after paratroopers had jumped from other craft and equipment had been dropped from cargo planes. Each C-122 landing in a drop zone carried a total of 8,000 lbs. of vehicles, weapons and troops which were unloaded with maximum speed. The planes were then loaded with casualties who had suffered injuries in the jumps and took off to fly these casualties back to Pope Field for hospitalization at the Fort Bragg Station Hospital. A total of 368,000 lbs. of equipment was delivered without damage.

In addition to its C-123 production program Chase in 1951 was awarded several classified engineering research contracts which increase the company's present backlog to a total of approximately $125,000,000.

Convair XP5Y-1 turboprop flying boat

Consolidated Vultee Aircraft Corporation

Consolidated Vultee Aircraft Corporation's top 1951 achievement was a developmental contract to produce the nation's first atomic-powered aircraft. This was announced Sept. 5, under approval of the U. S. Air Force. Announcement was made at the company's Fort Worth, Tex., division.

The company will be concerned principally with developing the airframe, while the General Electric Company will have primary responsibility for developing the nuclear propulsion system.

Both companies will work closely with the Atomic Energy Commission and the Air Force.

Convair and the Air Force continued to improve the company-built XF-92A delta wing research fighter, world's first aircraft incorporating the triangular wing configuration.

Equipped with its new, powerful Allison J33-A-29 turbojet engine with afterburner, the triangle-shaped plane was returned from the San Diego Division to Edwards Air Force Base, Muroc, Cal., for further flight tests by the Air Force prior to being turned over to the National Advisory Committee for Aeronautics for additional testing.

With its previous powerplant, an Allison J33-A-23, rated at a maximum of 5200 pounds thrust, the XF-92A made more than 80 flights, many at speeds in the transonic range. The new engine develops considerably more thrust and is expected to provide substantially greater performance at high altitudes. The XF-92A's initial flight program, together with extensive wind tunnel testing, indicated certain superior characteristics for the delta wing configuration at very high speeds. The XF-92A has a wing sweep-back of 60 degrees. It has "elevons" instead of ailerons and elevators.

Pointing up Convair's progress in the field of interceptor aircraft was the announcement in September that the Air Force had awarded a contract to Convair for further development of a new, very high performance interceptor airplane. Studies for the new interceptor were conducted by Convair research and engineering teams at the company's laboratories in San Diego, Cal., and Daingerfield, Tex., and in supersonic wind tunnels at the Southern California Cooperative Wind Tunnel, Pasadena, Cal., and at the Ames Laboratory, Palo Alto, Cal.

Convair's extensive hydrodynamics research program was accentuated during the year with the first public announcement that jet-propelled, supersonic, water-based aircraft—incorporating the proven aerodynamic advantages of the company-developed XF-92A delta wing and the entirely new hydrodynamic concept of a blended wing-and-hull design—merit "serious consideration in strategic planning."

In a paper delivered at Brighton, England, before the third international joint conference of the Institute of the Aeronautical Sciences and the Royal Aeronautical Society of Great Britain, Ernest G. Stout, assistant to the chief engineer of Convair's San Diego Division, said:

"Through a new blended wing-hull design approach, coupled with the development of an extremely effective (water) spray suppression device known as a 'spray dam,' it has been possible to water-base idealized high Mach number aerodynamic forms without compromising hydrodynamic performance, seaworthiness, or stability.

"By utilizing jet power plants, it has been demonstrated that water-based aircraft can be developed into efficient and dependable transonic and supersonic aircraft.

"With our research program well into the considerations of supersonic design, it is safe to say that the probability of achieving the original objective of this effort is excellent, and it is not too early to take serious cognizance of this versatile new weapon and give high-speed water-based aircraft serious consideration in strategic planning."

Convair's hydrodynamics research—conducted in cooperation with the U. S. Navy Bureau of Aeronautics—is based on the use of radio-controlled, dynamically-similar scale models of aircraft, so that the models are, in effect, flying miniatures of the full-size airplane that will perform every maneuver of the full-scale aircraft and at a rate of movement directly to scale. From this program evolved, at a considerable saving of time and expense, Convair's XP5L-1 Navy high-speed flying boat now undergoing flight tests off San Diego Bay.

More recently, in Project Skate, Convair's dynamic models have incorporated the flight-proven aerodynamic performance of the delta XF-92A and the hydrodynamic configuration stemming from the Convair-developed blended wing-and-hull design, the latter so named because it is difficult to draw any sharp line of demarcation between an aircraft's aerodynamic and hydrodynamic function.

During the year, the company began production of guided missiles for the U. S. Navy Bureau of Ordnance. The company's integrated plant was activated on March 1, 1951, at San Diego, as a new operating division of Convair. Later in the year, the Navy Bureau of Ordnance let the contract for construction of a facility at Pomona, Cal., designed for the exclusive production of guided missiles. Ground breaking ceremonies for this Convair-Navy guided missile plant were held on August 6 and completion is scheduled for mid-1952. Transfer of missile production from San Diego to Pomona will be accomplished without interruption of operations. All details of the production missile's design, mission, tactical performance, and production rate are classified.

The company's new division, known as the Guided Missile Division, is supervising construction of the Pomona plant and will operate it under Navy contract, involving a government investment of over $50,000,000. The Pomona factory will have an aggregate floor area of more than 1,200,000 square feet. The main manufacturing building will be 1280 feet long and 600 feet wide. Smaller structures will house administrative units, engineering and experimental departments, and modification operations.

Convair has been designing, manufacturing, and testing guided missiles for the armed services since 1944.

On October 22, the company got an order for production of a limited number of new twin-engine T-29 turboprop airplanes for the Air Force. Patterned after the Convair-Liner 340 commercial transport and its T-29 Air Force navigator-bombardier trainer, the new planes will be used by the Air Force for service test purposes. Some of the new craft will carry the latest equipment for bombardier training, some will be without special equipment, and others will have the latest electronic equipment and instruments for navigation instruction.

At first the new planes will be powered with 3000-hp Allison T-28 gas turbine engines. Structural provision will be made for easy installation of even more advanced Allison turboprop engines of much higher horsepower as soon as they become available. First delivery of the new pressurized ships will be accomplished in a relatively short time since the design was developed from the T-29 and the Convair-Liner, both of which are in current production.

Convair's largest facility-improvement program in recent years was a three-way expansion of research, design, and production potentials at San Diego, Daingerfield, Tex., and Fort Worth.

The company contributed $1,000,000 to a $6,000,000 conversion of the jointly-owned sub- and transonic Southern California Cooperative Wind Tunnel to continuous supersonic testing. With its 8x12-foot test chamber capacity, and the newly-added high-speed feature, this wind tunnel now becomes an important tool in the nation's overall research program.

Continuing its research program at Daingerfield, Tex., is the Ordnance Aerophysics Laboratory which Convair operates for the Navy Bureau of Ordnance under direction of The Johns Hopkins University Applied Physics Laboratory. The facilities at OAL include a supersonic wind tunnel, a ramjet engine test burner, and a high-altitude chamber for testing large-scale ramjet engines at simulated altitudes of approximately 20 miles above the earth and at four times the speed of sound.

Engineering expansion was assured by the start of construction for a new three-story, $2,658,000 Engineering Development Center at San Diego. Erected on Lindbergh Field adjacent to the company's present engineering building, the Center will contain 225,700 square feet of floor area. Space will be provided for design engineering sections, including aerodynamics, hydrodynamics, hydraulics, and other groups.

An electronics guidance section, research laboratory, instrumentation laboratory, and a radar testing section will be included in the Center, due for completion in December, 1951. Special equipment for the structure will cost approximately $400,000, bringing total expenditures for the Center to more than $3,000,000.

Further indication of this trend was the construction at the Fort Worth Division of a $650,000 aircraft testing laboratory which will have the nation's most complete industry-operated facilities for simulating any environmental condition on or above the earth.

Also built at Fort Worth was a $270,000 jet engine test stand, in which four units can be tested at one time. The stand provides two concrete cells, each large enough for two engines.

Production expansion was heralded by the authorization of a $5,000,000 heavy tool and equipment buying program designed to increase the San Diego Division's manufacturing capacity by 25 percent. The Division's former Plant II was also reoccupied.

Production of planes at Convair was in high gear by mid-'51. Construction began at Fort Worth on two prototype YB-60's, all-jet, long-range, intercontinental bombers with sweptwings and eight jet engines. The first YB-60 is scheduled for initial flight early in 1952.

Convair received a new Air Force order for an additional undisclosed number of B-36 bombers in September and these will be built at Fort Worth. In San Diego, the company received an Air Force contract for further modernization and overhaul of B-36's, continuing the modernization program begun in March, 1950. The new contract expires in December, 1952. The San Diego Division continues to build B-36 components for shipment to Fort Worth for installation on production B-36's.

First flight of the B-36F bomber, the new and more powerful model of the B-36, was made on Nov. 18, 1950, with initial deliveries to the Air Force starting in mid-1951. At high speed, the B-36F develops the equivalent of more than 44,000 horsepower. Whereas the B-36D bomber was powered by six Pratt & Whitney 3,500-hp piston engines and four General Electric J-47 jet engines, each piston engine on the B-36F produces 3,800 horsepower. The "F" model also uses the four J-47 jet engines. More than 25 design improvements have been incorporated in the new P&W 3800-hp engine, which bears the designation, R-4360-53. The B-36F can fly faster and at a higher altitude than the B-36D, which the Air Force rates at a

SMALL PLANTS

Although aircraft manufacture is big business, it is made up of no less than 60,851 companies of which more than 52,000 are firms employing less than 500 people. These small companies are doing more than 60 percent of the actual manufacturing of aircraft, accessories, parts and supplies.

top speed of more than 435 mph, with a service ceiling exceeding 45,000 feet.

Delivery was made to the Air Force of the last B-36A's modernized at Fort Worth and redesignated RB-36E reconnaissance airplanes. The "A" planes were equipped with six 3000-hp piston engines. The RB-36E's are propelled by six 3,500-hp piston and four J-47 jet engines and, in addition, they carry a variety of cameras and other equipment needed in high-altitude photography.

The Convair Turboliner, which made its initial flight at San Diego on Dec. 29, 1950, was delivered in the spring of 1951 to the Allison Division of General Motors Corporation for an extensive flight test and demonstration program. Powered by two 2750-hp Allison 501 turboprop engines and equipped with Aeroprop propellers manufactured by General Motors' Aeroproducts Division, the Turboliner is a research transport of the Convair-Liner 240-type, ordered by Allison to test their gas turbine engines—developed under sponsorship of the U. S. Navy—in commercial-type aircraft. The plane has a gross weight of 41,790 pounds and a fuel capacity of 1550 gallons.

United Air Lines, which has ordered 40 44-place Convair-Liner 340's, will receive its first production model early in 1952. Other airlines for which more than one hundred 340's are being produced include Delta Air Lines, Braniff Airways, Mid-Continent Airlines, Northeast Airlines, Hawaiian Airlines, Philippine Air Lines, and Continental Air Lines. Several executive types have also been ordered.

Speeding the production of the prototype 340 (from engineering to flight in seven months) was Convair's design and construction of its first *metal* mockup, which provided engineers with a three-dimensional layout for all design stages.

Fifteen domestic and foreign airlines had logged more than 2,700,000,000 passenger miles with fleets of Convair-Liner 240 transports by June 1, 1951, which marked the beginning of the fourth year of service with the planes. Estimated total distance traveled by the 240's during their first three years of operation was 125,000,000 miles.

The first modified T-29A navigator-bombardier trainer was delivered by Convair-San Diego to the Air Force during the summer. The first of an undisclosed number of T-29B's, pressurized version of the T-29A, is expected to be delivered to the Air Force late in 1951.

The T-29A's were returned from Air Force operations and equipped with new outer wing panel tanks which increase fuel capacity to 1500 gallons. A few structural changes were incorporated in the "A" models to increase gross weight from 40,500 pounds to 43,575 pounds. Other modifications included new radar equipment to provide students with the latest electronic devices for navigator-bombardier training. Based on the Convair-Liner 240 design, the T-29 Flying Classroom has complete training facilities for 14 students and instructors.

Convair-San Diego is nearing the ending of its tooling-up program for production of an undisclosed number of long-range Navy R3Y turboprop transports, based on the design of the high-speed XP5Y-1 turboprop flying boat being test flown from San Diego Bay. The second XP5Y-1, a military version of the first model, which was designed for long-range search-rescue and anti-submarine missions, awaits engine installations.

During the year, the Air Force's Convair-built XC-99 troop-and-cargo transport flew 200,000 ton-miles of cargo on its first mission in an extensive evaluation program carried on from Kelly Air Force Base, San Antonio, Tex. Cargo consisted primarily of 42 airplane engines weighing 2,300 pounds each.

Both San Diego and Fort Worth plants are at work on many development projects of a restricted nature. Convair-San Diego continues to build nose sections for the Boeing B-50 bomber. Millions of dollars worth of parts were being subcontracted in a dozen states to speed B-36 output at Fort Worth. Dollar volume of the B-36 subcontracting program increased from 12 percent of total production costs in 1949 to 33 percent in mid-1951.

As of October 15, 1951, employment at Convair-Fort Worth totaled 31,101, greater than the World War II peak of 30,609. Of the total, 4,766, or 16 percent, were women. At the San Diego Division, employment totaled 18,336, including 5,065 women, while Guided Missile Division employment had reached 1,053, of whom 207 were women. Daingerfield OAL employment totaled 254. Employment at the three operating plants was expected to increase well into 1952.

Wage increases were granted to employees at all Divisions late in 1950 and during 1951 in line with the rising costs in living, and the monthly payroll at the Fort Worth Division reached approximately $10,000,000 in the fall of 1951.

Active programs designed to recruit engineering and production personnel were carried on by the company. The Fort Worth Division offered jointly with Southern Methodist University studies leading to a master of science degree in engineering. All classwork is done at the Fort Worth plant.

The past year saw several personnel elections and appointments to Convair's corporate and division staffs. I. M. Laddon, a Convair director since May, 1931, was elected chairman of the executive committee of the board of directors. A. P. Fontaine was elected vice president and general manager.

T. G. Lanphier, Jr., and Edward F. Jones were appointed assistants to the president. R. O. Ryan was promoted to vice president-manufacturing from Fort Worth Division manager.

Val C. Zimmer was appointed director of industrial security for the company, and Howard Golem was named corporate director of procurement. C. E. (Ned) Root was named manager of public relations.

Convair reported income of $5,922,941 after federal tax provisions for the first nine months ended August 31, 1951, equal to approximately $2.50 a share of outstanding common stock. This compares with $5,536,311, or about $2.38 a share, for the like period of 1950 when no tax provision was required. Included in the 1950 figure, however, was $2,200,000 of suspended profits on prior years' work which was brought into total income due to a change in the company's method of accounting.

In the nine months ended Aug. 31, 1951, income totaled $8,710,941 before taxes, or about $3.68 a share. Sales for the same nine months increased to around $226,000,000 compared with $191,000,000 for the like period in 1950. Because of the change in the method of accounting above referred to, the latter figure included $70,000,000 of sales on which profits were suspended. Unfilled orders, including those being negotiated and expected to mature, increased the total backlog on Aug. 31 to over $750,-000,000.

For the fiscal year ended Nov. 30, 1950, Convair showed a net profit of $10,241,644, compared with $3,713,156 for the fiscal year ended Nov. 30, 1949. Earnings for 1950 equaled approximately $4.36 a share, based on the number of common shares issued, compared with approximately $1.60 a share for 1949. Net sales for 1950 approximated $256,000,000 against $197,000,000 for 1949. Backlog of unfinished work on Nov. 30, 1950, approximated $215,000,000.

The company declared a year-end dividend of $1 a share on Sept. 11, 1950, and quarterly dividends of 35 cents a share on Feb. 2, June 29, and Sept. 9, 1951.

On April 18, 1951, Convair-Fort Worth celebrated the tenth anniversary of the ground-breaking for the plant.

Curtiss-Wright Corporation

By mid-year 1951, Curtiss-Wright Corporation, once again back in a position of leadership, had a backlog for engines, propellers, and electronic equipment for aircraft of over a billion dollars.

To meet increasing military and commercial orders, the company upped the floor space of Wright Aeronautical, its engine division, which also purchased and converted a nearby textile mill to feed parts to the main plant in Wood-Ridge, N. J.

Propeller Division, Caldwell, N. J., stepped up output of steel-blade propellers, including the world's largest for the B-36, and began production of the Turbolectric series of single and dual rotation models for turbo-prop engines up to 20,000 hp.

Curtiss-Wright also established an Electronics Division at Carlstadt,

N. J., to concentrate on design and production of electronic simulators and related products. This new division moved from Caldwell to its new quarters early in the summer. During the year the new electronics Division delivered two flight simulators for the B-50 to the USAF and a jet simulator for the Banshee to the U. S. Navy. With these deliveries Curtiss Wright became the first company to have its simulators accepted by the USAF, the Navy and a commercial airline. Pan American Airways reported that its Curtiss-Wright simulator for the Boeing Stratocruiser in use since 1948 had reduced overall training costs sixty percent in 13,000 hours of simulator training time.

A Metals Processing Division was established in two newly-acquired buildings at Buffalo, N. Y., to manufacture a wide variety of metal products, and apply new metallurgical techniques to manufacturers of the company's line of high power jet engines.

Despite an expansion unequalled since World War II, Curtiss-Wright was keeping the growth of its own facilities to a minimum. Of the billion-dollar backlog, some 60 percent was to be subcontracted.

The experience of the engine division, Wright Aeronautical, which is undergoing the most rapid expansion in orders, is typical of the Curtiss-Wright approach to the subcontractor recruitment problem. Early in 1950, the company began an intensive campaign, using Air Force procurement offices in principal eastern and middlewestern cities as temporary bases wherever possible. Advertising in local publications announced that company representatives would be in town on certain days, ready to interview subcontractors. Those who apparently qualified as subcontractors after the screening interviews were asked to list equipment, personnel, and other pertinent facts with the company. After that, a team of men representing purchasing, metallurgy, and inspection departments from the plant in Wood-Ridge made an on-the-spot check of the subcontractors' plants.

In addition to subcontracting a variety of parts and subassemblies, Wright licensed Buick, Chevrolet, Kaiser-Frazer, and the Lycoming Division of AVCO at Bridgeport to build various models of the Turbo-Compound, Cyclone 18, Cyclone 9, and Cyclone 7 engines, as well as the J-65 turbo-jet.

Curtiss-Wright in 1951 also published the second of its reports on the machinability of metals used in aircraft and automotive production. These reports, compiled under the sponsorship of the Air Force, were the result of laboratory study of the effect of microstructure on speed, feed, and choice of tool material for a wide variety of commonly-used alloys.

The pressing need for machine tools to meet defense orders led Curtiss-Wright to seek foreign sources of supply during 1951. A successful purchasing campaign carried out by company representatives in Europe led to the establishment of a tool procurement agency, staffed by Curtiss-Wright personnel, under sponsorship of the Air Force. This agency was assigned the job of selecting foreign machine tools for the entire industry.

Late in the year, Paul V. Shields, who had directed the company's postwar reorganization and expansion as chairman, resigned and Roy T. Hurley, the company's president, took over the chairmanship on January 1, 1951. Mr. Shields continued to serve as a director of Curtiss-Wright and Mr. Hurley continued as president.

Curtiss-Wright Propeller Division

Curtiss-Wright Propeller Division celebrated its tenth year in its modern Caldwell plant with three major achievements.

In March it revealed a new mass production process for the manufacture of hollow-steel propeller blades.

Called the "hot extrusion" method, production begins with a white hot chrome-nickel-molybdenum steel billet, extrudes it through appropriate dies with a 5,500-ton press, and produces a 200-pound, 10-foot propeller blade tube. The tube is then flattened and machined, resulting in a tough, homogeneous unit which provides greater resistance to the more severe stresses to which propellers for higher horsepower piston and turbo-prop engines, now in production or being designed, will be subjected. This process allows a substantial reduction in the requirements for critical material, machine tools and manpower skills.

During the year, Propeller Division began production of the Turbolectric series of propellers designed for turbo-prop powered aircraft at subsonic, trans-sonic, and supersonic speeds. The first of the new propellers is used on planes which will cruise at 500 to 600 miles per hour. However, the research on which the Turbolectrics are based indicates that much higher speeds can be achieved by propeller-driven aircraft of the future.

Another Curtsis-Wright Propeller Division development of '51 was the "Zep-prop," which enables Navy blimps to back up in flight and to hover in a stationary position. The "Zep-prop" and its Curtiss controls adds ease and precision of control to the recognized long-range, sustained-flight advantages of lighter-than-air craft for anti-submarine defense.

Douglas Aircraft Company, Incorporated

Expansion of plant facilities, production activity and personnel marked the progress of Douglas Aircraft company during 1951, a year highlighted by achievements in highspeed research and transport aircraft production.

A major addition to the previous three-plant manufacturing establishment resulted from re-activation of the bomber plant operated by Douglas during World War II at Tulsa, Okla. There the company was preparing at year's end to begin production of the B-47 Stratojet bomber for the U. S. Air Force.

In the three California plants, where production was stepped up on five military aircraft types and one commercial model, employment virtually doubled during the year.

In June and August, the Douglas-Navy D-558-2 Skyrocket made aviation history, and in the transport field, Douglas produced, tested and delivered commercial and military versions of the DC-6A and DC-6B aircraft, improved and enlarged models of the four-engine airliner which has been in global service more than four years. The company also began delivery of the twin-engine R4D-8 to the Navy while the huge, C-124A Globemaster II Air Force transport entered widespread operational service.

Four Douglas aircraft types were employed by United Nations forces in miltiary operations against Red troops in Korea: the C-47 Skytrain, C-54 Skymaster and C-124 Globemaster transports, the B-26 light bomber, and the AD Skyraider.

A strike by a local of the UAW-CIO interrupted production of the Globemasters at the Douglas Long Beach plant for nearly seven weeks. Workers returned to the plant after the dispute was referred by President Truman to the Wage Stabilization Board.

Orders and re-orders for the improved "B" model of the DC-6 were received from 14 airlines. As the year was drawing to a close, sales totalled more than 140. Nineteen aircraft of the companion DC-6A Liftmaster, all-cargo version of the same basic airplane, also were purchased by three airlines.

At the present writing, 24 airlines had purchased a total of 334 transports of the DC-6 series. An undisclosed number of the Liftmasters also were ordered by the Navy and the Air Force.

Although originally certificated for a take-off gross weight of 100,000 pounds, new DC-6 models will be operated also at 103,000 and 106,000 pounds. In the latter, DC-6B's will have enough fuel to permit non-stop crossing of the North Atlantic in either direction. DC-6B's will be in service with seating accommodations for from 48 to 92 passengers.

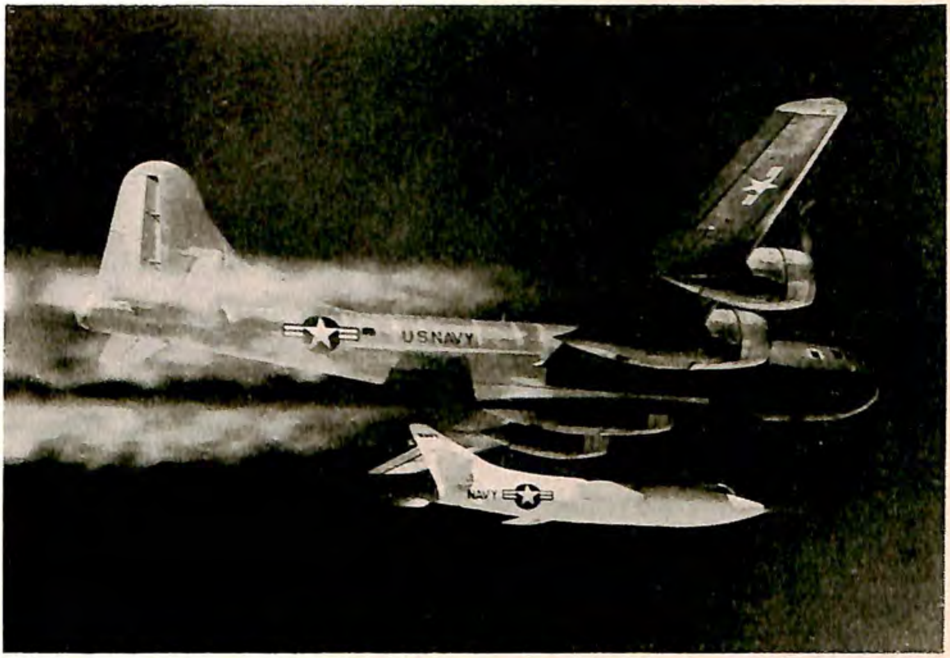
Three airlines, two domestic and one foreign, started operating DC-6B's, and one domestic freight carrier put DC-6A's in service during 1951.

First of the Navy R6D-1 transports also were delivered during October to VR-3 and VR-5 at Moffett Field, Cal., strengthening considerably the Navy's airlift potential. Because of its greater speed, greater payload and longer range, each R6D develops an airlift equivalent to two R5D's, previously the Navy's principal transport.

The Navy also began to take delivery in October of twin-engined R4D-8 transports, military configuration of the commercial Super DC-3's. Douglas had an order for 100 of the modernized cargo carriers.

Design changes made to the basic R4D's to double their range and increase their speed by 50 miles an hour include more powerful engines, new outer-wing panels, lengthened fuselage, larger empennage, fully-enclosed landing gear wells, retractable tail wheel, high-pressure hydraulic system and wing-panel tanks to double fuel capacity.

Normal gross weight of the R4D-8 is 31,000 pounds, permitting a capacity payload of 7,000 pounds, and the speed ranges from a top of 270 mph to 225 mph at 60 percent of normal rated power.



Launching the Douglas Skyrocket

Transports of the DC-6 series and the R4D's are produced by the Douglas Santa Monica Division.

Historic flights of the D-558-2 Skyrocket were among the major projects undertaken by the Douglas Testing Department. On one of the tests, the needle-nosed, swept-wing airplane exceeded the world's speed and altitude records for inhabited aircraft.

Bill Bridgeman, 34-year-old Douglas test pilot who established both records in the Skyrocket in June, flew the white research craft to a new and higher altitude mark on August 15. In both instances the Skyrocket was air-launched from a modified B-29 over the Air Force Flight Test Center at Edwards, Cal. For the flight which culminated the three-year test program, it was dropped at an altitude of 35,000 feet.

Within ten seconds, the four rocket motors blasted the airplane through the sound barrier while climbing. When the Skyrocket reached the prescribed altitude, Bridgeman leveled off to record high speed performance data.

As deliveries to the Air Force were stepped up, the giant C-124A Globemaster II transport gained widespread attention through a number of spectacular performances. The C-124 is produced by the Douglas Long Beach Division.

Early in the year, the four-engined Globemaster took off at 210,000 pounds, 35,000 pounds over the design gross, carrying a payload of more than 70,000 pounds. The airplane hauled the simulated cargo a distance of 1,000 miles, was unloaded, and returned to base without refueling.

The test was conducted by the Air Materiel Command's Flight Test Section to determine maximum load-carrying capabilities.

In operations by Strategic Support Squadrons of the Strategic Air Command, the Globemaster carried men and supplies to SAC's global network of bases in a number of missions necessarily classified for security reasons.

It also flew the first air evacuation mission by FEAF's 315th Air Division in October, removing 127 ill and wounded soldiers from the Korean battlefront to Japan.

The following week, the same transport carried 35,000 pounds of hand grenades to the battle area and returned with 160 patients and seven medical attendants.

The YC-124B, turbo-prop powered version of the Globemaster, is now under construction at the Long Beach Douglas plant. It is scheduled to fly in 1952. With horsepower virtually doubled, the prototype will utilize four Pratt & Whitney YT34-P-1 turbine engines, developing 5,500 horsepower each, to drive three-bladed Curtiss propellers with a diameter of 18 feet. Design gross weight will go up to 200,000 pounds and payload up to 64,000 pounds.

Two types of Navy attack bombers, a night fighter and a new interceptor occupied the engineering and production facilities of the Douglas El Segundo Division during the year.

Production and delivery of the AD Skyraider series of piston-powered attack planes continued. Operating from all classes of carriers, the Skyraiders were especially active giving ground support in the Korean war.

Development of a second attack bomber, the turbo-prop driven XA2D, continued while Douglas began to produce them as successors to the Skyraiders. The Skyshark is powered by the T-40 Allison twin turbo-prop engine driving two contra-rotating propellers. Offensive punch of the carrier-based plane is delivered by a variety of bombs, rockets, aerial torpedoes or other weapons carried on external wing racks.

As production of the F3D Skynight rolled into high gear, the twin-jet all-weather fighters went into service with units of the Navy and Marine Corps. Space is provided in the big, all-weather fighter for a crew of two men, pilot and radar operator, who ride in a pressurized, air-conditioned cockpit.

A fast Navy interceptor of unique planform, the bat-wing Douglas XF4D made its maiden flight early in 1951 and was under development testing during the year. Designed for catapult take-off from carriers and fast climb, the XF4D Skyray is a jet-powered fighter with swept-back, low aspect ratio wings and only a vertical stabilizer in place of a conventional tail. Tooling is under way to put this highly classified interceptor into production.

Douglas also announced production orders for two types of guided

Douglas AD production line

missiles, one for the Navy and one for the Army Ordnance Corps. As major sub-contractor on the two projects, Douglas has had both missiles under development for the past five years in collaboration with two of the nation's top electronic research organizations.

One of the missiles is a supersonic ground-to-air anti-aircraft weapon developed by the Army. The other is an air-to-air rocket missile which will be built for the Navy Bureau of Aeronautics.

A number of other missiles are under development by the Santa Monica Division engineering department, which was responsible for the production design and construction of the Wac-Corporal, Bumper-Wac and Corporal E series of test missiles.

Subcontracting of major components was stepped up to major proportions by Douglas during 1951. One of the largest subcontracts went to the Plymouth Division of Chrysler Motors Corp., to produce the entire tail section of the C-124 Globemaster. The work, to be performed in the

Chrysler Los Angeles plant, presently is being done at the Douglas Santa Monica plant for Long Beach, which has the prime contract.

Other multi-million dollar subcontracts let during the year included one to Texas Engineering and Manufacturing Co. of Dallas, for projection of major sub-assemblies of the A2D Skyshark and to Nevada Air Products Co., of Reno, for parts of the AD-4 Skyraider.

More than two million dollars worth of new buildings were added to Douglas manfacturing plants at four locations during 1951. Under construction at the Tulsa plant is a million dollar electronics testing building. Four buildings were erected at the Santa Monica plant, including a 170,000 square foot structure for missile production. Two other buildings, totaling 70,000 square feet, were added to existing Santa Monica facilities for expanded and more efficient production. The third project was a special building to house computers and calculating machines.

One addition to Santa Monica's facilities was an outright purchase of a four-acre tract and some 60,000 square feet of buildings in Southeastern Los Angeles for the fabrication of Douglas honeycomb construction material and production of sub-assemblies for Santa Monica-built aircraft.

At El Segundo, two major additions were constructed at a cost of $685,000. One enlarged an assembly building and the other is a new building for static testing of Navy aircraft.

President Donald W. Douglas early in 1951 announced a revamping and strengthening of the company's top level executive structure.

Each of the four plants were given the status of semi-independent operating divisions under the direction of general managers. Subsequently, the board of directors elevated three of the general managers and one other executive to the position of vice president.

Donald W. Douglas, Jr., was named vice president-military sales while retaining his previous post as director of testing.

Harry Woodhead, veteran aircraft production executive who had headed the Douglas Western Pressed Metals Division, was appointed vice president-general manager of the newly-activated Tulsa Division.

L. A. Carter, manager of the Santa Monica plant, and T. E. Springer, manager of the El Segundo plant, both were appointed vice president-general managers of newly-created operating divisions at those locations.

James (Jock) Simpson, former plant manager, was advanced to general manager of the Long Beach Division following the death of Fred W. Herman; and John C. Buckwalter, assistant to the vice president-engineering, was named chief engineer of the Long Beach Division to succeed the late Fred J. Stineman.

Douglas stockholders on April 19 accepted a directors' proposal to increase the total number of shares from one million to two million. This action enabled the directors to effect a two-for-one split of the 600,000 shares of capital stock then outstanding.

A backlog of unfilled orders exceeding $1,335,000,000 and sales totaling $153,371,814 were reported by Douglas for the nine month period ended August 31.

Net income was $5,249,513, or $4.37 per share for the 1,200,000 shares outstanding, compared with $4,748,230 or $3.96 per share for the same period of fiscal 1950.

Net sales, exceeding $153,000,000, compares with a total of $95,276,-036 at the close of the 1950 third quarter.

The $1,335,634,863 backlog represented firm contracts, largely military, to October 1. This was a 70 percent increase over the last reported figure of $786,766,213 for July 1, 1951.

Orders on the books were 89.5 percent military and 10.5 percent commercial.

Douglas had a working capital of $52,459,000, some $3,429,000 less than at the end of the first nine months of 1950, a reduction accounted for by the increase in expenditure for fixed assets. To finance inventories, work in process and receivables, arrangements were made with a small group of banks for commercial accommodations up to $60,000,000 at prime interest rates.

Employment soared from a 1950 total of 22,000 in the three California Douglas plants to 49,000 at year's end in all four divisions.

Fairchild Aircraft Division
Fairchild Engine and Airplane Corporation

Production at Fairchild Aircraft Division in 1951 was marked by heightened demands for C-119 Flying Boxcars. After being stalled by a strike which lasted from January 8 until February 14, the company resumed production under a contract calling for the construction of a substantially increased number of the twin-tailed aerial workhorses, for use by the Air Force and Marines. Employment topped the 6,000 mark by October.

A seven-million-dollar expansion program was begun at the Division in September. Included in the over-all program to implement production of C-119's are construction of a factory addition which will double the present assembly area, as well as warehouses, hangars and ramp space.

Late in June, officials of the USAF Mid-Central Air Procurement District announced turning over the huge, government-owned building, used by Douglas for production of C-54's during World War II at O'Hare International Airport, Park Ridge, Ill., to Fairchild for the building of additional C-119's. Admiral H. B. Sallada, U.S.N., retired, former Navy Bureau of Aeronautics chief, is managing the Chicago division of Fairchild, with a number of personnel from the Hagerstown plant in supervisory posts. Production was scheduled to get under way late in the year.

During the year the Kaiser-Frazer Corporation received a contract from the Air Force to build a substantial number of Fairchild C-119's at their Willow Run plant.

Fairchild Flying Boxcars completed a year of around-the-clock operations on the Korean airlift in September. Their day-to-day activities made headlines on numerous occasions, as when C-119's made the world's first airdrop of a bridge in December, 1950. They parachuted eight spans to Marines trapped by an impassable gorge, enabling them to cross it and escape.

On March 23, C-119's were head-lined as they mounted the biggest airdrop of men and supplies in the Korean campaign. Thirty-three hundred paratroopers of the 187th Regimental Combat Team jumped from the Flying Boxcars, with ammunition, artillery and jeeps and trucks following them in quick parachute delivery. Boxcars also parachuted two million pounds of gasoline to ground forces in a single day.

Europe-based C-82's performed a variety of military air transport duties, including paratroop training, heavy equipment dropping, service as hospital ships, and air indoctrination flights for ground troops. Fairchild C-82's of the 60th Troop Carrier Wing in Europe were joined by C-119's of the 433rd Troop Carrier Wing in August, the first USAF outfit to be sent to Europe to bolster General Eisenhower's NATO forces.

Fairchild C-119's, as in previous years, participated in numerous training exercises and maneuvers, though the number of them taking part was limited by the fact that many were committed to the Korean airlift and others were sent to Europe. An Arctic suitability test at Ladd Air Force Base, Alaska, saw C-119's undergoing a three-month test program to determine their suitability for troop and cargo transport operations in the Arctic aerial resupply, hauling of heavy equipment, and aerial evacuation. Exercise Firestep, in April, a joint Army-Navy-Air Force maneuver, tested ground and air defenses in the Alaskan theatre, with 24 Flying Boxcars participating.

In large-scale war games near Fort Bragg, Exercise Southern Pines, C-119's delivered howitzers, jeeps, trucks and anti-tank guns to help paratroopers consolidate an airhead in aggressor territory. NATO C-82's and C-119's dropped troopers in Exercise Combine, largest post-war air-ground games staged in Europe.

To expedite an iron ore development project undertaken in Canada by civilian companies, and of top importance to both the U. S. and the Dominion in the overall defense picture, the Flying Boxcar and a 10-man Fairchild task force headed by Assistant Chief Test Pilot E. R. "Dutch" Gelvin put the plane through its paces for two months, flying tractors, power shovels, scrapers, loaders, three-and-one-half ton trucks, compressors, rooters, generators and winches over 320 miles of wilderness between the St. Lawrence Port of Seven Islands and the ore fields of Knob Lake, Labrador. Over two million pounds of cargo were airlifted. The total number of ton-miles flown was 195,370.

The Fairchild XC-120 Packplane was tested during the year by the Air Materiel Command at Dayton, O., and the Air Proving Ground at Eglin Air Force Base, Fla. The tests showed that the pod plane can get into relatively small fields when heavily loaded, detach its pod, and fly away for another loaded pack without losing costly time in unloading.

Fairchild's Packplane (C-120) as a blood bank

The C-119's outline was changed slightly when dorsal fins were added to the tail booms of all production models, to provide increased stability and ease of control at low airspeeds. Tandem type gears were developed and tested on four production model Packets under a contract from the Air Force's Air Materiel Command. The experimental gears provide a wider "footprint" for landing on unprepared or soft surfaces.

A new version of the Flying Boxcar, the C-119H, is expected to be ready for its first flight early in 1952. The most apparent modification will be an increase in the wing area to lower minimum speeds and to take off and land in shorter distances and carry greater military loads than preceding models.

It will carry a payload of twelve and a half tons for 1,500 miles of combat range.

The C-119H will be equipped with Wright R-3350-85 compound engines developing 3,500 hp each at takeoff, and Aeroproducts four-bladed propellers.

General Electric Company

Contributions to aviation research and development came this year from many units within the General Electric Company including the aircraft gas-turbine department, the small and medium motors department, the electronics division, the general engineering laboratory, the control department, the fractional horsepower motor department, the specialty transformer and ballast department, the lamp division, the large motor and generator department, the meter and instrument department, and the aeronautic and ordnance systems department.

Highlights of the year's activities included the unveiling of the first J-47-GE-21 "all weather" turbojet, since designated the J-73; announcement of G-E responsibility for developing an aircraft nuclear powerplant for the Atomic Energy Commission and the U. S. Air Force; completion of a USAF order for the largest and most complex radar systems ever produced; development of a "traffic light" system which aids in-flight refueling; continued expansion of the company's Lockland jet headquarters to result in facilities more than three times its original size; the first public report on a special jet engine test program being conducted for the Air Force by the company, using a North American B-45 as a "flying laboratory"; and development of a complete new line of 3-phase, a-c generators especially designed for aircraft.

The new J-73, which is destined for still unannounced advanced military aircraft, puts out far more thrust than the present J-47 which is rated in excess of 5,200 pounds, although the J-73 has the same frame size. Developed in record time—18 months from drawing board to completed unofficial 50-hour tests—the J-73 has a low rate of fuel consumption and combines new design with battle-tested features of the present J-47.

The company's current production J-47 turbojets power such Air Force planes as the Boeing B-47; the North American F-86, and B-45; the Republic XF-91; and the Martin XB-51. In addition, J-47 turbojets serve as auxiliary powerplants on the Convair B-36.

Early in the year, C. W. LaPierre, general manager of the G-E aircraft gas-turbine department, announced that General Electric—by more than tripling the space and by expanding employment to a peak in excess of 10,000—would make Lockland, O., its jet engine center. In addition to production facilities, Lockland will be headquarters for A.G.T. executive and engineering staffs, for testing and development activities in turbojets and turboprops, and for the newly-created aircraft nuclear propulsion project, of which D. R. Shoults was named director. These facilities, plus the company's turbojet and turbo-supercharger plants at Lynn and Everett, Mass., will be needed to meet increased Air Force needs.

A large portion of the company's J-47 production in the coming months will be concentrated on the all-weather J-47-GE-23 turbojet. To meet the Air Force's powerplant requirements for the B-47, supply lines will reach virtually every state in the nation. High volume production of engines is scheduled by the company and by the Packard Motor Car Company and the Studebaker Corporation as licensees.

Rated at more than 5,000 pounds of thrust, the "23" will give future models of the B-47 even greater speed and range. First of the company's all weather jet engine series, the "23" eliminates the icing problem by its "hot nose." Hot air from the turbojet's compressor is bled to hollow parts of the nose, where the resultant temperatures are enough to melt any ice crystals forming.

Dr. Miles C. Leverett of the G-E aircraft nuclear propulsion project, in an I.A.S. paper, enumerated the principles involved in the development of an atomic power plant for aircraft and described some of the problems confronting the project. Among the problems he listed are the development of materials capable of withstanding high temperatures and intense radiation, and the design of the necessary shielding to protect crew and plane. "The combined effects of high temperatures, corrosion by various coolants, radiation damage, thermal and mechanical stresses can be extremely serious in some cases. The aircraft reactor presents these problems to an unusual and critical degree," he said.

Summarizing two years of turbosupercharger operation on Boeing Stratocruisers, a G-E engineer reported to the SAE in April that turbos have accumulated more than a million hours in commercial service, have flown more than 43 million miles, and have operated under tougher conditions than normally experienced by military planes. He said the four G-E BH4 turbosuperchargers give the Stratocruiser an operating altitude as high as 25,000 feet, a maximum cruising speed of over 300 miles per hour, and a maximum range of more than 4,000 miles.

In the first public report on a special jet engine test program being conducted for the Air Force at altitudes of seven miles or more, the company disclosed that turbojet powerplants have required only relatively minor maintenance to date and that engine inspection and maintenance has taken less than half the time needed for piston engines under similar conditions. The "flying laboratory" is a North American B-45 bomber assigned 16 months ago by the Air Force to the company for accelerated " service life" tests of its four J-47 powerplants under closely controlled conditions which cannot be attained in normal military operations.

E. M. Beattie, pilot, and Newell Davis, flight engineer, in a joint report to the SAE said that the entire icing problem appears to be greatly alleviated with the jet airplane, that during the initial 125 hours of flight time, no engine maintenance other than routine servicing was required, and that jet transports could operate safely from most of the nation's airports when free from ice and snow.

Late this year the company's control department announced development of a new center-of-gravity type vibration isolation mount which protects aircraft voltage regulators from shock and vibration. Developed with the cooperation and assistance of the Navy Department's Bureau of Aeronautics, the new mount is designed to withstand a shock or sustained acceleration of 10 G's. Four phosphor-bronze laminated spiral springs located at the corners of a movable base so protect the device that it may be mounted in any plane and subjected to shock and vibration in any direction.

The control department also announced design of a line of a-c voltage regulators using magnetic amplifiers. These "amplistat" voltage regulators will augment the present a-c voltage regulators using carbon pile elements and will give heretofore unrealized stability, response, and accuracy under the increased acceleration, shock, vibration, and expanded environmental conditions experienced on present military aircraft.

The control department continued to manufacture aviation equipment including voltage regulators, generator protective panels, limit switches, relays, and a variety of other devices.

The company's meter and instrument department, with headquarters in West Lynn, Mass., has this year increased its production of tachometer indicators and generators, position indicators and transmitters, liquid level indicators and transmitters, and some gyroscopic devices.

The fractional horsepower motor department has announced a new gear motor designed for heavy-duty, hydraulic pump-drive applications. It is rated at three and one-half-horsepower for continuous duty. Precision gear design and manufacture with new oil lubrication provide lower gear and bearing temperatures and higher efficiency. Careful electrical design results in long brush life in high altitude operation as well as at sea level. The explosion-proof motor is available with standard Air Force-approved mounting pads, connectors, radio noise suppression filters, and other special features.

The specialty transformer and ballast department, with headquarters at Ft. Wayne, Ind., continued to produce a complete line of general-purpose transformers and fluorescent ballast for air frame manufacturers, plus transformers for airborne electronic applications. These include both hermetically sealed transformers and a line of Permafil treated units.

General Electric's electronics division in 1951 took important steps in the fields of aircraft detection and electronic reliability. In October, G-E announced completion of a U. S. Air Force order for the largest and most complex radar systems ever produced.

Capable of detecting aircraft at long ranges, the systems have been installed by the Air Force as major posts in the radar fence now protecting the U. S. and Canada against sneak enemy air attack.

Many men are required to operate the multiple operational positions at each installation on a 24-hour basis. A single system can intercept a large number of enemy air raids simultaneously, a feature enabling it to perform the combined work of many similar radars used in World War II.

In the field of electronic reliability, the G-E tube department announced development of two new ones.

The first, a miniature thyratron, is designed for long-life use in aircraft control circuit operations. The second, a shock and vibration resistant beam-power amplifier, is for use in medium power audio-frequency service. Developed in co-operation with the country's commercial airlines, 11 of these super-reliable tubes are now in production under rigid specifications at the company's Owensboro, Ky., plant.

In-flight refueling got an assist this year from the company's lamp division when tanker versions of the Boeing B-29 and C-97 installed G-E "traffic lights" to aid in keeping the plane being refueled in proper position.

The lights, four red and a green, are triggered automatically by microswitches connected with the boom. Lettering on the oblong panels on the belly of the tanker reads "up," "down," "fwd" and "aft." In full view of the receiving pilot, they advise him when his plane is out of position.

GE's traffic light system for in-flight refueling

In November, the small and medium motor department announced it was nearing production stage of a complete new line of 3-phase, a-c generators especially designed for aircraft. Available in a variety of ratings from 15 to 90-kva at 120/208 volts, the alternators have normal operating speeds ranging from 3,800 to 8,000-rpm and may be either wye or delta connected. Three main advantages of the new alternators are their lighter weight, positive short circuit protection, and nearly perfect sine wave allowing proper operation of electronic equipment demanding a low percentage of harmonics in the voltage wave form.

The company's new "QAD," quick attach-detach generator mount, developed this year by engineers of the small and medium motors department, cuts generator replacement time from hours to minutes and can be used to mount a generator on piston engines or a starter-generator on jet engines.

What will be one of the world's most powerful wind tunnel drives—a 250,000 hp unit capable of creating supersonic blasts of air—went into construction late this year at the company's Schenectady works. The giant drive will be installed in a new wind tunnel now being built for the National Advisory Committee for Aeronautics at the Lewis Flight Propulsion Laboratory in Cleveland, O. The drive will consist of four 37,500-hp and three 33,334-hp variable speed, a-c induction motors linked to two axial-flow compressors. Construction was also begun this year of a 180,000-hp wind tunnel drive for NACA's Ames Aeronautical Laboratory at Moffett Field, Cal.

Early in 1951, the last of an initial series of General Electric-designed missiles was launched at the White Sands Proving Ground. The information obtained from these tests, conducted for the Army Ordnance Department, will make it possible to achieve goals established by the military in accuracy, range and payload necessary for a tactical missile. The Malta Test station facilities near Schenectady are being expanded to include a static firing test stand. When completed, it will be possible to test missile prototypes and check out the propulsion, guidance and flight control systems except for the effects of altitude and velocities.

The company's participation in the assembly and firing of German V-2 rockets was successfully completed in July after more than 65 rockets had been launched.

Goodyear Aircraft Corporation

Goodyear Aircraft Corporation increased its activities during 1951 both at Akron, O., and at its Arizona plant near Phoenix.

The reactivated factory in Arizona received a multi-million dollar contract for the manufacture of wing and empennage assemblies for North American's T-28 Air Force trainer. The plant also was engaged in the fabrication of envelopes for Navy blimps, transparent plastic canopies and nose enclosures for planes, tow targets and radar structures.

Letters of intent for the production of the Navy's newest jet fighter, the McDonnell F3H-1 Demon, were received in September. The dollar value and number of planes involved were not disclosed but Goodyear announced that the fighters would be built in Akron.

The first ZPN airship, newest weapon in the Navy's modernized anti-submarine warfare team, had its maiden flight from the giant airship dock in Akron in June. Construction of additional airships is underway, the Navy having disclosed orders for at least four more of the N-type.

The ZPN is 324 feet long and the ship's envelope has a capacity of 875,000 cubic feet of helium gas compared with 725 cubic feet capacity for the M-type Navy airship that currently holds the world's sustained flight record without refueling of more than one week. The K-type blimps used extensively by the Navy in anti-submarine service during World War II had an envelope capacity of only 456,000 cubic feet and were 253 feet in length.

Goodyear Aircraft and the aviation products division of the Goodyear Tire and Rubber Company, the parent organization, were turning out a heavy volume of other component parts and eqiupment for commercial and private planes, as well as for military aircraft.

The Wright Air Development Center announced the first successful application of the Goodyear cross-wind wheels on a large tricycle landing gear plane in the C-54. A smaller tricycle gear Beechcraft Bonanza plane has been flying with Goodyear cross-wind wheels for approximately two years.

Goodyear's newest electrically-heated anti-icing equipment, designed to eliminate icing conditions on wings and tail surfaces at altitudes and speeds never before reached by airliners, was installed on the Canadian Avro Jetliner in conjunction with the National Research Council (Canada). The electrothermal ice guards consist of resistance wire elements molded into an erosion-resistant synthetic rubber compound installed on leading edges of wings, cabin air intakes and horizontal and vertical stabilizers.

Giant pliocel nylon fuel cells weighing less than .085 pounds per square foot for the Air Force; other types of bullet sealing fuel and oil cells; airplane wheels, brakes, tires and tubes; Airfoam and molded rubber goods for aviation use; heated rubber aviation hose; life rafts and landing floats were among the products produced by the rubber organization while aircraft manufactured complete airships and amphibious airplanes, wheels and brakes, metal fuel tanks, aircraft fuselages, control surfaces, and other metal components, pilot enclosures, radomes, radar antennae and towers and many other defense items.

Goodyear Aircraft continued its confidential research in the fields of missiles, radar and electronics, and started construction of a new plant at Akron to broaden this phase of activity.

Employment increased at Aircraft's Akron operations to 7,600 and neared the 2,000 mark in Arizona.

Grumman Aircraft Engineering Corporation

The highest volume of work at Grumman during 1951 was on military aircraft, although sizable production was registered in other fields.

No new designs went into production, but the output of the three military models was accelerated. The planes were the Panther, carrier-based jet fighter for the Navy, the Albatross, a twin-engine utility amphibian for the Air Force, Navy and Coast Guard, and the Guardian, a single-engine anti-submarine plane. Both the Panther and the Albatross figured in the news from Korea, the Albatross doing specially spectacular work for the Air Rescue Service of the Air Force, and the Panther continuing its outstanding work as a carrier jet.

Although production tapered off, owing to defense needs, on metal boats, a number were produced early in the year. Similar drop in production was registered by Aerobilt Bodies, Inc., a wholly-owned Grumman subsidiary.

Grumman went into 1952 with one of the largest backlogs of its history, but total figures were discouraged by security.

Hamilton Standard Division
United Aircraft Corporation

Substantial backlogs of both military and commercial business set the stage for a shift in production emphasis at Hamilton Standard Division of United Aircraft Corporation. Even as the division tooled up and prepared to expand to meet an unusually heavy defense load, it was bending every effort to maintain the heaviest commercial schedules in years.

At the end of 1951, commercial transports were creating heavy demands for Hamilton Standard propellers. Once again, the division has a "universal" propeller, the 43E60 reversing Hydromatic, which has become the 1951 equivalent of 1941's 23E50.

Conversion programs, in which the 43E60 is replacing older propeller types, took place at several airlines. The 43E60 also is in demand for new Air Force and Navy transports, and a new twin-engine trainer.

Integral oil control assemblies are ordered in quantity for the C-119, the Boeing C-97, the Chase C-123, and Grumman's SA-16 (UF-1) amphibian. The latter airplane is using the 43D50 propeller with 6621 and 6601 dural blades.

First deliveries of the 43D50 propeller with 6915 blades for Grumman's S2F twin-engine anti-submarine plane were scheduded for early 1952.

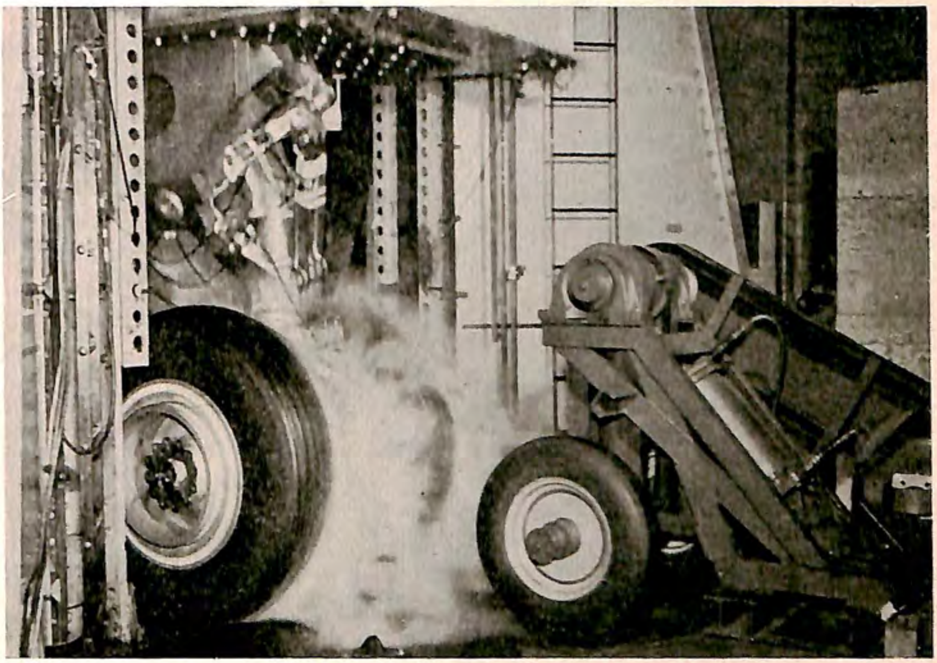
In the accessory field, substantial orders were being processed for the air-cycle refrigeration units for North American F-86D and H, Lockheed F-94C, and Chance Vought F7U jet fighters. The unit also is scheduled for use on the Consolidated Vultee turbo-prop flying boat, the R3Y.

During the year, the division announced the development of two more items of aviation equipment, a jet fuel control and a jet starter. The fuel control, combining an electronic "brain" with hydro-mechanical "brawn," passed endurance tests on Pratt & Whitney Aircraft J-57 engines and flight testing was in progress during the summer and fall months.

The new turbine-engine starters, which went into limited production in the fall, are considerably lighter than the electrical equipment currently in use and deliver many times its horsepower. They will start the highest-powered turbine under consideration, cutting to seconds the time required to "scramble" alerted jet interceptors and bombers.

A 19-foot propeller for turbine engines was being tested by the USAF Air Materiel Command at Wright-Patterson Air Force Base. The propeller was developed under Air Force sponsorship for power plants delivering over 5,000 hp.

The new propeller is the third of Hamilton Standard's line of specially designed turbine propellers, called Turbo-Hydromatics, to reach the stage



Cleveland Pneumatic's "spin-up" test for gear struts

of Air Force or Navy testing after extensive endurance tests by the manufacturer. Two others are being tested by the Navy, a smaller four-bladed propeller now in the flight stage, and a dual rotation eight-bladed version.

A training program for Air Force technicians in charge of propeller maintenance and instruction at the nation's Air Force bases was carried out early in the year by the division in conjunction with the Air Force. Classes of twelve men each from widely-scattered AF installations were graduated every three weeks after intensive indoctrination in the various types of Hamilton Standard propellers installed on modern Air Force aircraft.

More than 5,000 students have graduated from the school since it was established in 1942.

The entire force of hourly rated personnel at Hamilton Standard Division of United Aircraft Corporation officially started a forty-eight hours, six-day week effective in April. The longer work week also was extended to some of the salaried employees.

Salaried supervisors in the manufacturing and engineering departments automatically joined their hourly rated personnel on the forty-eight hour week.

A new machine for the mass production of turbine blades for turbojet and turbo-prop aircraft engines was developed by Hamilton Standard and placed in operation early in the year. Ten of the machines were turned over to Pratt & Whitney Aircraft.

The machine uses an endless abrasive belt to strop the blades. The belt surface is varied in consistency according to the job to be performed and the amount of stock to be removed. Ideally suited for finishing the blade surfaces after they have been rough ground, the machine also will process the blade from rough forging to finished blade if necessary. It will remove up to three thirty-secondths of an inch of stock in fifteen minutes or less.

Developed by Sigmund A. Czarnecki, master mechanic at Hamilton Standard and others of the tool engineering department, the machine removes stock accurately at high speed without distorting the blades or setting up damaging surface stresses. While processing blades at a higher rate than is possible with other methods, it also gives an unusually smooth finish.

T. A. Sims, was appointed assistant general manager of the Division, leaving his post as general manager of the Air Forces NEPA (Nuclear Energy for the Propulsion of Aircraft) project and as vice president of Fairchild Engine and Airplane Corporation. He took up his new duties with Hamilton Standard June 1, 1951.

In the continuing effort to increase production, Hamilton Standard increased its number of subcontractors and suppliers by almost one-half. The total rose to approximately 2,800, an increase of 1,200 since the start of the Korean war. Seventy-five percent of the finished parts going into Hamilton Standard propellers are purchased as complete units from suppliers. By cost, 40 percent of each propeller is subcontracted.

Of major importance to the future of Hamilton Standard was the decision, announced in April, to move to a new plant at Windsor Locks, Conn., 14 miles away from the East Hartford plant. Ground-breaking ceremonies were held April 19, and the division was expected to be established in its new quarters within a year.

The new plant, covering an area 1,000 by 600 feet, will increase the division's productive area by approximately one-third and make possible a more efficient lay-out of production lines.

Expanded production of the division's Hydromatic propellers above its own capacity was made possible through the signing of a license agreement with the Chrysler Corporation. Chrysler will build the 24260 and propeller and its integral oil controls for the military forces at a newly-built Dodge plant at San Leandro, Cal. The San Leandro plant, originally scheduled for production of Dodge car components, was scheduled for completion by December, 1951, and was expected to turn out its first propeller by November, 1952.

Hamilton Standard itself continued to increase its own production as employment doubled. The division expected to employ approximately 5,000 by the time the new plant at Windsor Locks was ready for occupancy.

The Hiller ramjet Hornet

Hiller Helicopters

Top '51 news from Hiller Helicopters was the introduction and certification of the H-23B, the company's first rotorcraft designed for military service.

In the fall of 1950, after a few Marine helicopters had shown their unique ability in Korea, Hiller Helicopters, within a matter of days, converted its commercial Hiller 360 into the Navy HTE-1, and later the Army H-23A. Essentially, these civilian helicopters were equipped with "fixes," such as extra radio, floor stick and special electronic equipment.

When these units were pressed into service in Korea, the United States and Europe, their performance in the field led, in the first few months of '51, to an engineering conference at Hiller, where all of the suggestions from the field were incorporated in an entirely new helicopter design.

Some 54 major engineering changes were started through engineering.

Following the meeting, a large order for H-23B's was awarded, and by fall production was in full swing.

All design changes were not incorporated at one time. As production cut-in would allow, major changes were put in. New transmissions, new bodies, new tail sections, completely new electronic system, new controls, new cockpit enclosure—all of these have been added.

Kaman Aircraft Corporation

In 1951, the Kaman Aircraft Corporation placed in production the type HTK-1 helicopter for the U. S. Navy. The HTK-1 is a three-place machine powered by a 240-horsepower Lycoming engine. Detail specifications are classified. The HTK-1 is primarily a trainer and as such will carry three persons. Dual controls and two side-by-side seats are supplemented by a jump seat located behind the pilot. The left-hand front seat and left-hand controls are readily removable to permit carrying a litter. As an aerial ambulance the HTK-1 will carry pilot, litter patient, and a medical attendant or walking casualty.

Kaman Aircraft is also developing the type HOK-1 for the Navy. HOK-1's will go into production in 1952. This is a four-place liaison helicopter which, like the HTK-1, is convertible to an ambulance. Details are classified. In addition to the HOK-1, the corporation is working on several other new developments including a gasoline turbine-powered helicopter. Again, details are classified.

During 1951 employment increased from 175 persons to its present level of 610. It is still on the increase and it is expected to keep on rising for at least the next six to eight months. The corporation's military backlog rose from $2,000,0000 to more than $18,000,000. Floor area increased from 45,000 square feet to approximately 100,000 square feet.

The corporation recently received a contract to construct a Navy-financed plant on an 85-acre tract in Bloomfield, Conn. The new plant will have 104,000 square feet of manufacturing, engineering, and office area.

Kollsman Instrument Corporation

Change of ownership was the major 1951 event at the Kollsman Instrument Corporation, manufacturers of precision aircraft and optical instruments and systems, as well as special-purpose motors and generators. In January, 1951, Kollsman became a wholly-owned subsidiary of Standard Coil Products Co., Inc., the country's leading manufacturer of tuners for television sets and producers of various electronic products and components.

While Kollsman is primarily a supplier of the military, the two companies are related in certain aspects of engineering, in electronic research, and in production facilities for precision devices. The present emphasis on radar and communication provides a common ground for the design and development work of both organizations.

With the trend in aircraft instruments moving from indication toward automatic control of flight, Kollsman has been active in the field of electromechanical units which give intelligence to automatic controls or to visual indicators. Among these instruments are angle of attack transmitters, synchro-indicators, resistance pickups, Synchrotel pickups, absolute pressure switches, radiosonde modulators, altitude and airspeed controllers, tachometer indicators, cabin pressure controls, and turbine time indicators.

The present increase in the altitude, speed and range of aircraft has demanded more exacting instruments and more intricate systems to guide and control the aircraft, as well as more complex related and accessory apparatus. In production at Kollsman are computers for navigation, automatic pilots, and other restricted devices. In addition, there are flight recorders, drop sondes, wire sondes, cabin pressure systems, and various other servo systems.

Kollsman continues the manufacture of its own optics. The Kollsman periscopic sextant, a navigation instrument, is in volume production for long-range aircraft. Recently developed is the periscopic sextant with a true heading scale. Other optical units in production at Kollsman are gun sights, drift sights, special purpose prisms, lenses, reticles, and a line of Sard binoculars.

The Kollsman pressure instruments, marked by increased sensitivity and wider range of indication, are altimeters, airspeed indicators, true airspeed indicators, machmeters, mach airspeed indicators, vertical speed indicators, manifold pressure gages, air pressure gages, absolute and differential pressure gages, aneroid barometers and cabin pressure indicators.

Kollsman electrical units, produced in volume during the year, include induction and synchronous motors, induction generators, synchros, motor generators, Circutrols, phase shifters, permanent magnet generators, tachomemter generators, and hysteresis motors. During the year, Kollsman also continued to make a variety of devices, such as pitot static tubes, accelerometers, compasses, flight training instruments, mechanical tachometers, and others.

With the pressing requirements of the military, Kollsman has been increasing its personnel and expanding its facilities. The manufacturing facilities of Standard Coil Products Co., Inc. are also being utilized.

Lockheed Aircraft Corporation

The first production models of a new American transport, the Lockheed Super Constellation, took to the air July 14, 1951. Even before the first plane flew, the Super Constellation had built up the highest transport backlog in Lockheed history, with orders for nearly $100,000,000 worth of the luxury liners from five airlines and an even greater volume from military services.

Advent of the Super Constellation was but one of numerous Lockheed Aircraft Coroporation highlights in 1951.

President Robert E. Gross described the year as a make-ready period. It was a time for activating long-standing plans for production expansion. More plans were made. Huge military orders were received. New facilities were constructed. Supply lines were set up to subcontractors and vendors for increasingly heavy procurement of materials, parts and subassemblies. The labor force was expanded, with thousands of new employees trained in aircraft manufacture.

Meanwhile, output of airplanes picked up speed according to pre-planned schedules. But next year, 1952, would be the time for more significant production achievements.

The year 1951 was a period of growth not only of the Lockheed Corporation's plant, personnel, production and long-range plans but also its airplanes. Every model in production at the year's end represented growth of a design first introduced years ago.

The Super Constellation, basically the veteran Constellation transport with an 18.4 foot longer fuselage and more powerful engines, is an example. When the first Constellation flew in 1943, it was a 72,000-pound airplane. The Super Constellation will have a maximum takeoff weight of 130,000 pounds. Its usable space has been increased 37 percent, for a gain of 35 percent in passenger capacity and 65 percent in cargo capacity.

Super Constellation growth has been possible because of a steady progression of power increases. First Super Constellations have 2,500-hp jet-stack reciprocating engines, replaceable later with 2,750-hp compound engines and ultimately with propjet power plants capable of 400 mph.

Since Constellations first went into production, nearly 400 have been built or ordered.

Super Constellations have been redesigned internally to take more powerful engines and faster speeds ahead. When dependable commercial turboprops are available, they can be installed in place of jet-stack or compound engines without structural modification, according to Hall L. Hibbard, vice-president and chief engineer.

Among the first airlines to place Super Constellation orders were Eastern, 30; TWA, 10; KLM, 9; Air France, 10; Pakiston International, 3; Trans-Canada, 5; Quantas, 1. First deliveries were scheduled for EAL in late 1951.

Lockheed jet fighter planes also represent growth. F-94 interceptors stem from the famed F-80 Shooting Star, and F-94B all-weather interceptor was produced in large quantities in 1951. The F-94C, a later version with improved electronic gear and armament, moved into production and still another model, the F-94D, approached the assembly-line stage.

Meanwhile, Lockheed's T-33 jet trainer (designated TO-2 by U. S. Navy) poured from the factory in the heavy quantities. The trainer was the first outgrowth of the F-80 configuration.

The Shooting Star, a one-place plane, was lengthened about 3 feet when Lockheed saw the opportunity to install dual controls and create a much-needed trainer. Once a two-place ship was available, it was a natural next step to convert it to a flying-eye interceptor by putting a radar operator in the rear seat, providing enemy-spotting radar devices, boosting speed and power with an afterburner and obtaining a plane able to fly to the defense of vital targets despite storms or darkness. The F-94C is also a two-place plane, but the F-94D has been redesigned as a one-place plane primarily for ground support.

The P2V Neptune, serving the Navy on long-range patrol and anti-submarine missions, is another example of Lockheed airplane growth. Its growth has been principally in power, through substitution of 3250-hp Wright compound engines for earlier reciprocating engines. In production as the P2V-5, the Neptune has been designated also as a special air-sea rescue craft. The far-flying twin-engined planes are going also to the Royal Air Force and Royal Australian Air Force.

Lockheed also developed an all-freight transport, closely resembling the Super Constellation in appearance. It is designated for conversion to turboprops, with resultant powered ton-mile costs.

The Air Force selected a Lockheed design for a new all-cargo medium transport, powered by four turboprop engines. It is designated the XC-130, The high-wing plane is rated as capable of moving a 25,000-pound payload 2,500 miles. It will be of exceptionally rugged construction, squat in appearance, with a highly utilitarian fuselage with large aft cargo doors and sturdy floor built 45 inches from the ground. Allison T-38 turboprop engines of 2,750 horsepower each are prescribed.

Lockheed's interest in air cargo included development of a portable electric freight elevator, which can be dismantled and carried with the plane; an in-plane chain conveyor for moving bulky cargo down the fuselage; and other new loading tools.

Lockheed's backlog passed the billion-dollar mark in 1951. Counting letters of intent, it was reported at $1,245,600,000 in September. Of that amount $895,438,000 then was in final contract form.

Employment rose from 20,241 for Lockheed and subsidiaries at the end of 1950 to an estimated 35,000 at the end of 1951. Personnel officials expected sharp employment increases in 1952.

Many Lockheed executives and employees were transferred during the year to the company's Marietta, Ga., division. At Marietta, Lockheed reopened a government-owned factory, commenced modifying B-29's removed from mothballs, and prepared to start production of B-47 jet bombers for the U. S. Air Force.

A contract was signed in September with the Air Force for building a $12,600,000 final assembly plant and flight test facility at Palmdale, a community on the edge of the desert in the Antelope Valley, 65 miles northeast of Los Angeles.

Lockheed in 1951 inaugurated feeder plant operation, with subassembly work planned for Beverly Hills and Bakersfield.

Production of T-33 trainers in Canada was arranged, with Lockheed contracting with the Canadian government for licensed manufacture of the ships on assignment to Canadair, Ltd.

The make-ready year brought numerous physical expansions at Lockheed facilities. A $2,000,000 office building was completed at the main plant. A $400,000 addition to research laboratories was built at Plant B1, and a $400,000 hangar at Palmdale Airport (to become part of the $12,600,000 Air Force facility).

Glenn L. Martin Company

Vastly accelerated engineering and production activity, as well as new financing, manpower growth and plant expansion to meet the demands of post-Korean new orders, marked the Martin Company's 43rd year. Deliveries were made against existing contracts for both commercial and military aircraft, for missiles and other special weapons. The Company's backlog rose from $162,000,000 at October 1, 1950, to over $425,000,000 at September 30, 1951.

Most noteworthy, among items of new business during the year, was the U. S. Air Force order for a considerable quantity of a night intruder version of the English Electric Canberra light bomber. The Navy's original requirement for P5M-1 Marlins was substantially increased, and order for an additional 27 Martin 4-0-4 airliners brought that contract total to 103 planes. Two of these were purchased by the Coast Guard. New orders were received, too, for missiles, for 250-CE turrets and for subcontract items such as the Western Electric radar trailer.

The results of the Company's intensive manpower recruiting campaign were measured by a rapid build-up to over 20,000 from a total of about 11,000 employees at the year's beginning. This represented a tripling of the payroll, as against the post-war low of 7,000 recorded just two years ago. Training courses, offering instruction in sheet metal work and other basic shop skills, handled more than 10,000 newcomers during 1951.

Plant expansion was characterized by increased utilization of existing areas, including construction of an electronics and other work balconies and arbors, by newly leased warehouses providing 220,000 additional square feet for storage, and by the occupancy of nearly one third of a nearby plant containing 1,500,000 square feet of floor space. Operated by Martin during the war, this latter facility was taken over by the U. S. Army Signal Corps in 1946. It is scheduled to be wholly reoccupied by mid-1952.

The U. S. Air Force version of the Canberra twin-jet airplane is being built by Martin under the designation B-57A. Power will be furnished by Wright J-65 Sapphire engines, in place of the Rolls-Royse Avons with which the RAF Canberra is equipped. The aircraft has a rather conventional configuration, possessing excellent maneuverability and high speed. Wing span is 64 feet; length, 65½ feet; and height 15½ feet. It has tricycle gear, and landings will be slowed by a deceleration parachute.

Engineering and tooling for the B-57A were well advanced by the end of the year. The work of redesign, of course, has been complicated by the necessity for reconciling a foreign product—component by component—with American equipment and methods of fabrication. Deliveries are scheduled to begin during the spring of 1953.

Two English Electric Canberras were flown across the Atlantic, one in February and the other in September, and turned over to the Martin Company. Both flights set records for westward, non-refueled hops from the British Isles to Gander. The second passage was officially clocked at 4 hours, 18 minutes. Another Canberra landed at Melbourne, Australia, in August, completing a 12,677-mile delivery flight from England at an average speed of 490 mph. Top speed reached 580 mph.

First flight of the Martin 4-0-4, in production since 1950, occurred on July 27. CAA type certification followed on October 5, and the first delivery was made, to Eastern Air Lines, later that month. Trans World Airlines accepted the first of its 41 new airliners early in November. The entire contract quantity is due for delivery before the end of 1952. Meanwhile, until a like number of 4-0-4's have been put in service, TWA will continue to fly the 12 Martin 2-0-2A airplanes leased in September 1950, for interim use.

The production model P5M-1 flying boat was first flown on June 22, and deliveries under the original Navy contract of March, 1949, were begun late in the autumn. Meanwhile, on October 17, two Marlins participated in an extensive flight demonstration at Norfolk, for the benefit of high Navy officials.

Successor to the Martin PBM Mariner of World War II fame, the P5M-1 is featured by a long afterbody, or hull extension, the keel being under water from just behind the nose to the sternpost. Gull wings are complemented by a high, single vertical tail. Engines are twin 3,350 Wrights. Accommodating a crew of seven, the Marlin was designed primarily as a long range sub-hunter and destroyer. It is adaptable, however, for use as a cargo carrier, air-sea rescue or general utility plane. The P5M-1 is equipped with the latest electronic detection devices.

Martin guided missile activities made the headlines in Septmber, when the Air Force announced the formation of its first pilotless bomber squadron —to be equipped initially with the B-61 Matador. The new squadron is being trained at the USAF Missile Test Center, Cocoa, Fla., under supervision of the 6555th Guided Missile Wing. Several successful launchings of the Matador were accomplished during the year. The B-61 is fired from a zero-length launcher, by rocket propulsion. Once under way, the rocket drops off—and a turbojet takes over. The Matador went into production during the year.

The seventh of ten Vikings ordered by the Navy in 1946, the single-stage, high-altitude research rocket developed by Martin under direction of the Naval Research Laboratory to replace the German V-2, was fired on August 7. It soared to a point 135.6 miles above the White Sands launching site, establishing a new altitude record for single-stage rockets. Several KDM-1 Plover gunnery target drones also, were fired during 1951. Powered by a Marquardt ramjet engine, the Plover is radio-controlled. In quantity production for the Navy throughout the year, it was first flight-tested in 1950.

Other items in production at the Martin plant, included a large number of 250-CE deck turrets, besides subcontracted wing and tail-surface assemblies for the Grumman F9F-4 and 5 Navy fighter, radar trailers for the Western Electric Company and parts for General Electric jet engines. Data on other special weapons and electronics programs, numbering upwards of thirty in all, cannot be revealed because of security restrictions. Electronics has become a major enterprise at Middle River, where some 300 engineers are specialized in the design, production and testing of guidance systems, fire-control radar, telemetering devices and antennas for airborne use.

During 1951, the company farmed out a number of P5M-1 Marlin and B-57A Canberra components to subcontractors. This business amounted to over $50,000,000. Outer wings for the Marlin are being built by Intercontinental Manufacturing Company; fin and rudder, by Bellanca Aircraft; ailerons, by Majestic Aircraft; flaps and bomb-bay doors, by Texas Engineering & Manufacturing; elevator and stabilizer, by Marine Aircraft; floats and struts, by Aluminum Company; flotation tanks for beaching gear, by General Bronze; tail canopy, by E. L. Cournand & Company. Canberra tail and aft fuselage was subcontracted to Hudson Motors; outer wing with nacelle, to Kaiser Metal Products; landing gear, to Cleveland Pneumatic Tool Company.

In July, James Allen, special assistant to the administrator of the Reconstruction Finance Corporation, was elected to membership on the Martin Board of Directors. Executive changes included W. B. Bergen's appointment as vice president and chief engineer, and Vernon L. Rawlings' promotion to the position of factory manager.

In reporting a small operating profit and a backlog of orders in excess of $425,000,000, the Martin Company announced a net loss of $17,969,369 for the nine months ended September 30, 1951. The reported net loss resulted principally from provision made for estimated loss in the amount of $17,500,000 anticipated in the completion of the 103 commercial airplanes then in production. In accordance with the Company's consistent accounting policy, this financial statement reflected the full estimated loss for the entire commercial production on order, which extends through most of 1952.

The reported net loss was after giving effect to provision in the amount of $950,000 to reduce inventories under a fixed-price military subcontract to estimated realizable value and to reversal of a provision for 1950 federal income taxes no longer required because of the loss carry-back provisions of present Federal Income tax laws. The net charge against surplus resulted in an earned surplus deficit of $8,724,347 as compared with earned surplus at the beginning of 1951 of $9,245,022. The capital surplus and capital stock accounts remain unchanged, and are stated at $12,363,315 and $1,134,229, respectively, resulting in net worth of $4,773,197.

Sales totaled $28,142,731 for the first nine months of 1951, compared with $33,857,832 for the first three quarters of 1950. Although volume deliveries had not yet commenced, inventories after valuation reserves had increased to above $30-million as compared with less than $15-million at September 30, 1950.

Aircraft Division
McCulloch Motors Corporation

McCulloch Motors Corporation, Los Angeles, Cal., announced the formation of an aircraft division in March of 1951, and concurrently

McCulloch's tandem-rotor helicopter

exhibited a completed, flying, production prototype of their MC-4 helicopter. The company also later revealed development programs on other helicopter models.

General manager of the aircraft division is Russell E. Gage. The company has been active in the industry for years prior to formation of the new division, and is well known as manufacturer of engines for target drone aircraft.

McCulloch Motors also operates two wholly-owned subsidiary companies active in the aircraft industry: Rhodes Lewis Co., manufacturers and engineers of blowers, launching mechanisms, and other integral aircraft components; and Pacific Optical Corporation, designers and mass-producers of aircraft scanning windows and other glass and plastic optical elements and equipment. Both are located in Los Angeles.

A contract has already been received from the Navy Bureau of Aeronautics to build MC-4's for evaluation tests, and major negotiations are underway with other branches. Rapid progress is being made toward obtaining a type certificate, and plans are to produce helicopters in quantity.

The MC-4 helicopter is a tandem-rotor, two-place design with some unusual features providing simplified piloting, low production costs, and low maintenance. The usual major expense of engine, drive, and rotors is reduced by the use of a standard aircraft engine, with horizontal output shaft, mounted horizontally; by the use of a simple, reliable 12-unit vee-belt drive from engine to drive shaft, eliminating a clutch completely; and by the development of new all-metal rotor blades, which reduces cost and at the same time improves aerodynamics.

McDonnell Aircraft Corporation

McDonnell Aircraft Corporation of St. Louis, Mo., continued expansion during 1951 to keep pace with its additional production and development contracts for airplanes and helicopters.

Late in 1951, more than 9,000 employees were on the McDonnell payroll and on June 30, 1951 the backlog figure was $278,636,137, and the total personnel was 8,226—the highest backlog and employee figures ever attained in the firm's 12-year history. This compares with the $62,695,281 backlog and the 5,560 personnel reported as of June 30, 1950.

New production contracts announced during 1951 were for the F3H-1 Demon, a single-jet, carrier-based fighter, and for the larger and improved model of the F2H Banshee series, the F2H-3.

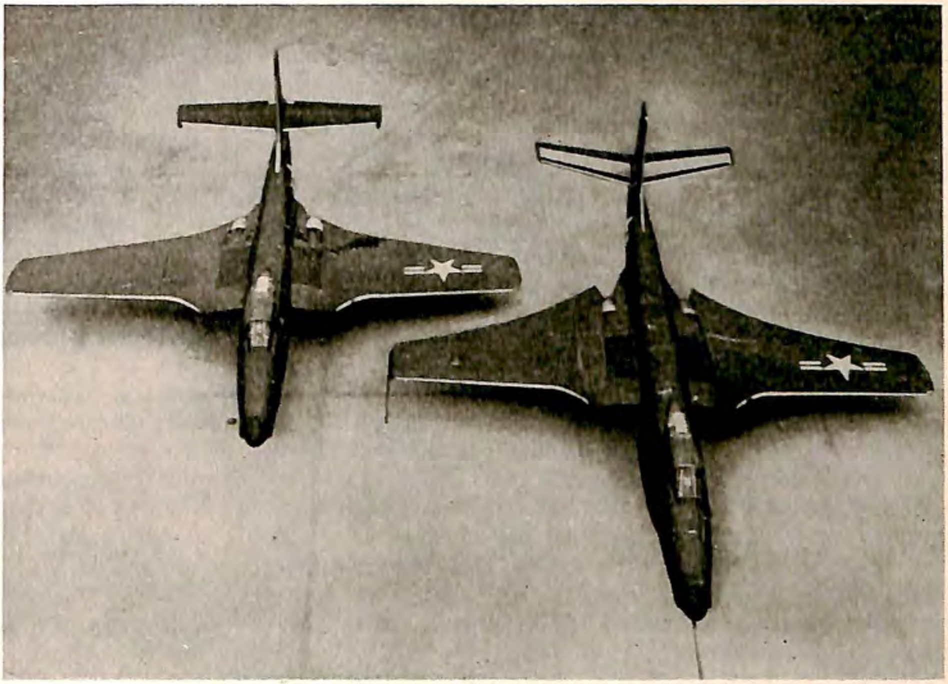
Three development contracts were awarded during the calendar year, all for rotary-wing aircraft. These called for development of a Navy assault-type helicopter, a "convertiplane" for the Air Force, and a cargo-unloader type helicopter for the Navy.

Plant expansion followed a Board of Directors approval to spend $17,513,486. Of this amount, $9,873,093 was to acquire the main portion of the company's plant at the Lambert-St. Louis Municipal Airport, which was purchased from the City of St. Louis on July 31, 1951. A total of $3,500,000 went for a new flight-test hangar, and $2,000,000 for wind tunnels. New propulsion test laboratories and helicopter test facilities are planned.

Ground was broken for the new flight-test hangar in November a few hundred feet west of the firm's present main high-bay area at the airport. It will be completed by October, 1952.

Production deliveries of the F2H-2 Banshee, which began in fiscal 1950, continued at an accelerated rate in fiscal 1951. Current production contracts for this model call for deliveries to continue until April, 1952. Deliveries of the F2H-2N night fighter version of the Banshee were completed in fiscal 1951 and the first deliveries of the F2H-2P photographic models were made during the year.

The Banshee photographic airplane has completed successful missions at altitudes ranging from fifty feet to ten miles. The pilot using cockpit controls, can rotate cameras to any position from horizon to horizon while in flight. A combination view finder provides the pilot with a clear, unobstructed view of the terrain below and ahead of the airplane. Performance figures are identical with the F2H-2 model.



McDonnell's prototype F2H-3 (right) and F2H-2

Even greater production started during the year on an improved Banshee the F2H-3. Greatly improved radar, permitting accomplishment of combat missions under all-weather conditions, more powerful armament and increased internal fuel capacity are some of the major improvements in the F2H-3. Deliveries are scheduled to begin in fiscal 1952.

The XF3H-1 Demon, third of a line of Navy fighters produced by McDonnell, made its initial flight at St. Louis on August 7, 1951. Like its predecessors the FH-1 Phantom and F2H Banshee, the Demon is a carrier-based jet fighter. Its performance, however, will exceed by far either of the previous fighters. Armament has been increased and a single Westinghouse engine of much greater power is used.

In March, McDonnell received a sizeable contract for the F3H-1 production airplane. Goodyear Aircraft Corporation of Akron, O., will also produce these planes for the Navy under a McDonnell license.

A Navy squadron equipped with F2H-2 Banshees made its debut in Korea on August 23. Operating from the carrier USS Essex as part of Task Force 77, the twin-jet fighters repeatedly were employed for armed reconnaissance, photo escort, heavy-bomber escort and combat air patrol.

Other operational Navy Banshee squadrons, some in the Mediterranean area, continued training during the year.

The company became active in helicopter research and development during the year. In June, McDonnell received an experimental contract from the Air Force for a convertiplane which has a small lifting rotor with pressure jets for vertical flight and a reciprocating engine driving a four-bladed propeller for high forward speed.

McDonnell also recevied an experimental contract from the Navy for an assault transport helicopter in June, 1951. Details of the craft have not yet been made available.

On September 24, Navy announced award of a contract to build a jet-powered "Cargo-unloader" type helicopter to McDonnell. McDonnell's winning design employed a single, three-bladed rotor driven by small jet blade-tips engines. The proposed helicopter will have powerful winch equipment and retractable cargo sling and is also designed to airlift cargo pods.

In propulsion, considerable progress was made during the year on short afterburners, and experimental contracts were received for McDonnell afterburners for new model Allison and General Electric turbo-jet engines.

In April, 1951, McDonnell established a separate missile engineering division headed by Ben Bromberg. At the same time, Kendall Perkins was advanced from manager of engineering to engineering vice president.

On June 30, McDonnell had 8,226 employees and a payroll of $27,-438,060 for the fiscal year. Sales were reported at $66,623,014. This includes about $17,750,000 attributable to work performed in prior years, but included in fiscal 1951 because of a change in the accounting method. Sales were formerly accrued only when airplanes were delivered; now they are accrued on a percentage of completion basis as work progresses.

On these sales of $66,623,014, earnings after taxes were $3,291,262, equal to 4.82 per common share. The ratio of earnings after taxes to sales has averaged 4.57 percent for the 12 years since the beginning of the company, and was 4.94 percent in fiscal 1951.

A total of $2,613,073 of McDonnell's 1951 earnings were retained to continue the growth of the company, and the book value per common share increased from $11.27 to $15.80. The capital stock and earned surplus increased from $7,623,881 to $10,769,854.

Minneapolis Honeywell Regulator Company

Expansion was the big word at Minneapolis-Honeywell Regulator Company's aeronautical division in 1951. A multimillion dollar program moved rapidly toward completion, highlighted by new production achievements and greatly intensified research and development work involving virtually every type of automatic control for aircraft and guided missiles.

Significantly, Honeywell's aeronautical expansion was launched well in advance of the present defense build-up. It was prompted, not by any thought of war, but by long-range, peacetime planning based on the big control manufacturer's desire for greater diversification, along with its confidence in aviation's future.

Backed by its many years in the automatic control business and its aircraft experience during World War II, when it turned out vast quantities of automatic pilots and turbo regulators, Honeywell foresaw the great emphasis that is today being placed on electronic controls by highspeed, high-altitude craft, and particularly by developments in the guided missile field.

Expansion plans were made accordingly. The impact of the Korean conflict has, of course, accelerated the program, but not to the extent that the company's long-range plans are distorted.

Since early 1950, Honeywell has invested approximately $7,000,000 in specialized aeronautical facilities, by means of a five-year accelerated amortization plan. Early in 1951, it completed a new 120,000-square foot engineering building, representing an investment of about $2,500,000. New production space also was added during the year, bringing the total to 400,000 square feet. By comparison, this is more production space than the company had for all its Minneapolis operations 10 years ago.

Honeywell's expenditures for aeronautical engineering last year neared the $5,000,000 mark—an increase of 500 percent over what was spent only three years ago. Employment also mushroomed during the year, from about 2,000 to about 4,000 persons, of whom 700 are engineering personnel.

Elaborate testing equipment in the new engineering building permits complete testing of designs and advanced products under every conceivable environmental and service condition. Model manufacturing facilities are available for all stages of design progress. Recently the company also acquired its own computing equipment.

Honeywell's growing engineering program already reaches into virtually all phases of automatic control for aircraft and missiles. It includes various flight control projects; work on high precision gyros and servos for flight control, fire control and guided missile applications, and projects dealing with power control and fuel measurement, including the problems involved in measurement of fuel for jets.

The company has entered the fighter autopilot field, not only as a second source of supply to the Air Force for the Lear F-5 autopilot, but also with development contracts. It has expanded its flight and power control programs to include continuing projects in missile guidance and jet engine controls.

Five new developments announced during the year indicate the diversity of Honeywell's control work. These are:

1. A new constant altitude controller that is ten times more sensitive than any previous unit. Designed originally to meet the AMC's requirements for a stabilized bombing platform, it also can be applied to jet fighters and helicopters.

2. A new type autopilot control, called "Easy Joe," which helps reduce pilot fatigue, eases the task of maneuvering heavy craft, and simplifies cockpit instrumentation. The device, which is still classified by the company as experimental, is an accessory to Honeywell's E-6 autopilot, of the type now in service on the B-36 and B-50.

3. A cabin temperature control system which solves the problem of

keeping a pilot comfortable in jet planes, despite the rapid and extreme temperature changes that result from high-speed, high-altitude flying.

4. A new capacitance-type fuel gauge system, which incorporates a reference unit within the fuel tank to overcome the problems created by jet fuels with wide variables in electrical characteristics. The reference unit provides a Fuel Deviation Index which automatically calibrates the electronic gauging system to the fuel in the tank.

In this same field, Honeywell, under an Air Force contract, is now working on a method to use the improved electronic fuel gauge for center of gravity control. With fuel tanks now being installed wherever space is available, the center of gravity travels as they are emptied. The new system would automatically transfer fuel from one tank to another as required to maintain the proper center of gravity.

5. A portable, eight-channel flight recorder which is expected to speed the testing of new aircraft and equipment.

Production-wise, Honeywell's Aeronautical Division in 1951 exceeded its output for any previous year.

North American Aviation, Inc.

Victories of North American-USAF F-86 Sabres over Russian-built MiG-15's in Korean skies headlined North American Aviation achievements during the year.

To prepare a broadening base of production, the company added new subcontractors and suppliers to a list of 4,600, including 3,680 small businesses; added personnel including engineers and electronics experts, still in short supply; created an additional function for research, development and manufacture of new aircraft products; expanded facilities already occupied, and acquired new facilities.

North American's AJ-1 Savage, Navy carrier attack plane, went into operation with a carrier-based atomic unit, the Navy revealed. The AJ-1, fully equipped to carry the A-bomb, has taken off carriers with simulated A-bombs.

Mid-year of 1951 saw North American produce its 45,000th airplane, an F-86E Sabre jet. Fifteen years before, the Air Force had accepted the firm's first plane, the BT-9, a basic trainer which within nine weeks emerged as a neat prototype trainer that won a production contract and enabled North American to move from Maryland to the Los Angeles area. The BT-9, powered by a radial reciprocating engine, stands in sharp contrast to the larger, sleek F-86 Sabre, with its 5,200 pound thrust GE jet engine which hurls the plane through the air at near-sonic speeds.

Of the 45,000 military planes that streamed through the North American doors in 15 years, there were 16,428 fighters (F-51 Mustangs, F-82 Twin Mustangs, FJ-1 Furies, and Sabres) 10,970 bombers (mostly B-25 Mitchells and 139 B-45 Tornado bombers); 17,278 trainers (mostly the celebrated and ageless T-6 Texans, with accent on T-28 trainers in recent

MUSTANG - SABRE

In the aircraft field, J. H. Kindelberger, chairman of the Board, North American Aviation, Inc. enlightened the House Appropriation Committee with some comparisons of manufacturing problems on World War II's top fighter plane, the P-51 Mustang, and today's jet-driven F-86 Sabre. The P-51 weighed 9,340 lb., the F-86 weighs 13,885 lb., about half again as much. The P-51 turned up 1,461 hp., the F-86's thrust horsepower is 10,400. At comparable production rates—both planes being turned out at the rate of 20 per day in runs of 4,000—the P-51 airframe alone cost $14,117 against a projected cost of $47,954 for the F-86 airframe today.

years) 238 observation planes (of the late '30s and early '40s) 3 transports, and 83 liaison planes.

As in the past, North American in 1951 concentrated on fighters, trainers, and bombers. Heading the fighters were new models in the Sabre series. Some modification work was also done on earlier F-86's. The faster F-86E Sabres, with all-flying tail, irreversible controls, and artificial feel, found acceptance by the Air Force as well as the Commonwealth of Australia, which was licensed to produce the airplanes. During the year, Canadair started turning out production models of the Sabre in Montreal, under a similar license agreement with the Canadian Government.

Shortage of power plants held to a minimum production and delivery of the shark-nosed F-86D all-weather interceptors, with radar and the capacity to blast enemy bombers into scrap by means of the Mighty Mouse, 2.75 inch solid propellant rocket.

T-28 trainers flowed steadily off final assembly lines. Continuation of the remanufacturing program to convert T-6 Texan trainers to T-6G's was an important part of the 1951 production pattern. Assembly line production of the B-45 Tornadoes, first four-jet bombers to take the air, was completed during the year, but special modifications were being made on some of the models.

With preparations underway to provide for possible expanded production, it was inevitable that additional personnel and more floor space would be needed. Total employment in the Los Angeles area plants reached 25,480 and the Columbus Division, 9,768. Extent of expansion is perhaps most evident in floor-space square footage for 1951 (7,596,883) as compared with that for 1950 (4,067)—a gain of 3,529,883.

These figures include 130,000 square feet of covered floor space for hangar and manufacturing facilities at Fresno, Cal., Air Terminal, acquired under short term lease. An option for 50,000 additional square feet is included in the lease. Hiring in excess of 300 employees was anticipated.

Late in 1950 North American reached an agreement on transfer terms of a Navy-owned plant in Columbus, O., where the Curtiss Airplane Division of Curtiss-Wright had manufactured airframes since 1941. Well into 1951, North American worked to fill contracts and subcontracts transferred from Curtiss-Wright, as well as spare parts requirements formerly handled at the Downey, Cal., plant.

Converting, clearing, rehabilitating and occupying the buildings formerly used by a prefabricated housing company afforded a total Columbus square footage of almost 2½ million. Here F-86F Sabres and advanced AJ Savages are to be turned out. Four months after the Texan trainer remanufacturing program was launched, the first T-6G was ready for test flight. The newly created Columbus Division also was in the tooling stage for the sweptwing FJ-2 Fury, Navy carrier fighter, an offshoot of the earlier North American FJ-1 Fury.

Charles J. "Chuck" Gallant, assistant to the president, was named vice president and general manager in charge of the Columbus Division. Simultaneously another new phase of operations, an Electro-Mechanical Division, was created at the Downey plant with L. L. "Larry" Waite, assistant to the president, elevated to Vice President in charge. Waite continued to direct the firm's aerophysics and atomic energy projects. The new Electro-Mechanical Division was the outgrowth of a need for specialized electronic equipment and complete guidance controls systems for aircraft and missiles produced by North American and other companies.

Although the corporation has done extensive research and development in electronics and electromechanics for some years, the Electro-Mechanical Division was formed to carry research, development, and design one step farther—into the manufacturing stage.

Anticipating the day when automatic control devices may replace pilots in conventional aircraft and completely direct and govern missiles, the Electro-Mechanical Division is developing automatic devices in three specific fields: (1) automatic control, (2) automatic navigation, and (3) automatic fire control. Mating a new digital differential analyzer (an electronic brain produced by Computer Research Corp.) with these North American automatic controls, the Electro-Mechanical Division has carried on automatic ground flying. A large transport plane has been equipped as a flying laboratory to carry out experiments. The electronic brain issues orders to control devices which guide the plane under actual flight conditions of altitude, temperature and vibration, and reactions are recorded.

The Electro-Mechanical Division is closely allied with the Aerophysics section, which is deep in research, study and design of guided missiles—with focus on aerodynamics, power plants and general design. To implement this program, the Aerophysics Laboratory, high in the Santa Susana mountains north of Los Angeles, is conducting static tests of rocket motors. Study of the rocket propellants under various conditions is an important part of the work under contracts for design and construction of guided missiles.

Significant progress into scientific areas even less well charted than aerophysics—those of atomic energy—has been made in 1951 by the Atomic Energy Research Department. Work was completed on a North American-designed low power nuclear reactor for test and research groups in universities and other scientific bodies. In planning and building such a furnace, various materials were tested and will continue to be tested to determine their ability to contain the tremendous heat of fissionable material while protecting researchers from radioactivity.

Meanwhile, in the field of aircraft, a number of 1951 achievements led to extending the range of two North American airplanes—the RB-45C Tornado and the F-86 Sabre.

The first successful air-to-air refueling of a U. S. jet bomber was carried out above Edwards Air Force Base with the Tornado, a 550-miles-an-hour, four-jet, reconnaissance bomber. Flying 15 feet to the rear and 20 feet below a KB-29P tanker, the RB-45C held steady for a fast fuel transfer, accomplished by means of a flying boom. This aerial method of fueling up has extended the Tornado's normal tactical range beyond 1,200 miles.

Also taking part in air-to-air refueling over the desert at Edwards Air Force Base, the F-86 Sabre not only took on fuel on straight and level flights but demonstrated that banks and turns can be made during such operations.

In the Bendix Trophy Race, exclusively for military airplanes, an F-86A Sabre jet flown by Col. Keith K. Compton, a senior pilot with 56 combat missions, sped from Edwards Air Force Base, Cal., to Detroit in 3 hours, 27 minutes, 56 seconds at an average speed of 553.761 miles an hour. Col. Compton, wearer of half a dozen of the nation's top military honors, shattered the old mark of 529.614 miles an hour set in 1949. An F-84 Thunderjet was second in the Bendix dash with a four-jet North American B-45 Tornado bomber flown by Lt. Col. George B. Thabault only a minute behind, and averaging 532.637 miles an hour, while also breaking the former Bendix record.

In a departure from former Thompson jet races, this year's race was billed as an attempt to break the 100-kilometer record set in 1948 by a British de Havilland jet. Col. Fred J. Ascani, director of experimental flight test engineering at Edwards Air Force Base, made a scorching dash around the six pylons with an F-86E Sabre on August 17, at an amazing speed of 635.411 miles per hour average to shatter the British high of 605.23 miles an hour. Another noteworthy happening was a race against time by four F-86 Sabres on the 237-mile course from Chicago to Detroit. Flying in formation, the Sabre quartet smashed the world record of 670 miles an hour by a single Sabre with an average speed of 672.189 miles per hour.

World War II F-51 Mustangs, as well, racked up new marks. Piloted by Captain Charles F. Blair, a flame red Mustang, Stormy Petrel, set a non-stop record for piston-engine airplanes from New York to London in 7 hours and 48 minutes. On May 29, Captain Blair, a commercial airline pilot with more than 18,000 hours in the air, flew his Mustang from Bardufoss, Norway, across the North Pole to Fairbanks, Alaska. In covering this distance of 3450 miles in 10 hours and 29 minutes, he was the first person ever to make a solo flight over the Pole in a single-engine airplane.

Famed for her many flying achievements, Jacqueline Cochran piloted an F-51 Mustang to a new record for prop-driven airplanes when she flew faster than 469 miles an hour. She was clocked over an open 16-kilometer (10 statute miles) course by National Aeronautic Association officials.

On the military scene, among the new outfits were the first F-86 Sabre group to make permanent base in England and the second U. S. Navy outfit flying the AJ-1 Savage attack plane to be qualified for carrier duty, Composite Squadron VC-6 of Heavy Attack Wing I, aboard the Midway.

An F-86 Sabre pilot, Capt. James Jabara, became the world's first jet ace by downing his fifth Russian-built MiG-15 and, shortly after, his sixth. Two other Sabre pilots reached jet ace status by shooting down five MiG-15's each—Capt. Richard S. Becker and Lt. Ralph (Hoot) Gibson. The trio became aces while pilots with the 4th Fighter Interceptor Group of the Fifth Air Force.

New airplanes for national defense were designed at North American in 1951. Two faster, more maneuverable, higher-climbing Sabres are planned for production in 1952. The F-86F, will be manufactured in the Columbus, O., and Los Angeles plants, and the F-86H, in Los Angeles.

With a production contract for an undisclosed number of FJ-2 Fury, sweptwing jet fighters, awarded North American by the Navy's Bureau of Aeronautics, a prototype was turned out at the Los Angeles plant. Full production was slated for the Columbus Division in 1952. The FJ-2 is an advanced development of the North American FJ-1 Fury, first American jet aircraft to make operational landings and take offs aboard a carrier at sea.

Several changes in key personnel took place in late 1950 and 1951. Alexander T. Burton, North American's eastern representative in Washington for nine years, returned to the Los Angeles plant as a vice president. To fill the vacancy left by Burton, E. W. Virgin, chief of engineering flight test, was named North American's eastern representative in Washington, with George Mellinger promoted to the position formerly held by Virgin.

After 20 years' service with the company, Harold Raynor, Director of Material, resigned during the year. Rulon Nagely, Purchasing Agent since 1946, was named the new Director of Material with Kenneth Petterson, in the Material Division for 13 years, promoted to Purchasing Agent.

North American reported an estimated net income of $4,450,000 for the period between Oct. 1, 1950 and June 30 with sales and other income amounting to $119,979,390 for the nine month period. Cost of sales and other expenses were $110,255,390, with provision of $5,274,000 for Federal income and excess profits taxes.

Unfilled orders on June 30, 1951 were $510,207,542. Two dividends totaling $1.25 per share were paid on 3,435,033 shares of capital stock during the fiscal year.

Northrop Aircraft, Incorporated

With the largest backlog in the company's history, Northrop Aircraft, Inc., continued an accelerated production schedule of building the U. S. Air Force's Scorpion F-89 all-weather interceptors during 1951, and simultaneously engaged in numerous other projects, including work in the field of guided missiles.

The company's major production facilities were devoted to production of Scorpions. Within a three month period in early 1951, the U. S. Air Force twice increased its orders for production of the twin-jet F-89's. An F-89 letter of intent received in January, 1951, boosted the company's backlog to approximately $180,000,000, and in March, a second production boost skyrocketed the company's backlog to an all-time high of approximately $300,000,000. The new order followed a statement by Secretary of the Air Force Thomas K. Finletter that the F-89 would be ordered into heavy production, and that the plane had been designated to assume a major role in the Air Force's all-weather defense fleet.

Around-the-clock, around-the-calendar tests of early production models of the Scorpions were conducted at two major Air Force bases. At the Air Force Flight Test Center, Edwards Air Force Base, Cal., F-89's were flown 24 hours a day, seven days a week under an accelerated service testing program, scheduled to cram six months flight time into as short a period as possible.

Simultaneously, tactical-suitability tests of F-89's were carried out at the Eglin Air Force Base Air Proving Ground in Florida.

In mid-1951, Scorpions went into operational service with the Western Air Defense Force, and were first assigned to fighter-interceptor squadrons at Hamilton Air Force Base, San Rafael, in the San Francisco Bay area.

Elaborate electronic equipment enables the Scorpion to operate in darkness and under adverse weather conditions. The rugged fighter-interceptor operaters at speeds in the 600-mile-per-hour range and at altitudes above 40,000 feet. It is heavily armed with six 20-mm cannon, as well as provisions for rockets.

Northrop Aircraft also continued its activity in the field of guided missiles during 1951, and its Special Weapons Division, established in 1950 following five years of research and development, continued projects in the field of pilotless aircraft. The company announced plans to establish a new test base for its guided missile activities at the U. S. Air Force's Long Range Proving Ground (LRPG), near Patrick Air Force Base, Cocoa, Fla., S. E. Weaver, chief of the Northrop Special Weapons Division, announced the appointment of Verl Smith, Jr., former Special Weapons personnel manager, as base administrator for the Florida operation. Northrop Aircraft personnel attached to guided missile activities at Holloman Air Force Base, Alamogordo, N. M., were slated to be progressively transferred to the Florida site.

In June, 1951, Northrop Aircraft and the U. S. Air Force jointly announced plans for a 30 percent expansion of the company's manufacturing facilities. The expansion program was keyed to increased production requirements and provides for construction and equipping of approximately 450,000 square feet of additional manufacturing area. Approximately $5,300,000 is being spent jointly for buildings, machine tools and equipment under the program. The Northrop portion of the expansion program is being effected under a National Production Authority certificate of necessity. With completion of the new building program, Northrop facilities will be housed in more than 2,000,000 square feet of covered area.

Almost simultaneously with its expansion plans, Northrop Aircraft revealed plans to establish a branch factory on a 34-acre site at Anaheim, Cal., for production of optical range finders for the U. S. Ordnance Corps for use in tanks.. Ground for the 250,000 square foot building was broken in August. R. R. Nolan, formerly director of service at Northrop, was named general manager of the Anaheim Division. The building was slated for occupany November 1, 1951, with full scale operation set for 1952.

During 1951, Northrop's Associated Products Laboratory continued production of the Northrop-developed desk-size computer, Maddida. The Maddida computer, a digital differential analyzer is being used in industry and by technical institutes throughout the United States. The name Maddida is a coined word developed from "Magnetic Drum Digital Differential Analyzer."

A division of Northrop Aircraft, Inc., the Northrop Aeronautical Institute, continues to operate at about a 1000-student capacity, offering courses in Aeronautical Engineering and Aircraft and Engine Mechanics. Also during 1951, the U.S. Air Force's Air Training Command announced selection of the Northrop Institute as a training center for Air Force ground personnel. The institute is training several hundred Air Force recruits in a 16-week course qualifying them as airframe repairmen. The long-range Air Force program at the Institute was begun in March 1951, and is being held in addition to regular civilian career courses.

Early in 1951, Northrop Aircraft passed its World War II employment peak of 10,000 personnel, and toward the end of the year, was rapidly approaching a figure of 15,000 on its payroll. Employment had increased from 8500 at the beginning of 1951.

The company earned a net profit after taxes of $3,276,052.94 during the fiscal year endede July 31, 1951. Profit before taxes amounted to $3,758,052.94 and a total of $482,000 was deducted for estimated federal income tax. No federal excess profits tax is payable because a portion of losses suffered in prior fiscal years has been applied against this year' taxable income, it was pointed out.

The earnings are equivalent to $7.28 a share on the 450,039 shares of common stock outstanding during the fiscal year. In August, 1951, however, the company issued and sold an additional 125,000 shares, and if applied to the present total stock outstanding the earnings amount to $5.70 per share.

Piasecki Helicopter Corporation

This year marked the beginning of a production era for the Piasecki tandem rotor helicopter.

Navy's all-purpose HUP's began to roll off the line by mid-summer and accelerated deliveries resulted in Navy's forming HUP squadrons.

TRANSPORT HELICOPTERS

The Air Coordinating Committee, made up of representatives of all government agencies interested in aviation, has evolved an official Federal Policy regarding the development of commercial transport helicopters. The policy includes recommendations that: use of helicopter mail delivery in the Los Angeles and Chicago areas be continued and other metropolitan area services be authorized; a study be made of the probable impact of multi-engine transport helicopters on the travel market in connection with future route pattern planning; draw up specifications for one or more transport helicopter types and request funds for their testing in simulated airline operation, prepare studies of heliport requirements, permit purchases of transport helicopters by commercial airlines under existing defense agency regulations, and increase the scientific study of helicopter problems such as stability, fatigue, anti-icing, instrument flight and various rotor configurations. Participating in the policy are the Post Office Department, Civil Aeronautics Board, Civil Aeronautics Administration, Department of Defense and the National Advisory Committee for Aeronautics.

Close behind the production of HUP's was the roll-out and start of production on the Air Forces' H-21—the so-called Arctic Rescue Helicopter.

During 1951 Piasecki received additional production orders from the Navy, the Air Force and the Army, which is to get both HUP and H-21 types (the HUP is to be known as the H-25 in the Army).

Concurrent with a ten-fold increase in orders during 1951, which boosted the Piasecki backlog to well over $100,000,000, the company started a building-expansion program which will provide over 500,000 sq. ft. of space by early 1952. Employment jumped from around 700 on the payroll just before Korea to 3,000 in mid-summer, with 4,000 employees as the goal for 1951-year-end.

For 1951, Piasecki ran a high sub-contracting rate over 75 percent of the dollar volume being subcontracted to over 1,600 firms throughout the country of which about 90 percent were small businesses.

In 1951, Piasecki began the actual fabrication of the huge XH-16. The first of two prototypes is expected to fly in early 1952.

Pioneering in the development of automatic flight for the helicopter, Piasecki in conjuntion with Sperry, successfully adapted the A-12 gyropilot with modifications to give the helicopter complete hands-off flying. An auto-pilot equipped XHJP (prototype of the HUP), flew from the company's heliport in Morton, Pa., to the Naval Air Station, Anacostia, D. C., completely on the autopilot in record time and without incident. Production HUP's will be autopilot, equipped as the A-12's become available, as will the H-21's.

Piper Aircraft Corporation

Piper Aircraft Corporation of Lock Haven, Pa., experienced a greatly enlarged production as the year of 1951 progressed, with major activity in military plane production, and manufacture of components for military airframe contractors and other suppliers. Civilian aircraft production was maintained at a rate somewhat higher than in 1950 and 38 percent higher dollar-wise.

Employment at the plant, which embraces more than 330,000 square feet of production space, rose from 595 people at the beginning of 1951 to 867 employees in all categories by November 1.

Volume of production and activity during the year was devoted approximately 70 percent to production of civilian aircraft of the Super Cub and Pacer series and service parts; 13 percent to production of military versions of the Super Cub and spares; and 17 percent to production of parts and sub-assemblies for military and naval aircraft.

Indications were that over 1,100 civilian aircraft would be delivered in 1951. A total of 552 Pacers and Tri-Pacers and 461 Super Cubs were delivered by Nov. 1.

In the sub-contracting field, Piper's greatest single customer has been Grumman Aircraft Engineering Corporation. For this leading producer of naval aircraft, Piper has been building canopy assemblies for the F9F and the AF-1 anti-submarine plane, seat assemblies in large quantity for the SA-16 Air Rescue amphibian and a number of other smaller parts.

For the Bell H-13D helicopter, Piper has been building all the welded structure for the fuselage, the company's extensive welding facilities being ideally suited for this type of work.

Baffles and other sub-assemblies for the mobile Lycoming jet engine starter are also being produced by Piper in large quantity for the Lycoming-Spencer Division of the Avco Manufacturing Corporation.

Piper's production of civilian aircraft, now going virtually 100 percent to defense-active businesses or for increasing farm production, has not been too greatly effected by materials shortages. Production has been hampered more by temporary scarcities of specific items. To keep it rolling at virtually uninterrupted pace, Piper has used extensively its own aircraft to expedite parts deliveries. An average of 15 trips have been made per week, to secure urgently needed parts and materials. A round-trip the same day from Lock Haven to points as far as Illinois and back is not uncommon.

The company has also effectively used its own fleet of eight aircraft, maintained for demonstration, administrative and production purposes, to deliver finished products to its customers. Virtually all the wind shields for the Grumman F9F first became airborne in the cargo hold of a Pacer or Tri-Pacer on the 200-mile hop from Lock Haven to Long Island. Such shipments eliminate costly crating or packing, and inventory in transit. The same planes which take a load of parts to Grumman often return with parts or supplies from New York, Philadelphia or other eastern points.

During the year, Piper's agricultural development division cooperated with a number of state and government agencies in developing new uses for aerial application. One of the most significant developments is aerial spraying of rights of way to kill growth of trees and brush under power lines. Piper Super Cubs also have been used to scatter salt over icy highways with great success.

A severe plague of locusts throughout the Middle East, the worst in nearly a century, has focused attention on the Piper Super Cub spray plane. In April, 1951, six Piper sprayers were rushed to Iran to combat the grasshoppers. A 90 percent kill was reported in areas treated. Another fleet of the sprayers is operating in Pakistan. As the plague in other Middle East nations grew more severe, Piper's Sales Manager, J. W. Miller, and Export Representative Frank S. Jonas made a tour to Europe and North Africa late in 1951.

Late in 1951, Piper announced a special agricultural version of the Super Cub for agricultural purposes, the PA-18-A. It has a 110 gallon capacity bin and many special features for agricultural work such as wire cutters on the landing gear, removable belly of the fuselage for cleaning, reinforced loading areas, improved dust and spray dispersal equipment and other features.

A military version of the Super Cub went into volume production in the latter half of 1951. Several hundred 125 horsepower L-21's have been delivered to the United States Army while additional versions with the Continental 90 hp engine are delivered to a number of Atlantic Pact nations under the Mutual Defense program.

Production plans for 1952 call for continued manufacture of the Pacer, Tri-Pacer, the Super Cub and the new PA-18-A. The Pacer series incorporates a number of detail improvements and refinements for added comfort, performance and serviceability.

Development work is being pushed on a new larger Stinson model which was scheduled to be test flown in late December, 1951, and is expected to be in production the latter part of 1952.

Pratt & Whitney Aircraft
Division of United Aircraft Corporation

Pratt & Whitney Aircraft made 1951 aviation history by being awarded an Air Force contract to work on an atomic aircraft engine.

During 1951 Pratt & Whitney Aircraft's own designs of axial-flow turbojet and turboprop engines of extremely high power reached the stage where they were ready for quantity production. The axial-flow J-57 turbojet reached the flight-test stage early in the year and initial deliveries of this engine were made to both Boeing and Convair before the year's end. Thomas Finletter, Secretary of the Air Force, officially announced that the J-57 had been picked to power both of the Air Force's new long range jet bombers—the Boeing B-52 and the Convair B-60.

The axial-flow T-34 turboprop of Pratt & Whitney Aircraft's own design was also picked by the Air Force to power the latest version of the giant Douglas Globemaster transport series—the YC-124B. Replacement of the four P&WA 3,500-hp Wasp Major piston engines now used in the C-124A by four P&WA 5,500-hp T-34 turboprops is credited by

Douglas engineers with making possible an increase in payload of 25,000 pounds for the YC-124B with faster cruising speeds and shorter take-off and landing requirements. The T-34 will also be used in prototype aircraft of the Navy.

Meanwhile the centrifugal-flow J-48 Turbo-Wasp was picked to power two new Air Force and Navy high-speed aircraft—the Lockheed F-94D, an Air Force low-level attack plane, and the Grumman F9F-6, sweptwing Navy carrier-based fighter. Production of the J-48 continued in P&WA's East Hartford plant for the Grumman F9F-5, the latest in the Navy's Panther series and the Lockheed F-94C, an Air Force all-weather interceptor. The Lockheed F-94C uses the J-48 with an afterburner that greatly increases its basic power rating of 6,250 pounds static thrust.

An outstanding achievement in Pratt & Whitney Aircraft's year was the authorization by the U. S. Navy to allow the J-42 Turbo-Wasp to operate for 1,000 hours between major overhauls. The J-42 reached this peak in only two years of active service with Navy and Marine fighter squadrons, powering the Grumman F9F-2 Panther. During this same period, when the overhaul interval jumped from 150 hours to 1,000 hours, the J-42 operated for more than 150,000 hours in the air without a single turbine blade failure, and made its combat debut in Korea.

Continued development of the R-4360 Wasp Major piston engine of the military C series engines also will be made available to the commercial airlines using the Wasp Major on Boeing Stratocruisers.

The R-2800 Double Wasp piston engine continued its production span now stretching over more than a decade with many new applications in military and commercial aircraft and helicopters. Two new Air Force planes ordered into production will use a pair of Double Wasps. They are the Chase C-123 assault transport and the Beech T-36, a multi-engine trainer. New Navy applications came in the Bell HSL anti-warfare helicopter and the Vought AU-1, a new low level attack version of the Corsair. The new airliners—the Martin 404 and the Convair 340—also took to the air for the first time during 1951. Both were powered by a pair of the latest model R-2800's. By the fall of 1951 the backlog of P&WA-powered commercial airliners on order reached a post-war peak of 289. Of these, 85 were Douglas DC-6A's and B's powered by four R-2800 CB-16 engines; 103 were Convair-Liner 340's and 101 were Martin 404's.

Employment stood at 14,000 when the Korean war began, passed 20,000 workers at the beginning of 1951, and was climbing toward 30,000 as the year ended. A training school was established in Hartford to teach new employees the special machine tool skills required in the engine building plants.

The Navy industrial reserve plant at Southington, Conn., was transformed during the first six months of 1951 from an empty shell into an operating plant stocked with more than 1,000 machine tools and 3,000 workers turing out a wide variety of piston engine parts for final assembly operations in the main East Hartford plant. Both the East Hartford and Southington plants continued on a 48-hour, three-shift work week.

Construction was begun on a new plant at North Haven, Conn., to provide an additional 500,000 square feet of manufacturing area and work was begun to enlarge the present Hamilton Standard facilities in East Hartford to a total of 500,000 square feet of manufacturing area by the time P&WA takes over these facilities early next year. When this expansion program is completely early in 1952, Pratt & Whitney Aircraft will have a total of 3,500,000 square feet of manufacturing area in its Connecticut plants.

Another important factor in P&WA expansion was its network of some 5,200 subcontractors and suppliers. By the middle of 1951 these subcontractors and suppliers had doubled their output to P&WA from their pre-Korean levels.

Approximately 90 percent of the P&WA subcontractors and suppliers were classified as small business. During the year the subcontractor network continued to expand, particularly to fill new needs arising out of the rapidly growing production program for P&WA axial-flow jet engines.

To further expand the production capacity for P&WA engines beyond that of its own organization and its subcontractor network the technique of licensing was again introduced as part of the industrial mobilization program of the Air Force and Navy. These licenses were granted to other organizations to produce engines for the military service without fee or royalty to P&WA. The Ford Motor Company, licensed to build the R-4360 Wasp Major piston engine in the fall of 1951, was expected to begin production in 1952. The Dodge division of the Chrysler Corporation was licensed to build the J-48 Turbo-Wasp in a Navy-financed plant near Detroit and by the fall of 1952 construction of this facility had begun. Nash had also begun work on new facilities at Kenosha, Wis., to build the R-2800 Double Wasp piston engine.

In addition to powering a wide variety of combat planes in action over Korea, Pratt & Whitney Aircraft engines were used by virtually all of the military airlift from the front-line helicopter shuttles to the 7,000 mile trans-Pacific route from California to Korea. All planes of the 315th Combat Cargo Division in Korea from the old workhorse C-47's (R-1830), C-46's (R-2800), and C-54's (R-2000) to the newer Fairchild Packets (R-4360) and Douglas Globemasters (R-4360), were powered by Pratt & Whitney Aircraft piston engines.

The entire trans-Pacific airlift, with the exception of a single squadron of RCAF North Stars using Rolls-Royce Merlins, was also P&WA-powered.

Republic Aviation Corporation

In its most intensive 12-month period since World War II, Republic Aviation Corporation in 1951 met the demands imposed by the international emergency by more than doubling employment, sharply expanding facilities, creating a successful training program, unveiling two new warplane types and mushrooming production of the F-84E Thunderjet.

Other outstanding developments included initiation of shipments of the Thunderjet to America's European allies under the Mutual Defense Assistance Program, growth of backlog to more than $550,000,000, successful completion of several significant technical advances—such as optical tooling and fuel system testing—and expedited production preparation on the swept-wing F-84F fighter.

As the company pressed work on the 'F,' which exceeds the 630 mph. 'E' in every category, it also developed, in conjunction with General Motors, a USAF-sponsored program under which the auto concern will produce the new, swept-wing fighter.

The F-84E, introduced to combat by the 27th Fighter-Escort Wing, which was succeeded in the last half of 1951 by the 49th, 116th and 136th Fighter Wings, by October 1 rolled up nearly 40,000 hours of combat flying.

Compiling this record, with a 70 percent utilization factor, the Thunderjet repeatedly defeated the vaunted Russian-built MiG jet fighter. At the same time it carried out its other functions of ground force support and destruction of enemy troops, installations and supply lines.

The Thunderjet showed special ability to sustain battle damage and bring its pilot back safely to base, and ease of maintenance.

From employment of 4,900 pre-Korea, personnel increased to more than 15,000 by September. Unique out-of-plant training programs, established to prevent interference with production, produced hundreds of critically-needed engineers who were converted from non-aeronautical pursuits to aviation work by a transition training program, and many more hundreds of shop workers.

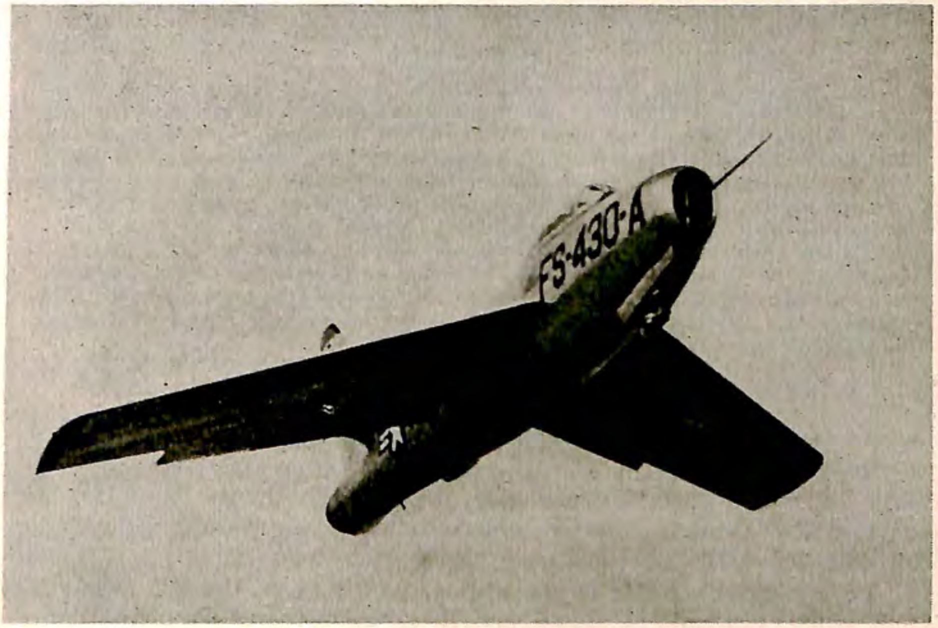
To meet the expansion program, more than $1,500,000 was committed for new facilities, in the plant and in neighboring areas.

Two highly significant events during the year were introduction of the F-84G and the RF-84F. The 'G,' production fighter fully equipped for single-point in-flight refueling, was delivered to Air Force wings.

The RF-84F, announced by the Air Force, is a high-speed, long range, high or low altitude, day or night, tactical reconnaissance plane, equipped with latest type cameras, whose primary mission will be photography of enemy territory and installations. It is a modification of the F-84F and has been ordered in undisclosed numbers by the Air Force.

Principal changes from the F-84F include side air intake ducts at the wing roots, instead of in the nose, to permit camera installations in the nose; removal of machine gun mounts from the nose and installation of two guns in the leading edge of each wing, and inclusion of electronic devices to aid the jet pilot in navigation.

Single-point, in-flight refueling as features of the F-84G, heralds the beginning of an era of increased flexibility and mobility for AF fighter forces. It means that complete fighter wings can be moved quickly from one part of the globe to another, that they can strike deeper into the territory of an aggressor or, with heavy loads of armament, they can hover



Sapphire-powered Republic F-84F

on call for longer periods over battle lines, ready to blast enemy targets for friendly ground troops.

The 'G' refueling system is designed for use with the Boeing developed flying boom method of in-flight refueling. A complete refueling can be accomplished, while in flight, with fuel passing to the fighter at the rate of several hundred gallons a minute, within 2½ minutes.

Into the 'G' also went a more powerful engine, the Allison J-35-29, to provide 5,600 pounds thrust, or 10 percent more than is available in previous engines of the same model. In addition, more thrust is obtained through Republic-engineered refinement of the ejector.

The 'G' now in production for many months, replaced 'E' production entirely toward the end of the year, and was going to USAF wings for use throughout the world, and to the MDAP countries.

Number of Thunderjets ordered for MDAP was undisclosed, but four MDAP nations had received them by October, with aircraft carriers in use as transports, carrying nearly forty a trip.

By the close of the third quarter, Thunderjets were in use by approximately 15 USAF fighter wings in Korea, the U. S., England and Germany, in addition to the MDAP air forces and several Air National Guard units in the U. S.

During 1951, a larger, more powerful engine was installed in the F-84F, and successfully flown. It was decided that all production models

REFUELING

The Air Force is going ahead very rapidly with refueling. Refueling is no longer an experiment. It is now a standard operating operation in the Air Force. The difficulty with refueling is that with any given aircraft you only get one-third of the usage from that aircraft that you would normally if it was operating from a base much closer. There are several reasons for this. One is that the longer flight time requires more time for overhaul when it comes back. The second factor is that in an operation of that type where your bases are further away, your losses of crippled aircraft will be much higher. On the other hand, we are leaving no stone unturned within the money that we have to insure that the United States Air Force is as free as possible from dependence upon base locations. Speaking generally I would say that the closer the bases are to the vital objectives that we would be forced to operate against in case of war the greater would be the efficiency of the operating forces.

—GENERAL HOYT S. VANDENBERG,
Chief of Staff, USAF

of the 'F' would contain this engine, the 7,200-lb.-thrust Sapphire, built from a British design by the Wright Aeronautical Corporation, the American licensee.

To accommodate the larger engine, which gives the 'F' more than 2,000 pounds of additional thrust over the original power plant installation, the fuselage was deepened, with seven inches added to the height of the nose air intake duct.

A striking demonstration of the flight endurance of the F-84E was given during the National Air Races when three 'Es,' participating in the Bendix Trophy race from Muroc, Cal., to Detroit, flew the 1,919-mile course non-stop, while the only other fighter type in the race had to land twice to refuel.

Thunderjets played other significant roles at the Air Races, with 22 planes in all participating—the largest number of any type to take part. Nearly 200,000 spectators saw a 'G' refueled in mid-air, in the first public demonstration of the system.

The demands of the new world emergency taxed the ingenuity of engineers, as well as administrative and production departments.

Republic engineers developed a system of constructing jigs and fixtures by an optics-castings method by which increased accuracy is achieved and substantial time and money savings are affected.

The system makes possible rapid reproduction of jigs or fixtures which may be lost to war damage. Republic, after proving the worth of the system, proceeded to prove its emergency application by building, knocking down and flying fixtures to "bombed-out" West Coast aircraft plants in a simulated emergency movement.

Another technical accomplishment was the completion of a $100,000 fuel system testing laboratory in which problems caused by increasing complexity of high-speed jet fighter fuel systems are being studied.

The main feature of the laboratory is a special flying jig composed of a fighter fuel system, complete with provisions for external fuel tanks. It is installed on a carriage which can be positioned in several attitudes of flight by means of hydraulic controls. It has provisions for measuring fuel flow, temperature and pressure at as many as 25 points. Fuel can be pumped into the system at very high rates of flow from a 10,000-gallon reservoir.

Tests have been run to study the effect of roll or pitch of the fighter during fuel transfer operations with the tanker under various combinations of altitude, speed and temperatures.

In the first quarter, Republic sales were $19,437,760, with net income of $404,754. By the end of the second quarter, total sales for the year were up to $52,281,021, with net income for the six-month period at $1,349,532. For the corresponding first six months of 1950, sales were $29,566,356, with net profit at $698,803.

The $52-million sales figure for the first six months of 1951 approached total sales for all of the preceding year of 1950, which were $57,713,432.

By October of 1951, the weekly payroll was approximately $1,300,000. The company, which reached a subcontracting peak of 67 percent in World War II, aims at that figure again. By the end of 1951 it expected to reach 37 percent.

Ryan Aeronautical Company

The year 1951 brought to Ryan a big push to accelerate production through acquisition of some of the largest machine tools in the country, and to improve quality of output through advanced research.

It was a year, also, in which plant facilities were considerably enlarged by construction of a 75,000 square foot building to accommodate the vastly increased jet engine components projects, and a 14,000 square foot hangar warehouse for Ryan Navion spare parts production and storage. Today, almost 750,000 square feet of floor space is humming with activity.

Ryan converted completely to military work in 1951, suspending its Navion program for the duration of the emergency in order to devote all its space and energies to numerous Air Force and Navy contracts in both its airplane and metal products divisions.

From a backlog of $8,000,000 when the Korean war broke out, the amount of unfilled orders at Ryan by the end of 1951 had leaped to approximately $45,000,000.

The payroll has more than doubled and the ceiling has not been reached. In July, 1950, there were 1,600 employees. At the end of this year, it had gone up to 3,500. Hundreds more are needed.

It was a year in which a long period of pioneering in such advanced developments as ceramic coating of hot spots in exhaust systems began to pay off, and when quantity production was launched on such new projects as the refueling pods for the Boeing KC-97 flying tanker, and on rocket motors for Firestone Tire & Rubber Co. At the same time, Ryan continued to turn out large numbers of aft fuselage sections for the Boeing C-97 Stratofreighter and of huge external fuel tanks.

In the background of these developments was delivery to Ryan in a steady stream of a massive array of new machinery, with much more to come in 1952. More than $2,500,000 worth of new equipment has been installed or is on order. From small drills, these devices range up to mammoth tools that can crush, pull, weld, cut and machine aircraft structures with titanic force. Many of them have been specifically tailored to meet Ryan's requirements.

Among these is the world's largest expanding mandrel, which can exert a pull of 600 tons to stretch stainless steel cones to precise size for jet engines. The heaviest piece of equipment ever installed at Ryan, a 223,000-pound mechanical press, with a 600-ton pressing capacity, was delivered. It required the support of eight steel pilings driven 65 feet deep. Three other mechanical presses, two of 400-ton capacity, and one of 100-ton capacity, were added to the battery of hydraulic presses already in action.

The largest boring mill with raised bed ever delivered to a Pacific Coast plant, a 32-ton behemoth 13 feet high, is now in service, and has in a short time stepped up production of large aluminum fuel tank rings by 25 percent.

Ryan took long strides in maintaining its position as one of the nation's leaders in resistance welding fabrication by adding some of the largest spot and seam welding machines ever designed. Fifty such machines are in operation, and 28 more are on order.

In the comparatively new field of ceramic coating, Ryan got a large production order for protection of exhaust system parts through this process. Ryan is also providing ceramic coated exhaust system parts for the entire fleet of Boeing 377 Stratocruisers in the service of Pan American World Airways, Northwest Airlines, United Air Lines, British Overseas Airways Corp. and the Military Air Transport Service. In addition, production orders have been received from Convair for replacements on the fleets of 240 Convair Liners operated by American, Pan American, Western, Continental, Northeast and Midcontinent Airlines. The new 340 Convair Liners will have ceramic coated exhaust systems. And on the ground, Continental Motors Corporation's 825 hp engine for the mighty General Patton tank will have ceramic coated manifold sections.

Experimental ceramic coating work also is being performed for Pratt & Whitney on its latest series R-4360 engines used on the Boeing C-97 and B-50 and on the Convair B-36, and for Douglas Aircraft Company and United Air Lines on DC-6 transports.

Another aviation frontier was crossed by Ryan in 1951—that of rockets. After experimental production of a limited number of rocket motors for Douglas Aircraft Company, Ryan was awarded a contract for quantity output of such engines for the Firestone Tire and Rubber Company, of Los Angeles.

In the jet engine field, Ryan is producing at top speed for the nation's major engine manufacturers — General Electric, Pratt & Whitney, and Westinghouse. Flowing from the factory are thousands of exhaust cones, combustion chambers, aft frames, afterburners, case assemblies, exhaust nozzles and other components.

For the Boeing B-47 and Convair B-36 bombers, tail pipes are in production.

Development work of an advanced phase is being conducted for all jet engine manufacturers and users.

Major airframe and engine companies using Ryan-designed exhaust systems and accessories for piston engines include:

Douglas (C-124, DC-6, C-54, C-47 and others); Boeing (C-97, 377, B-50, B-29 and others); Wright, 3350 engine nozzles and ball and socket joints; Pratt & Whitney and Ford, R-4360 Wasp Major engine exhausts; Continental, 1790 tank engine exhausts; Convair, 240 and 340 Convair-Liners, and T-29; North American, B-25, AT-6 and others; Fairchild, C-82 and C-119; Goodyear, blimps; and Piasecki, helicopters.

Test work continued during the year at Holloman Air Force Base, Alamogordo, N. M., of the Ryan XQ-2, a pilotless, jet-propelled target plane about half the size of a fighter plane.

A significant advance design study is being conducted for the Navy in a new concept of jet propulsion, and for both the Air Force and the Navy, intensive electronics research is under way. Radar devices for use in extremely advanced-type aircraft are being built experimentally.

The Ryan L-17B military liaison planes continued to make news, especially in Korea, where they are used for transporting high-ranking officers, for artillery spotting and leading fighters to their targets, and for general reconnaissance and courier duties. One L-17B even took off from an aircraft carrier to rendezvous with a General ashore.

Five L-17B's comprised part of the Marshall Plan aid to Greece, and are now being employed by the Royal Hellenic Air Force in various missions. With the U.S. Army Field Forces and the National Guard principal users of these multi-purpose utility planes, the U.S. Air Force has procured three Super Navions from private owners with which to conduct cold weather experiments in Canada.

Sikorsky Aircraft Division
United Aircraft Corporation

On September 20th, 1951, a fleet of ten-place HRS Sikorsky helicopters made air combat history by flying an entire company of battle-ready United States Marines to an important objective atop a 3,000-foot mountain peak in Korea. In this single action—first of its kind in the world—helicopters abruptly and dramatically introduced revolutionary tactics in warfare over difficult terrain.

The entire operation, including landing 228 fully-equipped Marines, ammunition and almost nine tons of food, and laying telephone wires back to command headquarters, took only four hours. By foot travel during such a period the enemy might have jeopardized the success of the whole operation.

This achievement was the payoff for almost four years of training and research by Marine Corps planners and Sikorsky engineers and technicians. It established the helicopter as a tactical weapon of first rank.

Further definite indication of the helicopter's future in military use was the operation on October 10th in which a battalion of battle-equipped Marines—nearly 1,000 men—was moved up to the top of a strategic ridge within sight of Communist emplacements. This operation, leap-frogging over 18 miles of sawtooth terrain, was completed in six hours and fifteen minutes, approximately one-half hour ahead of schedule.

On October 27th, thirty-three Marine Corps volunteers were carried in HRS helicopters into an actual combat attack against 150 Red guerrillas. This objective was seven miles from the takeoff point and was the world's first true helicopter combat attack behind enemy lines.

Thus, in a few short weeks what had been military theory became military fact.

Meanwhile the Navy and the Air Rescue Service of MATS, as well as the Marine Corps, had been using their four-place Sikorskys to effect seemingly impossible rescues, evacuations, and some missions still classified. The United Nations negotiators at the Kaesong cease-fire talks were carried to the daily discussions by Air Rescue Service in Sikorksy H-5's and the Sikorsky H-19. Air Rescue Service using Sikorksky equipment exclusively, had chalked up 3,000 rescues and evacuations by press time. The total of all rescues and evacuations in Korea by Bridgeport-built helicopters had reached uncheckable proportions when the year was only three-quarters gone.

Delivery of HO4S models to the United States Coast Guard in mid-November added that service to the Navy, Marine Corps, Field Forces and Air Force as buyers of the Sikorsky ten-place type.

Another Sikorsky model, the S-52-2, was certificated by CAA in March. Under the designation H-18 for the Army Field Forces and HO5S-1 for the Marine Corps, this aircraft was delivered in limited quantities before the year end.

Announcement was made March 14th by the Navy Department of the award of an experimental transport helicopter contract to Sikorsky. The announcement stated that the design for the Marine Corps included a single five-bladed main rotor and the anti-torque rotor typical of previous Sikorsky designs.

The foregoing was followed in April by an Air Force announcement that the company had been co-winner of its convertiplane design competition, Sikorsky having been designated in the retractible rotor category.

In Los Angeles, October 1st marked the fourth anniversary of the world-pioneering helimail operation. During this four-year period Los Angeles Airways, Incorporated, using four-place Sikorsky models exclusively, had completed 119,946 flights, carried 14,194,250 pounds of mail, flown 19,991 hours and 1,235,497 miles.

Ground was broken March 11th to start a plant expansion program destined to add approximately 150,000 square feet of manufacturing and shipping space to the main plant. It was expected that this project would be 70 percent complete by the end of December.

Westland Aircraft, England, licensed to build the S-51 and S-55, increased production of the four-place machine during the year and flew its first Bridgeport-built S-55 in mid-summer. Two Westland Sikorsky S-51's started a new passenger service from Birmingham to London on June 1st.

Elsewhere around the globe the S-51 was performing specialized helicopter tasks on every continent.

Sikorsky Winged S rescue pins and certificates had been awarded to 172 pilots and crewmen involved in helicopter lifesaving exploits. This total includes military as well as commercial airmen.

In summary, 1951 saw the ten-place S-55 series go into action as the first combat troop transport helicopter. The year added almost countless names to the roster of rescuers and rescuees in the Korean theatre. It saw expanding use of the Sikorsky S-51 series in all parts of the world. The basic Sikorsky single main rotor configuration was awarded Marine assault and Air Force convertiplane contracts. Foreign flight hours were greatly expanded. The division faced the approaching year with expanded production facilities speeding to completion, with S-52 and S-55 production lines in operation for defense production on tested designs, and with forward looking designs and progress.

Solar Aircraft Company

Solar reached an all-time high in 1951 in its production of heat-resisting components for aircraft engines, and expanded its facilities for fabricating the hot parts in which it specializes. New developments in the associated fields of ceramic coatings and small gas-turbines were announced, and plans for mass producing the new products are underway.

Manufacturing exhaust manifold systems for piston engines, in which Solar first became proficient almost a quarter of a century ago, reached new heights in the fabrication of Solar's manifold for the Pratt & Whitney R-4360 engine used on the B-36F. In addition to this manifold assembly, in which the colector ring measures better than 60 inches in diameter, Solar manufactured plane-mounted sections for installation by Convair. Other exhaust manifolds and intake pipes were produced for the U. S. Navy, the U. S. Air Force, and for a number of the principal plane manufacturers including Lockheed, Convair, North American, Boeing, Chance Vought, Northrop, Grumman and Douglas.

Based originally on the skills developed in the manufacture of exhaust manifolds, Solar has turned much of its increased capacity toward producing hot parts for jet engines.

In the turbojet field, the component parts of engines manufactured include exhaust cones, aft frames, transition liners, and combustion chambers for the General Electric J47 engine; diffuser assemblies for the Westinghouse J34; ring and tube assemblies, combustion chambers, and exhaust cones for the Allison J33; aft frames, transition liners and combustion chambers for the Allison J35; afterburners for the F7U airplane; afterburner components for the J33 and J35 engines; tailpipes for the Lockheed F-80 and North American B-45 airplanes, and numerous other assemblies and heat resistant parts.

Solar made other deliveries to prime contractors during the year on components of rocket and pulse jet engines; experimental diffuser cones and afterburners; and many items of a developmental nature. These include parts on important new engines such as the Pratt & Whitney T34 and Allison T40 turboprops, the Allison J71 and Pratt & Whitney J57 turbojets.

As a prime contractor, Solar has centered its work around a number of research and experimental projects. Secrecy wraps on small gas turbine engineering data have not been completely removed, but it is of interest that two units designed and built by Solar are undergoing evaluation by the U. S. Navy as the forerunners of what promises to be an important production line. The first of these, the Solar T-45, is a portable gas turbine-driven water pump. Using the same turbine as a prime mover, design work reached an advanced stage to prepare a production model of a light weight generator set which will supply electric power for cargo hoists on NATS planes. It is the first gas turbine designed for hand-crank starting. Solar's second small gas turbine, the T-400, is of greater horsepower and is adapted to an electric generator set which will find many uses as a portable source of power for airfields and for auxiliary use in planes. The current model now undergoing tests was developed for the U. S. Navy for shipboard use.

Another research project of almost 10 years' duration culminated during the year in the filing of applications for U. S. Patents on the Solaramic Process. So important is this process of protective ceramic coatings which gives greatly extended service life to high alloy materials and allows the use of the lower alloys where extreme heats are encountered, that it was held for some time under secrecy imposition by the Armed Forces and only recently has been released for publication and general application.

The manufacture of aircraft bellows that take up heat expansion and vibration movements in aircraft engine parts was greatly increased. A typical example of the bellows requirements in aircraft is indicated in the J47 where 18 of these bellows in three different sizes are needed.

Preparing to meet the production demands of an $80-million backlog, largest in its history, Solar highlighted 1951 with the dedication on October 14 of its new Wakonda Plant in Des Moines, adding to an extensive program of expansion at the Grand Avenue plant in Des Moines and the main plant in San Diego.

Presently planned production schedules for 1952 call for over 5,000 employees housed in more than 1,100,000 square feet of work area. The San Diego plant with 2,300 workers and 480,000 square feet will still be the largest single unit, but the addition of the new Wakonda Plant with almost 300,000 square feet and more than 1,000 employees are expected to make Solar the largest industrial employer in Des Moines. First job of the new plant will be the production of jet engine components for the J47 to fill an $8,000,000 contract from Packard Motor Car Company.

Upon the retirement of vice-president and plant manager Joseph E. Padgett, president Edmund T. Price added the management of the San Diego plant to his regular duties of guiding Solar policy and production.

Sperry Gyroscope Company
Division of The Sperry Corporation

Sperry Gyroscope Company continued to expand—at double the rate begun late in 1946. Employment increased over 1950 another 4,000, bringing the year-end total to 14,500. The United Nations, which has occupied one-quarter of the Lake Success plant since 1946, completed its move to New York City in May. Two new affiliated companies, Sperry Farragut Corp. in Bristol, Tenn., and Sperry Gyroscope Co. of Canada, Ltd., in Montreal were formed. The Sperry Farragut plant under construction in Bristol will manufacture guided missiles developed by Sperry Gyroscope Co., the Navy announced.

Meanwhile new developments continued to flow from the engineering laboratories to the manufacturing lines and into airplanes all over the world. At the same time tight security continued on most of the work in the company. Few details were declassified.

As the new year opened in Korea, MiG's and Red ground troops began to feel the lethal accuracy of the first versions of the new Sperry "triple threat" gunsight—an all-weather radar-directed sight which computes for gunnery, rocketry, and bombing in jet fighters. The sight met its first combat commitment with entry of Republic's F-84E Thunderjets into Korea. One nine-day operation with the sight credited the 27th Wing's Thunderjets with destroying or damaging 17 planes in air-to-air combat plus causing more than 10,000 troop casualties and destroying some 11,000 buildings.

Later at a Nevada training ground, pilot-instructor John W. Roberts made a gunnery record with the sight by drilling 175 holes in a tow target with only 180 rounds from his Thunderjet's six machine guns.

While gunsight-equipped Thunderjets arrived in Korea, a small group of engineers and Navy officers at Morton, Pa., watched intently as the pilot of a large helicopter, hovering a few feet off the ground, held both hands out the window of his craft. They witnessed the first successful use of an automatic pilot in a helicopter. On the first try, the Piasecki XHJP-1 hovered and maneuvered under control of an electronic automatic pilot similar to the ones which fly scheduled airliners. The new development solves the helicopter's lack of stability and enables it to operate around the clock in all weather. Additional production is scheduled to equip new HUP-1 helicopters with A-12 Gyropilot automatic flight controls.

A new version of the standard A-12 and Air Force E-4 automatic pilots entered production in 1951. Known as the A-12D, it will equip the new B-47B Stratojet bombers produced by Boeing.

In civil aviation, A-12's in 1951 equipped commercial airfreighters, two DC-6 Liftmasters operated by Slick Airways in 11-hour coast-to-coast service at over weather altitudes. A-12's also equipped United Air Line's new fleet of 40 Convair 340 luxury airliners in addition to 61 DC-6B's under construction at Douglas for American Air Lines and Pan American World Airways. American and PanAm installations will also include Gyropilot automatic approach control units which enable the electronic pilot to handle bad weather landings automatically.

The first of American's 41 A-12 equipped DC-6B's reeled off one of the fastest transcontinental airline flights on record when it beat General MacArthur's DC-6B, the Bataan, by one hour on April 18. The airliner, under the charge of flight superintendent William H. Dunn and chief pilot Harry L. Clark on its first long flight, left San Francisco with a load of newsmen 29 minutes after the Bataan, arrived in Washington 32 minutes ahead of it, and gave reporters another chance at the General. The plane flew on automatic control 90 percent of the flight.

Private aircraft, especially corporate business aircraft, continued in 1951 as a sizable market for A-12's as well as Zero Reader gyro flight computers, engine analyzers and other instruments. By autumn, 75 executive aircraft had A-12 Gyropilot installations.

Steps towards the first fleet-wide airline use of Zero Reader instruments were begun by Pan American World Airways in the fall with orders for 26 of the all-weather flight computers. Twenty of these will equip new DC-6B's on order from Douglas Aircraft.

Zero Reader flight computers also found new uses in 1951. Tight formation flying of swift Lockheed F-94 jet fighters was greatly simplified through use of the instrument by pilots in the Far Eastern Air Force. In close-knit flight array, the pilots climb to cruising altitude and then set up their course on the instrument. A vertical crosshair on the Zero Reader indicator tells them how to move the stick, right or left, to stay on the selected flight path. Once in formation, pilots claim the instrument will keep wing tanks of trailing aircraft lined up with tip tanks of the lead aircraft.

Engine analyzers built up new performance records as production orders were stepped up to keep pace with the Air Force's decision to fit the the electronic instrument to all aircraft of four or more engines. USAF began in 1950 to equip its B-36 and B-50 squadrons with analyzers to make new trouble shooting and cruise control techniques possible. By mid-1951 the 330th Squadron of the 93rd Bomb Wing at Castle AFB achieved the record of flying 11,332 hours without an engine change in its 24 B-50's. Teamwork of crews and analyzers was credited. The analyzers, considered an unmatched safety device by Castle crewmen, give flight engineers a constant check on engine operation during flight and forewarn of troubles requiring engine feathering.

A new use for the analyzer is aboard the Navy's largest blimp, the

ELMER

Civil Aeronautics Administration has developed a lifelike rubber dummy of a pilot which simulates the human body in great detail. Among its similarities are center-of-gravity, muscular contraction, compressibility, flexion and natural relaxation. It is made of alternate sheets of steel and foam-rubber. It is being used for research work on crash studies, seat-belt design, shoulder harness design and pilot deceleration in a crash. The 216-lb. dummy is, of course, known affectionately as "Elmer."

long range ZPN ship launched in 1951. The instrument will monitor and trouble shoot power plant and transmission gear during more than week-long cruises. The blimp is designed with the engines mounted inboard so one engine can be shut down for servicing while the other drives the ship's props through a special transmission system.

Briefly, and within the bounds of military security, major manufacturing Sperry efforts as of mid-1951 can be listed in order of magnitude as follows:

Army ordnance systems, bombing navigation computers, aircraft instruments (compasses, altitude gyros, Zero Reader gyro flight directors, engine analyzers), automatic flight controls (automatic pilots, automatic approach controls), guided missile systems, aircraft ordnance (gunsights, gunlaying interceptor radars), Navy ordnance systems, marine, aeronautical, and special electronics "commercial" items.

The word "commercial" is put in quotes because each of these items has military potential.

Similarly, development activities in the engineering division include guided missile systems, bombing systems, naval navigation systems, ground ordnance systems, aircraft gunsights, naval ordnance systems, special aircraft control projects, and miscellaneous projects.

Taylorcraft, Inc.

Taylorcraft, practically dormant for about three years and kept alive with personal funds, in 1951 adopted a long-range plan carrying over several years into the future. A worldwide sales organization of dealers and distributors has already been set up.

Variations of three basic models feature planes planned for production. The Sportsman heads the side-by-side series. Powerd by an 85 hp Continental engine with starter, generator and 12-volt system, skylights which, in a turn, give the pilot visibility comparable to that of low wing planes, it compares in beauty, performance, speed and comfort with high priced airplanes.

The new version was ATC'd on June 30, 1951, as Model 19, and has a gross load of 1,500 pounds.

The Tourist is a 4-place airplane designed for comfort, eye appeal and easy flying for non-professional, Sunday pilots. It was ATC'd on April 3, 1951.

Temco T-35 Buckaroo

The Tandem, for agricultural spraying, dusting, seeding, fertilizing, defoliating; for banner towing, for flight training, has flown with outstand-performance. It will be ATC'd when conditions warrant.

The company is active in war production. Additional contracts are being negotiated with several of the largest producers of Air Force airplanes.

Texas Engineering & Manufacturing Co., Inc.

An armed version of the Temco T-35 Buckaroo Military Trainer was demonstrated to the Armed Services as a light highly maneuverable ground support aircraft, during 1951.

The armed Buckaroo is equipped with two 30-caliber machine guns, gun-sight, gun camera and ten 2.75 inch rockets.

The Temco gun installation was developed over a year ago at the request of friendly foreign governments and has been proved in a series of air and ground firing tests. It differs from other trainer installations in that the guns are submerged completely within the wing, and are mounted on the torsional axis of the wing in a manner similar to the gun mountings in fighter aircraft. The result is better cooling and exceptional accuracy.

Temco built ten Burcaroos with these gun provisions during the year.

The Temco rocket installation likewise is of the big airplane type. Five rockets are mounted on rails under each wing, and fire control is by an intervalometer type system which permits the automatic firing of single rockets or any series of rockets in sequence. The rocket installation has been so engineered that it has little effect on the flight characteristics or maneuverability of the aircraft, according to pilots who have flown the rocket equipped version.

While Temco is demonstrating its gun-and-rocket-equipped Buckaroo to the Armed Services, three other T-35's are being evaluated by the Air Force at Goodfellow AFB as primary-basic trainers—the mission for which the plane was designed initially.

United Aircraft Corporation

Because United Aircraft Corporation's four divisions operate autonomously, discussion of the company's 1951 activities are found under the names of the divisions—Pratt & Whitney Aircraft (engines), Hamilton Standard (propellers and aircraft accessories), Chance Vought Aircraft (airframes), and Sikorsky Aircraft (helicopters).

In 1951, United Aircraft embarked upon a major, privately financed expansion program. Two new plants, two major additions to existing facilities, and several leases of auxiliary buildings were included in the program.

Construction of the two new plants, each with 500,000 square feet of production area, began in the spring. They will be ready for occupancy in March, 1952. A new home for Hamilton Standard is being built at Bradley Field in Windsor Locks, Conn., and a branch plant of the Pratt & Whitney Aircraft division is under construction in North Haven.

When Hamilton Standard moves to its new quarters in Windsor Locks, the Pratt & Whitney Aircraft division will take over the vacated plant in East Hartford. An addition is being built adjacent to the Hamilton Standard East Hartford plant which will add 180,000 feet of production and office space to the Pratt & Whitney Aircraft facilities.

At Bridgeport, the Sikorsky Aircraft division is engaged in a plant-expansion program that will enlarge further its facilities there, already the largest devoted solely to the production of helicopters. The two new wings added to the present structure will increase by one-third the present plant area.

United Aircraft has gained additional space for the expanding engine production of the Pratt & Whitney Aircraft division by leasing several properties in the vicinity of East Hartford, ranging from small office space areas to medium-sized manufacturing areas. All of the leased space is being utilized for non-production operations such as storage, shipping, receiving and inspection.

Westinghouse Electric Corporation

Production and development activities of the Aviation Gas Turbine Division of Westinghouse were stepped up considerably during 1951, keeping pace with the increasing demands placed on industry by the expanding national defense program.

In January, the Westinghouse J40 passed its military qualification test and went into production at the South Philadelphia Works. The J40 will also be produced at the Kansas City Works of the Aviation Gas Turbine Division. In addition to Westinghouse production of this engine, the Lincoln-Mercury Division of Ford Motor Company has contracted to build the J40 for the U. S. Navy at its new Gas Turbine Plant in Detroit.

Production of the J34 engine reached a record rate during 1951, with the Kansas City Works carrying the bulk of the production load. In September, the 3000th turbojet engine to be produced by Westinghouse was delivered from the Kansas City Works.

The productive capacity of the Kansas City Works will be increased soon with the establishment of additional manufacturing and assembly facilities that are designed to handle the production orders for the J40 and J46 turbojets. According to present schedules, this huge plant will produce concurrently and in quantity, three distinct Westinghouse turbojet engines, the J34, J40 and J46.

Supplementing the efforts of the Kansas City Works in the manufacture of jet engine components will be the new $25,000,000 jet engine component parts factory Westinghouse has under construction at Columbus, Ohio. This new plant will feed finished engine parts to the Kansas City Works, where they will be assembled and tested.

Wright Aeronautical Division

Wright Aeronautical Division in 1951 Americanized, further developed and programmed quantity production of the J-65 Sapphire turbojet engine, rights for which were obtained late in 1950 from Great Britain.

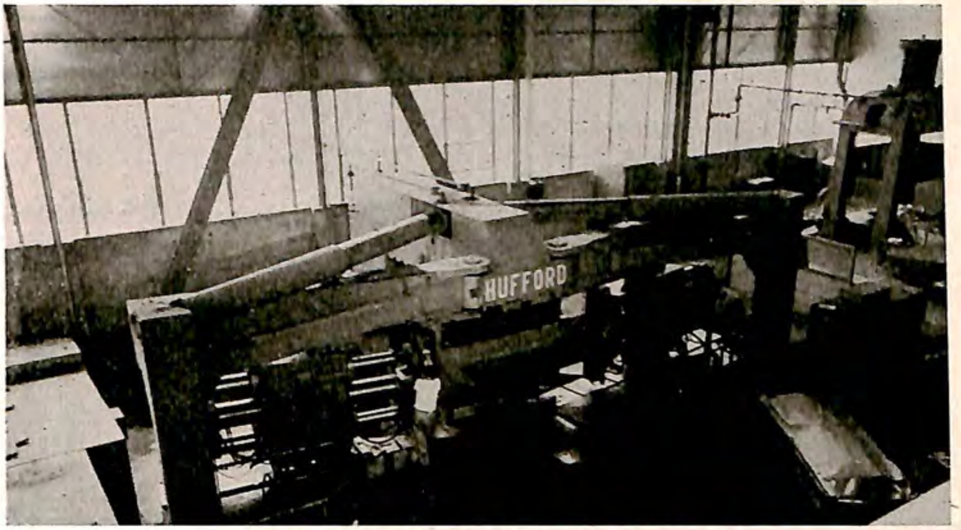
Within a year's time of the signing of the agreement between Wright and Armstrong Siddeley, the J-65 was being assembled at the Wright plant in Wood-Ridge, N. J. To do this, more than 3,000 drawings received from the British were redone at Wright to "translate" them to American standards. Accessory manufacturers in the United States had begun to turn out equipment such as starters for the 7,200-pound-thrust engine. Production and engineering men, working in close cooperation, had redesigned many of the J-65's major parts to make heavy cuts in the man hours necessary for production.

In addition, engineers were working on development of the engine to a higher output than that achieved by the British. Under the agreement with Armstrong Siddeley, the British and American companies are exchanging research and development data to eliminate duplication.

The agreement with Armstrong Siddeley also gave Wright the American rights to the Mamba, Double Mamba, and Python turbo-prop engines. At the same time Wright signed an agreement with Bristol Aeroplane of Great Britain for rights to an undisclosed engine of high performance.

Late in the year, Wright began flight testing of the J-65 in its B-17 Flying Laboratory at Caldwell Wright Airport.

Other engines, installed in the Republic F-84F swept-wing fighter,



Hufford stretch press in use by Lockheed

were going through successful flight tests at Edwards Air Force Base, Cal.

The ramjet, another Wright engineering project, made satisfactory progress in the development stage during 1951 in the company's expanding ramjet Laboratory. Details are classified by the Air Force.

The Wright Turbo-compound rated at 3250 to 3500 hp and said to be the most economical of piston engines, was selected to power outstanding new commercial transports by two leading airlines against a background of thousands of hours of military operation. Eastern Airlines specified the turbo-compound for a new fleet of Super Constellation transports. American Airlines selected the turbo-compound to power its DC-7, with which it hopes to cut trans-continental time to a little more than eight hours. The turbo-compound is in mass production for military and commercial use.

Other U. S. Industries

The 1951 reviews of activities by individual aircraft and accessory manufacturers are incomplete without more than passing mention of other U. S. industries. The response of these, representing all branches of the nation's manufacturing might, to aviation's call for help in the defense program made aviation once again, to some degree, everybody's business.

To tell how these industries carried out their share of the program would fill another Year Book. But to write anything on 1951 aviation in the United States without recognizing their role in the air defense effort would be to leave out an important part of the story.

There is, to cite one of numberless examples, the case of an idea that came to James H. ("Dutch") Kindelberger, chairman of the board at North

American Aviation. The idea was to develop a totally new set of curved jaws for use on stretch-wrap forming presses. It was born some eighteen months ago, out of Kindelberger thinking toward speeding up defense aircraft production and at the same time cutting costs.

The idea was taken to engineers at Hufford Machine Works, Inc., who specialize in such presses, and today a new curved-jaw model is working overtime at North American.

Of course, it was not as simple as that. The job took eighteen months, and the completed press is a complicated piece of engineering. Basic goal of the design is to produce a jaw capable of gripping a sheet vertically and then assuming the approximate contour of the die in the vertical plane. Such a jaw saves metal through use of a series of independent jaw gripper units, hinged together so that they will conform to almost any shape encountered in actual production. Each unit is equipped with three hydraulic cylinders. After the desired curve is established, calibrations are recorded for fast, easy duplication.

The Hufford-Kindelberger idea proved a good one—the new press, according to preliminary estimates, has already paid for itself. Trimming and handling time, as well as set-up time, has also been saved, and since the transitional material formerly wasted is no longer needed, longer dies may be used.

Scores of other examples could be cited of activities too technical or too undramatic for general news.

Typical and deeply involved in the defense effort is the work of Vickers, Incorporated, a division of the Sperry Corporation, whose aircraft hydraulic controls were expanded during 1951.

Principal Vickers products were fixed displacement hydraulic pumps and motors, automatic pressure control pumps, electrically controlled servo pumps, and various combinations of these units with other Vickers products, such as unloading valves, relief valves and accumulators.

These items were employed in a variety of aircraft control functions, including engine driven pumps supplying the main hydraulic circuits for actuating control surfaces, landing gear and flaps; electrically driven pumps for standby and emergency operations; cabin supercharger drives and controls responding automatically to air pressure signals; hydraulic motors for positioning flaps and accomplishing miscellaneous functions requiring rotary motion; hydraulic transmissions for aircraft machine gun turrets and airborne radar drives; hydraulic motors and associated control valves for helicopter rescue hoists, in-flight refueling operations, tow target winches, and air compressor drives.

In addition to its production activities, Vickers devoted a large amount of engineering and laboratory work to further improvement and development of its line of aircraft hydraulic mechanisms. Significant accomplishments resulting from this work were concerned particularly with: increased reliability of various hydraulic units and consequent lengthening of overhaul periods; higher speeds and pressures for pumps and motors resulting in greater power-to-weight ratios; new and improved hydraulic equipment for constant-speed control circuits such as airborne alternator drives; better units for variable-speed applications such as cabin supercharging systems; pumps, motors and solenoid metering valves especially designed for use in high-response servo circuits of both the velocity and positioning types, with either linear or rotary outputs; and publication of dynamic response performance data and other specialized information of particular interest to designers of servo circuits.

During 1951 certain Vickers engine-driven, constant displacement, piston type pumps passed military qualification tests under AN-P-11b specifications. They have been awarded AN approval and assigned AN numbers.

A Vickers development of special interest for constant pressure system applications was the addition of electrical centering to automatic pressure control pumps. This feature provides a pump which will not only automatically adjust its output to meet varying system demands, but will unload the system to zero pressure whenever there is no demand for hydraulic operations.

Another active company in aviation was Cleveland Pneumatic Tool, originators and pioneers in the manufacture of pneumatic-hydraulic shock-absorbing landing gear units. Pneumatic further increased its manufacturing capacity by erecting four new buildings and placing well over a hundred additional machine tools and related equipment units in the production lines, with many more to follow. The total additional floor space was more than 100,000 square feet.

In production are a full range of landing gears for many of the country's commercial and military aircraft.

The company continued during the year to develop and refine methods of determining the efficiency of its units by drop-testing under varying conditions of simulated service. The gears are tested repeatedly in temperatures exceeding 160°F., and also under conditions of extreme cold.

During the past year Cleveland Pneumatic's automotive division acquired the engine stand equipment line formerly produced by Clayborne Manufacturing Co. of Chicago. A desirable building of 18,000 square feet floor area was acquired within a block of the main plant for this operation. Engine stands and dollies for automative aircraft and engine overhaul are among the principal products of this activity. A principal product of this division is a transmission jack which is adaptable to extensive application in aviation maintenance depots.

The New York Air Brake Company continued to develop and produce aviation hydraulic pumps. These include conventional constant delivery configuration as well as three distinct variable delivery designs in both direct engine driven and electric motorized units. Capacities range from one-quarter gallon to ten gallons per minute at nominal rating speed of 1,500 rpm with continuous working pressures to 3,000 psi. The normal maximum continuous operating rpm is 3,750, with 4,500 rpm available for intermittent operation.

Three important new pump developments are a positive return piston actuator, a dual pressure pump with remote oil pilot controlled pressure regulation, and an electric control device for remote selective pressure control and pump unloading.

Pumps incorporating the positive return actuator were designed to meet new specifications calling for higher reservoir pressurization. This design insures adequate pump by-pass under all back pressure conditions to provide fluid circulation for cooling and lubrication during the zero flow, full pressure cycle. In circuits where two or more pumps are manifolded in a single circuit the positive priming characteristics of these pumps eliminate the necessity of priming valves and independent pump priming.

Jack & Heintz, Inc., Cleveland, was another company that greatly expanded its production facilities in 1951 to meet the demands for the aircraft industry. Its line of electrical, hydraulic or mechanical devices developing, controlling or using power are in wide use on the nation's top military aircraft and on commercial planes as well. Keeping pace with the advances in aviation were a number of other interesting developments.

An ingenious automatic jaw meshing mechanism, incorporated on a new model gas turbine starter, was one of them. The mechanism, utilizing a friction ring jaw mesh arrangements, replaces the d-c solenoid usually used for jaw meshing action. The starter itself is a constant current variable voltage unit, designated as Model D31-1.

Included in the advantages of this new starter are reduced weight, reduced overall length, and elimination of a potential source of trouble. In case of a solenoid failure, the starter jaw will not extend to mesh with engine jaw and, hence, no starting action will result. The new starter, with the automatic jaw meshing mechanism, will always have positive meshing as long as there is sufficient electrical power to rotate the armature.

This starter has a 0-30 v. d-c, 1,000 amp, 800 rpm, 20½ hp rating. Specifications applicable are Navy Spec. 86S1 and AND20002, Type XII-F for Type 1, Class 1 starters.

Another feature of this starter is that it can be installed or detached in seconds.

There has been an important Jack & Heintz development in the completely integrated electrical control system. In these systems, protective and control devices are mounted on a vibration-proof control panel with simplified plug-in connections and held in a shock-mounted tray, ready for installation in the airplane as a unit. The many advantages offered by this panelled system include simplified wiring with only an external connection required, space and weight saving; economical and simplified maintenance, and, in military aircraft, minimum vulnerability against combat damage through better location and the use, if desired, of armor plate.

CHAPTER TWO

Department of Defense

THE AIR FORCE began the year building towards its 95-wing strength targeted for mid-1952 and by mid-1951 had a total of 87 groups in active service. However, early in the Congressional session a strong move developed for a more rapid expansion of the Air Force and this was finally formalized with a program calling for 126 combat wings plus 17 troop carrier wings. This latter program was outlined for future planning and included substantial appropriations towards that end but the current program remained within the 95-group structure as an immediate goal.

All details of the military aircraft production program as well as the Air Force combat unit expansion and equipment were withdrawn under a tighter and tighter cloak of security as the year moved on. The curtain was completely dropped on aircraft production or contract award unit figures. Thus, only general indications of the progress of the program were available at years end.

It was revealed that a supplemental appropriation approved early in the year totalling $1,135,000,000 would purchase 3,092 aircraft. The final aircraft procurement appropriations for the 1952 fiscal year totalled more than $15¼ billion divided $11,215,000 for Air Force aircraft procurement, $4 billion for Naval Aviation and $44 million for Army aircraft procurement. In addition, one more billion divided $666,666,000 for the Air Force and $333,334,000 for the Navy was appropriated for expansion beyond the 95-wing program. The fiscal 1952 program called for 5,064 military aircraft plus 1600 liaison and helicopter aircraft for the Army. Thus, a total of 9,156 aircraft was placed on order during the year.

However, these appropriations and contracts had little bearing on aircraft production during the year, which was expanding to a 50,000 airplane-per-year production base. Defense Mobilizer Charles E. Wilson announced that aircraft production at mid-year had been doubled over the preceding year and expected it to be tripled by the first of the new year. This would place production at year's end at a rate of about 5,000 aircraft annually.

The overriding Air Force problem during the year was coordinating this tremendous expansion while conducting combat operations in Korea, maintaining air strength throughout the nation, in the Pacific and in Europe and contributing to MDAP program for the NATO nations. It was a tremendous job inherently containing fits and starts and temporary logjams.

Throughout the year the expansion of bases in the U. S. continued with new sites, by far the vast majority being reactivated World War II fields, being named. In addition, civilian contracting was resorted to for pilot and aircrew training, overhaul and maintenance, airlift and, of course, procurement. Compounding the entire program was the rapidly-increasing complexity and cost of highspeed jet aircraft and related electronic equipment which placed increasing strains on production, training and maintenance.

To meet these overwhelming problems, the Air Force underwent a general de-centralizing in all functions during the year to reduce the peacetime concentrations of command and direction. Heaviest immediate burden lay on procurement and this function was removed from its previous concentration with the Air Materiel Command at Dayton, Ohio and moved into six Air Force procurement districts: Northeastern at Boston, Eastern at New York, Central at Detroit, Mid-central at Chicago, Southern at Fort Worth and Western at Los Angeles. All procurement, inspection and acceptance functions of the Air Force lying within these regions were assigned directly to their District offices and only the latter were reporting directly to Wright-Patterson Air Force Base.

Virtually the whole of the engineering, testing and research functions at Wright-Patterson were reassigned during the year to the new Air Research and Development Command and most of the units moved to other locations.

Officer command assignments were numerous during the year, typifying expansion, and retirements were frequent, signifying a realignment of the entire Air Force command structure. A vast number of promotions, from four-star general down through captain, were made during the year, the first mass promotion in several years.

Naval Aviation found itself fully recognized and supported by the Congress for the first time since its dark days of the Louis Johnson regime, and expansion, though dollarwise far less, kept pace proportionately with that of the Air Force. The "super carrier" was ordered and a variety of large carriers removed from mothballs, their decks strengthened for heavier jet aircraft and placed in service.

Aircraft procurement centered on late models of familiar types, product of the economy years of 1947-48, although a handful of prototypes was flown during the year, particularly by the Navy.

The Air Force punctuated its tremendous expansion by extensive and constant reorganization during the year. The Air Research and Development Command, established last year, was formalized during the year and a variety of scattered functions assigned to its cognizance. Edwards Air Force Base, California flight test center, was transferred to the new command as was the Enginering, Flight Test and All-Weather Flying Divisions of the former Air Materiel Command at Wright-Patterson Air Force Base, Ohio. Also transferred to ARDC was the Office of Air Research,

Battered Republic F-84 Thunderjet holds up under battle damage

the Cambridge Laboratories, Cambridge, Mass.; the Electronics Laboratories at Rome, N. Y. and Holloman Air Force Base, New Mexico, guided missile station. The new Arnold Air Development Center at Tullahoma, Tenn. was dedicated by President Truman during the year and assigned to the ARDC for direction.

The Technical Training Air Force was activated in Biloxi, Miss. to conduct all USAF technical training of mechanics, electronics specialists, radio operators and other technical specialists. The new TTAF is a component of the Air Training Command, which includes the Flight Training Air Force.

The 12th Air Force was reactivated in Europe to combine the activities of all USAF units in Germany and Austria. Maj. Gen. Robert Douglass, Jr. was named commanding general with headquarters at Wiesbaden, Germany.

The Central Air Defense Force was established and headquarters will be established at the new air base now under construction near Grandview, Mo. The new unit completes the organization of the Air Defense Command, which includes Eastern and Western Air Defense Forces.

The Seventh Air Division was organized in the United Kingdom and Maj. Gen. Archie J. Old, Jr. named commanding general. The new unit will have command of all units of the Strategic Air Command during their tours of duty in the U. K. as well as two permanent wings.

War in Korea

The touchstone of the tremendous expansion of U. S. Air Power in 1951 was the campaign in Korea, despite frequent administration pleadings to the contrary. Whether literally geared to Korea or not, the expansion program was a product of the international Communist threat symbolized by the fighting in Korea.

Despite this fact, the action in Korea continued a firmly limited engagement with the size of the forces on the United Nations side at least remaining substantially unchanged. Jet air battles continued to increase in size until 150-plane contests had been witnessed. Surprisingly, however, these huge jet air battles produced astonishingly few casualties proportionately, the number of aircraft destroyed or damaged being only one-tenth that of similar World War II battles with piston-engine fighters.

This reflected something inherent in jet aircraft. Despite the frequent statement that the jet fighter offers a more stable gun platform than its piston-engined counterpart, the speed and space of the battles apparently forbade exploitation of this characteristic, as it was so amply demonstrated against ground targets. Red MiG-15 fighters, joined during the year by a later and faster model, continued to stay close to their Manchurian sanctuary but increased steadily in numbers until full Red air divisions (equivalent to USAF group) were on patrol.

Qualitatively, it appeared late in the year that the highly-touted North American F-86 *Sabre* and the much-dismissed MiG-15 fighter were stacking up in quite the reverse direction with Air Force Chief of Staff General Hoyt S. Vandenberg announcing publicly that the *Sabre* superiority seemed to extend to only about 30,000 ft. above which the Red jet was superior. To cope with these the Navy sent in its high-altitude McDonnell F2H *Banshee* carrier jet, which operates effectively at altitudes above 50,000 ft. Characteristically, however, these *Banshee* carrier squadrons were assigned to low altitude missions well down the peninsula and as the year closed had not yet been permitted far enough north to test their capabilities against the MiG. But the *Banshees* were on hand—just in case.

Air losses continued surprisingly low, although casualties due to noncombat accidents maintained their percentage. The ruggedness of the jet airplane, both its airframe and its engine, continued to confound the experts and offered real optimism for its combat usefulness in the future. Turbojet engines continued to deliver thrust even with a handful of turbine blades missing and airframes held together despite gaping ground fire shell holes. This phenomenon reflected the higher-strength alloys now common in their construction and the vastly improved mechanical design of U. S. turbojet engines.

The helicopter expanded its surprisingly vital role in Korea and new records were established for evacuation and rescue missions completed successfully. Its activities in the theater reached their zenith late in the year when a full Marine battalion was air landed by helicopter in full view of the enemy virtually without opposition, presaging the long-predicted day of vertical envelopment.

The airlift continued to new tonnage totals until it has surpassed the historic Berlin airlift in daily ton-miles flown. This amazing aerial train performed its long-range delivery expansion while attaining new records for safety and MATS hung up the lowest accident rate record of

All-out production on North American F-86 Sabre

any Air Force command during the year, a truly significant accomplishment.

But there was evidence at years end that continuation of Korean hostilities would require improved aircraft and plans were being made for the introduction of advanced models at an early date. The *Sabre,* as the foremost fighter in the U. N. air arsenal, was due to be replaced by a later model incorporating advances in performance and controllability but no radically-improved combat airplane was available nor planned in the near future.

The oft-repeated concept of the Korean war as a Russian air force proving ground seemed very much the same thing for the USAF and Naval Aviation with a wide variety of new types entering the theater during the year. The Air Force introduced the Republic F-84E *Thunderjet* fighter in large numbers early in the year as a ground cooperation type and it served to inaugurate use of the 11.75-in. *Tiny Tim* rocket in combat. The *Thunderjet* carries two of the huge rockets under its wings. The straight-wing F-84 took over most of the load carried by the pioneering Lockheed F-80 *Shooting Star.* Admittedly no match for the super-fast MiG-15 Russian jet fighter, the *Thunderjet* nevertheless held its own in infrequent combat with it but the latter's principal duties remained close air support.

The four-jet North American RB-45C was seen in the theater for fast reconnaissance duties on a limited basis. Also sent to the theater for trial was the Lockheed F-94 two-man all weather fighter. These new aircraft augmented the North American F-86 *Sabre,* which has carried the brunt of the battle—and with marked success—against the highly-touted MIG fighter, one of which was finally captured and returned to the U. S. for close study.

The Navy introduced its McDonnell F2H-2 *Banshee* jet fighter into Korea during the year especially due to its high-altitude capabilities. It is at high altitude that the MIG-15 has proved most effective. The *Banshee* joined the Grumman F9F *Panther* jet fighter in combat, the latter proving successful as a ground cooperation machine using rocket loads.

The big Sikorsky HO4S (USAF H-19) entered Korean combat late in the year in a dramatic debut. A full Marine Corps battalion was air landed near Wonson by 160 helicopter flights in a total time of 6 hr. 15 min., the first such maneuver in history.

Navy Carrier Program

Expansion of Naval Aviation required the de-mothballing of additional carriers, contracts for new ones and modernization of still others. The now-famous "super carrier" was ordered at last, following the bitter fight it touched off in the reign of Secretary of Defense Louis Johnson and Navy Secretary John L. Sullivan. The carrier will be named the "U.S.S. James V. Forrestal" after the late Navy Secretary and will gross 59,900 tons, the largest Naval vessel ever projected in history. It will feature a flush deck and four catapults and will be capable of handling the heaviest and fastest Naval aircraft ever operated at sea. It will be 1040 ft. long and 252 ft. wide, the latter dimension prohibiting its use of the Panama Canal. It is estimated to cost $218 million and will require three years to build.

In order to accommodate the heavier and faster new jet aircraft and carrier attack planes, the Navy continued its program of deck strengthening on existing aircraft carriers of the *Essex*-class. These include the *Bon Homme Richard, Hancock, Lexington* and *Yorktown.* In addition the *Hornet* and *Kula Gulf* were ordered out of mothballs and equipped for sea duty.

Atomic Air Weapons

The Air Force was wing deep in the lengthy series of atomic tests in Nevada late in the year and, although secrecy hung heavy throughout the Department of Defense in all its announcements and speeches, it seemed clear that the so-called "baby A-bomb" was a reality. This, of course, is a misnomer insofar as it applies to the physical size of the mechanism and its nuclear contents, but it does signify an entirely new stage in air power.

Statements were painfully guarded but the enthusiasm of Secretary of Air Force Thomas K. Finletter and Air Force Chief of Staff General Hoyt S. Vandenberg left no doubt that the tactical use of the A-bomb employing combat aircraft for its delivery was an accomplished fact. Their statements, too, strongly insisted that the surface of the tactical A-bomb potentialities hadn't even been scratched.

The Navy, too, continued its insistence that although strategic bombing was, indeed, the province of the Air Force, that Naval Aviation had a right-

High-altitude McDonnell F2H-2 Banshee carrier fighters

ful place in the A-bomb picture and that present Naval aircraft were fully equipped and their crews trained for delivery of atomic weapons when required. The heaviest carrier-based aircraft in Naval history were successfully proved during the year and the number of carriers equipped to handle them increased steadily.

New Aircraft

The economies of the 1947-48 period bore fruit during the 1950-51 years in a dearth of new aircraft and a plethora of modifications and improvements to existing types. This development work simplified the production expansion problem since new models introduced only minor tooling problems but the years were passing quickly in the lives of the nation's top military airplanes and most of them were fast reaching their development peak. The North American *Sabre* jet fighter was in its F-86E model on the production line but at the year end a new model featuring increased wing sweep from 35 to 45 deg. and an improved General Electric J47 turbojet engine was in development.

The Republic F-84F made its first flight during the year, the model being the standard *Thunderjet* with a swept wing and the Wright J65 *Sapphire* turbojet engine installed. The F-84G, a development of the standard straight-wing version, went into production during the year. It featured in-flight refueling equipment, an automatic pilot and numerous detailed refinements over preceding models.

The USAF ordered the conversion of a huge Douglas *Globemaster II* cargo carrier into the model YC-124B to be powered by four Pratt & Whitney T34 turboprop engines of 5500 hp each. The big transport will also feature wingtip heater installations. Navy also strengthened its interest in the turboprop engine by orders for the Douglas R6D (DC-6B) and Lockheed R7O (L-1049 *Super Constellation*) transports equipped with Allison T38 and Pratt & Whitney T34 engines respectively. To equip its Convair R3Y and Douglas A2D aircraft with engines, Navy also let a $23 million contract to Allison for T40 turboprop engines.

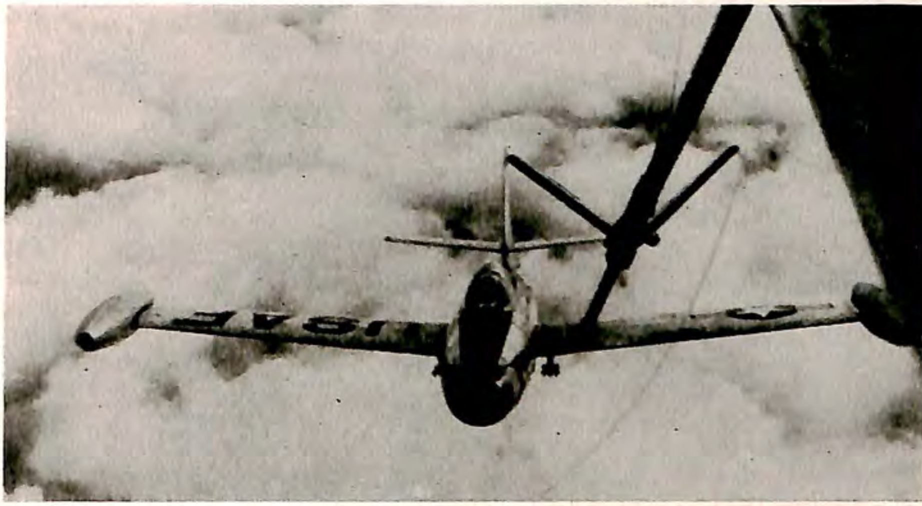
A new version of the Fairchild *Packplane,* the XC-128, was ordered. It will feature a solid nose containing the crew compartment with the huge pack fitting in behind the nose and under the wing. The nose section will contain the nose wheel, thereby permitting a conventional tricycle landing gear rather than the unsatisfactory quadricycle gear used on the XC-120.

For the first time in 34 years the U. S. has ordered a foreign airplane into production on these shores, the English Electric *Canberra* jet bomber. The sleek, high-climbing bomber is to be built by the Glenn L. Martin company as the Air Force B-57A. It will also be powered by an importation, the Armstrong-Siddeley Sapphire turbojet engine manufactured as the J65 by the Curtiss-Wright Co. This 7200-lb. thrust engine will also power the Republic F-84F and, perhaps, other new jet aircraft. Its major advantage is its comparatively low fuel consumption over comparable U. S. turbojet engines. An idea of the speed of the *Canberra* can be gained from its record-breaking crossing of the Atlantic in just 4 hr. 18 min. on a delivery flight to the Martin Co.

The Navy ordered the North American *Sabre* into production at the company's newly-occupied Columbus, Ohio plant as the FJ-2. The carrier *Sabre* will offer very high speed to the Navy's fighter fleet. The *Sabre* actually began life as a Navy airplane, the FJ-1 *Fury* and the wing sweep was added for Air Force use. The first FJ-2 is not scheduled for delivery until early in 1952.

The huge Boeing *Stratocruiser* was improved during the year and the Air Force placed the new C-97C model into production. It features a structural strengthening of the fuselage to accommodate heavier and bulkier cargoes but the payload remains the same. Also introduced was the KC-97E model which is rapidly convertable between troop carrier, heavy cargo and flying tanker versions through the use of kits.

Experiments were completed during the year in the flight refueling of virtually every USAF combat airplane. First jet bomber to be refueled in flight was the North American RB-45C and this development was followed by successful tests using the Boeing B-47 *Stratojet* six-jet bomber. Fighters refueled in flight included the North American F-86 *Sabre* and the Republic F-84G *Thunderjet.* Both Boeing KB-29F and Boeing KC-97B tankers are available for the job.



Republic F-84G shown here in mid-air refueling

Something of the amazing scope of the USAF's plans for the Boeing B-47 *Stratojet* bomber production was revealed during the year when, in addition to the huge program at the Boeing-Wichita plant, contracts were signed for quantity production of the bomber by the Douglas Aircraft Co. at Tulsa, Okla, and Lockheed Aircraft Corp. at Marietta, Ga. Both plants were used for aircraft production during World War II. Observers cite the B-47 project as the largest in scope yet attempted by the aircraft industry, even eclipsing the Boeing B-17 and Boeing B-29 production programs of World War II.

Navy continued its development of the highly successful McDonnell F2H *Banshee* carrier jet fighter during the year. The F2H-2P model mounting six cameras in the elongated nose was the first Navy photo-fighter to enter carrier service. Also introduced into the production line was the newer F2H-3 model featuring an elongated fuselage to accommodate additional fuel tanks providing increased range for the already long-ranging jet.

Vought continued development of the seemingly-ageless piston-engined *Corsair* a decade after its initial model. The new F4U-6 model, now in production, was redesignated the AU-1 to give cognizance to the truly all-round combat ability of the aircraft which is truly an attack (dive bombing, rocket attack, etc.) airplane rather than simply a fighter.

The F4U-7 model was placed in production especially for the French Air Force under terms of the Mutual Defense Assistance Program.

All of these modifications and improvements to existing models were not the full extent of aircraft development in the services however and a trikle of new prototypes kept the flame of aircraft progress alive. The Air Force made the most striking announcement in this field during the year by revealing that the huge Boeing XB-52 eight-jet strategic bomber had been ordered into quantity production well in advance of the first flight of the prototype, which was scheduled for early 1952. The giant bomber is slated to replace the intercontinental B-36 some years hence, although because of the jet engines of the Boeing craft it will not have the 10,000-mile range of the huge B-36.

Even the latter was scheduled for tremendous advances in performance and the USAF revealed the YB-60 models as a swept-wing, eight-jet version of the B-36. Both the B-52 and YB-60 will be powered by eight Pratt & Whitney J57 turbojet engines rated in the 10,000-lb. thrust class.

Navy announced the first test flights of two radical new jet fighters during the year. The Douglas XF4D *Skyray* featured a radical delta-wing configuration and was designed specifically for catapult takeoff and rocket-like interception of enemy bombers. It was undergoing flight tests with the big Westinghouse J40 turbojet engine installed at year's end.

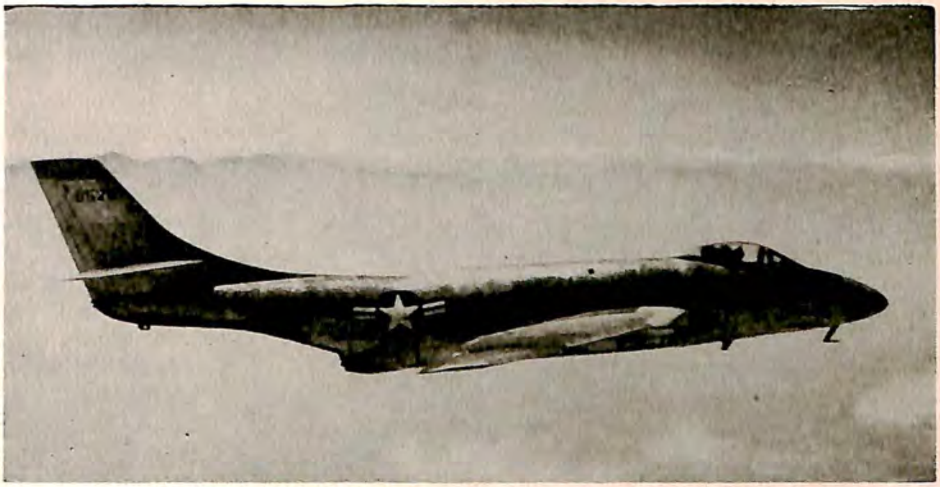
The swept-wing McDonnell XF3H *Demon* completed initial test flights during the year, although the prototype was destroyed in a tragic accident. It is powered by a Westinghouse J40 turbojet engine fitted with huge afterburner that produces up to 15,000 lb. thrust for short bursts at supersonic speed. The sleek fighter was ordered into production by McDonnell and Goodyear Aircraft Corp.

Air Force announced the Martin B-61 *Matador* as the first production long-range guided missile and established the 6555th Guided Missile Squadron to handle the swept-wing pilotless aircraft. Powered by a conventional Allison J35 turbojet engine, the blood-red missile features swept wing and tail and a flush air inlet in its belly. It was being tested over the new long-range missile proving ground along the Bahamas from Patrick Air Force Base, Fla.

In the missile field, the Navy smashed all records during the year with a Martin *Viking* flight to an altitude of 135 miles, during which the research missile attained a speed of 4100 mph. Used solely for upper atmosphere research purposes, the *Viking* also provides experience in missile handling and launching techniques.

Air Force announced contracts for the first nuclear-powered airplane during the year, indicating final fruition of the long research program. Convair is slated to build the airplane and the General Electric Co. will build the nuclear power plant, the exact form of which was not announced. Informed speculation, however, centered about an airplane of B-36 size using turboprop engines driven by the atomic powerplant. Award of the contracts signalled the end of the study phase of the Nuclear Energy for Propulsion of Aircraft (NEPA) program directed by Fairchild over the past five years. Participating in the engine part of the program was the Allison, Continental, Lycoming, General Electric, Wright and Frederic Flader engine companies.

Decided during the year were a number of strenuous competitions active over the past few years. Both Convair and Republic were declared winners of the interceptor competition in which six companies submitted



McDonnell XF-88 fighter features short afterburners

12 different designs. The interceptor is to be ready for production in 1954 and it is to be both a piloted and pilotless aircraft with Hughes Aircraft Co. supplying the guidance and control system.

Air Force officially recognized the convertaplane as a practical new type of aircraft with award of development contracts for three different configurations. Bell Aircraft Corp. will design a craft in which the rotor tilts over 90 deg. to function as a propeller in level flight. Sikorsky Aircraft Division, United Aircraft Corp. will produce a convertaplane in which the rotor is folded and stowed in flight with the aircraft moving forward using a conventional engine and propeller. McDonnell won a contract for development of a design in which the lift is "unloaded" from the rotor onto its fixed wing as high speed flight is gained.

Navy expanded its interest in helicopters by award of a contract to Bell Aircraft for the model XHSL-1 combat helicopter especially equipped for anti-submarine warfare. The tandem rotor design will inaugurate the company's change from the single rotor-anti-torque rotor combination used heretofore.

The Marine Corps, through the Navy, awarded a contract to both McDonnell and Sikorsky for production of heavy assault helicopters capable of carrying either troops or cargo. The two companies were adjudged winners over 23 designs entered.

The Navy also awarded a development contract to McDonnell for work on a huge "flying crane" helicopter capable of lifting a 36,000-lb. load. The big jet-driven rotor will use chains and hooks to enable its attachment to tanks, bulldozers, bridge segments, etc. for fording rivers, woods or other obstacles. This parallels USAF work on the Hughes XH-17 design, work on which was continuing during the year.

Beech Aircraft Corp. was declared winner of a twin-engined trainer competition and received a production contract for the new T-36 design. It will be similar to the World War II Beech twin-engine trainers but will feature higher power and larger size.

The DeHavilland-Canada *Beaver* light transport was declared winner of the hard-fought liaison aircraft competition and production contract was let to the company for the L-20 design. It features rugged construction and very rapid takeoff performance. It will be built in Canada.

The Navy placed a development order with Kaman for application of a turboprop engine to the helicopter and the company began studies using the Boeing 502 small gas turbine engine in its standard HOK and HTK helicopter model. The combination is a logical one with both the turbine engine and the rotor operating best at a high, constant speed.

Air Force announced that the Convair *Terrier* anti-aircraft missile would go into quantity production in the company's new Pomona, Calif. plant. The two-stage missile features a booster rocket unit for quick takeoff and a sustainer rocket for flight. It carries an explosive charge in its nose and is electronically stabilized and guided.

USAF let a contract to the Lockheed Aircraft Corp. for construction of a new turboprop transport capable of carrying a 25,000-lb. payload for 2000 miles at highspeed. The design won a competition over several entries. It will be an entirely new design powered by four Allison T38 turboprop engines.

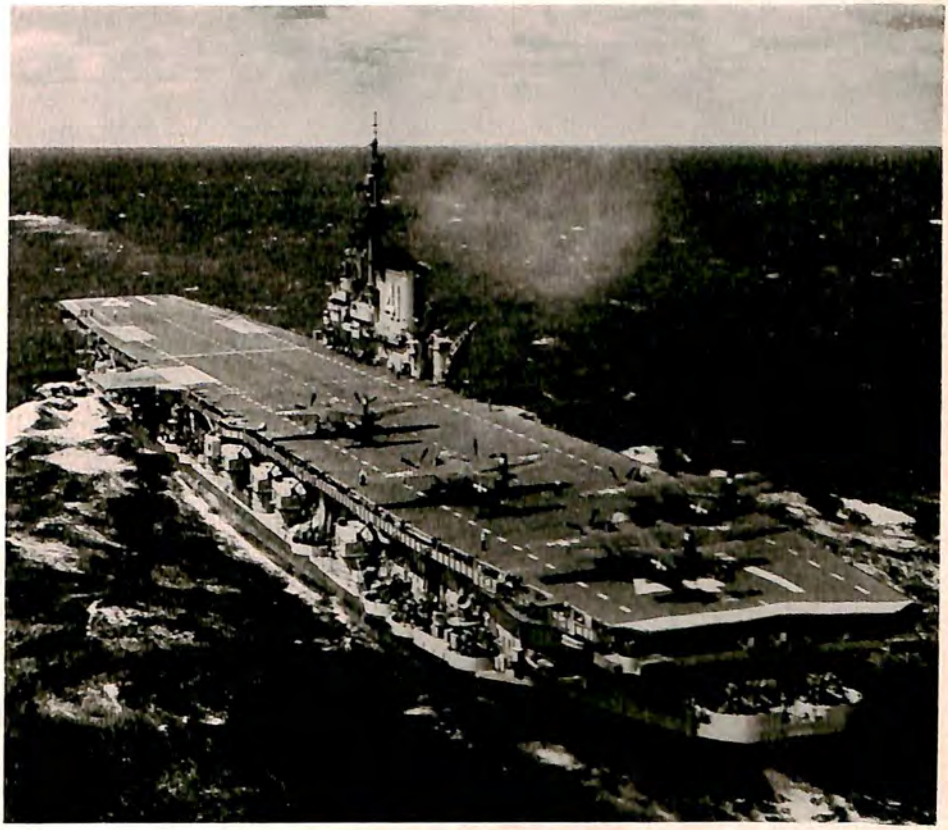
Navy announced production of the new Vought F7U-3 model of the tailless *Cutlass* carrier jet fighter. The new model features more powerful engines and substantial detail improvements expected to make it the fastest of its type.

The Bell X-5, latest of a series of special highspeed piloted research airplanes, made its initial flights during the year. It pioneers the use of an adjustable-sweep wing, held by many experts as the ideal solution to the problem of highspeed aircraft at low speeds. The wing is straight for the slow speeds of takeoff and landing but in the air its angle of sweep may be adjusted in accordance with the speed of the airplane desired. The prototype uses an Allison J35 turbojet engine and is intended for basic research on the problem rather than the attainment of high speeds but results of the program are expected to permit the design of aircraft capable of very high supersonic speeds yet able to takeoff and land at moderate speeds.

Air Force announced plans for tests of a turboprop-powered Convair Liner transport fitted as a flying classroom. The new trainer will be powered by two Allison T38 turboprop engines. It will be similar to the Convair-Allison *Turbo-Liner* but will feature the larger fuselage and wings of the newer Convair 340 transport.

Chase C-123 won a hard-fought battle for assault transport production and awards were made to the company and the Kaiser-Frazier Corp. for its volume output. Air Force has operated the airplane as a glider, a piston-powered airplane and, during the year, as a four-jet transport.

Boeing developed a training version of its big B-50 piston-engined bomber, the TB-50D. Removal of bomb bays and gun turrets permitted



North American AJ-1, heaviest regular carrier airplane

installation of accommodations for two student navigators and two student bombardiers in addition to the regular crew.

First Ryan XQ-2 pilotless target airplane was delivered to Holloman Air Force Base, New Mexico. The tiny jet-powered aircraft, on which no details were revealed, is a joint Air Force-Navy project designed to provide jet fighter speeds for anti-aircraft and missile interception training.

Air Reserve

With all USAF Reserve wings already on active duty the Air Force Reserve Training Program acquired new impetus during the year. The new program is a continuation, with some variation, of the Five-Part Air Reserve Training Program begun in June, 1949. This includes Air Force Reserve Training Centers, Corollary Units and Mobilization Assignments in the Organized Reserve, on pay status, and Mobilization Designees and Volunteer Reserve Training Units on non-pay status.

Vacancies in the Organized Air Reserve are expected to be filled from among those now in the Volunteer Air Reserve, from Air Force veterans not previously in the Reserve and from re-enlistments of reservists returning to civilian life from active duty. The new Air Force Reserve Training Center program has as its goal the training of approximately 3,000 officers and 8,700 airmen during the year. The centers, together with corollary units and mobilization assignments, are expected to include a total of 11,000 officers and 20,500 airmen. Membership in Volunteer Air Reserve Training Units, with present inactive duty training of the academic type and without pay, will total about 8,000 officers and 17,000 men. A total of 95 training centers are being established in major cities.

The new long-range plan is expected to answer the problem of providing men for the Air Force expansion program as well as to provide continuity in reserve activities lacking in previous programs. The needs of the program are seen in the fact that more than 170,000 reservists were on duty in Korea at year's end, all of them scheduled for return home at stated intervals.

Scheduled reserve flying training will not be resumed until June, 1952 and the current program calls for ground training only. However, these will include intensive correspondence courses, two-week training tours with regular Air Force units and attendance at civilian contract training schools.

Air National Guard

With 80 percent of all Air National Guard squadrons on active duty as the year ended, the training of replacement pilots became essential. The Air Force announced a plan whereby young men enlist in their local Air National Guard, are given flight training by the Air Force and then returned to their ANG unit at the completion of training. In those cases where the unit is still on active duty, the trainee is assigned to the unit but is returned home at the same time as the unit. To assist the new program the USAF has reactivated 28 air bases on which ANG units are now located in order to formalize their status. This activation in no way affects commercial activities at these airports. Authorization has also been given to the home bases of ANG units now on active duty in Korea to recruit and expand the base units in preparation for return of the flying units and their demobilization. This program will ensure continuation of these ANG units with new personnel immediately upon return home.

Air ROTC

A total of 62 colleges and universities was authorized to start Air ROTC units during the year, bringing the total of such schools to 187 as the year ended. All Air ROTC graduates were commissioned and called into active military service within 90 days after graduation. These included about 5,000 new officers from the February and June graduating classes.

CHAPTER THREE

Technical Progress

TECHNICAL PROGRESS, the life-blood of the aircraft industry in its battle for speed and performance, proceeded on a broad front throughout the year. There were new aircraft and modification advances on old ones. There were entirely new fabrication techniques and the application of processes familiar in other industries to aircraft for the first time.

Increasing production demands for the expanding U.S. armed forces and the needs of the NATO countries abroad placed the technical emphasis during the year on tooling and fabrication processes and there were tremendously interesting developments in this field. Here are reports of the more important ones to the extent the ever-lowering curtain of security permits.

Boeing Airplane Company

The year 1951 marked the 35th anniversary of the Boeing Airplane Company and many developments during the year were concerned with advancing research techniques. Development of the "aeroelastic" B-47 wind tunnel model series was one of these projects. Boeing engineers had designed the six-jet Stratojet with thin, swept back wings, a necessity for extremely high speed flying. But the thin, flexible wings posed a new problem for the company's wind tunnel engineers—how could flexible qualities best be studied when all previous experience had been with solid wind tunnel models possessing very little "give"? The problem was solved by developing a new model-building technique, capable of providing both structural and aerodynamic answers not only for static conditions, but for all cases of flutter and dynamic stability. Instead of making models of traditional steel or high-strength alloys, the model crew shifted to thin aluminum alloy beams, balsa wood and other lightweight materials, putting them together in such a manner that the finished model had exactly the same flexibility as the full-scale airplane.

Three types of tests were set up for arriving at the aeroelastic flight data: (1) the effect of aeroelasticity on static stability and control characteristics was determined with the model mounted on a rigid support; (2)

dynamic stability tests were conducted by "flying" the model with varying restraint while providing several degrees of freedom for the type of problem being investigated, and (3) flutter testing was conducted with all types of model suspension. Small cut-out sections in the models allow the addition of lead weights to simulate fuel or bomb loads of the real airplane. Even transparent plastic tanks have been devised to duplicate "sloshing" effects of a fuel load under turbulence or flutter.

The second Boeing research development aimed at speeding research itself was a six-pen graphic flight recorder which gives engineers immediately usable flight test data. When tests were made on the company's XB-47 *Stratojet*, motion picture cameras were used conventionally to record required information as it appeared on 79 indicators. Although accurate, this method by itself, entailed a two-week delay while details were transcribed. What Boeing researchers needed was a record usable immediately after flight—so they developed "Wigglin' Willie."

This machine writes with six pens on a moving roll of graph paper 150 feet long. Each describes faithfully the airplane movement to which it is linked. One of the pens marks off time intervals, while the others record such functions as air speed, angle of pitch, normal acceleration, elevator position and elevator hinge movement. In their newest version the "Wigglin' Willies" move the graph paper at four speeds ranging from one-and-one-half to 75 inches per minute.

Also aimed primarily at speeding analysis is Boeing's new BEAC analog computer, developed by the company to solve motion problems in its laboratories. Operating on the analog principle—duplicating in electrical voltages the possible motions of the system under investigation—use of one of the computers makes it possible for a man to solve in one week a problem which otherwise would require his work for more than a year with a desk calculator. Nine of the upright, cabinet-size computers were ordered during the year by Johns Hopkins University's Applied Physics Laboratory and four aircraft manufacturers. Twenty-one are in use in the company's own laboratories.

Invention of aluminum decals resulted from the inadequacy of conventional paper appliques which for years have spelled out "No Step," "Jack Here" and similar instructions inside and outside all airplanes. Besides becoming almost indistinguishable after routine airplane cleaning and maintenance within the airplane, paper transfers tended to curl, then disintegrate when they are buffeted by the airstreams on today's high-speed airplanes. The new Boeing-designed appliques—known as Metal-Cals—are made from paper-thin, .003-inch-thick aluminum foil, are almost abrasion-proof and, in their latest edition, have a cellophane-covered "postage stamp" back which enables them to be applied simply with no danger of curling.

Key to Metal-Cal production at Boeing is the manner in which the aluminum stock is processed so that die-fast letters can be imprinted on it. First, a color retentive coating is created on the surface of the foil. Printing then is applied by a standard offset multilith process. More exacting than color film developing and printing, Metal-Cals can be made to reproduce any color. In addition to Boeing's Metal-Cal production for its own use at Seattle, and for use by other aircraft companies, more than 50,000,000 of the aluminum decals have been manufactured by a Boeing licensee for hundreds of products ranging from golf clubs to refrigerators.

Another significant Boeing engineering development during the year was the unique four-pound mechanism which dehumidifies air entering the cockpit of the B-47 Stratojet. It prevents formation in the airplane's cockpit of rain, fog and snow which all too frequently occured in jet airplanes whose speed is capable of shooting them from sea-level altitudes into the sub-stratosphere in a very few minutes. With outside temperatures often changing as much as 200 degrees during this brief time interval, the airplane's air conditioning system normally has all it can do to maintain a comfortable temperature inside the cabin, much less control the vapor content.

Boeing's dehumidifier is an impeller with a cyclonic rotor attached—80 percent efficient by test. The 20 percent residue, in addition to making the cabin air more suitable for breathing than if it were completely dry, evaporates, thereby assisting the cabin cooling process. In operation the cyclonic-impeller combination literally gushes the water extracted from the air into a trap which discharges it into the air stream.

Boeing's research in connection with electrically heated windshields for airplanes is the continuation of a program begun in 1947 when the company became interested in the new type glass for use on its commercial Stratocruisers. Working with the manufacturers, Pittsburgh Plate Glass Co. and Libby-Owens-Ford, Boeing developed—and continues to develop—many new techniques in the design, application and heat regulation of the new windshields and special purpose windows. Not only do these windows effectively prevent ice and fog formations, but they also make the windshield more impact resistant and hence better able to stand mechanical shock such as collisions with birds.

Boeing research in the metallurgy field is being pursued along several different lines. In titanium the company is evaluating several different alloys as substitutes for high alloy steels. These new alloys indicate good possibilities for weight saving in aircraft structures by use as substitutes for steels of up to 160,000 and 180,000 psi heat—treat-range, and by redesign of parts usually fabricated from even higher strength steel. Sheet, plate, tubing and forgings all are being considered. Fabrication and processing of structural components from alloys are being examined.

BOEING B-47

According to official company count, there are 52,000 parts in a Boeing B-47 Stratojet bomber. In the skin of each set of wing panels there are 15,000 drilled bolt holes. Each of these parts and drilling operations must be scheduled so that they will be the right part at the right place at the right time.

Studies are being conducted also in connection with the new heat-treatable stainless steel 17-7PH. This new steel presents the possibility of replacing conventionally work-hardenable stainless steels which are difficult to form in the hardened condition and for replacing annealed stainless steels with an increase in properties. The new alloy permits forming and welding in a soft condition. Then it can be heat-treated to obtain tensile strength of 180,000 to 200,000 psi.

A new aluminum alloy, XA-78S, is being tested to compare its properties with the present high strength alloy 75ST now used extensively on all production Boeing airplanes. Fabrication tests are being conducted to study the new metal's forming characteristics and to obtain a comparison with 75ST.

Early in 1951 Boeing concluded perhaps the most all-inclusive structural testing program ever conducted for an airplane. Begun in June of 1950, more than 100 different tests were included in the over-all program to prove the structural design of the B-47 Stratojet bomber. The tests included application of more than 700,000 pounds of load to the wing of a complete B-47 in the Boeing Wichita Division plant and bending of the airplane's wing tips over a total arc of more than 20 feet. Hydraulic jack-actuated cables pulled on wings, tail surfaces and body of the Stratojet, simulating extreme flight conditions.

More than 350 tons of structural steel was used in fabricating the jigs and scaffolding to support the test airplane. Some 10,000 feet of steel pipe carried hydraulic power to jacks, which exerted the necessary pressures through a cable and pulley system. Although the static test airplane did not leave the ground—at least in the normal sense—during one phase of the program it was supported completely by cables. Cables attached to body and tail surfaces pulled down while other cable systems exerted upward forces on the wings. In addition to the entire airplane, components also were tested as individual units.

Continental Motors Corporation

Continental Motors Corp. revealed that it had been in production during the year on a new line of air-cooled engines which the Army Air Force is using extensively in a wide range of ground installations. The engines can be started at temperatures as low as 65° below zero and have a power range from 15 to 250 hp.

The new line includes five horizontally-opposed models and one single-cylinder model. All are military adaptations of certain models in Continental's standard line of airplane engines, with which they have a very high degree of parts interchangeability. The horizontally-opposed units are built with 2, 4, 6 and 8 cylinders. Two 4-cylinder engines and one 6-cylinder model are in production at present.

A unique feature of the new engines is a load-sensing governor which operates in accordance with speed changes and venturi pressure to increase or decrease engine speed automatically as the applied load changes. It is the first governor of its kind ever developed, and adds much to economy of operation, according to Continental engineers.

The engines are of extremely light aircraft-type construction. They are capable of running at full rated power continuously, although operation at 75 percent of rated power is recommended for maximum engine life. Each engine is equipped with a cooling fan, cooling shroud and baffles, flywheel, exhaust manifold cooling shroud, self-contained heating system and load-sensing governor, and is completely radio-shielded.

Douglas Aircraft Company

Installation of combustion-type heaters on wing tips of the C-124A Globemaster II transport was an interesting 1951 development by the Douglas Aircraft Company, Long Beach Division. Heaters were installed in pods supported from the ends of wing spars in place of smaller units placed within the wing. This arrangement offered several advantages over the previous installations, carried over from the C-74. In that airplane, and in the early versions of the C-124A, anti-icing heaters were buried within the wings.

First improvement resulting from the change was a reduction in the total number required for the entire anti-icing installation on the airplane from 10 heaters of three different sizes to only four heaters of the same size and capacity: 600,000 BTU. Not only was there a net gain of 900,000 BTU for anti-icing purposes, but an improvement in service through interchangeability of all heater units.

Another advantage is that wing tip heaters are separated from the nearest fuel tanks by 34 feet. Previously, heaters and wing fuel tanks were one foot apart and separated by the front spar web. Added weight at the wing tip also is desirable from a structural standpoint because it reduces the bending moment in the spars. The final advantage was an increase in the airplane's service ceiling by approximately 1,300 feet because of the favorable end-plate effect of the pods.

Design of the pods and the heater installation proved a challenge to engineering ingenuity which was met successfully through studies and extensive physical tests, including loads as high as 20 g's for the heater supports. Heater pods were tested up to their ultimate loads by dropping from a guillotine-type test jig while the heating units actually were operative.

Originally conceived by Warren Brass of the Long Beach engineering air conditioning group, the wing tip heater installation was developed under the direction of W. F. Walker, chief of that section, and C. G. Brown, design engineer.

Research in manufacturing techniques with titanium was another major Douglas development. It was learned that this newly-refined metal meets many of the requirements for construction of high speed airplanes in which skin temperature rise caused by friction augments the internal temperatures generated by jet or rocket engines.

O. A. Wheelon, production design engineer in the Santa Monica Division, was in charge of this work.

In the construction of one advanced airplane, Wheelon pointed out, a limited application of commercially pure titanium made possible a saving of approximately 5 percent of the structural weight. Lessons learned by Douglas in pioneering the use of 75S aluminum alloy proved valuable in developing manufacturing techniques with titanium. The method was to first learn the fundamental characteristics of the metal and then find tooling and manufacturing methods best applicable to those characteristics rather than proceed by trial and error. Similar approaches have been made in developing methods of employing artificially aged 24S aluminum alloy and the new alloy, XA-78S.

The Douglas El Segundo Division made a novel departure from conventional aircraft design in developing the new XF4D *Skyray* jet interceptor for the U. S. Navy. The object was to combine high rate of climb and high speed at altitude required for interception with low speed and landing characteristics required for carrier operations.

Theoretical studies indicated the desirability of a swept-wing planform with low aspect ratio wing with only a vertical stabilizer in place of conventional empennage. Aerodynamic studies, first substantiated by extensive wind tunnel tests, later were confirmed in free flight.

Fairchild

Having achieved an enviable production record in turning out planes for the Air Force at one of the lowest costs per airframe pound in the entire industry, Fairchild developed a number of aids to production during the year. Designed to speed quality control operations, they included a completely automatic machine for testing and certifying the hardness of sheet metal parts, and an adaptation of a General Electric "metals comparator" for segregation of identical small metal parts or stockpiles of bars, rods or sheets from mixed lots.

Of note also was the successful application of an IBM electronic calculator to the solving of complicated engineering problems at the Aircraft Division. The technical methods used at Fairchild to obtain outstanding results from the mechanical brain were observed and recorded by Robert Lowey, noted aircraft research specialist, and electrical circuits used in making calculations on C-119's were reproduced to be used by the Cornell University Aeronautical Research Laboratory. The Fairchild engineering staff has been able to set up and solve on the machine complicated sequential equations involved in flutter analysis, aerodynamics, weight and balance problems, and other aspects of structural design.

The company's tool engineering department evaluated during the year a co-ordinate setting machine or "optical tooling jig" for the Air Force's Materiel Command. The optical tooling device, originally introduced at Republic Aircraft, has proved a complete success in the setting up of large jigs to be used in fabrication of the company's C-119H model Flying Boxcar, and it is planned to make use of it in the construction of other large jigs in the future.

Hamilton Standard Division
United Aircraft Corporation

Hamilton Standard Division of United Aircraft Corporation continued during 1951 to push its research and development programs on high speed blade aerodynamics and control of propellers for use on gas turbines. Attention was focused during the year on adaptation of the proved Hydromatic propeller, already in heavy production for military and commercial aircraft, to the turbine engine. Sharing development emphasis was the division's expanding line of aviation accessories.

The Hydromatic, in conjunction with the integral oil control assembly, conclusively demonstrated its adaptability to turbine engines in many flight tests on a Pratt & Whitney Aircraft turbine engine in a Boeing B-17 "flying test bed." Good governing and stability characteristics were noted by pilots conducting the tests.

To complete the adaptation of the Hydromatic to turbine engines, however, involves the addition of a direct blade angle control for ground handling and landing operations, plus changes in the propeller control to prevent overspeeds resulting from sudden applications of large amounts of power. Hamilton Standard's direct blade angle control was subjected to extensive testing on a turbine engine during the year.

Instantaneous propeller response to changes of as much as 4,000 hp, one of the extreme requirements of the turbine engine, remained a problem for the Hydromatic propeller until the development of a new device for momentarily resetting the propeller governor. The device, operated by movement of the pilot's power lever, makes maximum pitch change rate available almost instantly.

Tests by the Air Force and Navy on both turbine and reciprocating engines continued to prove the basic principles of the division's new line of Turbo-Hydromatic propellers. This propeller uses an electronic control to regulate engine operation in flight. On the ground, control of propeller blade angle by the pilot permits him to maneuver the airplane by varying blade pitch to change the amount and direction of propeller thrust.

The most recent Turbo-Hydromatic announced during the year was a 19-foot model, whose blade pitch is changed rapidly by two pumps, each the size of an inkwell. Requiring a total of fifteen horsepower from the engine shaft to drive them, the pumps are used together only for rapid pitch adjustment in the event of sudden power changes, and for feathering and reversing. Each pump can deliver thirty quarts of oil a minute for hydraulic operation from the propeller's own oil reservoir. Under normal conditions, only one pump is used for propeller operations.

Still a third type of propeller, designed for use on high power turbines, was under development during the year. Including the best features of the Hydromatic and the Turbo-Hydromatic, it would make provision for high speed blades and for an engine mounting capable of absorbing the high bending moments encountered at high speeds with large propellers and high engine powers. Also included is a pitch lock to prevent the propeller from going into low pitch unless called for.

Investigation into the aerodynamic problems of high speed blades continued throughout the year with emphasis on actual testing in the wind tunnel of United Aircraft Corporation's research department. Intended to increase the general knowledge of the division's aerodynamicists and establish more firmly the design requirements for supersonic propellers, the investigations were leading toward a more effective compromise between the structural and aerodynamic requirements of an efficient propeller capable of supersonic operations.

In adding new products to its expanding line of aircraft accessories, Hamilton Standard encountered a variety of problems. Its high-power starter, in common with other units relying on high speed turbine wheels, initially shared the problems of complex vibration spectrums involved with high speed operation. Hamilton Standard's long years of experience in the techniques of vibration measurement and control aided materially in meeting these problems.

The division's jet fuel control, in which electronics plays an important part, led the engineers to draw on years of experience in developing a variety of propeller controls, notably synchronizing and synchro-phasing constant speed controls. The electronic unit, as a result, is developed from the viewpoint of the mechanical engineer and is divorced from the principles of radio-type construction.

A 30-year background in the development of hydraulic and mechanical operating systems was indispensable in developing the fuel control's hydraulic unit. Many months of investigations into materials, finishes and surface hardnesses were devoted to developing a corrosion-proof control whose moving parts are not lubricated, and do not set up leakage problems.

Hamilton Standard's air cycle refrigeration unit for jet fighter cockpits, its first item of aviation equipment to be announced, was selected for a number of important installations. North American's F-86D was joined by the North American FJ-2, the Lockheed F-94C and Chance Vought F7U among the fighters. Large aircraft for which orders were received included the Consolidated Vultee R3Y. Development efforts in this field were centered in developing units designed to meet the specific physical and operational requirments of each airplane.

Kollsman Instrument Corporation

The activities of the Research and Engineering Laboratories of Kollsman Instrument Corporation in 1951 were directed toward instruments and systems for the various branches of military aviation and these are, for the most part, classified. It may be mentioned, however, that emphasis is being placed on centralized computing of flight data to reduce complex cockpit instrumentation.

ELECTRONIC UNITS

The Air Force and Navy will spend about $50 million for electronic flight simulators to speed the training of crews in not only the operation of the airplane but its electronic equipment as well. The complex electronic units simulate in every detail except "g load" the operation of a combat airplane. Four major suppliers of the units are; Link Aviation Corp., Binghamton, N. Y.; Engineering Research Corp., Riverdale, Md.; Curtiss-Wright Propeller Division, Wood Ridge, N. J., and Goodyear Aircraft Corp. Akron, Ohio.

The simulators cost anywhere from $275,000 to $500,000 each, depending on the aircraft represented but these amounts are saved—and more—in only a few months of operation over that required to use the actual airplane for training purposes. All aircraft types are represented: Link is building simulators of the Boeing B-47, Northrop F-89, Douglas F3D and North American SNJ; ERCO is building the North American F-86, Douglas AD, Douglas F3D, Grumman F9F, Lockheed P2V and Martin P5M; Curtiss-Wright is building the Boeing B-50, McDonnell F2H, Convair B-36, Boeing C-97, Fairchild C-119, Douglas C-124 and Douglas A2D and Goodyear is building a simulator for its Navy blimp.

One of the design projects at Kollsman is a master computer, a single unit which will compute true air speed, indicated air speed, Mach number, relative air density, true temperature and the various altitude indications. The new computer will be an electro-mechanical system which will utilize synchros to relay the functions of flight to the automatic controls of the aircraft. It promises to eliminate the customary four to five repeats of each given instrument presently required in an airplane. Along with space-saving features, combined with efficiency of operation and simplicity of installation, the new Kollsman computer should reduce instrument costs for each aircraft.

During the year, Kollsman expanded its radio communications engineering section in keeping with the present military program. In conjunction with Standard Coil Products Co., Inc., of which Kollsman is a wholly-owned subsidiary, the company has broadened and intensified its development work in the field of radio communications and navigation equipment. Many of the newer projects are in the microwave field and stress radar and other navigation devices. Additional engineering and technical personnel, as well as supplementary research facilities, were procured for the expanded section.

Lockheed Aircraft Corporation

Tubular extrusions have been flattened by a bi-axial stretch method developed in the Lockheed plant during 1951. These parts are now in production on fighter airplanes and additional production was scheduled for fall, using integrally stiffened extruded surfaces on the *Constellation* transports' wings. Forming investigations have shown that quite severe conical shapes can be formed satisfactorily and such a procedure has been developed.

Lockheed has also been testing new types of finishes for metal surfaces exposed to the weather. The best chemical finish developed is called chromic or sulphuric annodizing. All these finishes are inorganic materials as distinguished from painted finishes.

It was found that abrasive belt grinding, which has been used for many years for polishing stainless steel and other high-gloss metal finishes, had a practical use in aircraft construction. It was also possible to taper sheets by this precision method and to clean up surfaces of raw stock which is to be held on a vacuum chuck for machining.

Lockheed tested various cemented configurations of wing trailing edge assemblies for the Constellation during the year. Metal-to-metal cementing will offer advantages here because of an existing problem, due to concentrated "buckling loads" at rivets and spot welds in the present design. Reason for the problem is that the gauge of skin is so thin at this place, it has a tendency to crack at rivets and spot welds. Use of cement will avoid this concentration of stress points. Lockheed is now making several studies of designs for possible application in making a wing using metal-to-metal bonding.

Lockheed is developing new applications for use of "Honeycomb" construction all the time. One new springboard to more expanded usage of this type of construction is the development of high peel characteristics.

Lockheed is keenly aware of the structural possibilities of titanium and its alloys, and therefore is actively engaged in investigation of structural, machining and forming properties of this new promising material, as well as its application to forgings, fittings, and bolts.

Extensive research and development tests were conducted on hydraulic, pneumatic, mechanical, and control units and systems for current and experimental airplanes, to determine their operational fitness, performance characteristics, and conformance to specifications, methods of eliminating malfunctions, plus tests to improve efficiency, serviceability and reliability. Life size mock-ups of the mechanical and hydraulic systems are constructed and tests conducted to insure satisfactory operation and life, and also to insure that all the units and systems are coordinated to meet the design requirements.

Comparison, evaluation and development tests were conducted on seals, fittings, packings, fuel and air connectors, bearings, pumps, valves, and metering devices. Friction, lubrication, and corrosion problems were investigated to determine actual values, causes of malfunctions and means for improvements. Long-range general research projects were conducted to solve basic problems and to explore new methods, devices, and systems applicable to aircraft.

The electrical research department at Lockheed was loaded during the year with an unprecedented amount of testing and development problems.

Gains were also made in non-project work. This effort was directed toward the development of new electrical devices for aircraft, the testing of new manufactured products for consideration for future use in Lockheed planes, and the development of new techniques and equipment to improve and expand the facilities of the laboratory.

Many improvements have been made in the instrumentation equipment used in structural tests, such as apparatus for ultra-fast recording of strain and load or any other two variables; the application of strain gauges to non-metallic test specimens; a tachometer generator without commutator ripple, and automatic range-changing for recording instruments.

Research activities of the metallurgical-chemical research department at Lockheed during the past year included development of foamed plastic materials having improved structural and electrical properties, development of new radome shapes having improved radar and aerodynamic performance, development of low-cost foamed plastic materials for use as thermal insulation and structural adhesives in the fabrication of Arctic shelter panels, development of various techniques for fabrication of metal-clad boots for wing leading edge de-icing, and investigation toward improving the physical properties of light alloy castings by applying supersonic vibrations during the solidification process.

Glenn L. Martin Company

Some few new design projects may be mentioned here as having occupied the best efforts of Martin engineers during 1951, without compromising the nation's security. The Canberra, for instance, because of its foreign origin, presented a great many production design problems in connection with its conversion, engineering-wise, to American manufacturing standards and shop practices.

All sheet metal parts required redesigning to wider dimensional tolerances, to make the B-57A skins and bent-up section susceptible to handling by machine methods. Manual fabrication customs of the British, moreover, accounted for oversize sheets and other design specifications that were incompatible with the equipment and methods in use in this country. Again, the Canberra has an integral "garden gate" structure, athwart its center wing section—formed by hogging out of an aluminum billet. The component had to be redesigned, since billets of that size are in short supply.

The importance attaching to electronics, these days—and to the many, mostly classified, accomplishments of Martin electronics engineers—is indicated by the Company's erection of a 60,000-square-foot balcony, exclusively for the design, construction and testing of fire-control radar, missile guidance systems, telemetering devices and airborne antennas.

Recent developments in electro-mechanical engineering at the Martin Company include the zero-length, roadable launcher for the Air Force's B-61 Matador. Another noteworthy advance is the application, in the Martin 4-0-4 heating and air-conditioning system, of iris-action valves of the Lundy type. Installed in the aftercooler, bypass and windshield-defogging ducts, these valves save weight and space—and afford greater accessibility for purposes of repair and maintenance.

A number of engineering projects were under way during 1951, in the field of rocket propulsion and pyrotechnics. A successful solid fuel was developed for the volume-generation of gases to run auxiliary powerplants in missiles. Research directed toward the improvement of JATO bottles is progressing, in experiments with cylinders made of new lighter-weight materials such as magnesium, as well as with protective high-heat-resistant coatings for the throat of the JATO nozzle.

New facilities for testing, manned by a staff of experts in pyrotechnics, have accounted for a considerable amount of advanced research, last year, in explosive-release mechanisms—such as detonating bolts for emergency ejection devices.

Martin structures engineering was responsible for the improved main landing gear of the 4-0-4 airliner, which incorporates an oleo drag strut designed to absorb shock forces in both a vertical and a fore-and-aft direction. This self-contained device reduces spin-up loads by nearly one-third. Then again, under structural developments, belongs the proving out of aluminum Honeycomb material as the sole stiffening for the wing and tail surfaces of missiles. Installation of Honeycomb in the KDM-1 *Plover* represents a considerable saving in weight and fabrication costs.

The slot-type aileron developed and tested for possible use as in auxiliary flight control surface for the Martin 4-0-4, among other things, stands to the credit of the Company's aerodynamicists. This aileron gives higher rates of roll than are attainable by most fighter airplanes. A special advantage lies in the fact that the control forces are irreversible—so that no added stick loads are fed back to the pilot. The Company's engineers were most active, during 1951, in the field of hydrodynamics—a traditional specialty at Martin.

Pioneering experiments were conducted in the "water-basing" of hull-type seaplanes—embracing all known methods of high-speed landing and takeoff from water. Improved seaworthiness and reduced aerodynamic drag feature the several design refinements applied so far to Martin flying boats in the 1950's.

North American Aviation

Highlighting production innovations at North American Aviation in 1951 were new technical implements and methods for mastering old problems common to the industry.

One of the oldest problems—putting rivets in their proper place with accuracy and a minimum of rejections—was solved to a great extent when North American acquired a General Drivmatic riveter at its Torrance plant. Still the element of human fatigue in handling and setting up heavy wing skins of the F-86 Sabre for riveting left engineers thinking of accessories that would better adapt the riveter for the company's specific uses.

A pair of production methods engineers, Harold Hubbard and Al Gerber, worked out two invaluable accessories—a 42-foot handling jig and a correlated photo-electric cell arrangement for spotting proper riveting places through a specially-scaled template with holes.

Advantages of General Drivmatic with the added accessories over hand operation are many; riveting can be done about three times faster than by the manual method; the machine, unlike human beings, does not tire; quality of work is far higher; all rivets are centered at the same pressure. There is only one percent rivet rejection as compared with 12 to 13 percent through hand operation. Approximately 99 percent of rivet head milling is eliminated through this method.

Equally arresting as new riveting equipment and developments were implements and processes initiated in the company's machine forming department.

Despite value of the hydraulic press in forming metal parts such as flanges and beads, it has a marked shortcoming in leaving wrinkles in formed parts. Wrinkles mean extra work. A bout with the problem of how to keep wrinkles down to a minimum or completely out of sheet metal parts in the hydraulic press process led two experts of the machine forming department, Lyle Boarts and Carl Anderson, to an idea that is revolutionizing machine forming of parts.

Simple and easy to put into operation without demanding the change of costly press equipment on hand, the new system of forming flat sheet metal still utilizes pressure on a rubber mat, which "flows" around a die to shape the part. A pair of metal hydropress clips makes the difference between near perfect parts and those that add extra hours and cost to the finished product.

From ordinary 75S-T6 aluminum alloy sheet, one of these clips can be bandsawed into the shape of the part to be formed and made ready for use within three hours. Three attached flat sheets of metal—a triple-decker—make up the hydropress clip. To allow room for the metal to be formed, the middle sheet, a "spacer," extends less than halfway to the clasping end of the clip. The spacer, one gauge thicker than the sheet to be held for forming, permits insertion of metal as two pieces of bread might be hinged slightly open to accept a slice of cheese.

Both ends of the metal sheet stock to be formed are fitted into the clasping ends of the clips. The metal is placed across a form block. When the rubber mat of the hydraulic press charges down to form the metal to desired shape, the clips, too, move with the downward flow of the rubber, taking

IMPACT

Everyone knows just about what would happen to the passengers if an automobile traveling 120 miles per hour were stopped completely in 19 feet.

Yet exactly this situation was simulated recently at Edwards Air Force Base, Calif., when Major John Paul Stapp, aero medical scientist, had himself decelerated in a special sled.

During the tests, intended to determine how much impact a pilot can stand in an airplane crash and still survive if properly protected by restraining harness, Major Stapp experienced a gravity pull of 45 Gs, the highest known ever encountered voluntarily by man. At no time, the officer reported, did he black out or lose control of his vision, hearing or ability to move his limbs.

the "slack" out of the metal. The clips are forced off as the part is completely formed.

The new clips have been used successfully on severe stretch flanges to form parts without permitting cracking. Clips restrict stretching along sensitive edges until point of disengagement with the part, thereby causing an even stretch away from the edge.

That the ratio of handwork to hydraulic press time was reduced from 10 to 1 in 1947 to less than 2 to 1 today is not entirely attributable to the revolutionary hydropress clips. Two other tools have contributed to making the forming of metal parts a more economical operation.

One, originated by shop men, works on the pneumatic hammer principal. A rivet gun motor attached to a table is rigged so that the trigger operates automatically by pressure of the formed part against the rivet gun head. The pneumatic head of the rivet gun is fitted with a small phenolic block. Contours of the formed part are set by rolling it in its form block rapidly back and forth on the block fitted to the gun head. This fixed type pneumatic hammer quickly beats out the wrinkles.

Second of the tin-beater tools is the mechanical lead slapper. Its greatest advantage is in striking harder, more evenly and faster than the human tin-beater and, furthermore, doesn't tire. The slapper and the small pneumatic hammer are now being produced under North American Aviation license by Hufford Machine Works of Redondo Beach, California, for the aircraft industry.

Ryan Aeronautical Co.

A new high-production machine, capable of stepping up machining speeds, simplifying set-up procedure and improving surface finish, was installed during 1951 to speed production at Ryan. An accessory to a Bullard turret lathe in the jet assembly department, the machine is a Turchan hydraulic duplicator. It converts the vertical turret lathe into an automatic production tool with time savings approaching 100 percent.

Designed as the ultimate in high precision control attachments, it consists of a motor-driven hydraulic pump which supplies uniform oil pressure of 500 pounds per square inch to a sensitive valve and master control cylinder. The valve is actuated by a tracer point which "feels" the outlines of a pattern, or template, and meters oil directly to the control cylinder. The piston in this cylinder moves a tool slide which supports the cutting tool. When attached to the Bullard turret lathe, the duplicator accomplishes exact duplicates of master patterns directly in metal.

Another massive multi-purpose machine tool of high precision was also added at Ryan. A horizontal boring, drilling and milling marchine, it is made by the Giddings and Lewis Machine Tool Company of Fond Du Lac, Wisconsin.

With an unusually large bed and open-type structure, it is especially suited for handling large, unwieldly and odd-shaped castings or fabrications.

With its wide flexibility, it can be efficiently used on single pieces, short runs or quantity production.

Where formerly it took approximately 40 hours work to drill and bore the exacting positioning holes in the General Electric J-47 jet engine tools for the tail cones, the new machine does the job in 8 hours.

Weighing 19,000 pounds, the machine has the necessary size and weight to insure extreme precision on work over a large area.

Precision drilling of the 160 bolt holes in the flanges of the General Electric J-47 jet engine exhaust cones is now accomplished in a fraction of the time normally required by means of several Ryan-built drill jigs now in use. Designed and built by the Ryan plant engineering department, these accurate tools drill the bolt holes in the cone assemblies in only 80 minutes.

Each drill jig consists of a precision-made steel tool which rigidly holds the General Electric component while a pair of Keller airfeedrills cut through the one-half-inch stainless steel flange. After the cone assembly is locked in the jig, the drills are pivoted into position in such a way that their cutting bits are exactly located as required by engineering specifications. The hole pattern for these bolts must be accurate within ten thousandths of an inch, radially. Hole size tolerance is plus .004" and minus .001".

A single valve is pressed by the operator to drive the drills, which start simultaneously, cut through the tough metal and return to their starting position without supervision. After drilling, the jet assemblies are removed and placed in a Ryan-built deburring machine which carefully removes the burrs of metal caused by the drills, without undercutting the flange itself.

Latest development in Ryan's progress with ceramics is their application to exhaust manifold "high spots ."

No deterioration by oxidation, carbon absorption or corrosion attack was evidenced in the ceramic-protected exhaust headers which were tested in actual flight for periods running to 1,623 hours. This is the first occasion in Ryan experience where an examination of high temperature headers disclosed no deterioration after substantial hours of service.

Encouraging results were obtained in a thermal shock test conducted with the ceramic coated headers. This study showed that the .001" to .002" thick coatings are not affected by thermal shock as encountered in exhaust system service at any temperatures between -70°F. and 1700°F. and that the ceramic will stand a surprising amount of mechanical impact without sustaining damage.

Several months ago Ryan arranged with Pan American World Airways and the Boeing Airplane Company for the flight testing of the exhaust system headers on the R-4360 Pratt and Whitney engines of *Stratocruisers* operating on the Transpacific run. Subsequently, a variety of exhaust headers, both coated and uncoated with ceramic material, have been tested and examined to form the basis for the metallurgical report.

No reduction in thickness was found, by dial gauge measurement, in the headers which were ceramic coated on both interior and exterior surfaces. On the headers which were coated on the interior only, a reduction of .003" was found to have occurred on the exterior surface as a result of high temperature scaling.

Flying radar stations for use in extremely advanced-type aircraft are being built experimentally at Ryan Aeronautical Company in "packages" almost small enough to fit a briefcase.

These new subminiature radar stations represent the ultimate in the years-long effort to shrink them to an absolute dimensional minimum. Huge radar installations with parabolic scanning units the size of a parachute canopy have been reduced in size to fit into a bulbous radome like that between the two fuselages of the F-82 *Twin Mustang* or enclosed in a Northrop F-61 *Black Widow* night fighter. Then such radar units were compacted into still smaller space, and compressed again and again to fit into packages of ever decreasing dimension.

The latest Ryan unit, an electronic brain with the same uncanny, instantaneous information-gathering and transmitting ability of huge radar installations on ships and military bases ashore, has been crammed into an amazingly small space. Its only limitation is the range the information can travel. Tubes, resistors and coils no larger than a fingernail, a paper clip, or a key are packaged amidst an intricate maze of wiring, some strands as slender as 3/1000ths of an inch.

Solar Aircraft Company

Development work at Solar Aircraft Company was undertaken in two main spheres. One type of research was directed toward improving the design and manufacture of existing products, and the other type aimed toward associated products, new to the Solar line.

Several basic changes in the design and fabrication of manifolds were made possible through Solar's patented Sol-A-Die process—many portions which were previously added as welded segments were formed as integral parts of the assemblies. The Sol-A-Die Process, which stretches the metal first and then merely folds it to the desired shape, made similar design changes possible in several turbojet components, thereby eliminating much of the necessary welding and reducing costs.

As part of the overall expansion program, a set of eight mechanized conveyor lines were installed at the San Diego plant to adapt mass production techniques to the fabrication of turbojet combustion chambers. Chief difficulty in effecting the adaption was the necessity for holding the close tolerances required in forming these parts which are subject to extreme temperatures in service operations. However, improved techniques have resulted in greatly increased production and substantial decrease in costs resulting from the greater efficiency of each assembly worker.

PRIME CONTRACTS

During World War II the aircraft manufacturing industry received 22.5 percent of the total defense prime contracts. Astonishingly enough, the industry now holds 22.3 percent of the nation's defense prime contracts. In the years since World War II, however, the relative position of the various aircraft companies among the top 100 industrial firms of the nation have changed rapidly. Many medium-size World War II aircraft builders are now comparatively small. Here is their relative standing among the top 100 companies of the nation together with their World War II standing and percentages of the nation's defense business:

Present Rank	World War II Rank	Company	Present Rank	World War II Rank	Company
1	6	United Aircraft	18	17	Bendix Aviation
3	5	Douglas Aircraft	19	—	McDonnell Aircraft
5	12	Boeing Airplane	21	73	Fairchild
6	22	Grumman Aircraft	22	14	Glenn L. Martin
7	10	Lockheed Aircraft	24	100	Northrop Aircraft
8	20	Republic Aviation	31	25	Bell Aircraft
9	11	North American	45	—	Piasecki Helicopter
13	2	Curtiss-Wright	68	69	Beech Aircraft
17	4	Consolidated Vultee			

Beyond the company's regular production of engine components, Solar research developed new projects, including a line of ceramic coatings and several small gas turbines. Although security regulations have not been relaxed completely, some information was released during the year based on results of tests conducted on these items in their initial adaptations.

Tests and a long series of experiments have proven that the Solar developed ceramic coatings, known as Solaramic, will permit the use of lighter gage stock and/or the substitution of stainless steel for high alloy, strategic materials in many aircraft 'hot' parts. Solaramic is applied in a very thin flexible coating and surface protection is afforded parts which must withstand operating temperatures ranging from 1500°F to 1900°F. Work was begun on mass production orders, but progress continued in developing the anti-galling characteristics of the coating and its qualities which resist corrosion and fatigue.

The Solaramic process includes a number of different ceramic mixes for use under varying conditions. While the coating is extremely tough, it is much thinner than other ceramic coatings and can be heated or cooled rapidly without cracking or flaking. In some applications, the coating actually expands and contracts with the metal.

Solar's two gas turbines completed their first tests during the year. Initial adaption of the T-45 as a portable fire pump for the Navy was followed by work on the J-2 model, where the same Solar turbine will be used to power an electric generator set. First application of the generator will be to provide electric power for cargo hoists on NATS planes. The T-45 may be started by hand cranking, burns either diesel oil or gasoline, and develops 45 horsepower at 40,300 rpm.

The somewhat larger turbine, known as the T-400, was developed as a prime mover in an emergency generator unit for the U. S. Navy. Although complete performance data has not been released at this time, its application for auxiliary electric installations at airfields and on large planes has been projected.

CHAPTER FOUR

The Government and Aviation

Civil Aeronautics Administration

AVIATION EDUCATIONAL efforts from the local to the international level was a principal feature of the operational programs of the Civil Aeronautics Administration during 1951.

Through active participation in the affairs of the International Civil Aviation Organization, CAA representatives advanced the CAA's hopes for worldwide adoption of VHF airway aids as standard. The dominance of English as a universal language of the air was recognized, and the intricate task of working out a safe and acceptable international air vocabulary was begun.

This, with the demonstration in actual use in several other countries of the VOR ranges, instrument landing system, and other new airway aids developed here, promised wider acceptance of U. S. methods and equipment.

Also educational in its effect was the continued work for facilitating air travel across national boundaries, with CAA officials taking the lead in ICAO conferences on this subject. Their task was the gradual elimination of border barriers that today had inherited from yesterday's slow and outmoded forms of transportation.

Locally, those who fly felt the force of nationwide educational efforts toward safety in flight, with the CAA sponsoring work in prevention of stall-accident deaths, and a self-education program to reduce pilot-caused accidents. CAA educational work in elementary and secondary schools brought an award to Dr. H. E. Mehrens, of the CAA, of a national trophy for "the promotion of air youth."

Efforts of the CAA for many years to hand over to industry the certification of its own products came to flower in 1951 when two manufacturers of light planes, Piper Aircraft Corporation and the Cessna Aircraft Co., adopted the suggested CAA method.

Safety in air transportation was creditable, with the scheduled airlines producing a record for domestic and international safety equal to the excellent one established last year, 1.3 fatalities per 100,000,000 passenger miles. In domestic operations, the record was slightly above that of last year, with

1.4 for 1951, compared to 1.1 in 1950. The international rate bettered from 2.1 in 1950 to 1.2 in 1951.

Large irregular carriers had accomplished 53 months of passenger carrying operation free of fatal accidents at the time this went to press.

Revenue passenger miles flown by domestic scheduled carriers increased 32 percent, from 7,766,008,000 to an estimated 1951 figure of 10,150,000,000. International operations accounted for an estimated 2,559,000,000 in 1951 as against 2,206,396,000 in 1950, an increase of 16 percent.

Ton-miles of freight carried by domestic scheduled carriers decreased by an estimated 6 percent, but ton-miles of express increased by an estimated 32 percent. Both express and freight ton-miles in international operations increased by an estimated 17 percent.

Other aspects of the CAA's promotional and educational program for 1951 were the training of more than 100 important individuals from other countries in the methods, policies and equipment of our civil aviation, and the demonstration of U. S. airway aids and the CAA's 25-year history through a graphic exhibition at the Paris International Aviation Salon.

On June 30, 1951, the end of the fifth year of the Federal airport aid program, a total of $166,537,603 in Federal Funds had been programmed, of which $162,194,067 had been put under contract. Funds had been granted to 1,952 projects of which 410 were under construction, 1,295 had been completed and 247 were being processed for construction.

Major task of the CAA during 1951 continued to be implementation of the "common system" of airway aids, and substantial progress was recorded, both in this country and abroad. Of the approximately 400 VOR facilities needed for complete coverage of the country, 305 had been fully commissioned and 11 others were operating on a test basis. Ninety-eight instrument landing systems were in operation, continuously improving the regularity of schedule of air carriers. Nine airport surveillance radar systems, and nine precision approach radar facilities were in operation at Boston, New York International and LaGuardia, Newark, Washington National, Atlanta, Chicago Midway, Cleveland and Los Angeles airports. The new plastic domes to house VOR transmitters, resembling large white derby hats, began to appear on U. S. airways, as the CAA replaced the square wooden houses to improve VOR performance.

These airway aids were also going into operation internationally. More than 30 instrument landing systems were in operation in the European area, with VOR facilities commissioned at London and Wales and planned for sites in France and Italy. DME, (Distance Measuring Equipment) an integral part of the new common system, was operating at London, Paris and Rome. Manufacturing companies in France and Germany were building or preparing to put into production, these special aids, a move calculated to assist these countries in equipping their airways with the least expenditure of their scarce U. S. dollars.

In its planning ahead in various aviation fields, the CAA sponsored a highly productive trip by representatives of government and industry to

North American F-86 being readied for wind tunnel tests

Europe for the study of foreign civil air transport development progress. The working group found that in jet-powered transport, the U. S. has lagged behind, since its entire output of jet engines has been taken by the military. The observers reported, however, that our manufacturing ability, added to the development work already done under military contract, would minimize this backwardness when the shift to this type of transport became imperative.

Looking ahead also, the CAA reported to the Air Coordinating Committee that local air transportation by helicopter can be expected soon, and a committee which studied the question forecast that 10-to-20-passenger helicopters would be in regular operation on routes from downtown big cities to nearby communities probably by 1953 or 1954.

Outstanding among the CAA's activities for flying safety during the year was work done by the stall demonstration plane throughout the United States. This plane, equipped with the same stall-warning devices used in the CAA's extensive studies of stall accidents, was flown by many hundreds of CAA safety agents, designated examiners and instructors, to show a better method of stall recovery. The CAA's research has showed that less altitude is lost in recovery from a stall by restoring the plane to level flight than by diving it. Lack of funds and time prompted CAA officials to request that pilots themselves spread this information throughout the industry in a strong effort to reduce stall accidents, still the dominating cause of private flying fatalities.

The CAA also returned to the principal of written examinations for private pilots, hoping thereby to persuade new pilots to learn what they should know to fly safely. To call attention to accidents which pilots themselves cause, the CAA inaugurated panel discussion meetings based on CAA and CAB reports of such accidents.

The CAA announced a new policy under which certificates of waiver of the air traffic rules would be issued for air races, air meets and similar aeronautical demonstrations, "only when it is shown that such activities will contribute directly to the advancement of, and public confidence in, aviation."

Discussion was carried on with aircraft manufacturers concerning certain turbine type engines which they were considering for powering civil transport aircraft. One civil transport was equipped with a turbine-propeller engine and was flying on an experimental basis. Money that had been authorized for CAA development and service-testing of jet-powered and turbine-powered aircraft was not appropriated by Congress, and plans for this activity were stopped, although CAA engineers gathered information from military and civilian sources on the general problems expected to be encountered in the use of such planes. Twenty-four new engine models ranging in power from 90 hp to 3500 hp were approved.

An important follow-up of one of the CAA's developments came with the certification of the second type of crosswind landing gear, a simpler and less expensive device hailed as a contribution to safety and economy of flying operations and airport construction.

Civil aviation felt the impact of the international situation. Remembering the last war when military requirements arbitrarily grounded most of our civil flying, the CAA cooperated actively with the industry to arrange for civil aviation to do its part in the country's defense preparations. A standard plan for mobilization of civilian pilots and their planes was prepared and submitted to the states, most of which prepared civil defense plans of their own which included private fliers.

The CAA, acting as the claimant agency for civil aviation, assisted in obtaining material for making at least 3,500 private planes for 1951. At the request of the military, and in line with preparations for defense, the CAA issued identification cards to all active pilots, and collaborated in establishing air defense security zones along the coasts and on the Northern border of the country. CAA airways operations stations were integrated into the defense plans of the military along with the radar warning network being rapidly completed.

Civil aviation again proved its emergency value to the people of the country in the assistance it rendered to flood sufferers in Kansas and Missouri. Protecting food crops by the aerial application of insecticides, weed-killers and other chemicals continued. The CAA's specially-designed agricultural plane completed its national test-flight tour and was returned to its designers for the development of better dispensing equipment of the chemicals which it was designed to apply.

CAA's medical division continued its studies of the effect of sudden decompression on passengers in high-flying, pressure-cabin airplanes, and in the fastest methods of evacuating passengers from crashed planes.

During the year, the CAA sold three transport planes which it had obtained as war surplus, returning them to service with airlines which needed them and realizing $800,000 for the treasury.

In May of 1951, Charles F. Horne, who had been director of the office of federal airways, was appointed Administrator of the CAA, succeeding Donald W. Nyrop, who became Chairman of the Civil Aeronautics Board.

The Civil Aeronautics Board

The Civil Aeronautics Board made air transport history in 1951 with a series of major decisions.

One defined the limits under which air coach services may operate domestically, at the same time recognizing this type of service as a permanent fixture in domestic air transport operations. A second put the Board on record favoring tourist rates in international air travel, particularly to Europe. A third, for the first time in U. S. transport legal history, separated mail and subsidy pay to airline operators. A fourth paved the way for extensive future use of helicopters in air transport.

In its coach service decision, the Board indicated that it felt the operation of coach services on an unlimited basis "is merely a part and parcel of the broad air transportation system of the country and that the present certificated airlines have the duty and will be required to provide adequate regular unlimited coach service." The Board viewed regular coach services as "not being supplementary to the operations of the certificated airlines, but merely a component part of such operations."

At the same time, the Board took a stand against "unlimited air coach operations on routes already served by . . . certificated airlines."

In making its decision, the Board indicated that in its judgment the question of coach services is largely one of price and that the people of the United States are entitled to expect the development of our air transportation system to the point where transportation by air will be within the reach "of the great majority of the people rather than those of high incomes." However, the Board indicated that this is a natural development of the air transportation system and can and will be brought about without the necessity for provision of unlimited service by new companies over routes already adequately served.

In its stand favoring North Atlantic tourist rates, the Board came out strongly favoring low-fare air travel to and from Europe in 1952. Stating that "the North Atlantic tourist service should be inaugurated prior to the 1952 summer season," the Board declared that "a New York-London one-way tourist fare of $265, with a 10 percent on-season discount and a 25 percent off-season discount for round trips, with Shannon as a gateway, is a sound fare structure."

"This fare structure," the Board added, "will meet the break-even need and provide a reasonable element of profit for coach operations. . . The higher off-season discount will, in the Board's opinion, tend to off-set normal seasonal unbalance and facilitate attainment of the average load factor.

"The proposed fare structure is therefore economically feasible, but at the same time low enough to provide for an adequate test of the untapped low-fare air traffic potential across the North Atlantic."

In its historic mail-subsidy pay separation, the Board stated on Oct. 1, 1951, that it had "effected an administrative separation of service mail payments from subsidy payments for the domestic air carriers of the United States which are certificated for the transportation of (air) mail."

Goal of the new policy is four-fold:

The Civil Aeronautics Board has effected an administrative separation of service mail payments from subsidy payments for the domestic air carriers of the United States which are certified for the transportation of mail in order:

"To identify those amounts which are compensation to the air carriers for carrying the mail, and provide the public with full information as to the cost to the Federal Government of maintaining and developing the domestic airline industry.

"To provide the President and the Congress with information which will permit a review of the amounts being spent for domestic airline subsidies.

"To provide information which will assist the Board in arriving at policy decisions affecting the development of the domestic air transportation industry.

"To eliminate the uncertainty with respect to that portion of the Post Office Department deficit which is directly traceable to subsidies to the domestic airline industry."

The Board has effected this administrative separation of service mail payments from subsidy through staff study and without consultation with the air carriers. The administrative separation in no way affects the total amount of mail compensation paid or to be paid to each air carrier by the Postmaster General in accordance with the effective rate orders of the Board. Such rate orders can be modified only through the normal rate-making processes of the Board.

The Board announced that it would "attempt to place most of the domestic, international, overseas and territorial air carriers on final mail rates on or before June 30, 1952," and would "release a further report not later than June 30, 1952, setting forth the administrative separation of service mail pay and subsidy for the United States carriers in international, overseas and territorial operations which are certificated for the carriage of mail. In future years the Board will prepare an annual report separating service mail payments from subsidy payments for the entire air carrier industry of the United States. Each such report will present a separation for the preceding fiscal year on the basis of actual results, and a separation for the next two succeeding fiscal years on a projected basis.

"In all mail rate cases for domestic air carriers processed after October 1, 1951, that portion of the payment which is for the service of carrying the mail and that portion which is subsidy will be appropriately identified."

A few months before its separation decision, the Board on August 7 announced an opinion proposing final mail rates for the so-called big four air carriers—American, Eastern, Trans World and United—which will result in these carriers paying back to the government nearly five million dollars. Each of the carriers had been getting mail pay on a temporary basis pending the Board's decision.

In the helicopter decision, made early in July, the Board gave Los Angeles Airways, Inc., authority to operate helicopter passenger service in the Los Angeles area for five years. Los Angeles had been operating under an experimental certificate since 1947.

In making the decision, the Board said that it "believed the authorization . . . for a full five-year period will be adequate to test Los Angeles Airways' experiment in passenger service and to permit further development of its property and mail service."

The Board's approval was made on the basis of the service being given exclusively with rotary-wing aircraft.

Major personnel changes of the Board during 1951 were headed by the appointment of Donald W. Nyrop, former Administrator of Civil Aeronautics, as chairman of the Board. He was sworn in on May 18. Chan Gurney, former U. S. Senator from South Dakota, was sworn in as a Board member on March 12, and Joseph P. Adams became a member on Feb. 6. Mr. Adams was formerly director of Aeronautics for the State of Washington.

NACA delta-wing research model being readied for launching

National Advisory Committee for Aeronautics

In 1951, despite a necessary cloak of security, the National Advisory Committee for Aeronautics was able to report progress. One of the most important research advances to be announced during 1951 was the transonic ventilated wind-tunnel throat, which makes possible the study of transonic problems in wind tunnels, hitherto impossible because of the choking of the conventional wind tunnel as the speed approaches that of sound. Despite the earlier development of such techniques as those using rocket-powered models and full-scale, high-speed research airplanes, the importance of a reliable laboratory method for transonic experimentation was not decreased by the progress in developing alternate techniques.

Rather, it was increased as information from these other methods focused attention more sharply on fundamental problems of fluid mechanics. In order to complete theoretical and mathematical calculation of transonic air flow, there was still needed the opportunity to experiment with standardized equipment, using nonexpendable models under conditions so closely controlled as to permit detailed measurements of local pressures as well as the application of optical means for visualization and measurement of the flows.

Very great effort was placed upon development of a new concept of wind tunnel design, which would permit gathering the needed precise information under laboratory conditions. The effort has been successful, it was announced in 1951. But because of world conditions, discussion of the "how" of this new tunnel concept has not been forthcoming.

The NACA has placed in operation two large tunnels, as well as smaller ones, which are capable of providing accurate aerodynamic information about flow conditions in the full transonic range. Transonic test sections now are being installed in other large tunnels, and it may be expected that all high-speed wind tunnels in this country will be converted to transonic operation as rapidly as the necessary funds are supplied.

Great improvements in the aerodynamic characteristics of aircraft shapes at transonic and supersonic speeds have already been made, as a result of information gained through use of the transonic-type tunnels. Such improvements have included large drag reductions, and improved stability and control. A striking feature of the results has been a realization that relatively small details of design are extremely important, emphasizing the need for much additional testing and experimentation.

In addition to aerodynamic studies of airplane and missile models in the transonic speed range, the new tunnels will be used in the investigation of high-speed propeller characteristics. A 6000-hp propeller dynamometer can be installed in the test section of the tunnel, permitting testing of high-speed and supersonic-type propellers at large scale up to low supersonic speeds.

One of the most spectacular accomplishments in the field of aircraft propulsion research in recent years has been the work which resulted in development of the afterburner for the turbojet engine. Late in 1951, the

Interior view of Langley 16-foot wind tunnel

NACA disclosed that its Lewis Flight Propulsion Laboratory at Cleveland had begun, more than five years before, fundamental research on the problems involved, and that progress had been made to the point where it could be said this "reheat" device enables the pilot to more than double the useful thrust of his engine at supersonic speeds with only a slight increase in weight and size of the engine.

Basically, the afterburner is a ram-jet engine installed in the tail pipe of the turbojet engine. Present turbojet engines have a temperature limit of about 1500° F in the turbine, and as a consequence, a substantial part of the air passing through is not burned. It is this air which is used in the afterburner, which is an auxiliary power plant characterized by its simplicity of concept and application. Fuel burned in the exhaust pipe of the turbojet engine increases the temperature of the gases flowing through the engine, and results in an increase in jet velocity, which produces the greater engine thrust output desired.

Engineers at the Lewis Laboratory calculated the benefits which would result from use of such afterburning equipment on a hypothetical airplane designed to fly at 1350 mph. If engines not equipped with afterburning were contemplated, the bulky turbojet engines would require nacelles which would be larger than the fuselage of the airplane itself. Such a design would be so unrealistic and impractical as to be worthless. But if afterburners were installed in the turbojet engines of the hypothetical design, a sleek, practicable airplane could be attained.

At the same time the NACA announced the progress made with afterburners, it was conceded that operation of afterburners is accompanied by several problems, including combustion efficiency, altitude operating limits, ignition, and combustion stability. Research on all these problems is continuing, utilizing all the major altitude and sea-level facilities of the Lewis Laboratory.

During 1951 information about aerodynamic behavior in the supersonic range was a matter of immediate need both for missiles and high-speed airplanes, and the NACA's large, faster-than-sound tunnels were used intensively to provide such data. The Langley 4 x 4-foot supersonic pressure tunnel, with an operating Mach number range from 1.2 to 2.2 and variable density to permit attainment of large-scale results, has been particularly adapted for research on both supersonic airplane and supersonic missile shapes.

One phase of the work done in this tunnel during the past year utilizes complete missile models in the study of wing-body interference, downwash, inlet characteristics, stability factors, and other basic problems of current interest. Instrumentation, connected to outside-the-tunnel recording apparatus through a sting-type model mount, includes a six-component balance The control surfaces of the model can be controlled electrically, and mass flow through the inlets can be varied to simulate full-scale operation under varying conditions.

A second phase of this experimental research, which also is closely connected with missile work, has involved study of the effects of scale on the skin-friction drag characteristics. The desirability of maintaining laminar boundary layers has long been recognized. The attainment of laminar layers at subsonic speeds has been found impracticable in the majority of cases; however, research results indicated that conditions more favorable to maintenance of laminar flows may exist at supersonic speeds.

If means can be developed for maintaining a laminar boundary layer for the high-altitude and high-speed flight conditions of a typical missile, the skin-friction drag could be reduced to about one-fourth the values currently existing for turbulent boundary layers. The overall drag would be reduced by about one half.

Aerodynamic heating, at the high Mach numbers at which tomorrow's missiles will be flying may become of equal or even greater importance than drag. Here again, delay of the flow transition from laminar to turbulent offers an opportunity to extend greatly both the speed and duration of flight which now are limited severely by allowable structural temperatures.

A missile initially at atmospheric temperature absorbs heat from the hot boundary layer and rises in temperature. By attaining laminar flow, the amount of heat absorption could be lessened greatly. Another factor in aerodynamic heating is atmospheric density. At 100,000 feet, for example, the atmospheric temperature is the same as at 50,000 feet, but the density is much less, which reduces greatly aerodynamic heating. If it proves feasible to combine the advantages of laminar flow and low atmospheric density, the temperature limit of ordinary materials used in missile construction would not be exceeded, even on long flights at high Mach numbers.

NACA research during 1951 also probed into the hypersonic range, beyond Mach numbers of 5. In certain types of long-range missiles, most effective performance is obtained by operation at high altitudes and at Mach numbers in the range from 5 to 10.

At hypersonic speeds, it has been determined, shock waves are swept back close to the model, and the boundary layer becomes thick. The boundary layer also grows at a much faster rate at hypersonic than at lower speeds. The thick boundary layer changes the surface, this altering the effective wing or body shape. This problem has been found to be of considerable importance at Mach numbers of 7 on slender shapes suitable for missile use, and will assume even greater importance as the Mach number is increased still further.

The NACA also disclosed that it is conducting exploratory research at even higher Mach numbers. This work is being conducted in small ballistic-type facilities at both the Ames and Langley Laboratories.

With missiles flying faster than twice the speed of sound and tactical supersonic airplanes a certainty, the NACA in 1951 found it necessary to give immediate attention to the problem of how to eliminate or lessen the serious effects upon power-plant output imposed by flight maneuvers. At the same time study was continued on problems of further improvement of engines for such high-speed flight, and on the additional problems created by mating of the power plant with other components of a supersonic airplane or missile. One of the most valuable research tools available for such work has been the Lewis 8 x 6-foot supersonic tunnel.

Among factors influencing the thrust of supersonic air-breathing engines, the most important from an engine installation viewpoint is the total pressure "felt" by the engine inlet; a 25 percent pressure loss, for example, between the free-stream and the combustion-chamber inlet will result in a 35 percent thrust reduction. Although pressure losses are not wholly avoidable, the inlet problem has been explored and data assembled to enable design of inlets giving good engine thrust at twice the speed of sound, at zero angle of attack. However, the problem remains that if the angle of attack is increased to 20°, as might be essential during climb of a missile, pressure losses would be so large as to reduce engine thrust to 70 percent of the output at zero angle of attack.

To provide a missile with certain control advantages, it is desirable to locate the horizontal stabilizing fin as a bow plane at the front instead of at the rear. This breaks up the uniform flow field ahead of the missile, and the resulting distrubances, which trail rearward, may seriously affect engine performance. Besides being a region of disturbed flow, there is also a general area of reduced pressure. A combination of these losses would result in a considerable reduction in engine thrust at a time during the start of a maneuver where maximum power is required.

Because such pressure-reduction effects are not a steady operating condition, there is no easy solution to this sort of power-plant installation problem. Instead of an isolated problem demanding solution, the NACA research scientists have been faced with a complex assortment of questions requiring complete evaluation through the whole range of anticipated flight conditions for several possible power-plant locations. The installation position finally chosen undoubtedly will represent a compromise which permits the missile to perform its intended mission, in all particulars, most capably.

With respect to installations where the engine is submerged in the fuselage instead of in nacelles, it is important, to avoid undue thrust losses, to remove adequately the boundary layer, or low-energy friction layer, that forms along the fuselage surfaces ahead of the engine inlet. When it is impossible to position the submerged engine so as to avoid the boundary-layer problem, it becomes necessary to incorporate a boundary-layer removal system.

Improvements in gas-turbine-engine performance, through adoption of afterburners on turbojet engines for thrust augmentation, mentioned above, have complicated the problem of engine control, and NACA research was concentrated on this subject. The technical characteristics of jet engines require operation near the safe limits of speed and temperature. Application of turbine-propeller engines likewise presents a control problem which places an intolerable burden on the operator unless quick-acting, accurate, stable, and safe control systems are fitted to the engines. The solution of these problems has required equipment for operating the complete system under altitude conditions, and the use of analogue computors for rapid study of the effects of design changes.

In order to obtain high performance, the hot parts of jet engines are made of high-temperature alloys which contain alloying metals either not found in the United States or in limited supply. A major trend in engine development has been the reduction of strategic material content to permit large-scale production. An important part of NACA research has been devoted to this problem, ranging from basic investigations on why materials behave as they do to substitute materials and to turbine blade cooling. Turbine blade cooling, it was announced in 1951, offers a promise either of permitting removal of practically all of the strategic materials from the blades while retaining present performance, or of enabling substantially increased output for applications for which the strategic materials can be allocated in sufficient quantity.

The Weather Bureau

During 1951 the Weather Bureau continued a program of increasing the number of professional employees at many of its airport stations by replacing some of the subprofessional with professional personnel so as to provide an even higher quality of weather briefing services to aviation interests. Such assignments will serve to supplement the weather forecasting services at 23 aviation forecast centers.

In addition, flight advisory weather service (FAWS) was maintained by the Weather Bureau at each of the 26 air route traffic control centers. These units supply latest reports and forecasts to air route traffic controllers and to the pilots in flight via air-ground radio facilities.

Continued progress is being made in the development of instruments and observing techniques for obtaining current information for use with instrument landing systems, particularly along the glide path and instrument runway. To this end the Air Navigation Development Board (ANDB) and the Bureau are making an intensive study of weather observational techniques at air terminals to improve the information given to pilots during conditions of low ceiling and visibility.

The Weather Bureau is using a Cessna 190 airplane for in-flight and on-station checking of its aviation weather service.

Department of Agriculture
Forest Service

The number of aircraft owned and operated by the Forest Service, Department of Agriculture, in 1951 remained at 16. In addition, a number of commercially operated aircraft were chartered or contracted. The use of chartered or contract helicopter services increased considerably in California. The primary use of Forest Service owned aircraft is in fire prevention and suppression work in the National Forests. However, with the development of special techniques and accessory equipment, their use for other forestry purposes is increasing steadily. Following is the latest annual summary of the use of aircraft by the Forest Service.

Activity	Fixed Wing Aircraft		Helicopter	
	No. Flights	No. Hours	No. Flights	No. Hours
Forest Fire Control	5180	7910	Approx. 2900	1267
Engineering	145	304		31
Timber Management	84	203		76
Range Management	130	142		
Wildlife Management	20	7		
General Administration	296	335		7
Unclassifield	80	27		
Total	5935	8928	Approx. 2975	1381

Transported:	
Passengers	10,244
Air Freight	408,679 lbs.
Parachuted Cargo	345,398 lbs.
Total Cargo	754,077 lbs.

In addition to the aircraft use given above, the Forest Service again in 1951 participated in the spruce budworm (insect spray) control project with the Bureau of Entomology and Plant Quarantine and the States of Oregon and Washington. On this project 940,000 acres of timbered, rough, mountainous terrain was sprayed by 7 contractors during the months of June and July 1951. Approximately half of the program was under the jurisdiction of the Forest Service and half administered by the Oregon State Board of Forestry. Continuation of the program is expected in 1952.

Department of Agriculture
Bureau of Entomology and Plant Quarantine

Growers made increasing use of aircraft spraying and dusting for insect control in 1951. From the green pea growing areas of the Northwest to the Cotton Belt, commercial airplane application of insecticides was a competitive business.

The U. S. Bureau of Entomology and Plant Quarantine continued to use its 15 planes in one location or another throughout the season; some of them on cooperative insect control with several of the States, others on experimental spraying, or on surveys. The Bureau consolidated all work on adaption and utilization of its aircraft and other special equipment for agricultural pest control at the Aircraft and Special Equipment Center, Oklahoma City. This center is responsible for the acquisition, assignment, modification and disposition of aircraft used by the Bureau.

Airplane spraying continued on spruce bud worm infestations in Washington and Oregon where 940,000 acres were sprayed with a DDT oil solution. This was contract work by the States of Washington and Oregon, in cooperation with the Forest Service and the Bureau of Entomology and Plant Quarantine.

Aircraft spraying on federal lands was contracted for the control of other forest insects. In the Lake States, 4,000 acres were sprayed for control of walking sticks, and 3,500 for the jack pine form of the spruce budworm. In the Southwest, 1,500 acres were sprayed for the Great Basin tent caterpillar. In the Southeast, an area of 1,500 acres was privately sprayed for the control of the pine sawfly.

Growers of green peas in the Northwest contracted for planes to apply parathion emulsion to 26,000 acres.

Insecticides, as dusts or sprays, were applied by commercial aircraft to 9 million acres of cotton in 1951—all on private contract basis.

In the Northeast, 177,713 acres were sprayed by aircraft with DDT oil solution to control gypsy moth. Work in New York continued to be shared by the State and the Bureau of Entomology and Plant Quarantine. The cooperative work in New England was done by federal planes, or commercial aircraft under contract.

An oil solution of aldrin was applied by aircraft to 450,000 acres of rangeland in Wyoming for grasshopper control. Planes for this work were contracted for by the State of Wyoming, with the assistance of Federal planes. The areas sprayed by individuals or groups of individuals in other range or in crop areas is not known.

Approximately one million acres of wheat were sprayed by airplane for green bug control in 1951—about the same acreage as in 1950. Federally-owned planes did not participate in this work.

It is expected that in 1952 even larger acreages will be treated by aircraft.

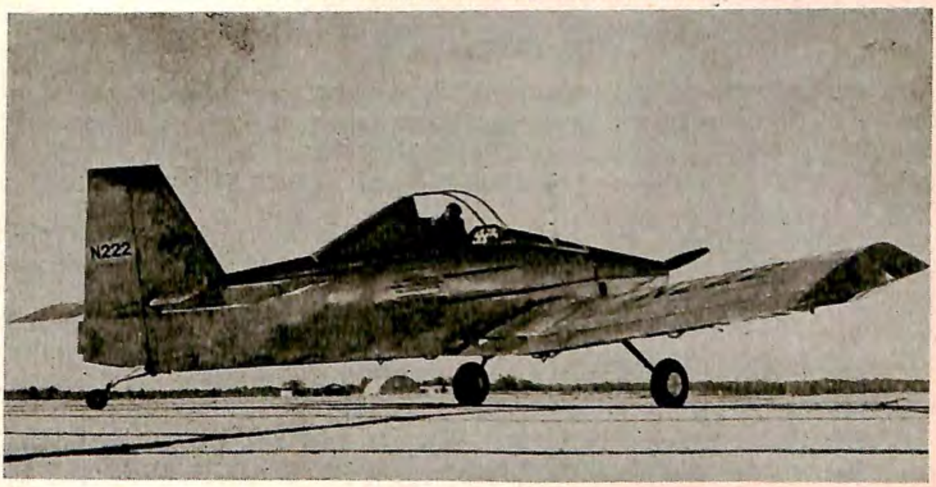
Department of the Interior
Fish and Wildlife Service

The Fish and Wildlife Service owned and operated 46 aircraft during fiscal year 1951, of which 29 were based in Alaska and 17 in the United States. While the exact figures are not yet available for 1951 operations, it is estimated that more than 8,000 hours were flown by Service planes and pilots in the United States, Alaska, Canada, Mexico and the West Indies. Waterfowl surveys, hunting coyotes and wolves, conducting duck and big-game censuses, and game law enforcement and fishery patrol are some of the functions for which the Service employs aircraft.

Under the direction of Chief Pilot John N. Ball, the Service's planes are piloted by both full-time pilots (located in Alaska) and other Service employees who hold CAA private and commercial pilot certificates and letters of flight authority in continental United States. Service policy is to use pilots who are qualified game management agents, refuge managers, biologists, or predator and rodent control agents so that these men can use planes as auxiliary tools in their work. Newly-appointed game management agents, who enforce conservation laws, are now being trained as pilots.

The Branch of Game Management with 20 planes, and the Branch of Alaska Fisheries with 9 planes, make most extensive use of aircraft in law enforcement. In order to facilitate the detection of illegal shooting of

CAA-Weick engineered agriculture plane



ducks and geese, an efficient air-ground communiction system has been developed recently whereby Federal game agent-pilots keep in constant touch with ground crews and direct them with a minimum of delay to scenes of illegal hunting. Areas formerly notorious for game law violations are now being rigidly patrolled. Patrol planes in Alaska equipped with aerial cameras are reducing illegal commercial fishing operations. Such photographs when produced in court result in speedy convictions for the violators. Annual aerial surveys and patrols in Alaska have materially improved the handling of the valuable salmon runs.

Federal Communications Commission

The Aeronautical Radio Services (ARC) division of FCC reported an expansion of aviation radio from less than 1,500 aeronautical stations of all kinds in 1938 to more than 34,000 authorized aircraft and ground stations at the close of fiscal 1951.

The largest increase was that of private aircraft. There were more than 30,000 authorized aircraft radio stations at the close of the year as compared with approximately 20,000 in 1950. Of the former, more than 28,000 were private aircraft.

To meet the congestion of communication channels which resulted from expansion of civil aviation, additional very high frequencies (VHF) were placed in service. New communication and traffic control procedures were adopted and utilized.

During the year, the Commission broadened its participation in the various inter-agency coordinating and policy groups, both domestic and international, such as the International Administrative Aeronautical Radio Conference (IAARC) of the International Telecommunications Union, the International Civil Aviation Organization (ICAO), the Air Coordinating Committee (ACC) and the Radio Technical Commisison for Aeronautics (RTCA).

Post Office

The fiscal year ending June 30, 1951, showed a continued increase in the use of the air services. Over one billion pieces of domestic letter mail were transported, an increase of approximately 25 percent, while air parcel post increased in about the same ratio with the number of pieces approximately 12,500,000.

The total weight of air mail and air parcel post was over 63,000,000 pounds, exceeding the previous year by nearly 10,000,000 pounds or approximately 18 percent.

During the fiscal year 1951, a total of over 14,000,000 pounds of United States mail was transported by air to foreign and overseas destinations. Parcels and other articles accounted for 1,275,000 pounds.

Foreign air parcel post service is now available to 78 countries. Air service for other articles, i.e., prints, samples, newspapers, etc., has been extended to three additional countries.

Air Coordinating Committee

The Air Coordinating Committee, established in 1946 by the President to coordinate federal policy in the field of aviation, is composed of members from the eight government departments or agencies having an important interest in aviation.

The Chairman is Donald W. Nyrop, Chairman of the Civil Aeronautics Board. The Vice Chairman is E. H. Foley, Jr., Under Secretary of the Treasury, and the other members are James E. Webb, Under Secretary of State; John F. Floberg, Assistant Secretary of the Navy for Air; Roswell L. Gilpatric, Under Secretary of the Air Force; John M. Redding, Assistant Postmaster General; Thomas W. S. Davis, Assistant Secretary of Commerce; and J. Weldon Jones, Assistant Director of the Bureau of the Budget. The Executive Secretary is Charles O. Cary.

Some of the activities of the Committee during 1951 included the coordination of domestic and foreign civil aviation requirements for new aircraft, maintenance, repair and operating supplies (MRO) for both air carrier and non-air carrier aircraft; development of a policy of equal priority with the military for the production of essential civil carrier aircraft; the submission of recommendations to the Defense Production Administration covering complete programs for essential civil aviation requirements and the necessary issuance of priority assistance; development of policies regarding coordination between the military and civil agencies on aircraft matters, including the planning, construction, modification, maintenance, operation and use of airports; formulation of a federal policy regarding the development of commercial transport helicopters; implementation of procedures and installation coordination program in regard to the U. S. common system of all-weather air navigation and traffic control; at the request of the Defense Air Transportation Administration, coordinated and implemented the Airway recommendations of the NSRB Air Transport Mobilization Survey; establishment of a U. S. policy and schedule for the decommissioning of the low and medium frequency radio range system and the commissioning of a national VHF Omni Range System.

Other areas considered in 1951 included coordination among the member agencies of communication instruction for use by operators of United States and domestic and international commercial carriers in reporting vital intelligence sightings from aircraft; approval of standards and recommended practices of the International Civil Aviation Organization; coordination of problems arising out of the joint military and civil use of airspace; facilitation of entry of air commerce into this country; aviation policy for occupied areas; continued review and approval of recommendations for the elimination of important deficiencies in international air navigation facilities; revision of international law applying to aviation with particular reference to the "Surface Damage Convention" and the "Warsaw Convention"; preparation of the United States positions for the Fifth Session of the International Civil Aviation Organization Assembly as well as United

States positions for other international conferences and meetings dealing with aviation problems.

The ACC provides liaison between the United States and the International Civil Aviation Organization through the office of the U. S. Representative to the Council of ICAO located in Montreal, Canada.

CHAPTER FIVE

The Airlines

WIDESPREAD EXPANSION and achievements marked air transport activities during 1951, with domestic and foreign U. S. operated trunk lines leading the way.

The role of the airlines in the Korean airlift continued to be outstanding, and, although profits were cut by higher taxes, leading scheduled air carriers had the biggest financial year of history. With the exception of air freight, traffic increased in all departments. Local air services also showed spectacular gains, and some of the leading all-cargo lines broke tonnage records.

Below is a comparative chart showing scheduled air carrier traffic gains of the major lines in 1951.

U. S. DOMESTIC TRUNK LINE STATISTICS

	1950	1951 (Estimated)	% Change
Revenue Passenger Miles (000)	$ 7,766,008	$ 10,150,000	+30.7
Revenue Passenger	15,978,172	20,850,000	+30.5
Revenue Planes Miles	327,054,341	328,700,000	+ 0.5
Mail Ton-Miles	46,314,753	62,803,000	+35.6
Express Ton Miles	36,538,183	45,291,000	+24.0
Freight Ton Miles	112,860,631	99,935,000	−11.5
Operating Revenue	$524,108,162	$647,542,000	+23.6

Often exceeding these gains were those of the 17 local service carriers certificated by the Civil Aeronautics Board. These operations, which went forward under Board approval beginning in August, 1945, have expanded from 165 certificated service points in 1946 to 490 in 1951 and jumped the route mileage from less than 8,000 in 1946 to more than 28,000 in 1951. The local lines showed spectacular gains in all branches of their services. As summarized in October, 1951, local line mail ton-miles jumped from 20,738 to 662,407 between 1946 and 1951. Revenue passenger traffic in the same period was up from 12,502 to 1,198,661, express and freight ton-miles from 3,240 to 1,638,530, and revenue passenger miles from 3,680,000 to more than 234-million.

A company-by company sampling of air carrier activities follows in alphabetical order.

All-American Airways

Increased tourist services and traffic to eastern shore resorts, extended routes in West Virginia and Ohio, and a charter-flight program combined during 1951 to give All-American Airways the best year of its three as a scheduled airline.

Statistics through August, 1951, indicate that the airline will break all 1950 passenger, mail and air express records:

	1950 calendar year	1951 through August
Passengers	150,843	142,253
Mail Ton Miles	43,187	36,927
Revenue Ton Miles	2,236,857	2,102,224

By opening direct service between Newark and Atlantic City, N. J., plus intermediate resorts, the airline had the biggest month in its history in August, with over 26,000 passengers carried. Charter flights accounted for $15,000 in new business in October.

The line gained additional working capital in June when the Civil Aeronautics Board ordered retroactive mail pay amounting to nearly a million dollars. This was used in part to retire debts. CAB at the same time established a permanent mail rate.

All American's Engineering and Research Division at DuPont Airport, Wilmington, Del., netted a profit of $25,975 during fiscal 1950 from projects amounting to approximately $251,000. The division now has a backlog of about $1.2-million.

From the National Safety Council All-American won a safety award for flying more than 33-million passenger miles in 1950 without a passenger or crew fatality.

Personnel changes during the year included promotion of David L. Miller, former secretary and director of sales, to vice-president of sales. E. K. Arnold, former assistant to the president, was elected secretary of the corporation, and Robert B. Cotton, former chief engineer, was promoted to vice president of the engineering and research division.

American Airlines

American Airlines, Inc., again had a record-breaking year. A net income of $9,621,290 was reported for the nine months ending September 30, 1951, comparing with $6,010,811 for the same period in 1950. The sum has been restated to take into account a loss of $922,000 on liquidation of American Overseas Airlines, to reclassify prior years' mail pay adjustment and to reflect excess profits tax applicable to that period. Operating expense per revenue ton mile was 41 cents compared with 43 cents for the first nine months of 1950.

Passenger miles for the nine months period totaled 1.9-billion, an increase of 45 percent. In May, American operated 214,914,916 passenger miles, the first airline to compile more than 200-million passenger miles in a single month. The all-time peak record was set in June when the company operated 248,042,985 passenger miles. The daily record was set on August 31, with 8,885,000 passenger miles flown. The previous monthly record, reached in June, 1950, was 179,400,000 passenger miles; previous daily record was 6,615,000 passenger miles set on June 14, 1950.

American received a two-billion-mile safety award from the National Safety Council covering the period of November 29, 1949 to the end of 1950.

AIRLINE TRAVEL

Most first class airline travel is for business reasons but most coach class travel is for pleasure, according to a survey of 58,000 responses to a questionnaire by the Institute of Transportation and Traffic Engineering of the University of California. Three times as many men travel for business reasons as those who fly for pleasure. Just the opposite situation exists among women travelers who travel three times as often for pleasure as for business. Here are the figures:

First Class Travel	Business	Pleasure	Total
Men	49%	14%	63%
Women	10%	27%	37%
Total	59%	41%	100%
Coach Class Travel			
Men	26%	19%	45%
Women	9%	46%	55%
Total	35%	65%	100%
Combined First Class and Coach Class Travel			
Men	45%	15%	55%
Women	10%	30%	45%
Total	55%	45%	100%

The company ordered 30 new airplanes from the Douglas Aircraft Company for delivery in 1953. The new planes included 24 52-passenger DC-6B's and six DC-6A's for the cargo operation. The new contract is in addition to 17 DC-6B's being delivered during 1951. Total cost of the new planes ordered and now being delivered is in excess of $54,000,000, and will bring American's fleet to 188 aircraft, all of which have been developed in the post-war period.

By year's end, American's fleet numbered 159 airplanes, including 79 Convairs, 17 DC-6B's, 49 DC-6's, and 14 DC-4's.

The company and the Air Line Pilots Association signed a contract covering wages and working conditions of 1,043 pilots. Under the terms of the agreement, all pilots will receive more money; limits on their duty time and new and more complete bidding procedures are set.

Braniff International Airways

Braniff International Airways reported record earnings during 1950, but 1951 was the best year in the airlines history.

South American expansion highlighted the year. Service was extended into Buenos Aires, Argentina, and Asuncion, Paraguay, and new schedules added between the United States and South America. Five new offices were opened in South America, and service inaugurated to Sao Paulo, Brazil.

Braniff this year has $15,000,000 worth of equipment on order to augment its present fleet. This includes a 50 percent increase in its DC-6 fleet, and 20 new type Convairliners. Delivery of the Convairs begins early in 1952.

During 1950 Braniff completed 98.7 percent of its domestic schedules and 98.5 percent internationally.

A unique program of promoting business and culture between the Americas has met with favorable response from business men and civic leaders in both hemispheres.

The largest airline based in the southwest, with a 65-acre headquarters at Dallas Love Field, Braniff celebrated its 23rd birthday this June. The airline had flown some 1.7-billion passenger miles with complete safety to passengers and crews. Braniff recently received its eighteenth annual award from the National Safety Council for flying another full year in perfect safety. Braniff also received a 1950 Inter-American Aviation Award from the Inter-American Safety Council in New York,—an award Braniff has won every year it has operated in the international air transport field.

Captain R. V. Carleton, 20-year Braniff veteran, and now director of flight operations, was named one of the nation's outstanding top ten pilots.

Capital Airlines

Capital Airlines estimated that by the end of 1951 they would have carried in excess of 2-million passengers between the 75 stations on its highly industrialized routes. This was an increase of 33⅓ percent over last year, when the airline carried 1.5-million passengers.

Early in the year J. H. Carmichael, President of Capital, announced that the airline would add seven more Constellations to its already existing fleet of four-engine, high-speed Lockheed planes. No additional financing was needed.

Outstanding in 1951 was Capital's "Brass Brigade," called upon five times to take over operations of stations on its system. The brigade consists of members of management from President Carmichael down, who operate a station for a full shift if that station has made its passenger and revenue quota for twelve straight months. Regular personnel take the day off while executives load and unload planes, sells tickets, makes reservations and do all the necessary work connected with running an airline station. Carmichael, in coveralls, is always assigned to cargo handling with his assistant R. M. Averill. The five stations who played host to the wrecking crew in 1951 are Harrisburg, Detroit, Milwaukee, Washington and Newport News.

The brigade originated in 1949 with James Austin, vice president in charge of traffic and sales, and was first put to work by Capital's Youngstown, O., station.

Capital employees twice contributed to airline safety and maintenance during 1951.

William S. Smoot, a project engineer for the airline, installed a whirling police-car type light, on a Capitaliner on the theory that it, could be seen by an airport control tower at a greater distance than standard running lights. Washington National Airport tower picked up the swiveling beacon 20 miles away. Par for that distance under similar weather conditions with the usual wing tip lights is usually six miles. Tests of the new light are being run by the CAA and the Air Transport Association.

The other contribution to airline maintenance was conceived by Al Bobel, an instructor in air conditioning for Capital, who devised a simplified method of changing and inspecting windows in Constellations.

Before Bobel went to work on his idea, it was necessary to apply pressure to the inner window panel when windows were being replaced on Constellations. The cabin had to be pressurized, which required moving the plane from the hangar and running the engine outdoors. Six men had to be present in the cabin screwing windows in place while temperatures inside sometimes rose to as high as 120 degrees.

The Bobel method allows the windows to be changed or inspected in the hangar merely by pressurizing each window individually, instead of the entire cabin, and it does away with running the engines.

Bobel designed a circular metal plate which fits over the outside of the Constellation window. Around the plate is a sponge rubber seal. Vacuum is applied inside the plate through a fitting. Through the vent hole the same vacuum is also applied between the inner and outer panel. This thereby applies differential pressure to the inner panel and equalizes pressure on both sides of the outer panel.

Last March Capital and National Airlines announced they would interchange equipment to provide through service between Detroit, Cleveland, Pittsburgh, Washington, Jacksonville and Miami.

Capital's financial picture continued to improve in 1951. In the first nine months, the airline reported earnings of $2,787,252 before taxes, an increase of $1,415,506 or 103 percent over the $1,371,746 pre-tax earnings of the first nine months of 1950.

Revenue for the nine months from January to September reached a record $29,237,062 marked by an increase in passenger revenue alone of 61 percent.

One year ago the Company had a long-term debt of $8,526,131, almost three times its capital and surplus of $2,936,363. On Sept 30, 1951, the long-term debt had been reduced to $3,962,731, a decline of $4,563,400, while capital and surplus increased to $7,307,562.

The third quarter of the year was the most successful in the company's history. Revenues of $10,774,311 were the largest of any previous quarter and net income before taxes was $1,453,238, or $1.86 per share. Net income after taxes was $768,238, or 98 cents per share.

Despite the fact that Capital contributed two of its all-cargo planes to the Korean airlift, the cargo department reported that from January to September 30, 1951, the airline flew 7,862,525 pounds of air mail, 1,411,119 ton miles; 12,111,583 pounds of air express 1,952,838 ton miles, and 15,220,347 pounds of air freight 3,889,627 ton miles.

During the year C. Pate Hutchens was appointed executive assistant to J. B. Franklin, vice president, operations and maintenance. He was formerly superintendent of stations and flight service.

Chicago and Southern Airlines

Completion of its *Constellation* program and substantial increases in operation totals gave Chicago and Southern Airlines one of the best years in its history in 1951.

During the year, the company received delivery of three more *Constellations,* bringing the total to six. Result was that for the first time the airline offered four-engine service over its Detroit-Indianapolis-Memphis route, and from Houston to Detroit. Seat miles flown daily went up 44 percent over the preceding year, and revenue passenger miles during the first six months of the year jumped 36.3 percent. Total operating revenues were up 18.2 percent from $6,169,709 to $7,295,428 and net income from operations jumped 108.4 percent from $259,655 to $541,154.

Continental Air Lines

The year 1951 proved to be one of the most successful in the history of Continental Air Lines, now serving more than 3,000 miles of route in Colorado, New Mexico, Texas, Kansas, Oklahoma and Missouri. New highs were reached in passenger traffic, and special charter flights increased far ahead of other categories.

For six months of 1951, 127,181 passengers flew on Continental's planes compared with 94,207 for the same period of 1950. In the charter category for first six months of 1951, 3,233 passengers were carried while 741 were carried for a similar period of 1950.

Early in 1951, Continental Air Lines received a special award from the National Safety Council for 15 years of perfect safety. At that time the airline had flown one and one-quarter million passengers 473,262,000 passenger miles without accident.

Continental Air Lines carried 848,564 pounds of air mail in first six months of 1951 as compared with 573,476 for the first six months of 1950. In air express 405,133 pounds were flown in 1951 as compared with 1950

AIR PARCEL POST

Robert W. Prescott, president of The Flying Tiger Line, believes that the time has come for air parcel post to be flown at air freight rates. Tracing the growth of the air freight industry, Prescott points out that in 1945 its total volume amounted to only a few-million ton-miles but in 1950 this had risen to 152,000,000 ton-mile and in 1951 topped well over 200 million ton-miles. Flying Tiger Lines had flown more ton-miles during the first nine months of 1951 than during the entire year of 1950. He notes that during the first six months of 1951 the nine major passenger airlines flew a total of 47 million ton-miles of freight, whereas Slick and Flying Tiger together hauled 49 million ton-miles.

and 1,317,100 pounds of air freight were flown compared with 1,070,192 pounds for 1950.

In March, 1951, the line signed purchase agreements for seven Convair 340's with an option to buy three more.. Continental now has five Convair 240's, 12 DC-3's. In September, 1951, a Douglas DC-4 was leased for approximately one year to provide additional equipment for charter flight program.

In October, contracts were signed to buy two DC-6B's for delivery in May and June, 1953.

In July, Continental and American Air Lines inaugurated a one-plane through DC-6 service between Houston and Los Angeles, and on October 11 the Civil Aeronautics Board approved an equipment interchange with Mid-Continent Air Lines between Denver and St. Louis, via Kansas City, Mo.

Continental Air Lines transported many unusuaul cargoes during 1951, the most important being huge shipments of human blood originating at virtually all of the airline's 34 cities, and destined for use in Korea. Other shipments included mail-order by air merchandise from Sears Kansas City warehouse, drugs of all types from a Kansas City manufacturer by air to Denver and thence onward to druggists and doctors in the hinterlands via surface parcel post; and shipments of accordians, gorillas and expensive show dogs.

Air transportation became an especially noteworthy aid to humanity during the Kansas floods early in 1951. Surface transportation was virtually nonexistant in the area and Continental transported many emergency items to and from the flood-stricken areas.

During 1951, three new vice presidents were elected. Stanley O. Halberg, former general traffic and sales manager was made vice president, traffic and sales; Lynn H. Dennis, former director of flight service was made vice preseident, flight service and Colonel Harry Short was made vice president of maintenance.

John A. Smith, formerly cargo sales manager, was named assistant to the vice president and Harold W. Bell was named personnel director.

Huge increases in passenger and charter revenues for the first six months of 1951 resulted in an unaudited net income of $120,240, representing 68 cents per share compared with $1,456 representing ½ cent per share for the first half of 1950.

On July 30, 1951 a dividend of 25 cents per share was paid to stockholders.

Delta Air Lines

Typical of advances made by Delta Air Lines during 1951 was the revenue passenger mile figure for March, 39,419,393, 43 percent ahead of the total for March of the year before and the highest monthly total in the company history.

Revenue passengers carried climbed steadily, reaching a peak in August, with 87,113. The same month saw a new high in mail poundage, at 585,609, freight pounds flown steadied over the million-a-month mark, and express pounds reached a peak of 495,342 in May.

For the fifth straight summer, Delta offered all-expense package vacations to Miami Beach and Caribbean resorts with price reductions designed to attract those who vacation on a budget. Vacations began April 20 and continued through November 30, and prices included a round-trip flight to Miami, limousine service both ways between airport and hotel in Miami Beach, hotel room, breakfasts, boat cruise, and sightseeing tour. Three extensions to the Miami Beach vacation were available via airliner to Havana, Nassau, or to Jamaica. All included sightseeing tours and entertainment.

Delta's vacation sales as of Aug. 31, 1951, totalled 3,080, almost double the total 1950 figure.

Delta was also active in 1951 in arranging charter flights for military personnel, football teams, and movie stars.

In June, 1951, the airline received a National Safety Council 1950 aviation safety award for completing 665,470,000 miles without a passenger fatality.

Delta announced in March plans to supplement its Douglas fleet with 10 Convair Liner 340 transports, scheduled for delivery in 1952 at a cost of approximately $6,000,000 including spare parts. The company has also taken an option to buy five additional ships. The Convair 340, a larger and faster version of the Convair 240, now in service, will be used over the entire Delta system on both short and medium-length hops. The Delta version of the Convair 340 will have 44 seats.

Delta, American, and National Airlines inaugurated on May 1 a three-carrier through-plane service with DC-6's between Miami and the West Coast via Tampa, New Orleans and Dallas. American and Delta continued to operate through-plane DC-6 service between Atlanta and the West Coast via Birmingham or New Orleans and Dallas.

Eastern Air Lines

During 1951 Eastern Air Lines finished arrangements for a complete fleet replacement program at a cost of $100-million, one of the largest programs undertaken in the airline history.

First components of a fleet of 30 *Super Constellations*, built by the Lockheed Aircraft Corporation, and 60 Martin twin-engine Silver Falcons, built for Eastern by Glenn L. Martin Co., had begun to arrive at the close of the year.

Eastern's new fleet is designed for quick conversion to jet power.

Eventually the new fleet will replace 72 of Eastern's transports now in service—everything except 20 new-type *Constellations*.

Provisions for financing the Company's major fleet replacement program were completed some time ago when a credit of $30-million was negotiated with a group of 27 banks in territory served by Eastern. To date the company has already made advance payments to the manufacturers depreciation will, it is estimated, total approximately $42.5-million over the next three years. Cash on hand, amounting to more than $47-million, and future earnings are expected to more than cover the remaining cost of the program.

Eastern showed a gain of 27 percent in passenger miles during the first three months of the year and third quarter figures were expected to boost this total even higher .

Three officers were added to top management during the year. William Van Dusen, veteran aviation publicist with more than 20 years service with Pan American World Airways, became vice president in charge of public relations, advertising and news bureaus in February. In May Captain Eddie Rickenbacker, Eastern president and general manager, promoted two men to vice presidencies—Charles Froesch, noted aviation engineer, to vice president in charge of engineering and J. H. Brock, a 20-year veteran with Eastern, to vice president in charge of personnel relations.

SAFETY RECORD

Hawaiian Airlines is now the all-time record-holder for safe flight having completed its 21st year of operation without a fatality to either passenger or crew members. This is the longest period of safe operation yet recorded, according to the National Safety Council. Trans World Airlines has passed the four billion passenger-mile mark without a fatality, the second airline to accomplish the feat. American Airlines is already on its way to five billion passenger-miles without accident. Other long-time safety airlines are Colonial, which has had no fatality in 20 years; Inland Air Lines 19 years, Northeast Airlines 17 years, Mid-Continent 16 years, Chicago and Southern 14 years, Braniff Airways 11 years and Pan American-Grace 7 years.

Hawaiian Airlines

On November 11, 1950, Hawaiian Airlines, Limited, completed 21 years with a perfect safety record, the longest period of safe operation of any airline. Hawaiian was the first airline to receive the National Safety Council's 20-year award in 1949 and has maintained its perfect safety record to date.

Hawaiian's passenger traffic is up slightly in 1951. During the period January through August 1951, Hawaiian carried 234,590 revenue passengers as compared with 232,656 revenue passengers carried during the same period in 1950.

Mail carried during the first eight months of 1951 amounted to 319,418 pounds, a drop from the 511,190 pounds carried during the same period in 1950. Express was off slightly, 902,988 pounds being carried during the first eight months of this year as against 1,068,212 carried in 1950. Freight carried by Hawaiian during the first eight months of 1951 almost doubled that carried in 1950. A total of 9,203,212 pounds of freight were carried during the first eight months of 1951 as compared to 5,583,890 in 1950.

Hawaiian ordered six 44-passenger Convair-Liner 340's from Consolidated Vultee early in 1951 and expects delivery on the first of the new planes in September, 1952.

In August Hawaiian completed installation of the first commercial multiplex microwave communication system in Hawaii. The system provides a radio link between Honolulu Airport and one of Hawaiian's VHF radio stations in the Waianae mountains. In October, with the completion of two remote control radio stations on the island of Maui, Hawaiian Airlines put into operation one of the first complete non-government VHF air-ground radio systems in the United States and the only one in Hawaii.

Personnel changes during the year included appointment of David Watson, treasurer, to vice president and treasurer; John S. Pugh, general traffic manager, to secretary and general traffic manager; William R. Faris, assistant superintendent of stations, to superintendent of stations, and E. Curtis Cluff, Jr., to director of public relations.

Mid-Continent Airlines

The celebration of its 15th year under present ownership and management was the highlight event for Mid-Continent Airlines in 1951.

Also during the year the Kansas City-based air carrier announced the execution of a formal purchase agreement with the Consolidated Vultee Aircraft Corporation for the delivery in 1953 of six new 44-passenger model 340 Convair-Liners and began construction of a new hangar at its Twin Cities overhaul base, to be finished before the end of the year.

Other highlights of 1951 for Mid-Continent included the launching of an extensive program to modernize and convert its 23 DC-3 aircraft from 21 to 24 passenger capacity.

Figures for the first half of 1951, third quarter unaudited figures, and final quarter estimates on the number of revenue passengers and revenue ton miles flown indicate a substantial increase over 1950.

Mid-Continent's new Convair aircraft, new hangar facilities at Minneapolis/St. Paul, and DC-3 conversion program call for capital expenditures of approximately $5-million by the end of 1953.

Major personnel changes within the company in 1951 were the election of P. H. Carr of Kansas City as secretary and the appointment of Warren L. Duncan as superintendent of interline sales and development.

Mid-Continent reports an increase in business in all categories for the year 1951. In the first 8 months of 1951 the line carried 286,215 revenue passengers a total of 85,295,487 revenue passenger miles. Unaudited figures for September, plus those estimated for the final quarters of 1951, reveal that 442,178 revenue passengers will have flown approximately 129,800,000 revenue passenger miles during the year.

In 1950, the company carried 359,079 revenue passengers and the figure for passenger miles flown was 106,445,570.

Mid-Continent also reports substantial gains for mail, express, and freight ton mileage. Mail ton miles flown are expected to show a 36 percent gain, from 334,962 in 1950 to 454,956 in 1951; air express ton miles are estimated at 324,673—an increase of 27 percent over the 254,824 figure for 1950; and air freight shows an estimated 566,568 ton miles flown as compared with 534,594 ton miles in 1950.

Operations-wise, Mid-Continent reports that for the first eight months of 1951 its fleet of 23 Douglas DC-3 and 4 Convair aircraft completed 97.47 percent of all scheduled flights.

Pan American World Airways

Steadily increasing traffic, extended services, a number of anniversaries, and participation in the 1951 "Little" Berlin airlift was among the highlights at Pan American World Airways.

Indications of traffic increases were numerous. Revenue passenger miles flown between North and South American in August, for example, reached a peak of 9,624,000, and freight and express ton-miles rose to 213,293. Passenger traffic at Miami during the same month totalled 29,199 passengers, a gain of 5 percent over the same 1950 period. During the first eight months of the year, the airline carried 551,971 on its Latin American division, 12 percent ahead of the matching period last year. At the end of the tenth month, Pan American claimed a new world record for international air cargo shipments at Miami. Total poundage handled through that port was 16,748,202, a gain of 331 percent over the same months in 1950. The volume was upped by record-breaking shipments in October, when Miami cargo totals reached 2,298,701 pounds, due in part to cargo diverted from New York owing to a longshoreman's strike.

In all divisions, the airline reported flying 480,277,000 passenger miles during the third quarter of the year, against 409,439,000 in the same period of 1950. Third-quarter plane miles flown totalled 16,678,638 compared with 15,352,743 a year ago.

A number of additional services were put in during the year. Among these was a fourth weekly schedule between San Francisco and Tokyo and an increase in the weekly frequency of the Tokyo-Hongkong run from two to three.

Twice-weekly non-stop service was put in between Los Angeles and Guatemala City, using Constellations. The flight continues non-stop to Panama. The Los-Angeles-Guatemala flight covers the route distance of 2,190 miles in eight and a half hours, and the entire Los-Angeles-Panama flight takes only 13 hours, with a one-hour stop-over in Guatemala.

Pan American combined with American Airlines to establish connecting schedules at Los Angeles providing a 22-hour-15-minute flight from New York to Honolulu, via Chicago. Sleeper and Sleeperette accommodations are available on the Boeing Stratocruisers used in this service.

The line also added three new services on its international routes, giving non-stop flights both ways between London and Istanbul, London and Oslo, and Karachi and Calcutta.

On November 2, Pan American completed its 35,000th flight, without injury to passenger or crew, from Miami to Havana, and has carried more than 725,000 passengers in its 24 years of this operation. On June 18, the airline began its fifteenth successive year of uninterrupted operations between the U. S. and Bermuda.

Pan American provided two planes to the "little" Berlin airlift, set up by U. S. and its allies to fly export shipments which the Russians had refused to let pass by rail through the Soviet sector of Germany. British European Airways also had two planes in the operation, and Air France one.

The Russians had blocked surface transport of cargoes without certificates as to their origin, on the grounds that some of the products might be made from materials illegally imported from the Russian zone. Applications for such certificates had been pigeonholed for weeks and only a minute percentage of the export shipments were permitted to go by rail.

The little airlift broke this bottleneck.

In the first case in which a court ruled on Pan Am's right to the use of the word "Clipper" as a trade mark, a New York Federal District Court ruled in the airline's favor against Clipper Van Lines, Inc., an ICC certificated truck line. Pan Am has used the word since 1931.

Early in the fall, the airline announced that it would begin trans-Atlantic tourist service next summer, whether other lines do so or not. Vice president of traffic and sales Willis G. Lipscomb said Pan Am was going ahead, pending government approval, on a fare between $225 and $250.

The Lipscomb statement was affirmed by Juan T. Trippe, president of Pan American, who predicted that such a service could up tourist spending abroad from one to three billion dollars.

"The surface has only been scratched," he said. "Four million additional Americans, who would go abroad if they could, would leave another one and a half to two billion dollars abroad each year—dollars which can strengthen the free world."

Piedmont Airlines

Traffic figures for the first eight months of 1950 and 1951 showed marked gains in all but freight poundage for Piedmont Airlines, with revenue passenger miles up more than 78 percent. The statistics:

	1950	1951	% Increase (Decrease)
Mail	334,678 pounds	476,004 pounds	42.22%
Express	508,944 pounds	650,777 pounds	27.86%
Freight	691,857 pounds	610,049 pounds	(11.82%)
Total Revenue Passengers	78,585	123,302	56.90%
Revenue Passenger Miles	16,133,642	28,749,524	78.20%

Piedmont set an all-time record among local service airlines during June when its break-even mail pay need amounted to 2.5 cents per plane mile.

During 1951 Piedmont received the National Safety Council's 1950 aviation safety award in recognition of its 57,212,000 passenger miles of scheduled passenger-carrying flight operations without a passenger or crew fatality. This is the third award received during the three years of Piedmont's scheduled airline operation.

One DC-3 was added to the line's fleet of nine, bringing the total number of DC-3 aircraft in scheduled operations to ten.

Piedmont's omni-directional radio navigation equipment program will be completed early in 1952.

Trans World Airlines

Altogether, 1951 was a very good year for Trans World Airlines.

It started out with a novel precedent in the annals of American business. TWA's board of directors held their meeting in London, symbolizing how the airplane has linked, within hours, the great cities of the world.

Before year-end, TWA had rung up new records in passenger and cargo traffic over its 32,000 miles of skyways, flown its 11,000,000th passenger, and filed with the Civil Aeronautics Board asking a return to area competition on international airways. It also had advocated new low-cost tourist fares for 1952.

A record 194,000,000 revenue passenger miles were flown by TWA in June—the greatest in TWA's history. By year's end an estimated 2,-170,000 passengers had been flown domestically by TWA, an increase of approximately 37 percent over 1950, and an estimated 135,000 persons over international routes, more than an 8 percent increase over the preceding year.

Revenue was up, too. During the first half of 1951, TWA earned $2,603,000, or $1.07 a share, as compared with $1,029,000, or 42 cents a share, in the same period of 1950. Total operating revenues for the airline hit an all-time high of $66,416,000; operating costs advanced only $12,-817,000.

In the first six months of 1951, TWA flew 63,000 persons internationally—four times the number flown in the first six months after the airlie was certificated, six years ago, to operate overseas.

Since it inaugurated its overseas routes, TWA—now serving 20 cities in Europe, the Middle East and India as well as 60 cities in the United States—has carried approximately 545,000 passengers more than a billion passenger miles internationally.

Domestically, too, the airline made big strides, with sky coach travel, for example, showing a typical gain. In 1951 TWA coaches carried an estimated 185,000 passengers, bringing the three-year total—since the service was begun in February, 1949—to nearly 400,000.

The first coach planes operated between New York, Pittsburgh and Chicago, and between Kansas City and Los Angeles. In May, 1949, 81-passenger capacity Constellations were introduced, and by September 30 of this year, San Francisco and St. Louis had been added to the sky coach routes, bringing the total number of coach flights to five.

In the fall, the tri-city area of Binghamton, Endicott and Johnson City, in upper New York State, were added to TWA routes.

In 1951 there was an estimated 30 percent increase in family travel as compared with 1950. An average of 11,000 persons used the plan every month on TWA coast-to-coast routes, and the total carried under the plan was approximately 132,400 family heads and their dependents.

Between its first passengers and its 11,000,000th, TWA racked up 8,776,000,000 passenger miles. With approximately 210,000 passengers carried every month, five passengers board a Skyliner each minute.

On June 29, 1951, TWA marked the first anniversary of its participation with the Military Air Transport Service in the Korean campaign. Since that date five TWA DC-4's have been operated for MATS between the West Coast, Japan and Korea, carrying personnel and cargo. Altogether the company's aircraft have flown more than 12,000 hours in the MATS service.

In 1951 the airline was honored for its safety record with a National Safety Council award for flying more than four billion passenger miles with a perfect safety record. TWA thus became the second airline to achieve this safety record, and led the list of 43 scheduled airlines receiving the council's awards.

In 1950, TWA flew well over 26,000,000 ton miles of cargo, a 3,000 percent increase over 1941. In 1951, it flew an estimated 30,367,000 ton miles, a 15.3 percent increase over the previous year.

In its four-engine Skyfreighters TWA flew everything from Count

Turf, the Kentucky Derby winner, to rush shipments of iron lungs, needed in areas where poliomyelitis epidemics had broken out.

By fall almost a quarter of all its air cargo was connected with the defense effort—radio tubes, gun parts, engine shafts, aircraft wingtip tanks and other important mechanical equipment were all traveling by air.

During 1951, several TWA officials were advanced in rank. Among them John A. Collings, who was promoted from vice president in charge of operations to executive vice president. He now combines the duties of operational vice president with his new position. The fourth pilot employed by Transcontinental Air Transport, a predecessor company of TWA, Mr. Collings helped set up the first transcontinental air-rail service offered by the company in 1929.

David W. Harris and Gordon Gilmore were elected vice presidents of industrial relations and public relations, respectively. Both men had previously been directors of their departments.

In addition to its present fleet of 66 *Constellations*, the airline had on order 10 new Model 1049 *Super Constellations*, with delivery expected in the spring of 1952. Delivery of 40 Martin 404's was begun, the balance to

MANPOWER PROBLEMS

The air transport industry is short at least 19,000 workers of those required to meet full-mobilization demands according to report of the Air Transport Mobilization Survey. This shortage includes a shift from a 40-hour to 48-hour work week and an extension of piloting time from 85 to 100 hours per month. The survey reveals that 41 percent of current airline pilots are in the reserve of the armed forces and 33 percent of the crew members would be subject to call in a war emergency.

follow in the next few months. The twin-engine Martins are used for short flights within the United States, the *Constellations* for long-haul domestic service and for overseas flights. At the end of 1951, the TWA fleet totalled 150 aircraft.

An increase in trans-Atlantic service occurred during the summer when TWA again offered direct, one-plane service to and from Chicago and Detroit and Paris and Rome, with similar service provided for the first time between the midwestern cities and London and Frankfurt.

Using its international services to further the State Department's "Campaign of Truth," TWA brought to this country 35 editors and journalists representing the press of 14 countries in the British Isles, Europe, North Africa, the Middle East and India.

The two-week tour, planned to give the overseas journalists a complete picture of life in the United States, took place in May and covered eight cities from coast to coast. High spot was an interview with President Truman.

To help acquaint the people of this country with those of Europe, TWA arranged a number of tours ranging from all-inclusive types to summer study-travel groups for American students.

According to Dr. John H. Furbay, TWA air world education director, a record 50,000 students visited between the United States and other nations of the world this year, many of them traveling by air and many—such as those participating in TWA's study-travel tours—attending European universities.

Growing international travel was reflected also in a TWA survey of the travel habits of United Nations personnel. The survey showed that at least 65 percent of all international travel by U.N. officials is made on scheduled airlines — approximately a 100 percent increase compared to three years ago.

Studying the economic aspects of airline transportation, TWA statisticians found that the airline dollar is still worth 89 cents in terms of pre-war buying value. That is measured against a food dollar now worth only 43 cents, clothing 50 cents and house construction 44 cents.

From the navigators there came interesting information, too. TWA crew members figured out that a passenger flying at 20,000 feet has a maximum range of vision to the horizon, in all directions, of 175 miles, so that his eye sweeps a potential area of more than 96,000 square miles. That would include the entire states of Pennsylvania, Massachusetts, Connecticut, New Hampshire, Rhode Island, Vermont, Delaware, Maryland and New Jersey.

Out-of-the-way events added color to TWA operations. For instance, the TWA station manager at Santa Fe was notified that a "big wheel" was arriving aboard a flight due within a few minutes. So, expecting an important celebrity, the manager rolled out the red carpet. And then he rolled it up again. Because the big wheel was just that—cast iron and weighing 160 pounds.

CHAPTER SIX

Personal Aircraft and Helicopters

Personal Aircraft

THE PERSONAL AIRCRAFT industry continued during 1951 to attempt to produce civil aircraft for which strong demand existed. The proved usefulness of light aircraft in the fields of business, industry and agriculture and their increasing daily utilization resulted in a demand that the industry was unable to fulfill because of its inability to obtain all of the materials needed to maintain civil production at levels commensurate with this demand.

Production, which was at an annual rate of 4,000 at the time materials were put under priority control, has now dropped to an annual rate of less than 2,000. Despite the strong endorsement of the Office of Aviation Defence Requirements of the Department of Commerce and the Air Coordinating Committee, both of which vigorously endorsed the essentiality of continuing civil manufacture, these actions were not recognized by the Defense Production Administration and National Production Authority until July, 1951 and the inauguration of the Controlled Materials Plan. Prior to that time the industry had to seek its materials in the open market where they were becoming increasingly scarce.

The industry considered the continuance of civil production to be in the public interest since light aircraft tend to speed industry and to increase the production of food. Their production also quantitatively improves the existing fleet of aircraft which would be useful for essential transportation and civil defense if a full-scale emergency should develop.

Studies conducted for the Air Transport Mobilization Survey of the National Security Resources Board have borne out the opinion of the industry. The essentiality of the continuance of a reasonable scale of civil aircraft production has been endorsed by the Air Coordinating Committee and is being supported with allocations of materials by the Defense Production Administration and National Production Authority.

The actual civil production rate of the light aircraft industry is presently at an all-time post-war low, but the allocated materials now flowing into production lines would tend to reverse this trend. The early part of 1952 is expected to see the industry regaining more normal production levels and in a better position to supply demand.

Like all divisions of the aircraft industry, the personal aircraft manufacturers have undertaken substantial production assignments for the Department of Defense which are entirely commensurate with the corporate size of the companies and thus favorably comparable to the industry's overall effort. These assignments are principally of a sub-contracting nature. The industry's proved record of accomplishment in the last war established its ability to do the job, causing these facilities to be sought quickly for similar purpose when the Korean campaign resulted in the rapid acceleration of the military build-up.

However, the industry is also supplying substantial numbers of light aircraft to the armed forces, principally the Army Ground Forces. These aircraft have already seen substantial action in the Korean theater and are also being shipped abroad under the Military Aid Program. It is interesting to note that practically every currently-manufactured civil type aircraft has been procured in either an identical or closely-similar form by the armed forces. For this reason, currently-built light aircraft, although commercially marketed, serve to maintain production facilities "in being" which can be utilized more fully should intensification of the emergency require.

Though the industry has been unable to continue to produce civil aircraft at the rate the actual essential demand would justify, they have continued under great handicap to maintain their civil production while devoting more and more of their facilities to the military build-up. The net result is that the industry is maintaining a high over-all production with full utilization of facilities but there is an unfortunate unbalance between military and civil production brought about by the long delay in the establishment of a proper program to support essential civil production.

The past several years have seen steadily increasing utilization of light aircraft for business, industry and agriculture. A recent Civil Aeronautics Administration statistical study undertaken at the request of the National Security Resources Board to provide information on civil aircraft use for its Air Transport Mobilization Survey revealed that there are approximately 60,000 light civil aircraft in active daily use. Although there are an additional 30,000 registered with the CAA, these aircraft are largely obsolescent types including many thousands of worn-out surplus trainer types unsuited to present-day utilitarian civil tasks and obsolete as trainers. Of the 60,000 aircraft in daily use, 49,000 can be identified with activities related to business, industry and agriculture, considered essential to the civil mobilization economy by the NSRB's Air Transport Mobilization Survey, activities which would also screen against a "criteria of essential use" prepared by that body. The limited number of new aircraft the industry has been able to deliver have been going to such essential users and the industry has unanimously undertaken to voluntarily police its distribution so that it will go only for such essential use.

Helio Courier stresses slow flight

Something of the fundamental change that has been taking place in civil aviation is seen in a detailed break-down of the 60,000 civil aircraft now flying. Of this total, 1,500 are operated by the scheduled airlines, the remainder being light aircraft. Of these, 12,000 airplanes are used for instructional flying and training; 11,500 are operated by ranchers and farmers of which about 5,000 are equipped for the aerial application of dusts and sprays; 18,000 are used directly in connection with business and professions of which 8,000 are corporately owned and used for executive transportation; 4,000 are used for charter work; 2,000 are engaged in industrial activities such as pipeline and powerline patrol, aerial survey, and mineral prospetcing; leaving only about 11,000 airplanes used for personal pleasure flying.

Thus, only about one-sixth of the total number of civil aircraft in the nation are classified as "private planes," whereas the remainder are used directly in some form of business endeavor. This heavy preponderance of business use of the light airplane indicates that it is definitely becoming an integral part of the national transportation system.

A new development in taxi and charter service is now being pioneered. A number of fixed base operators maintaining aircraft for charter and taxi-for-hire service have formed an organization known as the National Air Taxi Conference. In turn they have worked out agreements with the scheduled airlines so that it will be possible in many places, when you purchase your airline ticket, to arrange to have an air taxi meet you at the scheduled airline terminal and carry you to an off-airline point. Despite the magnificent scheduled air transportation system of our country, only about 500 places are accessible directly by such service.

A number of communities conducted civil defense exercises during the year to determine the help which small aircraft could provide. A typical example is one recently carried out in Des Moines, Iowa. Within two hours after that city had been theoretically A-bombed, approximately 400 light aircraft had converged on the area and were ready to carry out relief activities.

Light aircraft frequently were the only useful transportation and the difference between life and death for isolated farms during floods or blizzards. During the March, 1951, blizzards in Minnesota, 26 inland airports reported 646 service operations to snowbound farmers and others of which about 150 were in the nature of acute emergencies. Had these aircraft not been in existence permitting these service oprations to snowbound farmers and communities, there would have been a really disastrous condition.

Civil light aircraft production for the year was estimated at about 2,500 units, representing a volume of roughly $16 million. These figures, of course, do not include the substantial deliveries of the same aircraft to the military services. The manufacturers estimated that without materials problems and based on firm orders they could have delivered more than 5,000 civil aircraft.

The strong trend towards four-place business airplanes begun in 1947 continued during the year with Beech delivering the largest dollar volume of civil light aircraft. Total production was estimated at 400 airplanes (including single and twin-engine types) with a value of nearly $9 million. Largest unit producer was the perennial leader Piper Aircraft, which delivered nearly 1,200 two- and four-place aircraft having a value of almost $4 million. Cessna, the third large producer in the field, produced more than 500 aircraft with a value of more than $3 million.

Ryan Aeronautical ceased production of the famed *Navion* in May following a freezing of orders late in 1950. Aeronca discontinued civil orders early in the year. However, again, all of these producers continued their full-volume production of aircraft and equipment for the armed forces, the drop coming only in the actual commercial sale of their products.

Helicopters

One of the outstanding developments of the entire industry during the past year was the substantial growth of the helicopter industry resulting from the exceptional performance of rotary-wing aircraft in the Korean campaign. The unique capabilities of the helicopter to operate under conditions hitherto considered a complete bar to aircraft usage brought about a very substantial increase in demand by the Services. By October 1st, the backlog in round figures approximated four hundred million dollars as against about eighty million at the same time in 1950. The number of personnel employed in helicopter production had tripled during the year as did the plant area in use and under construction.

While the helicopter was noted particularly in the public eye as a rescue vehicle, it emerged also as an efficient transport for the carriage of

TO THE RESCUE

Most spectacular rescue of the New York City Police Department was in 1951, when a workman fell from scaffolding to the roof of the Cathedral of St. John the Divine, breaking his hip and suffering other injuries.

The roof to which he fell is 160 feet above the ground. A winding stairway leading to it was too narrow for a litter. He refused to be lowered by rope.

A Bell H-47D1 helicopter with a policeman pilot made a landing on the roof, its blades clearing the base of the scaffolding by inches and its tail protruding beyond the roof into space. The injured man was picked up and flown to an ambulance rendezvous in a nearby park.

armed United Nations fighting men to combat areas extremely difficult to reach by other means. It also proved itself on sea as well as on land. All aircraft carriers are now equipped with helicopters to replace destroyers in safety surveillance of carrier take-offs and landings.

Although the helicopter industry is heavily involved in military production, its leaders are looking ahead to the day when commercial production can be resumed and development of the helicopter as a civil transport pursued vigorously. The Helicopter Council of AIA, including eight of the leading manufacturers, is already laying definite plans for the age of commercial helicopter usage. Under the leadership of Harvey Gaylord, Vice President of the Bell Aircraft Corporation and General Manager of their Helicopter Division, as Chairman and Stanley Hiller, Jr., President of Hiller Helicopters as Vice Chairman, the Council in 1952 will prosecute a carefully planned program to develop this market.

The recognition according the helicopter during 1951 was highlighted by the award of the coveted Collier Trophy for 1950: "To the Helicopter Industry, the Military Services, and the Coast Guard for Development and use of Rotary-Wing Aircraft for Air Rescue Operations."

Accompanying this citation was the following statement which sums up the important status of rotary-wing aircraft in the air world of today:

"The helicopter, although giving earlier evidence of its effectiveness in air rescue operations in all parts of the world, emerged in 1950 as a major factor in the modern concept of air rescue under conditions of warfare. This development was the culmination of many years of effort in the design and construction of rotary-wing aircraft, led by Igor Sikorsky who, in 1939, achieved control and stability with the VS-300 helicopter.

"The helicopter's dependability under fire in the Korean campaign made possible the adoption of new tactics and techniques by the military services in the rescue of wounded or stranded United Nations personnel in exposed positions and from behind enemy lines. Critically wounded personnel were quickly evacuated to bases where prompt medical attention resulted in the saving of thousands of lives. Thus, rotary-wing vehicles proved an important factor in the maintenance of high morale among our fighting forces.

"The effectiveness of the helicopter in rescue work was not confined to land operations, although the concentration of such rescue work in Korea centered a great deal of public attention on that phase. In the patrolling of our coastal areas, the Coast Guard has effectively used the helicopter in numerous rescue missions. The helicopter has also proved a valuable aid to the Fleet. Stricken naval personnel have been transferred to vessels where medical treatment was available. The crew of a grounded warship was safely evacuated by helicopter under enemy fire. In guarding pilot personnel of aircraft carriers by effecting speedy rescue of pilots whose planes have plunged into the sea, the helicopter has virtually eliminated the need for the use of destroyers with airplane carriers for pilot safety surveillance."

CHAPTER SEVEN

Planes in Production

EXPANSION and more expansion was the keynote of 1951 aircraft production. This placed the emphasis on the quantity output of existing models rather than the development of new ones. However, within the framework of "frozen" designs the industry still managed to continue its development work on existing models.

In the preparation of this section, a careful check has been made to insure that only those aircraft actually in quantity production during the year are included. For this reason, there are no prototype aircraft or experimental types included.

It will be seen that the process of "stretching" existing types was used liberally throughout the year. In the commercial transport field, virtually all of the familiar models received fuselage extensions to add passenger space or cargo volume without extensive redesign of the airplane. In some cases, the added weight required larger wing panels to accommodate the new load without increases in landing and takeoff speeds. In the case of combat aircraft, the changes were generally concentrated on the addition of radar and other electronic equipment resulting in added nose shapes and much higher gross weights. The solution here has been additional power, rather than added wing area, and most of the familiar combat aircraft received more powerful engines during the year. In the case of piston engine aircraft, in which additional horsepower has been obtained by the use of compound engines or even the addition of turbojet power, the gross weights climbed enormously resulting in compromises in performance but greatly increased range and load-carrying capacity.

The personal aircraft field saw the development of a new twin-engine four-seat type and continued improvement in existing models with emphasis on specialized versions for agricultural and industrial uses. There was more pressure in the lightplane industry than in the big plane industry for design "freezing" in view of the former's increasingly tight materials situation. At year's end this problem was being resolved, however, by the award of the required priorities.

All of the material in this chapter has been provided by the manufacturer, except for those few cases which are noted, and a final check by them has insured that the many facts and figures are as accurate as possible within the limits of security, which, more than ever before, has veiled the full performance of many aircraft and engines and shielded many new types of both from inclusion in this volume. These will appear in future volumes as they become available.

AERO DESIGN AND ENGINEERING CO.

Oklahoma City, Okla.

Aero Commander demonstrates single-engine performance

A 5-place, closed land high-wing monoplane. CAA TYPE CERTIFICATE: TC 6A1 for model L3805. Production model not certificated at year end. MANUFACTURER'S MODEL DESIGNATION: 520.

DATA

POWERPLANT: Two Lycoming GO-435-C2, 260 hp (takeoff) and 240 hp normal. FUEL CAPACITY: 150 gal. PROPELLERS: Hartzell constant speed full feathering.

SPECS

SPAN: 44 ft. LENGTH: 32 ft. HEIGHT: 12 ft. WEIGHTS: EMPTY, 3,000 lb.; GROSS, 4,800 lb.

PERFORMANCE

SPEEDS: MAXIMUM, 206 mph; CRUISING, 183 mph; STALLING (full flaps power off), 57 mph; full flaps power on, 40 mph; no flaps, 62 mph). RATE OF CLIMB: 2,012 ft. per min. SERVICE CEILING: 24,000 ft. RANGE: 850 mi.

REMARKS

First production delivery for the Aero Commander came off Sept. 1, 1951. The plane demonstrated its one engine versatility during the year on a flight from Oklahoma City to Washington, D. C. on one engine. The flight took off at full gross and was logged as a routine affair. The Commander is available as a passenger, rescue, cargo, seaplane, ski and gas turbine-powered light transport. PRICE: $45,000.

Multi-engine aircraft designers have long proclaimed that their products would fly safely with one or more engines out, but the builders of the Aero Commander have given dramatic proof of their airplane's ability to fly on one engine. On May 9, 1951 the twin-engine airplane took off from Oklahoma City at its full certificated gross weight—with one propeller completely removed. On a single engine it flew non-stop to Washington, D. C. and taxied to a halt having made the longest flight in history by a twin-engine airplane using only one engine. Despite the fact that this 2½-ton transport carries up to seven people, it has a landing speed of only 57 mph, comparable to that of lightplanes.

AERONCA AIRCRAFT CORP.

Middletown, O.

Aeronca Sedan

A 4-place, closed, land or sea, high-wing monoplane, normal category. CAA TYPE CERTIFICATE NUMBER: TC 802. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 15AC, Sept. 23, 1948. ENGINEERING PERSONNEL: Leon Wolfe, ch. engr. TEST PILOT: Lou Wehring.

DATA

POWERPLANT: Continental, C-145-2, 145 hp. FUEL CAPACITY AND CONSUMPTION: 36 gal., 8.8 gal. per hr. OIL CAPACITY: 2 gal. APPROVED PROPELLERS: Sensenich 73BR-45, -44, Lewis L6FK39, or McCauley 1A170-DM7647. For the seaplane model, McCauley 1A170-DM7645. GEAR: Fixed two wheel, steerable tailwheel.

SPECS

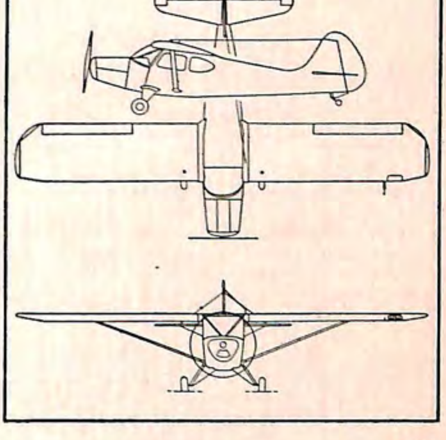
SPAN: 37 ft. 6 in. LENGTH: 25 ft. 3 in. HEIGHT: 7 ft. WEIGHTS: EMPTY, 1,150 lb.; GROSS, 2,050 lb.; USEFUL LOAD, 900 lb. WING LOADING, 10.2 lb. per sq. ft. POWER LOADING, 14.1 lb. per hp; BAGGAGE, FULL SEATS AND TANKS, 120 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 129 mph; CRUISING, 112 mph; STALLING, 53 mph. RATE OF CLIMB, 800 ft. 1st min. SERVICE CEILING: 13,000 ft. RANGE: 456 mi.

REMARKS

Visibility in this model is claimed to exceed that of a current automobile sedan. It is equipped with a 12 volt system and includes a landing and taxi light rated at 400,000 candlepower located outboard on the leading edge of the left wing. Sedan production was discontinued during the year when Aeronca went into defense work.

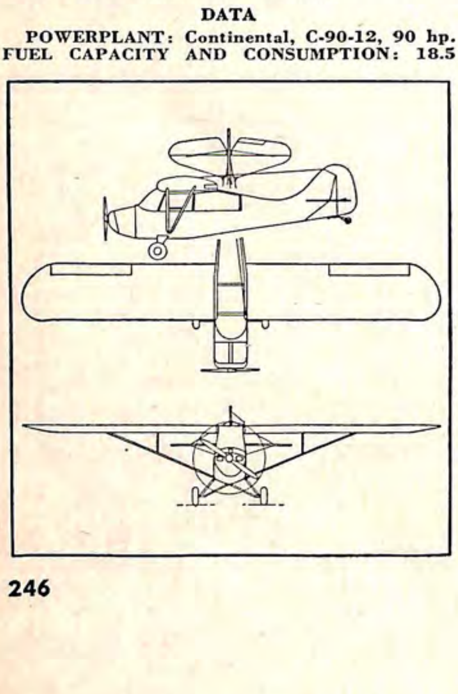


Aeronca Champion

A 2-place, closed, land or sea, high-wing monoplane, normal category. CAA TYPE CERTIFICATE NUMBER: TC 759. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 7 DC, July 12, 1948. ENGINEERING PERSONNEL: Leon Wolfe, ch. engr. TEST PILOT: Lou Wehring.

DATA

POWERPLANT: Continental, C-90-12, 90 hp. FUEL CAPACITY AND CONSUMPTION: 18.5 gal., 5.5 gal. per hr. OIL CAPACITY: 1¼ gal. APPROVED PROPELLERS: Sensenich 72CK-44, -45, -46, or McCauley 1A90. GEAR: Fixed two wheel, steerable tailwheel.



SPECS

SPAN: 35 ft. 2 in. LENGTH: 21 ft. 8 in. HEIGHT, 7 ft. WEIGHTS: EMPTY, 890 lb.; GROSS: 1,450 lb.; USEFUL LOAD, 491 lb. WING LOADING, 7.63 lb. per sq. ft. POWER LOADING, 15.3 lb. per hp.; BAGGAGE, FULL SEATS AND TANKS, 50 lb.

PERFORMACE

SPEEDS AT SEA LEVEL: MAXIMUM, 110 mph; CRUISING, 100 mph; STALLING, 44 mph. RATE OF CLIMB, 800 ft. 1st min. SERVICE CEILING: 14,500 ft.

REMARKS

The first of the Champion line, the 7AC, was certificated, Oct. 18, 1945. It had a 65 hp Continental, and was replaced by the 7BCM with an 85 hp Continental in Sept., 1947. This model was followed by the 7CCM, July 12, 1948 with the installation of a 90 hp Continental, increased fin area, auxiliary fuel wing tank, and fuselage member changes.

Aeronca Champion for 1951 was in production for only part of the year. Aeronca closed down all its civilian production to devote its activities exclusively to defense work.

ANDERSON, GREENWOOD AND CO.

Houston, Tex.

Anderson Greenwood AG-14

A 2-place, closed, land, mid-wing monoplane, normal category. CAA TYPE CERTIFICATE NUMBER: 4A1. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 14 September 21, 1950. ENGINEERING PERSONNEL: Marvin Greenwood, vice-president, engineering, and Lomis Slaughter, Jr., chief engineer.

DATA

POWERPLANT: Continental C-90-12FP, 90 hp. FUEL CAPACITY AND CONSUMPTION: 23 gal., 5 gal/hr. APPROVED PROPELLER: Hartzell ground adjustable, HA-12-UF-1/L214. FLAPS: trailing edge, 2 position, 45° and 23°. LANDING GEAR: long-stroke tricycle, steerable, oil and spring, dual acting brakes.

SPECS

SPAN: 34 ft. 7 in. LENGTH: 22 ft. HEIGHT: 7 ft. 9 in. WEIGHTS: EMPTY, 850 lb.; GROSS, 1400 lb.; USEFUL LOAD, 550 lb.; WING LOADING: 11.7 lb. per sq. ft.; POWER LOADING: 15.5 lb. per hp.; BAGGAGE, FULL SEATS AND TANKS: 80 lb. MAXIMUM BAGGAGE: 250 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, over 120 mph; CRUISING, over 110 mph; STALLING, 57 mph; RATE OF CLIMB, over 700 ft/min.; SERVICE CEILING, over 16,000 ft.; ENDURANCE, 4 hours.

REMARKS

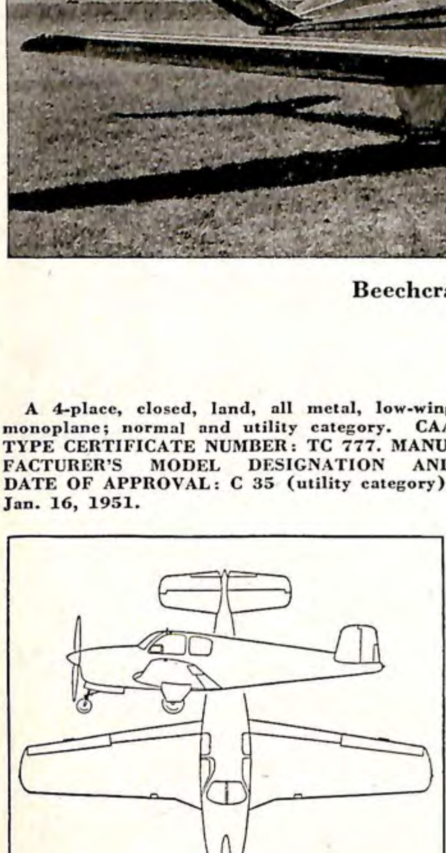
Initial production on the AG-14 started in late 1950 and during 1951 four aircraft were completed before the line was temporarily shut down due to material shortages. PRICE (f.a.f.): $4,495.

BEECH AIRCRAFT CORP.

Wichita, Kans.

Beechcraft Bonanza

A 4-place, closed, land, all metal, low-wing monoplane; normal and utility category. CAA TYPE CERTIFICATE NUMBER: TC 777. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: C 35 (utility category), Jan. 16, 1951.



DATA

POWERPLANT: Continental E-185-11, 205 hp at 2,600 rpm. FUEL CAPACITY AND CONSUMPTION: 39 gal. (59 gal. with auxiliary tank). 9.5 gal. per hr. at 175 mph. OIL CAPACITY: 2½ gal. PROPELLER: Beech electrically controlled continuous variable pitch, series 215 (all metal). FLAPS: NACA slotted. GEAR: Retractable tricycle.

SPECS

SPAN: 32 ft. 10 in. LENGTH: 25 ft. 2 in. HEIGHT: 6 ft. 6½ in. WEIGHTS: EMPTY, 1,625 lb.; GROSS, 2,700 lb.; USEFUL LOAD, 1,075 lb. WING LOADING, 15.2 lb. per sq. ft. POWER LOADING: 14.6 lb. per hp. BAGGAGE: Maximum, 270 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM 190 mph; CRUISING, 175 mph at 8,000 ft., STALLING, 55 mph (with flaps). RATE OF CLIMB: 1,100 ft. 1st min. SERVICE CEILING: 18,000 ft. RANGE: 775 mi. at 10,000 ft. at 165 mph (1180 mi. with auxiliary tank).

REMARKS

The Bonanza holds the lightplane non-stop world's distance record of 4,957.240 miles (see RECORDS). Popular with the business executive, the Bonanza has a successful feederline operational history. Over 3,000 have been manufactured. PRICE (f.a.f.): $15,990.

Beechcraft Twin Bonanza

A six-place, high-performance, twin-engine, cantilever low-wing monoplane with retractable tricycle landing gear and full equipment as standard. CAA TYPE CERTIFICATE NUMBER: 5A4. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: Model 50, May 25, 1951. FIRST FLIGHT: November 15, 1949.

DATA

POWERPLANT: Two Lycoming GO-435-C2 engines, takeoff rating 260 hy. at 3400 rmp. FUEL CAPACITY AND CONSUMPTION: 134 gal. (88 main inboard wink tanks—46 auxiliary outboard wing tanks), 22.8 gal per hr. OIL CAPACITY: 12 quarts per engine. PROPELLERS: Beechcraft Constant Speed B200-116; Beechcraft Feathering 214-101. FLAPS: NACA slotted. GEAR: Re'ractable tricycle.

SPECS

SPAN: 45 ft. 3.375 in. LENGTH: 31 ft. 6.468 in. HEIGHT: 11 ft. 4 in. WEIGHTS: EMPTY, 3800 lbs.; GROSS, 5500 lbs.; USEFUL LOAD, 1700 lbs. WING LOADING: 19.87 lbs. per sq. ft.; POWER LOADING: 11.46 lbs. per hp. BAGGAGE: 200 lbs. maximum allowable, rear; 100 lbs. maximum allowable, forward.

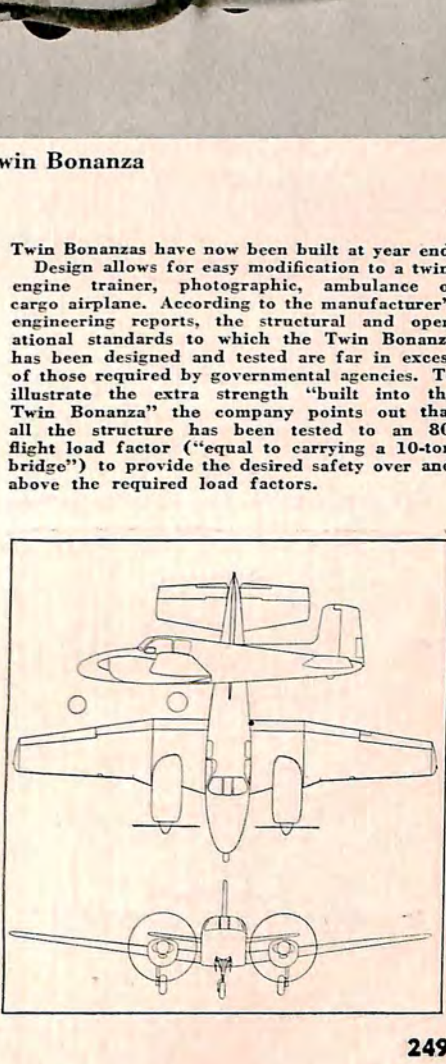
PERFORMANCE

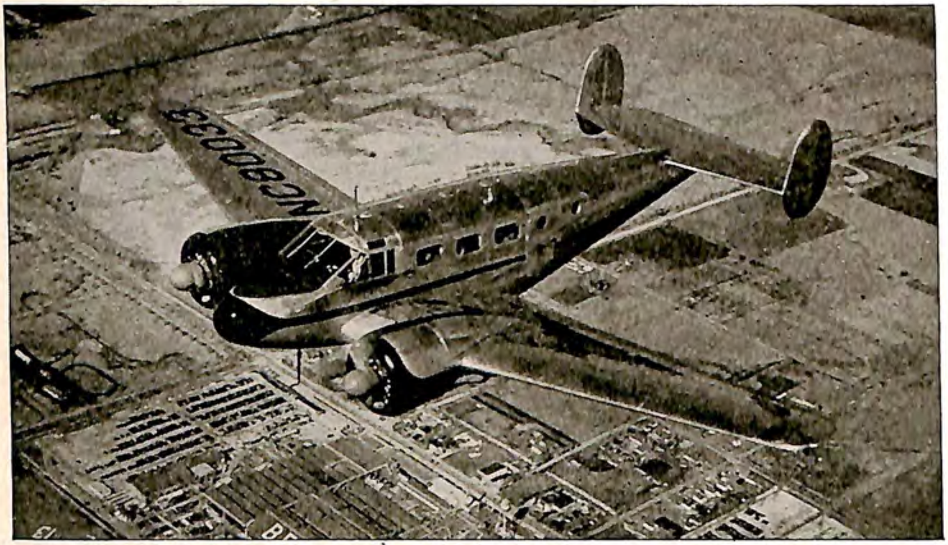
SPEEDS AT 2500 ft.: MAXIMUM, 202.5 mph; CRUISING, over 190 mph at 10,000 ft. at 65 percent power; STALLING, 64 mph. RATE OF CLIMB: 1500 ft. per min. SERVICE CEILING: 19,000 ft. RANGE: 1155 miles at 10,000 ft. at 50 percent power.

REMARKS

As a six-place, high-performance, twin-engine cantilever low-wing monoplane with retractable landing gear, the Beechcraft Twin-Bonanza made its initial flight on November 15, 1949. Eleven Twin Bonanzas have now been built at year end.

Design allows for easy modification to a twin-engine trainer, photographic, ambulance or cargo airplane. According to the manufacturer's engineering reports, the structural and operational standards to which the Twin Bonanza has been designed and tested are far in excess of those required by governmental agencies. To illustrate the extra strength "built into the Twin Bonanza" the company points out that all the structure has been tested to an 8G flight load factor ("equal to carrying a 10-ton bridge") to provide the desired safety over and above the required load factors.



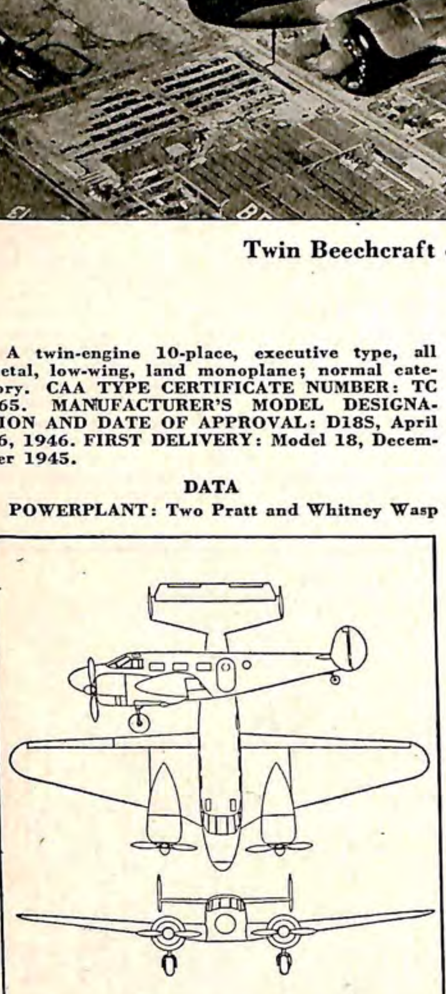


Twin Beechcraft executive transport

A twin-engine 10-place, executive type, all metal, low-wing, land monoplane; normal category. CAA TYPE CERTIFICATE NUMBER: TC 765. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: D18S, April 26, 1946. FIRST DELIVERY: Model 18, December 1945.

DATA

POWERPLANT: Two Pratt and Whitney Wasp Jr. R-985, 450 hp at 2,300 rpm. FUEL CAPACITY AND CONSUMPTION: 206 gal.; 33 OIL CAPACITY: 17 gal. APPROVED PROPELLERS: Hamilton Standard Hydromatic 22D30. FLAPS: Plain 45 degrees. GEAR: Two wheel retractable.



SPECS

SPAN: 47 ft. 7 in. LENGTH: 33 ft. 11½ in. HEIGHT: 9 ft. 2½ in. WEIGHTS: EMPTY, 5,770 lb., hydromatic; GROSS, 8,750 lb., hydromatic; USEFUL LOAD: 2,980 lb. WING LOADING: 25.07 lb. per sq. ft. POWER LOADING: 10.92 lb. per hp.

PERFORMANCE

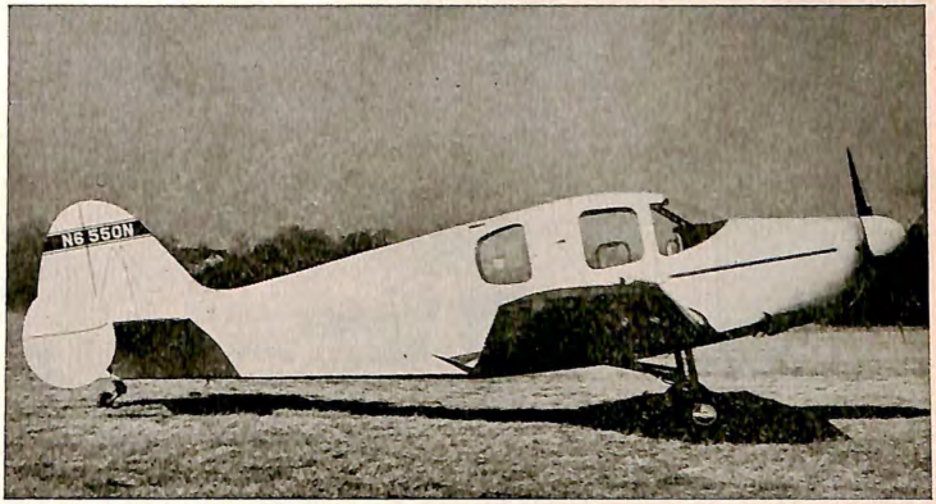
SPEEDS: MAXIMUM, 230 mph at 400 hp.; CRUISING, 211 mph at 10,000 ft. at 300 hp. RATE OF CLIMB, 1,190 ft. 1st min. (8,500). SERVICE CEILING: 20,500 ft. (8,500 lb.). RANGE: 750 to 1,500 mi. depending on fuel arrangement.

REMARKS

World-famous for its many commercial and military versions of the Model 18 twin-engine transport-trainer, Beech Aircraft is the world's largest producer of light transport and twin-engine trainer aircraft. More than 90 percent of the U.S. bombardiers and navigators, and about 50 percent of the multi-engine pilots were trained in the more than 7,000 military versions of this model manufactured during World War II. Current commercial models have many post-war improvements, a number of seating arrangements, and a wide selection of interior styling. More than 625 have been manufactured since V-J Day. PRICE (f.a.f.): $74,050 up.

BELLANCA AIRCRAFT CORP.

New Castle, Del.



Bellanca Cruisemaster

A 4-place, closed, low-wing, land, monoplane. CAA TYPE CERTIFICATE NUMBER: 773. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 14-19, Sept. 26, 1949. ENGINEERING PERSONNEL: G. M. Bellanca and B. J. Salvadori.

DATA

POWERPLANT: Lycoming O-435A, 190 hp. FUEL CAPACITY AND CONSUMPTION: 40 gal., (25 gal. auxiliary installation in baggage compartment is optional), 9.5 gal. per hr. OIL CAPACITY: 2 gal. APPROVED PROPELLERS: Hartgell-Hydro Selective. FLAPS: Slotted, 45 degrees. GEAR: Retractable-conventional.

SPECS

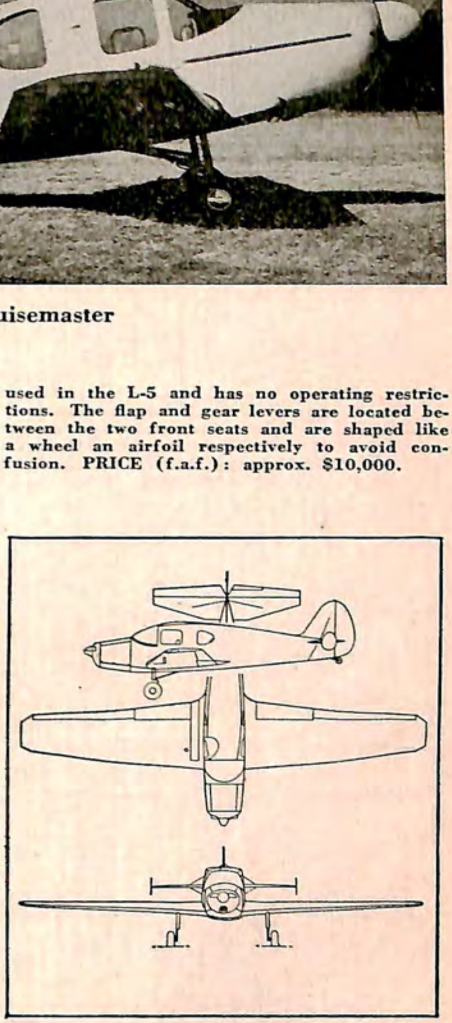
SPAN: 34 ft. 2 in. LENGTH: 23 ft. HEIGHT: 6 ft. 2½ in. WEIGHTS: EMPTY, 1,525 lb.; GROSS, 2,600 lb.; WING LOADING, 16.09 per sq. ft. POWER LOADING, 13.68 lb. per hp.; MAXIMUM BAGGAGE: 198 lb.

PERFORMANCE

CRUISING SPEED: (75% power) at 6,000 ft., 180 mph. RATE OF CLIMB, 1,400 ft. per min. SERVICE CEILING: 22,500 ft. RANGE: 680 mi. with 40 gal. fuel.

REMARKS

The Cruisemaster has a plastic bonded, laminated spruce wing and spar; the airframe is constructed of chrome molybdenum steel, fabric covered. The Lycoming engine is the same model used in the L-5 and has no operating restrictions. The flap and gear levers are located between the two front seats and are shaped like a wheel an airfoil respectively to avoid confusion. PRICE (f.a.f.): approx. $10,000.

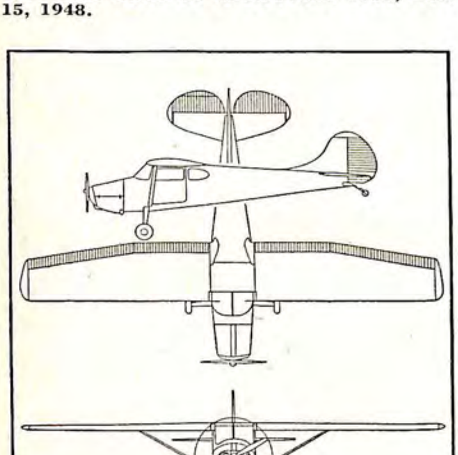


CESSNA AIRCRAFT CO.

Wichita, Kans.

Cessna's Model 170

A 4-place, closed, all-metal, land or seaplane, high-wing monoplane, normal and utility category, CAA TYPE CERTIFICATE NUMBER: TC 799. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 170A, Dec. 15, 1948.



DATA

POWERPLANT: Continental, C-145-D, 145 hp. FUEL CAPACITY AND CONSUMPTION: 42 gal., 7.5 gal per hr. OIL CAPACITY: 2 gal. APPROVED PROPELLERS: McCauley 1A170, Sensenich 73BR-50. FLAPS: Trailing edge, 50 degrees. GEAR: Fixed two-wheel, steerable tailwheel.

SPECS

SPAN: 36 ft. LENGTH: 25 ft. HEIGHT: 6 ft. 7 in. WEIGHTS: EMPTY, 1,185 lb.; GROSS, 2,200 lb.; USEFUL LOAD, 985 lb.; MAXIMUM PAYLOAD, 743 lb. WING LOADING, 12.8 lb. per sq. ft. POWER LOADING, 15.5 lb. per hp. BAGGAGE, FULL SEATS AND TANKS: 68 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 140 mph; CRUISING, 120 mph; STALLING, 53 mph (with flaps), 58 mph (without flaps). RATE OF CLIMB: 690 ft. 1st min. SERVICE CEILING: 15,500 ft. RANGE: 640 mi.

REMARKS

The rear seat of the 170 can be removed in three minutes to provide added cargo space. There is a wide range of optional equipment including skis, seaplane floats, crosswind wheels for single strip all-wind conditions, stretcher for ambulance use, blind flight hood, spraying equipment, and provisions for oblique or vertical aerial photography and mapping. PRICE (f.a.f.): $7,245.

Cessna 190-195

A 5-place, closed, land or seaplane, all-metal, monoplane, normal and utility category. CAA TYPE CERTIFICATE NUMBER: TC 790. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 190, July 1, 1947; 195, June 2, 1947. ENGINEERING PERSONNEL: Tom Salter, ch. engr.

DATA

POWERPLANT: Continental W760-23, 240 hp. FUEL CAPACITY AND CONSUMPTION: 80 gal., 13 gal. per hr. OIL CAPACITY: 5 gal. APPROVED PROPELLERS: Hamilton Standard 2B20 hub with 6135A-15 blades.

SPECS

SPAN: 36 ft. 2 in. LENGTH: 27 ft. 1 in. HEIGHT: 8 ft. WEIGHTS: EMPTY, 2,015 lb.; GROSS, 3,350 lb.; USEFUL LOAD, 1,130 lb.; MAXIMUM PAYLOAD, 810 lb. WING LOADING, 15.35 lb. per sq. ft. POWER LOADING, 13.95 lb. per hp. BAGGAGE, FULL SEATS AND TANKS: 131.5 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 178 mph; CRUISING, 160 mph; STALLING, 62.5 mph.. RATE OF CLIMB: 1,050 ft. 1st min. SERVICE CEILLING: 16,100 ft. RANGE: 750 mi.

REMARKS

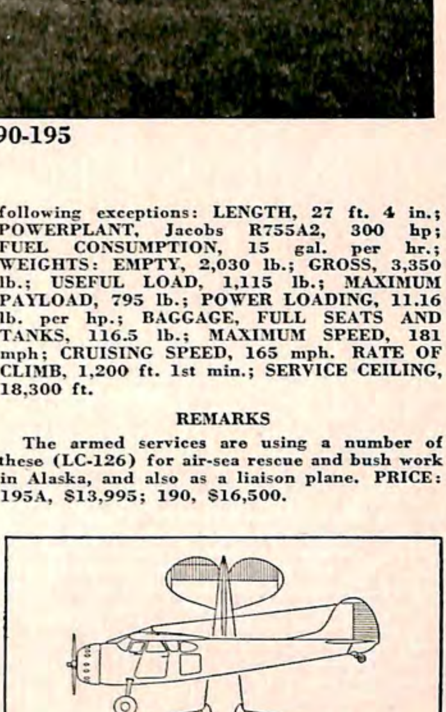
The 190 and 195 are Cessna's bids for the executive type personal airplane market. Good range, roomy interior, and easy conversion to a utility model are among its qualifying features. Maintenance is claimed to be simplified by the use of a hinged mount that can be swung by removing two bolts. PRICE: $13,-250. 1950 SHIPMENTS: As of Nov. 1, 400.

195

This model is similar to the 190 with the following exceptions: LENGTH, 27 ft. 4 in.; POWERPLANT, Jacobs R755A2, 300 hp; FUEL CONSUMPTION, 15 gal. per hr.; WEIGHTS: EMPTY, 2,030 lb.; GROSS, 3,350 lb.; USEFUL LOAD, 1,115 lb.; MAXIMUM PAYLOAD, 795 lb.; POWER LOADING, 11.16 lb. per hp.; BAGGAGE, FULL SEATS AND TANKS, 116.5 lb.; MAXIMUM SPEED, 181 mph; CRUISING SPEED, 165 mph. RATE OF CLIMB, 1,200 ft. 1st min.; SERVICE CEILING, 18,300 ft.

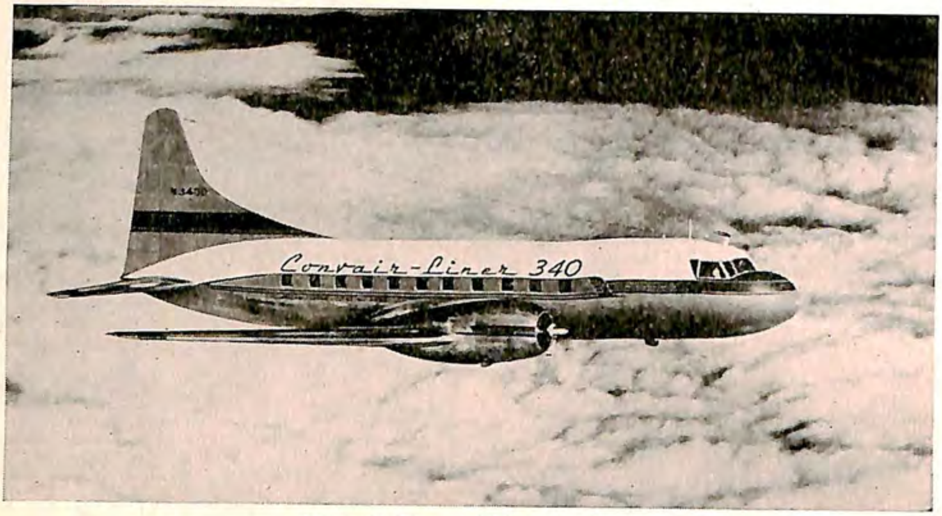
REMARKS

The armed services are using a number of these (LC-126) for air-sea rescue and bush work in Alaska, and also as a liaison plane. PRICE: 195A, $13,995; 190, $16,500.



CONSOLIDATED VULTEE AIRCRAFT CORP.

San Diego, Cal.



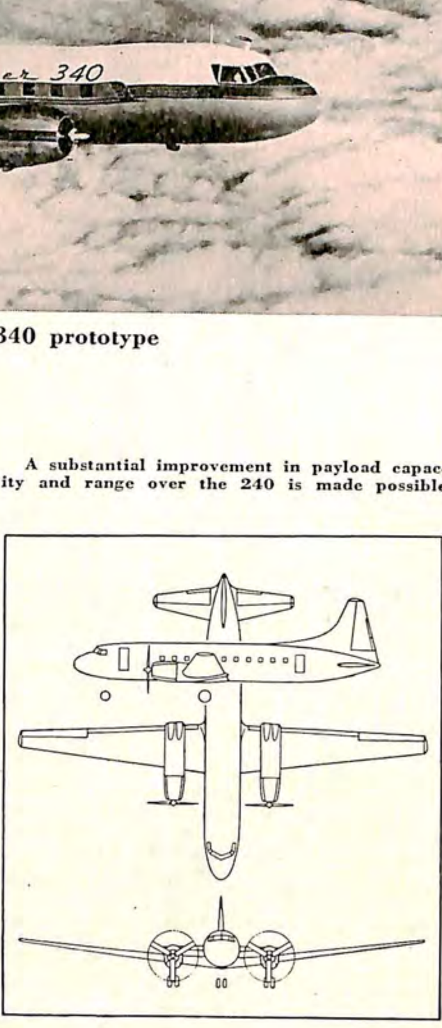
Convair-Liner 340 prototype

OUTSTANDING FEATURES: Consolidated Vultee's 340 is based on the design of the 240 which has seen over 600,000 airline hours. There are many new features which make it a new airplane including more wing area, longer fuselage, higher gross weight, more powerful engines, and many interior design improvements. The plane was designed to meet the needs of airlines for a high-speed transport with maximum performance flexibility. The increased wing area, power, and fuel capacity will enable airlines to use the 340 not only for medium-range schedules but also as an alternate plane for 4-engine equipment. In addition the plane was designed for feeder-line operations.

The 340 wing span is 13 ft. 11 in. greater than the 240 and the wing area 920 sq. ft. as compared with 817 for the 240. The wing area increase is one of the most important advancements in the new model. The extra area, together with a new flap system, gives the plane added short field advantages. At equal weights, the new model reduces the required CAA takeoff field length by 1,000 ft. compared with the 240.

The 340 wing, with a greater area in newly designed panels outboard of engine nacelles combined with an increased aspect ratio (12 compared with 10 on the 240), makes it possible to increase takeoff gross weight 3,210 pounds over the 41,790-pound gross weight of the 240.

A substantial improvement in payload capacity and range over the 240 is made possible



with the new wing. For the same range, the 340 can carry approximately 2,000 pounds more payload at higher cruising speeds. The 340 will climb faster and to higher altitudes than the 240. The extra wing area also increases fuel capacity 150 gallons. Integral fuel tanks carry 1,700 gallons compared with the 1,550-gallon capacity of the latest 240 version.

While the fuselage of the 340 will be the same diameter as that of the 240 (9 ft. 5 in.), length of the 340 is 79 ft. 2 in., an increase of 54 in. A 38-in. cylindrical fuselage section is added aft of the wing and a 16-in. section forward of the wing. This extra space can be used for 4 passenger seats, making passenger capacity 44, or it can be used for cargo purposes. The extra length also allows more latitude in loading because of a greater center-of-gravity range.

The two 2,400-hp Pratt and Whitney CB series engines improve performance because of allowable higher cruising powers. The CB engines develop takeoff power to much higher altitudes, thus improving takeoff performance at high altitudes. At the same weight and power settings, and for maximum range conditions, the 340 will cruise approximately 8 miles an hour faster than the 240.

The Hamilton Standard propellers have a 6-in. greater diameter than those on the 240.

The 340 pressurization and air-conditioning system includes a number of improvements. A new type engine-driven supercharger with two-speed operation has been installed. Air conditioning during ground operation is possible because a hydraulic clutch automatically compensates for reduced engine speeds. New air conditioning equipment will be installed to match the performance of the new supercharger.

The distribution ducting, valves, and temperature controls have been engineered to incorporate changes considered advisable after extensive experience acquired with 175 Convair-Liners in domestic and foreign service.

Cabin ventilating air is distributed through overhead diffusers which provide more effective cooling, heating, and ventilation. Flight deck ventilation has been improved. An electric heater is installed in the duct leading to the flight deck to provide for variations between cabin air and flight-deck air temperatures.

The 340 has a completely new electrical system. The basic system has overvoltage and generator feeder-fault protection. The control and power components are separated into different units to simplify circuitry and to increase safety of the system.

An electrical compartment is provided aft of the co-pilot's station for installation of major accessories. This central station permits convenient servicing and maintenance for the majority of electrical units.

The 340 hydraulic system is similar to that which was used for the 240.

A forward entrance stairway is installed on the left side of the fuselage. The standard 240 stairway is on the right side. The change in position is being made to facilitate utilization of ground equipment already in use by airlines.

The 340 integral stairway will be completely operated by hydraulic power—the 240 stairway is operated by a combination of hydraulic and mechanical power.

The 340 landing gear is longer than that installed on the 240, and is completely new. The main strut is 2½ inches longer. Low pressure, Type III tires, either in 11.00-16 or 12.50-16 sizes have been selected to reduce tire pressures, thus increasing the ground contact areas and extending tire life. Both the strut and wheels were designed for installation of a Decelostat unit to extend life of tires by preventing skidding. Tread of the main gear is 25 feet.

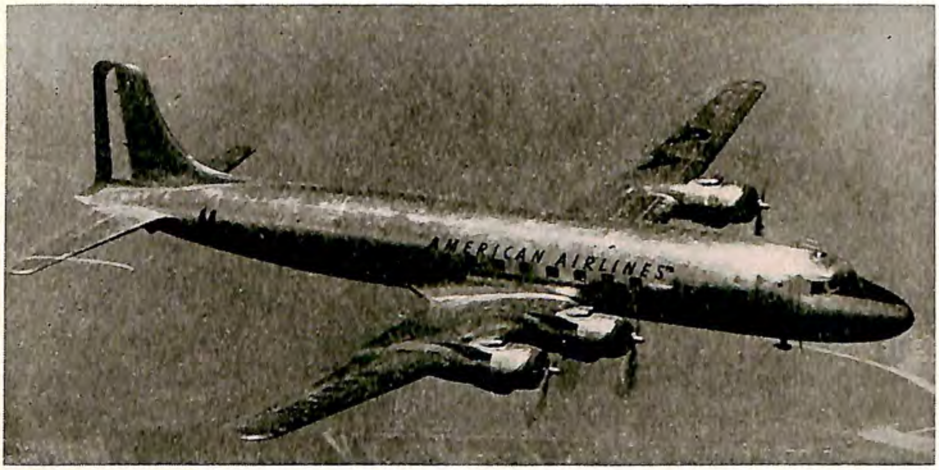
The 340 was designed so that turboprop engines can be installed with a minimum of modification and expense as soon as gas turbine engines are available for commercial operation.

POWERPLANT: Two Pratt and Whitney R-2800-CB-16, two speed 18 cylinders. Take-off power (wet), 2,400 bhp at 4,000 ft. and 2,800 rpm. Take-off (dry), 2,050 bhp at 6,000 ft. and 2,700 rpm. Take-off (dry) alternate, 1,950 bhp at 8,000 ft. and 2,800 rpm. Max. continuous rating: Low blower, 1,800 bhp at 8,500 ft. and 2,600 rpm; High blower, 1,700 bhp at 14,500 ft. and 2,600 rpm. FUEL CAPACITY: 1,700 gal. APPROVED PROPELLERS: Hamilton Standard Hydromatic, 3 blades, automatic full-feathering and reversible; diameter 13 ft. 1 in. WING SPAN: 105 ft. 8 in. LENGTH: 79 ft. 2 in. HEIGHT: 27 ft. 9 in. (over tail, 3-point position). GEAR: Tricycle. WEIGHTS: EMPTY, 29,486 lb.; GROSS, 44,500 lb. (max. landing), 45,000 lb. (max. take-off). WING LOADING: 48.9 lb. per sq. ft. (max. take-off). PAYLOAD: 11,632 lb. (max.). POWER LOADING: 9.38 lb. per bhp (max. take-off). PERFORMANCE: CRUISING, 280 mph at 16,000 ft., 1,200 bhp with 43,000 lb.

PRODUCTION on the first Convair-Liner 340 started in 1951 with the first delivery scheduled for early 1952. At the end of 1951 there were more than 100 340's ordered by twenty-two domestic and foreign airlines. Before production closed down on the 240's there had been a total of over 160 come off the production line. Oct. 5, 1951 saw the first test flight of the 340, the same day that taxi tests were started. United Air Lines had the biggest order on the books at year end with a program calling for forty with the first production model due for delivery in early 1952. Other airlines with 340's on order included: Delta Air Lines, Braniff Airways, Mid-Continent Airlines, Northeast Airlines, Hawaiian Airlines, Philippine Air Lines and Continental Air Lines. There have also been several executive types ordered. PRICE: $520,000.

DOUGLAS AIRCRAFT CO., INC.

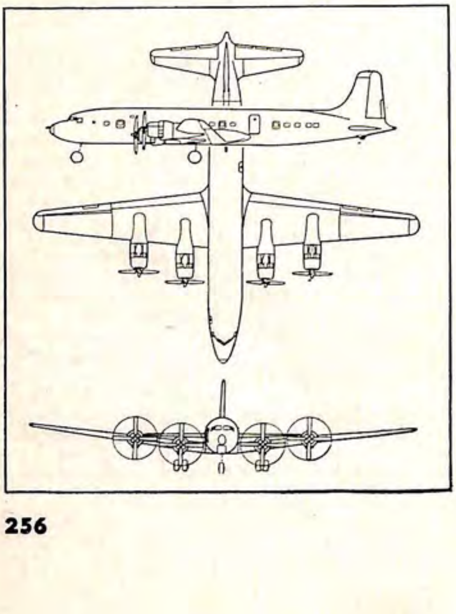
Santa Monica, Cal.



Douglas DC-6B transport

CAA TYPE CERTIFICATE AND DATE: TC 6A4, Apr. 11, 1951.

OUTSTANDING FEATURES: All of the proven features and systems of the basic DC-6, with a number of improvements are incorporated in the subsequent DC-6B version. Cabin pressurization is increased, in some models, to 25,000 ft. flight altitude with 8,000 ft. cabin altitude pressure. Increased flow of cabin air also is available at customer option. Interior configurations range from 44 passenger luxury sleeperettes to 92 passenger high density planes.



ENGINEERING PERSONNEL: Edward F. Burton, chief engineer; J. B. Edwards, project engineer.

NOTES: First step in the evolution of the DC-6B was the prototype DC-6A Liftmaster, designed to carry either commercial or military cargoes. Fuselage of the standard DC-6 was lengthened five feet, gross weight increased to 100,000 lbs. and horsepower of the engines raised correspondingly. After flight testing and demonstrating the cargo configuration, it became apparent that the same aircraft with passenger interior accommodations would be an attractive airliner with passenger-mile operating costs even lower than the DC-6. Beginning in January, 1951, DC-6Bs will be delivered to American Airlines, United Air Lines, Pan American World Airways, Pan American-Grace Airways and Swissair.

FLIGHT CREW: Pilot, co-pilot, flight engineer on domestic flights. Navigator and radio operator added for over-water operations.

POWERPLANT: Four Pratt and Whitney R-2800CB-16. HP at take-off, 2,400 BPH each (with CB17, 2500 BHP with water and 115 octane fuel). Normal rated power, 1,800 BHP each. NORMAL FUEL CAPACITY: 4,248 to

5,530 gal. OIL CAPACITY 140 gal. PROPELLER: Hamilton Standard reversible. WING SPAN: 117 ft. 6 in. LENGTH: 105 ft. 7 in. HEIGHT: 28 ft. 8 in. GEAR: Fully retractable tricycle using two sets of dual-type main wheels mounted aft of the center of gravity, and a steerable nosewheel. WEIGHTS: Maximum take-off gross weight, 100,000 lb. with CB16 engines. (106,900 lb. with CB17 engines and auto-feather props); structural design landing gross weight, 85,000 lb. to 88,200 lb. WING LOADING (Gross weight, 100,000 lb.): 68.4 lb. per sq. ft. (Gross weight 106,900 lb.) 73 lb. per sq. ft. POWER LOADING (Take-off power at 100,000 lb): 10.4 lb. per BHP. (at 106,900 lb.) 10.69 lb. per BHP.

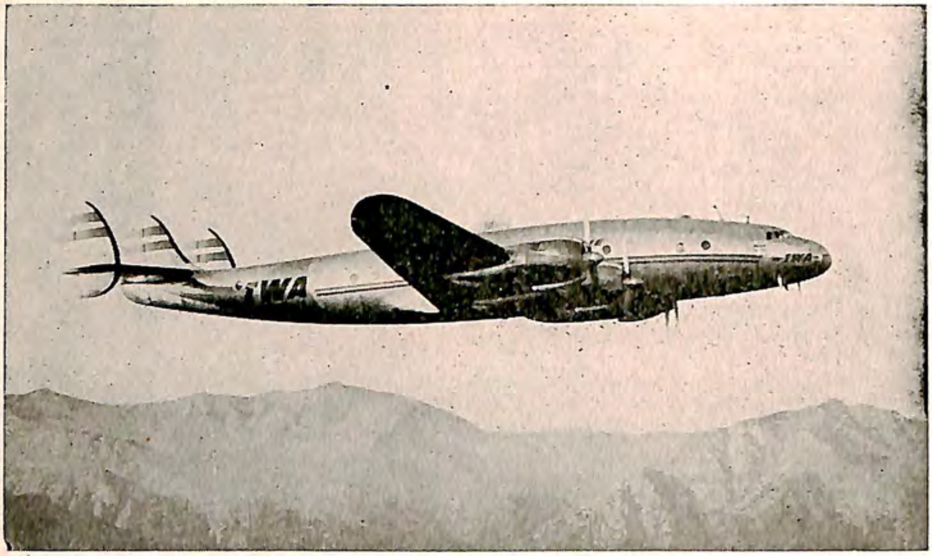
PERFORMANCE: Maximum cruise power, high blower, 1,200 BHP, 318 mph. with a gross of 90,000 lb. at 20,600 ft.; 311 mph. with a gross of 90,000 lb. at 20,600 ft.; and 290 mph with a gross of 100,000 lb. at 20,300 ft. Sixty percent sea level maximum continuous power at 10,000 ft.; 274 mph. with 85,000 lb.; 269 mph with 90,000 lb. and 257 mph with 100,000 lb. TAKEOFF C.A.R. FIELD LENGTH: Sea level without water injection, 85,000 lb., 4,400 ft.; 90,000 lb., 5,140 ft. Sea level with water injection, 85,000 lb., 3,630 ft.; 90,000 lb., 4,200 ft.; 100,000 lb., 5,700 ft. At 5,660 ft. At 5,000 with water injection, 85,000 lb., 4,930 ft.; 90,000 lb., 5,850 ft. LANDING, C.A.R. FIELD LENGTH at 85,000 lb.: Sea Level, 4,990 ft; at 5,000 lb., 5,710 ft. SERVICE CEILING: 27,300 ft. with 85,000 lb. RANGE: 4,000 mi. with 4,248 gal. or 5,450 mi. with 5,530 gal.

DESIGN GROWTH

In the early days of aircraft design the structure was stressed as precisely as possible to the design gross weight of the airplane, its performance estimated on the basis of that weight and every detailed part made to fit only the precise configuration than in design. More recently designers have learned to provide "room to grow" in new aircraft designs and the Douglas DC-6B is an example of the rewards available from technical foresight. It all began with the original DC-4 back in 1938 when this airplane was the largest of its kind ever built. Following nationwide service tests of the big triple-tailed DC-4, the design was modified to slightly smaller dimensions with single tail and initial production of the new version was underway when the nation went to war on Dec. 8, 1941. The passenger airliner was quickly converted into a military cargo plane and, as the Air Force C-54 *Skymaster*, began to flow from the assembly lines early in 1942. It continued in quantity production throughout World War II with more than one thousand entering the armed forces. Late in 1944 Douglas engineers began "stretching" the big transport by adding 6 ft. of fuselage, providing bigger engines and making numerous detailed refinements. The new military transport, the XC-112A, made its first military flight February, 1946, and went into production for the airlines as the DC-6. Hardly had the DC-6 production line began volume output when, again, Douglas engineers began to stretch the airplane by adding yet another 6 ft. of fuselage and more refinements. The result was the DC-6B. From an initial gross weight of 73,000 lb., the design has grown to its present total of 100,000 lb. Still the designers are not satisfied and as the year came to a close they announced the new DC-7 version, which will weigh 116,800 lb. and be powered by four Wright Turbo-Compound engines of 3,500 hp each, or more than three times the power of the original design. This is the kind of astonishing growth of which a sound basic design is possible provided the engineers have kept their eye on the future. Assuredly there is none today who would be foolish enough to predict the absolute limit of usefulness of this world-famed airplane design for studies have already been completed for turboprop engine versions. Douglas has a backlog of well over 100 of the standard DC-6 design in various models for airlines throughout the world and orders are continuing to pour in. From the point of view of speed, the big transport has improved from the top of 274 mph in its original form to more than 400 mph in its newest guise, an improvement of 46 percent—yet speed is the toughest obstacle the designer who wishes to stretch an airplane must overcome. From the point-of-view of capacity, the accommodation of the giant transport has increased from 42 passengers to 92 passengers. The useful load has been increased from 34,800 lb. to 51,850 lb., or a fifty-percent improvement. This is the kind of phenomenal accomplishment that is possible using the same wing and fuselage of an airplane design that has been laid down with a sharp eye on the future.

LOCKHEED AIRCRAFT CORP.

Burbank, Cal.



Global transport, Lockheed Constellation

CAA TYPE CERTIFICATE AND DATE: TC 763, Mar. 14, 1947.

POWERPLANT: Four Wright Cyclones 749C-18BD1. 2,500 hp each at takeoff. FUEL CAPACITY: 5,820 gal. OIL CAPACITY: 216 gal. APPROVED PROPELLERS: Curtiss Electric reversible C634S—C306 hub with three 830-2064-0 blades. WING SPAN: 123 ft. LENGTH: 95 ft. 2 in. HEIGHT: 22 ft. 5 in. GEAR: Tricycle, fully retractable, steerable nosewheel.

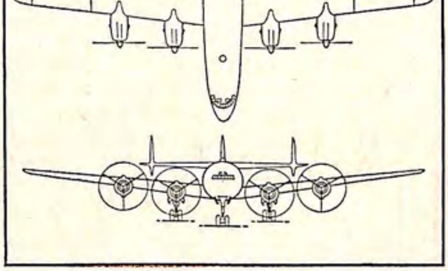
WEIGHTS: EMPTY, standard interior, 59,109 lb.; GROSS, 107,000 lb.; USEFUL LOAD 47,891 lb.; MAXIMUM PAYLOAD, 22,000 lb. WING LOADING: 64.9 lb. per sq. ft. POWER LOADING: 10.7 lb. per hp.

PERFORMANCE

SPEEDS: MAXIMUM, 343 mph at 19,200 ft. CRUISING, 300 mph at 23,000 ft.; STALLING, 91 mph at sea level. RATE OF CLIMB: 1,234 ft. per min. at sea level and maximum gross. TAKEOFF: 2,160 ft. LANDING: Over a 50 ft. obstacle and to a full stop, 2,880 ft. without using reversible propellers. SERVICE CEILING: 27,800 ft. fully loaded. RANGE: 5,100 mi.

PRICE: Approximately $1 million.

PRODUCTION: There have been completed or are on order 243 Constellations. The production line at Lockheed's Burbank factories has not stopped since the first production models were put in service in 1945. Preesnt orders assure continued manufacture well into 1952 (including the military version (C-121).



Lockheed Super Constellation

OUTSTANDING EATURES: The Super Constellation is the latest development of Lockheed's Constellation series of long-range, high altitude transports. The fuselage conforms in general to the air flow line over the wings at cruising. The camber of the fuselage reduces lift-drag ratio and allows for optimum floor arrangement. The multiple tail adds stability and also reduces the over-all height.

Seventeen of the world's transport systems are, or soon will be, equipped with Constellations or Super Constellations. Military versions of these transports have been in use on high priority assignments; large quantities of Super Constellations are on order for the Air Force and Navy.

FAMILY: Other Lockheed transports before the Super Constellation include, in addition to the Constelaltion, the Lodestar and Electra designed in 1939. The Super-Electra became the British Hudson bomber in 1938, and in the same year Lockheed began building the P-38 Lightning, for the Army Air Corps. Lockheed aircraft go back to 1912 and include the Vega, the X-35, the first pressurized plane, which flew successfully in the sub-stratosphere in 1936.

DEVELOPMENT: Design on the original Constellation was started in 1939. The first Constellation flew on Jan. 9, 1943, after ten million engineering man-hours and nearly $59 million had been spent on the project. The first flight was made at Lockheed Air Terminal, Burbank, Cal., with Eddie Allen at the controls. This transport became the wartime C-69.

The Super Constellation is 18.4 ft. longer than its sister ship and carries about 40 percent more pay load. The first production model flew on July 14, 1951. It is scheduled to enter air line service around the first of 1952.

During 1951 Constellations were in use by TWA, Eastrn Air Lines, Pan American, Panair do Brasil, British Overseas Airways Corp., Linea Aeropostal Venezolana, Capital Airlines, Air France, KLM, Qantas, Air India, South Africa Airways, Chicago & Southern, Avianca and El Al.

Among airlines ordering Super Constellations were TWA, Eastern Air Lines, KLM, Pakistan International, Air France, Trans-Canada Airlines and Qantas.

The Constellation was the first transport to be certificated, on Sept. 1, 1949, under International Civil Aviation Organization standards.

Lockheed's commercial Super Constellation backlog had risen to more than $100 million, a new company record, covering 68 planes, as of Sept. 1951.

Both the Constellation and Super Constellation are designed as special electronic airplanes for the Navy.

ENGINEERING PERSONNEL: Hall Hibbard, chief engineer, C. L. Johnson, chief research engineer.

PASSENGER ACCOMMODATIONS: Various seating arrangements are used by the different airlines flying Constellation-type transports. The latest commercial Super Constellations designed call for a minimum of 47 seats and a maximum of 88; military transports can carry up to 110. Super Constellations are pressurized to maintain 5,000 ft. pressure at 20,000 crusing altitude. The new aircraft contain improved heating and refrigeration equipment.

FREIGHT FEATURES: Passenger Super Constellations will have 65 percent more cargo capacity than their companion Constellations. They will have 424 cu. ft. in the lower aft compartment and 269 cu. ft. forward. Con-

stellations have 280 cu. ft. aft and 154 cu. ft. forward; this may be increased by approximately 400 cu. ft. by use of the Speedpak, an optional external cargo carrier.

The Super Constellation has been designed also as an all-freight transport, designated model 1049-B. It will have a maximum capacity of 40,000-43,000 pounds; average 38,600 pounds domestically, 36,300 Trans-Atlantic. Its cost per ton mile has been estimated at less than five cents. Main cargo compartment is 84 ft. long, total cargo volume 5,568 cu. ft., fuselage over-all 113 ft. 7 in. It has cargo doors fore and aft.

SPECS

FLIGHT CREW: In domestic operations, pilot, co-pilot, and flight engineer; in overseas operations, a navigator-radio operator is added; on certain long-range flights, additional relief crew members are carried.

POWERPLANT: Some Super Constellations are designed to have Wright Cyclone C18CA1 engines with 2,700 hp, all will be convertible to Wright Turbo-Cyclone C18DA1 engines, specified for original installation on later models. These engines will have: FUEL CAPACITY: 6,507 gal. APPROVED PROPELLERS: Hamilton Standard 6903A. WING SPAN: 123 ft. LENGTH: 113 ft. 7 in. HEIGHT 23 ft. GEAR: Tricycle, fully retractable, steerable nosewheel.

WEIGHTS: EMPTY, standard interior, 68,642 lb.; GROSS: 130,000 lb. USEFUL LOAD: 61,358 lb. MAXIMUM PAYLOAD, approximately 23,750 lb. WING LOADING: 78 8 lb. per sq. ft. POWER LOADING: 10.0 lb. per hp.

PERFORMANCE

SPEEDS: MAXIMUM, 374 mph at 19,000 ft. CRUISING: 320-340 mph at 20,000 ft. STALLING SPEED: 94 mph at sea level. RATE OF CLIMB: 1,195 ft. per minute at sea level and maximum gross. TAKEOFF: 1,930 ft. LANDING: Over 50 ft. obstacle to a full stop, 3,180 ft. SERVICE CEILING: 27,600 ft. fully loaded. RANGE: 5,020 miles.

PRICE: Approximately $1,500,000.

PRODUCTION: Manufacture of Constellation-type transports has been continuous since 1943. Commercial and military orders assure uninterrupted production at least through 1953.

AND ON AND ON

It is unusual for a heavy transport to see service as a combat airplane but the Lockheed *Constellation* is doing just that in its special Early Warning Radar version delivered to the U. S. Navy. The special radar antennas jut out from the normally-sleek fuselage of the Connie above and below to give it an ugly appearance belying its unmatched usefulness as a flying warning station. It has added a new dimension to warfare by solving the problem of the earth's curvature. Since radar beams travel in a straight line, their effectiveness is limited by this curvature. The special PO-1W and PO-2W models of the Connie solve this problem by acting as a high altitude relay station for long-range radar detection work. Both the Air Force and the Navy use high-speed transport versions of the Connie for strategic airlift purposes and the latest model will be powered by four turboprop engines giving it a cruising speed of 394 mph. Other versions of the new Super Connie include all-cargo versions for international freight operators, high-density air coach models for transcontinental low-cost transportation and luxurious long-range models for transoceanic travel. With such astonishingly high performance and tremendous long-distance capabilities, it is easy to suppose that the Super Connie is a new, postwar design featuring the latest research in aerodynamics and propulsion. Actually, the Connie is 12 years old for its design began back in June, 1939 and it saw extensive service in World War II as the C-69 long-range transport. After the war commercial versions flowed from the Burbank, Calif., assembly line to the major airlines of the world. In 1950 Lockheed engineers added 18 ft. to the fuselage to provide capacity for 92 passengers or 5,568 cu. ft. of cargo. The addition of the power and economy of the Wright Turbo-Cyclone engines has made the Super Connie the fastest piston-engined transport in the world and has placed it well within the operational realm of the turboprop transport. It is easily adaptable to turboprop power and many airlines now ordering it have their eye on such conversion at a future date. Lockheed currently has the largest backlog of orders for the new Super Constellation of any civil transport manufacturer in the world, and the end of such orders is still far from in sight. Which isn't bad for a 12-year-old airplane, which should have reached the end of its useful life many years ago. The life of the Super Connie is actually just beginning.

THE GLENN L. MARTIN AIRCRAFT CO.

Baltimore, Md.

Martin 4-0-4, medium range transport

TYPE: Transport. DESIGNATION: 4-0-4.

DATA

POWERPLANT: Two Pratt & Whitney R-2800 CB16. FUEL CAPACITY: 1,350 gal. PROPELLERS: Hamilton Standard, 3 blade reversible. GEAR: Tricycle.

SPECS

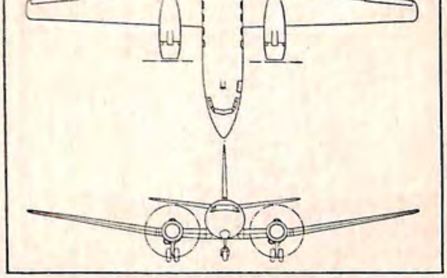
SPAN: 93 ft. LENGTH: 74 ft. 7 in. HEIGHT: 28 ft. 6 in. WEIGHTS: TAKEOFF GROSS, 43,650 lb.; LANDING, 41,000 lb. MAXIMUM PAYLOAD: 10,040 lb.

PERFORMANCE

SPEEDS: MAXIMUM, 312 mph; CRUISING at 10,000 ft. and 1,080 bhp, 248 mph. STALLING, 81 mph. ALTITUDES: Maximum, 27,600 ft.; Single engine, 7,900 ft. TAKEOF DISTANCE: 3,800 ft. RANGE: 710 mi (operational).

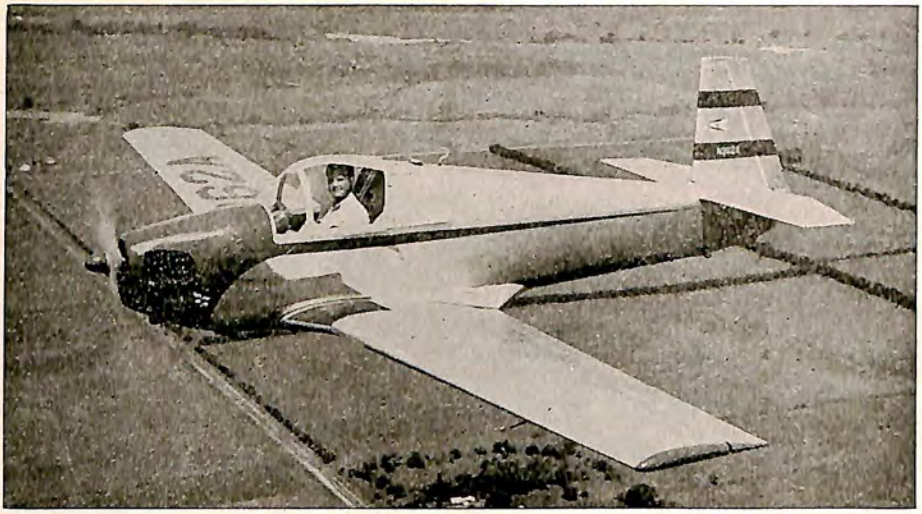
REMARKS

The Martin 4-0-4 is a pressurized twin-engine transport airplane designed especially for short and medium distance service. Spaciousness, in terms of wide aisles, roomy seats and large windows, characterize the passenger cabin—which, besides pressurization, has sound-proofing and air conditioning on the ground as well as while airborne. Great stability and excellent all-round flight characteristics have been emphasized in the airframe design. A large permissable center of gravity travel permits unrestricted distribution of passengers. The wing flaps are mechanically interconnected with the horizontal stabilizer, minimizing trim changes with movements of the flaps. To enter the Martin 4-0-4, passengers walk up a built-in, retractable tail ramp.



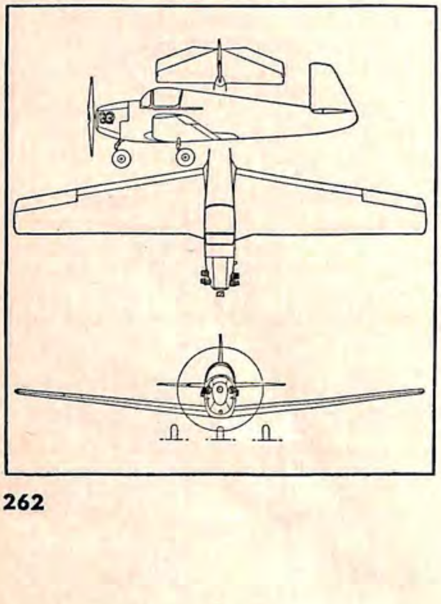
MOONEY AIRCRAFT, INC.

Wichita, Kans.



Single place Mooney features low operating cost

A 1-place, closed, land monoplane, normal and utility category. CAA TYPE CERTIFICATE NUMBER: TC 803. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: M-18L, Mar. 15, 1949: FIRST DELIVERY: March, 1949. ENGINEERING PERSONNEL: N. E. Miller, ch. engr. TEST PILOT: W. W. Taylor.



DATA

POWERPLANT: Lycoming or Continental, 65 hp. FUEL CAPACITY AND CONSUMPTION: 11 gal., 3 to 4 gal. per hr. OIL CAPACITY: 1 gal. APPROVED PROPELLERS: Sensenich Models 66CB-54 and 66CB-52. FLAPS: Slotted, 16½ degrees. GEAR: Tricycle retractable.

SPECS

SPAN: 26 ft. 10½ in. LENGTH: 17 ft. 7¼ in. HEIGHT: 6 ft. 2½ in. WEIGHTS: EMPTY, 500 lb.; GROSS, 780 lb.; USEFUL LOAD, 280 lb. WING LOADING, 8.2 lb. per sq. ft. POWER LOADING, 12 lb. per hp. BAGGAGE, FULL SEATS AND TANKS: 40 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 138 mph; CRUISING, 125 mph; STALLING, 40 mph. RATE OF CLIMB: 1,090 ft. 1st min. SERVICE CEILING: 19,400 ft. RANGE: 390 mi.

REMARKS

300 flying hours covering approximately 36,000 miles for $674.00 which includes fuel, oil, maintenance, and insurance is claimed by the manufacturer. This figures out to about 2c per mile. The Mooney line is now complete including Model M-18LA Standard with Lycoming engine, Model M-18C Standard with Continental power. The Deluxe model of each includes starter, generator, and position lights. PRICE (f.a.f.): approx. $2,100.

PIPER AIRCRAFT CORP.

Lock Haven, Pa.

Latest Cub

A 2-place, closed, land or sea, high-wing monoplane. CAA TYPE CERTIFICATE: TC 1A2. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: PA-18, Nov. 18, 1949. There were two models of the 1951 Super Cub, 95 and 125.

DATA

POWERPLANT: (95) Continental, 90 hp; (125) Lycoming O-290-D 108 hp. FUEL CAPACITY: 18 gal. 36 gal. optional.

SPECS

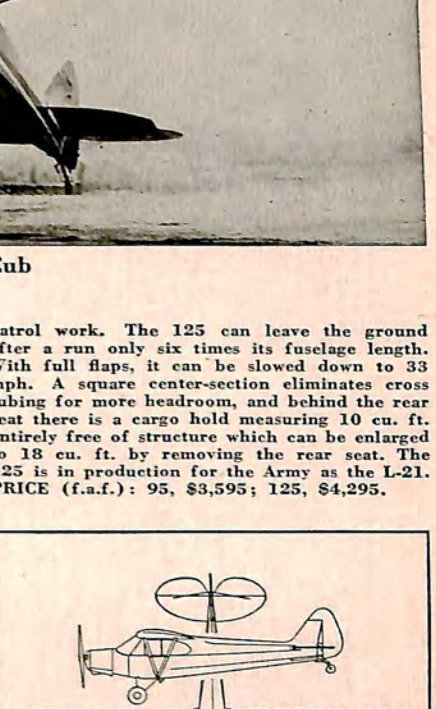
SPAN: 35.3 ft. LENGTH: 22.4 ft. HEIGHT: 6.7 ft. WEIGHTS: EMPTY (95) 800 lb.; (125) 845 lb.; GROSS: 1,500 lb. USEFUL LOAD: (95) 700 lb.; (125) 655 lb. WING LOADING: 8.4 lb. per sq. ft. POWER LOADING: (95) 16.6 lb. per hp.; (125) 12 lb. per hp.

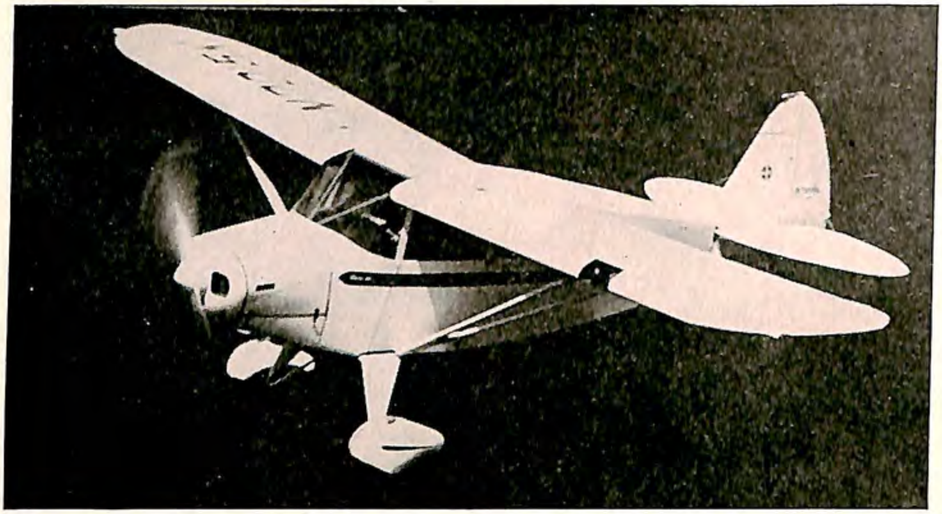
PERFORMANCE

SPEED: MAXIMUM (95) 110 mph; (125) 123 mph; CRUISING: (95) 100 mph; (125) 108 mph; STALLING: (95) 42 mph; (125) 38 mph. RATE OF CLIMB: (95) 624 ft. per min.; (125) 870 mph. SERVICE CEILING: (95) 13,500 ft.; (125) 17,100 ft. CRUISING RANGE: (95) 360 mi.; (125) 270 mi.

REMARKS

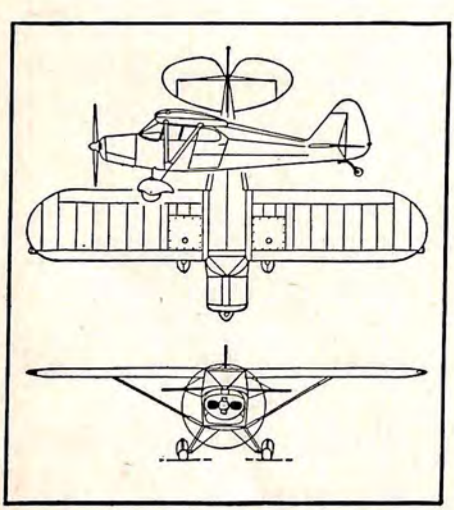
The Super Cub models for 1951 were designed for a number of jobs among them dusting and spraying, small field operations, and patrol work. The 125 can leave the ground after a run only six times its fuselage length. With full flaps, it can be slowed down to 33 mph. A square center-section eliminates cross tubing for more headroom, and behind the rear seat there is a cargo hold measuring 10 cu. ft. entirely free of structure which can be enlarged to 18 cu. ft. by removing the rear seat. The 125 is in production for the Army as the L-21. PRICE (f.a.f.): 95, $3,595; 125, $4,295.





Piper Pacer

A 4-place, closed, land high-wing monoplane, normal category. CAA TYPE CERTIFICATE NUMBER: TC 1A4. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: PA-20 (Model 125) PA-20 (Model 135), Dec. 21, 1949.



DATA

POWERPLANT: Lycoming O-290-D, 125 hp. FUEL CAPACITY AND CONSUMPTION: 36 gal. 7.7 gal. per hr. OIL CAPACITY: 2 gal. APPROVED PROPELLERS: Model 125 has a fixed pitch and the 135 is equipped with either an Aeromatic or Sensenich controllable pitch. GEAR: Fixed two wheel, steerable tailwheel.

SPECS

SPAN: 29.3 ft. LENGTH: 20.4 ft. HEIGHT: 74.5 in. WEIGHTS: EMPTY, 970 lb. (125), 990 lb. (135); GROSS: 1,800 lb.; USEFUL LOAD: 830 lb. (125), 810 lb. (135). WING LOADING: 12.2 lb. per sq. ft. POWER LOADING: 14.4 lb. per hp. BAGGAGE: 50 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: 135 mph; CRUISING, 125 mph (125), 134 mph (135); STALLING, 48 mph (with flaps). RATE OF CLIMB: 810 ft. per min. (125), 850 ft. per min. (135). SERVICE CEILING: 15,500 ft. both models.

REMARKS

The 1951 Pacer line came in two models, the 125 and 135. The 125 is equipped with a fixed pitch propeller and the 135 with an Aeromatic or Sensenich Skyblade. Also in production was the Tri-Pacer, model PA-22, approved Dec. 20, 1950. It has a full-size steerable nosewheel and inter-connected flight controls. Addition of the nosewheel has cut about 2 mph from the performance, otherwise the general specifications and performance are the same as the PA-20 135, $5,660. (PA-22): 125, $5,355; 135, $5,840.

RYAN AERONAUTICAL CO.

San Diego, Calif.

Standard Ryan Navion

A 4-place, closed, all-metal, land, low-wing, monoplane, normal and utility category. CAA TYPE CERTIFICATE NUMBER: TC 782. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: NAvion, Jan. 28, 1947. FIRST DELIVERY PRESENT MODEL: April 15, 1950. ENGINEERING PERSONNEL: Bruce Smith, dir. engineering; D. H. Williams, project engr. TEST PILOT: P. J. Girard.

DATA

POWERPLANT: Lycoming GO-435-C2, geared 260 hp at 3,400 rpm. FUEL CAPACITY AND CONSUMPTION: 60 gal., 12½ gal. per hr. OIL CAPACITY: 3 gal. APPROVED PROPELLERS: Hartzell 12x20-8C/9333 or Koppers. FLAPS: Split-type, 45 degrees travel. GEAR: Retractable tricycle.

SPECS

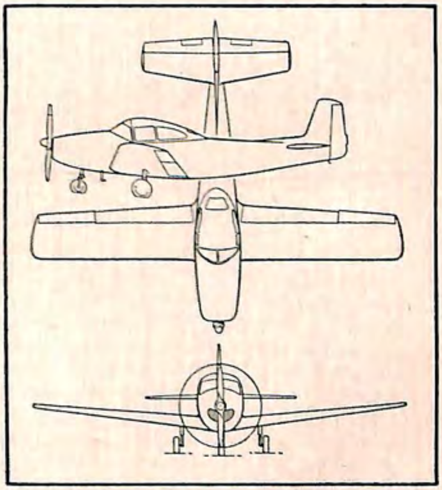
SPAN: 33 ft. 4½ in. LENGTH: 27 ft. 6 in. HEIGHT: 8 ft. 7⅝ in. WEIGHTS: EMPTY, 1,897 lb.; GROSS, 2,850 lb.; USEFUL LOAD, 953 lb. WING LOADING, 15.41 lb. per sq. ft. POWER LOADING, 10.86 lb. per hp. BAGGAGE, FULL SEATS AND TANKS: 80 lb. MAXIMUM PAYLOAD: 690 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 174 mph; CRUISING, 170 mph; STALLING, 55 mph. RATE OF CLIMB: 1,250 ft. per min. (with metal prop, 1,000 ft. per min.). SERVIVE CEILING: 18,000 ft. RANGE: 640 mi.

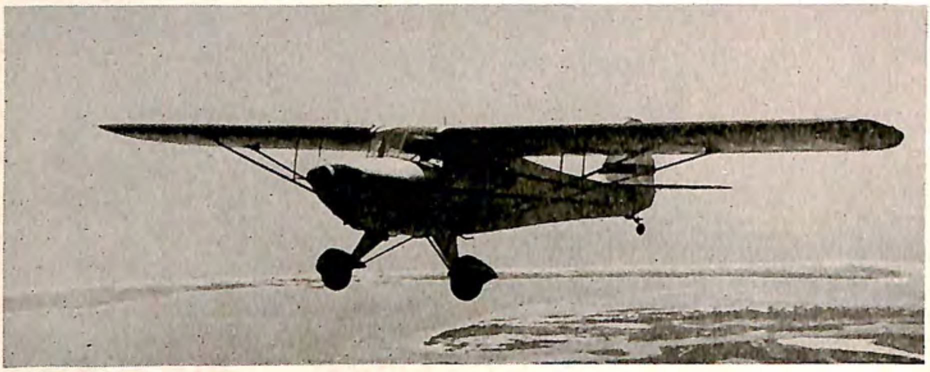
REMARKS

Production of commercial model Ryan Navion Super 260s were temporarily suspended during the year in order for Ryan to devote all its facilities to the defense program. Navion L-17 military liaison planes were in active service in the Korean War theatre.

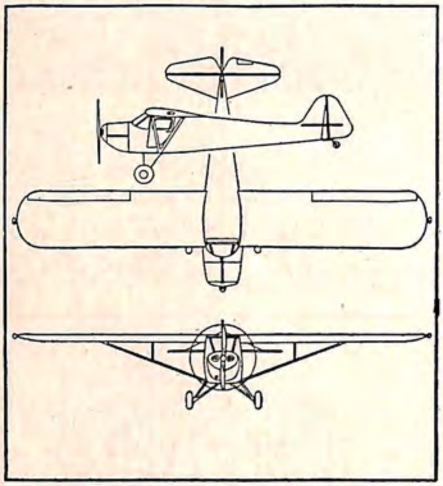


TAYLORCRAFT, INC.

Conway, Pa.



Taylorcraft Sportsman



A 2-place, closed land and sea high-wing monoplane. CAA TYPE CERTIFICATE: TC 696.

DATA

POWERPLANT: Continental, 85 hp. FUEL CAPACITY AND CONSUMPTION: 18 gal., 5 gal. per hr. OIL CAPACITY: 1 gal. APPROVED PROPELLER: Lewis. GEAR: Fixed, steerable tailwheel.

SPECS

SPAN: 36 ft. LENGTH: 22 ft. HEIGHT: 6 ft. 6 in. GROSS WEIGHT: 1,500 lb. WING LOADING: 8 lb. per sq. ft. POWER LOADING: 17.5 lb. per bhp.

PERFORMANCE

SPEEDS: MAXIMUM, 120 mph; CRUISING, 110 mph. RATE OF CLIMB: 700 ft. 1st min. RANGE: 300 mi.

REMARKS

The Sportsman is the new Model 19, successor to the BC12D line. PRICE: $3,895.

EVERYMAN'S AIRPLANE?

The "father" of the lightplane, C. Gilbert Taylor, is still pioneering in the field. Inventor of the immortal "Cub", C. G. Taylor is now experimenting with a Diesel-powered version of his lightplane. He has just announced plans for development of a new liaison airplane using the principle of the Custer Channel Wing in which the usual straight wing is replaced by two channels. The propellers operate to pull the air through the wing, rather than the wing through the air. Taylor believes that this new principle is as revolutionary as flight itself and forecasts a new era in which "Everyman's airplane" will become a reality. In addition, Taylorcraft, Inc., is heavily engaged in subcontracting work for the armed forces.

TEXAS ENGINEERING AND MANUFACTURING CO., INC.

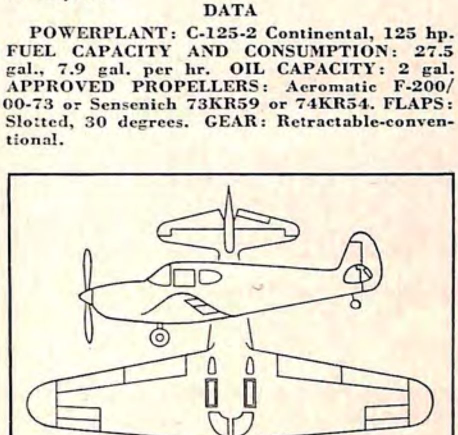
Dallas, Texas

TEMCO Swift

A 2-place, closed, land, all-metal, low-wing monoplane; CAA TYPE CERTIFICATE NUMBER: TC 766. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: GC-1B, Sept. 20, 1946. ENGINEERING PERSONNEL: L. A. Childs, Jr. TEST PILOT: L. P. Meyers.

DATA

POWERPLANT: C-125-2 Continental, 125 hp. FUEL CAPACITY AND CONSUMPTION: 27.5 gal., 7.9 gal. per hr. OIL CAPACITY: 2 gal. APPROVED PROPELLERS: Aeromatic F-200/00-73 or Sensenich 73KR59 or 74KR54. FLAPS: Slotted, 30 degrees. GEAR: Retractable-conventional.



SPECS

SPAN: 29 ft. 4 in. LENGTH: 20 ft. 10¾ in. HEIGHT: 6 ft. 1 in. WEIGHTS: EMPTY: 1,185 lb.; GROSS, 1,710 lb.; USEFUL LOAD, 525 lb. WING LOADING, 13 lb. per sq. ft. POWER LOADING, 13.7 lb. per hp. There is no baggage allowance with full seats and tanks.

PERFORMANCE

SPEEDS: MAXIMUM, 150 mph; CRUISING, 140 mph; STALLING, 48 mph. RATE OF CLIMB: 1,000 ft. 1st min. SERVICE CEILING: 16,000 ft. RANGE: 425 mi.; 575 mi. with 9 gal. auxiliary tank.

REMARKS

The Swift prototype, powered by an 85 hp Continental, was developed just before the war. Wings were plywood and the fuselage and control surfaces fabric covered. Operations on this model were suspended during the war, and before it had received its final CAA certification. After the war Globe Aircraft re-engineered and certificated the Swift as an all-metal plane with fabric-covered controls. This madel used the 85 hp Continental.

Soon after Globe developed a 125 hp model and contracted with Texas Engineering and Manufacturing Co. to produce it. In Dec., 1946 Globe Aircraft failed and TEMCO purchased all rights and inventories.

1950 improvements included better soundproofing and 2-way radio in the Standard Deluxe. The Custom Deluxe had whipcord upholstery and a primary instrument group added. PRICE (f.a.f.): Standard, $4,495; Deluxe, $5,150. 1950 SHIPMENTS: As of Nov. 1, 18.

TEMCO at year end had a military trainer model being evaluated by the Air Force. Although the modifications have produced an almost new airplane, much of the basic design is that of the Swift. The new model, called the Buckaroo, features high performance and economy.

MILITARY

The following list of military aircraft includes, so far as possible, only those in production during the year. All material for this section, including pictures and 3-view drawings has been compiled from data supplied from the military or manufacturers.

BELL AIRCRAFT CORP.

Buffalo, N. Y.

Bell H-12 can carry eight combat-equipped infantrymen

TYPE: Helicopter. **DESIGNATION:** (AF) H-12B.

DATA

POWERPLANT: Pratt & Whitney R-1340-55, 600 hp at takeoff. **FUEL CAPACITY:** 121 gal. (normal), 200 gal. (overload). **OIL CAPACITY:** 14 gal. **GEAR:** Fixed 4 wheel.

SPECS

MAIN ROTOR DIAMETER: 47.5 ft. **ANTI-TORQUE ROTOR DIAMETER:** 8.5 ft. **LENGTH:** 58.8 ft. **HEIGHT:** 14.3 ft. **WEIGHTS:** EMPTY, 4,674 lb.; GROSS, 6,513 (normal), 6,800 (overload). **USEFUL LOAD:** 1,839 lb. **DISC LOADING:** 36.8 lb. **POWER LOADING:** 12.36 lb. per bhp.

PERFORMANCE

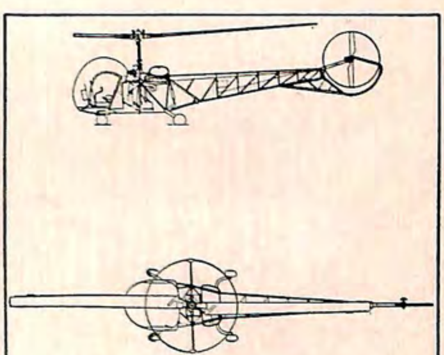
SPEEDS AT SEA LEVEL: MAXIMUM, 120 mph; CRUISING, 85 mph. **RATE OF CLIMB FULLY LOADED:** 900 ft. per min. **SERVICE CEILING:** 10,000 ft. **RANGE:** 300 mi.

REMARKS

The H-12, built for the Air Force can carry eight fully equipped combat troops into forward line position. Unloading takes four seconds through the large removable cargo doors. In production for U. S. Air Force.

Bell H-13D evacuating Korean wounded

TYPE: Helicopter. DESIGNATION: (N) HTL-4, (Army Field Forces) H-13D.



DATA

POWERPLANT: Franklin 6V4-178-B32, 178 hp. FUEL CAPACITY: 29 gal. OIL CAPACITY: 2 gal. GEAR: Four-wheel type or twin floats.

SPECS

MAIN ROTOR DIAMETER: 35 ft. 1½ in. ANTI-TORQUE ROTOR DIAMETER: 5 ft. 9 in. LENGTH: 41 ft. 5 in. WEIGHTS: EMPTY, 1,442 lb.; GROSS, 2,204 lb.; USEFUL LOAD, 782.5 lb.; MAXIMUM PAYLOAD, 656 lb. ROTOR DISC LOADING: 2.31 lb. per sq. ft. POWER LOADING: 11¾ lb. per bhp.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 90 mph; CRUISING, 76 mph. RATE OF CLIMB FULLY LOADED: 1,000 ft. per min. SERVICE CEILING: 13,000 ft. RANGE: 160 mi.

REMARKS

Standard Bell design available as commercial model but is furnished Navy as HTL-4 and Army Field Forces as H-13D equipped for training, rescue, 5-place evacuation, liaison, observation, instrument training, 4-place assault and light cargo missions.

BOEING AIRPLANE COMPANY

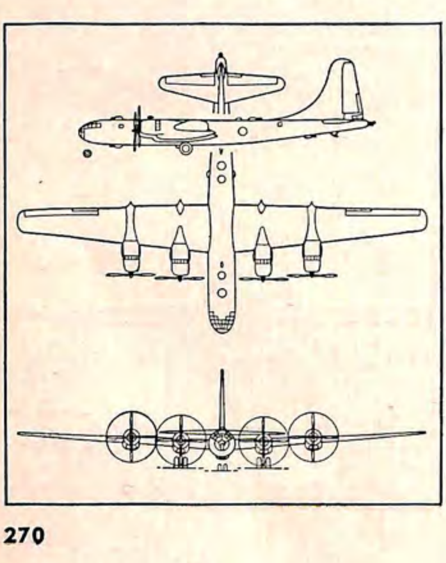
Seattle, Washington

Boeing B-50 Superfortress

TYPE: Medium Bomber. DESIGNATION: (AF) B-50D.

DATA

POWERPLANT: Four Pratt and Whitney R-4360, 3,500 hp each at takeoff. PROPELLERS: Curtiss Electric. GEAR: Tricycle retractable. Tractor treads have been used to test operations from unimproved landing fields.



SPECS

SPAN: 141 ft. LENGTH: 99 ft. HEIGHT: 32 ft. 9 in. GROSS WEIGHT: 164,000 lb. BOMB LOAD: Over 28,000 lb.

PERFORMANCE

SPEEDS: MAXIMUM, over 400 mph; CRUISING SPEED, approximately 300 mph. SERVICE CEILING: Over 30,000 ft. RANGE: 6,000 mi. with 10,000 lb. bomb load.

REMARKS

Since the first one, models have included the B-50B which is the same as the A except for a stronger wing; B-50C, redesignated B-54 (later cancelled), and the B-50D.

The chief difference between D and earlier models is the provision for installing either a 700 gallon droppable wing tank or 4,000 pound bomb beneath each wing. Each B-50D was equipped as a receiver airplane under the new Boeing "Flying Boom " aerial refueling system.

The Air Force received delivery on the first modified RB-50B April 27, 1950. This model is equipped as a photographic and weather reconnaissance "laboratory." Designed to handle the same missions previously taken care of by similarly modified B-29's, the new Superforts will fly faster and at altitudes ranging up to 40,000 ft. Another special modification is the TB-50D "Flying Schoolhouse" navigator-bombardier trainer, a number of which have been delivered to the Air Training Command.

Air Force's Boeing Stratojet

TYPE: Medium Bomber. DESIGNATION: (AF) B-47.

DATA

POWERPLANT: Six General Electric J-47 turbo-jets, each rated at 5,200 lb. thrust. GEAR: Dual main wheels in tandem with a single outrigger under inboard pod. All are retractable.

SPECS

SPAN: 116 ft. LENGTH: 108 ft. HEIGHT: 28 ft. GROSS WEIGHT: Over 185,000 lb. NORMAL BOMB LOAD: Over 20,000 lb.

PERFORMANCE

MAXIMUM SPEED: "600 mph class." SERVIVE SEILING: Over 35,000 ft. RANGE: More than 3,000 miles.

REMARKS

Robert M. Robbins, Boeing project pilot, and Scott Osler, another Boeing test pilot, made the first flight in the Stratojet in late 1947, two years after design work had started on the project.

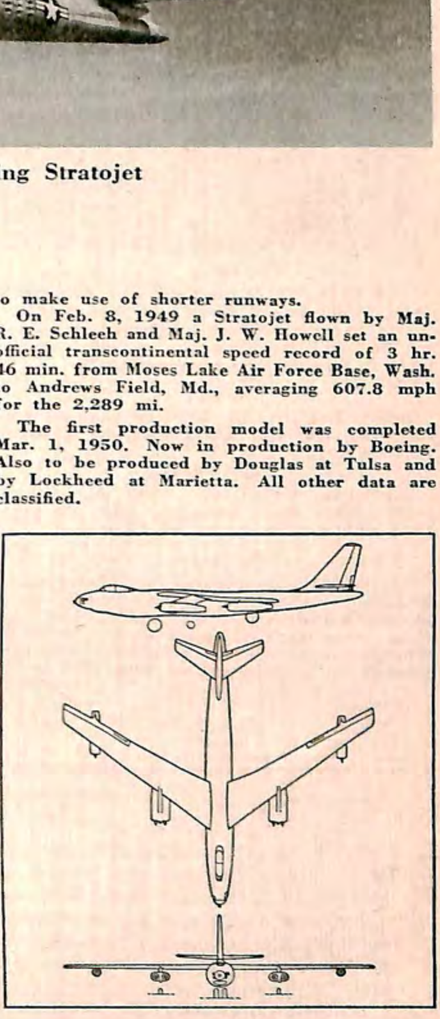
The 35 degree swept-back wing and tail is the first to be used on a bomber. The thin wing is flexible for its size, and on the ground has a drooped appearance which changes to a slight dihedral in flight. Each wing carries three engines, one pod of two on outriggers under and forward of the inboard section, and a single mount near e ach wing tip. Liquid RATO gives the production model an additional 20,000 pound thrust.

Pilot, co-pilot, and navigator-bombardier make up the crew, with the pilot and co-pilot riding tandem under a plastic bubble that gives them 360 degree visibility.

An Air Force ribbon type "deceleration parachute" has been used successfully on landings to make use of shorter runways.

On Feb. 8, 1949 a Stratojet flown by Maj. R. E. Schleeh and Maj. J. W. Howell set an unofficial transcontinental speed record of 3 hr. 46 min. from Moses Lake Air Force Base, Wash. to Andrews Field, Md., averaging 607.8 mph for the 2,289 mi.

The first production model was completed Mar. 1, 1950. Now in production by Boeing. Also to be produced by Douglas at Tulsa and by Lockheed at Marietta. All other data are classified.



Boeing C-97 cargo and troop transport

TYPE: Cargo. DESIGNATION: (AF) C-97.

DATA

POWERPLANT: Four Pratt and Whitney R-4360, 3,500 hp at takeoff. FUEL CAPACITY: 7,790 gal. PROPELLERS: Four-bladed Hamilton Standard full feathering reversible thrust. GEAR: Tricycle dual-wheel retractable.

SPECS

SPAN: 141 ft. 3 in. LENGTH: 110 ft. 4 in. HEIGHT: 38 ft. 3 in. DESIGN GROSS WEIGHT: 150,000 lb.

PERFORMANCE

CRUISING SPEED: Over 300 mph. MAXIMUM SPEED: Over 375 mph. SERVICE CEILING: 30,000 ft. RANGE: Over 4,000 mi.

REMARKS

The C-97 is a military version of the Boeing Stratocruiser (See Civil Section), and is now in production for the Air Force as a standard long-range cargo transport-tanker with a 20 to 25 ton cargo capacity. As a military passenger plane it can be equipped to carry 134 troops with combat equipment or 83 litters. Self-contained ramps under the tail allow tanks, trucks, heavy guns, and similar equipment to be loaded with a minimum of effort. An aerial delivery system used in the plane can drop 25,000 lb. of supplies through the rear hatch in 12¾ secs. In special overload flight tests a C-97 took off at a gross weight of 174,500 lb. carrying a simulated 96,500 lb. useful load. A Military Air Transport C-97 flew from Hawaii to California with a new record load for over-water hospital plane service at that time. Seventy-seven persons were carried on the flight, including the passengers, flight crew and medical attendants.

One of the features of the new model is a large cargo door entering the upper deck just aft of the control cabin to facilitate freight handling. Cargo can be loaded through the new door by fork lift trucks and can be moved along the upper deck by an electrically-operated self-contained cable rail. PRODUCTION: The KC-97E is in quantity production for USAF Strategic Air Command. All other data are classified.

PIGGYBACK IN COMFORT

One of the oft-repeated questions during World War II, when bombers were pouring from the nation's assembly lines, was: "Will they be useful as transport planes after the war is over?" The answer was always negative simply through lack of space inside the long, sleek fuselages designed to carry only high-density loads of bombs. Boeing engineers refused to take this answer as final and solved the problem of converting the successful B-29 bomber into a transport by adding a big passenger cabin on top of the existing bomber fuselage. The result is the familiar "hour glass" fuselage of the C-97 *Stratocruiser*—the transport whose passengers ride piggyback on a bomber fuselage.

CESSNA AIRCRAFT CO.

Wichita, Kans.

Cessna L-19A for Army Field Forces

TYPE: Liaison. **DESIGNATION:** L-19A. (Army).

DATA

POWERPLANT: Continental, O-470-11, 190 hp (normal) at 2,300 rpm, 213 hp (takeoff) at 2,600 rpm. **FUEL CAPACITY:** Two 21 gal. wing tanks.

SPECS

SPAN: 36 ft. **LENGTH:** 25 ft. **HEIGHT:** 7.5 ft. **WEIGHTS:** EMPTY, 1,448 lb.; GROSS: 2,100 lb. **WING LOADING:** 12.1 lb. per sq. ft. **POWER LOADING:** 11.05 lb. per hp.

PERFORMANCE

SPEEDS: CRUISING at 5,000 ft. using 29% hp, 104 mph; OBSERVATION, 46 mph. **TAKE-OFF:** Over a 50 ft. obstacle on a sod field, 560 ft. **LAND:** Over a 50 ft. obstacle on a sod field, 600 ft. **RATE OF CLIMB:** Sea level, 1,290 ft. per 1st min. **SERVICE CEILING:** 22,900 ft. **ENDURANCE:** With 20 gal. fuel, 3.1 hr.

REMARKS

Early in June, 1950 Cessna came out the winner in the Army Field Forces' observation reconnaissance competition, with the first order amounting to 400 planes. This has been followed by a steady stream of orders for this model. The evaluation program was divided in two parts; one at Wright-Patterson AFB for a technical evaluation by the Air Force, and the other by the Army Field Forces at Fort Bragg for the service testing.

The L-19A is all-metal, has a wide door opening and ample rear cockpit and baggage space that can be used for stretcher installation. Cruising speeds up to 145 mph at optimum altitude are claimed. Flaps are the high-lift type and extend rearward as they are lowered. Maximum flap travel is 60 degrees. All other data are classified.

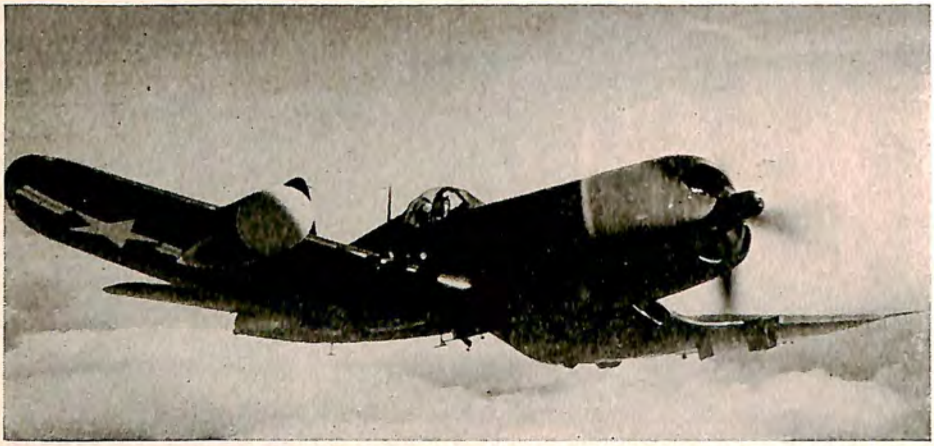
EARLY LESSON

The Army liaison airplane had its beginning in 1940 when several heavy, complex experimental types were procured for as much as $50,000 each. The following year the personal aircraft industry proved in Army maneuvers in Louisiana that "Off the shelf" production models could do the safe job at less than one-tenth the cost. More than 10,000 standard lightplanes served the armed forces throughout the world during World War II.

CHANCE VOUGHT AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORP.

Dallas, Tex.

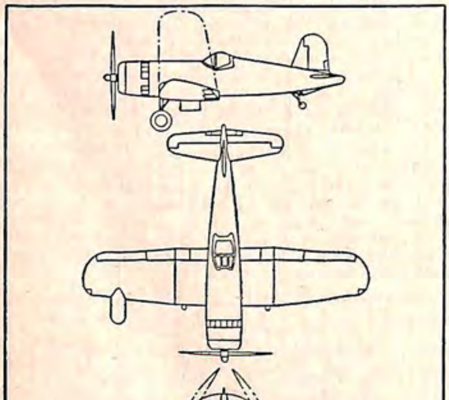


Chance Vought Corsair, in Navy service since 1938

TYPE: Fighter. DESIGNATION: (N) F4U-5.

DATA

POWERPLANT: Pratt and Whitney R-2800-32W, 2,300 hp at takeoff. FUEL CAPACITY: 234 gal. OIL CAPACITY: 33 gal. PROPELLER: Hamilton Standard. FLAPS: Slotted, 50 degree travel. GEAR: Conventional retractable.



SPECS

SPAN: 40 ft. 11¾ in. LENGTH: 34 ft. 6¼ in. HEIGHT: 14 ft. 9½ in. WEIGHTS: EMPTY, 10,099 lb.; GROSS, 13,297 lb.; USEFUL LOAD, 3,198 lb. WING LOADING, 42.35 lb. per sq. ft. POWER LOADING, 8.86 lb. per bhp.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 379 mph; CRUISING, 227 mph; STALLING, 110 mph. RATE OF CLIMB: 4,340 ft. per min. SERVICE CEILING: 41,100 ft. RANGE: 1,270 mi.

REMARKS

The F4U is the oldest fighter-bomber in first line service with the Navy. The present model is the product of over 20,030 production changes since the F4U-1 made its first appearance back in 1938.

The Corsair came into its own again during the first phases of the Korean War and stayed at the front through the closing months of the year. The Marines and Navy flew F4U-4 equipment both from carriers and land. Most of these planes carried four 20 mm rapid fire cannon and eight five inch HVAR's under the wings. On special missions the Corsairs would go out with two Tiny Tims weighing more than 1,150 lb. and blast tanks or heavily fortified positions.

The Corsairs could provide cover for six hours at a stretch and often operated at altitudes low enough to draw enemy small arms fire. 1951 production continued on the F4U-5N, the radar-equipped night fighter. All other data are classified.

Carrier based twin-jet Cutlass

TYPE: Fighter. DESIGNATION: (N) F7U.

DATA

POWERPLANT: Two Westinghouse J-34-32 turbo jets. GEAR: Tricycle, retractable, 15 in. stroke.

REMARKS

This 600-mph-plus twin engine Navy carrier-based jet fighter started on the design board in Oct., 1945, and by July 1946, the Navy had approved construction of three X models. The first one flew Sept. 29, 1948.

There are many features of this plane that do not conform to the conventional type. Probably the most noticeable are two vertical tails and the absence of a horizontal tail surface, replaced by "ailavators" which act as elevator and ailerons at the same time. "Slats" are used instead of flaps. They are located in the leading edge of the wing and become operative when pushed forward. Fins and rudders are conventional.

Lateral and longitudinal controls are hydraulically operated. This system is more than a boost, since all that is required of the pilot is essentially a signal to complete control movement. This almost eliminated any "feel" control a pilot experiences in a conventional set-up, so a system was designed to simulate ordinary control forces.

After trying to place the engines one on top of the other, one in each wing, and several other arrangements, Chance Vought engineers came up with the solution by spreading the fuselage laterally to house the twin jets. This gives a short path for the air flow—always a desirable characteristic for a jet engine. Afterburners were insatlled for additional power.

The wing configuration of the Cutlass combines swept wings with a low aspect ratio which tends to overcome negative control characteristics. These larger-than-usual wings give the plane a decided maneuverability advantage.

An ejection pilot's seat is used for quick bail out. Both pilot and seat are ejected at a rate calculated to clear all parts of the plane, and during the final descent the seat is jettisoned for a normal parachute landing.

The first production model and one of the experimental models were turned over to the Naval Air Test Center at Patuxent River, Md., in June 1950 for carrier test landings. Production continued in 1951.

All other data are classified.

CHASE AIRCRAFT CO., INC.

Chase troop cargo C-123B

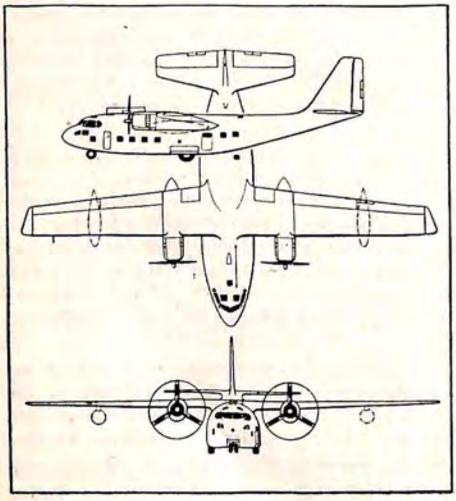
TYPE: Cargo. DESIGNATION: (AF) C-123B.

DATA

POWERPLANT: Two Pratt & Whitney R-2800-52W, 2,300 hp each. PROPELLERS: Hamilton Standard, constant speed, full feathering, reversible 3 blades, 15 ft. diam. FLAPS: Slotted, 60 deg. travel. GEAR: Tricycle, retractable.

SPECS

SPAN: 110 ft. LENGTH: 77 ft. 1 in. HEIGHT: 34 ft. 1 in. WEIGHTS: EMPTY, 29,906 lb.; DESIGN GROSS, 52,600 lb.; DESIGN USEFUL, 22,694 lb.; MAXIMUM USEFUL LOAD, 41,000 lb., WING LOADING, 43 lb. per sq. ft. POWER LOADING, 11.2 lb. per bhp.



PERFORMANCE

SPEEDS: MAXIMUM, 255 mph; CRUISING, 215 mph; STALLING, 75 mph. RATE OF CLIMB: 1,150 ft. per min. SERVICE CEILING: 25,000 ft. RANGE: (normal) 2,200 mi., (ferry) 4,700 mi.

REMARKS

The C-123B now in quantity production for the U. S. Air Force was declared winner of the Assault Transport Evaluations conducted by the Air Force in the fall of 1950 and also was awarded top spot in special long range rescue competition which the Air Force conducted during 1951.

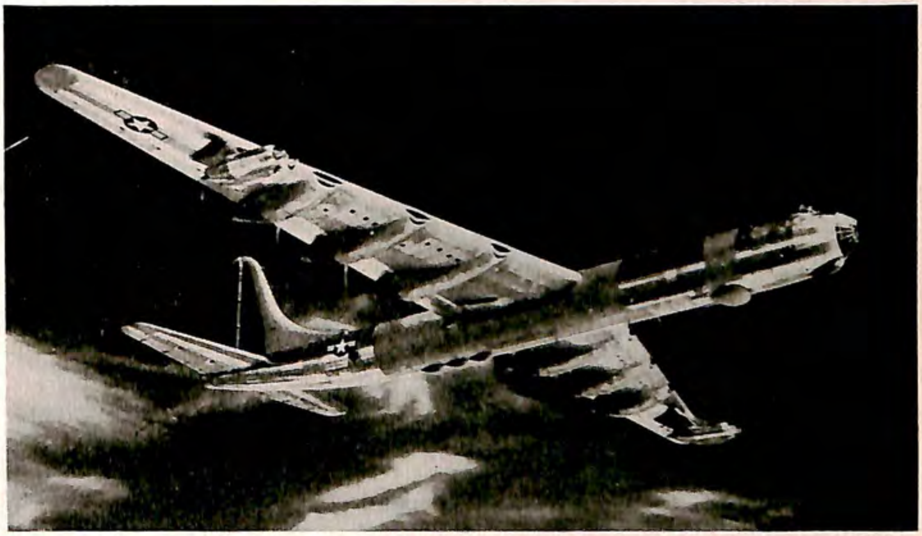
Normal load of the plane is sixty fully equipped troops or 16,000 lb. of cargo. By virtue of its ability to operate in extremely short fields, it can deliver its load into forward combat areas. It has also been successfully tested for evacuation and has carried fifty litter patients, twenty ambulatory patients and six medical attendants at one time.

Equipped with the integral hydraulically operated ramp and cargo door, it reduces to a minimum, time required for loading and unloading. Special loading demonstrations conducted by the Army showed that a 155 mm howitzer and ¾-ton truck as prime mover, can be completely loaded and tied down in less than two minutes. The same cargo can be unloaded in as little as one minute.

Tie down fittings capable of withstanding a pull of 10,000 lb. in any direction are spaced on the cargo compartment floor on a 20 inch grid pattern. All other data are classified.

CONSOLIDATED VULTEE AIRCRAFT CORP.

San Diego, Cal.



Convair B-36D 10-engine bomber for the Air Force

TYPE: Heavy bomber. DESIGNATION: (AF) B-36D.

DATA

POWERPLANT: Six Pratt and Whitney pusher-type, R-4360-25, 3,500 hp each. "D" and "E" series also have four General Electric J-47 jets, 5,200 lb. static thrust each. These replace the Allison J-35-19 first used on the B-36. FUEL CAPACITY: 21,116 gal. carried in integral fuel tanks within the main wing box spar. OIL CAPACITY: 1,200 gal. PROPELLERS: Six Curtiss Electric, reversible, 3-bladed, 19 ft. diameter. GEAR: Tricycle, dual-wheel nose gear, 4-wheel truck main gear.

SPECS

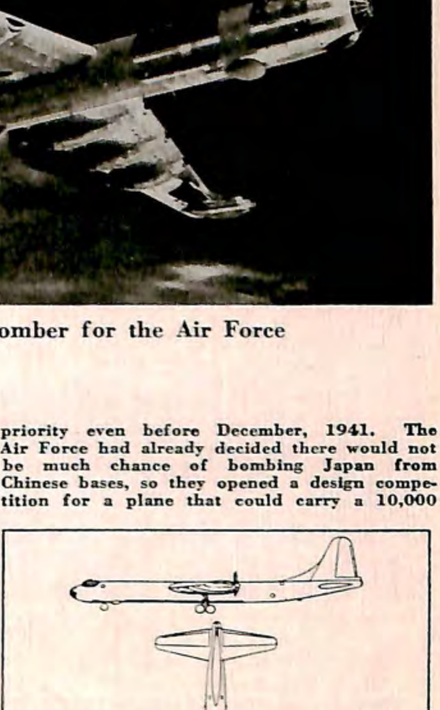
SPAN: 230 ft. LENGTH: 162 ft. HEIGHT: 46 ft. 9 in. WEIGHTS: MAX. GROSS, approx. 358,000 lb. WING LOADING, 58.3 lb. per sq. ft. POWER LOADING, 15.4 lb. per hp.

PERFORMANCE

MAXIMUM SPEED: Over 435 mph (AF figure). SERVICE CEILING: over 45,000 ft. RANGE: 10,000 mi. with 10,000 lb. bomb load. DESIGN BOMB LOAD: 10,000 lb. MAXIMUM BOMB LOAD: 84,000 lb.

REMARKS

The world's largest bomber, the B-36 Peacemaker, was designed to get anywhere and back. Tied in with the atom bomb, it was given top priority even before December, 1941. The Air Force had already decided there would not be much chance of bombing Japan from Chinese bases, so they opened a design competition for a plane that could carry a 10,000



lb. bomb load 10,000 miles. Consolidated won out with the Peacemaker. Later in the war, when Pacific bases were captured for use by B-29's, the B-36 lost its top priority rating.

This held up the first procurement contract until Aug. 19, 1944, which called for 100 B-36's. Two years later, on Aug. 8, 1946, the XB-36 made its first flight. The first production model, the YB-36, first flew Dec. 4, 1947. Both the A and B models showed up well in tests, and it was decided to continue the program. On Dec. 5, 1947, the AF approved the B-36C program. This series was to have tractor props instead of the pushers, in hope of raising top performance to over 400 mph. Inadequate cooling at altitude, and the interference to the airfoil by having six breaks on the leading edge of the wing, led to cancellation before the first plane was built. Emphasis is now on the D series, which uses four jet engines arranged in pods of two each on either wing outboard of the piston engines. The jets are cut in only on takeoff, or when increased speed is needed. Their use shortens the takeoff run to 3,500 ft., a saving of over 1,500 ft.

The plane has a pressurized nose and tail section which are connected by a pressurized tunnel. The 15 crew members can get back and forth by pulling themselves along on a dolly in the passage. There are four bomb bays. A load of 10,000 lb. for a long mission is normal, but this can be upped to 84,000 lb. if the mission is short. Most of the guns are remotely controlled by the latest in electronic devices.

In June, 1950, RB-36 deliveries got under way. This new model is in the D series with modifications for reconnaissance work. It carries 14 cameras in the forward bomb bay including one with a 48 inch focal length. A modification program was also started to convert B-36B's into the D series by adding four jet engines. Ground and flight tests were made on the prototype model equipped with a tractor type gear, the first flight taking place March 29 with B. A. Erickson, manager of flight and A. S. Witchell, company test pilot at the controls.

The latest B-36 model, the B-36F, also got into production during the year. The major modification was the installation of Pratt & Whitney R-4630-50 engines increasing takeoff power per engine to 3,800 each. Production was on both the D and F models during the year. All other data are classified.

Convair T-29A, "Flying Classroom"

TYPE: Trainer. DESIGNATION: (AF) T-29A.

DATA

POWERPLANT: Two Pratt and Whitney R-2800-CA18, 2,400 hp each. FUEL CAPACITY: 1,500 gal. PROPELLERS: Hamilton Standard 3-blade, full feathering and reversible.

SPECS

SPAN: 91 ft. 9 in. LENGTH: 74 ft. 8 in. HEIGHT: 26 ft. 11 in. GROSS WEIGHT: 43,575 lb.

PERFORMANCE

SPEEDS: MAXIMUM, 316 mph at 13,500 ft.; CRUISING, 260 mph at 20,000 ft.; STALLING, 88 mph. ENDURANCE: 6.4 hr. at cruising. RATE OF CLIMB: 20,000 ft. in 17.5 min. SERVICE CEILING: 26,100 ft.

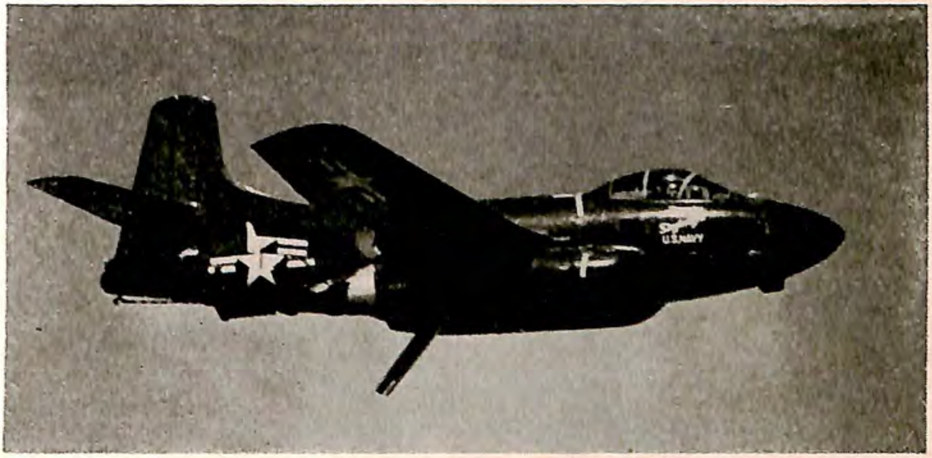
REMARKS

Dubbed the "Flying Classroom," the T-29A is a modified version of the Convair 240 Convair Liner. It is used as a navigational bombardier trainer and carries 14 students plus instructors and crew. Radar training equipment provides for three students with instructors. Other special equipment includes four astrodomes, 18 antennas and standard radar unit under the fuselage. The T-29B scheduled for delivery in late 1951 is a pressurized version.

Production of a limited number of turboprop models for the Air Force was also announced late in the year. The new model will be patterned after the commercial 340 (see civil section). Initial powerplant will be the Allison T-38. Initial production will be for service test purposes. All other data are classified.

DOUGLAS AIRCRAFT CO., INC.

Santa Monica, Cal.



Twin-jet Skyknight by Douglas

TYPE: Fighter. DESIGNATION: (N) F3D.

DATA

POWERPLANT: Two Westinghouse J-34 (24C). GEAR: Nose-wheel type.

REMARKS

Preliminary design was begun on this two-place monoplane in Sept. 1945, and on Mar. 23, 1948, it made its first flight. During 1949 and 1950 it went into full scale production at Douglas' El Segundo Plant.

The F3D Skyknight is a carrier-based jet night fighter with advanced radar equipment embodying features of search, automatic gun-firing and tail warning aids. Flight tests with the F3D have demonstrated that interception of bombers in daytime or at night at altitudes of over 40,000 feet is practical with this airplane. This model can fly at high speeds for great distances, and at high altitudes, making it adaptable as an attack-fighter, long-range patrol or reconnaissance airplane or as a long-range escort fighter.

A special system of cockpit lighting to prevent glare is used. All instrument letters and numbers are etched in transparent lucite on panels lighted from the rear with a red light. Emergency pilot escape is by an underside bail-out chute similar to a slide fire escape. Speed brakes are hydraulically operated and extend outward from the fuselage just forward of the tail. All other data are classified.

SEEING EYE

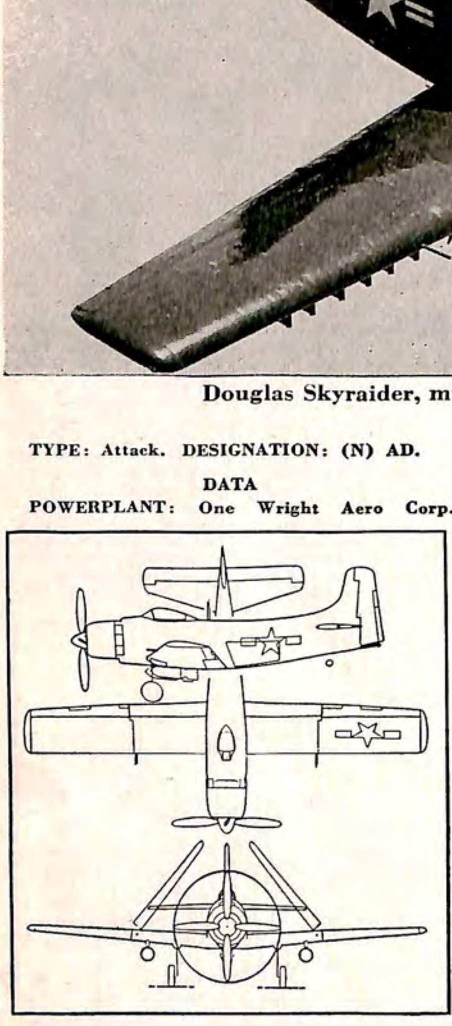
During World War II a storm at sea was welcomed by surface vessels for it meant that they could carry out their operations without fear of detection by enemy aircraft. The Japanese Navy particularly took careful advantage of bad weather by carrying out their largest Naval attacks and beach landing under cover of storms while U. S. Navy carrier pilots sat disconsolately in their war rooms. But all of this will be changed in any future war with the development of all-weather carrier combat aircraft, such as the Douglas F3D *Skynight*. This compact, rugged fighter will leave its carrier deck in the stormiest of weather safe in its thousands of pounds of special radar and communication equipment which will permit it to navigate to the enemy, detect and destroy him and come back to the carrier without the dread fear of the carrier pilot: being lost at sea. The two-man crew of the *Skynight* is seated side-by-side so that both may observe the various radar scopes simultaneously, rather than the older arrangement of the radar operator transmitting instructions to the pilot. The F3D carries a heavy load of fuel for long-range operations and a full complement of 20 mm cannon, bombs and rockets for offensive operations.

Douglas Skyraider, multi-purpose attack plane

TYPE: Attack. DESIGNATION: (N) AD.

DATA

POWERPLANT: One Wright Aero Corp. R3350-26W, 2,700 hp at takeoff and 2,900 rpm. FUEL CAPACITY: 350 gal. with provisions for two 150 gal. drop wing-tip tanks. PROPELLER: Aeroproducts. GEAR: Conventional retractable.



SPECS

SPAN: 50 ft. 3/16 in. LENGTH: 38 ft. 10 in. HEIGHT: 15 ft. 7½ in. WEIGHTS: EMPTY, 10,950 lb.; GROSS, 16,667 lb.

REMARKS

AD Skyraiders have been produced at Douglas' El Segundo Plant, including AD-1's, -2's, -3's and -4's. Numerous versions have been designed and produced, ranging from attack-dive bombers, night attack, radar counter-measures, airborne early warning, and anti-submarine to target towing utility types. Although the basic AD is a single place airplane, the Q and N versions have accommodations for an additional radar operator, and the W version can carry two additional crew members.

The versatile AD airplane, now standard on all carriers, was on the scene in Korea and among the first to enter combat, and was used in close support of ground troops.

All other data are classified.

The latest in the Skyraider line is the AD-5 scheduled for 1952 production. It will be the only AD production model and will feature extensive redesign adaptable to a wide variety of uses.

Douglas C-124 Globemaster cargo transport

TYPE: Cargo **DESIGNATION:** C-124A.

DATA

POWERPLANT: Four Pratt and Whitney R-4360-20W, 3,500 hp at takeoff. **FUEL CAPACITY:** 11,100 gal. **OIL CAPACITY:** 330 gal. **PROPELLERS:** Curtiss Electric 3-blade, reversible. **FLAPS:** Douglas full span, deflector vane, double slotted 40 degrees. **GEAR:** Tricycle, dual main and nosewheel.

SPECS

SPAN: 173 ft. 3 in. **LENGTH:** 127 ft. 1 in. **HEIGHT:** 48 ft. 3.6 in. **WEIGHTS:** EMPTY, 95,707 lb.; DESIGN GROSS, 175,000 lb.; DESIGN USEFUL LOAD, 79.293 lb.; DESIGN PAYLOAD, 50,000 lb. **WING LOADING:** 69.7 lb. per sq. ft. **POWER LOADING:** 12.5 lb. per bhp.

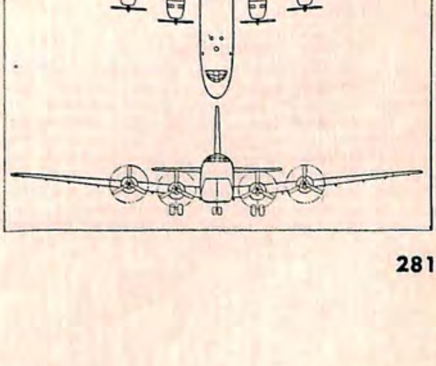
PERFORMANCE

SPEEDS: MAXIMUM, 298 mph at 20,800 ft.; CRUISING, 264 mph at 13,600 ft.; STALLING, 99.5 mph with 160,000 lb. gross; **RATE OF CLIMB SEA LEVEL,** 800 ft. per min. with 175,000 lb. gross. **SERVICE CEILING FULLY LOADED:** 22,050 ft. **RANGE:** 6,280 ft.

REMARKS

The C-124A is the largest heavy cargo and troop transport in production today. It is equipped to handle pieces of cargo as large as 130 in. wide by 140 in. high through the opening in the nose (which will accommodate 94 percent of all Air Force and Ground Force equipment). A hydraulically operated ramp to the door provides a 17-degree slope for easy loading. The ramp can be varied in width to accommodate vehicles of different tread. It is stowed in the fuselage nose below the crew compartment.

There is another loading door amidships in the underside of the fuselage which can take cargo measuring 89 in. wide, 155 in. long and 85 in. high. This cargo hold is stressed for 16,000 lb. Loading is speeded by the use of an electrically operated elevator. A folding

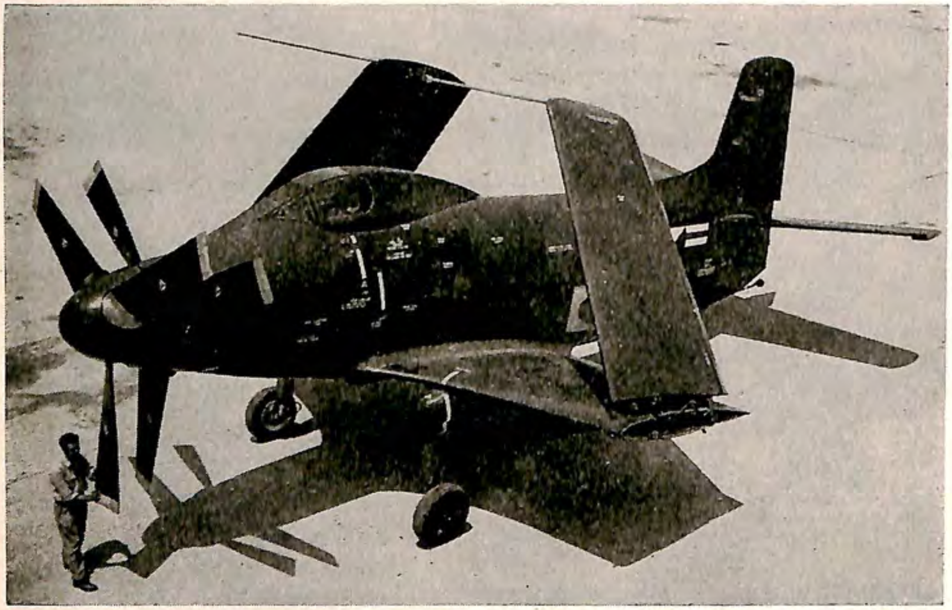


upper deck, hinged at the fuselage, is divided into segments and is supported by stanchions. With the upper deck in position a truck can back into the nose opening and load both the upper and lower levels at the same time. Included in the loading facilities are two electrically powered traveling cranes, each able to lift 8,000 lb.

The Globemaster can be converted into a two-deck troop carrier able to carry 200 troops and their equipment, or as a hospital plane, 127 litter patients and their attendants.

The C-124 is a development of the C-74 and uses basically the same landing gear and wing and tail surfaces. The fuselage is new and the engines more powerful than in the 74. The Globemaster was begun in Oct., 1947, a contract received in Apr., 1948, and the first flight scheduled for late Nov., 1949, a few days ahead of schedule.

The Air Force had ordered 80 production models prior to July 1, 1950. Subsequently large additional orders have been placed, the exact quantity being restricted.



Skyshark for carrier operation

TYPE: Attack. **DESIGNATION:** A2D.

DATA

POWERPLANT: Allison T40. **GEAR:** Conventional retractable.

REMARKS

The A2D Skyshark is the latest in the Douglas-El Segundo series of carrier attack airplanes. The first American attack airplane to use turbo-prop power plant, this new model will outstrip all its predecessors in performance.

The Skyshark incorporates the latest design innovations to the highest efficiency and the greatest safety. The pilot location as far forward as possible permits maximum vision. The cockpit has been designed for increased resistance to crash loads. Cabin pressure and cooling are provided by an expansion turbine type system. A Douglas developed upward ejecting seat permits safe escape at this airplane's high speeds.

The A2D Skyshark is unique in its combination of an extremely short takeoff, an unusually high operating altitude, a high speed approaching that of jet fighters, and an unusually high load carrying ability. These characteristics make it particularly well suited as a general purpose, carrier-based attack or ground support aircraft.

This model was successfully flown for the first time on May 26, 1950 and is in production at Douglas' El Segundo Plant. All other data are classified.

Douglas R4D-8

TYPE: Transport. **DESIGNATION:** (N) R4D-8.

OUTSTANDING FEATURES: Designed as a successor to the famed R4D, C-47, DC-3 series of transport aircraft, the R4D-8 carries greater payload, has larger cabin volume and higher speed. It is produced by extending the fuselage of existing R4D type transports, mounting higher powered engines in re-designed nacelles and attaching outer wing panels of new design. Aerodynamic alterations account for approximately 50 percent of the improvement in performance. A new cabin heating system, new bird-proof windshield and doubled fuel capacity are other major changes.

ENGINEERING PERSONNEL: Edward F. Burton, chief engineer; M. K. Oleson, project engineer.

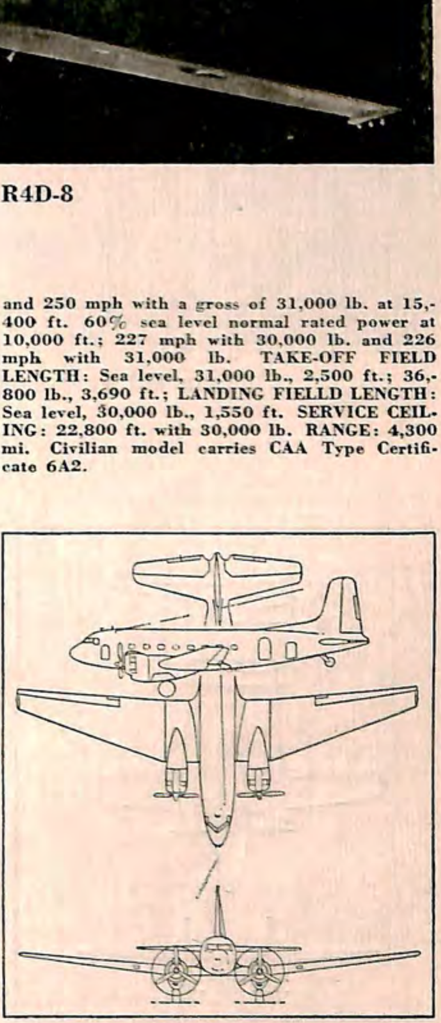
FIRST DELIVERY: Oct. 26, 1951.

POWER PLANT: Two Wright Cyclone R-1820-968C9HE2, hp at takeoff, 1475 bhp each. Normal rated power, 1275 hp each. **NORMAL FUEL CAPACITY:** 1600 gal. **OIL CAPACITY:** 58 gal. **APPROVED PROPELLER:** Hamilton Standard Hydromatic. **WING SPAN:** 90 ft. **LENGTH:** 67 ft. 8 in. **HEIGHT:** 18 ft. 3 in. **GEAR:** Retractable conventional.

WEIGHTS: Maximum takeoff gross, 31,000 lb.; structural design landing gross, 30,000 lb. **WING LOADING (GROSS WEIGHT, 31,000 lb.):** 32.0 lb. per sq. ft. **POWER LOADING (TAKEOFF POWER AT 31,000 lb.):** 10.5 lb. per bhp.

PERFORMANCE

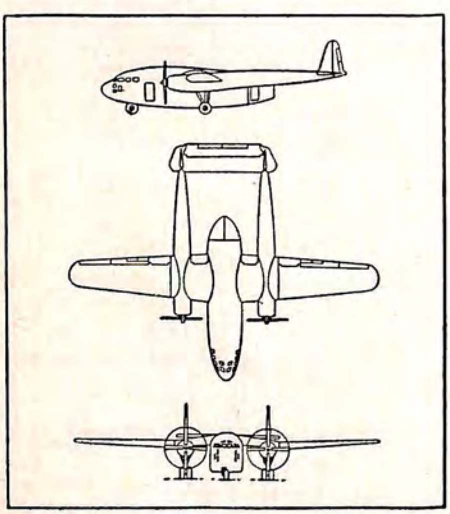
Sea level normal rated power, 855 BHP, 251 mph with a gross of 30,000 lb. at 15,400 ft.; and 250 mph with a gross of 31,000 lb. at 15,400 ft. 60% sea level normal rated power at 10,000 ft.; 227 mph with 30,000 lb. and 226 mph with 31,000 lb. **TAKE-OFF FIELD LENGTH:** Sea level, 31,000 lb., 2,500 ft.; 36,800 lb., 3,690 ft.; **LANDING FIELLD LENGTH:** Sea level, 30,000 lb., 1,550 ft. **SERVICE CEILING:** 22,800 ft. with 30,000 lb. **RANGE:** 4,300 mi. Civilian model carries CAA Type Certificate 6A2.



FAIRCHILD AIRCRAFT DIVISION

Hagerstown, Md.
Park Ridge, Ill.

Standard troop-carrier, Fairchild C-119C



TYPE: Cargo and Troop Carrier. DESIGNATION: (AF) C-119C, (N) R4Q-1.

DATA

POWERPLANT: Two Pratt and Whitney R-4360-20WA, 3,500 hp at takeoff. FUEL CAPACITY: 2,624 gal. in four tanks. OIL CAPOCITY: 120 gal. in two tanks. PROPELLERS: Hamilton-Standard, four bladed reversible. FLAPS: Slotted. GEAR: Tricycle, electrically retractable.

SPECS

SPAN: 109.3 ft. LENGTH: 86.5 ft. HEIGHT: 26.5 ft. WEIGHTS: MAXIMUM GROSS, 73,150 lb. WING LOADING: 50.5 lb. per sq. ft. at maximum gross. POWER LOADING: 10.4 lb. per bhp at maximum gross, maximum power.

PERFORMANCE

SPEEDS: MAXIMUM, 287 mph at combat weight; STALLING: 108 mph at maximum gross with flaps. RATE OF CLIMB: 730 ft./min. at maximum gross, normal power. USABLE CEILING: 29,800 at combat weight, normal power. RANGE: Combat range with 16,000 lb. cargo, 1,566 mi. Ferry range, no auxiliary range, 2,238 mi. 3-view is C-119B.

REMARKS

The first of the Packets, XC-82, started on the drafting boards in 1941. The development, engineering, and preliminary testing of the prototype, which first flew Sept. 10, 1944, took less than 21 months after the mock-up approval by the U. S. Army. The result was the first all-cargo twin engine transport. It is the standard troop carrier plane of the Air Force and the only one used for paratroop and equipment drops.

Production of the C-82 was started by Fairchild and additional production was assigned North American, but was continued only by Fairchild after the war. North American had built three C-82N's before the contract was cancelled. Fairchild built 220 of this model before it went out of production in Sept. 1948.

Late in 1947 a new version of the C-82 was flown. Designated the C-119, this new model was a larger, faster, and heavier load-carrier than the 82. One of the most noticeable changes was the relocation of the flight deck from the top of the fuselage to the nose.

The square-shaped unobstructed fuselage and the twin tail boom construction allows loading similar to a railway flatcar or boxcar. Reinforced floors are at truck-bed level and can be reached through a door on the left side of the fuselage or through the main cargo clam shell doors at the rear. These are opened on a vertical hinge, providing an entrance opening as wide as the cargo hold. Two ramps for loading vehicles can be carried in each plane.

Packets were used to good advantage on the Berlin Airlift, carrying cargo too bulky for the conventional side-door transports, including earth graders, jeeps, aircraft engines, dump trucks, steam shovels, snowplows, and cement mixers.

The Packet can also be used to carry 62 fully-equipped combat troops or 35 litter patients with attendants. There is an electrically operated monorail used for discharging paracans through a hatch in the bottom of the fuselage. Twenty 500-lb. bundles can be released with this equipment.

Normal crew: Pilot, co-pilot, navigator, and radio operator.

The Packet line so far has included the following: C-82A, powered by two Pratt and Whitney R-2800-85 engines. This was the production model of the XC-82. The C-82 was followed by the C-119A, a prototype modified from the standard C-82A to test the new nose configuration and powerplant. The C-119A first flew in Nov. 1947. The current Packet, C-119C, became the production version of the C-119A.

Engineering personnel for the C-119C included Armand J. Thieblot, chief engineer, and Mike Cozzoli, project engineer. Richard Hensen was chief test pilot.

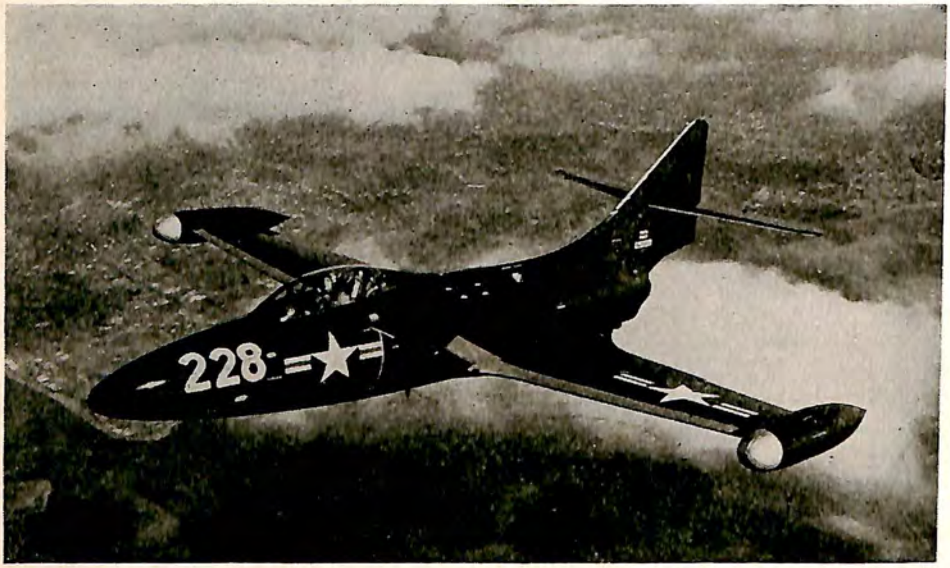
A new Packet with detachable cargo unit was completed on June 20, 1950. Dubbed the Pack-Plane, it will carry a detachable pod or pack that can be loaded before being hoisted into position against the bottom of the fuselage. Figured as a great time saver, since it doesn't have to be idle during loading and unloading operations, the Pack-Plane seems assured of a good future. Design specifications call for a loaded gross of 64,000 lb., a useful load of 23,535 lb., and a cargo capacity of 2,700 cu. ft. The Pack-Plane (XC-120) was test flown on Aug. 11, 1950 by chief test pilot Richard Henson.

FAST FREIGHT

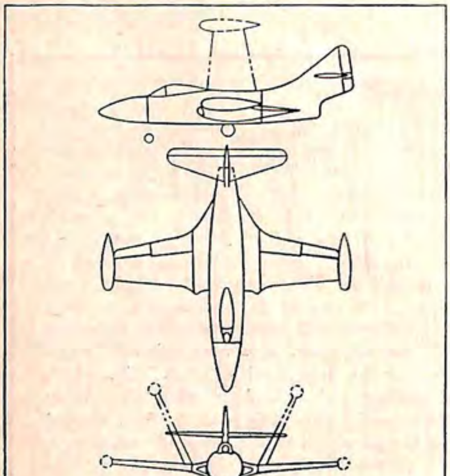
The "Flying Boxcar" comes by its name more naturally than most laymen suppose. Because of its aptness, it might be imagined that the term is a natural result of the plane's appearance. The truth is quite the other way around, for the big C-119 actually began life as a design problem in taking a standard railway boxcar and making it fly. Designer Armand Thieblot, since resigned, set down the basic dimensions of a small railway boxcar: 38 ft. 6 in. long, 8 ft. wide and 7 ft. high and resolved to put wings on it. Instead of the familiar sliding doors on the sides, however, it was decided to load the freight car from the rear and large, clamshell-like doors were added at the aft end. The flight crew was stationed atop the boxcar, much as in the cupola of a caboose. The final design was set when wings were added and the tail supported on twin booms projecting from the rear. Not satisfied with this arrangement, however, Fairchild engineers subsequently made a true Flying Boxcar out of the design with the XC-120, which actually parks its freight car on a siding for loading and unloading while the flying portion of the combination is returning for another load. The ability of the big, rugged transport has been proved beyond expectations in Korea where it has dropped paratroops, supplies and ammunition up and down the length of the battlefront. It is a fine tribute to the group who took seriously the age-old demand for "putting wings on a boxcar" and did it with tremendous success.

GRUMMAN AIRCRAFT ENGINEERING CORP.

Bethpage, L. I., N. Y.



Navy's newest Grumman Panther, the F9F-5



TYPE: Fighter. DESIGNATION: (N) F9F-5.

DATA

POWERPLANT: Pratt & Whitney turbojet J48-P-4 in the F9F-5. Thrust is rated at well over 5,500 lb. GEAR: Tricycle.

REMARKS

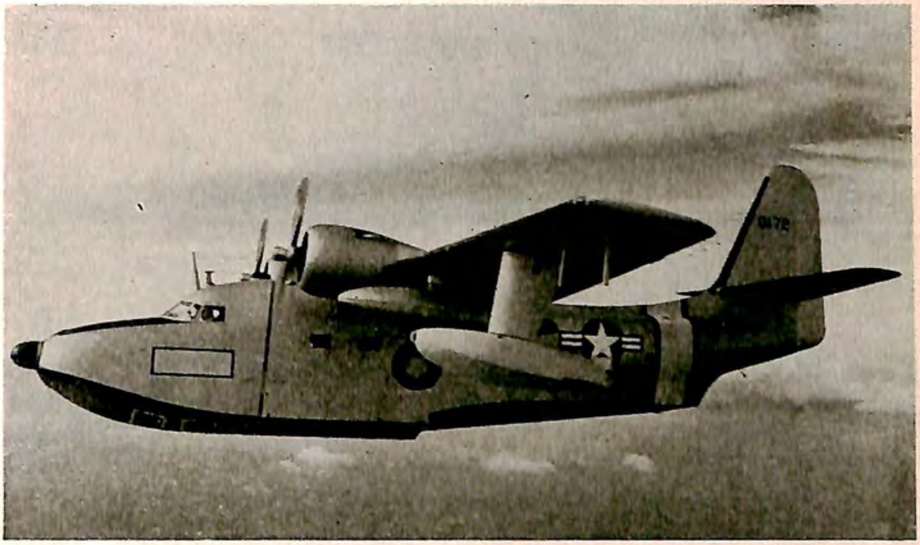
The first experimental Panther was powered with the Rolls Royce Nene turbojet and flew in late 1947. The XF9F-3, with an Allison J-33A engine, first flew Aug. 16, 1948.

The Panther is in the 600 mph class and is designed for carrier operation without a catapult assist. It has the Grumman square wing tips which fold upward, and also features a wing whose leading edge moves in conjunction with the wing flaps in landing and takeoff. Known as the "droop snoot," it provides added lift and improved stall characteristics. The cockpit has been designed around the standards determined by Naval medical studies as being most ideal from the standpoint of physical and psychological requirements of pilots.

C. H. Meyer handled most of the test flying.

The new -5 Panther is basically the same design as its predecessors, main improvements being a thinner wing and tail areas and the more powerful Pratt and Whitney J-48 engine.

The Panther is the first Naval jet fighter to be used in combat, having seen action in Korea during the year. All other data are classified.



Grumman Albatross for the Air Rescue Service of the USAF

TYPE: Transport and utility. **DESIGNATION:** (AF) SA-16A, (N) UF.

DATA

POWERPLANT: Two Wright R-1820-76 engines, 1,425 hp at takeoff. **PROPELLERS:** Hamilton Standard, 3 blade. **GEAR:** Tricycle retractable.

SPECS

SPAN: 80 ft. **LENGTH:** 61 ft. 4 in. **HEIGHT:** 24 ft. 5 in. **SPEEDS:** MAXIMUM, 270 mph; CRUISING, 225 mph.

The Albatross claims a "first" in aviation history—the only airplane in production that successfully operates from land, water, ice or snow. Previously, a complete gear change would be necessary for an airplane to operate from these different surfaces.

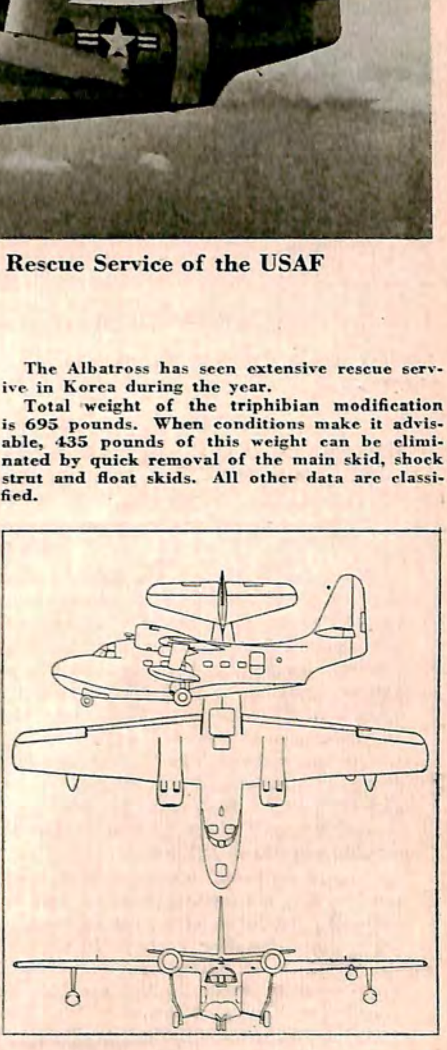
The Air Rescue Service of the USAF conceived the idea of one airplane with triphibian landing features. The Air Material Command laid down the specifications, and Grumman undertook the design and development of the airplane.

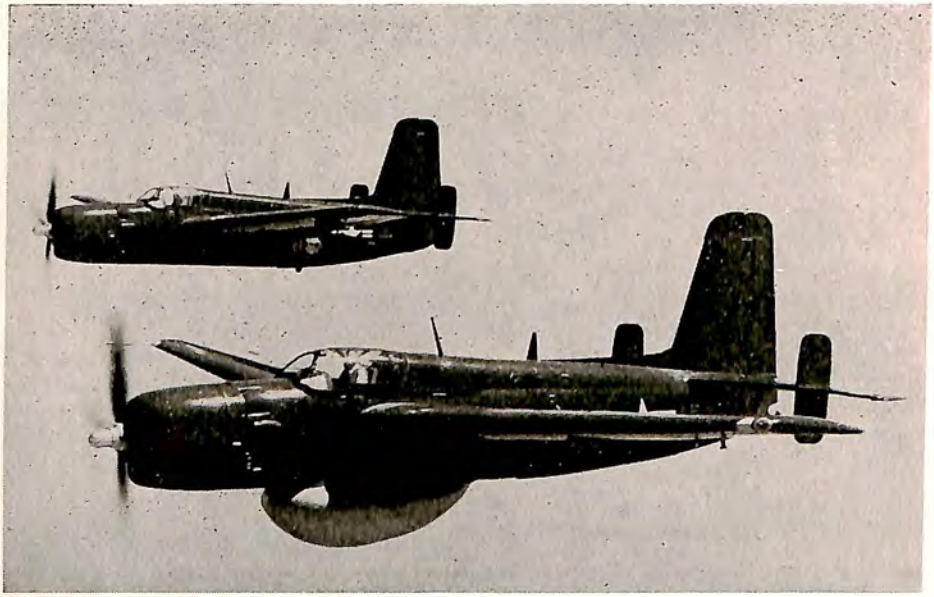
Successful snow tests were conducted in Feb. and Mar. 1951.

The Albatross was originally produced as a utility amphibian under an experimental contract from the U. S. Navy. The majority of the production models, however, are delivered to the Air Rescue Service of the Air Force. A smaller amount go to the Navy and Coast Guard.

The Albatross has seen extensive rescueservive in Korea during the year.

Total weight of the triphibian modification is 695 pounds. When conditions make it advisable, 435 pounds of this weight can be eliminated by quick removal of the main skid, shock strut and float skids. All other data are classified.





Grumman AF-2W (bottom) and AF-2S in "hunter-killer" formation

Type: Attack. DESIGNATION: (N) AF-2S and 2W.

DATA

POWERPLANT: Pratt and Whitney, R-2800, 2,250 hp. PROPELLER: Hamilton Standard. GEAR: Conventional.

REMARKS

Claimed the largest single-engined aircraft in the world, the Guardian operates from carrier decks. The Navy says this plane's "mission will be to seek out and destroy enemy submarines." Most of the test flying was done by William Cochran. It carries the latest in submarine radar equipment. Armament details and other data are classified.

HUNTER-KILLER

The idea of the "hunter-killer" team of two airplanes working together was born not as a shrewd new concept of anti-submarine warfare but as the solution to the problem of carrying all of the required equipment in one high-performance airplane. Grumman engineers saw clearly that an airplane capable of carrying all of the search gear, the offensive weapons and the fuel for the range necessary would be entirely too large for carrier operation so they simply split the load in half and divided it up between two airplanes. Thus, the AF-2W airplane carries the powerful, long-range search radar and the other special detection equipment needed to seek out the enemy submarine. Flying nearby is the AF-2S, the "killer" member of the team armed with bombs, depth charges, torpedoes and aircraft cannon for disposing of the submarine. In this manner, both aircraft have the high speed for escape and the huge fuel capacity required for 10-15 hour search missions, something a single airplane could not accomplish. The prototype Guardian featured an auxiliary turbojet engine in its tail to provide the added thrust for escape following submarine attack but this feature was abandoned when it became necessary to concentrate more on long range than on speed. The new Guardian represents the beginning of an era in which the airplane will replace the destroyer as the prime anti-submarine weapon. In this new concept the range and speed of the search-attack team is increased many times and using an aircraft carrier as a base its field of surveillance is practically limitless. It's the third dimension in this desperate underwater-surface-air triangle of foes.

HILLER HELICOPTERS

Palo Alto, Cal.

Hiller's H-23's feature new skid landing gear

TYPE: Helicopter. DESIGNATION: (AF) H-23A.

DATA

POWERPLANT: Franklin 6V4-178-B33, 178 hp at 3,000 rpm at sea level. FUEL CAPACITY: 27 gal.

SPECS

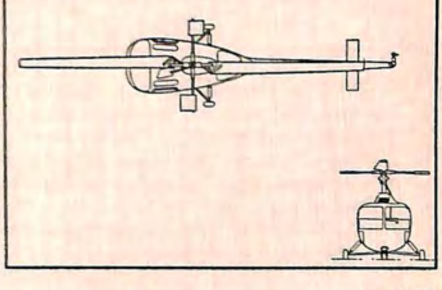
MAIN ROTOR DIAMETER: 35 ft. LENGTH: 38.7 ft. HEIGHT: 9.5 ft. FUSELAGE WIDTH: 4.9 ft. (max.) WEIGHTS: GROSS, 2,400 lb.; EMPTY, 1,697 lb.; USEFUL LOAD, 703 lb.

PERFORMANCE

All data are classified on this model according to the manufacturer.

REMARKS

Besides the H-23A, there are three other models in the Hiller line. They are: HTE-1, similar to the H-23 except for minor modifications, HTE-2 and H-23B whose major difference is a Franklin 6V4-200-C33, 200 hp at 3,100 rpm at sea level. The 3-view shown here is of the civilian model 360, no longer in production, but whose general configuration is the same as the military models described herein.



KAMAN AIRCRAFT CORP.

Windsor Locks, Conn.

Kaman HTK-1 for the Navy

TYPE: Helicopter. DESIGNATION: (N) HTK-1.

REMARKS

In 1951 Kaman Aircraft placed in production the type HTK-1 helicopter for the U. S. Navy. The HTK-1 is 3-place, powered by a 240 hp Lycoming engine. It was designed primarily as a trainer with dual controls and two side-by-side seats with a jump seat behind the pilot. Either set of controls can be removed to carry a litter internally. As an aerial ambulance the HTK-1 will carry a pilot, litter patient and a medical attendant. All other data are classified on this model according to the manufacturer. Listed below are specifications and performance for the civilian model K-190 (no longer in production) on which the HTK-1 was patterned.

POWERPLANT: Lycoming 0-435-X, 190 hp. FUEL CAPACITY AND CONSUMPTION: 40 gal., 12 gal. per hr. OIL CAPACITY: 3 gal. GEAR: Tricycle.

MAIN ROTOR DIAMETER: 38 ft. LENGTH: 23 ft. HEIGHT: 11 ft. WEIGHTS: EMPTY, 1,750 lb.; GROSS, 2,500 lb.; USEFUL LOAD, 800 lb. ROTOR DISC LOADING: 1.9 lb. per sq. ft. POWER LOADING: 13.3 lb. per bhp.

SPEEDS AT SEA LEVEL: MAXIMUM, 75 mph; CRUISING, 70 mph. RATE OF CLIMB FULLY LOADED: 700 ft. per min. SERVICE CEILING FULLY LOADED: 10,000 ft. RANGE: 194 mi.

Late in the year Kaman achieved the distinction of flying the first gas turbine powered helicopter in the world when its K-225 airframe powered by a Boeing YT50 turboprop engine took to the air. Both airframe and engine were developed under Navy Bureau of Aeronautics auspices. The mating of the gas turbine with the helicopter is considered ideal by engineers since both operate at maximum efficiency under conditions of high, constant speed. The "free wheeling" turbine of the Boeing unit eliminates the heavy, complex gearing of the piston engine and cooling fan problem.

LOCKHEED AIRCRAFT CORP.

Burbank, Cal.

Lockheed T-33 jet trainer

TYPE: Trainer. DESIGNATION: T-33A.

DATA

POWERPLANT: Allison J-33-A-23, model 400 C-5, 4,600 lb. thrust at takeoff. FUEL CAPACITY: 683 gal. GEAR: Tricycle, fully retractable.

SPECS

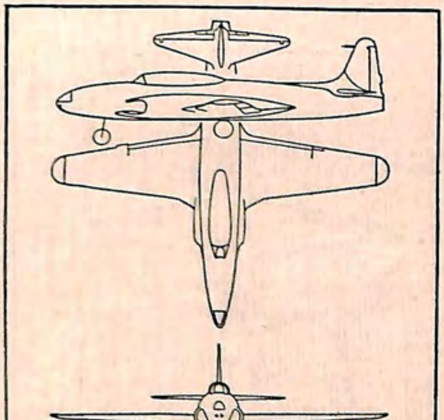
SPAN: 38 ft. 10½ in. LENGTH: 37 ft. 8½ in. HEIGHT: 11 ft. 8-1/3 in. WEIGHTS: EMPTY, 8,084 lb.; GROSS, 14,442 lb.; USEFUL LOAD, 6,358 lb. WING LOADING: 60.8 lb. per sq. ft. POWER LOADING: 3.3 lb. per lb. of thrust.

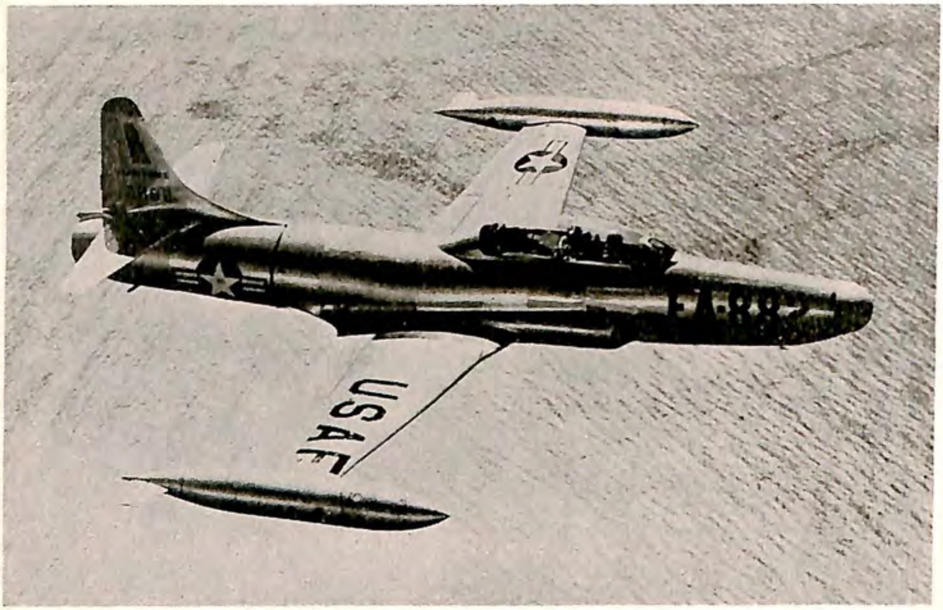
PERFORMANCE

SPEEDS: MAXIMUM, 580 mph; STALLING, 117 mph. RATE OF CLIMB: 5,525 ft. per min. SERVICE CEILING: 40,000 ft. fully loaded. RANGE: 1,345 mi.

REMARKS

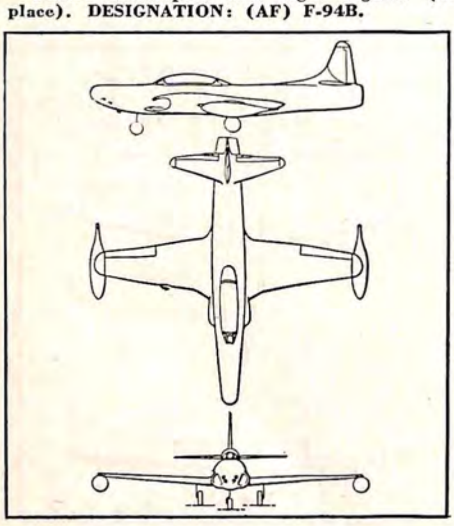
The T-33A is the only jet trainer now in production or use by the U. S. military services. All other data are classified.





Lockheed F-94B two-place jet interceptor

TYPE: Interceptor and Night Fighter (2-place). DESIGNATION: (AF) F-94B.



DATA

POWERPLANT: Allison J-33-A-33, 5,200 lb. thrust at takeoff plus afterburner. GEAR: Tricycle retractable.

SPECS

SPAN: 38 ft. 9 in. LENGTH: 40 ft. 1 in. HEIGHT: 12 ft. 7 in. MAXIMUM GROSS TAKE-OFF WEIGHT: over 16,000 lbs.; USEFUL LOAD: two 1000 lb. bombs or eight 5-in. HVAR rockets.

PERFORMANCE

SPEEDS: 600 mph class; STALLING, 122 mph; SERVICE CEILING: over 45,000 ft. fully loaded. RANGE: 500 mile combat radius. Performance figures are approximate.

REMARKS

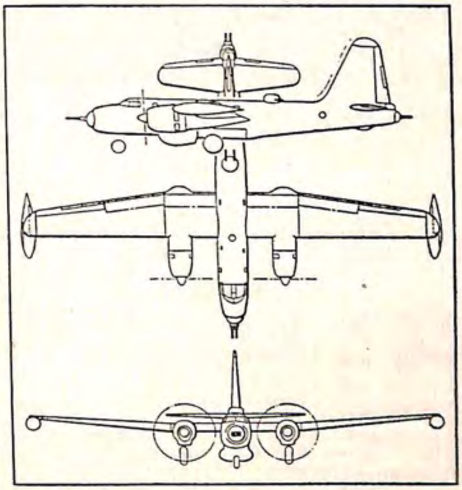
The F-94B, containing certain modifications from the earlier F-94A including new electronic nose for night fighting, is another development of the original F-80 Shooting Star, which was built by Lockheed as the first mass produced jet fighter and first jet to see combat in Korea. It carries a radar operator. F-94 series aircraft have been ordered in substantial quantities. Other data are classified.

Radar-equipped Lockheed Neptune

TYPE: Patrol. DESIGNATION: (N) P2V-4.

DATA

POWERPLANT: Two Wright R-3350-30W, 3,250 hp (dry) and 3,700 hp (wet) for take-off. FUEL CAPACITY: 4,700 gal. PROPELLERS: Hamilton Standard 2460-85/2J17Q-365. GEAR: Tricycle retractable.



SPECS

SPAN: 100 ft. LENGTH: 81 ft. 6.8 in. HEIGHT: 28 ft. 1 in. WEIGHTS: EMPTY, 41,758 lb.; GROSS, 76,152 lb.; USEFUL LOAD, 30,279 lb. WING LOADING: 76 lb. per sq. ft.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 312 mph; STALLING, 109 mph (power off at full gross). RATE OF CLIMB: 1,640 ft. per min. at sea level and gross weight. SERVICE CEILING: 28,000 ft fully loaded. RANGE: 4,750 mi.

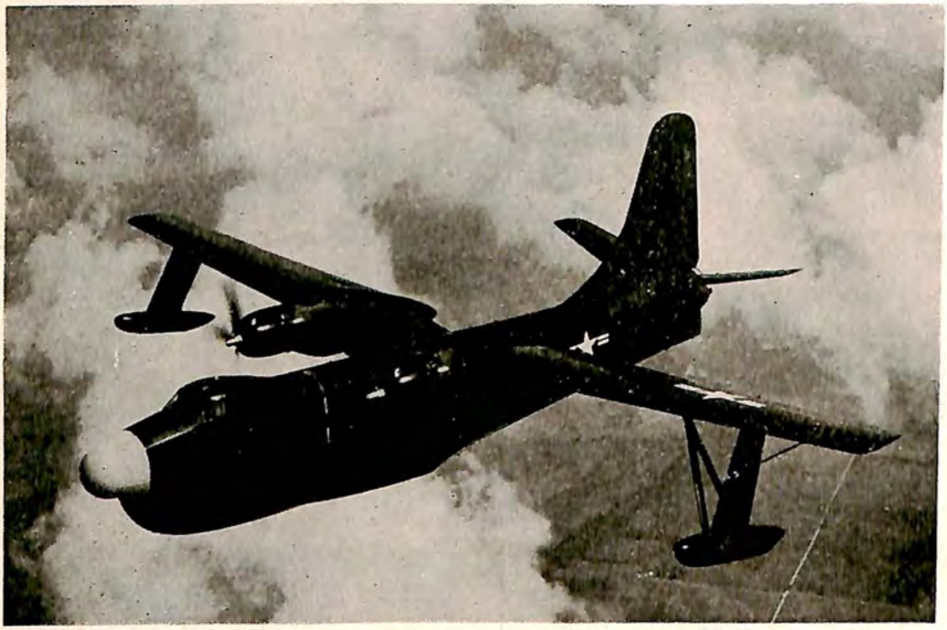
REMARKS

The P2V-5 is the newest model in the P2V line. Its specifications and performance data parallel those for the P2V-4 listed above. The -5 is equipped for anti-submarine and anti-surface vessel search and destruction. It carries the latest in radar apparatus. Other models have included the P2V-1 with R-3350-8 engines rated at 2,300 hp; P2V-2 with R-3350-24W engines rated at 2,500 hp; and the P2V-3 with R-3350-26W rated at 2,700 hp. P2V's have been designed to operate from carriers with JATO assist. All other data are classified.

The prototype Lockheed XP2V-1 *Neptune* posed a serious problem for the top officials of the Federation Aeronautique Internationale, official record-keeping international body: it may have established a record that can never be broken. In September, 1946, the big blue Navy plane set a distance record of 11,235 miles in a flight from Perth, Australia to Columbus, Ohio. Under the existing rules the greatest distance an airplane can fly in a straight line is about 12,000 miles, since any greater distance would involve flying back around the other side of the globe, which would be shortening the airline distance between the two, measured in the opposite direction!

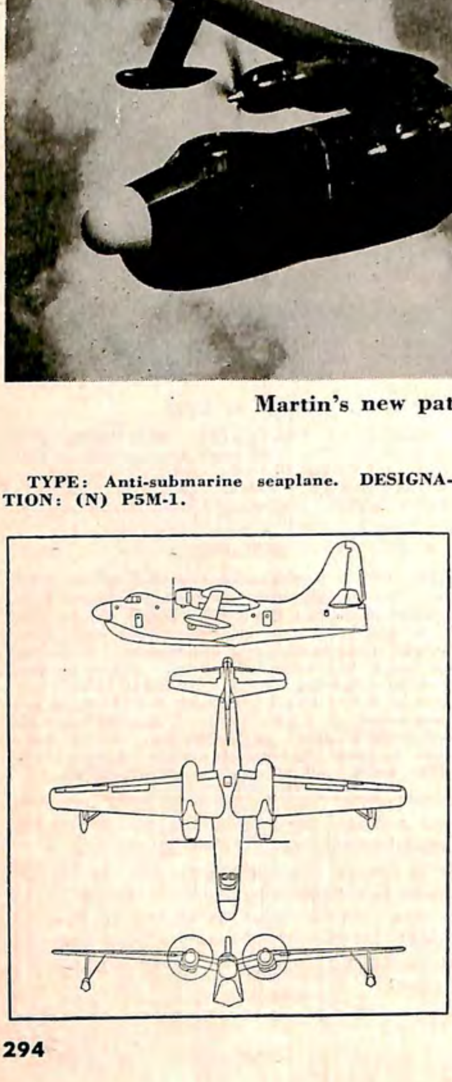
THE GLENN L. MARTIN AIRCRAFT CO.

Baltimore, Md.



Martin's new patrol plane, the P5M

TYPE: Anti-submarine seaplane. DESIGNATION: (N) P5M-1.



DATA

POWERPLANT: Two Wright Model 3350-30 engines. PROPELLERS Hamilton Standard 4-bladed, Model 34E60, reversible.

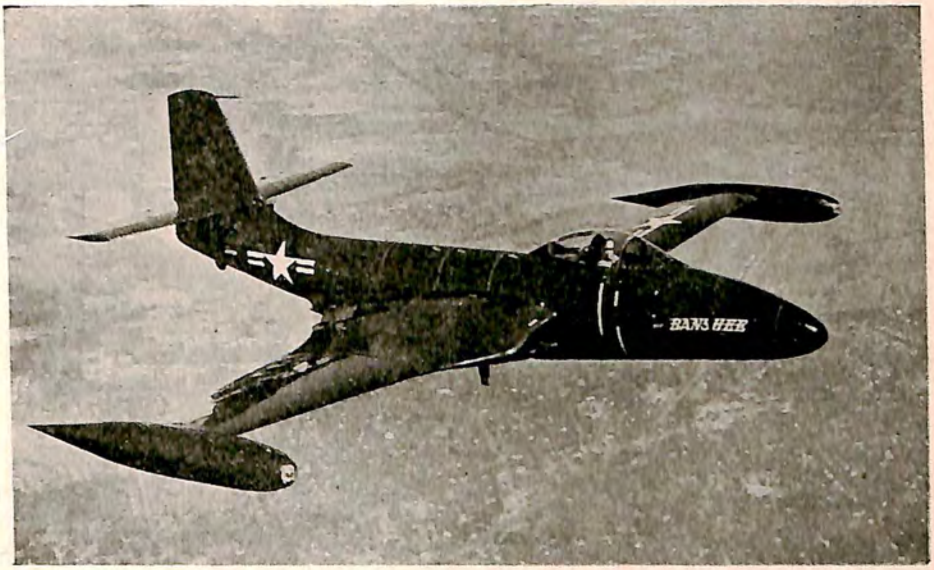
SPECS

SPAN: 118 ft.; AREA: 1,406 sq. ft.; LENGTH: 95 ft. HEIGHT: 35 ft. 2 in. GROSS WEIGHT: over 70,000 lbs.

REMARKS

The Martin Marlin is a medium range, twin-engine seaplane intended primarily for anti-submarine patrol duty. The P5M-1 is equipped with the latest Navy all-weather, day-and-night electronic devices for tracking suspected targets. Within its two nacelle bomb bays and on the wings, the Marlin carries a variety of torpedoes, rockets and/or mines. A gun turret is located in the tail. An important feature of the aircraft is the long after-body hull designed for rough water operations. The hull makes take-offs and landings easier under adverse sea conditions—and has reduced aerodynamic drag due to elimination of the main step. Another item of special interest is the hydroflap, or underwater rudder, installed for greater maneuverability in taxiing. All other data are classified.

McDONNELL AIRCRAFT CORP.
St. Louis, Mo.



McDonnell twin-jet Banshee

TYPE: Fighter. DESIGNATION: (N) F2H-2.

DATA

POWERPLANT: Two Westinghouse J-34 turbojets, approximately 3,000 lb. thrust each. FUEL: Over 5,000 lb. in five self-sealing internal tanks. GEAR: Tricycle retractable.

SPECS

SPAN: 41 ft. 7.4 in. LENGTH: 40 ft. 1.8 in. HEIGHT: 14 ft. GROSS WEIGHT: Approximately 14,000 lb.

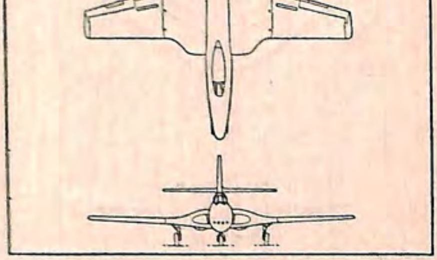
PERFORMANCE

MAXIMUM SPEED: Reported close to 600 mph. RATE OF CLIMB: Over 9,000 ft. per min. CEILING: Approximately 48,000 ft. RANGE: Over 2,000 mi. (max.)

REMARKS

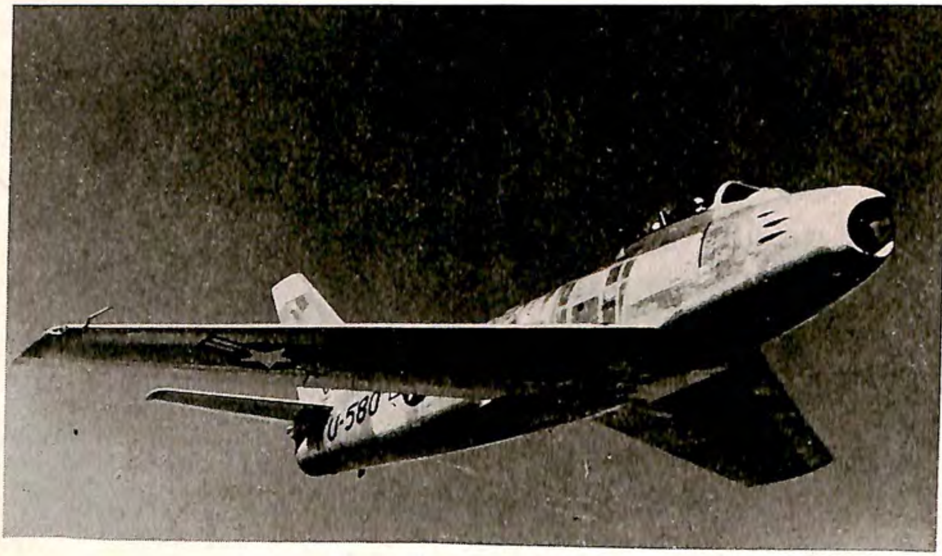
The Banshee is the outgrowth of the Phantom, first Navy carrier-based jet, which is out of production. The Banshee has almost double the power, thinner wings and tail, smoother outer surfaces, heavier guns, better pilot visibility, and a number of maintenance improvements.

The Banshee, like the Phantom, has one jet in each slightly thickened wing root. This lessens the drag over the conventional nacelle placement, and also gives better single-engine performance. For greater carrier utility the Banshee is equipped with folding wings and a "kneeling" feature which allows 25 percent more planes to be stored. Another Banshee model, the F2H-2P, first jet-carrier based photographic airplane ever developed was in production during the year. All other data are classified.



NORTH AMERICAN AVIATION, INC.

Los Angeles, Cal.

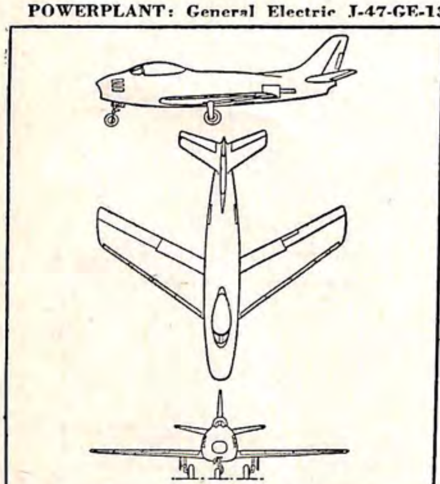


North American's Sabre

TYPE: Fighter. DESIGNATION: (AF) F-86E.

DATA

POWERPLANT: General Electric J-47-GE-13,



5,200 lb. thrust. GEAR: Tricycle, retractable, steerable nosewheel.

SPECS

SPAN: 37 ft. LENGTH: 37 ft. HEIGHT: 14 ft. WEIGHT: 16,000 lb.

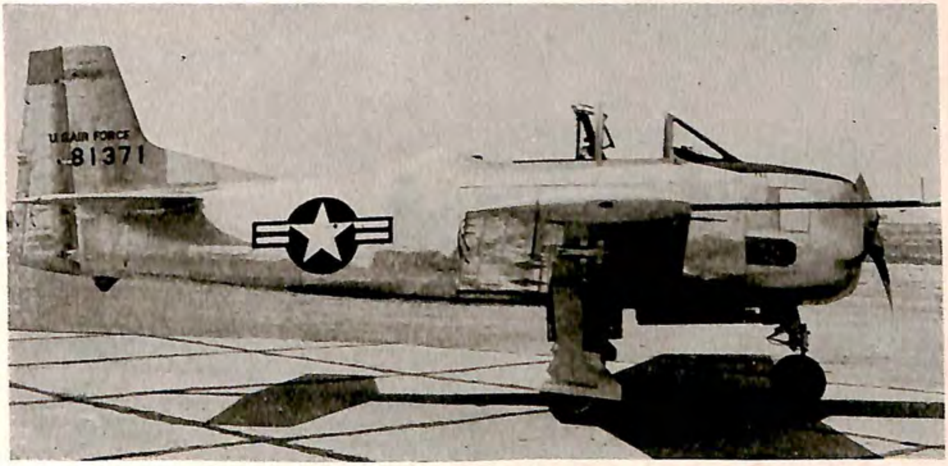
PERFORMANCE

SPEEDS: Set official world's record of 670.981 mph, Sept. 15, 1948, and unofficial record of 710 mph, Feb. 11, 1949. SERVICE CEILING: Over 40,000 ft. TACTICAL RADIUS: Over 500 mi.

REMARKS

Basically similar to the original sweptwing F-86 Sabre, whose first production model flew on May 20, 1948, is the F-86E. First Sabre with super power boost controls, the F-86E is different from the original F-86's in having an all-flying tail, artificial and irreversible control systems. By means of chain linkage, both the elevator and stabilizer are movable in coordination.

The all-weather interceptor model, F-86D, has a longer fuselage (40 ft.), a General Electric J-47-GE-17 jet with 5,700 lb. thrust, plus afterburner, and an intake duct under the nose to permit radar installation. All other data are classified.



North American advanced trainer T-28

TYPE: Advanced trainer. DESIGNATION: (AF) T-28.

DATA

POWERPLANT: One Wright 7 cyl., R-1300-1, 800 hp. FUEL CAPACITY: 125 gal. PROPELLER: Aero Products, 2-bladed, constant speed. GEAR: Tricycle, hydraulically retractable.

SPECS

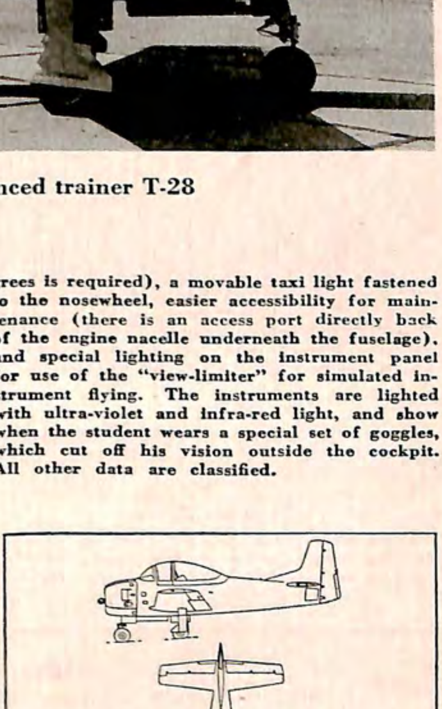
SPAN: 40.1 ft. LENGTH: 32 ft. HEIGHT: 12.66 ft. WEIGHTS: EMPTY, 5,111 lb.; GROSS, NORMAL 6,365 lb.; GROSS, MAXIMUM TAKE-OFF, 6,759 lb. WING LOADING, 23.8 lb. per sq. ft. POWER LOADING, 7.96 lb. per hp.

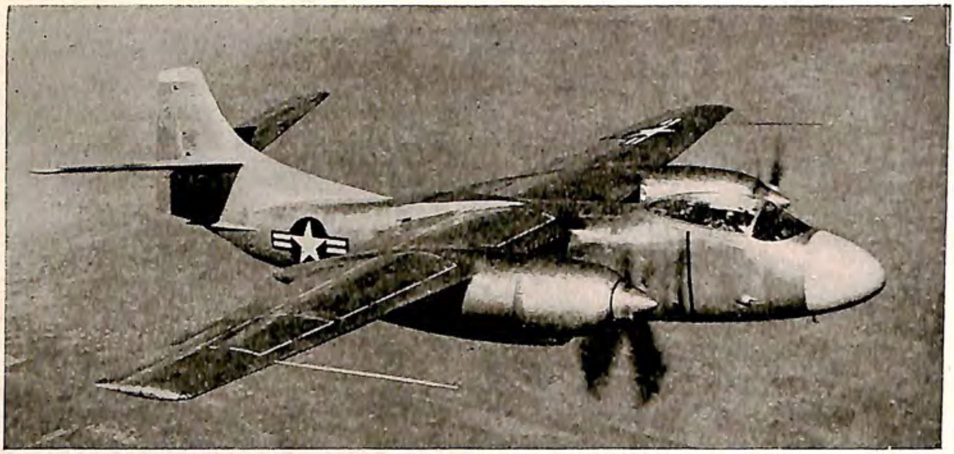
PERFORMANCE

SPEEDS: MAXIMUM (at 5,900 ft.) 288 mph; CRUISING, 190 mph; STALLING, 72 mph; RATE OF CLIMB, 2,570 ft. per min. SERVICE CEILING: 29,800 ft. RANGE: 1,008 mi.

REMARKS

The Air Force's new T-28 was designed to replace the AT-6 used during the war. With a top speed of 288 mph as against 205 mph for the old type, this new trainer is expected to fill the gap between the slow trainer and the jets. It is the first U. S. training plane to use a tricycle gear. Additional improvements include a 12½ degree visibility over the nose (11 degrees is required), a movable taxi light fastened to the nosewheel, easier accessibility for maintenance (there is an access port directly back of the engine nacelle underneath the fuselage), and special lighting on the instrument panel for use of the "view-limiter" for simulated instrument flying. The instruments are lighted with ultra-violet and infra-red light, and show when the student wears a special set of goggles, which cut off his vision outside the cockpit. All other data are classified.





Carrier-based North American AJ-1

TYPE: Attack. DESIGNATION: (N) AJ-1.

DATA

POWERPLANT: Two Pratt & Whitney Double Wasp R-2800-44W and one Allison J33-A-10 turbojet engine. GEAR: Tricycle retractable.

SPECS

SPAN: 71 ft. LENGTH: 63 ft. WEIGHTS: EMPTY, 28,000 lb.; GROSS, 55,000 lb.; USEFUL LOAD, 27,000 lb.

PERFORMANCE

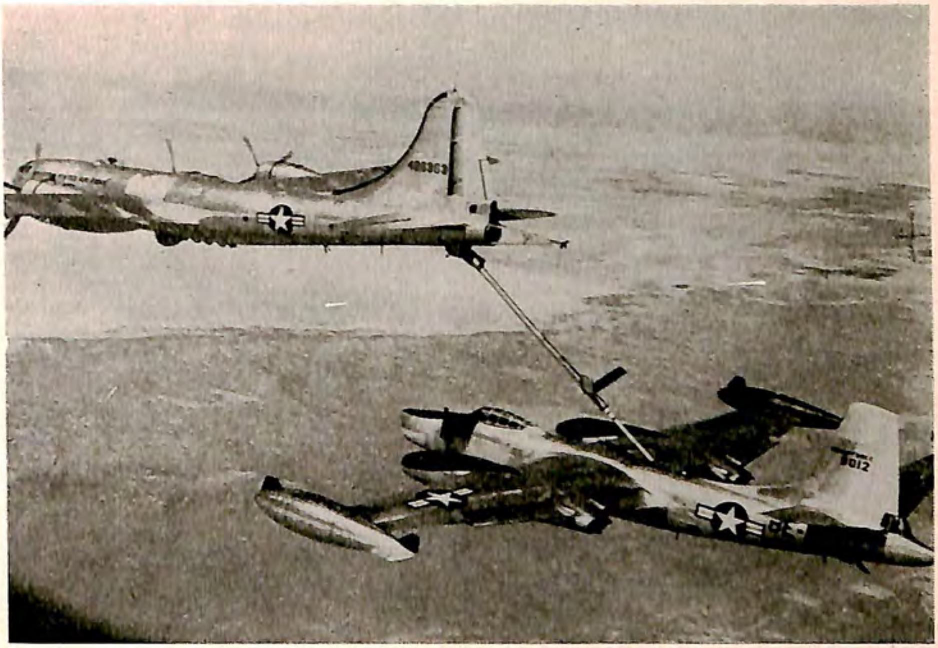
SPEED AT SEA LEVEL: 500 mph on all engines, 425 mph on piston engines alone; CRUISING, 300 mph on piston engines alone. RATE OF CLIMB: 4,000 ft. per min.; SERVICE CEILING: 40,000 ft. RANGE: more than 3,000 miles.

REMARKS

The AJ-1 was designed as a carrier-based bomber to deliver the atom bomb. Its jet engine is located in the aft fuselage and is used only periodically for takeoff, speed over the target, escape from pursuing airplanes. The outer wing panels fold vertically, the fin folds to starboard for shipboard accommodation. Crew of three rides in pressurized cabin. First group of AJ-1's in service, Squadron VC-5 at N.A.S. Norfolk, completed carrier qualification tests in Oct., 1950. Second group of AJ's to go into carrier operation was Composite Squadron VC-6 of Heavy Attack Wing 1, aboard the Midway. All other data are classified.

CARRIER BOMBER

If we were to go to war tomorrow, here is the Navy carrier aircraft that would be called upon to deliver the atom bomb. The *Savage* is fully equipped to carry the A-bomb to the enemy wherever our carriers can take it, its crews are carefully rehearsed and it stands as the No. 1 offensive weapon of the U. S. Navy. Hidden in its tail is a big Allison turbojet engine to give it that burst of speed over the target that will permit it to drop its cargo on the enemy. The AJ-1 is the biggest aircraft ever to land on board a carrier and this simple fact has meant careful training of both air and deck crews to insure safe, efficient operation. For more prosaic attack missions the big plane is able to settle down to cruise positioon of its throttles and fly for thousands of miles on long-range assignments. It represents a long dream of Naval Aviation pioneers: the true heavy bomber operating from carrier decks. It is indeed a far cry from the carrier bomber of World War II, which weighed only one-third as much and carried only one-fourth its lethal load.



North American RB-45C shown being refueled by a Boeing KB-29P

TYPE: Bomber. DESIGNATION: (AF) B-45.

DATA

POWERPLANT: Four General Electric J-47 (TG-190) 5,200 lb. thrust each. GEAR: Tricycle, hydraulically retractable.

SPECS

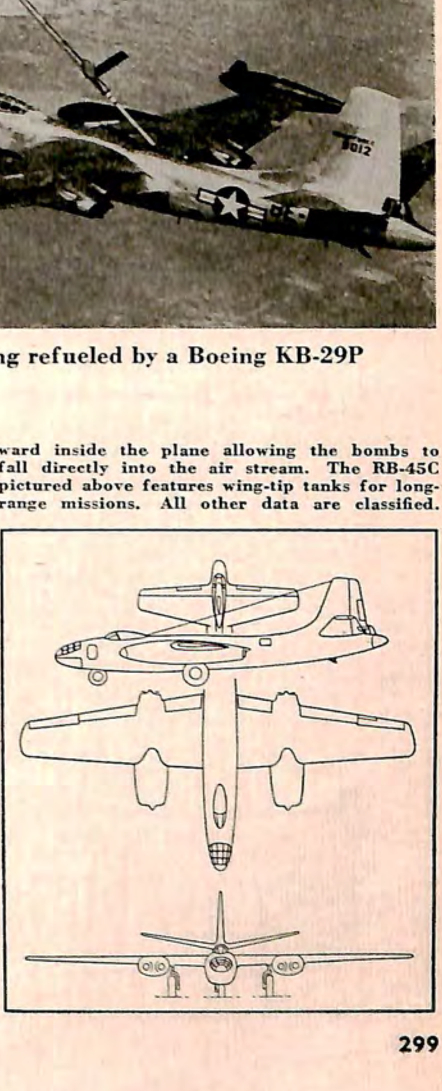
SPAN: 89 ft. 6 in. LENGTH: 74 ft. HEIGHT: 25 ft. GROSS WEIGHT: 82,600 lb. WING LOADING: 70.3 lb. per sq. ft. BOMB LOAD: Over 10 tons.

PERFORMANCE

MAXIMUM SPEED: In 550 mph class (unofficial speed record of 675 mph set by Capt. Louis H. Stokes and Col. Charles Overstreet on Mar. 1, 1949). SERVICE CEILING: Over 40,000 ft. RANGE: Tactical radius over 800 mi.

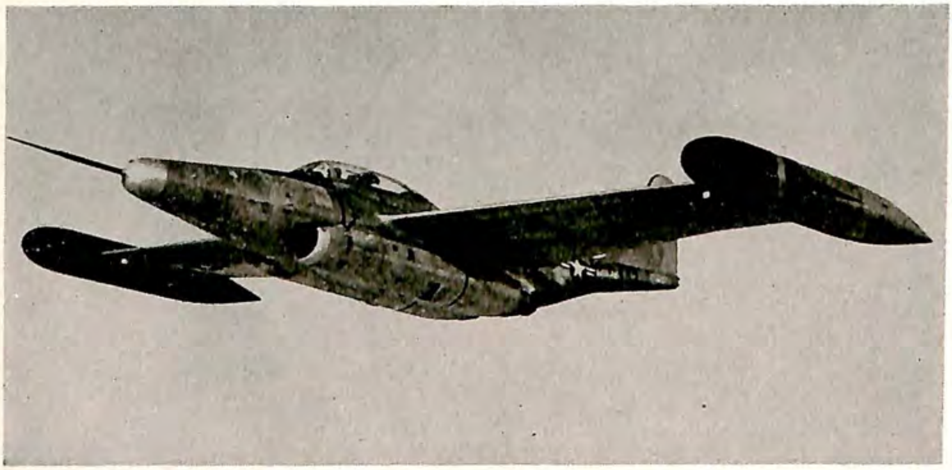
REMARKS

The B-45 was the first four-jet plane to fly in United States. The four jets are arranged in pairs in single nacelles on each wing. The engines are located entirely ahead of the leading edge of the wing. The only protuberance is the plastic bubble covering the pilot and co-pilot, who sit in tandem in a pressurized cockpit. The problem of air turbulence causing bombs to climb and tumble was overcome by folding or overlapping bomb bay doors which slide upward inside the plane allowing the bombs to fall directly into the air stream. The RB-45C pictured above features wing-tip tanks for long-range missions. All other data are classified.



NORTHROP AIRCRAFT, INC.

Hawthorne, Cal.

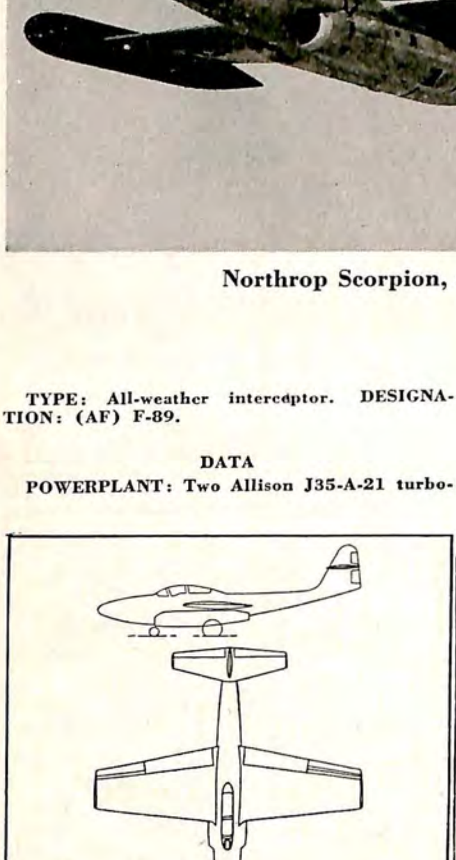


Northrop Scorpion, all-weather interceptor

TYPE: All-weather interceptor. **DESIGNATION:** (AF) F-89.

DATA

POWERPLANT: Two Allison J35-A-21 turbojets with afterburners carried in separate nacelles on the lower section of the fuselage. **GEAR:** Tricycle retractable.



SPECS

SPAN: Approximately 56 ft. **LENGTH:** Approximately 53 ft. **HEIGHT:** Approximately 15 ft. **GROSS WEIGHT:** Over 30,000 lb.

PERFORMANCE

MAXIMUM SPEED: 600 mph range. **OPERATIONAL CEILING:** Over 40,000 ft.

REMARKS

Known as the "all-weather interceptor," the Scorpion was designed as a twin-jet successor to the Black Widow, F-61. In addition to the pilot, a radar operator is carried to handle the complex electronic equipment used for search missions. The cockpit is equipped with ejection seats, is pressurized, and has a power-operated canopy.

The Scorpion's thin wing prevented the installation of regular spoilers, so a split aileron was designed. Known as "decelerons," the lower portion is split and can be used as a dive or maneuvering flap. The regular inboard flap panels are the slotted type.

The name, Scorpion, was derived from the appearance of the tail section, which is swept-up to keep it away from wing turbulence and the hot jet exhaust.

W. R. Clay was project engineer.

All other data are classified.

PIASECKI HELICOPTER CORP.

Morton, Pa.

Navy shipboard helicopter, Piasecki Retriever

TYPE: Helicopter. DESIGNATION: (N) HUP-1.

DATA

POWERPLANT: Continental R-975-34, 525 hp at takeoff. FUEL CAPACITY: 100 gal. GEAR: Tricycle.

SPECS

LENGTH: 31 ft. 7 in. HEIGHT: 12 ft. 6 in. WEIGHTS: EMPTY, 3,966 lb.; NORMAL GROSS, 5,355 lb.; OVERLOAD GROSS, 5,355 lb.

PERFORMANCE

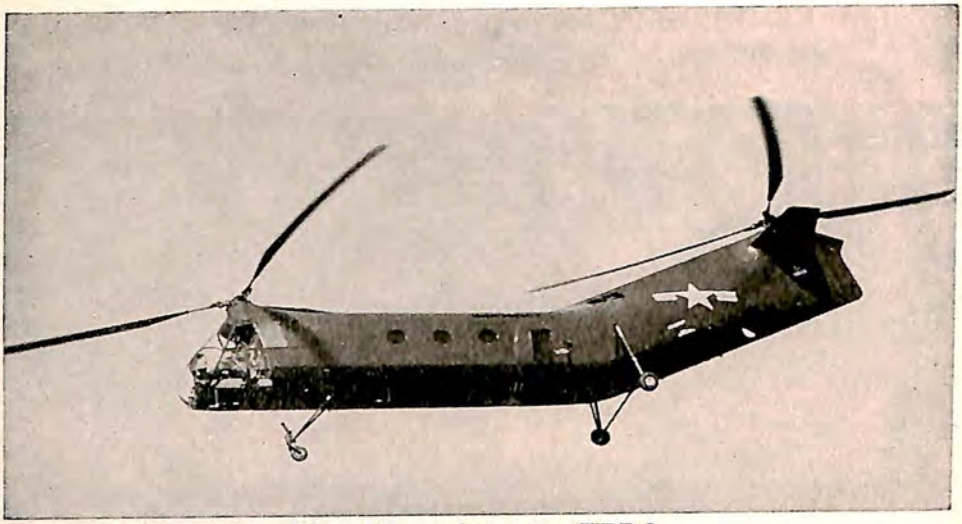
SPEEDS AT SEA LEVEL: MAXIMUM, over 125 mph; CRUISING, over 100 mph. RATE OF CLIMB: Normal rated power (best climb speed 50-60 mph), 1,200 ft. per min. SERVICE CEILING: Over 12,000 ft. RANGE: Over 400 mi. cruising.

REMARKS

Three experimental models (XHJP-1) were constructed as prototypes for the present production model (HUP-1) and won a Navy production contract. It was the first helicopter to use the overlapping tandem rotor arrangement. It is a 5-place, single engine, semi-monocoque, aluminum alloy fuselage land helicopter. Service type is passenger and cargo. Production continued during the year under Navy contract.

LISTENING POST

This is the first helicopter designed especially for aircraft carrier operation, although earlier designs were adapted to the purpose. The HUP has been equipped with a Sperry automatic pilot which permits its flight completely "hands off", considered one of the outstanding accomplishments in helicopter history. By relieving the flight crew of the fatigue associated with constant "flying" of the machine, their effectiveness is increased enormously. The HUP serves as a passenger transport, a cargo transport, an evacuation transport and a new version, now under construction, will be specially equipped for anti-submarine warfare where its ability to hover for long durations will make it virtually a stationary mid-air listening post for enemy submarines.



Piasecki's tandem rotor HRP-2

TYPE: Helicopter. DESIGNATION: (N) HRP-2.

DATA

POWERPLANT: One P & W 1340-AN-1 600 hp at takeoff; 550 hp normal rated power. FUEL CAPACITY: 100 gal. GEAR: Tricycle, fixed.

SPECS

LENGTH: 54 ft. HEIGHT: 14 ft. 10 in. ROTOR DIAMETER: 41 ft. WEIGHTS: EMPTY, 5,205 lb.; NORMAL GROSS, 7,129 lb.; NORMAL USEFUL LOAD, 1,924 lb.; OVERLLOAD GROSS, 7,425 lb.; OVERLOAD USEFUL LOAD, 2,220 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, over 105 mph; CRUISING, over 85 mph. SERVICE CEILING: Over 11,000 ft. RATE OF CLIMB: (vertical, zero airspeed—takeoff power) 380 ft. per min.; (best climb speed, 50-60 mph—normal rated power) 950 ft. per min. RANGE: (cruising) 285 mi.

REMARKS

The HRP-2 is a 10-place, tandem, semimonocoque, aluminum alloy fuselage, land helicopter. The service type is passenger and cargo transport. Initial design work started on this model in Jan., 1948, as an improved version of the successful HRP-1 which had seen extensive Navy and Marine service. In June, 1948, proposals were completed and submitted to the Bureau of Aeronautics and in Aug., a letter of intent came from the Navy for five. The most obvious change in the new 'copter was the semimonocoque construction of the fuselage for more space and greater rigidity to remove it from the natural frequencies encountered in the HRP-1. Other changes included: (1) Improved cockpit, permitting side by side seating and much better visibility in all flight conditions. (2) Added features for carrier operation. (3) Twice as much cabin capacity. (4) Improved maintenance characteristics.

An advanced version of the HRP-2, designated the H-21, is now in production under an Air Force contract. It is the first helicopter designed specifically for large scale Arctic rescue work. It will be operated by the USAF's Air Rescue Service, a division of MATS. The Army is also scheduled for this model. Basically, the H-21 follows the HRP-type tandem configuration and with the "omniphibious" landing gear, it will be able to land on snow, ice, water, tundra, marsh or land without changing the gear. The specially designed gear combines regular landing wheels, floats and skis into one unit. The H-21 has provisions for up to 20 troop seats and in an emergency can take as many as 27 persons. Is is equipped with a Wright Cyclone R-1820-103A engine. The H-21 order gives the Air Force its first tandem helicopter.

REPUBLIC AVIATION CORP.

Farmingdale, L. I., N. Y.

Republic Thunderjet equipped for mid-air refueling

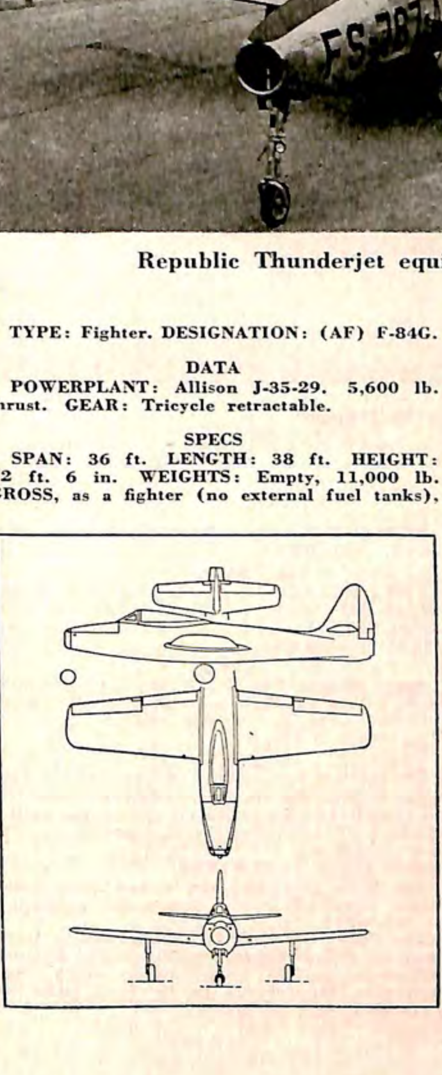
TYPE: Fighter. DESIGNATION: (AF) F-84G.

DATA

POWERPLANT: Allison J-35-29. 5,600 lb. thrust. GEAR: Tricycle retractable.

SPECS

SPAN: 36 ft. LENGTH: 38 ft. HEIGHT: 12 ft. 6 in. WEIGHTS: Empty, 11,000 lb. GROSS, as a fighter (no external fuel tanks), 15,000 lb.; as a fighter-bomber (external fuel tanks), over 18,000 lb.



PERFORMANCE

MAXIMUM SPEED: Over 630 mph. SERVICE CEILING: Over 45,000 ft. RANGE: 1,000 miles-plus with external tanks.

REMARKS

The F-84G, current production model of the Thunderjet series, has a 10 percent increase in power over the F-84E, combat-tested predecessor from which it differs only in possession of single-point, in-flight refueling equipment, automatic pilot, refined ejector configuration, and additional access doors. Maintenance and accessibility features include retractable battery-lift, hinged gun deck, guide rails, snap-on electrical leads, throttle disconnects for rapid engine change. Wing tip tanks have aerodynamic fins allowing the plane to go through maneuvers usually restricted when carrying external tanks. Cockpit pressurized and air-conditioned.

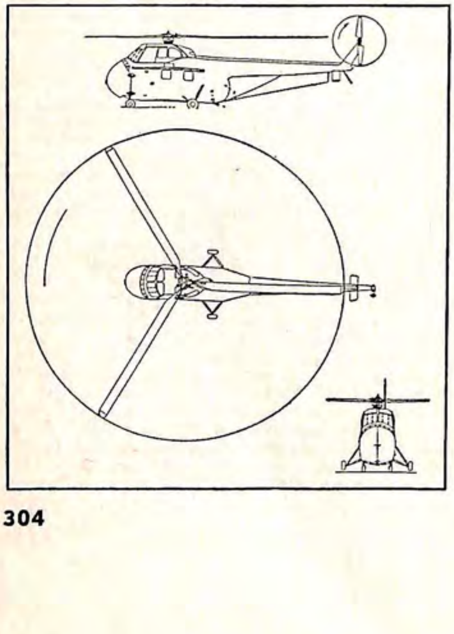
Firepower includes six .50 calibre machine guns as standard fixed equipment, 32 five-inch HVARs or two 11.5-inch HVVARs and 16 five-inch HVARs. Napalm bombs. Two 1,000 lb. bombs and 18 five-inch HVARs. Various combinations possible. Longest range of any single engine jet fighter. The F-84E, which entered combat in Korea in December, 1950, was experimentally flown non-stop across the Atlantic in September, 1950. The experiment led to development of the 'G.' The 'E,' in Korea, defeated the Russian-built Mig at an 8-1 ratio, and also performed interdiction, armed reconnaissance and ground support missions. All other data are classified.

SIKORSKY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORP.

Bridgeport, Conn.

Sikorsky 10-place helicopter



TYPE: Helicopter. DESIGNATION: (AF) H-19A, (N) HRS-1.

DATA

POWERPLANT: Pratt & Whitney Wasp R-1340 S3H2 600 hp. FUEL CAPACITY AND CONSUMPTION: 180 gal., 36 gal. per hr. GEAR: Quadricycle.

SPECS

MAIN ROTOR DIAMETER: 53 ft.; LENGTH: 41 ft. 8½ in.; HEIGHT: 14 ft. 8 in.; WEIGHT EMPTY: 4,395 lb.; GROSS: 6,800 lb.; USEFUL LOAD: 2,405 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: HIGH SPEED: 110 mph; CRUISING: 86 mph; MAXIMUM RATE OF CLIMB AT SEA LEVEL: 1,130 ft. per min.; SERVICE CEILING: 13,500 ft.; RANGE: (with reserve) 477 mi.

REMARKS

The H-19 is a 10-place, closed, land helicopter fitted for rescue cargo and passenger transportation.

The HRS-1 was used by the Marines to land an entire fully-equipped battalion on a Korean hilltop during late 1951. Twelve took part, completing the mission in six hours without a casualty.

CHAPTER EIGHT

Engines in Production

The following list of aircraft engines includes only those in production during the year. Unless otherwise noted the specifications are the manufacturers'.

AEROJET ENGINEERING CORP.

Azusa, Cal.

MODEL: 14AS-1000 (Jato Motor).

DATA

TYPE: Solid propellant rocket.

SPECS

DIAMETER: 10.25 in. LENGTH: 35.4 in. EMPTY WEIGHT: 120 lb. LOADED WEIGHT: 200 lb.

PERFORMANCE

RATING: 1,000 lb. thrust, or 330 hp, for a duration of 14 sec.

EQUIPMENT

Jato motor consists of a steel cylinder closed on fore end with exhaust nozzle, igniter and safety diaphragm located on aft end. Thrust is transmitted through three mounting lugs welded on the cylinder to the aircraft attachment fittings.

REMARKS

The 14AS-1000 Jato motor is CAA-certificated and its use on the Douglas DC-3 and Douglas DC-4 airplanes has been approved by CAA for commercial airline operation.

MODEL: Liquid rocket engine (Aerobee).

DATA

TYPE: Liquid bi-propellant rocket, gas or chemically pressurized.

SPECS

DIAMETER: 15 in. LENGTH: 138 in.

EQUIPMENT

Assembly consists of a cylindrical section which contains the oxidizer, fuel and pressurizing tanks. The pressure regulator and rocket motor are attached to the tank section.

REMARKS

This rocket powerplant is used to propel the Aerobee high-altitude sounding rocket.

AIRCOOLED MOTORS, INC.

Syracuse, N. Y.

MODEL: Franklin 6AG4-185-B12.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

SPECS

LENGTH: 40 19/32 in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7.5:1. DRY WEIGHT: 369 lbs. with hub and accessories. WEIGHT PER HP: 1.86 lbs.

PERFORMANCE

TAKE-OFF POWER, 183 hp at 3,100 rpm. CRUISE: 135 hp. FUEL CONSUMPTION: .51 lbs. per hp hr. OIL CONSUMPTION: .002 lbs. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION: Dual Scintilla. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A.C. Spark Plug Co.

MODEL: Franklin 6A4-165-B3.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

SPECS

LENGTH: 37 13/32 in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 324 lb. with hub and accessories. WEIGHT PER HP: 1.97 lb.

PERFORMANCE

TAKE-OFF POWER: 165 hp at 2,800 rpm. CRUISE: 124 hp at 2,800 rpm. FUEL CONSUMPTION: .5 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-6. IGNITION. Dual Scintilla S6RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: AC.

MODEL: Franklin 4A4-100-B3.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 239.

SPECS

LENGTH: 27 15/16 in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 225 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 230 lb. with hub and accessories. WEIGHT PER HP: 2.3 lb.

PERFORMANCE

TAKE-OFF POWER: 100 hp at 2,550 rpm. CRUISE: 75 hp at 2,320 rpm. FUEL CONSUMPTION: .5 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA3SPA. IGNITION: Dual Eisemann LA-4. STARTER: Auto Lite or Delco-Remy. GENERATOR: Auto Lite or Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: Franklin 6V4-200-C32, C33.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 244.

SPECS

LENGTH: 29 1/32 in. FUEL GRADE: 91 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 8.5:1. DRY WEIGHT: 333 lb. with hub and accessories. WEIGHT PER HP: 1.66 lb.

PERFORMANCE

TAKE-OFF POWER: 200 hp. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION: Dual Scintilla S6-RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: Weldon.

REMARKS

This model was designed for helicopter installations.

MODEL: Franklin 6V4-178-B32 and B-33.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed; hp 178; CAA TYPE CERTIFICATE: 244.

SPECS

LENGTH: 34¾ in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 308 lb. with hub and accessories. WEIGHT PER HP: 1.73 lb.

PERFORMANCE

TAKE-OFF POWER: 178 hp. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION. Dual Scintilla S6RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: Weldon.

MODEL: Franklin 6A4-150-B3.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

SPECS

LENGTH: 37⅝ in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 321 lb. with hub and accessories. WEIGHT PER HP: 2.14 lb.

PERFORMANCE

TAFE-OFF POWER: 150 hp at 2,600 rpm. CRUISE: 113 hp at 2,350 rpm. FUEL CONSUMPTION: .5 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA-3SPA. IGNITION: Dual Eisemann LA-6 or Scintilla S6RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: Franklin 6V6-245-B16F.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 258.

SPECS

LENGTH: 39 7/32 in. FUEL GRADE: 80 octane. BORE: 4.75 in. STROKE: 4 in. DISPLACEMENT: 425 cu. in. COMPRESSION RATIO: 7.5:1. DRY WEIGHT: 353 lb. with hub and accessories. WEIGHT PER HP: 2.26 lb.

PERFORMANCE

TAKE-OFF POWER: 245 hp at 3,275 rpm. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix PS-7BD. IGNITION: Dual Eisemann LA-6.

REMARKS

Used in Sikorsky helicopters.

ALLISON DIVISION
GENERAL MOTORS CORP.
Indianapolis, Ind.

MODEL: J33-A-16.

TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 49.5 in. LENGTH: 99.25 in. WEIGHT: 1,945 lb. FUEL GRADE: AN-F-48.

REMARKS

All other data restricted. Used in Grumman F9F-4 Panther.

MODEL: J33-A-31.

TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 49.5 in. LENGTH: 107 in. WEIGHT: 1,795 lb. COMPRESSION RATIO: 4.41:1. AIR MASS FLOW: 87 lb. per sec. EXHAUST TEMP.: 1,240 deg. F. FUEL GRADE: JP-3. FUEL CONSUMPTION: 1.12 lb. per lb. per hr.

Allison J-33-A-33 is equipped with long afterburner for bursts of added power in Lockheed F-94

PERFORMANCE

TAKE-OFF: 5,400 lb. at 11,750 rpm with water injection, 4,600 lb. at 11,750 rpm dry. NORMAL: 3,900 lb. at 11,250 rpm. CRUISE: 3,160 lb. at 10,575 rpm.

MODEL: J33-A-33.

TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 49.5 in. LENGTH: 103 in. WEIGHT: 1,895 lb. COMPRESSION RATIO: 4.41:1. AIR MASS FLOW: 87 lb. per sec. EXHAUST TEMP.: 1,275 deg. F. FUEL GRADE: JP-3. FUEL CONSUMPTION: 1.16 lb. per lb. per hr.

PERFORMANCE

TAKE-OFF: 4,600 lb. at 11,750 rpm. NORMAL: 3,900 lb. at 11,250 rpm. CRUISE: 3,160 lb. at 10,575 rpm. Rating with afterburning classified.

REMARKS

Model is equipped with afterburner, which increases length to 213 in. and weight to 2,465 lb. It is used in Lockheed F-94A all-weather fighter.

MODEL J33-A-35.

TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 49.5 in. LENGTH: 107 in. WEIGHT: 1,820 lb. COMPRESSION RATIO: 4.41:1. AIR MASS FLOW: 87 lb. per sec. EXHAUST TEMP.: 1,265 deg. F. FUEL GRADE: J-P3. FUEL CONSUMPTION: 1.14 lb. per lb. per hr.

PERFORMANCE

TAKE-OFF: 5,400 lb. at 11,750 rpm with water injection, 4,600 lb. at 11,750 rpm dry. NORMAL: 3,900 lb. at 11,250 rpm. CRUISE: 3,160 lb. at 10,575 rpm.

REMARKS

Used in Lockheed T-33 and TO-2 two-seat jet trainers.

MODEL: J35-A-21A.

TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 37 in. LENGTH: 138 in. WEIGHT: 2,230 lb. COMPRESSION RATIO: 4.9:1. AIR MASS FLOW: 85 lb. per sec. EXHAUST TEMP.: 1,300 deg. F. FUEL GRADE: JP-3. FUEL CONSUMPTION: 1.115 lb. per lb. per hr.

PERFORMANCE

TAKE-OFF: 5,100 lb. at 7,900 rpm. NORMAL: 4,400 lb. at 7,500 rpm. CRUISE: 3,510 lb. at 7,050 rpm.

REMARKS

Afterburner equipped, increasing weight to 2,695 lb. and length to 196 in. Used in Northrop F-89A all-weather fighter.

MODEL: J35-A-29.

TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 37 in. LENGTH: 146 in. WEIGHT: 2,305 lb. COMPRESSION RATIO: 5.1:1. AIR MASS FLOW: 90 lb. per sec. FUEL GRADE: JP-3. FUEL CONSUMPTION: 1.03 lb. per lb. per hr.

PERFORMANCE

TAKE-OFF: 5,600 lb. at 8,000 rpm. NORMAL: 4,900 lb. at 7,650 rpm. CRUISE: 4,410 lb. at 7,400 rpm.

REMARKS

Used in Republic F-84G long-range Thunderjet fighter.

MODEL: T38-A-4.

SPECS

DIAMETER: 40 in. LENGTH: 149 in. WEIGHT: 1,650 lb. AIR MASS FLOW: 30 lb. per sec. COMPRESSOR: 17-stage axial. TURBINE: 4-stage axial. FUEL GRADE: Mil-F-5624. FUEL CONSUMPTION: 0.603 lb. per hp. hr. OIL CONSUMPTION: 2.5 lb. per hr.

PERFORMANCE

TAKE-OFF: 2,750 ESHP at 14,300 rpm.

REMARKS

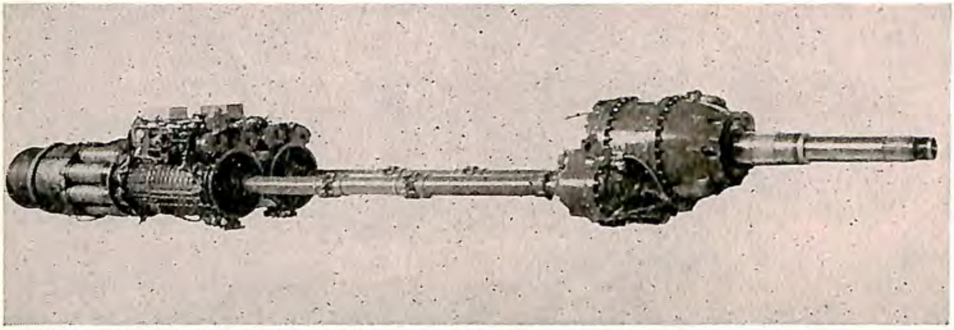
Used in Convair Turbo-Liner, first U. S. turboprop-powered transport.

MODEL: T40-A-6, -10.

TYPE: Axial-flow turboprop.

SPECS

LENGTH: 185 in. WIDTH: 45 in. HEIGHT: 45 in. WEIGHT: 2,575 lb. COMPRESSOR: 19-stage, axial-flow. TURBINE: 4-stage, axial-flow. AIR MASS FLOW: 60 lb. per sec. FUEL GRADE: AN-F-48A. FUEL CONSUMPTION: 0.603 lb. per hp. hr. OIL CONSUMPTION: 4 lb. per hr.



Allison T-40-A-2 turboprop has dual power unit, single gear box for counter-rotating props

PERFORMANCE

TAKE-OFF: 5,500 ESHP at 14,300 rpm.

REMARKS

Model -6 is used in Douglas A2D Skyshark carrier bomber. The model -10 is similar, except for relocation of accessories, and is used in the Convair R3Y flying boat.

MODEL: T40-A-4 (500)

TYPE: Axial-flow turboprop.

SPECS

LENGTH: 248 in. WIDTH: 43 in. HEIGHT: 31 in. WEIGHT: 2,618 lb. COMPRESSOR: 17-stage, axial-flow. TURBINE: 4-stage, axial-flow. AIR MASS FLOW: 60 lb. per sec. FUEL GRADE: AN-F-28. FUEL CONSUMPTION: 0.640 lb. per hp. hr. OIL CONSUMPTION: 4 lb. per hr.

PERFORMANCE

TAKE-OFF: 5,500 ESHP at 14,300 rpm.

REMARKS

Used in Convair XP5Y-1, prototype of R3Y transport flying boat.

CONTINENTAL MOTORS CORPORATION

Muskegon, Mich.

MODEL: A65-8F.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 205.

SPECS

LENGTH: 30.41 in. FUEL GRADE: 73 octane. BORE: 3.875 in. STROKE: 3.625 in. DISPLACEMENT: 171 cu. in. COMPRESSION RATIO: 6.3:1. DRY WEIGHT: 176 lb. with hub and accessories. WEIGHT PER HP: 2.7 lb.

PERFORMANCE

TAKE-OFF POWER: 65 hp at 2,350 rpm. CRUISE: 53 hp at 2,150 rpm. FUEL CONSUMPTION: .49 lb. per hp hr.

EQUIPMENT

CARBURETOR: Stromberg NA-S3B. IGNITION: Eisemann AM4 or J. I. Case 4-CAM. FUEL PUMP: A. C. Spark Plug Co.

MODEL: C85-12F.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 233.

SPECS

LENGTH: 32 in. FUEL GRADE: 73 octane. BORE: 4.062 in. STROKE: 3.625 in. DISPLACEMENT: 188 cu. in. COMPRESSION RATIO: 6.3:1. DRY WEIGHT: 182 lb. with hub and accessories. WEIGHT PER HP: 2.14 lb.

PERFORMANCE

TAKE-OFF POWER: 85 hp at 2,575 rpm. CRUISE: 63 hp at 2,400 rpm. FUEL CONSUMPTION: 5.4 gal. per hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg NA-S3A1. IGNITION: Scintilla S4LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: C90-12F.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 252.

SPECS

LENGTH: 31¼ in. FUEL GRADE: 80 octane. BORE: 4.062 in. STROKE: 3.875 in. DISPLACEMENT: 200.91 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 186 lb. with hub and accessories. WEIGHT PER HP: 2.07 lb.

PERFORMANCE

TAKE-OFF POWER: 90 hp at 2,475 rpm. CRUISE: 68 hp at 2,350 rpm. FUEL CONSUMPTION: .52 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg NA-S3A1. IGNITION: Scintilla S4LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL C125-2.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 236.

SPECS

LENGTH: 41 in. FUEL GRADE: 73 octane. BORE: 4.062 in. STROKE: 3.625 in. DISPLACEMENT: 282 cu. in. COMPRESSION RATIO: 6.3:1. DRY WEIGHT: 257 lb. with hub and accessories. WEIGHT PER HP: 2.05 lb.

PERFORMANCE

TAKE-OFF POWER: 125 hp at 2,550 rpm. CRUISE: 98 hp at 2,400 rpm. FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel MA-3SPA. IGNITION: Scintilla S6LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: C145-2.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 253.

SPECS

LENGTH: 41 in. FUEL GRADE: 80 octane. BORE: 4.062 in. STROKE: 3.875 in. DISPLACEMENT: 301.37 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 265 lb. WEIGHT PER HP: 1.77 lb.

PERFORMANCE

TAKE-OFF POWER: 145 hp at 2,700 rpm; CRUISE: 108 hp at 2,450 rpm; FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel MA-3SPA. IGNITION: Scintilla S6LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: E185.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 246.

SPECS

LENGTH: 46.66 in. FUEL GRADE: 80 octane. BORE: 5 in. STROKE: 4 in. DISPLACEMENT: 471 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 350 lb. WEIGHT PER HP: 1.89 lb.

PERFORMANCE

TAKE-OFF POWER: 205 hp at 2,600 rpm. CRUISE: 130 hp at 2,050 rpm. FUEL CONSUMPTION: .5 lb. per hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5C. IGNITION: Scintilla S6LN-21. STARTER: Provisions for direct cranking starter. GENERATOR: Delco-Remy. FUEL PUMP: Thompson or Romec. This engine also available with full AN accessory section.

MODEL: E-225.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 267.

SPECS

LENGTH: 48.4 in. FUEL GRADE: 80/86 octane.. BORE: 5 in. STROKE: 4:00 in.

PERFORMANCE

TAKE-OFF POWER: 225 hp at 2,650 rpm. CRUISE: 170 hp at 2,400 rpm. FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5C. IGNITION: Scintilla S6LN-21. STARTER: Eclipse Type 397-13. GENERATOR: Delco-Remy. FUEL PUMP: Romec. This engine also available with full AN accessory section.

MODEL O-315.

DATA

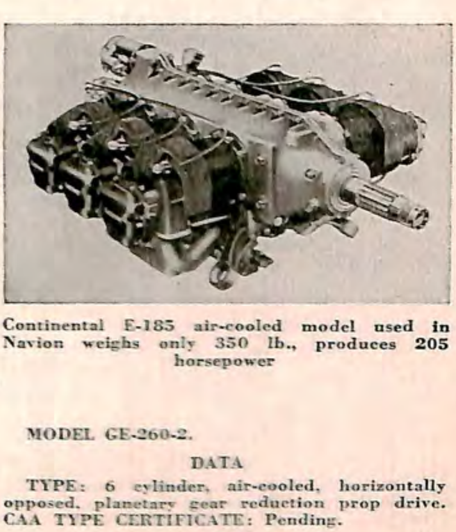
TYPE: 4 cylinder, air-cooled, horizontally opposed.

SPECS

FUEL GRADE: 80/86 octane. BORE: 5 in. STROKE: 4 in. DISPLACEMENT: 315 cu. in. COMPRESSION RATIO: 7:1 DRY WEIGHT: 287 lbs. WEIGHT PER HP: 1.91 lbs.

PERFORMANCE

NORMAL RATED POWER: 150 hp at 2,600 rpm. CRUISE: 115 hp at 2400 rpm. FUEL CONSUMPTION: .5 lb. per hp hr.



Continental E-185 air-cooled model used in Navion weighs only 350 lb., produces 205 horsepower

MODEL GE-260-2.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed, planetary gear reduction prop drive. CAA TYPE CERTIFICATE: Pending.

SPECS

LENGTH: 50.4 in. FUEL GRADE: 80/86 octane. BORE: 5 in. STROKE: 4 in. DISPLACEMENT: 471 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 431 lbs. WEIGHT PER HP: 1.66 lbs.

PERFORMANCE

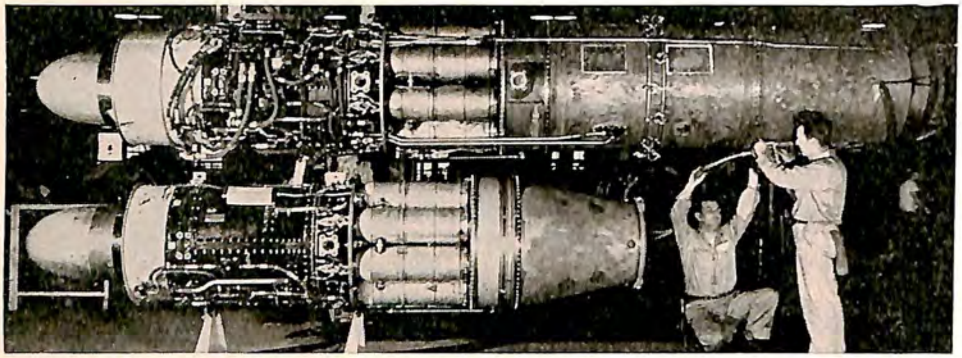
TAKE-OFF POWER: 260 hp at 3,100 rpm. CRUISE: 195 hp at 2,700 rpm. Prop drive reduction ratio .69:1. FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5C. IGNITION: Scintilla S6LN-21. STARTER: Eclipse. GENERATOR: Delco-Remy . FUEL PUMP: Romec. This engine also available with full AN accessory section.

GENERAL ELECTRIC CO.

Schenectady, N. Y.



General Electric J47-GE-17 with afterburner compares length with standard J47-GE-11 model below

MODEL: J47-GE-11, 13, 15.

SPECS

WEIGHT: 2,500 lb. (approx.). FRONTAL AREA: 7.35 sq. ft. LENGTH: 144 in. DIAMETER: 36.75 in. COMPRESSOR: 12 stage axial flow. COMPRESSION RATIO: 5:1. TURBINE: single stage. INLET AIR FLOW: 90 lb. per sec. FUEL GRADE: AN-F-58 or 100/130 gasoline.

PERFORMANCE

TAKE-OFF THRUST: Over 5,200 lb. at 7,950 rpm at sea level. NORMAL RATING: 4,320 lb. at 7,370 rpm. CRUISE RATING: 3,700 lb. at 7,000 rpm.

MODEL: J47-GE-17, 23

The -17 engine is the standard production model redesigned to reduce its use of strategic materials by using substitute materials wherever possible. This redesign resulted in a saving of about 20 percent in special metals used previously. In addition, the engine is equipped with a long afterburner assembly. This auxiliary unit provides a substantial increase in thrust for short periods by the injection of raw fuel into the hot tailpipe gases, resulting in additional fuel consumption. The -23 engine features special anti-icing equipment and a special ignition system making starts possible at altitudes of more than 50,000 ft.

JACOBS AIRCRAFT ENGINE CO.

Pottstown. Pa.

MODEL: R-755A Series.

DATA

TYPE: 7 cylinder, air-cooled. CAA TYPE CERTIFICATE: 237.

SPECS

DIAMETER: 44 in. LENGTH: 39.5 in. FUEL GRADE: 80 octane. BORE: 5.25 in. STROKE: 5 in. DISPLACEMENT: 757 cu. in. COMPRESSION RATIO: 6:1. DRY WEIGHT: 505 lb. WEIGHT PER HP: 1.68 lb.

PERFORMANCE

TAKE-OFF POWER: 300 hp at 2,200 rpm. FUEL CONSUMPTION: .45 lb. per hp hr. OIL CONSUMPTION: .010 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg NA-R7A IGNITION: 1 Scintilla VMN-7DF5, 1 Scintilla W67A distributor with coil. STARTER: Eclipse. GENERATOR: Eclipse.

REMARKS

Used in Cessna 195 aircraft.

LYCOMING-SPENCER DIVISION

AVCO MFG. CORP.

Williamsport, Pa.

MODEL: O-235-C1.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed; 115 hp. CAA TYPE CERTIFICATE: 223.

SPECS

LENGTH: 29.56 in. FUEL GRADE: 80 octane. BORE: 4.375 in. STROKE: 3.875 in. DISPLACEMENT: 233.3 cu. in. COMPRESSION RATIO: 6.75:1. DRY WEIGHT: 236

lb. with hub and accessories. WEIGHT PER HP: 2.05 lb.

PERFORMANCE

TAKE-OFF POWER: 115 hp 2,800 rpm. CRUISE: 86 hp at 2,350 rpm. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .012 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA-3A. IGNITION: Dual Scintilla S4LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

MODEL: GO-435-C2

DATA

TYPE: 6-cylinder, horizontally-opposed, geared, air-cooled. APPROVED TYPE CERTIFICATE No. 228.

SPECS

LENGTH: 39.57 in. HEIGHT: 29.59 in. WIDTH: 33.12 in. BORE: 4.875 in. STROKE: 3.875 in. DISPLACEMENT: 434 cu. in. COMPRESSION RATIO: 7.3:1. WEIGHT: 432 lb. FUEL GRADE: 91/98.

PERFORMANCE

TAKE-OFF POWER: 260 hp at 3,400 rpm. RATED POWER: 240 hp at 3,000 rpm. FUEL CONSUMPTION: 0.47 lb. per hp. hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA-4-5. MAGNETOS: Scintilla SF6LN-8. SPARK PLUGS: Autolite SH-2K.

MODEL: O-435-A.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 228.

SPECS

LENGTH: 38.10 in. FUEL GRADE: 80 octane. BORE: 4.875 in. STROKE: 3.875 in. DISPLACEMENT: 434 cu. in. COMPRESSION RATIO: 6.5:1. DRY WEIGHT: 392 lb. with hub and accessories. WEIGHT PER HP: 2.06 lb.

PERFORMANCE

TAKE-OFF POWER: 190 hp at 2,550 rpm. CRUISE: 145 hp at 2,300 rpm. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .0012 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel Schebler MA-4-5. IGNITION: Dual Scintilla SFGLN-8. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

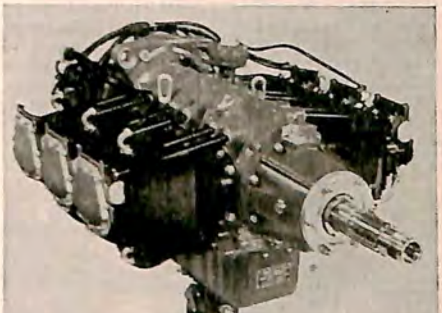
MODEL: O-290-D.

DATA

TYPE: 4-cylinder, horizontally-opposed, direct-drive, air-cooled. APPROVED TYPE CERTIFICATE No. 229.

SPECS

LENGTH: 29.56 in. HEIGHT: 22.81 in.



Lycoming GO-435-C2

WIDTH: 32.32 in. BORE: 4.875 in. STROKE: 3.875 in. DISPLACEMENT: 289 cu. in. COMPRESSION RATIO: 6.50:1. WEIGHT: 255 lb. FUEL GRADE: 80 octane.

PERFORMANCE

TAKE-OFF POWER: 130 hp at 2,800 rpm. RATED POWER: 125 hp at 2,600 rpm. FUEL CONSUMPTION: 0.49 lb. per hp. hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA-3SPA. MAGNETOS: Scintilla S4LN-20/21. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

PRATT & WHITNEY AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORP.

East Hartford, Conn.

MODEL: Wasp Jr. B Series, (R-985).

DATA

TYPE: 9 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 123.

SPECS

DIAMETER: 46.10 in. LENGTH: 47.69 in. FUEL GRADE: 80/87. BORE: 5.187 in. STROKE: 5.187 in. DISPLACEMENT: 985 cu. in. COMPRESSION RATIO: 6:1. DRY WEIGHT: 684 lb., maximum.

PERFORMANCE

TAKE-OFF POWER: 450 hp at 2,300 rpm. FUEL CONSUMPTION: 0.575 lb. per hp hr. OIL CONSUMPTION: .025 lb. per hp hr.

EQUIPMENT

CARBURETOR: Stromberg NA-R9B. IGNITION: Dual Scintilla SB9R.

MODEL: Wasp H Series, (R-1340).

DATA

TYPE: 9 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: This series is manufactured under the following type certificates: 129 and 143 (See Remarks).

SPECS

DIAMETER: 51.8 in. LENGTH: 43.01 in. FUEL GRADE: 91/98. BORE: 5.75 in. STROKE: 5.75 in. DISPLACEMENT: 1,344 cu. in. COMPRESSION RATIO: 6:1. DRY WEIGHT: 865 lb.

PERFORMANCE

TAKE-OFF POWER: 600 hp at 2,250 rpm and 3,000 ft. NORMAL RATED POWER: 550 hp at 2,200 rpm and 5,000 ft.

EQUIPMENT

CARBURETOR: Stromberg NA-Y9E1. IGNITION: Dual Scintilla SB9R.

REMARKS

The major differences in the various versions of this model are in engine length. Performance is the same for all models.

DATA

MODEL: Twin Wasp C Series, (R-1830).

TYPE: 14 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 186.

SPECS

DIAMETER: 48.19 in. LENGTH: 61.16 in. FUEL GRADE: 91/98. BORE: 5.5 in. STROKE: 5.5 in. DISPLACEMENT: 1,830 cu. in. COMPRESSION RATIO: 6.7:1. PROP SHAFT: .5625 to 1 ratio. DRY WEIGHT: 1467 lb., maximum.

PERFORMANCE

TAKE-OFF POWER: 1,200 hp at 2,700 rpm and 4,900 ft. NORMAL RATED POWER: 1,050 hp at 2,250 rpm and 7,500 ft.

EQUIPMENT

CARBURETOR: Stromberg PD-12H4. IGNITION: 2 Scintilla SF-14LN-3.

REMARKS

Powers Douglas C-54 military transport, workhorse of World War II, the Berlin Airlift and the 1950-51 Trans-Pacific Airlift in support of the Korean campaign. ......

MODEL: Double Wasp CB Series, (R-2800)

DATA

TYPE: 18 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: to be obtained:

SPECS

DIAMETER: 52.8 in. LENGTH: 81.40 in. FUEL GRADE: 100/130 or 115/145. BORE: 5.75 in. STROKE: 6 in. DISPLACEMENT: 2,804 cu. in. COMPRESSION RATIO: 6.75 to 1. DRY WEIGHT: 2,357 lb., maximum.

PERFORMANCE

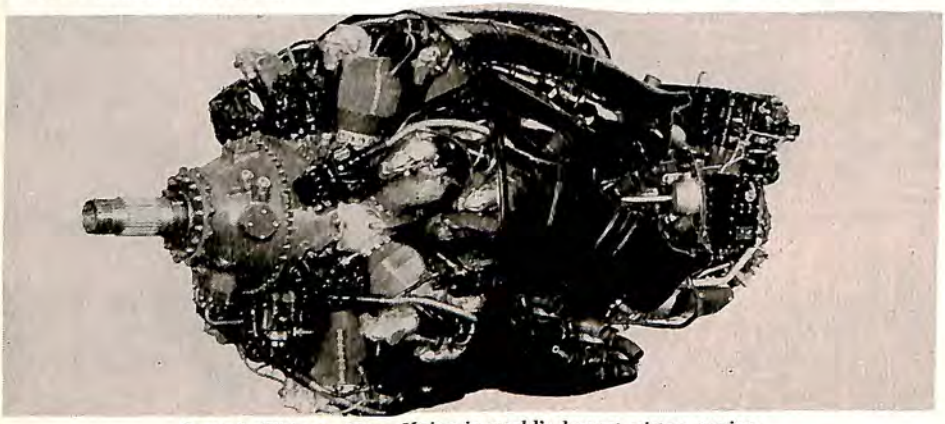
TAKE-OFF POWER: 2,400 hp at 2,800 rpm at 4,000 ft. with water injection; 2,050 hp at 2,700 rpm at 6,000 ft. dry. NORMAL RATED POWER: 1,800 hp at 2,600 rpm at 8,500 ft.

EQUIPMENT

CARBURETOR: Stromberg PR-58E5. IGNITION: Scintilla DLN-10 low tension.

REMARKS

The CB series includes the -3, -4, -16 and -17 models. Essential differences are in supercharger gear ratios and weights. Most other parts are interchangeable. The Double Wasp powers the following production aircraft: Beech T-36, Bell XHSL-1 helicopter, Chase C-123 transport, Convair T-29 trainer, Douglas C-118A cargo, Grumman AF-2S and -2W hunter-killer teams, North American AJ-1 carrier bomber and Vought F4U-5N fighter-bomber. Commercial versions power the Convair 240 and 340 transports, Douglas DC-6, -6A, and -6B transports and Martin 2-0-2A and 4-0-4 transports.



Pratt & Whitney Wasp Major is world's largest piston engine

MODEL: Twin Wasp D Series, (R-2000).

DATA

TYPE: 14 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 230.

SPECS

DIAMETER: 49.1 in. LENGTH: 61.02 in. FUEL GRADE: 100/130. BORE: 5.75 in. STROKE: 5.5 in. DISPLACEMENT: 2,004 cu. in. COMPRESSION RATIO: 6.5:1. DRY WEIGHT: 1585 lb., maximum.

PERFORMANCE

TAKE-OFF: 1,450 at 2,700 rpm and 2,800 ft. NORMAL RATED POWER: 1,200 hp at 2,550 rpm and 6,400.

EQUIPMENT

CARBURETOR: Stromberg PD-12F13. IGNITION: 2 Scintilla SF-14LN-8.

MODEL: Wasp Major B (R-4360).

DATA

TYPE: 28 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 247.

SPECS

DIAMETER: 55 in. LENGTH: 96.5 in. FUEL GRADE: 108/135. BORE: 5.75 in. STROKE:

6 in. DISPLACEMENT: 4,363 cu. in. COMPRESSION RATIO: 6.7:1. DRY WEIGHT: 3,670 lb.

PERFORMANCE

TAKE-OFF POWER: 3,500 hp at 2,700 rpm and 500 ft. (with water); 3,250 hp at 2,700 rpm and 700 ft. (without water). NORMAL RATED POWER: 2,650 hp at 2,550 rpm at 5,500 ft. (high blower).

EQUIPMENT

CARBURETOR: Stromberg PR-100B3. IGNITION: 4 Scintilla S14RN-15 low tension.

REMARKS

Wasp Major is used on Boeing B-50 bomber (4), Convair B-36 bomber (6), Boeing C-97 transport (4), Douglas C-124 transport (4), Convair C-99 transport (6), Fairchild C-119 Packet (2) and the Boeing Stratocruiser commercial transport (4). Development versions of the engine have already produced more than 4,000 hp, the most powerful reciprocating engine in the world.

MODEL: Turbo Wasp JT-6B (J42).

DATA

TYPE: Centrifugal-flow turbojet. CAA TYPE CERTIFICATE No. 260.

SPECS

DIAMETER: 49.5 in. LENGTH: 103.25 in. FRONTAL AREA: 13.36 sq. ft. COMPRESSOR: Double-sided, single-stage, centrifugal. TURBINE: axial-flow, single-stage. TAILCONE: Stainless steel outer cone, fixed inner cone. COMBUSTORS: nine through-flow can-type. WEIGHT: 1,729 lb. FUEL GRADE: 100/130 gasoline.

PERFORMANCE

TAKE-OFF THRUST: 5,750 lb. at 12,300 rpm at sea level with water injection; 5,000 lb. dry. NORMAL RATED THRUST: 4,000 lb. at 11,600 rpm. INLET AIR FLOW: 88 lb. per sec. TAILPIPE TEMPERATURE: 1,365 deg. F at take-off thrust. SPECIFIC THRUST: 300 lb. per sq. ft. frontal area. SPECIFIC WEIGHT: 0.431 lb. per lb. thrust.

EQUIPMENT

IGNITION: Two BG igniter plugs with integral fuel nozzles. FUEL PUMP: Lucas. FUEL CONTROL: Bendix.

REMARKS

The J42, which powers the Grumman F9F-2 Panther, has been authorized by the Navy for 1,000 hours between major overhauls, the first jet engine in the world to attain this mark.

MODEL: Turbo-Wasp PT-2 (T34).

DATA

TYPE: Axial-flow turboprop.

SPECS

DIAMETER: 30.39 in. LENGTH: 155 in. COMPRESSOR: 13-stage axial-flow. TURBINE: three-stage , axial-flow. PROPELLER REDUCTION GEAR: two-stage, 11:1 ratio. WEIGHT: 2,520 lb. FUEL: Kerosene, gasoline or special jet fuel.

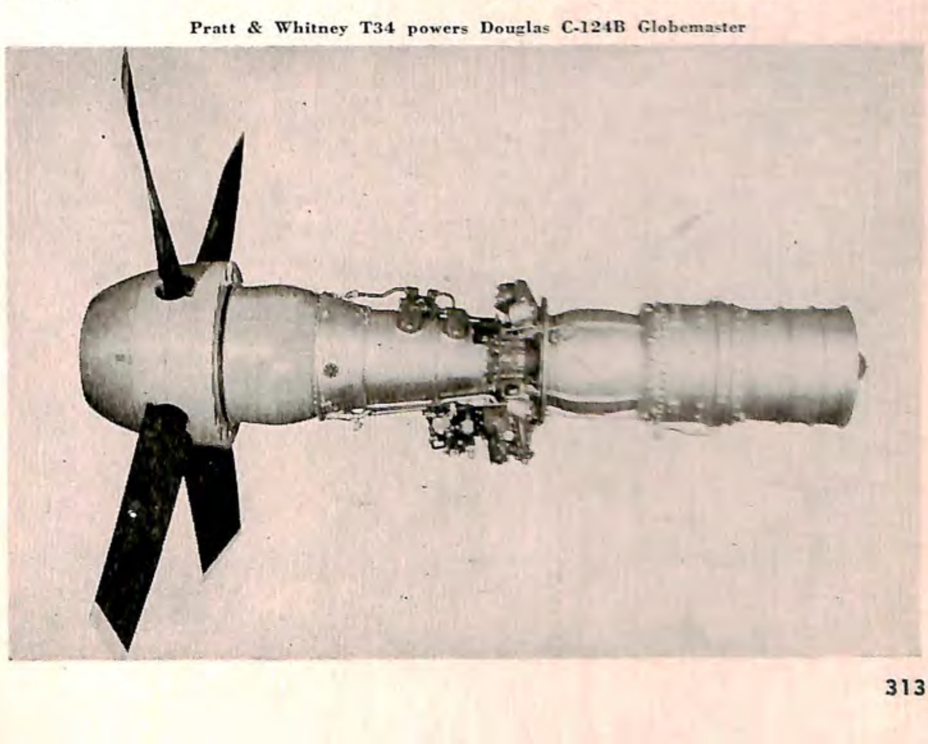
PERFORMANCE

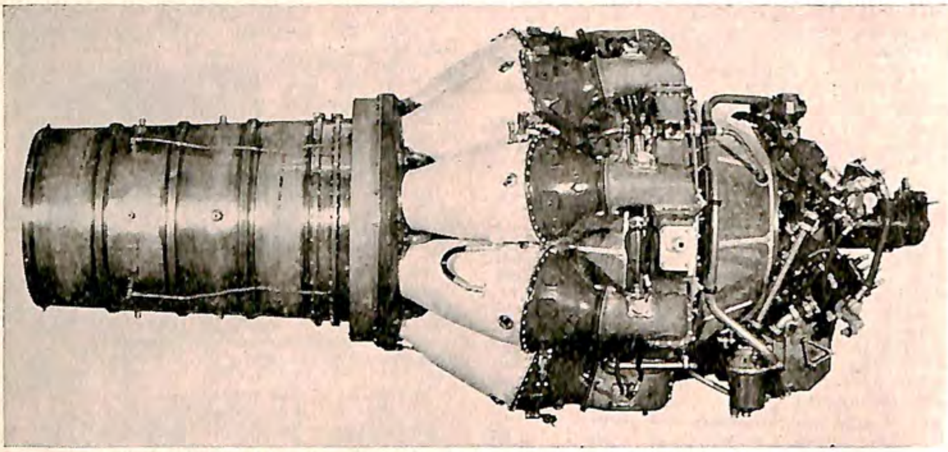
TAKE-OFF POWER: 5,000 to 6,000 hp, depending on equipment. FUEL CONSUMPTION: 0.62 lb. hp hr.

REMARKS

The T34 will be installed in two Lockheed R70-1's for Navy testing program and in the Douglas YC-124B for the Air Force.

Pratt & Whitney T34 powers Douglas C-124B Globemaster





J42 Turbo-Wasp, delivering 5,000 lb. thrust dry, powers Grumman F9F-2 Panther

MODEL: Turbo-Wasp JT-7 (J48).

DATA

TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 50.25 in. LENGTH: 106.75 in. COMPRESSOR: double-sided, single-stage, centrifugal-flow. TURBINE: axial-flow, single-stage. WEIGHT: 2,000 lb. FUEL: kerosene, gasoline or special jet.

PERFORMANCE

STATIC THRUST: 6,250 lb. dry. Thrust is greatly increased using water injection and afterburning but augmented ratings are still classified.

REMARKS

The J48 powers the Grumman F9F-5 Panther now going into service with the Navy and the Lockheed F-94C all-weather interceptor for the Air Force. It will also power the swept-wing Grumman F9F-6.

MODEL: Turbo-Wasp JT-3 (J57).

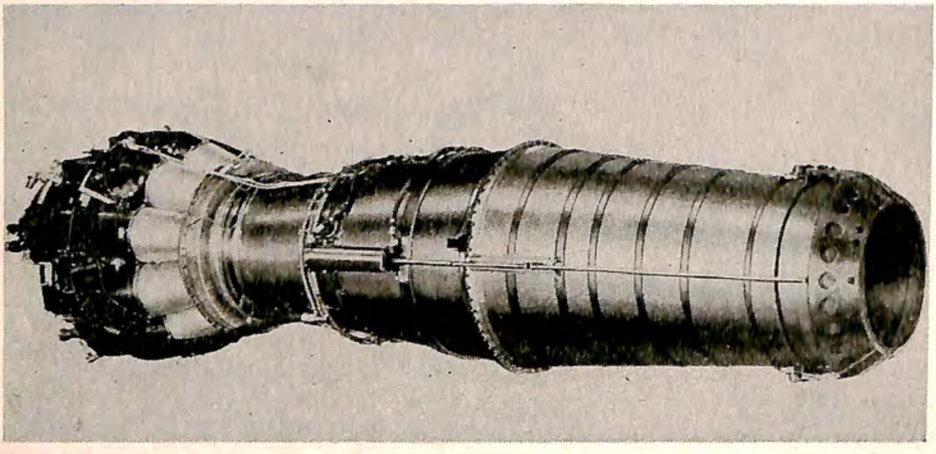
DATA

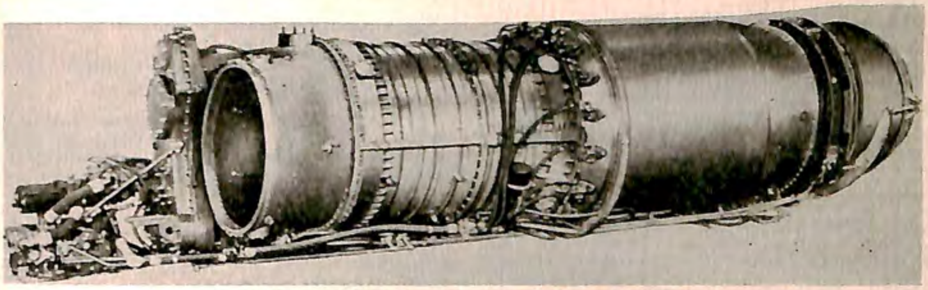
TYPE: Axial-flow turbojet.

REMARKS

Specifications and performance are still classified other than mention that engine is in the 10,000 lb. thrust class. It will power the Boeing B-52 long-range bomber and the Convair YB-60 swept-wing jet version of the familiar B-36.

Pratt & Whitney J48 with afterburner gives added thrust for emergency





Westinghouse J40 is used in new McDonnell F3H fighter

WESTINGHOUSE ELECTRIC CORP.
AVIATION GAS TURBINE DIVISION
Philadelphia, Pa.

Model: J34-WE-34.

TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 24 in. LENGTH: 120 in. TURBINE: two stage, axial-flow. COMPRESSOR: 11-stage, axial-flow. FUEL GRADE: AN-F-84 gasoline. WEIGHT: 1,233 lb.

PERFORMANCE

TAKE-OFF: 3,250 lb. NORMAL: 2,650 lb.

REMARKS

Principal production engine currently being manufactured in quantity at the Kansas City Works of the Aviation Gas Turbine Division. Powers Douglas F3D Skynight and McDonnell XF-88 Voodoo jet fighters. The J34-WE-34 engine is currently in production at the South Philadelphia Works of the company.

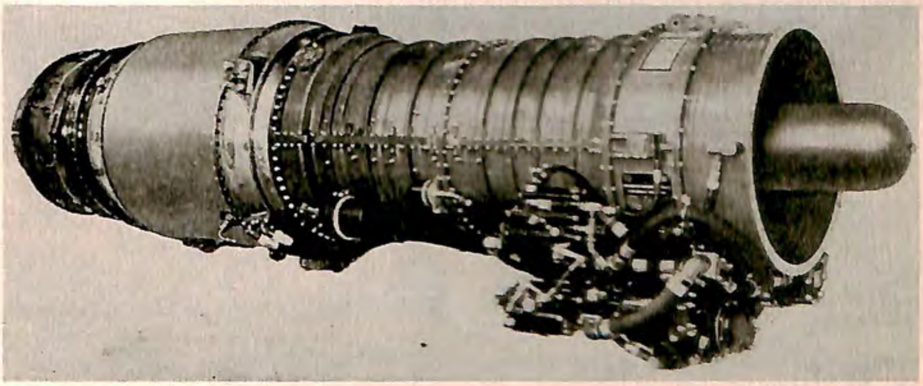
MODEL: J40-WE-6.

TYPE: Axial-flow turbojet.

REMARKS

All specifications and performance are classified. Engine is in production at South Philadelphia Works. Later versions of basic J40 engine are scheduled for production at Kansas City Works and also by Ford Motor Co. at the Lincoln-Mercury Division Gas Turbine Plant.

Westinghouse J34 powers McDonnell F2H Banshee



WRIGHT AERONAUTICAL CORP.
Wood-Ridge, N. J.

MODEL: R-1300-1.

DATA

TYPE: 7 cylinder, air-cooled, radial.

SPECS

LENGTH: 48.12. FUEL GRADE: 91/98 octane. BORE: 6.125 in. STROKE: 6.312 in. DISPLACEMENT: 1,300 cu. in. COMPRESSION RATIO: 6.2:1. DRY WEIGHT: 1,045 lb. WEIGHT PER HP: 1.28 lb.

PERFORMANCE

TAKE-OFF POWER: 800 hp at 2,600 rpm. CRUISE: 420 hp. FUEL CONSUMPTION: .48 lb. per hp hr OIL CONSUMPTION: .015 lb. per hp hr.

EQUIPMENT

CARBURETOR: Stromberg PD9F1. IGNITION: Dual Bosch SF7LU-2.

PERFORMANCE

TAKE-OFF POWER: 2,700 hp at 2,900 rpm. NORMAL RATED POWER: 1,900 hp. FUEL CONSUMPTION: .43 lb. per hp hr. OIL CONSUMPTION: .020 lb. per hp hr.

EQUIPMENT

CARBURETOR: Stromberg PR58U1. IGNITION: Dual Bosch DF 18LU-3.

REMARKS

The R-3350-30W is a compound version of the R-3350-26W using three small turbines driven by exhaust gas and connected by fluid couplings to the crankshaft. This increases the take-off power to 3,250 hp. Ignition system is Scintilla DLN-9; the carburetor, Stromberg PR58T1.

MODEL: 736C9HD3 (R-1820-76A).

DATA

TYPE: 9 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 243.

SPECS

LENGTH: 47.69 in. FUEL GRADE: 100/130. BORE: 6.125 in. STROKE: 6.875 in. DISPLACEMENT: 1,820 cu. in. COMPRESSION RATIO: 6.8:1. DRY WEIGHT: 1,365 lb. WEIGHT PER HP: .99 lb.

PERFORMANCE

TAKE-OFF POWER: 1,425 hp at 51.5 in. Hg. 2,700 rpm. CRUISE: 890 hp at 33 in. Hg., 2,300 rpm. FUEL CONSUMPTION: .46 lb. per hp hr. at 60% power. OIL CONSUMPTION: .020 lb. per hp hr. at 89% power.

EQUIPMENT

CARBURETOR: Stromberg PD12K14. IGNITION: Dual Scintilla S9LU-5.

REMARKS

This engine is the latest in a long line of 1820 cu. in. power-plants that were first introduced more than ten years ago. This model is also built with 2-speed supercharger and optional reduction gear ratios.

MODEL: 749C18BD1 (R-3350-24W).

DATA

TYPE: 18 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 218.

SPECS

LENGTH: 78.52 in. FUEL GRADE: 100/130. BORE: 6.125 in. STROKE: 6.3125 in. DISPLACEMENT: 3,350 cu. in. COMPRESSION RATIO: 6.5:1. DRY WEIGHT: 2,884 lb. WEIGHT PER HP: 1.1 lb.

PERFORMANCE

TAKE-OFF POWER: 2,500 hp at 2,800 rpm. CRUISE: 1,470 hp at 2,300 rpm. FUEL CONSUMPTION: .46 lb. per hp hr. OIL CONSUMPTION: .015 lb. per hp hr.

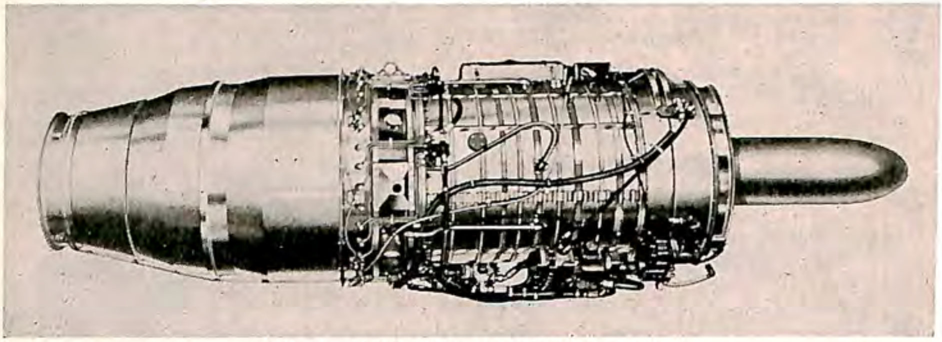
EQUIPMENT

IGNITION: Scintilla DLN-9. CARBURETION: Bendix No. 135091 direct fuel injection.

MODEL: R-3350-26W.

DATA

TYPE: 18 cylinder, air-cooled, radial.



Wright J65 Sapphire is British designed

SPECS

LENGTH: 81.93 in. FUEL GRADE: 115/145. BORE: 6.125 in. STROKE: 6.312 in. DISPLACEMENT: 3,350 cu. in. COMPRESSION RATIO: 6.5:1. DRY WEIGHT: 2,848 lb. WEIGHT PER HP: 1.05 lb.

MODEL: J65-W-1.

TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 37.3 in. LENGTH: 133.85 in. WEIGHT: 2,500 lb. FRONTAL AREA: 6.78 sq. ft. FUEL ONSUMPTION: 0.915 lb. per lb. per hr.

PERFORMANCE

TAKE-OFF: 7,220 lb.

REMARKS

Built under license from Armstrong-Siddeley, the Sapphire turbojet is slated for use in the Martin-built Canberra intruder, the Republic F-84F swept-wing Thunderjet and other new aircraft.

1951 DAY BY DAY CHRONOLOGY

(NOTE: The following chronology is condensed principally from *American Aviation Daily*, only daily in the aviation field; published by American Aviation Publications, Inc., Wayne W. Parrish, Editor.)

JANUARY

Jan. 3

President Truman creates Defense Production administration to be headed by William H. Harrison and to operate within framework of the Office of Defense Mobilization under Charles E. Wilson.

Senate completes action on Second Supplemental appropriation for defense, allowing additional $4.6 billion for Air Force; President signs Excess Profits Tax bill.

Jan. 4

Air Transport Association reports airline traffic gains in 1950 comparable to or greater than in record 1949.

New official world altitude record of 30,203 feet for Class II aircraft is set by Miss Caro Bayley at Miami, flying a 2-place Piper Super Cub Model PA-18 (125 hp Lycoming).

Jan. 5

Responsibility for issuing civil air transport DO (Defense Order) ratings is placed in hands of CAA.

Air Force plans to expand Fairchild C-119 production at the company's Hagerstown, Md. plant: final arrangements are completed for Kaiser-Frazer Corp. to build the plane at Willow Run, Detroit.

Jan. 8

UAW-CIO workers strike at Fairchild Aircraft Division.

Chrysler Corp. negotiates with Pratt & Whitney Aircraft Div. to build J-48 Turbo-Wasp jet engines.

President proposes expanding military plane production capacity to 50,000 per year.

Gordon M. Bain is named Director of CAB's Bureau of Air Operations.

Jan. 9

Aircraft Industries Association's Personal Aircraft Council reports that 1950 sales of personal aircraft topped 1949.

Jan. 11

Civil Aeronautics Board and military in agreement on wartime expansion of civil air transport, reports CAB Chairman D. W. Rentzel.

Air Coordinating Committee sets up four claimant agencies for civil aircraft and spares: CAB, CAA, Economic Cooperation Administration and Office of International Trade.

Jan. 17

Lt. Gen. Idwal H. Edwards, Deputy Chief of Staff, Operations, AF, confirms strength goal at between 95 and 100 groups.

Convair RB-36D reconnaissance bomber makes 51 hr. 20 min. non-stop flight without refuelling.

Jan. 19

Allison Div., General Motors Corp., receives $23 million Navy contract for T-40 turbo-prop engines.

Eric Johnston succeeds Alan Valentine as Economic Stabilization Administrator.

Jan. 23

Joseph P. Adams, Seattle attorney, nominated as member of the Civil Aeronautics Board, succeeding Russell B. Adams.

NACA reports that most research during the past year was directed toward problems of supersonic flight.

Jan. 22

Kaiser-Frazer receives subcontract from Lockheed Aircraft Corp. to build P2V sub-assemblies.

Jan. 25

Air Line Pilots Association asks higher pilot pay due to increased productivity of equipment they fly.

Air Force opens bids on three new flight training schools.

Secretary of Defense George C. Marshall announces establishment of Industry Advisory Committee on Traffic Matters under chairmanship of Francis X. Dunleavy.

Jan. 29

Hudson Motor Car Co. to manufacture Wright R-3350 piston engines; Packard Motor Co. negotiates to build General Electric J-47 jet engines.

Piasecki Helicopter Corp. places order with Sperry Gyroscope Co. for automatic pilots for helicopters.

Aeroproducts Division, GMC, gets production order for propellers for Fairchild C-119's.

Curtiss-Wright Co. creates new division to expand electronics field.

Avery McBee replaces Bert Goss as Director of Public Relations for the Aircraft Industries Association.

Jan. 30

Air Force has now issued contracts on over 90 percent of fiscal 1951 plane procurement.

Navy confirms successful first flight test of Douglas XF4D-1.

FEBRUARY

Feb. 1

Grand Central Airport Co. is awarded $19.2 million contract for reconditioning Boeing B-29's.

Republic Aviation Corp. begins F-84E jet fighter deliveries to North Atlantic Treaty nations.

Feb. 2

Aircraft Industries Association reports Brazil as leading foreign buyer of U. S. lightplanes.

Wright Aeronautical Corp. confirms use of its R-3350 engine in Fairchild C-119 Packet.

Feb. 5

Senate confirms nomination of Joseph P. Adams, Seattle attorney, as member of Civil Aeronautics Board; will be sworn in Feb. 6th.

Joseph J. O'Connell, Jr. named president of newly-formed Aviation Executives club.

Air Force places $14 million contracts with Lockheed Aircraft Corp. for unspecified aircraft.

Feb. 6

Wright Aeronautical Corp. confirms new engine license deals with Hudson Motor Car Co., Kaiser-Frazer Corp. and Lycoming-Spencer Div. to assist in their expanded production program.

Maj. Gen. William H. Tunner is relieved as commanding general of the Far East Air Force's Combat Cargo Command for reassignment; Brig. Gen. John P. Henebry replaces him.

Feb. 7

Link Aviation, Inc. receives $10 million Air Force contract for C-11A jet fighter trainers.

Feb. 12

Buick Motor Div. of General Motors Corp. is licensed by Wright Aeronautical Corp. to build Wright's J-65 British-designed Sapphire jet engine. The J-65 will power Republic's F-84F.

Lockheed Aircraft Corp. reports it's F-80's flew 26,356 sorties, dropped 1,662 tons of bombs and fired 49,873 rockets in Korea during the first seven months of combat (through January).

Feb. 13

Pan-American-Grace Airways Douglas DC-6 sets new record of 9 hr. 53 min. for 2,734-mile flight from Miami to Lima, Peru.

Douglas Aircraft Co. receives $12 million AF contract for airplanes; North American Aviation gets $4.8 million contract for aircraft spare parts; and Beech Aircraft Co. receives $4.9 million award for jettisonable fuel tanks.

Feb. 14

Republic Aviation Corp.'s F-84F swept-wing version of the Thunderjet, with Wright J-65 Sapphire jet engine, completes first flight at Edwards AFB, Muroc, Calif.

Feb. 16

Link Aviation, Inc. receives $6 million order for Northrop F-89C simulators from Air Force; Navy places $7 million order with Continental Aviation & Engineering Corp. for helicopter engines.

CAB reports that domestic trunk airlines traffic in December topped December, 1949, by 42.5 percent.

Feb. 19

Douglas Aircraft Co. receives $11.5 million facilities contract for B-47 production.

Feb. 26

Defense Mobilization Chief Charles E. Wilson asks production capacity of 18,000 jet engines per month.

Feb. 27

Robert Ramspeck, executive vice president of Air Transport Asociation, is nominated by President Truman as chairman of Civil Service Commission, succeeding Harry B. Mitchell.

Boeing Airplane Co. delivers first model of a new C-97 Stratofreighter series, the C-97C, to the Air Force.

Feb. 28

Harold A. Jones resigns CAB membership; President Truman nominates Sen. Chan Gurney (R., S.C.) to replace him.

Curtiss-Wright Corp. discloses its new hot-extrusion process for manufacturing steel propeller blades at showing in New York.

MARCH

Mar. 1

Executive order places new responsibilities in civil aviation mobilization on Commerce; CAB Chairman Delos W. Rentzel to be named Undersecretary of Commerce to carry out the new duties.

Rear Adm. Alfred M. Pride, chief of Navy BuAer is replaced by Rear Adm. Thomas S. Coombs.

Secretary of Air Force Finletter reports that the Boeing B-52 has been ordered into production for possible delivery late this year; he also discloses that the USAF will go ahead with jet version of the Convair B-36 and that the British English Electric B-2 Canberra will be built by Glenn L. Martin Co.

Mar. 2

American Aviation magazine reports well over $100 million let in military overhaul business since outbreak of Korean hostilities; another $251 million already funded by USAF for additional work and contracts.

Mar. 5

Gilfillan Brothers, Inc. develop new device to track three aircraft simultaneously from a distance of about five miles from the end of a runway.

Mar. 7

CAB tightens restrictions on route service by non-skeds but broadens military contract authority.

Lt. Gen. James Doolittle is named special part time consultant to Gen. Hoyt S. Vandenberg, Air Force Chief of Staff.

Mar. 12

CAA's Prototype Aircraft Advisory Committee will ask $2 million to test North American's B-45 jet bomber, the Convair Turboliner, the Chase C-122 and one large transport type helicopter.

C. S. (Casey) Jones, president of the Academy of Aeronautics, is named president of the National Air Council.

Edwards AFB Rocket Branch designs spherical nitrogen evaporator that cuts refuelling time for X-1 type rocket planes from half a day to about an hour.

Mar. 13

Air Force plans $120 million expansion at Edwards Air Force Base, Muroc, Calif.

Mar. 14

Navy BuAer awards contracts to Sikorsky Aircraft Div. of United Aircraft Corp. and McDonnell Aircraft Corp. for development and construction of two experimental transport-type helicopters.

Mar. 15

Boeing Airplane Co. successfully refuels a B-47 jet bomber in flight by a Boeing KC-97A Stratofreighter tanker.

Allison Div. of General Motors Corp. unveils the J-35-A-23 jet engine which will give Boeing B-47C about 40,000 pounds thrust per plane.

Mar. 19

Willys-Overland Motors, Inc. receives contract to build GE J-47 jet engine components.

Delos W. Rentzel is named Undersecretary of Commerce for Transportation; Donald W. Nyrop will head CAB; and Charles Horne is named Civil Aeronautics Administrator.

Texas Engineering & Manufacturing Co. receives AF production order for new two seat version of World War II North American F-51 Mustang.

Air Force awards Bendix Aviation Corp. $10 million contract and Gilfillan Brothers, Inc. a $9.5 million award for radar equipment.

Mar. 22

CAB announces its trans-Atlantic Charter Policy and opens door for possible scheduled trans-Atlantic air coach services by 1952 or earlier.

Mar. 23

An Air Force Douglas C-124 crashes into Atlantic midway between Newfoundland and Ireland.

Mar. 26

Republic F-84 Thunderjets amass more than 10,000 combat hours in three months in Korea.

Bureau of Labor Statistics reports 41-cent increase in wages and 1.3 percent increase in cost of living index during February.

McCulloch Motors Corp. plans full scale entry into helicopter field.

Mar. 27

Bell Aircraft Corp. discloses plans to build $3 million helicopter plant in Fort Worth, Tex.

Boeing Airplane Co. delivers first TB-50D (navigator-bombardier training version of B-50) to Air Force.

AIA Export Service reports that January lightplane shipments during January (5,000 pounds) more than double January, 1950, figure.

APRIL

Apr. 4

Nash-Kelvinator Corp. negotiates with Pratt & Whitney Aircraft Div. for a license to build P&W Double Wasp piston engine.

Nomination of D. W. Rentzel as Undersecretary of Commerce for Transportation, and D. W. Nyrop as chairman of the Civil Aeronautics Boar is opposed by Amos E. Heacock, representing the Aircoach Transport Association.

Apr. 5

Piper Aircraft Corp. applies for type certification of a twin engined aircraft designated model PA-23.

Apr. 6

Third 1951 supplemental defense appropriation request provides additional $1,135,000,000 for aircraft procurement.

Employment in aircraft and parts plants increased 100,000 in first six months after Korean war and is expected to go up another 20 percent, according to report by Labor Department's Bureau of Employment Security.

Apr. 9

Oldsmobile Div. of General Motors Corp. announces plans to build Wright J-65 Sapphire jet engine components for Buick Div.

Edwards AFB, Muroc, Calif., is transferred to newly-formed Air Research and Development Command which has taken over research and development work of Air Materiel Command.

American Helicopter Co. reports successful flight tests of its new single place pulse-jet powered XA-6 helicopter.

Apr. 12

Capacity of six of the nation's leading airports has increased two and a half times since 1947, reports Brig. Gen. Milton W. Arnold, vice president of Air Transport Association in speech to the Wings Club.

Apr. 13

Major Daniel K. Edwards, Durham, N. C., is nominated by President Truman as Assistant Secretary of Defense.

Civil Aeronautics Board reports that local service carriers showed a combind 1950 net operating inome of $592,061, as compared witch a net operating loss in 1949 of $315,507.

Apr. 16

Army now has a total of more than $95 million for aircraft and parts procurement.

North American Aviation's four jet B-45's go into action in Korea.

Apr. 18

Senate confirms appointments of Delos W. Rentzel (Undersecretary of Commerce for Transportation); Donald W. Nyrop (CAB chairman); and Charles F. Horne (Civil Aeronautics Administrator).

Apr. 19

It is announced that an American Airlines crew, with no previous jet experience, has been flying a North American B-45 in a service test program on the GE J-47 engine since Aug., 1950, resulting in much new information on limitations and capabilities of 550 mph class aircraft in airline use. Conclusion: no reason why jet transports couldn't operate safely from present airports if restricted to dry runways.

Douglas DC-6B, (P&W R-2800's), covering MacArthur homecoming, flies from San Francisco to Washington in 7 hr. 6 min.

Aircraft Industries Association reports February lightplane shipments were 231 (as compared with 215 last year).

Apr. 21

Chase Aircraft Company's XC-123A makes first test flight at Trenton, N. J.

Apr. 23

Large irregular carriers begin their "case for survival" before the Senate Select Committee on Small Business.

Apr. 24

Piper Super Cub, piloted by Mrs. Ana Louisa Branger, sets an international altitude record of 26,820 feet in the minus 1,103-pound category.

Apr. 27

Bell Aircraft Corp., McDonnell Aircraft Corp., and Sikorsky Aircraft Div. win Air Force's convertiplane design competition.

American Helicopter Society presents 1951 top awards to Igor Sikorsky and Col. Richard T. Kight.

Apr. 30

President's budget to Congress allows $14.6 billion for aircraft procurement during coming fiscal year.

Allis-Chalmers Manufacturing Co. gets multimillion dollar subcontract to build parts for Curtiss-Wright J-65 Sapphire jet engine.

An all-weather landing system, combining optics with electronics, is announced as being in process of development in Los Angeles; will restore pilot vision under any condition of visibility.

MAY

May 1

Lockheed Aircraft Corp. receives production order for the new version of its F-94 jet fighter, F-94D, a tactical fighter designed for long-range ground support.

May 3

Ford Motor Co.'s Lincoln-Mercury Division receives contract to build Westinghouse J-40 jet engines.

Eugene F. Bertrand is named assistant Defense Production Administration administrator.

May 10

Wright J-65 Sapphire will be used to power Martin-built B-57A Canberra.

Kaiser-Frazer Corp. purchases 49 percent of Chase Aircraft Co. stock.

May 11

Chase C-123 assault transport is ordered into production under Air Force contract.

May 14

Air Force and National Advisory Committee for Aeronautics start a new supersonic research program with the Convair XF-92A delta-wing (Allison J-33-A-29).

Consolidated Vultee Aircraft Corp.'s XC-99 sets long distance payload mark, carrying 85,000 lbs. of cargo during a 2,600-mile nonstop flight, Sacramento, Calif. to Savannah, Ga.

May 15

Max Conrad sets non-stop lightplane record in Piper Pacer (125 hp Lycoming), crossing the country in 23 hrs., 4 mins. and 31 secs.

May 17

Bendix School for Electronics to train Air Force and other personnel officially opened at Pimlico Airport, Baltimore.

May 18

National Advisory Committee for Aeronautics' pilotless aircraft flight test base at Wallops Island, Va., is opened for first public inspection to aviation writers.

NACA reveals that blind spot in high speed flight research (Mach. 95 to 1.2) has been bridged by transonic wind tunnel designs now in operation by NACA at Hampton, Va.

May 22

Frederick B. Lee is named deputy director for operations of the Civil Aeronautics Administration, filling post vacated by Donald Nyrop who became Administrator.

May 23

NACA reveals that a Cessna 190 has been outfitted with boundary layer control equipment and is nearly ready for flight tests.

Jet fighters now in Korea include Republic F-84E, Lockheed F-80 and F-94, and North American F-86 and B-45 bomber. Need stressed for lighter jet fighter designs and smokeless JATO propellant after trip to Korea by Lockheed's chief research engineer, Clarence L. Johnson.

May 25

Chase Aircraft Company's C-123 and Fairchild Aircraft Division's C-119 ordered into production by U. S. Air Force at Willow Run, Mich. and Chicago, Ill.

Senate Appropriations Committee reports that rising costs since Korea have cut defense buying power by 20 to 30 percent.

May 28

Consolidated Vultee Aircraft Corp.'s guided missile, Terrier, is ordered into production by Navy Bureau of Ordnance.

American Helicopter Corp. wins design competition for a collapsible, lightweight, jet propelled helicopter.

Roswell L. Gilpatric, New York lawyer, is sworn in as Assistant Secretary of the Air Force, replacing Harold C. Stuart, resigned.

May 31

First commercial airline order for Curtiss-Wright propellers with blades fabricated by hot extrusion process is placed by KLM Royal Dutch Airlines.

JUNE

June 7

CAA figures show more airline and less private flying now than during same period last year, and a drop of 299 commercial (non-municipal) airports.

Deputy Defense Secretary Robert A. Lovett tells Congress that $60 billion requested for defense spending in fiscal 1952 is only a minimum, more will probably be required.

June 8

Morwick Ross is named executive assistant to Civil Aeronautics Administrator Charles F. Horne.

Defense Department asks Congress to remove 70 group ceiling from USAF.

June 11

National Safety Council awards go to forty-three U. S. airlines cited for safe operations during 1950.

House passes $13 million bill authorizing development and expansion of five NACA laboratories.

June 12

Domestic and international subsidy separation legislation is introduced in Senate by Sen. Edwin C. Johnson (D., Colo.) to: (1) Fix the compensatory domestic airmail rate of the Big Four carriers at 42 cents a ton mile; (2) Set the international rate for U. S. flag carriers at $1.51 a ton mile; (3) Establish rate for regional carriers at 63c a ton mile and local service carriers at 84c.

June 13

Bell X-5 (Allison J-35-A-7 jet), first aircraft to feature wings whose degree of sweepback may be varied in flight, completes taxi tests and nears flight tests at Edwards AFB.

Airline traffic continues favorable upward trend for fifth consecutive month.

General Electric Co. develops new version of its J-47 jet engine with greater power and lower rate of fuel consumption.

June 15

Development work on Curtiss-Wright's XLR-25 rocket engine, power plant for the Bell X-2 special research plane, goes into its last stages.

James J. Haggerty, Jr., is elected president of Aviation Writers Association at its annual meeting in New York.

Republic Aviation Corp. unveils its F-84G, (Allison J-35), first operational jet fighter fully equipped for mid-air refueling.

June 16

1951 Airpower award for outstanding engineering achievement presented by N. J. Wing Air Force Association to Michael Stroukoff, founder and chief engineer of the Chase Aircraft Co. for his design of the C-123 and subsequent development of jet powered version.

AVIATION QUOTES

"I propose that in the spring of 1919, when we have a great force of bombardment airplanes, that an infantry division, preferably the First Division, be assigned permanently to the Air Service; that we arm the men with a great number of machine guns and train them to go over the front in our large airplanes which would carry 10 or 15 soldiers. We could equip each man with a parachute so that when we desired to make a rear attack on the enemy we could carry these men over the lines and drop them off in parachutes behind the German position. They could assemble at prearranged strong points, fortify them and we could supply them by aircraft with food and ammunition. Our low flying attack aviation would then cover every road in the vicinity, both day and night, so as to prevent the Germans falling on them quickly until they could thoroughly organize their positions. This is a perfectly feasible proposition."

General Billy Mitchell
to General Pershing,
October 17, 1918

June 19

Beech Aircraft Corp. wins Air Force competition for a new twin engined-pilot trainer, using P&W R-2800 engines.

AiResearch Manufacturing Co. successfully completes final cycling tests of a 140 hp air turbine starter.

Operating income of international airlines is up during first quarter of 1951.

June 20

First U. S. Air Force Northrop Scorpion F-89 all-weather interceptors assigned to service squadrons with the Western Air Defense Force, Hamilton Air Force Base, Calif.

June 25

Rep. Carl Vinson (D., Ga.) introduces bill to establish U. S. Air Force academy.

North American Aviation receives production order for its Navy FJ-2 carrier-based fighter.

June 26

Lt. Gen. Benjamin W. Chidlaw, commanding general of AMC at Wright-Patterson AFB, becomes new head of Air Defense Command at Ent AF Base, Colo.; Lt. Gen. Edwin W. Rawlings replaces Chidlaw at Dayton.

AVIATION QUOTES

"Why all this fuss about airplanes in the Army—I thought we already had one."

Unnamed Congressman to Washington reporters, October, 1910

June 28

Lockheed Aircraft Corp. wins USAF's design competition for aerial freighter capable of carrying 25,000 pounds of cargo over a 2,000 mile range.

AG-1 agricultural plane, built under CAA sponsorship with industry cooperation, is demonstrated at Washington National Airport.

June 29

Military Air Transport Service, reporting on first year of Pacific air lift, reports that 91,500 passengers and 20,600 tons of cargo had been moved to the Pacific, while 28,000 travellers and wounded had been airlifted to the U. S. during the past year.

JULY

July 2

Labor Department reports that aircraft industry employment hits 413,200 during April—about 160,000 more than April, 1950.

Col. David C. Schilling chosen as recipient of the 1951 Harmon International Aviation Trophy for his non-stop England-U.S. flight in Republic F-84E last September.

July 5

Navy announces Douglas Aircraft Co.'s D-558-2 Skyrocket, using four Reaction Motors rocket engines, flies faster and higher than any other piloted plane, at Edward AFB, Muroc, Calif., with Bill Bridgeman, Douglas test pilot, at the controls.

July 10

Demand for aviation gas during first four months of 1951 totalled 19,487,000 barrels—an increase of 80 percent over same period last year.

July 17

Air Lines Pilots Association votes to remove David L. Behncke as president; Clarence N. Sayen is elected to replace him.

Texas Engineering and Manufacturing Co. demonstrates new Luscombe Army observation and reconnaissance airplane, model T-8F-1 (Lycoming O-290-D1 125 hp engine).

July 18

Hamilton Standard Div. of United Aircraft Corp. develops new jet engine fuel control unit, combining electronic sensing unit with hydromechanical control unit.

July 20

Air Coordinating Committee approves priority assistance to assure lightplane production of 3,500 per year. ACC also supports government aid for commercial helicopter development.

Minneapolis-Honeywell Regulator Company announces development of new electronic control devices: a constant altitude controller, a system of fuel quantity gauging and a new method of using the electronic autopilot as an aid for flying large aircraft manually.

July 22

Chief of Naval Operations Adm. Forrest P. Sherman dies in Naples.

July 23

American Legion supports current drive for 150 Air Force wings and calls for Naval buildup to 7,000 first-line combat aircraft.

Lockheed flies first production model of L-1049 Super Constellation.

July 24

Boeing Airplane Co. and Curtiss-Wright Corp. top billion dollar mark in defense backlog.

July 25

President Truman nominates Francis P. Whitehair to be Undersecretary of the Navy, replacing Dan A. Kimball who will move up to Secretary.

Richard H. Johnson, Palm Springs, Calif., wins Bendix gold trophy at 18th National Soaring Contest, flying 360 miles from Elmira, N. Y. to Norfolk, Va.

July 26

Republic Aviation Corp. announces development of F-84F, reconnaissance version of F-84 Thunderjet, powered by Wright YF-65 Sapphire engine.

Diesel-powered Model 18 Taylorcraft makes first flight. The 125 hp diesel was designed by Fred Thaheld and manufactured by Diesel Power Corp. of Pittsburgh.

July 30

Martin 4-0-4 twin-engined transport (Pratt & Whitney R-2800's) completes first flight at Glenn L. Martin Co.'s Middle River, Md. plant.

AUGUST

Aug. 1

Military officials tell airlines that MATS civil planes requirement will remain at 60 (30 from non-scheduled lines and 30 from certificated lines), with a possibility that more may be needed.

Air Force testimony discloses that $11,092-million in fiscal 1952 budget for aircraft procurement is only partial; more may be sought later. Complete allocation will buy 5,604 planes.

Aircraft Industries Association report shows that lightplane shipments declined from 270 units in March to 208 units in June.

Aug. 2

Following the recommendation of ACC, the National Production Authority sets aside enough materials to build 3,500 lightplanes yearly.

President nominates Adm. William M. Fechteler as Chief of Naval Operations; Vice Adm. Donald B. Duncan named as Vice Chief.

Aug. 8

McDonnell XF3H-1 (Westinghouse J-40),

Navy's newest jet fighter, makes first flight, piloted by Bob M. Edholm.

Navy's Martin Viking VII sets new altitude record for single stage missiles flying 135 miles up from White Sands Proving Ground, N.M., reaching a top speed of 4,100 mph.

Aug. 14

Harold Mistele, Detroit, sets light seaplane altitude record, flying his 145 hp Aeronca to 18,325 ft. above sea level.

Aug. 15

Glenn L. Martin Canberra jet bomber flies London to Darwin, 10,249 miles, in 21 hr. 5 min.—an average of 486 mph.

Senate approves postal increases: first class mail, 3c to 4c, penny postcards to 2c, second class mail by about 10 percent.

Navy BuAer plans to build $2-million helicopter plant for Kaman Aircraft Corp. at Bloomfield, Conn.

Aug. 16

Mobilization Chief Charles E. Wilson reports an aircraft production rise of 50 percent during first half of '51, with an estimated 70 to 80 percent rise by the end of the year.

Aug. 20

Donald Webster is elected president of the National Aeronautic Association.

Civil Aeronautics Administration reports purchase of about $15-million electrical and electronic equipment during fiscal 1951.

Winners of all-woman lightplane air races held in connection with National Air Races announced: Claire McMillen, Santa Ana, Calif. won Powder Puff Derby, 2,348-mile handicap from Santa Ana to Detroit; Margaret Carson, Ottawa, Canada, won International Handicap flying 1,000 miles from Orlando, Fla. to Windsor, Canada.

Aug. 27

USAF Chief of Staff Hoyt S. Vandenberg indicates that the Air Force is developing tactical atomic weapons for use against ground forces.

Estimates indicate that total for 1951 revenue passenger miles for domestic airlines will pass 10.5-billion mark, up more than 2 billion over last year.

Aug. 28

Sperry Corp. receives $10-million Navy contract for guided missiles.

Lockheed's L-206 wins Air Force competition for a turbo-prop transport capable of carrying a 25,000 pound payload 2,000 miles.

Aug. 30

Navy's McDonnell F2H-2 twin jet joins air forces in Korea. Other jets now in the theater include: Navy's Grumman F9F Panther, Air Force's Lockheed F-80 and F-94, Republic F-84 and North American F-86 and B-45 bomber.

Aug. 31

Douglas D-558-Z with Bill Bridgeman piloting, unofficially tops world altitude record (72,394 ft., 1935). Exact altitude not revealed but Navy reveals the plane reached a speed of 1,000 mph while climbing to its record altitude.

AVIATION QUOTES

Requirements for Military Aviator Rating
Signal Corps, 1912

1. Attain an altitude of at least 2,500 ft. as recorded by a barograph.

2. Make a flight of at least 5 min. duration in a wind of at least 15 mph as indicated by an anemometer near the ground.

3. Carry a passenger to a height of at least 500 ft. and on landing bring the machine to rest within 150 ft. of a previously designated point, the engine being completely shut off prior to touching the ground; combined weight of pilot and passenger: at least 250 lb.

4. Execute a volplane from an altitude of at least 500 ft. with engine cut off and cause the airplane to come to rest within 300 ft. of a previously designated point on the ground.

5. Make a military reconnaissance flight of at least 20 miles cross-country at an average altitude of 1,500 ft. for the purpose of observing and reporting information concerning features of the ground.

SEPTEMBER

Sept. 5

Consolidated Vultee Aircraft Corp. is awarded an Air Force contract to work jointly with General Electric Co. in the development of a nuclear-powered airplane.

Lockheed Aircraft Corp. gets Air Force facilities contract for a new $12.6 million plant at Palmdale, Calif. for final assembly of jet aircraft.

Sept. 11

Aircraft manufacturers hold seven of top ten places as defense contractors for first six months of '51 according to Senate Small Business Committee survey.

Sept. 12

Robert A. Lovett nominated by President as Defense Secretary to replace Gen. George Marshall who has resigned.

Sept. 13

Air Force orders Martin B-61 Matador, a new guided missile, and establishes its first pilotless light bomber squadron at the Missile Test Center, Cocoa, Fla.

Navy orders swept-wing version of Grumman F9F Panther, designated F9F-6 (Pratt & Whitney J-48).

Sept. 17

Consolidated Vultee Aircraft Corp. and Republic Aviation Corp. get Air Force contracts to develop new interceptor.

Sept. 18

Goodyear Aircraft Corp. contracted by Navy to build McDonnell F3H-1 carrier based jets.

Domestic trunk airlines net operating income for first six months of '51 was $49-million, three times amount earned during same period last year.

> **AVIATION FACTS**
>
> The United States issued the world's first adhesive airmail stamp of distinctive design intended for use on scheduled service and printed the airplane upside down! Issued on May 15, 1918, the 24c carmine-and-blue stamp featured a sketch of an airplane that was inadvertently printed upside down. A sheet of 100 of these stamps, which cost $24.00, was sold three days later for $10,000 and by the mid-thirties these stamps were bringing as much as $3,500 each.

Sept. 24

McDonnell Aircraft Corp. wins Navy's "flying crane" helicopter competition with a design using a single three-bladed rotor system powered by small jet engines on the blade tips.

OCTOBER

Oct. 1

Joint Chiefs of Staff agree on 143 wing Air Force, including both combat and troop carriers.

Mobilizer Charles E. Wilson reports plant output now double what it was a year ago.

Oct. 4

Sperry Corp. receives Navy contract to build a $25-million guided missile plant near Bristol, Tenn.

Of the $1-billion voted for air expansion in 1952 defense appropriations bill, $667-million will go to Air Force, $333-million to Navy.

Oct. 5

Hamilton Standard Div. of United Aircraft Corp. develops new turbine starter line which will reduce time required to start turbine power plants.

Oct. 8

Atomic Energy Commission Chairman Gordon Dean predicts beginning of an Atomic Air Force in the U. S. by 1961.

Oct. 9

John A. McCone resigns as Under Secretary of the Air Force; Roswell L. Gilpatric is nominated by the President to replace him.

Lt. Gen. Laurence S. Kuter, commanding general of the Military Air Transport Service, is nominated as USAF's Deputy Chief of Staff for Personnel. Maj. Gen. Joseph Smith replaces him in MATS post.

Westinghouse Electric Corp's Aviation Gas Turbine Div. receives Navy orders for jet engines totalling "several hundred million."

Oct. 10

Civil Aeronautics Board report discloses that 80 percent of world's airline aircraft are U. S. built and 56 percent of these are Douglas.

Oct. 18

President signs $56.9-billion fiscal 1952 defense appropriations bill giving Air Force $20,642,785,000, the Army $19,888,032, 030, and the Navy $15,877,891,000. Overall procurement total for aircraft is more than $16.2 billion.

Oct. 22

Air Force orders a limited number of Consolidated Vultee Aircraft Corp.'s turbo-prop T-29 trainers.

Col. David C. Schilling receives 1951 Harmon International Trophy for his first non-stop England-U.S. flight in a jet fighter in September, 1950.

Oct. 25

National Air Council's awards for outstanding aviation research go to Capt. Walter S. Diehl (USN-Ret.) and Maj. John P. Stapp (USAF).

Oct. 26

North American Aviation receives production orders for two new models of the F-86 Sabre—the F-86F and the F-86H, both to be powered by General Electric J-47 engines.

Fairchild Engine Division begins production of 1,000 pound thrust jet engine for Navy and Air Force. Designated J-44, it weighs 325 pounds, is six feet long and 22 inches in diameter.

> **AVIATION QUOTES**
>
> "We should not lose sight of that happy period, which we would contemplate as a certainty in the future, when it will become as common to hear a man call for his wings, when going on a journey, as it is now to call for his boots and spurs."
>
> *The Family Magazine,*
> December, 1834

Oct. 30

Lockheed L-1049C Super Constellation price, purchased by Eastern Airlines, is set at $1,375,000.

Munitions Board creates new Defense Transportation office, headed by Col. Charles H. Voeller,, Air Force officer.

NOVEMBER

Nov. 1

Grumman Aircraft Engineering Corp. successfully test-flies its F9F-6 fighter (P&W J-48 jet engine).

Dr. Jerome C. Hunsaker, NACA chairman, wins 1951 Wright Brothers Memorial Trophy for "significant public service of enduring value to aviation."

Nov. 6

USAF loss summaries reveal that from the beginning of the Korean war until October 23rd, North American F-86's had destroyed 71 MiG-15's in air combat and accounted for another 13 probables; whereas the MiG-15's during the same period shot down seven F-86's and damaged another seven.

Navy's Bureau of Aeronautics and Douglas Aircraft Co. announce the Douglas AD-5 (Wright R-3350-26W) multi-function carrier plane.

Nov. 7

Aircraft Production Board says Air Force won't reach 138-wing goal before 1955, and 173-wing target the following year.

Nov. 8

CAB turns down applications of four non-scheduled airlines for transcontinental air-coach certificates.

Charles A. Coolidge is nominated as Assistant Secretary of Defense.

CAA and Bureau of Census report August, 1951, civil aircraft shipments less than half of August, 1950, total.

Nov. 13

Delos W. Rentzel resigns as Under Secretary of Commerce for Transportation.

Nov. 26

Northrop Aircraft, Inc. gets Air Force production contract for F-89D, new model of the Scorpion all-weather jet fighter.

U. S. is rapidly improving jet engines and electronic equipment, reports Secretary of Air Force Thomas Finletter: "The gas turbine is moving ahead in its thrust, its efficiency, in its fuel consuming efficiency by leaps and bounds."

DECEMBER

Dec. 4

Admiral DeWitt C. Ramsey is re-elected president of the Aircraft Industries Association at its semi-annual meeting; Lawrence D. Bell and Robert E. Gross named as board chairmen for 1952.

Dec. 18

Air Force announces award of a contract to Pratt & Whitney Aircraft for work on an atomic aircraft engine.

1951 AIRCRAFT YEAR BOOK GOES TO PRESS

AVIATION QUOTES

"Wright flew for almost an hour, often over the heads of the hundred thousand spectators, who acclaimed him with frenzied shouts. The altitude of his flight was slight, scarcely 350 feet, so I consider the thing to be merely a clever circus stunt without military value. It is however, a great sport."

Lieut. Gen. Walter von Eberhardt,
Templehof Field, Berlin,
September, 1909

AVIATION FACTS

An aviation record set in 1913 is still on the record book and has never been broken. It is the 87-hour endurance record in a balloon set Dec. 13-17, 1913 by Hans Kaulen in Germany. This same machine, piloted by Berliner, covered a distance of 3,052 kilometers Feb. 8-10, 1914 to establish a distance record that has not since been broken—38-year-old aviation records!

BIOGRAPHICAL BRIEFS

To include the names of all who are outstanding in current aviation activities in this section would expand it to a book. We have therefore been faced with the difficult problem of setting arbitrary limits, governed by space. If, as a result, we have omitted anyone who should have been included, we are extremely sorry—and hope that our readers will inform us of it for correction in future editions.

An asterisk (*) following a biographical sketch indicates that we have been unable to confirm the information.

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TURNER, Howard McMath, Air Force officer born in Avoca, Ia., Feb. 21, 1902; Major General (temporary). Address: U. S. Air Force, Washington 25, D. C.

TURNER, Roscoe, aviator and aviation executive born in Corinth, Miss., Sept. 29, 1895; president, Roscoe Turner Aeronautical Corp.; president, Turner Airlines, Inc. Address: Municipal Airport, Indianapolis, Ind.

TURNEY, Newton V., aviation executive born in Petros, Tenn., June 26, 1910; divisional controller, Chance Vought Aircraft Div., United Aircraft Corp. Address: P.O. Box 5907, Dallas, Tex.

TWINING, Nathan Farragut, Air Force officer born in Monroe, Wis., Oct. 11, 1897; Lieutenant General (temporary). Address: Washington, D. C.

UHL, Joseph A., airline executive born in Cincinnati, O., Aug. 1, 1906; vice president, secretary-treasurer, Continental Air Lines, Inc. Address: 20 Crestmoor Dr., Denver, Colo.

UHRICH Harold R., aeronautical engineer born in Millersville, Pa., Dec. 13, 1912; chief engineer, Aeromatic Propeller Dept., Metal Products Div., Koppers Company, Inc. Address: 4117 Taylor Ave., Baltimore 6, Md.

UPSTON, John Edwin, Air Force officer born in Tawas City, Mich., Sept. 9, 1890; Major General. Address: Hqs., Fourth Air Force, Hamilton AFB, Hamilton, Cal.

VALK, William E., patent attorney born in Washington, D. C., Aug. 29, 1889; director of patents, Curtiss-Wright Corp.; president, Manufacturers Aircraft Association. Address: 220 W. Ridgewood Ave., Ridgewood, N. J.

VANAMAN, Arthur William, Air Force officer born in Millville, N. J., May 9, 1892; Major General (permanent). Address: U. S. Air Force, Washington 25, D. C.

VANDENBERG, Hoyt Sanford, Chief of Staff, U. S. Air Force, born in Milwaukee, Wis., Jan. 24, 1899; General. Address: Chief of Staff, U. S. Air Force, Washington 25, D. C.

VANIK, Milford F., aeronautical engineer born in Cleveland, O., July 29, 1906; staff engineer, airworthiness requirements, Boeing Airplane Co. Address: 6001 Seward Park Ave., Seattle 8, Wash.

VAN NOSTRAND, George, assistant vice president, American Airlines. Address: Avenida del Ejido No. 7, Mexico D.F., Mexico.

VAN VUREN, John, pilot born in Chicago, Ill., Sept. 20, 1906; assistant chief pilot, Chicago base, Delta Air Lines. Address: 3929 Grand Ave., Western Springs, Ill.

VAN ZANDT, John Parker, aviation economist and author born in Chicago, Ill., Jan. 16, 1894; editor, *World Aviation Annual*. Address: 903 16th St., N. W., Washington 6, D. C.

VEST, George W., government official born in Buckner, Mo., Aug. 26, 1894; regional administrator, third region, Civil Aeronautics Administration. Address: 185 N. Wabash Ave., Chicago 1,, Ill.

VICTORY, John Francis, business executive born in New York, N. Y., Jan. 23, 1892; executive secretary, National Advisory Committee for Aeronautics. Address: 1724 F St., N. W., Washington 25, D. C.

VILLIERS, Charles A., president, American Rocket Society, Inc. Address: Rm. 719, 29 W. 39th St., New York 18, N. Y.*

VINCENT, Roy F., personnel director, Continental Air Lines. Address: Stapleton Airfield, Denver 7, Colo.*

deVOURSNEY, Andrew M., airline executive born in Butte, Mont., May 28, 1913; treasurer, United Air Lines. Address: 5959 S. Cicero Ave., Chicago 38, Ill.

WACKS, Peter J., aviation executive born in Binghamton, N. Y., June 30, 1907; personnel manager, Chance Vought Aircraft Div., United Aircraft Corp. Address: P.O. Box 5907, Dallas, Tex.

WAGENECK, Russell L., maintenance official born in Garrison, Ill., Dec. 4, 1910; director of maintenance, Slick Airways. Address: 6204 Goodland Pl., N. Hollywood, Cal.

WAGNER, Frank DeChant, Naval officer born in Pottstown, Pa., Aug. 22, 1893; Rear Admiral. Address: c/o Navy Dept., Washington 25, D. C.*

WAGNER, Robert, chief engineer, Aircraft Div., McCulloch Motors Corp. Address: 9775 Airport Blvd., Los Angeles 45, Cal.

WAGNER, William, public relations counsel born in Boise, Ida., July 28, 1909; public relations manager, Ryan Aeronautical Co. Address: 3544 Emerson St., San Diego, Cal.

WALKER, John B., vice president, Braniff Airways. Address: Braniff Airways, Love Field, Dallas, Tex.

WALKER, Randolph C., president and general manager, Audio Products. Address: 2265 Westwood Blvd., Los Angeles 64, Cal.

WALLACE, Dwane L., corporation executive born in Belmont, Kans., Oct. 29, 1911; president, Cessna Aircraft Co. Address: 5800 Pawnee Rd., Wichita, Kans.

WALLACE, William J., Major General, born in Church Hill, Md., Aug. 6, 1895; Commanding General, Aircraft, Fleet Marine Force, Pacific, MCAS, El Toro, Santa Ana, Cal.

WALNER, William R., pilot born in Wynnewood, Okla., June 20, 1905; assistant chief pilot, Braniff Airways. Address: Dallas, Tex.

WALSH, Raycroft, corporation executive born in Boston, Mass., Nov. 14, 1888; vice chairman, United Aircraft Corp. Address: 35 Westwood Rd., West Hartford, Conn.

WALSH, Robert LeGrow, Air Force officer born in Walla Walla, Wash., July 25, 1894; Major General (temporary). Address: U. S. Air Force, Washington 25, D. C.

WALTER, Don L., engineer born in Pelican Lake, Wis., Nov. 28, 1918; manager of engineering and manufacturing, member, board of directors, Marquardt Aircraft Co. Address: 12103 Hoffman St., Studio City, Cal.

WALTON, Leo Andrew, Air Force officer born in Salem, Ore., Oct. 7, 1890; Major General (retired). Address: P. O. Box 826, Winter Park, Fla.

WARD, Carrol Kramer, aviation executive born in Kansas City, Mo., Oct. 30, 1905; director of personnel, Mid-Continent Airlines. Address: 5540 Norwood, Kansas City, Kans.

WARD, Henry DeC., treasurer, American Meteorological Society. Address: 3 Joy St., Boston 8, Mass.

WARNER, Donald F., engineer born in Halifax, Canada, June 14, 1898; assistant to the manager of engineering, aircraft gas turbine engineering div., General Electric Co. Address: 920 Western Ave., W. Lynn, Mass.

WATERHOUSE, Helen, journalist born in Watertown, Mass., May 31, 1900; aviation editor and reporter, *Akron Beacon Journal*. Address: Westgate Manor, Akron, O.

WATSON, David, airline executive born in Glasgow, Scotland, Jan. 3, 1907; treasurer, Hawaiian Airlines, Ltd. Address: 2104 Hunnewell St., Honolulu 14, T. H.

WATTS, Robert B., lawyer born in Portland, Me., May 29, 1901; vice president and legal counsel, Consolidated Vultee Aircraft Corp. Address: 7949 Princess St., La Jolla, Cal.

WAUGH, John D., industrial publicist born in Herington, Kans., June 26, 1919; public relations counsel, Pendray and Company. Address: 55 W. 42nd St., New York 18, N. Y.

WEBB, Leland D., (Capt., USN, Retired) aeronautical engineer born in Chicago, Ill., Apr. 7, 1891; vice president, western region, Aircraft Industries Association. Address: 21756 Malibu Road, Malibu, Cal.

WEBB, Theodore J., engineer born in Chicago, Ill., Jan. 2, 1921; project engineer, American Helicopter Co., Inc. Address: 3616 Colorado St., Long Beach, Cal.

WEBSTER, Donald D., Col., president National Aeronautic Association and commanding officer of the National Capital wing of the Civil Air Patrol. Address: NAA, Washington, D. C.

WEBSTER, Robert M., Air Force officer born in Boston, Mass., Oct. 10, 1892; Major General (permanent). Address: U. S. Air Force, Washington 25, D. C.*

WECKEL, A. R., director of commercial sales, Sperry Gyroscope Co. Div. of Sperry Corp. Address: Great Neck, L. I., N. Y.

WEDBERG, Frank A., aeronautical engineer born in Bridgeport, Conn., Aug. 1, 1903; group leader, Engineering Laboratory, North American Aviation, Inc, Columbus Div. Address: 921 Francis Ave., Columbus 9, O.

WEIKERT, John Maurice, Air Force officer born in McKnightstown, Pa., Sept. 29, 1898; Major General (temporary). Address: The National War College, Fort Lesley J. McNair, Washington 25, D. C.

WEILER, J. F., chief pilot, Continental Air Lines. Address: Stapleton Airfield, Denver 7, Colo.*

WELLS, Edward C., aeronautical engineer born in Boise, Ida., Aug. 26, 1910; vice-president, engineering, Boeing Airplane Co. Address: Rt. 3, Box 297-B, Bellevue, Wash.

WELLS, Lester A., aviation executive born in Baltimore, Md., May 28, 1900; president, Engineering and Research Corp. Address: 10 E. Blackthorne St., Chevy Chase, Md.

WELLS, T. A., aircraft executive born in Corning, Ia., Mar. 12, 1907; vice-president, chief engineer, Beech Aircraft Corp. Address: 5 Lynnwood Blvd., Wichita, Kans.

WELSH, William W., aviation executive born in Alma, Colo., Sept. 16, 1893; technical assistant to the president, Fairchild Engine & Airplane Corp. Address: 1015 Cafritz Bldg., Washington 6, D. C.

WENDT, Charles W., airline executive born in New York, N. Y., 1903; vice president-treasurer, All American Airways. Address: 300 North View Terrace, Alexandria, Va.

WENTZ, Daniel S., II, aviation writer born in Hanover, Pa., Dec. 15, 1919; managing editor, *American Aviation Daily*. Address: 2000 Connecticut Ave., N. W., Washington 8, D. C.

WEST, C. C., Jr., airline executive born in Arcadia, Cal., May 9, 1906; vice president, Continental Air Lines, Inc. Address: 345 Jersey, Denver, Colo.

WEYLAND, Otto Paul, Air Force officer born in Riverside, Cal., Jan. 27, 1902; Lieutenant General, Commanding General, Far East Air Forces. Address: Hq. FEAF, APO 925, c/o P. M., San Francisco, Cal.

WHARTON, R. H., lawyer born in Birmingham, Ala., June 10, 1915; director of personnel, Delta Airlines. Address: Municipal Airport, Atlanta, Ga.

WHEELER, M. H., chief pilot, Northeast Airlines. Address: Logan International Airport, 239 Prescott St., E. Boston 28, Mass.

WHELAN, Bernard L., aviation executive born in Cincinnati, O., Nov. 19, 1890; general manager, Sikorsky Aircraft. Address: Bridgeport 1, Conn.

WHITAKER, Sidney F., pilot born in Phoenix, Miss., Oct. 25, 1895; assistant chief pilot, Delta Airlines. Address: Box 476, Miami Springs, Fla.

WHITE, John A., secretary, American Helicopter Co., Inc. Address: 4708 Crenshaw Blvd., Los Angeles, Cal.

WHITE, Thomas Dresser, Air Force officer born in Walker, Minn., Aug. 6, 1901; Major General (permanent). Address: U. S. Air Force, Washington 25, D. C.*

WHITEHEAD, Ennis Clement, Air Force officer born in Westphalia, Kans., Sept. 3, 1895; Lieutenant General (temporary). Address: CG, Con AC, Mitchel AFB, Hempstead, N. Y.

WHITEHEAD, Richard Francis, Naval Officer born in Fall River, Mass., Jan. 1, 1894; Rear Admiral. Address: Navy Dept., Washington 25, D. C.

WHITEHEAD, William C., business executive born in Salt Lake City, Utah, May 8, 1894; manager, Airsupply Co. Div. Garrett Corp. Address: 5959 W. 3rd St., Los Angeles 36, Cal.

WHITMAN, Ray P., aircraft executive born in Washington, D. C., Apr. 7, 1895; 1st vice-president, sales, Bell Aircraft Corp. Address: P. O. Box One, Buffalo 5, N. Y.

WHITNEY, E. N., airline executive born in Syracuse, N. Y., Oct. 27, 1902; director, flight operations, Western Air Lines. Address: 6060 Avion Dr., Los Angeles 45, Cal.

WHITTEN, Lyman Perley, Air Force officer born in Malden, Mass., Mar. 25, 1897; Major General. Address: Commanding General, U. S. Northeast Command, APO 862, c/o PM, New York, N. Y.

WHYTE, Jessel Stuart, business executive born in Chicago, Ill., Nov. 25, 1890; director, president and general manager, MacWhyte Co. Address: 2904 14th Ave., Kenosha, Wis.

WIEBEN, Herman C., aircraft executive born in New York City, Feb. 28, 1907; project engineer C-123, Chase Aircraft Co., Inc. Address: West Trenton, N. J.

WIEGMAN, Clarence H., engineer born in Detroit, Mich., Sept. 11, 1902; chief engineer, Lycoming-Spencer Div., AVCO Manufacturing Corp. Address: Williamsport 38, Pa.

WILD, Arthur W., business executive born in England, 1905; vice-president, Continental Motors Corp. Address: 1366 Whittier Rd., Grosse Pointe, Mich.

WILFORD, E. Burke, president and chief engineer, Pennsylvania Aircraft Syndicate Ltd. Address: 300 Linden Lane, Merion, Pa.

WILKIN, M. Cullen, airline executive born in Salt Lake City, Utah, Jan. 31, 1913; vice-president in charge of sales, Slick Airways. Address: San Antonio 9, Tex.

WILKINSON, Paul Howard, engineer born in St. Paul, Minn., Feb. 2, 1895; editor and publisher, *Aircraft Engines of the World*. Address: 5900 Kingswood Rd., Bethesda, Md.

WILKINSON, William L., corporation executive born in Prattville, Ala., Nov. 12, 1899; director of contracts, Solar Aircraft Co. Address: 2200 Pacific Highway, San Diego 12, Cal.

WILLEY, G. T., aircraft executive born in Birmingham, England, Sept. 29, 1901; vice president manufacturing and assistant general manager, The Glenn L. Martin Co. Address: Springwood Farm, Forest Hill, Md.

WILLIAMS, Betty Jane, commercial flight instructor born in Wilkes-Barre, Pa., Apr. 2, 1919; aeronautical technical writer, North American Aviation. Address: 637 25th, Manhattan Beach, Cal.

WILLIAMS, Lawrence E., aviation executive born in Jamestown, N. Y., Mar. 13, 1897; vice president, McDonnell Aircraft Corp. Address: Bywater Rd., Annapolis, Md.

WILLIAMS, Roger, newspaperman born in Oakland, Cal., Sept. 4, 1916; aviation editor, *San Francisco News*. Address: Oakland, Cal.

WILLIAMS, Thomas P., engineer born in Frostburg, Md., Jan. 29, 1914; assistant chief engineer, Aeroproducts Div., General Motors Corp. Address: 15 Skyview Dr., Vandalia, O.

WILLIAMSON, John H., pilot born in Dyson, S. C., Apr. 18, 1906; assistant chief pilot, Delta Air Lines. Address: 611 W. Lyle Ave., College Park, Ga.

WILLINGHAM, G. W., chief pilot, West Coast Airlines. Address: Boeing Field, P. O. Box 516, Georgetown Station, Seattle 8, Wash.*

WILSON, Alfred M., business executive born in Minneapolis, Minn., Dec. 31, 1903; vice-president, aeronautical div., Minneapolis Honeywell Regulator Co. Address: 2747 4th Ave., South, Minneapolis, Minn.

WILSON, Charles E., government official born in New York City, Nov. 18, 1886; Director of Defense Mobilization. Address: Room 102, Executive Office Bldg., 17th and Penn. Ave., N. W., Washington, D. C.

WILSON, Gill Robb, newspaperman born in Clarion County, Pa., Sept. 18, 1893; editor and publisher, Flying Magazine. Address: 366 Madison Ave., New York, N. Y.

WILSON, Ray M., aviation executive born in Newton, Ill., 1900; vice president in charge of operations, Frontier Airlines. Address: Stapleton Airfield, Denver, Colo.

WISENER, William T., personnel manager, Luscombe Airplane Corp. Address: P. O. Box 2126, Dallas, Tex.*

WITHINGTON, S. B., corporation official born in Hillsdale, Mich., Feb. 27, 1895; vice-president and general manager, Lycoming-Spencer Div., AVCO Manufacturing Corp., vice-president and general manager, Bridgeport-Lycoming Div. Address: 652 Oliver St., Wiliamsport, Pa.

WOLFE, Kenneth Bonner, Air Force officer born in Denver, Colo., Aug. 12, 1896; Lt. General. Address: Olkon Research Corp., Duryea Bldg., 1731 L St., N. W., Washington, D. C.

WOLFE, Leon C., aeronautical engineer born in Sherwood, Mich., Sept. 8, 1915; chief engineer, Aeronca Mfg. Corp. Address: 3208 Grand Ave., Middletown, Ohio.

WOOD, Charles R., Jr., pilot born in Kokomo, Ind., June 8, 1908; chief helicopter test pilot; McDonnell Aircraft Corp. Address: 703 N. Kirkwood Rd., St. Louis 22, Mo.

WOOD, Lysle Austin, aeronautical engineer born in Renville, Minn., Feb. 23, 1904; chief engineer, Boeing Airplane Co. Address: Seattle, Wash.

WOOD, Robert H., journalist born in Pratt, Kans., Nov. 4, 1911; editor, *Aviation Week*. Address: 330 W. 42nd St., New York, N. Y.

WOODWARD, Harper, attorney born in Rochester, N. Y., Nov. 26, 1909; counsel and aviation advisor to Laurance S. Rockefeller. Address: Rm. 5600, 30 Rockefeller Plaza, New York, N. Y.

WOOLMAN, C. E., president and general manager, Delta Air Lines. Address: Municipal Airport, Atlanta, Ga.*

WRIGHT, Theodore Paul, aircraft engineer and executive born in Galesburg, Ill., May 25, 1895; vice-president for research, Cornell University, president, Cornell Aeronautical Laboratory, Inc., and chairman, Executive Committee, Guggenheim Aviation Safety Center at Cornell University. Address: Cornell University, Ithaca, N. Y.

YOUNG, Ora W., government official born in Greenville, O., Mar. 25, 1893; regional administrator, region one, Civil Aeronautics Administration. Address: Federal Bldg., International Airport, Jamaica, L. I., N. Y.

YEASTING, John O., aircraft executive born in Helena, Ohio, Dec. 1, 1905; vice president, comptroller, Boeing Airplane Co. Address: Box 3107, Seattle 14, Wash.

YOUNG, Raymond W., mechanical engineer born in St. Joseph, Mo., Apr. 9, 1899; President and general manager, Reaction Motors, Inc. Address: Box 85, Hohokus, N. J.

ZIMMER, V. C., aviation executive born in Great Bend, Kans., Oct. 29, 1905; director of industrial security, Consolidated Vultee Aircraft Corp. Address: 1201 Virginia Way, La Jolla, Cal.

ZIPP, Harold W., aircraft engineer born in Lincoln, Neb., Sept. 10, 1906; executive engineer, Boeing Airplane Co. Address: 5001 E. Lewis, Wichita 8, Kans.

ZISCH, W. E., general manager, Aerojet Engineering Corp. Address: Azusa, Cal.*

ZWICKY, Fritz, Dr., born in Varna, Bulgaria, Feb. 14, 1898; director of research, Aerojet Engineering Corp. Address: Azusa, Cal.*

Foreign Chronology, Pre-Wright

150 B.C.—Principle of jet propulsion discovered by Hero with his Aeolipile, Alexandria, Egypt.

1496—Mechanical flying machine designed by Leonardo da Vinci, Milan, Italy.

1766—Hydrogen properties discovered by Henry Cavendish, Clapham Common, England.

1782, Nov.—Hot-air balloon constructed by Joseph Michel and Etienne Jacques Montgolfier, France.

1783, Aug. 27—Hydrogen balloon ascends, no passengers; released by J. A. C. Charles, Paris, France.

1783, Oct. 15-19—Jean Jacques Pilatre de Rozier makes first ascent by man in a Montgolfier hot-air captive balloon, Paris, France.

1783, Nov. 21—Pilatre de Rozier and the Marquis d'Arlandes make first free ascent by man in Montgolfier hot-air balloon, Paris, France.

1783, Dec. 1—First free hydrogen balloon ascent by J. A. C. Charles, French physicist, also credited with invention of first barometer, valve, and ballast.

1784, June 4—First woman aeronaut, Mme. Thible, ascends in a Montgolfier free balloon, Lyons, France.

1793—Balloon parachute descent by Jean Pierre Blanchard, Basle, Switzerland.

1804, July 24—First escape by parachute from aircraft disaster made by Kuparento, at Warsaw, Poland.

1842, Sept. 29—British patent to Henson on his "first complete description of a mechanical aeroplane." (It has all elements of modern airplane save ailerons.)

1848, June 30—First engine-driven aeroplane to fly—a steam model—is produced by John Stringfellow.

1852, Sept. 24 — Steam-powered airship designed and flown by Henri Giffard, Paris to Trappe.

1855 — Glider flight by Jean Marie Le Bris, near Douarnenez, France.

1858—First aerial photographs made by Tournachon (Nadar) from balloon. On Oct. 23, 1858, patent issued covering his system of aerial photography.

1866, June 27—F. H. Wenham's paper before the Aeronautical Society of Great Britain establishes the advantage of high aspect ratio and superposed wings, patenting biplane construction.

1870, May 21—British patent to Harte discloses wings whose rear edges are hinged, resembling the modern aileron. The 1868 patent of Boulton also expounds the three-torque principle.

1870, Sept. 23 - Jan. 28, 1871—Airmail and passengers flown out of besieged Paris. Propaganda by air introduced.

1871—Wind tunnel designed by F. H. Wenham for Aeronautical Society of Great Britain.

1872, Dec. 13, 14—Gas-engined airship designed and demonstrated by Paul Haenlein, Brunn, Austria.

1883, Oct. 8—Electric-powered airship flight by Albert and Gaston Tissandier, Auteuil, France.

1884—Horatio Phillips patents airfoil shapes, after wind tunnel tests which showed superiority of curved surfaces.

1884, Aug. 9 — Electric-powered airship round-trip flight by Renard and Krebs, Meudon-Paris.

1891—Possibility of soaring on rigid arched wings demonstrated by Otto Lilienthal.

1893, Feb. 16—The Maxim airplane lifts off its track, a weight of nearly 6,000 lbs. In 1894 a revised machine flies along a track 200 feet with crew of three. It weighs 8,000 lbs.

1896, June 22—Octave Chanute begins his glider experiments.

1896, Aug. 28-29—Gasoline-powered airship exhibited by Hans Wolfert, Berlin.

1897, Nov. 3—All-metal airship built by David Schwartz, Tempelhof Field, Berlin.

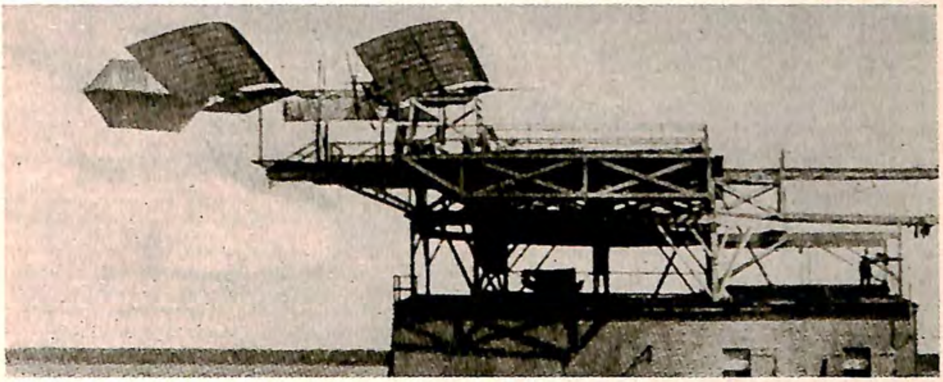
1898, Sept. 18—Santos Dumont airship flown, Bagatelle, France.

1898, June 30—Ascents are made by the one U. S. Army balloon at Santiago, Cuba. The balloon is old and is badly damaged by enemy fire.

1900, July 2—First Zeppelin ascent, Lake Constance, Germany.

1903, Aug. 31—About this date one Torres exhibits a model for the radio control of vessels, then considered applicable also to airships—a guided missile.

A CHRONOLOGY of U. S. AVIATION



Rare photo of Langley "Aerodrome" prior to ill-fated launching

The following chronology has been compiled and edited by Ernest L. Jones, (Lt. Col., ret.), civilian historian with the Air Historical Office, U. S. Air Force.

Although this chronology has been expanded considerably over previous editions, it still represents only brief excerpts from Colonel Jones' vast store of air data. Space has forced us to deal only with the highlights.

We are deeply indebted—as is aeronautics in the United States—to Colonel Jones for his thorough knowledge of aeronautics in this country and the generosity with which he shares it.

THE EDITORS

World's fastest and highest-flying aircraft, Douglas Skyrocket

United States Chronology

1784, Jan. 16—Airborne troops proposed by Benjamin Franklin in reporting on the first balloon ascents.

1784, July 17—First U. S. balloon flight in Peter Carnes' captive balloon, Baltimore, Md.

1784, Nov. 30—First ascent by an American abroad, by Dr. John Jefferies, physician, with French aeronaut Blanchard, at London. On Jan. 7, 1785, they make the first Channel crossing by air.

1793, Jan. 9—Balloon flight by Jean Pierre Blanchard from Philadelphia, Pa., to Woodbury, N. J. (Letter from George Washington carried on this flight.)

1837, Sept. 18—First parachute demonstration in America when John Wise drops animals from a balloon at Philadelphia.

1838, Aug. 11—John Wise safely lands with his parachuted balloon at Easton, Pa.

1840, Sept. 8—Col. John H. Sherburne urges Secretary of War to use night balloons to locate Seminoles.

1842, Oct. 22—John Wise proposes to capture Vera Cruz by air.

1844, Oct. 16—America's first air patent to Muzio Muzzi on direction of balloons.

1845, Sept. 18—Rufus Porter proposes steam airship line, New York-California, to carry goldseekers at $100 a trip. Stock sales unsatisfactory. His 1849 booklet illustrates a jet-propeller passenger rocket.

1859, July 1—World record balloon trip, 809 miles, St. Louis to Henderson, N. Y., by John Wise and three companions.

1859, Aug. 16—Airmail carried by John Wise in balloon flight from Lafayette to Crawfordsville, Ind.

1860, Aug. 21—Capt. E. B. Hunt, Corps of Engineers, U.S.A., advocates balloon telegraphy.

1860, Oct. 13—Successful aerial photos taken by William Black from a balloon, Boston, Mass.

1861, June 10—Military flight by James Allen, First Rhode Island State Militia, in balloon over Washington, D. C.

1861, June 18—Balloon telegraph demonstrated by T. S. C. Lowe. (Message to Abraham Lincoln.)

1861, June 22-24—Military reconnaissance by T. S. C. Lowe and Army officers from balloon using telegraph, over Arlington and Falls Church, Va. Military air observation continues into 1863.

1861, Aug 3—Civilian aeronaut La Mountain inaugurates aircraft carrier operations with his war balloon. Lowe follows.

1861, Sept. 24—Air artillery adjustment from Lowe's Army ballon near Washington.

1861, Nov. 7—Helicopter proposed for Union Army. After experiments, a machine is partly built before Appomattox ends the project.

1862, Mar. 9—War helicopter bomber designed and urged by William C. Powers of Mobile, Ala.

1866, May 25—Solomon Andrews' airship maneuvers over New York with 4 passengers.

1873, Oct. 7—Unsuccessful trans-Atlantic flight by W. H. Donaldson, Alfred Ford and George A. Lunt in balloon, *Graphic*, from Brooklyn, N. Y., to New Canaan, Conn.

1877—Prof. William H. Pickering, Harvard University, begins experiments with model helicopters. In 1903 a rabbit is sent aloft.

1880—Thomas A. Edison conducts helicopter experiments for James Gordon Bennett.

1883, Mar. 17—First of a series of glider flights by John Joseph Montgomery, Otay, Cal.

1885, Jan. 7—Russell Thayer, C. E., a graduate of West Point, urges on Secretary of War Robert T. Lincoln a compressed-air airship of his design. No action.

1887, Jan. 30—Thomas E. Baldwin makes his first parachute jump at San Francisco.

1886, July—W. E. Irish, publisher of *Aeronautical World*, proposes balloon radio.

1887—American altitude record made by aeronaut Moore and Prof. H. A. Hazen of U. S. Signal Service, at St. Louis; 15,400 feet, in balloon of St. Louis *Post Dispatch*.

1890, July 31—During the month, L. Gathmann, of Chicago, explodes a shell at high altitude in attempt to produce rain.

1890, Oct. 1—President Harrison approves legislation creating the Weather Bureau and reestablishing the Signal Corps which is charged with collection and transmission of information, among other duties. Military aeronautics is then considered as among such means, and Army aeronautics is revived.

1892, Oct. 10—Balloon section is being organized with each telegraph train by Chief Signal Officer, General A. W. Greely, who anticipates military airships and airplanes.

1892, Nov. 5—Wingless aerial torpedo suggested by Prof. A. F. Zahm.

1893, Aug. 1-4—International Conference on Aerial Navigation held at Chicago; Octave Chanute, Chairman; Dr. A. F. Zahm, Secretary.

1893, Oct. 9—The Chief Signal Officer, General Greely reports the purchase of a Lachambre balloon for the Signal Corps balloon section. First ascents since the war are made at the Chicago exposition from Oct. 31, 1893.

1896, Apr. 29—First American wind tunnel begins operation at M.I.T.

1896, May 6—Steam-powered airplane model flown by Samuel Langley, Washington, D. C.

1898, Apr. 29—War and Navy Departments examine Langley's work, approve, and Board of Ordnance and Fortification makes two allotments of $25,000 each to build his airplane.

1898, Dec. 22—The Secretary of War approves a Fort Myer site for barracks, officer quarters, administration building and a balloon house to concentrate Signal Corps schools at one point.

1901, Sept. 1—Simon Newcomb, Ph.D., LL.D., writes in *McClures* for September: "The first successful flyer will be the handiwork of a watchmaker and will carry nothing heavier than an insect."

In December, Rear Admiral Melville, USN, says in the *North American Review:* "A calm survey . . . leads the engineer to pronounce all confident prophecies at this time for future success as wholly unwarranted, if not absurd."

1902, Sept. 15—A. Leo Stevens sails his airship *Pegasus* over Manhattan Beach in a race with Edward C. Boyce in the latter's Santos Dumont airship.

1903, Mar. 23—Orville and Wilbur Wright

apply for patent on their flying machine. (Patent issued May 22, 1906.)

1903, Dec. 8—Samuel Langley's flying machine, piloted by Charles Manly, plunges in the Potomac and is wrecked on its second test, Washington, D. C.

1903, Dec. 17—First sustained controllable flight of powered heavier-than-air machine by Orville and Wilbur Wright, Kitty Hawk, N. C.

1904, Aug. 3—Circuit flight in airship (Curtiss motor) by Capt. Thomas S. Baldwin at Oakland, Cal.

1904, Wright brothers make 104 flights, covering 20 miles. British representative visits the Wrights in November.

1905, Jan. 18—Wright brothers open negotiations with U. S. War Department for disposition of their invention. Correspondence is had through 1907.

1905, Apr. 29—Daniel Maloney begins series of glides with Montgomery glider, taking off from captive balloon. Later killed.

1905, Aug. 5—Charles K. Hamilton begins series of kite flights, towed by cars and boats.

1905, Sept. 26-Oct. 5—Wright brothers make 55 flights, the longest being 24 miles in 38 min. 3 sec. Frank S. Lahm, in France, obtains report on Wrights' flying from Ohio relative. French remain skeptical. In October the French government is negotiating along with British.

1905—Lt. Frank P. Lahm becomes first Army balloon pilot.

1906, Jan. 13-20—First indoor aero exposition, New York.

1906, Mar.—French and British visit Wright brothers at Dayton.

1906, Sept. 30—First Bennett international balloon race won by Lt. F. P. Lahm—Paris to England.

1906, Dec. 1-8—Second indoor air exhibition of Aero Club of America.

1907, June 8—Building devoted exclusively to aeronautics dedicated at Jamestown (Va.) Exposition.

1907, Aug. 1—Aeronautical Division established, Army Office of Chief Signal Officer.

1907, Sept. 2—Walter Wellman airship *America* fails in polar attempt.

1907, Sept. 30—Ornithopter of H. C. Gammeter, multigraph inventor, lifts temporarily.

1907, Oct. 1—Aerial Experiment Association formed by Dr. A. Graham Bell, F. W. Baldwin, J. A. D. McCurdy, Glenn H. Curtiss and Thomas E. Selfridge.

1907, Oct. 3—Record altitude of 23,110 feet by U. S.- Weather Bureau meterological kite.

1907, Oct. 18—Air bombing prohibition signed at second Hague conference.

1907, Oct. 21—Second Bennett international balloon race, St. Louis, won by Oscar Erbsloh of Germany. Airship races are held Oct. 22-23.

1907, Oct. 28-29—International Aeronautic Congress held in New York.

1907, Oct. 28—Admiral C. M. Chester urges anti-submarine airships and shipboard airplanes at International Aeronautic Congress.

1907, Dec. 6—Seven-minute towed flight from motor boat tug in Dr. Bell's kite, flown by Lt. T. E. Selfridge.

1907, Dec. 16—Chief Signal Officer advertises for airship bids, resulting in purchase of Baldwin airship.

1907, Dec. 23—Chief Signal Officer advertises for airplane bids, after visit of Wrights.

1908, Feb. 10—First Army plane contract signed by Signal Corps with Wright Brothers. (Other contracts signed with A. M. Herring and J. F. Scott.)

1908, Mar. 12—First Aerial Experiment Association's plane, *Red Wing*, flown by F. W. Baldwin. Later, three other machines fly.

1908, May 6-13—Wright brothers renew flying preliminary to delivery of Army airplane. Charles Furnas is first airplane passenger.

1908, May 13—Balloon radio reception demonstrated by Signal Corps.

1908, May 31—G. H. Curtiss Manufacturing Company announces planes for sale.

1908, June 10—Aeronautical Society formed in New York and Morris Park Airfield shortly obtained—first of kind in U.S.

1908, June 20—Anthony radio-controlled airship model demonstrated.

1908, July 4—*Scientific American* Trophy awarded Glenn H. Curtiss for first public flight of one kilometer circuit in his biplane, *June Bug*, Hammondsport, N. Y.

1908, July 17—First air ordinance passed by Kissimmee, Fla., with registration and regulation.

1908, Aug. 8—Demonstration flights under French syndicate control begin near LeMans, France, by Wilbur Wright, continuing through December, making a number of astounding records. Training of students follows.

1908, July 31-Aug. 8—Henri Farman of France makes first exhibition airplane flights in U.S.

1908, Aug. 22—First Army Baldwin airship accepted.

1908, Sept. 17—First plane fatality, killing Signal Corps Lt. Thomas E. Selfridge and severely injuring Orville Wright, in delivery of first Army airplane, Fort Myer, Va.

1908, Dec. 28—Matthew B. Sellers makes several flights with 7 hp quadroplane.

1909, Jan. 22—Commercial airplane, built by Glenn Curtiss, sold to Aeronautic Society of New York.

1909, April 16-28—Wilbur Wright delivers an airplane in Italy and teaches pupils.

1909, June 10—President Taft presents Aero Club of America medal to Wright brothers. Congressional medal presented at a celebration at Dayton, June 17-18.

1909, June 26—Glenn H. Curtiss demonstrates at the Aeronautical Society's meet, Morris Park, New York, the machine ordered Jan. 22. Further flights are made at the Society's meet July 5, before removal of the machine to Mineola and the instruction of member Charles F. Willard.

1909, July 17—Curtiss flies 52 mins. in longest U.S. flight except Wrights and wins *Scientific American* trophy for second time. On this success in the Mineola flights the Aero Club of America names him as America's entry in the Bennett international race.

1909, Aug. 22-29—Glenn H. Curtiss wins first Bennett international airplane race and other events of first International Flying meet, Rheims, France. Speed: 45.7 mph.

1909, Aug. 25—First Army airfield leased at College Park, Md.

1909, Aug. 28—After instruction by Glenn H. Curtiss and subsequent practice in the machine contracted by the Aeronautical Society, Charles F. Willard gives his first exhibition at

Scarsborough Beach, Toronto—America's first exhibition pilot. His exhibitions continue over several years.

1909, Sept. 7-Oct. 15—At Berlin, Orville Wright makes flights under German contract, with more records.

1909, Sept. 30—Inception of Wright-Curtiss patent litigation.

1909, Sept. 30—Emile Berliner describes a proposed guided missile.

1909, Oct. 3—At Zurich, Switzerland, E. W. Mix wins the Bennett International balloon race the second time for America.

1909, Oct. 4—Wilbur Wright makes sensational flight, Governors Island to Grant's Tomb and return. Glenn H. Curtiss makes a short flight Sept. 29 and Oct. 3.

1909, Oct. 7—Glenn H. Curtiss flies his first exhibition at St. Louis. Chicago is next. The same month, Charles K. Hamilton and Otto Brodie learn to fly, followed by others. An exhibition company is formed and Curtiss returns to his development work.

1909, Oct. 8-Nov. 5—First Army aviators taught to fly by Wilbur Wright, College Park, Md.: Lt. Frank P. Lahm, Lt. Frederic E. Humphreys, and Lt. B. D. Foulois.

1909, Nov. 27—Anti-aircraft firings begin at Sandy Hook by Ordnance Department.

1909, Nov. 22—The Wright Co. formed with $1,000,000 capital. In 1914, Orville Wright buys the company back. On Oct. 13, 1915, a syndicate buys the company and adds the Simplex Co. In 1916 it becomes the Wright-Martin Co.

1910, Jan. 10-20—First flying meet held at Los Angeles; Louis Paulhan, of France, the star performer.

1910, May 29—Record flight from Albany to New York by Glenn Curtiss, 142.50 mi. in 2 hr., 50 min.

1910, Mar. 25—Wright patent condemnation urged by William M. Page, attorney for C. F. Bishop, president, Aero Club of America.

1910, June 13—Charles K. Hamilton flies New York-Philadelphia and return for N. Y. *Times* and Philadelphia *Public Ledger* and $10,000 prize—149.5 miles in flying time 3 hr. 27 min.; elapsed time, 6 hr. 57 min.

1910, June 13-18—First show of Wright exhibition team, Indianapolis, Ind. where Walter Brookins is star and makes new records. Exhibitions by single pilots or groups continue about the country until the Wright exhibition business is discontinued in Nov. 1911.

1910, June 30—Dummy bomb demonstration made by Glenn H. Curtiss to Army and Navy officers.

1910, Aug. 4—Plane-ground radio demonstrated by E. N. Pickerill.

1910, Aug. 8—Tricycle landing gear installed by Lt. B. D. Foulois on Army Wright at San Antonio.

1910, Aug. 27—Air-land plane radio used by J. A. D. McCurdy, Sheepshead Bay, N. Y.

1910, Sept. 2—First American woman pilot solos: Blanche Stuart Scott. First exhibition at Fort Wayne, Oct. 22.

1910, Oct. 8-10—Former President Theodore Roosevelt is flown at St. Louis exhibition by Arch Hoxsey.

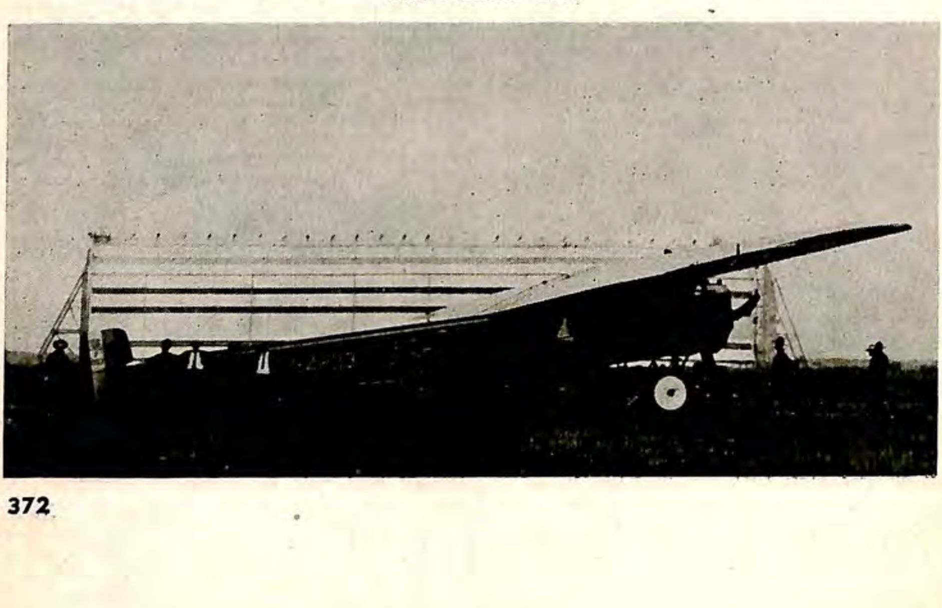
1910, Oct.14-16—Wellman airship, *America*, abandons trans-Atlantic trip after some 800 miles.

1910, Oct. 22-31—Second Bennett international airplane race won by C. G. White (Bleriot) at 61 mph during Belmont Park meet where numerous records are made.

1910, Nov. 14—First battleship takeoff by Eugene Ely from U.S.S. *Birmingham* in Hampton Roads, Va.

1910—Night flights by Walter R. Brookins

Lieutenants Kelly and MacReady made first non-stop transcontinental flight in this Fokker T-2



(Montgomery, Ala., Apr. 18) and Charles Hamilton (Camp Dickenson, Nashville, Tenn., June 21-26).

1911, Jan. 7—Didier Masson flies Los Angeles-San Bernardino to deliver *Times* newspapers. Mail and papers delivered Feb. 17 by Fred J. Wiseman.

1911, Jan. 7-25—Dive bombing, aerial photography, airplane radio demonstrated by Army officers in San Francisco meet.

1911, Jan. 27-28—Lieut. T. G. Ellyson, U.S.N., is first U.S. naval aviator when he takes his Curtiss off at San Diego during Curtiss exhibitions.

1911, Jan. 30—J. A. D. McCurdy attempts Key West-Havana flight but lands in water ten miles short and is rescued by Navy destroyer. In 1913 Domingo Rosillo makes the entire distance.

1911, Feb. 17—Curtiss flies tractor seaplane from North Island to cruiser *Pennsylvania*. Plane hoisted on board and return flight later made.

1911, Mar. 3—Lt. B. D. Foulois and P. O. Parmalee fly record cross-country Laredo-Eagle Pass, Tex., 106 mi. in 2 hr. 10 min. in Wright plane loaned Army by R. J. Collier. Messages dropped en route, radio received and sent.

1911, Mar. 13—Capt. W. Irving Chambers, U.S.N., is assigned the Bureau of Navigation to devote exclusive efforts to naval aeronautics.

1911, Mar. 31—About this date Missouri National Guard Signal Corps establishes air section and members taught flight and ballooning.

1911, May 8—First Navy airplane ordered, Curtiss Triad, amphibian. By July the three 1911 planes of the Navy are delivered—Curtiss A-1, A-2; Wright B-1.

1911, May 13—Lieuts. H. H. (Hap) Arnold and Thomas DeWitt (Tommy) Milling complete flying training at Wright School: 7th and 8th Army pilots.

1911, June 7—Lieut. John P. Kelley, Med. Res. Corps, assigned Army School at College Park—first U. S. air medical officer.

1911, June 8—Connecticut state air regulation is first state air law.

1911, June 21—Short-lived Aeronautical Manufacturers Assn'n. incorporated; Ernest L. Jones, president.

1911, June 30-July 11—Boston-Washington flown by Harry N. Atwood. Charles K. Hamilton flies with him most of way—longest continuous air journey to this date.

1911, July 1—Third Bennett plane race won for U. S. by Charles T. Weyman (Nieuport-Gnome 100) at 78 mph.

1911, July 31—During the month, Frank E. Boland begins flying his tailless, allegedly non-infringing airplane.

1911, Aug. 5—Lincoln Beachy wins over Eugene Ely and Hugh Robinson in New York-Philadelphia race for Gimbel $5000 purse. Elapsed time: 1 hr. 50 min. 18 sec.; one stop for fuel.

1911, Aug. 14-25—Harry N. Atwood flies St. Louis-New York, 1155 miles by route; longest cross-country flight to this date.

1911, Aug. 20—World altitude record set at 11,642 ft. by Lincoln Beachy in Curtiss biplane.

1911, Sept. 4—Earle L. Ovington (Bleriot-Gnome 70) wins over Lieut. T. D. Milling (Burgess-Wright-Wright 30) in 160-mile tri-state race during Boston meet, in 3 hr. 6 min. 22 sec.

1911, Sept. 7—Lt. T. G. Ellyson, U.S.N., demonstrates shipboard launching by taking off from aerial cable at Hammondsport, N. Y.

1911, Sept. 17-Nov. 5 — Transcontinental flight by Calbraith P. Rodgers from New York to Pasadena, Calif.—3,390 mi., 49 days.

1911, Sept. 23-30—Earle L. Ovington appointed Airmail Pilot No. 1, flying mail from Nassau Boulevard to Mineola, L. I., N. Y.

1911, Sept. 30—Lt. H. H. Arnold is "stunt man" for the lead in pioneer air movies at Nassau Boulevard meet where Army pilots compete.

1911, Oct. 9—Demonstration of Tarbox automatic pilot made before officers at College Park. Other similar inventions follow.

1911, Oct. 10—Bombsighting and dropping device demonstrated by Riley Scott, College Park, Md.

1911, Oct. 19-Feb. 12, 1912—Eastbound transcontinental flight of Robert G. Fowler (Wright B), Los Angeles-Pablo Beach, Fla., 2520 mi. in 116 days.

1911, Oct. 24—Orville Wright makes soaring record of 9 min. 45 sec. at Kitty Hawk.

1912, Feb. 12—Frank T. Coffyn takes automatic movie aerials over New York harbor.

1912, Feb. 17—First pilot physical exam published by U. S. Army.

1912, Mar. 1—Attached type parachute jump by Bert Berry from Benoist pusher plane, St. Louis.

1912, Apr. 16—First U. S. licensed woman pilot, Harriet Quimby, flies English Channel. (Killed at Boston Aviation Meet, July 1.)

1912, May 24—Paul Peck makes American duration record of 4 hr. 23 min. 5 sec. in biplane with Berliner Gyro engine.

1912, May 30—Death of Wilbur Wright by typhoid.

1912, June 7-8—Machine gun fired from Wright biplane by Capt. Charles DeForest Chandler, College Park, Md.

1912, July 2—Vaniman airchip *Akron* crashes off Atlantic City in renewed trans-Atlantic attempt.

1912, July 31—Plane launched from sea wall by catapult, Navy Lt. T. G. Ellyson in Curtiss AH-3.

1912, Aug. 12—First Army tractor plane, Burgess, received; flown by Lts. H. H. Arnold and Roy C. Kirtland from Marblehead, Mass.

1912, Oct. 6—In night flight, Lt. J. H. Towers, U.S.N., (Curtiss A-2) makes world seaplane duration record, 6 hr. 10 min. 35 sec. at Annapolis; American record for any plane.

1912, Oct. 8—First Navy physical exam for pilots published by Bureau of Medicine and Surgery.

1912, Oct. 9—First competition for Mackay Trophy won by Lt. H. H. Arnold.

1912, Nov. 5-13—First U. S. airplane artillery adjustment, Ft. Riley, Kans., Lt. H. H. Arnold and observer Lt. Follett Bradley.

1912, Nov. 6-Dec. 15—Antony Jannus (Benoist seaplane Roberts 2-cycle 100 hp) flies Omaha-New Orleans, with mail and merchandise, carrying passengers at stops en route—1835 mi., flying time 31 hr. 43 min.

1913, Jan. 13-Mar. 31—Air parcel post flight, Boston-New York, by Harry M. Jones (Wright B).

1913, Feb. 11—James Hay bill in Congress inaugurates the project of a separate air service.

1913, Feb. 13—Langley Field Aerodynamical Laboratory project inaugurated.

1913, Apr. 27—First cross-Isthmus flight by Robert G. Fowler and cameraman R. A. Duhem, Panama-Cristobal. Publication of story and pictures results in arrest.

1913, May 10—Didier Masson and bomber Dean attack Mexican federal gunboats in Guayamas Bay. A number of other Americans fly for Villa in this and subsequent years.

1913, May 28—Lt. T. D. Milling and Lt. W. C. Sherman make 2-man duration and distance record of 4 hr. 22 min. and 220 miles (Burgess tractor-Renault 70), Texas City-San Antonio.

1913, May 30—About this date is instituted M.I.T.'s aerodynamics course under Asst. Naval Constructor Jerome C. Hunsaker.

1913, June 20—First Naval aviator killed when Ensign W. D. Billingsley is thrown from seaplane.

1913, July 19—Sky writing initiated by Milton J. Bryant over Seattle.

1913, Oct. 12—Eighth Bennett international balloon race won for U. S. for fourth time at Paris by R. H. Upson and R. A. D. Preston, landing in England.

1913, Nov. 27—First exhibition loop by Lincoln Beachy in Curtiss biplane, Coronado, Cal.

1913, Dec. 4—Tactical Air Unit, First Aero Squadron, set up as provisional organization, San Diego, Cal.

1913, Dec. 12—Wright pilot Oscar Brindley reports at San Diego as Army's first civilian instructor. Scores of others subsequently employed through 1918.

1913, Dec. 31—Orville Wright demonstrates automatic pilot; awarded Collier Trophy.

1914, Jan. 1—First scheduled airline begins operations with Benoist flying boat between St. Petersburg and Tampa, Fla.; Tony Jannus, pilot.

1914, Jan. 31—During the month first U. S. Navy air station established at Pensacola, following temporary camps at San Diego and Annapolis, 1911-1912.

1914, Feb. 17—Seaplanes and flying boats classed as "vessels" by the Department of Commerce and the license No. 1 is issued to Antony Jannus.

1914, Feb. 24—Army Board condemns all pusher type airplanes.

1914, Apr. 15—Electric self starter fitted to Anzani 200-hp engine of Collier flying boat.

1914, June 23—Curtiss' Wanamaker trans-Atlantic flying boat tested. With outbreak of World War I the project is abandoned.

1914, July 2—Lawrence Sperry wins French War Dept. prize for "stable airplane" flown by early automatic pilot over Seine River in Paris.

1914, July 18—Aviation Section of Signal Corps created by Congress, authorizing 60 officers and students and 260 enlisted men.

1914, Dec. 1-16 — Two-way plane-ground radio demonstrated by Lt. H. A. Dargue and Lt. J. O. Mauborgne, Manila, P. I.

1915, Mar. 3—National Advisory Committee for Aeronautics established by Congress.

1915, May 14—Contract let for first Navy airship D-1 to Connecticut Aircraft Co. In July is contracted a floating airship shed.

1915, June 22—Wisconsin State Forester, E. M. Griffith, flown by Jack Vilas, in first air forest patrol.

Wright Biplane carries passenger, 1909

1915, Sept. 17—Joseph Dolgos of Philadelphia demonstrates air incendiary bombs.

1916, Feb. 9—Cpl. A. D. Smith (Martin S-Hall Scott 125) makes world seaplane duration record of 8 hr. 42 min.

1916, Feb. 12—Invitation for bids on airmail issued by Post Office in Massachusetts and Alaska.

1916, Mar. 15—First Aero Squadron, under command of Capt. B. D. Foulois, begins operations at Columbus, N. M., with Gen. Pershing's Punitive Expedition.

1916, Apr. 5—The Governors Island Training Corps organized by Philip A. Caroll.

1916, Apr. 14—A power-driven turret is proposed without result by Col. F. P. Cobham.

1916, June 3—National Defense Act increases strength of Aviation S. C. from 60 to 148 officers over 5-year period. President may fix increase of enlisted men from old figure of 260.

1916, June 18—U. S. aviator H. Clyde Balsley shot down. (Member of Lafayette Escadrille, flying for France.)

1916, Aug. 29—First U. S. Coast Guard Aviation Division organized.

1916, Oct. 2—Allocation airship development to Army or Navy raised by Chief Signal Officer. Rigids later assigned Navy.

1916, Nov. 2—Chicago-New York commercial airmail line asked by Glenn Muffly. Sponsored by New York *Times*, Victor Carlstrom flies mail demonstration, Nov. 2-3.

1916, Nov. 14—More than 60 civilians are enlisted as sergeants in the Reserve and sent to Curtiss contract school at Newport News, Va., beginning this date and before Apr. 6, 1917. Others are sent to Curtiss school at Miami. Gen. Mitchell learns to fly here at this period.

1916, Nov. 18-20—Group National Guard cross-county flight under Capt. R. C. Bolling from New York to Princeton, N. J. and return. On Dec. 30, another is made to Philadelphia.

1916, Nov. 19-20—Ruth Law flies her 1914 Curtiss pusher Chicago-New York, with 2 stops en route, for new cross-country record.

1916, Dec. 17—To this date the Aero Club of America has certified 636 airplane pilots. In addition are many other pilots who have never flown for the Aero Club certificate. On Dec. 31, the Army has graduated 122 pilots since 1909.

1916, Dec. 18—Non-exclusive licenses are offered by Wright-Martin Aircraft Corp. on royalty basis. Terms are considered prohibitory and in 1917 Congress appropriates $1,000,000 to acquire basic patents. Solution is the cross-license agreement of the Aircraft Manufacturers Association.

1917, Feb. 13—Capt. Francis T. Evans, U.S.-M.C., loops and spins a seaplane at Pensacola.

1917, Feb. 15—Aircraft Manufacturers Association completes organization.

1917, Apr. 6—U. S. declares war on Germany.

1917, Apr. 6—Official strength of the Aviation Section, S. C., is 131, including regular and reserve. Of these, 112 are airplane pilots or student pilots. Enlisted strength is given variously from 1087-1800. At armistice the figures are: total officers, 20,708 (pilots and student pilots, 12,449); enlisted, 174,315.

Airplane strength, "less than 300." Produced in U. S., Apr. 6, 1917—Nov. 1, 1919: 13,894; received from Allies, 5,229; total: 19,123.

1917, May 10—Arrangements made for eight ground schools for theoretical training Reserve officer candidates.

1917, May 16—Aircraft Production Board created. Superseded by the Aircraft Board Oct. 1. Dissolved May 19, 1919.

1917, May 23—French Premier Ribot asks U.S. to furnish 5,000 pilots, 50,000 mechanics, 4,500 planes for active service by spring 1918.

1917, May 29—Liberty engine project inaugurated. An 8-cylinder Liberty is flown in an L.W.F., July 25. The 12-cylinder production Liberty follows in December.

1917, June 1—Barlow robot bomber urged. Armistice ends project.

1917, July 13—Fiske torpedo plane tested with dummy missile. Experiments continue.

1917, July 24—First great U. S. air appropriation, $640,000,000. Act also provides for increase in organization of Aviation Section, S. C.

1917, July 27—Secretary of Navy authorizes a Naval Aircraft Factory at Philadelphia.

1917, July 27—First British DH-4 arrives to be the first American service plane put into production, with Liberty engine. First American DH-4 completed is flown Oct. 29 by civilian test pilot H. M. Rinehart.

1917, Aug. 5—Original First Aero Squadron leaves Columbus, N.M. for overseas under Maj. Ralph Royce.

1917, Aug. 13—First AEF squadron program calls for 89 wings and 508 squadrons. One wing equals six squadrons (5 airplanes, 2 balloons). A brigade comprises two or more wings.

1917, Sept. 5—Bristol fighter project started. Condemned July 20, 1918, after 27 planes are built.

1917, Sept. 22—Montgomery heirs sue Wright-Martin Aircraft Corp. for infringement. Suit withdrawn June 6, 1921. Suit of same date against U. S. is dismissed May 28, 1928.

1917, Oct. 16—Airplane to airplane radiophone conversation is demonstrated.

1917, Oct. 18—McCook Field established as Signal Corps Experimental Laboratory.

1917, Oct. 18—Aviation Medical Research Board established by Signal Corps.

1917, Nov. 15—J. Newton Williams' helicopter proposal results in recommendation of N.A.C.A. for Government prize of $20,000, not accomplished.

1917, Nov. 21, Robot bomber demonstrated to Army and Navy officers.

1917, Nov. 27—Brig. Gen. B. D. Foulois made Chief of Air Service, AEF.

1917—Gen. William Mitchell claimed as first officer to fly over enemy lines.

1918, Jan. 19—U. S. School of Aviation Medicine begins operations under Signal Corps Maj. William H. Wilmer, Hazelhurst Field, Mineola, L. I., N. Y.

1918, Feb. 28—Under President Wilson's proclamation, licenses are required for civilian pilots or owners; more than 800 are issued.

1918, Mar. 8—Maj. Edward C. Schneider and Maj. James L. Whitney, in simulated altitude flight, reach artificial altitude of 34,000 ft. in 24 min. at Signal Corps, Mineola, N. Y. laboratory.

1918, Mar. 11—First D.S.C. awarded Army air service personnel goes to Lt. Paul Baer of 103rd Squadron for his performance this date.

1918, Mar. 14—Two pilots of First Pursuit Group (95th Squadron) go on patrol.

1918, May 9—Flight Surgeons are organized at flying fields.

1918, May 11—U. S.-built DH-4 Liberty planes received by AEF.

1918, May 15—Congress establishes Air Mail Flyer's Medal of Honor. First award is to M. F. Freeburg, 1932.

1918, May 15—Regular airmail service flown by Army between New York and Washington, D. C.

1918, May 20—Army aeronautics severed from Signal Corps; two departments created: Bureau of Military Aeronautics and Bureau of Aircraft Production.

1918, June 26—A trans-Atlantic flight is urged by Gen. William L. Kenly, Director Military Aeronautics as "most necessary." On Aug. 8, Roy N. Francis is assigned to study project. Experiments continue to 1919 when Navy's NC4 makes the flight.

1918, July 4—Plan to distribute tons of propaganda by balloon over Germany this day fails attainment. Previously extended experiments had been conducted and contracts let.

1918, Aug. 2—First DH Liberty patrol by 135th Aero Squadron.

1918, Aug. 17—First Martin bomber flown at Cleveland by Thomas Eric Springer.

1918, Sept. 7—First U. S. demonstration of troop transport by air.

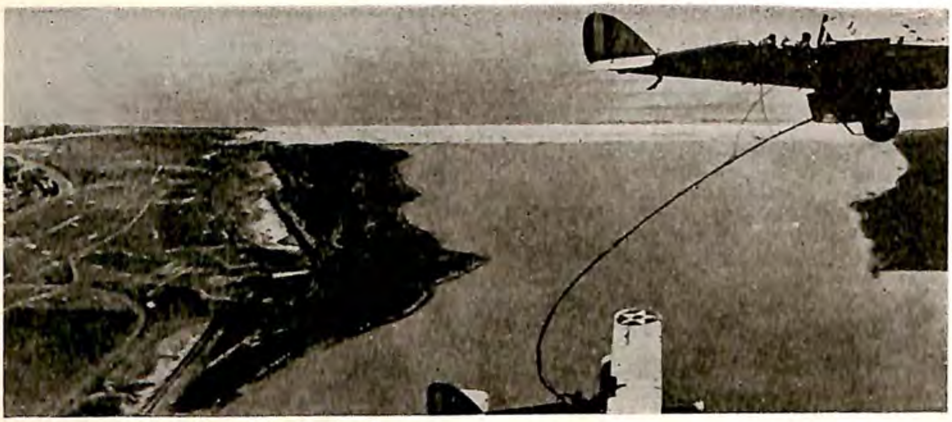
1918, Sept. 12-13—Greatest air concentration of history at St. Mihiel under Gen. William Mitchell—1481 planes.

1918, Sept. 16—German attached type parachutes being in use at least as early as May 1, 1918, the AEF cables need and suggests Floyd Smith, test pilot, prosecute development. Smith develops tree type 'chute. Leslie L. Irving makes first free jump Apr. 28, 1919.

1918, Sept. 18—Altitude of 28,899 ft. reached by Maj. R. W. Schroeder.

1918, Sept. 25—First Congressional Medal of Honor awarded for air activity voted 1st Lt. Edward V. Rickenbacker of 94th Aero Squadron.

1918, Sept. 26—First phase of Meuse-Argonne attack.



Lieutenants Smith and Richter set refueling record of 37 hr. in 1923

1918, Sept. 28—Pilotless airplane maneuvered from another airplane by radio, after some months of experiment. Various automatic pilots and radio controllers tried over the years.

1918, Oct. 2—First successful flights of Army's guided missile. Its prototype had been flown by H. M. Rinehart in July, substituting for the explosive load and the automatic controls.

1918, Oct. 3—Flight refueling demonstrated by Lt. Godfrey L. Cabot, U.S.N.R., continuing into 1920.

1918, Oct. 12—Use of oxygen tanks ordered all pilots over German lines.

1918, Oct. 25—Charles E. Hughes reports on his investigation of dishonesty in aircraft production.

1918, Nov. 11—Armistice signed.

1918, Dec. 4—First Army trans-continental flight made by Major Albert D. Smith's group of JN4 planes, San Diego-Jacksonville-New York-San Diego. Major Smith's plane alone completes the full round trip.

1919, Jan. 2—Maj. Gen. Charles T. Menoher becomes Director of Air Service.

1919, Jan. 21-30—Army second transcontinental flight; Major T. C. Macauley (DH-4 Liberty), Ft. Worth-San Diego-Miami-Ft. Worth. Repeated in April.

1919, Jan. 24—At Issoudun, France, 1st Lt. Temple M. Joyce (Morane) makes 300 consecutive loops.

1919, Mar. 3—U. S.-Canada airmail flown by Edward Hubbard in Boeing seaplane, Type C.

1919, Apr. 26—Lt. Comdr. H. B. Crow, U.S. N. in F5L flying boat makes non-stop endurance record: 20 hr. 10 min.

1919, Apr. 28—Leslie L. Irving makes first free type manually operated airplane parachute jump over McCook Field. (See 9/16/18).

1919, May 8-31—Trans-Atlantic crossing by Lt. Albert C. Read and crew from Rockaway Beach, N. Y., to Plymouth, England, in NC-4, 53 hr. 58 min.

1919, May 14—Navy airship C-5 makes American non-stop record of 25 hr. 50 min., Montauk Pt., L. I. to St. Johns, N.F.

1919, May 18—In first trans-Atlantic takeoff, H. C. Hawker and McKenzie Grieve alight in ocean 1200 miles and 14½ hours out with engine trouble. Rescued.

1919, May 19—First award of DFC made to M/Sgt. Ralph W. Bottriell for first jump by Army personnel with free-type 'chute.

1919, June 1—First organized and sustained forest fire patrol inaugurated at Rockwell.

1919, June 14—First non-stop Atlantic crossing by Capt. John Alcock and Lt. A. W. Brown (Vickers-2 Rolls 375) St. Johns to Clifden, Ireland: 1890 mi. in 16 hr. 12 min.

1919, June 28—Treaty of peace with Germany signed at Versailles.

1919, July 1—Aerial fish patrols inaugurated at San Diego by Comdr. E. W. Spencer, Jr., U.S.N.

1919, July 2-6—First airship ocean crossing, British R-34, E. Fortune, Scotland, to Mitchel Field, N. Y., 3270 mi. in 108 hr. 12 min.; Lt. Comdr. L. Lansdowne, U.S.N. on board. Return made July 9-12, Col. William M. Hensley, representing Air Service.

1919, Aug. 14—Airmail from Aeromarine flying boat to White Star liner, *Adriatic*.

1919, Aug. 27-29—New York-Toronto race of military and civilian pilots.

1919, Aug. 28-Sept. 19—Lawson "air liner," 26-passenger, twin Liberty biplane, makes demonstration trip Milwaukee-Washington via Chicago, New York and other cities. It returns Sept. 25-Nov. 6.

1919, Sept. 1—Dive bombing demonstrated about this date at Aberdeen Proving Ground.

1919, Sept. 16—Flood relief provided by four JN4D's from Corpus Christi to stranded inhabitants.

1919, Sept. 18—Roland Rohlfs (Curtiss triplane-K12 Curtiss 400) makes world altitude record of 31,420 ft.

1919, Oct. 8-31—Army transcontinental reliability and endurance test New York-San Francisco and return. Forty-four compete

westbound; 15 eastbound. Ten planes make round trip.

1919, Oct. 30—Reversible pitch propeller tested at McCook Field, Dayton, Ohio.

1919, Nov. 12-June, 1920—Six Navy F-5L's cruise New York to West Indies and return, covering 12,731 nautical miles.

1920—Moon eclipse observed by Lts. J. H. Tilton and W. H. Cushing of Rockaway Naval air station from height of some three miles.

1920, Feb. 27—World altitude record of 33,113 feet set by Maj. R. W. Schroeder (Le Pere-Liberty).

1920, Mar. 29-Apr. 22—Marine Corps group flight Washington-San Domingo and return, 4842 miles.

1920, June 7—Lt. John H. Wilson makes unofficial world parachute jump record of 19,800 ft.

1920, June 4—Army Reorganization Bill approved, creating Air Service in Army.

1920, July 7—F-5L Navy seaplane flown by radio compass from Hampton Roads, Va., to *U.S.S. Ohio*, at sea.

1920, July 15-Oct. 20—New York-Alaska flight; Capt. St. Clair Street, 1st Lt. Clifford Nutt, 2nd Lts. Ross C. Kirkpatrick, Eric H. Nelson and C. E. Crumrine, Sgts. James Long and Joseph E. English, Capt. Howard Douglas, advance officer; Mitchel Field, N. Y., to Nome and return.

1920, Sept. 8—Transcontinental mail route, combination plane-train, New York-Chicago-San Francisco, completed.

1920, Nov. 1—U. S. international passenger service started by Aeromarine West Indies Airways between Key West, Fla., and Havana, Cuba.

1920, Nov. 25—1st Lt. C. C. Moseley (Verville-Packard 600) wins first Pulitzer race at 156.54 mph; 24 contestants finish, 13 others start but do not finish.

1920, Dec. 13-14—Navy balloon of Lts. L. A. Kleer, Walter Hinton and S. A. Farrell land beyond Moose Factory, Ont., after 25 hours, 852 miles from start at Rockaway, N. Y.

1921, Feb. 18—First U. S. airplane parachute escape by C. C. Eversole, airmail pilot.

1921, Feb 22-23—Night airmail flown by Jack Knight from North Platte, Neb., to Chicago. Ill.

1921, Feb. 24—Lt. W. D. Coney completes transcontinental flight, San Diego-Jacksonville, 2180 mi. in 22 hr. 27 min.; 57 hr. 24 min. elapsed time.

1921, Mar. 23—Lt. A. G. Hamilton drops 23,700 ft. by parachute, Chanute Field.

1921, June 21—Navy F5L planes sink German sub U-117 in demonstration.

1921, July 18-21—Sinking of captured German cruiser, *Frankfurt*, and battleship, *Ostfriesland*, by U. S. bombs proves vulnerability of naval craft to aerial attack.

1921, Aug. 10—Navy Bureau of Aeronautics formed with Rear Admiral W. A. Moffett as Chief.

1921, Sept. 28—New world altitude record of 34,508 ft. set by Lt. J. A. Macready.

1921, Nov. 5—Bert Acosta (Curtiss Navy-C12 Curtiss 400) wins Pulitzer race at 176.7 mph.

1921, Nov. 12—Refueling in air: Earl S. Daugherty transfers *Wesley May* with can of gasoline from wing of another plane.

1921, Nov. 15—Italian airship *Roma* makes initial ascent in U. S. at Langley Field.

1921, Dec. 1—Helium airship, Navy dirigible C-7, flown from Hampton Roads, Va. to Washington, D. C.

1921, Dec. 29—World endurance record of 26 hr. 18 min. 35 sec. made at Roosevelt Field by Edw. Stinson and Lloyd Bertaud (CJL6 BMW 185).

1922, Jan. 1—Underwriters Laboratories starts registration of aircraft for benefit of insurance companies.

1922, Jan. 1—Aeronautical Chamber of Commerce organized, New York, with I. M. Uppercu, president.

1922, Feb. 21—Airship *Roma* destroyed.

1922, Mar. 20—Airplane carrier *U.S.S. Langley*, commissioned at Norfolk, Va.

1922, June 16—Helicopter demonstrated by Henry Berliner, Washington, D. C.

1922, July 14—Aeromarine Airways starts Detroit-Cleveland flying boat service.

1922, Aug. 5-7—Lt. Clayton Bissell completes first model airway flight, Washington-Dayton-Washington.

1922, Aug. 16—Sperry airway light beacon demonstration, McCook Field.

1922, Sept. 4-5 — Transcontinental speed flight by Lt. James H. Doolittle, Pablo Beach, Fla.-San Francisco, Cal., in 22 hr. 35 min. elapsed time.

1922, Sept. 14-23—Transcontinental Army airship flight with Maj. H. A. Straus commanding crew of Capt. G. W. McEntire and others, from Langley Field, Va. to Arcadia, Cal.

1922, Oct. 5-6—World endurance record, 35 hr. 18 min. 30 sec., Rockwell Field, by Lts. J. A. Macready and O. G. Kelly (Fokker T2 Liberty 375).

1922, Oct. 14—Lt. R. L. Maughan wins Pulitzer race at 206 mph (Army Curtiss-D12 Curtiss 375).

1922, Oct. 18—World speed record of 222.97 mph set by Brig. Gen. William Mitchell in Curtiss racer.

1922, Oct. 23—American Propeller Co. demonstrates reversible propeller at Bolling Field.

1922, Dec. 18—Army's De Bothezat helicopter makes first successful flight, 1 min. 42 sec., Dayton, Ohio.

1923, Mar. 29—Lt. R. L. Maughan makes world speed record 236.58 mph (Curtiss R6-Curtiss 465), Dayton, Ohio.

1923, Apr. 16-17—World duration—distance records by Lts. J. A. Macready and O. G. Kelly (Fokker T2 Liberty 375), 36 hr. 4 min. 34 sec., 2516.55 miles.

1923, May 2-3—Cross-country non-stop flight by Lts. J. A. Macready and Oakley G. Kelly in Fokker T-2, from New York to San Diego, 2,520 miles in 26 hr. 50 min. 3 sec.

1923, Aug. 27-28—Lts. L. H. Smith and J. P. Richter (DH-4E Liberty 400) made world duration-distance refueled records: 3293.26 miles, 37 hr, 15 min. 14.8 sec.; Rockwell Field.

1923, Sept. 5—Smoke screen demonstrated by Thomas Buck Hine during naval bombing maneuvers, Cape Hatteras, N. C.

1923, Sept. 5—Langley Field bombers sink naval vessels *New Jersey* and *Virginia*.

1923, Oct. 6—Lt. A. S. Williams, U.S.N. wins Pulitzer race (Curtiss R2C1-D12 Curtiss 460) at 243.68 mph.

1923, Oct. 25-27—Barling bomber makes series weight-carrying records with greatest weight 3000 kg.; duration, altitude records, 1 hr. 19 min. 11.8 sec., 5,344 ft.

1923, Nov. 4—Lt. A. J. Williams, U.S.N. (Curtiss R2C1-D12A Curtiss 500) makes world speed record 266.59 mph.

1923, Dec. 18—For $100,000 the Christmas Aeroplane Co. assigns its aileron patent to U. S. Government.

1924, Jan. 16—Navy airship *Shenandoah* tears loose from mast in storm and rides it out during the night.

1924, Feb. 21—Alaskan airmail flown by Carl B. Eielson from Fairbanks to McGrath.

1924, Feb. 22—Lt. J. A. Macready (Lepere-supercharged Liberty 400) reaches 41,000 ft. indicated altitude.

1924, Apr. 6-Sept. 28 — Round-the-world flight by Lts. Smith, Nelson, Arnold, and Harding, Seattle to Seattle, 26,445 miles, 175 days (368 hours flying time).

1924, June 2—Lt. James T. Neely and storm-riding meteorologist Dr. C. L. Meisinger, Weather Bureau, killed by lightning in balloon near Monticello, Ill.

1924, July 1—Through transcontinental airmail service begun by U. S. Post Office.

1924, Oct. 4—Lt. H. H. Mills wins Pulitzer trophy (Verville Sperry-Curtiss HC D12A) at 216.55 mph.

1924, Oct. 7-25—Navy airship *Shenandoah* makes record cross-country cruise over 7080 miles in 235 hr. 01 min. Air hours total of 422 hr. 23 min. includes time moored.

1924, Oct. 12-15—U. S. Navy's German airship *ZR3 (Los Angeles)* makes fourth aircraft Atlantic crossing, Friedrichshafen - Lakehurst, in delivery under reparations.

1924, Oct. 29—Fog dispersal by electrified silica and sand demonstrated at Bolling Field.

1925, Jan. 29—Eclipse pictures and astronomic data secured at high altitudes by Air Service pilots.

1925, Feb. 2—Kelly Bill signed by President Coolidge authorizing private contract air transport of mail.

1925, Apr. 7—Navy carrier *Saratoga* launched.

1925, May 21-July 6—Amundsen-Ellsworth polar flight.

1925, July 15—Dr. A. Hamilton Rice Expedition, first to employ planes in exploration, returns from Amazon; Lt. Walter Hinton, pilot, in Curtiss Seagull.

1925, Aug. 4-22—MacMillan polar expedition, with Navy assistance.

1925, Aug. 5—Seven American pilots leave Paris to fly for the French in the Riff campaign in Africa. Others follow to a total of 17 pilots, 5 observers.

1925, Aug. 31-Sept. 8—In Navy's attempted San Francisco-Honolulu flight, Commander John Rodgers and crew (PN9-2 Packard 500 flying boat) alight short of mark, making nonstop cross-country seaplane record of 1,841 miles.

1925, Sept. 3—Navy dirigible, *Shenandoah*, collapsed in storm over Ava, O., killing 14 of 43 on board.

1925, Sept. 12—Morrow Board appointed by President Coolidge. (Laid down U. S. air policy.)

1925, Oct. 12—Lt. Cyrus Bettis wins 6th Pulitzer race (Curtis R3C1-V1400 Curtiss 619) at 248.97 mph.

1925, Oct. 26—Lt. J. H. Doolittle wins 8th international Schneider Seaplane Trophy race in first contest in America (Curtiss R3C2—V1400 Curtiss 619) at 232.57 mph.

1925, Dec. 17—Gen. William Mitchell found guilty of violating 96th Article of War; had risked insubordination by demanding unrestricted use of air power. Sentenced five years suspension of rank, pay and command. Resigned.

1926, Jan. 18—A $2,500,000 air promotion fund established by Daniel Guggenheim.

1926, Jan. 29—Lt. J. A. Macready (XCO5A-Liberty 400) makes American altitude record: 38,704 ft.

1926, Feb. 11—Strip bombing tests made at Kelly Field.

1926, Apr. 16—First cotton dusting plane purchased by Department of Agriculture.

1926, Apr. 30—Capt. G. H. Wilkins and Lt. Carl B. Eielson complete third round trip Fairbanks-Pt. Barrow-Fairbanks.

1926, May 8-9—Flight over North Pole by

Explorer Wilkins and Eilson used this Lockheed Vega on polar flights in 1928

Richard Byrd, navigator, and Floyd Bennett, pilot, in Fokker monoplane.

1925, May 21-July 6—Amundsen-Ellsworth bile airship *Norge* crosses Pole in voyage Spitzbergen-Teller, Alaska in 71 hours.

1926, May 20—Air Commerce Act (Bingham-Parker Bill) signed by President Coolidge; Aeronautics Branch, Department of Commerce, established.

1926, May 30—Bennett international balloon race, Brussels, brought to America by the win of W. T. Van Orman and W. W. Morton in Goodyear III balloon. Capt. H. C. Gray, Air Service, second.

1926, July 2—Army Air Service renamed Army Air Corps.

1926, July 2—First reforesting by airplane, Hawaii.

1926, July 14—Armstrong seadrome model demonstrated at Wilmington, Del. to Air Service.

1926, Aug. 18—Metal-clad airship contract let at not over $300,000.

1926, Aug. 25—JN training plane dropped by parachute, San Diego Naval Air Station.

1926, Dec. 7—Airway beacon erected by Aeronautics Branch, Department of Commerce, on Chicago-Dallas route.

1926, Dec. 21-May 2 ('27)—Mass amphibian good will flight from San Antonio, Tex. through Mexico, Central and South America and West Indies, under Maj. H. A. Dargue.

1927, Mar. 9—American balloon altitude record of 28,508 ft. made by Capt. H. C. Gray.

1927, Apr. 12—New American duration record of Clarence D. Chamberlin and B. B. Acosta (Bellanca-15 Wright 200) 51 hr. 11 min. 25 sec.

1927, May 4—Record balloon altitude attempt by Capt. H. C. Gray, 42,470 ft.

1927, May 15-19 — Greatest concentration since World War I (109 planes) in maneuvers under Brig. Gen. J. E. Fechet.

1927, May 20-21—Non-stop trans-Atlantic solo flight by Charles A. Lindbergh, New York-Paris, 3,610 miles, 33 hr. 30 min. (13th aircraft to make completed crossing.)

1927, May 25—Outside loop demonstrated by Lt. James H. Doolittle.

1927, June 4—First nonstop flight to Germany, Clarence D. Chamberlin and passenger (Bellanca-15 Wright 200), 3,911 miles, 43 hr. 49 min. 33 sec.

1927, July 25—World airplane altitude record by Lt. C. C. Champion, U. S. N. (Wright-P & W 425 supercharged) 38,484 ft.

1927, Aug. 16-17—A. C. Goebel and Lt. W. V. Davis, U. S. N. (Travelair-15 Wright 200) win Dole Oakland-Honolulu race One team finishes. Two teams lost.

1927, Sept. 1—Air express operations begun by American Railway Express and major airlines.

1927, Sept. 10—Bennett international balloon race, Dearborn, Mich., won by E. J. Hillard and A. G. Schlosser with 745 miles; 15 contestants.

1927, Oct. 12—Wright Field dedicated.

1928, Feb. 3-Dec. 28—Lt. H. A. Sutton conducts a series of spin tests; awarded Mackay Trophy.

1928, Mar. 1-9—Transcontinental amphibian flight by Army Lt. Burnie R. Dallas and civilian Beckwith Havens in Loening.

1928, Mar. 28-30—Edw. A. Stinson and George Holderman (Stinson-Wright 200) make endurance record of 53 hr. 36 min. 30 sec.

1928, Apr. 12-13—First non-stop westbound North Atlantic airplane crossing made by Baron G. von Huenefeld, Capt. Hermann Koehl and Maj. James Fitzmaurice (Junker-Junker 280/310 metal cabin land monoplane) from Baldonnel, Ireland to Greenly Island, N.F., 2,070 miles in 37 hours.

1928, Apr. 15-21 — First eastbound Arctic crossing made by Capt. G. H. Wilkins and Lt. C. B. Eielson (Lockheed-Wright 225) Pt. Barrow-Green Harbor, Spitzbergen, 2,200 miles, 20 hr. 20 min.

1928, May 24—Gen. Umberto's airship is over the Pole in trip from Spitzbergen. It is wrecked May 25, with loss of lives of crew and rescuers.

1928, May 31-June 8—First U. S.-Australian flight, by Capt. C. Kingsford-Smith, Capt. C. T. P. Ulm, H. W. Lyon and James Warner (F7 Fokker-3 Wright 200) Oakland-Brisbane, 7,410 miles; 83 hr. 19 min.

1928, June 11-12—Mexico-Washington flight by Capt. Emilio Carranza (Bryan-Wright 200).

1928, June 17-18—First woman to fly Atlantic, Amelia Earhart with Wilmer Stultz, pilot, from Trepassey Bay, N.F., to Burryport, England, in trimotored Fokker, 2,140 miles, 20 hr., 40 min.

1928, July 30-31—Twenty-second Bennett international balloon race, Detroit, won by Capt. W. E. Kepner and Lt. W. O. Fareckson; 460 miles, 43 hr.

1928, Sept. 19—First Diesel engine to power heavier-than-air craft; designed by I. M. Woolson, manufactured by Packard Motor Car Co.; flight-tested at Utica, Mich.

1928, Oct. 19—Parachute troop demonstration at Brooks Field.

1928, Nov. 11—First Antarctic flight made by Lt. C. B. Eielson and Sir Hubert Wilkins (Lockheed-Wright 22). Other flights subsequently.

1928, Nov. 23-Dec. 30—New York-Girardot, Colombia, flight by Capt. Benjamin Mendez, 4,600 miles.

1928, Dec. 19—Autogiro flight by Harold F. Pitcairn, Pitcairn Field, Willow Grove, Pa.

1929, Jan. 1-7—Refueling endurance record set by Maj. Carl Spaatz and Capt. Ira C. Eaker, Lt. Elwood R. Quesada, Lt. Harry A. Halverson, S/Sgt. Roy W. Hooe in 150 hr., 40 min., 51 sec.

1929, Apr. 3—Floyd Smith trap-door parachute demonstrated.

1929, Apr. 30—Jack Barstow makes duration glider record of 15 hr. 13 min. at Point Loma, Cali.

1929, June 28-29—Round transcontinental flight by Capt. Frank M. Hawks (Lockheed-P & W) in 40 hr. 4 min. 32 sec. Capt. E. G. Harper repeats the performance July 11-26.

1929, July 13-30—World endurance record of 420 hr. 17 min. by Forrest O'Brien and Dale Jackson (Curtiss Robin-Curtiss 70).

1929, July 18-20 — N. Y.-Alaska flight by Capt. Russ G. Hoyt. Return flight ends at Edmonton, after covering 6,000 miles out of 8,469 itinerary.

1929, Aug. 5-6—Group transcontinental flight of 9 Keystone bombers under Major Hugh J. Knerr.

1929, Sept. 24—Demonstration by Lt. James H. Doolittle results in Guggenheim report blind flying solution.

1929, Oct. 21—Air Ambulance Service organized by Colonial Flying Service and Scully Walton Ambulance Co., New York.

1929 — Bennett international balloon race won by W. T. Van Orman and aide, 341 miles, 9 contestants.

1930, Mar. 15—Glider, piloted by Capt. Frank Hawks, released from seaplane, Port Washington, N. Y.

1930, Apr. 6—Transcontinental glider in tow, piloted by Capt. Frank Hawks; San Diego to New York; 2,860 miles in 36 hr., 47 min.

1930, May 20—Dirigible-launched Vought observation plane, flown by Lt. Comdr. Charles A. Nicholson from *U.S.S. Los Angeles* to *U.S.S. Saratoga*, Lakehurst, N. J.

1930, June 4—New world altitude record of 38,560 ft. set by Navy Lt. Apollo Soucek, Anacostia, Md.

1930, June 11-July 4—World endurance record of 553 hr. 41 min. 30 sec. established by John and Kenneth Hunter (Stinson-Wright 200).

1930, July 21-Aug. 17—Refueling endurance record raised to 647 hr., 28 min. by Forrest O'Brien and Dale Jackson in a Curtiss Robin, St. Louis, Mo.

1930, July 22—German air mail plane catapulted 250 miles out en route to New York; 198 such ship-shore flights 1929-1938.

1930, Sept. 1 — Bennett international balloon race again won for U. S. by W. T. Van Orman and aide, 542 miles.

1931, Feb. 14-19—Lts. W. W. Lite, Clement McMullen fly New York-Buenos Aires, 6,870 miles, 5 days, 5 hours elapsed time; 52:15:00 flying.

1931, Mar. 30—Airplane-airship mail transfer at Scott Field.

1931, Apr. 10—Airship sub-cloud observation car demonstration by Lt. W. J. Paul.

1931, May 25-28—World endurance record, non-refueled, set by Walter E. Lees and F. A. Brossi, Bellanca, Packard Diesel 225 hp; 85 hr., 32 min., 38 sec., Jacksonville, Fla.

1931, May 14-28—Transcontinental autogiro flight by John M. Miller, from Philadelphia to San Diego.

1931, June 4—Rocket glider flown by William G. Swan; remained aloft for 30 min. with 10 rockets, Atlantic City, N. J.

1931, June 23-July 1—World flight by Wiley Post and Harold Gatty (Lockheed-PW 550), New York-Harbor Grace-Berlin-Moscow-Irkutsk-Khabarovsk-Solomon Beach-Fairbanks-Edmonton-Cleveland-New York, in 14 hours. 8 days 16 hours, 16,500 miles.

1931, July 25-26—Glider duration record of 16 hr. 38 min. by 2nd Lt. John C. Crain, Honolulu.

1931, Oct. 3-5—Trans-Pacific non-stop airplane flight by Clyde Pangborn and Hugh Herndon, Samushiro Beach, Japan, to Wenatchee, Wash.

1931, Oct 3-5—Herndon and Pangborn (Bellanca-PW 420) left New York July 28 on world trip and had reached Japan Aug. 6, abandoning attempt to better Post-Gatty record.

1931, Oct. 6-9—Navy bomber tests on *U.S.S. Pittsburgh* in Chesapeake Bay.

1931, Nov. 3—Dirigible, *Akron*, carried record number of 207 persons in flight over New York and Philadelphia.

1931, Dec. 17-18—Glider duration record of 21 hr. 34 min. by Lt. Wm. A. Cooke, Honolulu.

1932, May 9—First solo blind flight, by Capt. Albert F. Hegenberger, Wright Field, Dayton, O.

1932, May 20-21—Amelia Earhart soloes across Atlantic, St. Johns, New Brunswick to Londonderry, Ireland, in Wasp-powered Lockheed Vega.

1932, Aug. 25—First woman to complete non-stop transcontinental flight, Amelia Earhart, Los Angeles to Newark.

1932, Dec. 1—Teletypewriter weather map service inaugurated by Department of Commerce.

1933, Jan. 19 — Rocket guided by sound waves from enemy aircraft proposed.

1933, Jan. 23 — Steam airplane project launched by Great Lakes Aircraft and General Electric Co. Later Besley brothers fly their steam airplane.

1933, Apr. 4—Navy dirigible, *Akron*, crashes into sea, killing 73; Comdr. Herbert V. Wiley, commanding.

1933, May 3-26 — Airborne troop logistics part of West Coast maneuvers, with 283 aircraft.

1933, July 15-22—Solo round-the-world flight by Wiley Post in Lockheed Vega monoplane, *Winnie Mae*, in 7 days, 18 hr., 49 min.

1933, Sept. 4—World speed record for land planes set at 304.98 mph by James R. Wedell in Wasp-powered Wedell-Williams racer.

1933, Nov. 20-21—World balloon altitude record set at 61,237 ft. by Lt. Comdr. T. G. W. Settle and Maj. C. L. Fordney over Akron, O.

1934, Jan. 10-11—Longest non-stop overwater mass flight completed by six P2Y-1 Navy flying boats under command of Lt. Comdr. Knefler McGinnis, San Francisco to Honolulu.

1934, Feb. 9 — Postmaster General Farley cancels certain mail contracts. Air Corps flies the mail Feb. 19-Mar 10; Mar. 19-May 5.

1934, June 12—Howell commission to study airmail act and report on all phases of aviation by Feb. 1, 1935.

1934, Dec. 31—War Department announces instruction governing GHQ Air Force organization and operation.

1935, Jan. 3—Antarctic flight by Ellsworth and Kenyon (Northrop-PW 600).

1935, Feb. 12—Navy dirigible, *Macon*, crashes into sea, killing 2.

1935, June 12-Aug. 14—Washington-Alaska-Washington flight (Douglas Amphibian-2 Wasps) in test of practicability of such flight with standard equipment and as any ordinary flight. Capt. Hez McClellan and crew of two.

1935, Aug. 15—Will Rogers and Wiley Post killed in take-off crash near Point Barrow, Alaska.

1935, Nov. 11—Balloon altitude record of 72,394 ft. by Capt. O. A. Anderson and Capt. Albert Stevens.

1935, Nov. 21-Dec. 5—Antarctic flights renewed by Ellsworth and Kenyon (Northrop-PW 600).

1935, Nov. 22-29—Trans-Pacific airmail flight by Capt. Edwin C. Musick, Pan American Airways, from San Francisco to Honolulu, Midway Island, Wake Island, Guam and Manila, in Martin *China Clipper*.

1936, June 7—All-instrument transcontinental flight by Maj. Ira C. Eaker, between New York and Los Angeles.

1936, Sept. 10-Oct. 20—Regular trans-Atlantic flying boat service by Deutsche Lufthansa. (Dornier twin Diesel engine 600.) Continued in 1937 and 1938.

1936, Sept. — Trans-Atlantic round-trip flight by Henry (Dick) Merrill and Harry Richman, New York to London and return.

1937, May 6—German dirigible, *Hindenburg*, burned on mooring, killing 36, Lakehurst, N. J.

1937, May 20-July 3—Amelia Earhart Putnam and Fred Noonan lost in Pacific in round-the-world attempt.

1937, June 25—Non-stop transcontinental amphibian flight by Richard Archbold in PBY-1, Catalina, from San Diego to New York.

1937, July 3-Sept. 3—Regular trans-Atlantic service test by Pan American Airways. Imperial Airways also similarly operate July 5-Aug. 2 and continue in 1938.

1937, Aug. 12—In joint coast defense exercise, Navy patrol planes locate target ship *Utah* 300 miles off San Francisco; Air Corps planes attack.

1937, Aug. 23—Wholly automatic landings made, "first in history," at Wright Field by Capt. Carl J. Crane with 2 passengers; awarded DFC.

1938, Feb. 15-27—Miami-Buenos Aires-Miami flight of 6 bombers under Lt. Col. Robert Olds, for inauguration President Ortiz.

1938, Feb. 26—Government acquires monopoly on helium by purchasing production facilities at Dexter, Kan.

1938, Apr. 22—Capt. E. V. Rickenbacker purchases Eastern Air Lines from North American Aviation, Inc., for $3,500,000.

1938, June 23—Civil Aeronautics Authority with five members, an administrator, and a three-man Safety Board, created under Civil Aeronautics Act signed by President. This supersedes Aeronautics Branch, Department of Commerce.

1938, July 10-14—Howard Hughes and crew of four fly short northern course around world in 3 days, 19 hr., 8 min.

1938, July 17-18—Douglas (Wrong-Way) Corrigan flies from New York to Ireland in nine-year-old Curtiss Robin.

1938, Aug. 3-12—Miami-Bogota-Miami goodwill flight of 3 bombers under Major Vincent J. Meloy.

1938, Aug. 10-11 — First Berlin-New York nonstop flight by Capt. Alfred Henke and crew (Focke-Wulf Condor 200), 4,577 miles, 24 hr. 54 min.

1938, Aug. 22—Civil Aeronautics Act becomes effective.

1939, Feb. 4-6—Langley Field-Santiago Red Cross flight by Major C. V. Haynes in XB bomber with medicinal supplies.

1939, Mar. 5—Non-stop airmail system by pick-up demonstrated by Norman Rintoul and Victor Yesulantes in Stinson Reliant planes, Coatesville, Pa.

1939, Apr. 3—The National Defense Act, providing for aerial rearmament, signed by President Roosevelt.

1939, Apr. 17—Inclined runways for assisted takeoff studied by Air Corps Board.

1939, May 20—North Atlantic airmail service begun by PAA between Port Washington, L. I., the Azores, Portugal and Marseille, France.

1939, June 27—Bill authorizing Civilian Pilot Training Program signed by President.

1939, Sept. 1-3—Germany invades Poland. England and France declare war on Germany.

1940, Mar. 26—U. S. commercial airlines complete a full year of flying without a fatal accident or serious injury to a passenger or crew member.

1940, July 1—Air Safety Board abolished with its functions delegated to the Civil Aeronautics Board. Civil Aeronautics Administration transferred to Department of Commerce.

1940, Sept. 23—House committee asks $80 million for airport development, in $500 million program; $40 million voted.

1941, Mar. 17—Milwaukee renames its airport as General Mitchell Field.

1941, Apr. 15—First officially-recorded rotor helicopter flight in western hemisphere, Vought-Sikorsky VS-300A, piloted by Igor I. Sikorsky; flight time, 1 hr., 5 min., 14.5 sec., Stratford, Conn.

1941, May—Barrage balloon defense transferred from Air Corps to Coast Artillery.

1941, June 5—Ferry Command, for delivery of planes to Britain, organized by Army Air Corps.

1941, June 20—Army Air Force, comprising office of Chief of Air Corps and Air Force Combat Command, created.

1941, June—First woman to ferry bomber across Atlantic, Jacqueline Cochran, Canada to British Isles.

1941, Sept. 5—Mass trans-Pacific flight of heavy bombers completed by nine Army B-17 Flying Fortresses.

1941, Dec. 7—Pearl Harbor.

1942, Apr. 8—First flight of Ferry Command over Himalayan "Hump" made by Lt. Col. William D. Old, between Assam, India and Kunming, China.

1942, Apr. 18—First bombing attack on Japanese mainland by 16 B-25 Mitchell bombers from Navy carrier, *Hornet;* Lt. Col. James H. Doolittle commanding.

1942, May 4-9—Battle of Coral Sea.

1942, June 20—Ferry Command redesignated Air Transport Command under Maj. Gen. Harold L. George.

1942, June 3-7—Battle of Midway.

1942, June 17—AAF tow planes successfully pick up gliders in tests at Wright Field.

1942, Aug. 17—First official bombing raid of Eighth Air Force, 12 Flying Fortresses, Brig. Gen. Ira C. Eaker commanding, Rouen, France.

1942, Sept.—Fifty American Eagle squadron pilots, RAF, all Americans, transferred to Eighth Air Force. (Fourth Fighter Group.)

1942, Oct. 1—Jet plane built and flown by Robert M. Stanley; Bell Airacomet (XP-59A), Muroc Dry Lake, Cal.

1943, Mar. 1-4—Battle of Bismarck Sea.

1943, Mar. 19—Lt. Gen. Henry H. Arnold, commanding general of the AAF, advanced to full four-star general, the first in air history.

1943, June 24—World's longest parachute drop, 40,200 ft., made by Lt. Col. W. R. Lovelace at Ephrata, Wash.

1943, June 11—First ground victory by air power when Pantelleria, Italy, surrenders unconditionally to Lt. Gen. Carl Spaatz. First case in history of a well-fortified citadel being defeated without aid of ground forces.

1943, Oct.—World's longest freight line opened by Capt. J. L. Okenfus and crew of five in 28,000-mile round-trip flight, Ohio to India.

1944, June—Army Air Force reaches peak with 78,757 aircraft.

1944—U. S. Aircraft industry ranks first in world with an annual production value of $16,745,000,000.

1945, May 8—War in Europe ends.

1945, Aug. 6—Atomic bomb dropped on Hiroshima from B-29, *Enola Gay*, under command of Col. Paul W. Tibbets, Jr.

1945, Aug. 14—Japan's surrender ends World War II.

1945, Sept. 28-Oct. 4—Round-the-world air service begun by Air Transport Command, Douglas C-54E, Globester, 9 passengers, 23,147 miles in 149 hr., 49 min.

1946, Jan. 26—Jet-propelled P-80, flown by Col. William H. Councill, sets non-stop transcontinental record of 4 hr., 13 min., 26 sec., between Long Beach, Cal., and New York.

1946, Mar. 12—First commercial helicopter license granted by Civil Aeronautics Administration for Bell 2-place Model 47.

1946, Mar. 22—First American-built rocket to escape earth's atmosphere, reaches 50-mile height. Constructed by Douglas.

1946, May 13—Federal Aid Airport Bill signed by President Truman.

1946, June 22—Jet-powered airmail delivery in two Army P-80's from Schenectady, N. Y., to Washington and Chicago.

1946, July 21—The McDonnell XFH-1 Phantom is first U.S. jet to operate from carrier, *U.S.S. Franklin D. Roosevelt*.

1946, Aug. 6—Two B-17 radio-controlled bombers with stand-by crews, fly non-stop, Hilo, Hawaii, to Muroc Lake, Cal.

1946, Aug. 8—Preliminary test flight of Army's B-36, Consolidated Vultee, world's largest land based bomber.

1946, Aug. 12—National Air Museum established under Smithsonian Institution.

1947, June 15—Special Board on Air Safety appointed by President.

1947, July 18—Air Policy Commission established by President.

1947, July 26—Army-Navy Merger Bill signed by President, making Department of Air Forces co-equal with Army and Navy, and creating Department of Defense.

1947, Oct. 17—First faster-than-sound flight by Capt. Charles E. Yeager in rocket-powered Air Force research plane, Bell XS-1, betters 760 mph. (Not announced officially until June 10, 1948.)

1948, June 18—Air parcel post system established by Congress; to begin Sept. 1.

1948, June 26—Berlin Airlift begins "Operation Vittles" with Douglas C-47's carrying 80 tons of supplies the first day. During first five months, Airlift tops cargo volume of all U.S. airlines by flying 93,000,000 ton-miles.

1948, July 1—Air Transport Command and Naval Air Transport Service consolidated as Military Air Transport Service (MATS) under command of Air Force Chief of Staff.

1948, Sept. 15—U. S. Air Force recaptures world speed record with North American F-86 jet fighter traveling 670.981 mph, flown by Maj. Richard L. Johnson.

1948—Northrop's YB-49 Flying Wing, first eight-jet bomber in the U.S. Air Force, makes longest jet-propelled flight on record of approximately 3,400 miles at average speed of 382 mph.

1949, Jan. 7—Air Force announces a new unofficial climbing speed record set by the Bell X-1 at Muroc Air Force Base with Capt. Charles E. Yeager at the controls, climbing more than 13,000 ft. per min., compared with 8-10,000 ft. per min. for jet planes.

1949, Jan. 14—Capt. William Odom, flying a specially modified Beechcraft Bonanza, sets a new lightplane distance record, crossing from Honolulu to Oakland, Cal.

1949, Feb. 7—Eastern Air Lines reports new transcontinental speed record for transport aircraft set Feb. 5 by new-type Lockheed Constellation on delivery flight from Los Angeles to La Guardia Field in 6 hr. 17 min. 39-2/5 sec.

1949, Feb. 8—Boeing XB-47 jet bomber sets cross-country speed record to Andrews Field, Washington, D. C. from Moses Lake, Wash. in 3 hr. 46 min.

1949, Mar. 2—Air Force completes the first nonstop round-the-world flight in history, as a Boeing B-50 bomber, *Lucky Lady II*, lands at Carswell AFB, Ft. Worth, Tex. at 9:30 CST, after a 94-hour trip; piloted by Capt. James Gallagher, assisted by a crew of 13, the B-50 flew a total of 23,452 miles at an average speed of 249 mph. Four refueling contacts were made with B-29 tankers.

1949, Mar. 8—New world distance record for light planes set by Capt. William Odom in a Beechcraft *Bonanza*, flying 5,273 miles from Honolulu to Teterboro, N. J., in 36 hr. 2 min.

1949, May 3—The Martin *Viking*, 45-ft. research rocket, is fired successfully at White Sands Proving Ground, Las Cruces, N. M., reaching an altitude of 51½ miles and a speed of 2,250 mph.

1949, May 6—Sikorsky S-52-1 helicopter sets new international speed record of 122.75 mph.

1949, Oct. 3—Navy jet-rocket special research plane, the Douglas D-558-II Skyrocket, reaches a top speed of slightly over 700 mph at an altitude of 25,000 ft. in test flight at Muroc, Cal.

1949, Nov. 22—*American Aviation Daily* survey of 1949 Air Force purchases reveals 2,324 planes were bought, totalling 31,746,000 pounds.

1950, Jan. 3—Jacqueline Cochran sets new official F.A.I. 500 kilometer closed course record flying a North American F-51 (Packard-built Merlin V1650) at 444 mph.

1950, Jan. 22—Paul Mantz sets new transcontinental record flying a North American P-51 Mustang (Allison) from Burbank, Calif. to La Guardia Field, N. Y. in 4 hr. 52 min. 58 sec.

1950, Feb. 9—Navy Lockheed P2V Neptune (Wright 3350) patrol bomber completes 5,156-mile flight in 25 hr. 57 min.

1950, Mar. 31—Ana Louisa Branger, flying a Piper Cub Special powered by a Continental C-90-8F engine, sets official new lightplane international altitude record of 24,504 feet.

1950, Sept. 5—North American Aviation announces successful completion of tests at Edwards AFB in which heavy bombs were dropped for first time at speeds over 500 mph with a B-45 Tornado (GE-J47).

1950, Sept. 22—Col. David C. Schilling and Lt. Col. William D. Ritchie fly London-New York nonstop with three in-flight refuellings in two Republic F-84E (Allison J-35A-17) jet fighters. (Schilling completed flight; Ritchie bailed out over Newfoundland and was later rescued by helicopter.)

1950, Nov. 10 — A Lockheed F-80 shoots down a Russian-built MIG-15 in first jet aerial combat, Korea.

OFFICIAL RECORDS

THE WHY AND HOW OF OFFICIAL AIRCRAFT RECORDS

The Federation Aeronautique Internationale, Paris, France, better known as the FAI, currently composed of the national aero clubs of thirty-two nations, is the governing body of the world for official aircraft records and sporting aviation contests. The FAI was organized in Paris in October, 1905, by representatives from Belgium, France, Germany, Great Britain, Italy, Spain, Switzerland, and the United States. Representing the FAI in the United States is the National Aeronautic Association, organized in 1922.

The rules for all official world and international aircraft records are proposed initially by the various national aero clubs who are members of FAI. Later they are evaluated by the International Sporting Aviation Commission of FAI and then submitted, for final approval, to the delegates of the many national aero clubs who attend each annual FAI conference. Developed over a period of forty-four years, the rules are markedly complete. All attempts to establish official aircraft records must meet identical FAI standards.

NAA also rules on the best national performances and on many records of strictly national interest, such as inter-city speed times of transport aircraft.

FAI-NAA rules have these goals: (1) an equal opportunity to every competitor, (2) competent, unbiased judging, and (3) scientifically accurate records.

The NAA Contest Board enforces FAI-NAA regulations in the United States.

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How to Establish an Official Aircraft Record

To attempt an official aircraft record, your first step is to get permission from the NAA Contest Board, 1025 Connecticut Ave., N. W., Washington 6, D. C. The request may be in a letter or by filling out the Contest Board's standard Record Sanction Request form. You must specify the record to be attempted, the aircraft and engine, the pilot, and the date and place of takeoff and finish. An application should be submitted at least two weeks in advance. The NAA sanction fee (see Record Test Information below) is variable, depending on the record to be attempted, and the preparation necessary. This fee must be paid in advance, and is not returnable, although it is good for sixty days after the initial record attempt.

The second important step is to get an NAA directing official or FAI timer if closed circuit speed or maximum speed over a three kilometer straightaway course is to be attempted. The NAA Contest Board has a number of accredited officials throughout the United States (see Registered FAI Timers in U. S. below). Where world records or others requiring special instruments and knowledge are concerned, it has been found necessary to use specialists from Washington for the job.

NAA contest headquarters advises the record sponsor of the instruments (certified watches, barographs, and electric timing equipment) required for recording the flight. Only NAA-approved instruments can be used for recording official record attempts. The instruments that are needed can be rented at cost from the NAA Contest Board; a deposit is required, Barographs are designed for easy installation. Each instrument has to have an official NAA seal and the clockwork mechanism started before take-off. At the end of the run, the clock is turned off and the instrument, with seals intact, forwarded to the National Bureau of Standards for calibration. The results show the pressure altitude of the aircraft during the entire flight. They also give a fairly accurate indication of the time aloft and a record of any intermediate landings.

Before an official stop-watch is used, it must pass an exhaustive test at an approved government laboratory, where it is subjected to heat and cold airbaths in six different positions. The more complex photo-electric timing apparatus owned by NAA, used in connection with the timing of straightaway speed dashes, is accurate to 1/100th of a second.

Straightaway short speed courses must be actually measured and the accuracy required is minus nothing, plus fifteen meters. No credit is given for extra distance flown. Closed circuit speed courses must be established from known geographic coordinates by determination of the arc of the great circle, taken at sea level, which unites the verticals of the points considered. Closed circuit speed courses may have as many sides as desired, but the start and finish times must be taken by an accredited timer at the same place using parallel sighting wires established in a plane perpendicular to and at right angles to one leg of the course. This line must be established by licensed engineers. Closed circuit speed courses may be longer than desired, but again no credit is given for extra distance flown.

As a general rule, octagonally shaped speed courses for short distances are best for high-speed aircraft; on the other hand two-way (out and return) courses, where the contestant passes to the outside of the turning point, are more desirable for long distances. Courses should be located to offer the pilot as much navigation help as possible.

Aircraft attempting world and international records for distance and closed circuit speed must carry at least one approved barograph, preferably two. For light aircraft altitude records, including helicopters, the barographs must be designed to connect to the static pressure system of the aircraft. For heavy aircraft altitude record attempts, with or without load, a photo panel to record pressure and outside air temperature indications simultaneously (on film) during both the ascent and descent, or other acceptable apparatus, such as radar, is essential; for maximum speed records over a measured three kilometer straightaway course, special photo-electric timing apparatus and observer aircraft, with barographs aboard, are required.

The final results of any official world or international record depend on instrument calibration results submitted to NAA by the Bureau of Standards. This usually takes about two weeks.

NAA barographs do not have to be used for national (U. S.) intercity speed records, since total elapsed time and distance covered are the only factors considered in the final computation. A number of these records have been established recently by airlines.

The International Sporting Aviation Commission of FAI has separated jets from reciprocating engine types and ruled that all closed speed records can be conducted at any altitude. Radar will be used if needed. Barographs are still used to establish level-flight altitude of the aircraft from start to finish. These changes were effective Jan. 1, 1950.

CHARLES S. LOGSDON
DIRECTOR, CONTEST DIVISION, NAA

Record Fee Information

The official FAI-NAA fee covers flight preparation and recording including a complete report to FAI and the sponsor for his own records. The FAI record registration fees for world and international records have been established by the official delegates from each nation who attend the annual FAI Conferences. The NAA portion of this is about one-half. When a national (U. S.) record only is established, the NAA registration fee amounts to $90.

Instrument calibration fees shown below are levied by the National Bureau of Standards. Other charges cover only the maintenance of NAA instruments. Specific fees and charges incident to the many types of world, international, and national records recognized by FAI and NAA are:

WORLD RECORD FEES

NAA sanction fee	$300.00
Barograph rental (2 dual traverse type)	60.00
Barograph calibration (depending on record)	$40.00- 150.00
Course (speed or closed circuit) license fee	50.00
Registration fee	2,000.00

INTERNATIONAL RECORD FEES

Maximum Speed over a Three Kilometer Straightaway Course

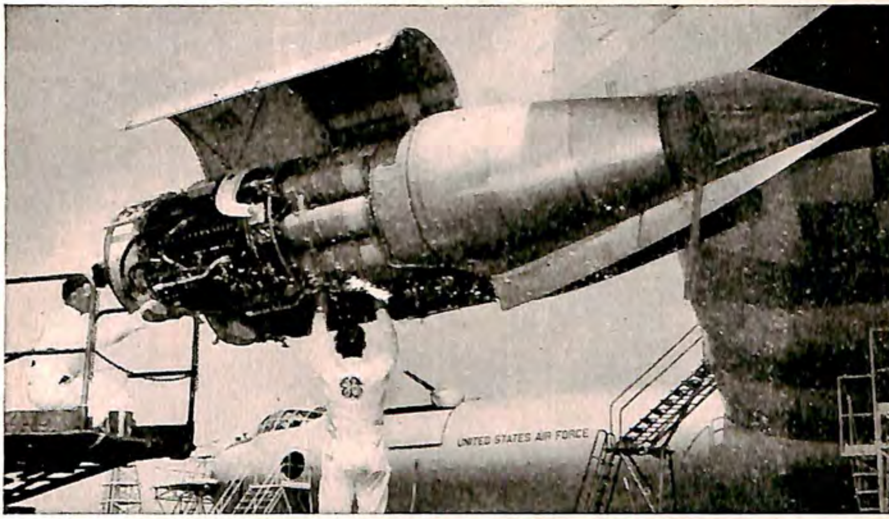
NAA sanction fee	$300.00
Barograph rental (four for two observer aircraft)	40.00
Rental of electric printing chronograph, cameras and accessories	150.00
Barograph calibration fees	70.00
Speed course license fee (if course not established)	50.00
Registration, new international record	230.00
Heavy categories	230.00
Light categories	
Altitudes, closed circuit, distance	
1st category	30.00
2nd category	60.00
3rd category	90.00
4th category	120.00
5th category	150.00

Speed in a Closed Circuit

NAA sanction fee	$150.00
Barograph rental (two small)	20.00
Barograph calibration fee	40.00
Rental of three certified chronometers	15.00
Speed course license fee (if course not established)	50.00
Registration, new national and international record (Same as above)	

Distance in a Closed Circuit and Distance, Refueling in Flight

NAA sanction fee	$150.00
Barograph rental (two small instruments)	20.00
Barograph calibration	20.00
Registration, new national and international record (Same as above)	


UNITED STATES AIR FORCE

Distance without Refueling (not in Closed Circuit)

NAA sanction fee	$ 75.00
Barograph rental (two small instruments)	20.00
Barograph calibration	20.00
Registration, new national and international record (Same as above)	

Altitude, with or without Load (Heavy Aircraft)

NAA sanction fee	$150.00
Sponsor provides instruments	
Instrument calibration	150.00
Registration, new national and international record (Same as above)	

Altitude (Light Aircraft)

NAA sanction fee	$ 75.00
Sponsor provides instruments	
Instrument calibration	50.00
Registration, new national and international record (Same as above)	

Transcontinental and Inter-City Records (all types)

NAA sanction fee	$ 25.00
NAA registration fee	90.00

ACTIVE FAI TIMERS

Carl Adams, Miami Springs, Fla.
Peter Altman, Detroit, Mich.
Byron Armstrong, New Orleans, La.
Capt. R. S. Barnaby, USN (Ret.), Phila., Pa.
Allan Bonnalie, San Francisco, Cal.
Richard F. Bradley, San Francisco, Cal.
Dr. J. D. Brock, Alton, Mo.
W. G. Broughton, Schenectady, N. Y.
Willis G. Brown, Washington, D. C.
L. B. Copley, Elmira, N. Y.
Luzern Custer, Dayton, O.
W. R. Enyart, Tarrytown, N. Y.
Frank A. Flynn, San Francisco, Cal.
Charles H. Gale, New York, N. Y.
Valentine Gephart, Seattle, Wash.
Dr. Ralph Greene, Jacksonville, Fla.
W. J. Hallahan, New York, N. Y.
Christos Harmantos, Washington, D. C.
J. P. V. Heinmuller, New York, N. Y.
H. B. Hendrickson, Washington, D. C.
W. H. Hitchman, Los Angeles, Cal.
F. K. Iszard, Elmira, N. Y.
J. H. Kangeter, Honolulu, Hawaii
H. W. Kirshbaum, Sunnyvale, Cal.
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A. E. Merriam, Wichita, Kans.
Joseph Nikerent, Los Angeles, Cal.
R. C. Oertel, New York, N. Y.
J. B. Petersen, USNR, Washington, D. C.
Odis Porter, Indianapolis, Ind.
H. A. Richert, Detroit, Mich.
Capt. E. W. Rounds, USNR
Carl F. Schory, E. Hartford, Conn.
N. F. Scudder, Los Angeles, Cal.
Lewis Sevier, Miami, Fla.
B. Russell Shaw, St. Louis, Mo.
Russell J. Smith, Milwaukee, Wis.
Norman Snyder, Syracuse, N. Y.
Earl R. Southee, Washington, D. C.
Dudley M. Steele, Los Angeles, Cal.
R. J. Underwood, Detroit, Mich.
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Walter D. Ward, Mineola, L. I., N. Y.
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OFFICIAL F.A.I. WORLD AIR RECORDS

MAXIMUM SPEED OVER A 1.864 MI. COURSE .... 670.981 mph.
Maj. Richard L. Johnson, USAF, United States, Sept. 15, 1948.

MAXIMUM SPEED IN A CLOSED CIRCUIT .... 635.686 mph.
Col. Fred J. Ascani, U.S.A.F., United States.
Detroit-Wayne Major Airport, August 17, 1951.

DISTANCE IN A STRAIGHT LINE .... 11,235.600 mi.
Comdr. Thomas D. Davies, USN.; Comdr. Eugene P. Rankin, USN.; Comdr. Walter S. Reid, USN.; Lt. Comdr. Ray A. Tabeling, USN.; United States, Sept. 29 - Oct. 1, 1946.

ALTITUDE .... 72,394.795 ft.
Capt. Orvil Anderson and Capt. Albert Stevens, United States, Nov. 11, 1935.

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OFFICIAL F.A.I. INTERNATIONAL AND NATIONAL "CLASS" RECORDS

AIRPLANES—(Class C) Group III

RECIPROCATING ENGINES

DISTANCE, CLOSED CIRCUIT

International Record .... 8,854.308 mi.
Lt. Col. O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot; Capt. William D. Bailey, Capt. F. O. Hinckley, 1st Lt. A. J. Orillon, 1st Lt. R. L. Lewis, M/Sgt. J. J. Blancio, T/Sgt. J. R. Sanders, S/Sgt. J. Gauthier, and M/Sgt. R. B. Corey, crew: USAAF, United States, Boeing B-29 monoplane, 44-84061, 4 Wright 3350-57A engines of 2,200 hp each, MacDill Field, Tampa, Fla., Aug. 1 - 3, 1947.

National (U.S.) Record .... Same as above.

DISTANCE IN A STRAIGHT LINE

International Record .... 11,235.600 mi.
Comdr. Thomas D. Davies, USN.; Comdr. Eugene P. Rankin, USN.; Comdr. Walter S. Reid, USN.; and Lt. Comdr. Ray A. Tabeling, USN; United States, Lockheed P2V-1 monoplane, 2 Wright R-3500 engines of 2,300 hp each, from Pearce Field, Perth, Australia, to Port Columbus, Columbus, O., Sept. 29 - Oct. 1, 1946.

National (U.S.) Record .... Same as above.

ALTITUDE

International Record .... 56,046 ft.
Mario Pezi, Italy, Caproni 161 biplane, Piaggio XI R.C. engine, Montecelio, Oct. 22, 1938.

National (U.S.) Record .... 47,910 ft.
Maj. F. F. Ross, pilot; Lt. D. M. Davis, co-pilot; Lt. C. B. Webster, Lt. L. B. Barrier, F/O Pamphille Morrissette, Sgt. W. S. George, crew; USAAF, Boeing B-29 monoplane, 4 Wright R-3350-23 A 2,000 hp engines, Harmon Field, Guam, M. I., May 15, 1946.

MAXIMUM SPEED OVER A 86.411 MI. MEASURED COURSE

International Record .... 469.220 mph.
Fritz Wendel, Germany, Messerschmitt B. F. 109R, Daimler Benz 601 1,000 hp engine, Augsburg, Apr. 26, 1939.

National (U.S.) Record .... 412.002 mph.
Jacqueline Cochran, North American F-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, Thermal, Cal., Dec. 17, 1947.

MAXIMUM SPEED AT HIGH ALTITUDE

International Record .... 464.374 mph.
Jacqueline Cochran, United States, North American F-51 low wing monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, near Indio, Cal., Apr. 9, 1951.

National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

International Record .... 635.685 mph.
Col. Fred J. Ascani, USAF, United States, North American F-86E, General Electric J-47 jet engine, Detroit-Wayne Major Airport, Romulus, Mich., Aug. 17, 1951.

National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

International Record .... 510.925 mph.
J. Reginald Cooksey, Great Britain, Gloster Meteor F.8, VZ 496, 2 Rolls Royce Derwent jet engines, 3,500 pounds thrust, Moreton Valence, Campo Ness Course, May 12, 1950.

National (U.S.) Record .... 462.970 mph.
1st Lt. Henry A. Johnson, USAAF, United States, P-80 jet, Allison J-33 engine, Dayton, O., June 3, 1946.


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SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

International Record .... 447.470 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard built Rolls Royce Merlin Engine of 1,450 hp near Palm Springs, Cal., May 22, 1948.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD

International Record .... 338.392 mph.
Capt. J. E. Bauer, pilot; Capt. J. E. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines of 2,200 hp each, Dayton, O., June 28, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD

International Record .... 273.195 mph.
Lt. Col. O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot; Capt. William D. Bailey; Capt. F. O. Hinckley, 1st Lt. A. J. Orillon, 1st Lt. R. L. Lewis, M/Sgt. J. J. Blancio, T/Sgt. J. R. Sanders, S/Sgt. J. Gauthier, S/Sgt. R. B. Corey, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-57A engines, 2,200 hp each, Wright Field, Dayton, O., July 29 - 30, 1947.
National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE

International Record .... 47,910.009 ft.
Maj. F. F. Ross, pilot; Lt. D. M. Davis, co-pilot; Lt. L. B. Barrier, Lt. C. B. Webster, F/O Pamphille Morrissette and Sgt. W. S. George, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 15, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI.

International Record .... 325.713 mph.
Furio Niclot, Italy, Breda 88, 2 Piaggio XI R. C. 40B, 1,000 hp engines, Dec. 9, 1937.
National (U.S.) Record .... 259.398 mph.
Capt. C. S. Irvine and Capt. P. H. Robey, USAAC pilots; Capt. C. J. Crane and Lt. P. G. Miller, USAAC, Boeing YB-17A monoplane, 4 Wright 840 hp engines, Dayton, O., Aug. 1, 1939.

SPEED FOR 1,242.739 MI.

International Record .... 365.649 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 338.392 mph.
Capt. J. E. Bauer, pilot; Capt. J. E. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines of 2,200 hp each, Dayton, O., June 28, 1946.
National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 4,409.244 LB.

ALTITUDE

International Record .... 46,522.217 ft.
Col. E. D. Reynolds, pilot; Capt. B. P. Robson, co-pilot; Lt. J. G. Barnes, Lt. Theodore Madden, Lt. K. H. Morehouse, S/Sgt. W. C. Flynn and Cpl. A. L. Lentowski, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 13, 1946.
National (U.S.) Record .... Same as above.

IN ANY LANGUAGE . . . .

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FORSVAR AV FREDEN

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SPEED FOR 621.369 MI.

International Record .... 369.692 mph.

Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI.

International Record .... 365.649 mph.

Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 338.392 mph.

Capt. J. E. Bauer, pilot; Capt. J. F. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Ross, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 28, 1946.

National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 11,023 LB.

ALTITUDE

International Record .... 45,252.534 ft.

Lt. J. P. Tobinson, pilot; Lt. Lloyd A. Lee, co-pilot; Lt. D. B. Gleicher, Lt. A. W. Armistead, Lt. R. M. Beattie, Lt. F. J. Royce, F/O R. F. Johnson and Mario R. Genta, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 14, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI.

International Record .... 369.692 mph.

Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI.

International Record .... 365.649 mph.

Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 266.023 mph.

Lt. Col. R. G. Ruegg, pilot; Lt. Col. Carl P. Walter, co-pilot; 2nd Lt. J. E. Wetzel, M/Sgt. William Cunningham and M/Sgt. R. L. Hilton, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 21, 1946.

National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 22,046 LB.

ALTITUDE

International Record .... 41,561.597 ft.

Capt. A. A. Pearson, pilot; Lt. V. L. Dalbey, co-pilot; Lt. R. S. Strasburg, Lt. I. E. Bork, Cpl. J. T. Collins and Cpl. Joseph Friedberg, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 8, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI.

International Record .... 357.731 mph.

Capt. J. D. Bartlett, pilot; Lt. William Murray, co-pilot; M/Sgt. C. M. Youngblood, Cpl. D. J. Shrader and Cpl. R. F. Wilden, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 19, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI.

International Record .... 357.035 mph.

Capt. J. D. Bartlett, pilot; Lt. William Murray, co-pilot; M/Sgt. C. M. Youngblood, Cpl. D. J. Shrader and Cpl. R. F. Wilden, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 19, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 266.023 mph

Lt. Col. R. G. Ruegg, pilot; Lt. Col. Carl P. Walter, co-pilot; 2nd Lt. J. E. Wetzel, M/Sgt. William Cunningham and M/Sgt. R. L. Hilton, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 21, 1946.

National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 33,069 LB.

ALTITUDE

International Record .... 39,520.918 ft.

Col. B. H. Warren, pilot; Maj. J. R. Dale, Jr., co-pilot; Lt. W. D. Collier, M/Sgt. Gordon S. Fish, S/Sgt. V. H. Worden and Sgt. Thomas H. Hall, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 11, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI. .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.

SPEED FOR 3,106.849 MI. .... No official record.

GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561,666 FT.

International Record .... 33,435 lb.

Col. B. H. Warren, pilot; Maj. J. R. Dale, Jr., co-pilot; Lt. W. D. Collier, M/Sgt. Gordon S. Fish, S/Sgt. V. H. Worden and Sgt. Thomas H. Hall, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 11, 1946.

National (U.S.) Record .... Same as above.

CIRCUIT OF THE WORLD .... No official record.

AIRPLANES—(Class C) Group II

JET ENGINES

DISTANCE, CLOSED CIRCUIT .... No official record.

DISTANCE IN A STRAIGHT LINE .... No official record.

ALTITUDE

International Record .... 59,445.359 ft.

John Cunningham, Great Britain, de Havilland 100 Vampire Mark I aircraft powered with a de Havilland Ghost 2/2 T.G. 278 jet engine, producing a thrust of 4,300 lb., at Hatfield, Hertfordshire, Mar. 23, 1948.

National (U.S.) Record .... No official record.

MAXIMUM SPEED

International Record .... 670.981 mph.

Maj. Richard L. Johnson, USAF, United States, North American F-86 Swept-Back-Wing monoplane, General Electric J-47 jet engine, Muroc Air Force Base, Cal., Sept. 15, 1948.

National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

International Record .... 605.230 mph.

John Douglas Derry, Great Britain, de Havilland D.H. 108 VW 120 Aircraft, de Havilland Goblin 4 jet engine, Hatfield, Hertfordshire, Apr. 12, 1948.

National (U.S.) Record .... 494.973 mph.

Capt. R. A. Baird, USAF, United States, Lockheed P-80R jet propelled monoplane, Allison J-33 engine, Dayton, O., Apr. 19, 1946.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

International Record .... 510.925 mph.
J. Reginald Cooksey, Great Britain, Gloster Meteor F. 8, VZ 496, 2 Rolls Royce Derwent 3,500 lb. thrust jet engines, Moreton Valence, Campo Ness Course, May 12, 1950.

National (U.S.) Record .... 462.970 mph.
Lt. John J. Hancock, USAAF, Lockheed P-80 monoplane, Allison J.33 jet engine, Dayton, O., May 19, 1946.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

International Record .... 440.298 mph.
Lt. John Hancock, USAAF, United States, Lockheed P-80 monoplane, Allison J-33 jet engine, Dayton, O., May 19, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD .... No official record.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE .... No official record.

SPEED FOR 621.369 MI.

International Record .... 410.431 mph.
Lt. Col. T. P. Gerrity, pilot; Capt. Wm. Rickert, co-pilot, USAAF, United States, Douglas XA-26F monoplane, 2 Pratt and Whitney R-2800, 2,000 hp and 1 General Electric I-16 jet engine, Dayton, O., June 20, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI. .... No official record.

SPEED FOR 3,106.849 MI. .... No official record.

LIGHT AIRPLANES—(Class C-1.a)

FIRST CATEGORY (AIRCRAFT WEIGHING LESS THAN 1,102.3 LB., IN FLYING ORDER)

AIRLINE DISTANCE

International Record .... 1,135.219 mi.
Albert Rebillon, France, Minicab G-Y 20 airplane, gross weight 499.5 kilograms, Continental 65 hp engine, from Paris (Toussus le Noble) to Rabat-Sale (Maroc), July 25, 1951.

National (U.S.) Record .... 1,190.631 mi.
Robert C. Faris, Mooney M-18L low wing monoplane, Lycoming O-145-B2 65 hp engine, from Wichita, Kansas, to Watertown, New York, Aug. 18, 1951.

(This U.S. Record could not be recognized as an international record because it did not exceed the former record by the required 100 kilometers.)

ALTITUDE

International Record .... 27,152 ft.
Mrs. Ana L. Branger, Piper Super Cub, model PA-18, Lycoming O-290-D 125 hp engine, Hybla Valley Airport, Alexandria, Va., Apr. 20, 1951.

National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

International Record .... 126.223 mph.
A. L. Cole, Great Britain, Comper Swift airplane, gross weight Pobjoy R 80 hp engine, Wolverhampton, June 17, 1950.

National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT .... No official record.

SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT .... No official record.

LIGHT AIRPLANES—(Class C-1.b)

SECOND CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 1,102.3 AND 2,204.6 LB.)

AIRLINE DISTANCE

International Record .... 2,155.940 mi.

John F. Mann, United States, Meyers monoplane, Continental 145 hp engine, Van Nuys, Cal. to Jacksonville, Fla., Jan. 13-14, 1950.

National (U.S.) Record .... Same as above.

ALTITUDE

International Record .... 30,203 ft.

Miss Caro Bayley, United States, Piper Super Cub high wing monoplane, gross weight 1,118 lb., Lycoming O-290-D 125 hp engine, Miami, Fla., Jan. 4, 1951.

National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

International Record .... 192.839 mph.

R. R. Paine, Great Britain, Miles Hawk Speed Six, gross weight 1,843 lb., de Havilland Gipsy Major 205 hp engine, Wolverhampton, June 17, 1950.

National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

International Record .... 138.913 mph.

Yacov D. Forostenco, U.S.S.R., Yak-18, gross weight, 2,107 lb., M-11 FR-1 160 hp engine, Touchino-Rel-Smolensk-Touchino course, Sept. 6, 1949.

National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT

International Record .... 110.471 mph.

Capt. Jan Christie, Norway, Klemm airplane, gross weight 818.8 kilograms, Hirth engine of 3,984 liters cylinder displacement, Stockholm-Oslo-Svenshogen-Stockholm course, May 24, 1951.

National (U.S.) Record .... None established.

LIGHT AIRPLANES—(Class C-1.c)

THIRD CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 2,204.6 AND 3,858 LB.)

AIRLINE DISTANCE

International Record .... 4,957.240 mi.

William P. Odom, United States, Beech Bonanza Model 35 airplane, take-off weight 3,858 lb., Continental E-185-1 engine from Honolulu, Hawaii to Teterboro, N. J., Mar. 7 - 8 (G.M.T.), 1949.

National (U.S.) Record .... Same as above.

ALTITUDE .... No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

International Record .... 168.443 mph.

J. N. Somers, Great Britain, Miles Gemini III, gross weight 2,639 lb., de Havilland Gipsy Major 10 130 hp engine, Wolverhampton, June 17, 1950.

National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

International Record .... 138.613 mph.

Capt. Jan Christie, Norway, Caudron Simoun C-635, Renault 6Q-01 240 hp engine, Stockholm-Oslo-Svenshogen-Stockholm course, Mar. 22, 1950.

National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.

WEST TO EAST TRANSCONTINENTAL RECORD

National (U.S.) Record .... 151.828 mph.

Charles W. Soderstrom, Jr., Beechcraft Bonanza monoplane, Continental 185 hp engine from Reeves Field, Terminal Island to La Guardia Airport, June 5-6, 1950. Distance: 2,461.7 mi. Elapsed time: 16 hr. 12 min. 50 sec.

EAST TO WEST TRANSCONTINENTAL RECORD

National (U.S.) Record .... 126.879 mph.

Charles W. Soderstrom, Jr., Beechcraft Bonanza monoplane, Continental 185 hp engine from La Guardia Airport to Los Angeles International Airport, June 12, 1950. Distance; 2,462.33 mi. Elapsed time; 19 hr. 24 min. 25 sec.

LIGHT AIRPLANES—(Class C-1.d)

FOURTH CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 3,858.1 AND 6,613.9 LB.)

AIRLINE DISTANCE .... No official record.
ALTITUDE .... No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

International Record .... 322.789 mph.

Miss R. M. Sharpe, Great Britain, Vickers Supermarine Spitfire 5B, gross weight 5,626 lb., Rolls Royce Merlin 55 M 1,280 hp engine, Wolverhampton, June 17, 1950.

National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.

LIGHT AIRPLANES—(Class C-1.e)

FIFTH CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT. IN FLYING ORDER, BETWEEN 6,613.9 AND 9,920.8 LB.)

AIRLINE DISTANCE .... No official record.
ALTITUDE .... No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

International Record .... 328.447 mph.

P. G. Robarts, Great Britain, Vickers Supermarine Spitfire 8 trainer, gross weight 7,474 lb., Rolls Royce Merlin 66 168 hp engine, Wolverhampton, June 17, 1950.

National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.

SEAPLANES—(Class C-2)

DISTANCE, CLOSED CIRCUIT

International Record .... 3,231.123 mi.

Mario Stoppani and Carlo Tonini, Italy, Cant Z I-LERO seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.

National (U.S.) Record .... 1,569 mi.

Lts. B. J. Connell and H. C. Rodd, Pn-10, 2 Packard 600 hp each, San Diego, Cal., Aug. 15 - 16, 1927.

AIRLINE DISTANCE

International Record .... 5,997.462 mi.

Capt. D. C. T. Bennett and First Officer L. Harvey, pilots; Great Britain, Short-Mayo Mercury seaplane, 4 Napier Rapiers J.I. 370 hp engines, from Dundee, Scotland to near Fort-Nolloth, S. Africa, Oct. 6-8, 1938.

National (U.S.) Record .... 3,281.402 mi.

Lt. Comdr. Knefler McGinnis, USN, Lt. J. K. Averill, USN, NAP T. P. Wilkinson, USN, Pilots; C. S. Bolka, A. E. J. Dionne and E. V. Sizer, crew; Navy XP3Y-1 seaplane, 2 Pratt and Whitney 825 hp engines, from Cristobal Harbor, C. Z. to San Francisco Bay, Alameda, Cal., Oct. 14-15, 1935.

ALTITUDE

International Record .... 44,429.04 ft.

Col. Nicola Di Mauro, Italy, Caproni 161 seaplane, (biplane), Piaggio XI RC 100 engine, at Vigna di Valle, Sept. 25, 1939.

National (U.S.) Record .... 38,559.594 ft.

Lt. Appollo Soucek, USN, Apache, Pratt and Whitney 425 hp engine, supercharged, at Washington, D. C., June 4, 1929.

MAXIMUM SPEED

International Record .... 440.681 mph.

Francesco Agello, Italy, M.C. 72 seaplane, Fiat A.S. 6 engine at Lake Garda, Italy, Oct. 23, 1934.

National (U.S.) Record .... 245.713 mph.

Lt. James H. Doolittle, USAF, Curtiss R3C-2, Curtiss V-1400, 600 hp engine, Bay Shore, Baltimore, Md., Oct. 27, 1925.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

International Record .... 391.072 mph.

Guglielmo Cassinelli, Italy, Macchi C. 72 seaplane, 2,400 hp Fiat AS 6 engine, Falconara-Pesaro permanent course, Oct. 8, 1933.

National (U.S.) Record .... 241.679 mph.

Lt. G. T. Cuddihy, USN, Curtiss R3C-2, Curtiss V-1500, 700 hp at Norfolk, Va., Nov. 13, 1926.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

International Record .... 250.676 mph.

M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 165.040 mph.

Maj. Gen. Frank M. Andrews, pilot; J. G. Moran and H. O. Johnson, crew; Martin BO12-A seaplane, 2 Pratt and Whitney 700 hp Hornet engines, Aug. 24, 1935.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

International Record .... 246.351 mph.

M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 157.319 mph.

Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 Seaplane, 4 Pratt and Whitney 670 hp Hornet enines, Aug. 1, 1934.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD

International Record .... 191.534 mph.

Mario Stoppani and Carlo Tonini, Italy, Cant Z I-LERO seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD .... No official record.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE

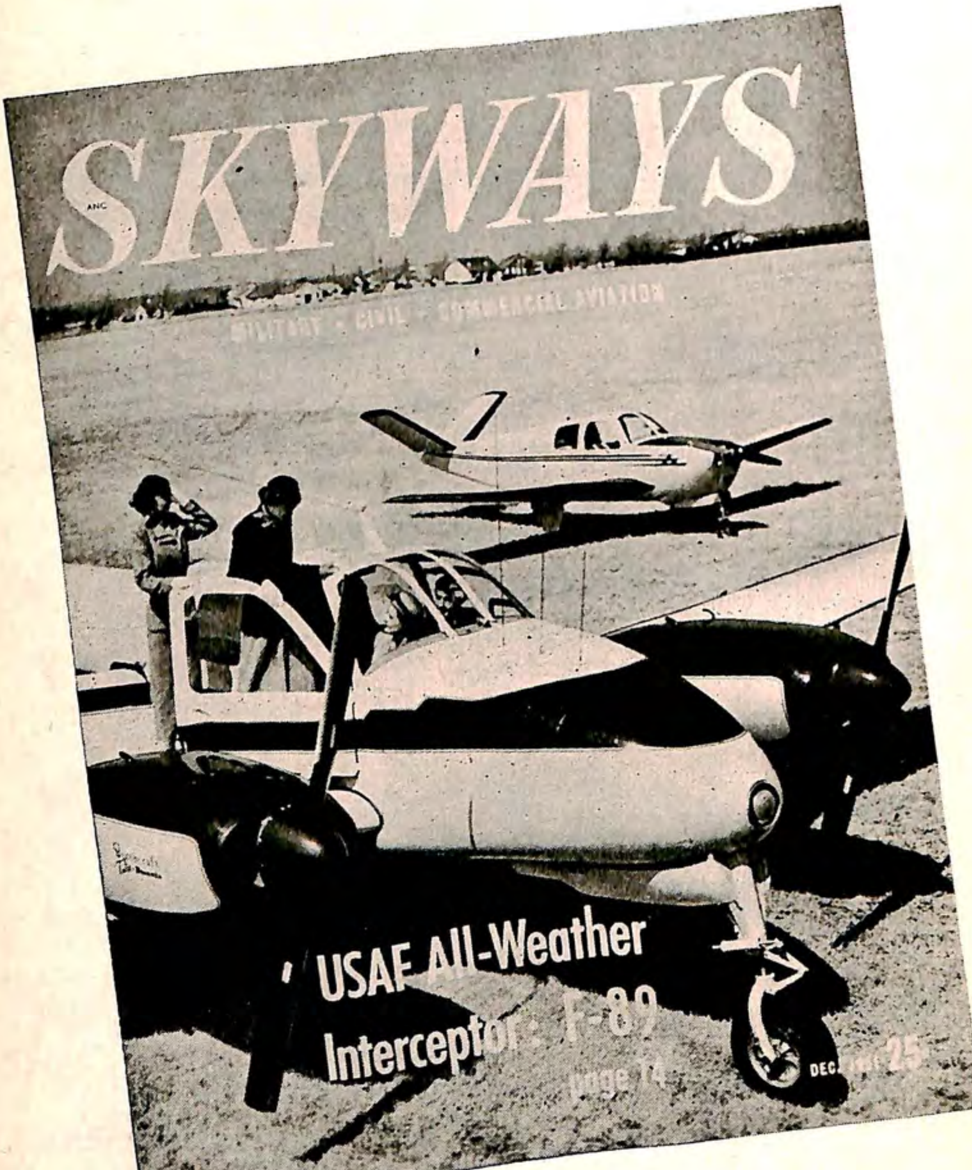
International Record .... 34,084.577 ft.

Nicola di Mauro and Mario Stoppani, Italy, Cant Z. 506 B. seaplane, 3 Alfa Romeo RC.55 700 hp engines, at Monfalcone, Nov. 12, 1937.

National (U.S.) Record .... 26,929.080 ft.

Boris Sergievsky, Sikorsky S-48 seaplane, 2 Pratt and Whitney Hornet, 575 hp each, at Bridgeport, Conn., July 21, 1930.

The Magazine of Business



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SPEED FOR 621.369 MI.

International Record .... 250.676 mph.

M. Stoppani, and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 165.040 mph.

Maj. Gen. F. M. Andrews, pilot; J. G. Moran and H. C. Johnson, crew; Martin B-12-A seaplane, 2 Pratt and Whitney 700 hp Hornet, engines, Aug. 24, 1935.

SPEED FOR 1,242.739 MI.

International Record .... 246.351 mph.

M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy Cant Z 509 seaplane, 3 Fiat A80 RC 41, 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 157.319 mph.

Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.

SPEED FOR 3,106.849 MI.

International Record .... 191.534 mph

Mario Stoppani and Niccola di Mauro, Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.

National (U.S.) Record .... No official record.

WITH PAYLOAD OF 4,409.244 LB.

ALTITUDE

International Record .... 29,366.737 ft.

Mario Stoppani and Nicola di Mauro, Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 hp engines, at Monfalcone, Nov. 3, 1937.

National (U.S.) Record .... 19,709.259 ft.

Boris Sergievsky S-38 seaplane, 2 Pratt and Whitney 424 hp Wasp, engines, at Stratford, Conn., Aug. 11, 1930.

SPEED FOR 621.369 MI.

International Record .... 250.676 mph.

M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 157.580 mph.

Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.

SPEED FOR 1,242.739 MI.

International Record .... 246.351 mph.

M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 157.319 mph.

Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.

SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 11,023.11 LB.

ALTITUDE

International Record .... 24,310.973 ft

Mario Stoppani and Nicola di Mauro, pilots; Forlivesi, mechanic; Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 hp engines, at Monfalcone, Nov. 7, 1947.

National (U.S.) Record .... 20,406.472 ft

Boris Sergievsky and Raymond B. Quick, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Bridgeport, Conn., May 17, 1934.

SPEED FOR 621.369 MI.

International Record .... 156.516 mph.

Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z, 508 seaplane, 3 Isotta-Fraschini Asso 11 R.C. 836 hp engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI.
International Record — 154.356 mph
Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z, 508 seaplane, 3 Isotta-Fraschini Asso 11 RC 836 hp engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.
National (U.S.) Record — No official record.

SPEED FOR 3,106.849 MI. — No official record.

WITH PAYLOAD OF 22,046.22 LB.

ALTITUDE
International Record — 15,954.691 ft.
Mario Stoppani, pilot; G. Divari and A. Spinetti, passengers; Italy, Cant Z 508 seaplane, 3 Isotta Fraschini Asso 11 R.C. 836 hp engines, Monfalcone, Apr. 13, 1937.
National (U.S.) Record — No official record.

SPEED FOR 621.369 MI.
International Record — 131.110 mph.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, Lucon-Aureilhan base, Dec. 27, 1937.
National (U.S.) Record — No official record.

SPEED FOR 1,242.739 MI. — No official record
SPEED FOR 3,106.849 MI. — No official record.

WITH PAYLOAD OF 33,069.33 LB.

ALTITUDE
International Record — 13,509.162 ft.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, at Biscarosse, Dec. 30, 1927.
National (U.S.) Record — No official record.

SPEED FOR 621.369 MI.
International Record — 117.899 mph.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, Lucon-Aureilhan course, Dec. 29, 1937.
National (U.S.) Record — No official record.

SPEED FOR 1,242.739 MI. — No official record.
SPEED FOR 3,106.849 MI. — No official record.

GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561.660 FT.
International Record — 39,771 lb.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, at Biscarosse, Dec. 30, 1937.
National (U.S.) Record — 16,608 lb.
Boris Sergievsky, Sikorsky S-42 seaplane, 4 Pratt and Whitney Hornet 650 hp engines, Bridgeport, Conn., Apr. 26, 1934.

LIGHT SEAPLANES—(Class C-2.a)

FIRST CATEGORY (LIGHT SEAPLANES WEIGHING LESS THAN 1,322.8 LBS.)

ALTITUDE
International Record — 20,169 ft.
Harold E. Mistele, U.S., Aeronca Seaplane, N-1454-H, Continental C-145 engine, Detroit Seaplane Base, Mich., Sept. 3, 1951.
National (U.S.) Record — Same as above.

No official records in any other events.

LIGHT SEAPLANES—(Class C-2.b)

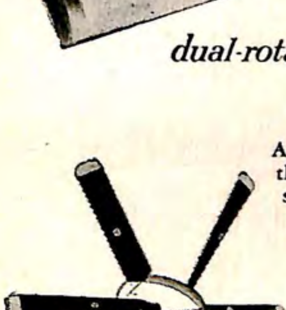
SECOND CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 1,322.8 AND 2,645.6 LB.)

ALTITUDE — No official record.
AIRLINE DISTANCE — No official record.
SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT — No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT — No official record.
SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT — No official record.
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT — No official record.

U. S. Navy's A2D Douglas Skyshark equipped with Aeroproducts dual-rotating propeller.

Aeroproducts

dual-rotating propeller converts power of the T40 into maximum thrust



Aeroprops efficiently harness the tremendous power of the Allison T40 engine in the U. S. Navy's A2D Skyshark. The result? Flashing, near-sonic speed *plus* range, climb and performance possible to date *only* with this great turbo-prop power and Aeroprop combination.

Years of research went into this amazing engine and propeller combination. Yes, years of research by some of the finest aeronautical engineers in the country—the men at Aeroproducts and Allison in cooperation with the Navy, which provided our Navy with a new and vastly more destructive weapon.

As a result, Aeroproducts is now preparing to deliver on the first production order existing for Turbine propellers.

Aeroproducts engineers are available for consultation if you have any propeller requirements in the subsonic, transonic, or supersonic range. Aeroproducts—backed by the full facilities of General Motors—will be glad to serve you.

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AEROPRODUCTS DIVISION
GENERAL MOTORS CORPORATION
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LIGHT SEAPLANES—(Class C-2.c)

THIRD CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 2,645.6 AND 4,629.7 LB.)

AIRLINE DISTANCE .... No official record.
ALTITUDE .... No official record.
SPEED FOR 62.137 MI. .... No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.

LIGHT SEAPLANES—(Class C-2.d)

FOURTH CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 4,629.7 AND 7,495.7 LB.)

AIRLINE DISTANCE .... No official record.
ALTITUDE .... No official record.
SPEED FOR 62.137 MI. .... No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.

LIGHT SEAPLANES—(Class C-2.e)

FIFTH CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 7,495.7 AND 11,023 LB.)

AIRLINE DISTANCE .... No official record.
ALTITUDE .... No official record.
SPEED FOR 62.137 MI. .... No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.

AMPHIBIANS—(CLASS C3)

AIRLINE DISTANCE
International Record .... 1,429.685 mi.
Maj. Gen. F. M. Andrews, pilot; Maj. John Whiteley, co-pilot; and crew, United States, Douglas YOA'5 amphibian, 2 Wright Cyclone 800 hp engines, from San Juan, Puerto Rico, to Langley Field, Va., June 29, 1936.
National (U.S.) Record .... Same as above.

ALTITUDE
International Record .... 24,950.712 ft.
Boris Sergievsky, United States, Sikorsky S-43 amphibian, 2 Pratt and Whitney 750 hp Hornet engines, Stratford, Conn., Apr. 14, 1936.
National (U.S.) Record .... Same as above.

MAXIMUM SPEED
International Record .... 230.413 mph.
Maj. Alexander P. de Seversky, United States, Seversky Amphibian, Wright Cyclone 710 hp engine, Detroit, Mich., Sept. 15, 1935.
National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD
International Record .... 209.451 mph.
Maj. A. P. de Seversky, United States, Seversky Amphibian, Wright Cyclone 1,000 hp engine, at Miami, Fla., Dec. 9, 1936.
National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD
International Record .... 186.076 mph.
Capt. W. P. Sloan and Capt. B. L. Boatner, USA AC, pilots; United States, Grumman YOA-9 amphibian, 2 Pratt and Whitney engines, 400 hp each, Dayton, O., July 31, 1939.
National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD
International Record .... 154.701 mph.
Giuseppe Burei and Enrico Rossaldi, pilots; Gino Velati, passenger; Italy, Macchi C-94 I.-NEP I amphibian, 2 Wright Cyclone 750 hp engines, Rovine Ansedonia-Faro Fiumicino Antignano temporary course, May 6, 1937.
National (U.S.) Record .... No official record.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD .... No official record.
SPEED FOR 6,213.689 MI. WITHOUT PAYLOAD .... No official record.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE
International Record .... 23,405.465 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 17, 1940.
National (U.S.) Record .... 19,625.925 ft.
Boris Sergievsky, Sikorsky S-43, 2 Pratt and Whitney 750 hp Hornet engines, Stratford, Conn., Apr. 25, 1936.

SPEED FOR 621.369 MI.
International Record .... 172.409 mph.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-85, 750 hp engines, Katcha-Kersoness-Taganrog course, Sept. 28, 1940.
National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.
SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 4,409.244 LB.

ALTITUDE
International Record .... 20,616.756 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 19, 1940.
National (U.S.) Record .... 19,625 ft.
Boris Sergievsky, United States, Sikorsky S-43 Amphibian, 2 Pratt and Whitney, 750 hp engines, Stratford, Conn., Apr 25, 1936.

SPEED FOR 621.369 MI.
International Record .... 149.694 mph.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian 4 M-85 750 hp engines, Katcha-Kersoness-Taganrog course, Oct. 7, 1940.
National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.
SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 11,023.11 LB.

ALTITUDE
International Record .... 17,122.669 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 19, 1940.
National (U.S.) Record .... No official record.

SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record
SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 22,046.22 LB.

ALTITUDE .... No official record.
SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.
SPEED FOR 3,106.849 MI. .... No official record.
GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561.660 FT.
International Record .... 11,023 lb.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, at Katcha, near Sebastopol, June 19, 1940.

LIGHT AMPHIBIANS

FIRST CATEGORY, CLASS C-3.a (less than 1,322.7 lb.)
SECOND CATEGORY, CLASS C-3.b (1,322.8 to 2,645 lb.)
THIRD CATEGORY, CLASS C-3.c (2,645.6 to 4,629.7 lb.)
FOURTH CATEGORY, CLASS C-3.d (4,629.7 to 7,495.7 lb.)
FIFTH CATEGORY, CLASS C-3.e (7,495.7 to 11,023 lb.)

AIRLINE DISTANCE .... No official record.
ALTITUDE .... No official record.
SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT .... No official record
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT .... No official record.

ROTORPLANES—(Class E)

DISTANCE, AIRLINE
International Record .... 703.6 mi.
Maj. F. T. Caschman, pilot; Maj. W. E. Zins, co-pilot; USAAF; U.S.; Sikorsky R-5 Helicopter, Pratt and Whitney 450 hp engine, from Dayton, O., to Logan Field, Boston, Mass., May 22, 1946.
National (U.S.) Record .... Same as above.

DISTANCE, CLOSED CIRCUIT
International Record .... 621.369 mi.
Maj. D. H. Jenson and Maj. W. C. Dodds; USAAF; U.S.; Sikorsky R-5A Helicopter, Pratt and Whitney 450 hp engine, Dayton, O., Nov. 14, 1946.
National (U.S.) Record .... Same as above.

ALTITUDE, WITHOUT PAYLOAD
International Record .... 21,220 ft.
Capt. H. D. Gaddis. USA, United States, Sikorsky S-52-1 Helicopter, Franklin 0-425-1, 245 hp engine, Bridgeport, Conn., May 21, 1949.
National (U.S.) Record .... Same as above.

MAXIMUM SPEED WITHOUT PAYLOAD
International Record .... 129.552 mph.
Harold E. Thompson, United States, Sikorsky S-52-1 Helicopter, Franklin 0-425-1 245 hp engine, Cleveland, O., Apr. 27, 1949.
National (U.S.) Record .... Same as above.

AIRSHIPS—(CLASS B)

AIRLINE DISTANCE
International Record .... 3,967.137 mi.
Dr. Hugo Eckener, Germany, L. Z. 127, *Graf Zeppelin* 5 Maybach 450-550 hp engines, from Lakehurst, N. J., to Friedrichshafen, Germany, Oct. 29, 30, 31, and Nov. 1, 1928.
National (U.S.) Record .... No official record.

GLIDERS—(CLASS D)
(Single-Place)

DISTANCE IN A STRAIGHT LINE
International Record .... 535.169 mi.
Richard H. Johnson, U.S. Ross-Johnson sailplane, N-3722C, from Odessa, Tex. to Salina, Kan., Aug. 5, 1951.
National (U.S.) Record .... Same as above.

DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE
International Record .... 374.287 mi.
P. Savtzov, USSR, "Rot-Front 7" glider, from Toula to Mikhailovka, July 31, 1939.
National (U.S.) Record .... 332.903 mi.
Wallace R. Wiberg, Laister-Kaufmann 10A sailplane, N-57826, from Odessa, Tex. to Guymon, Okla., Aug. 5, 1951.

DISTANCE TO A PREDETERMINED DESTINATION
International Record .... 374.287 mi.
P. Savtzov, USSR, Ront-Front 7 glider, from Toula to Mikhailovka, July 31, 1939.
National (U.S.) Record .... 227.152 mi.
E. J. Reeves, Schweizer 1-23 glider, N-91868, from Grand Prairie, Tex. to Muskogee, Okla., Aug. 10, 1949.

DURATION WITH RETURN TO POINT OF DEPARTURE
International Record .... 40 hr. 51 min.
Guy Marchand, France, Nord 2,000 glider, number 52, Gliding Center at Romanin les Alphilles, March 16-18, 1949.
National (U.S.) Record .... 21 hr. 34 min
Lt. William Cocke, Jr., Cocke Nighthawk glider, Honolulu, Hawaii, Dec. 17-18, 1931.

ALTITUDE GAINED
International Record .... 30,100 ft.
William S. Ivans, Jr., U.S., Schweizer SGS 1-23 sailplane, N-91876, Bishop, Cal., Dec. 30, 1950.
National (U.S.) Record .... Same as above.

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ALTITUDE ABOVE SEA LEVEL
International Record .... 42,100 ft.
William S. Ivans, Jr., U.S., Schweizer SGS 1-23 sailplane, N-91876, Bishop, Cal., Dec. 30, 1950.
National (U.S.) Record .... 309.678 mi.
National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. OVER A TRIANGLE COURSE
International Record .... 43.247 mph.
Siegbert Maurer, Switzerland, *Moswey III* glider, Muottas Muraigl-Weissfluhjoch-Piz Curver-Muottas Muraigl course, July 22, 1948.
National (U.S.) Record .... No official record.

(Multi-Place)

DISTANCE IN A STRAIGHT LINE
International Record .... 358.093 mi
J. Kartachev, pilot; P. Savtzov, passenger; USSR, Stakhanovetz glider, from Moscow-Izmailovo to Ochnia, July 17, 1938.
National (U.S.) Record .... 309.678 mi.
Richard H. Johnson, pilot; R. A. Sparling, passenger; Schweizer TG-2 glider, NC-479903, from Prescott, Ariz. municipal Airport to the Ackerman Ranch approximately 11 miles west of Governador, N. M., Sept. 8, 1946.

DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE
International Record .... 258.533 mi.
J. Kartachev and V. Petrotchenkova, USSR, Stakanovetz glider, from Toula to Kuklovo and return, Oct. 7, 1940.
National (U.S.) Record .... No official record.

DISTANCE TO A PREDETERMINED DESTINATION
International Record .... 307.591 mi.
J. Kartachev and V. Petrotchenkova, USSR, Stankanovetz glider, from Toula to Kharkov, June 19. 1940.
David C. Johnson, pilot; Robert Fronius, passenger; Schweizer TG-2 sailplane, NC-47903, from Adelanto, Cal. to Overton, Nev., July 3, 1950.
National (U.S.) Record .... No official record.

DURATION WITH RETURN TO POINT OF DEPARTURE
International Record .... 50 hr. 26 min.
August Bodecker and Karl H. Zander, Germany, Kranich glider, at Rossitten, Dec. 9-11, 1938.
National (U.S.) Record .... 12 hr., 3 min.
Leslie R. Arnold, pilot; Harry N. Perl, passenger; Schweizer TG-3A glider, N-68267, Warm Springs, Cal., Apr. 29, 1951

ALTITUDE GAINED
International Record .... 26,778 ft.
Andrzej Brzuska, pilot; Wladislaw Parczewski, passenger; Poland, Zurav-Kranich sailplane at Jelenia-Gora, Dec. 1, 1950.
National (U.S.) Record .... 24,300 ft.
Harland C. Ross, pilot; George Deibert, passenger; Schweizer TG-3 "Stratocruiser" glider, N-67532, Bishop, Cal., Jan. 27, 1950.

ALTITUDE ABOVE SEA LEVEL
International Record .... 38,305 ft.
Robert F. Symons, pilot; Dr. Joachim Kuettner, passenger; U.S., Pratt-Read sailplane, N-63197, Bishop, Cal., Mar. 5, 1951.
National (U.S.) Record .... Same as above.

SPEED FOR 100 KILOMETERS OVER A TRIANGULAR COURSE
International Record .... 40.999 mph.
Capt. Rene Fonteilles, pilot; Rene Lemblin, passenger; France, Kranich sailplane, LeBourget du Lac, May 5, 1951.
National (U.S.) Record .... 27.873 mph.
William G. Briegleb, pilot; Jack LaMare, passenger; Briegleb BG-8 glider, N-33636, Adelanto, Cal., Aug. 12, 1949.

BALLOONS (CLASS A)

FIRST CATEGORY—(21,189 CU. FT. OR LESS)

DURATION
International Record .... 46 hr. 10 min.
Serge Sinoveev, USSR, VR 80 Balloon, 21,082.458 cu. ft., take-off near Dolgoproudnaia, Mar. 30, 1941.
National (U.S.) Record .... No official record.

DISTANCE
International Record .... 499.69 mi.
Georges Cormier, France, July 1, 1922.
National (U.S.) Record .... No official record.

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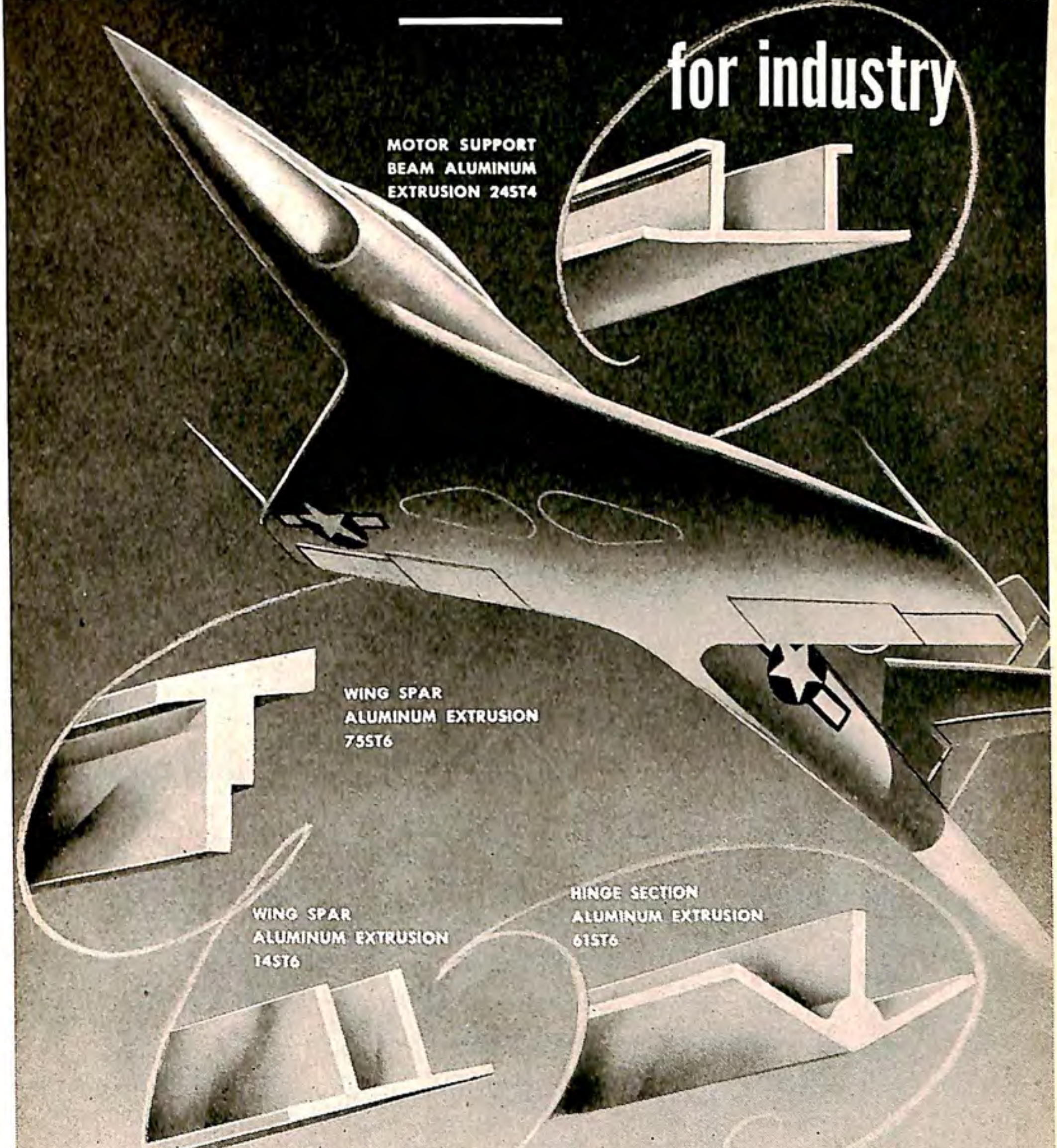

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ALTITUDE
International Record .... 23,285.712 ft.
Boris Nevernov, USSR, VR-80 Balloon, 13,984.344 cu. ft., at Dolgoproudnaia, Aug. 31, 1940.
National (U.S.) Record .... No official record.

SECOND CATEGORY—(21,224 - 31,783 CU. FT.)

DURATION
International Record .... 61 hr. 30 min.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, Apr. 3-6, 1939.
National (U.S.) Record .... 19 hr. 00 min.
W. C. Naylor and K. W. Warren, *Skylark*, Little Rock, Ark., to Crawford, Tenn., Apr. 29-30, 1926.

DISTANCE
International Record .... 1,056.950 mi.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, region of Koustanai, Apr. 3-6, 1939.
National (U.S.) Record .... 410.104 mi.
W. C. Naylor and K. W. Warren, *Skylark*, Little Rock, Ark., to Crawford, Tenn., Apr. 29-30, 1926.

ALTITUDE
International Record .... 27,718.117 ft.
Alexei Rostine, USSR, VR-70 Balloon of 29,451.876 cu. ft. at Dolgoproudnaia, Oct. 4, 1940.
National (U.S.) Record .... No official record.

THIRD CATEGORY—(31,818 - 42,376.8 CU. FT.)

DURATION
International Record .... 61 hr. 30 min.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, Apr. 3-6, 1939.
National (U.S.) Record .... 26 hr. 48 min.
E. J. Hill and A. G. Schlosser, Ford Airport to Montale, Va., July 4-5, 1927.

DISTANCE
International Record .... 1,056.950 mi.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, region of Koustanai, Apr. 3-6, 1939.
National (U.S.) Record .... 571.877 mi.
S. A. U. Rasmussen, Ford Airport to Hookerton, N. C., July 4-5, 1927.

ALTITUDE
International Record .... 27,718.117 ft.
Alexei Rostine, USSR, VR-70 Balloon, 29,451.876 cu. ft., at Dolgoproudnaia, Oct. 4, 1940.
National (U.S.) Record .... No official record

FOURTH CATEGORY—(42,411.8 - 56,502.4 CU. FT.)

DURATION
International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 26 hr. 46 min.
E. J. Hill and A. G. Schlosser, Ford Airport to Montvale, Va., July 4-5, 1927.

DISTANCE
International Record .... 1,719.215 mi.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 571.877 mi.
S. A. U. Rasmussen, Ford Airport to Hookerton, N. C., July 4-5, 1927.

ALTITUDE
International Record .... 27,718.117 ft.
Alexei Rostine, USSR, VR-70 Balloon, 29,451.876 cu. ft., at Dolgoproudnaia, Oct. 4, 1940.
National (U.S.) Record .... No official record

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HIGH STRENGTH-WORKABILITY

The HI-SHEAR rivet is the outstanding standard high strength fastener in the aviation industry. It possesses the strength of high tensile alloy steel bolts and nearly three times the strength of aluminum alloy aircraft rivets.

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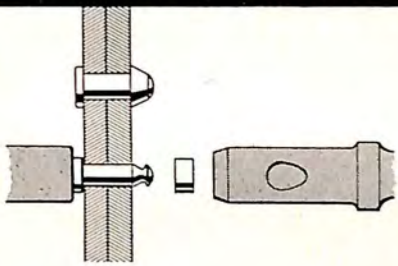

HI-SHEAR riveting is accomplished with standard riveting guns and squeezers.

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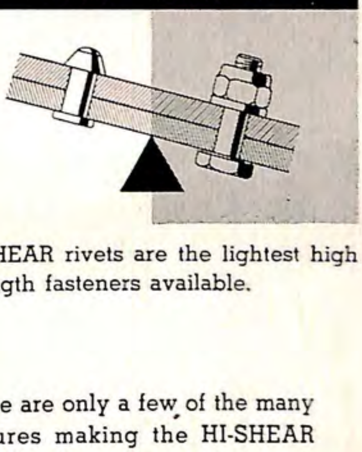
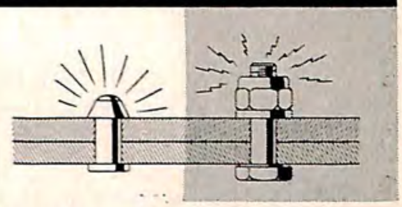


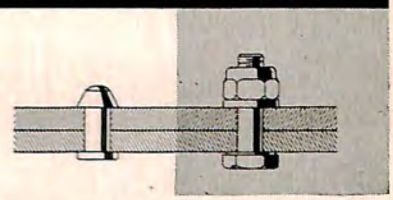
HI-SHEAR rivets are the lightest high strength fasteners available.

MAXIMUM SMOOTHNESS



The smooth, spherical rivet end eliminates chafing of adjacent fuel cells or other equipment. HI-SHEARS eliminate hazards in aircraft areas which are accessible to the flight crew, passengers, maintenance crews and cargo.

MINIMUM PROTRUSION



HI-SHEAR rivet has the smallest "headed end" of any high strength fastener.

These are only a few of the many features making the HI-SHEAR rivet the finest fastener for many purposes. Additional data will be supplied on your request.

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FIFTH CATEGORY—(56,537.7 - 77,690.8 CU. FT.)

DURATION

International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.

National (U.S.) Record .... 51 hr. 00 min.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE

International Record .... 1,719.215 mi.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.

National (U.S.) Record .... 963.123 mi.
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record .... 30,754.529 ft.
Josef Emmer, Austria, *OE-Marek Emmer II* Balloon, Vienna-Lac de Nuesiedl, Sept. 25-27, 1937.

National (U.S.) Record .... No official record.

SIXTH CATEGORY—(77,706 - 105,942 CU. FT.)

DURATION

International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk. Mar. 13-16, 1941.

National (U.S.) Record .... 51 hr. 00 min.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE

International Record .... 1,719.215 mi.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.

National (U.S.) Record .... 963.123 mi.
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record .... 30,754.529 ft.
Josef Emmer, Austria, *OE-Marek Emmer II* Balloon, Vienna-Lac de Neusiedl, Sept. 25-27, 1937.

National (U.S.) Record .... 28,508.413 ft.
Capt. Hawthorne C. Gray, Scott Field, Belleville, Ill., Mar. 9, 1927.

SEVENTH CATEGORY—(105,977 - 141,256 CU. FT.)

DURATION

International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.

National (U.S.) Record .... 51 hr. 00 min.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE

International Record .... 1,719,215 mi.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.

National (U.S.) Record .... 963.123 mi.
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record .... 32,811.132 ft.
Z. J. Burzynski, Poland, at Legjonowo, Mar. 29, 1936.

National (U.S.) Record .... 28,508.413 ft.
Capt. Hawthorne C. Gray, at Scott Field, Belleville, Ill., Sept. 2-4, 1933.

Banshees In Battle ...

McDONNELL F2H-2'S OVER KOREA . . . 1951

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EIGHTH CATEGORY—(141,291.3 CU. FT. OR OVER)

DURATION
International Record .... 87 hr. 00 min.
H. Kaulen, Germany, Dec. 13-17, 1913.
National (U.S.) Record .... 51 hr. 00 min.
Lt. Comdr. T. G. W. Settle and Lt. Charles H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE
International Record .... 1,896.856 mi
Berliner, Germany, Feb. 8-10, 1914.
National (U.S.) Record .... 1,172.898 mi.
A. R. Hawley, St. Louis, Mo. to Lake Tschotogama, Canada, Oct. 17-19, 1910.

ALTITUDE
International Record .... 72,394.795 ft.
Capt. Orvil Anderson and Capt. Albert Stevens, United States, *Explorer II*, take-off approximately 11 miles southwest of Rapid City, S. D., landing on school reserve land approximately 12 miles south of White Lake, S. D., Nov. 11, 1935.
National (U.S.) Record .... Same as above.

FEMININE RECORDS

AIRPLANES—(CLASS C) GROUP II

DISTANCE IN A CLOSED CIRCUIT .... No official record.

AIRLINE DISTANCE
International Record .... 3,671.432 mi.
V. Grisodoubova and P. Ossipenko, pilots; M. Raskova, Navigatrix; USSR; Soukhoi Rodina airplane, 2 M-96 800 hp engines, Sept. 24-25, 1938.
National (U.S.) Record .... 2,447.728 mi.
Amelia Earhart, Lockheed Vega monoplane, Pratt and Whitney Wasp 450 hp engine, from Los Angeles, Cal., to Newark, N. J., Aug. 24-25, 1932.

ALTITUDE
International Record .... 46,948.725 ft.
Mrs. Maryse Hilsz, France, Potez 506 biplane, Gnome and Rhone 900 hp engine, at Villacoublay, June 23, 1936.
National (U.S.) Record .... 30,052.430 ft.
Jacqueline Cochran, Beechcraft biplane, NX-18562, Pratt and Whitney 600 hp engine, Palm Springs, Cal., Mar. 24, 1939.

SPEED, MAXIMUM
International Record .... 412.002 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine; Thermal, Cal., Dec. 17, 1947.
National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD
International Record .... 469.549 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard Rolls Royce Merlin Engine 1,450 hp, Coachella Valley, Col., Dec. 10, 1947.
National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD
International Record .... 436.995 mph.
Jacqueline Cochran, United States, North American F-51 monoplane, Rolls Royce Merlin 1,450 hp engine; Desert Center-Mt. Wilson Course, Dec. 29, 1949.
National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD
International Record .... 431.094 mph.
Jacqueline Cochran, United States, North American F-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine; start and finish near Palm Springs, Cal., May 24, 1948.
National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD
International Record .... 447.470 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine; start and finish near Palm Springs, Cal., May 22, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.847 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 6,213.695 MI. WITHOUT PAYLOAD .... No official record.

MAXIMUM SPEED AT HIGH ALTITUDE
International Record .... 464.374 mph.
Jacqueline Cochran, U.S., North American F-51 low wing monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, near Indio, Cal., Apr. 9, 1951.
National (U.S.) Record .... Same as above.

AIRPLANES—(CLASS C)—GROUP I

JET POWERED AIRCRAFT

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT WITHOUT PAYLOAD
International Record .... 547.539 mph.
Mrs. Jacqueline Auriol, France, de Havilland "Vampire" aircraft, Goblin II DGN 301 jet engine, Istres-Avignon course, May 12, 1951.
National (U.S.) Record .... No official record.

SEAPLANES—(CLASS C2)

DISTANCE IN A CLOSED CIRCUIT
International Record .... 1,086.908 mi.
Lt. P. Ossipenko and Lt. V. Lomako, USSR, MP-1 monoplane seaplane, AM-34 750 hp engine, May 24, 1938.
National (U.S.) Record .... No official record.

DISTANCE, AIRLINE
International Record .... 1,392.801 mi.
Poline Ossipenko and Vera Lomako, pilots; Marina M. Raskova, navigatrix; USSR, MP-1 seaplane, AM-34 750 hp engine, from Sebastopol to Lake Kholmskoie, July 2, 1938.
National (U.S.) Record .... No official record.

ALTITUDE
International Record .... 29,081.304 ft.
Poline Ossopenko, USSR Canot Volant monoplane seaplane, AM-34 750 hp engine, at Sebastopol, May 25, 1937.
National (U.S.) Record .... 13,461.259 ft.
Mrs. Marion Eddy Conrad, Savoia-Marchetti seaplane, Kinner 125 hp engine, Port Washington, L. I., New York, Oct. 20, 1930.

MAXIMUM SPEED .... No official record.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD
International Record .... 79.138 mph.
Miss Crystal Mowry and Miss Edith McCann, United States, Kitty Hawk seaplane, Kinner 125 hp engine, Miami, Fla., Dec. 9, 1936.
National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 3,106.847 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 6,213.695 MI. WITHOUT PAYLOAD .... No official record.

GLIDERS—(CLASS D)

(Single-Place)

DURATION WITH RETURN TO POINT OF DEPARTURE
International Record .... 35 hr. 3 min.
Miss Marcelle Choisnet, France, Arsenal Air-100 glider, No. 5 Romanin les Alpilles, Nov. 17-19, 1948.
National (U.S.) Record .... 7 hr. 28 min.
Helen M. Montgomery, Stevens-Franklin glider, Crystal Downs Beach, 5 miles North of Frankfort, Mich., Sept. 4, 1938.


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DISTANCE IN A STRAIGHT LINE
International Record .... 465.532 mi.
O. Klepikova, USSR, Rot-Front 7 glider from Moscow to Otradnoie, region of Stalingrad, July 6, 1939.
National (U.S.) Record .... 124.008 mi.
Mrs. Betty McMillen Loufek, Laister-Kaufmann LK-10A glider, N-44781, July 4, 1950.

ALTITUDE GAINED
International Record .... 25,414 ft.
Mrs. Betty Loufek, Laister-Kaufmann 10-A, NC 44781 glider, at Bishop, Cal., Apr. 15, 1948.
National (U.S.) Record .... 14,496 ft.
Mrs. Yvonne Gaudry, France, N-2000 glider No. 12, St. Auban sur Durance, Jan. 20, 1951.

ALTITUDE ABOVE SEA LEVEL
International Record .... 27,342 ft.
Mrs. Yvonne Gaudry, France, N-2000 glider No. 12, St. Auban sur Durance, Jan. 20, 1951.
National (U.S.) Record .... No official record.

DISTANCE TO A PREDETERMINED DESTINATION
International Record .... 213.141 mi.
E. Prokhorova, USSR, Rot-Front 7 glider from Toula to Oboiane, June 19, 1940.
National (U.S.) Record .... 54.086 mi.
Betsy Woodward, Corcoran TG-1A glider, N-54318, from El Mirage Field, Adelanto, Cal. to 6-S Ranch, Saugus, Cal., Sept. 22, 1949.

DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE
International Record .... 140.610 mi.
Miss Marine Pylaeva, USSR, A-9 glider, from Grabtsevo airport, near Kalouga, to Kourakino and return, June 23, 1951
National (U.S.) Record .... 68.834 mi.
Mrs. Margaret M. Downsbrough, Schweizer 1-23 sailplane, N-91879, from Grand Prairie, Tex., to Clebourne, Tex., and return, Aug. 11, 1950.

SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE
International Record .... 31.069 mph.
Miss Irene Kempowna, Poland, "Sep" sailplane, number SP-552, Kiczera-Rownica-Pilsko-Kiczera Course, June 10, 1949.
National (U.S.) Record .... No official record.

GLIDERS—(CLASS D)

(Multi-Place)

DURATION WITH RETURN TO POINT OF DEPARTURE
International Record .... 16 hr. 3 min. 43 sec.
Mrs. Melk and Therese Buquet, France, Castel 242 glider, *La Montagne Noire*, Mar. 25, 1947.
National (U.S.) Record .... 3 hr. 20 min.
Mrs. Betty McMillen Loufek, pilot; Miss Claire Lee McMillen, passenger; Laister-Kaufmann sailplane, N-44781, from El Mirage Field, Adelanto, Cal., to Daggett, Cal., Aug. 12, 1949.

DISTANCE IN A STRAIGHT LINE
International Record .... 275.711 mi.
O. Klepikova and V. Bardina, USSR, Stakanovetz glider, from Toula to Konotop, June 19, 1940.
National (U.S.) Record .... 50.248 mi.
Mrs. Betty McMillen Loufek, pilot; Miss Claire Lee McMillen, passenger; Laister-Kaufmann sailplane, N-44781, from El Mirage Field, Adelanto, Cal. to Daggett, Cal., Aug. 12, 1949.

ALTITUDE ABOVE SEA LEVEL
International Record .... 23,104 ft.
Mrs. M. Choisnet-Gohard, pilot; Miss J. Queyrel, passenger; France, Castel Mauboussin CM glider No. 02, St. Auban sur Durance, Jan. 18, 1951.
National (U.S.) Record .... No official record.

ALTITUDE GAINED
International Record .... 19,921 ft.
Mrs. M. Choisnet-Gohard, pilot; Miss J. Queyrel, passenger; France, Castel Mauboussin CM glider No. 02, St. Auban sur Durance, Jan. 18, 1951.
National (U.S.) Record .... 10,797 ft.
Betsy Woodward, pilot; Vera Gere, passenger; Schweizer TG-3 glider, N-67871, El Mirage Field, Adelanto, Cal., Apr. 7, 1950.

DISTANCE TO A PREDETERMINED DESTINATION
International Record .... 138.959 mi.
L. Valikosseltzeva, pilot; A. Gorokhova, passenger, USSR, Stakanovetz biplane glider, from Toula to Lipetzk, July 23, 1939.
National (U.S.) Record .... No official record.

DISTANCE WITH RETURN TO POINT OF DEPARTURE .... No official record.

BALLOONS—(CLASS A)

FIRST CATEGORY (21,188.4 CU. FT. OR LESS)

DURATION
International Record .... 22 hr. 40 min.
A. Kondratyeva, USSR, SSSR BP-31 Balloon, Moscow to Loukino Polie, May 14-15, 1939.
National (U.S.) Record .... No official record.

DISTANCE
International Record .... 298.954 mi.
A. Kondratyeva, USSR, SSSR BP-31 balloon, from Moscow to Loukino Polie, May 14-15, 1939.
National (U.S.) Record .... No official record.
ALTITUDE .... No official record.

FOURTH CATEGORY (10,629.514 - 56,502.4 CU FT.)

DURATION
International Record .... 34 hr. 21 min. 36 sec.
Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.
National (U.S.) Record .... No official record.
DISTANCE .... No official record.
ALTITUDE .... No official record.

FIFTH CATGORY (56,537.714 - 77,690.8 CU. FT.)

DURATION
International Record .... 34 hr. 21 min. 36 sec.
Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.
National (U.S.) Record .... No official record.
DISTANCE .... No official record.
ALTITUDE .... No official record.

SIXTH CATEGORY (77,726.114 - 105,942 CU. FT.)

DURATION
International Record .... 34 hr. 21 min. 36 sec.
Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.
National (U.S.) Record .... No official record.
DISTANCE .... No official record.
ALTITUDE .... No official record.

SEVENTH CATEGORY (105,977.314 - 141,256 CU. FT.)

DURATION
International Record .... 34 hr. 21 min. 36 sec.
Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.
National (U.S.) Record .... No official record.
DISTANCE .... No official record.
ALTITUDE .... No official record.

EIGHTH CATEGORY (141,291.314 CU. FT. OR OVER)

DURATION
International Record .... 34 hr. 21 min. 36 sec.
Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.
National (U.S.) Record .... No official record.

DISTANCE .... No official record.
ALTITUDE .... No official record.

ROTORPLANES—(Class E)

DURATION, CLOSED CIRCUIT .... No official record.
DISTANCE AIRLINE
International Record .... 67.713 mi.
Miss Hanna Reitsch, Germany, FW. 61. V2, D-EKRA helicopter, from Stendal airport to Tempelhof airport, Oct. 25, 1937.
National (U.S.) Record .... No official record.

DISTANCE, CLOSED CIRCUIT .... No official record.
ALTITUDE .... No official record.
SPEED FOR 12.43 MI. .... No official record.

F.A.I. COURSE RECORDS

LOS ANGELES TO NEW YORK
International Record .... 580.935 mph.
Col. W. H. Councill, USAAF, United States, Lockheed P-80 jet propelled monoplane, Allison J-33 engine, from Long Island Beach Municipal Airport to La Guardia Airport, Jan. 26, 1946. Distance: 2,453.807 mi. Elapsed Time: 4 hr. 13 min. 26 sec.
National (U.S.) Record .... Same as above.

WASHINGTON, D. C. TO HAVANA, CUBA
International Record .... 314.070 mph.
Woodrow W. Edmondson, United States, North American P-51 monoplane, Packard Rolls Royce 1,450 hp engine, from Washington National Airport to Rancho Boyeros Airport, Nov. 25, 1947. Elapsed Time; 3 hr. 37 min. 28.6 sec.
National (U.S.) Record .... Same as above

HAVANA, CUBA TO WASHINGTON, D. C.
International Record .... 350.328 mph
Woodrow W. Edmondson, United States, North American P-51 monoplane, Packard Rolls Royce 1,450 hp engine, from Rancho Boyeros Airport to Washington National Airport, Nov. 27, 1947. Elapsed Time: 3 hr. 15 min. 13 sec.
National (U.S.) Record .... Same as above

CAPETOWN, AFRICA TO LONDON, ENGLAND
International Record .... 151.456 mph.
A. Henshaw, Great Britain, Percival Mew Gull airplane, D. H. Gipsy VI-2 motor, 205 hp. Feb. 7-9, 1939. Elapsed Time: 39 hr. 36 min.
National (U.S.) Record .... No official record

LONDON, ENGLAND TO ROME, ITALY
International Record .... 447.219 mph
John Cunningham and P. O. Bugge, Great Britain, de Havilland Comet DH-106 Mark I, 4 de Havilland Ghost Mark I jet engines, Mar. 16, 1950. Elapsed Time: 1 hr. 58 min. 37 sec.
National (U.S.) Record .... No official record

ROME, ITALY TO LONDON, ENGLAND
International Record .... 453.308 mph.
John Cunningham and P. O. Bugge, Great Britain, de Havilland Comet DH-106 Mark I, 4 de Havilland Ghost Mark I jet engines, Mar. 16, 1950. Elapsed Time: 1 hr. 58 min. 04 sec.
National (U.S.) Record .... No official record.

PARIS, FRANCE TO SAIGON, FRENCH INDO-CHINA
International Record .... 67.926 mph.
Miss Maryse Hilsz, France, Caudron Simoun C. 635 airplane, Renault engine, from Le Bourget Airport to Tan Son Nhut Airport, Dec. 19-23, 1937. Elapsed Time: 96 hr. 36 min. 15 sec.
National (U.S.) Record .... No official record.

PARIS, FRANCE TO HANOI, FRENCH INDO-CHINA
International Record .... 111.976 mph.
Andre Japy, France, Caudron Simoun airplane, Renault 6Q01, number 71 motor, from Le Bourget, Paris to Gia Lam Airport, Hanoi, Nov. 15-18, 1936. Elapsed Time: 50 hr. 59 min. 49 sec.
National (U.S.) Record .... No official record.

NEW YORK, N. Y. TO LOS ANGELES, CAL.
International Record .... 328.598 mph.
Capt. Boyd L. Grubaugh, pilot; Capt. J. L. England, co-pilot; M/Sgt. R. R. Pierron, M/Sgt. D. H. Atkins, M/Sgt. T. L. Wolfe, T/Sgt. D. B. Smith, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines, from La Guardia Airport to Burbank, Cal., Aug. 1, 1946. Distance: 2,453.805 mi. Elapsed Time: 7 hr. 28 min. 03 sec.
National (U.S.) Record .... Same as above

NEW YORK CITY, U.S.A. TO LONDON, ENGLAND
International Record .... 169.227 mph.
Henry T. Merrill and John S. Lambe, pilots, United States, Lockheed Electra monoplane, Pratt and Whitney SHI engine, May 9-10, 1937. Elapsed Time: 20 hr. 29 min. 45 sec.
National (U.S.) Record .... Same as above

LONDON, ENGLAND TO MELBOURNE, AUSTRALIA
International Record .... 159.038 mph.
C. W. A. Scott and T. Campbell Black, Great Britain, de Havilland Comet monoplane, 2 D H. Gipsy VI engines, Oct. 20-23, 1934. Elapsed Time: 71 hr. 00 min. 18 sec.
National (U.S.) Record .... 121.267 mph.
Roscoe Turner and Clyde Pangborn, Boeing 247-D monoplane, 2 Pratt and Whitney supercharged 550 hp engines, Oct. 20-24, 1934.

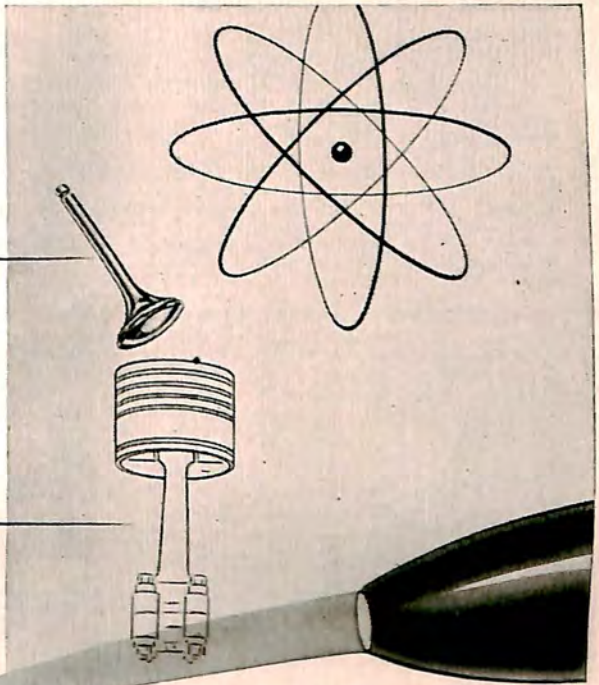
LONDON, ENGLAND TO SYDNEY, AUSTRALIA
International Record .... 130.309 mph.
F/O A. E. Clouston and Victor Ricketts, Great Britain, de Havilland Comet monoplane, 2 D H Gipsy VI engines, Mar. 21-26, 1938. Elapsed Time: 80 hr. 56 min.
National (U.S.) Record .... No official record.

SYDNEY, AUSTRALIA TO LONDON, ENGLAND
International Record .... 81.261 mph.
F/O A. E. Clouston and Victor Ricketts, Great Britain, de Havilland *Comet* monoplane, 2 D. H. Gipsy VI engines, Mar. 21-26, 1938. Elapsed Time: 130 hr. 3 min.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO WELLINGTON, NEW ZEALAND
International Record .... 194.657 mph.
Air Commodore N. H. d'Aeth, Squadron Leader J. S. Aldridge, Flight Lt. D. D. Hurditch, and crew, Great Britain, Modified Avro Lancaster Aries, 4 Rolls Royce Merlin engines of 1,200 hp each, Aug. 21-24, 1946. Elapsed Time: 59 hr. 50 min.
National (U.S.) Record .... No official record.

WELLINGTON, NEW ZEALAND TO LONDON, ENGLAND
International Record .... 83.454 mph.
A. F. Clouston and Victor Ricketts, Great Britain; D. H. Comet airplane, 2 D. H. Gypsy VI engines, Mar. 20-26, 1938. Elapsed Time: 140 hr. 12 min.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO CAPETOWN, AFRICA
International Record .... 279.244 mph.
Sq. Ldr. H. E. Martin, pilot, Sq. Ldr. E. B. Simone, navigator, Great Britain, de Havilland Mosquito R. G. 238, type PR 34, 2 Rolls Royce Merlin 114 A engines, Apr. 30-May 1, 1947. Elapsed Time: 21 hr. 31 min. 30 sec.
National (U.S.) Record .... No official record.



LONDON, ENGLAND TO KARACHI, INDIA
International Record .... 205.145 mph.
Air Commodore N. H. d'Aeth, Squadron Leader J. S. Aldridge, Flight Lt. D. D. Hurditch, and crew, Great Britain, Modified Avro Lancaster *Aries*, 4 Rolls Royce Merlin engines, 1,200 hp each, Aug. 21-22, 1946. Elapsed Time: 19 hr. 14 min.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO DARWIN, AUSTRALIA
International Record .... 189.523 mph.
Air Commodore N. H. d'Aeth, Squadron Leader J. S. Aldridge, Flight Lt. D. D. Hurditch, and crew, Great Britain, Modified Avro Lancaster *Aries*, 4 Rolls Royce Merlin engines, 1,200 hp each, Aug. 21-22, 1946. Elapsed Time: 45 hr. 35 min.
National (U.S.) Record .... No official record.

PARIS, FRANCE TO TANANARIVO, MADAGASCAR
International Record .... 94.391 mph.
Genin and Robert, France, Caudron Simoun airplane, Renault 180 hp engine, from Le Bourget airport to Ivato airport, Dec. 18-21, 1935. Elapsed Time: 57 hr. 35 min. 21 sec.
National (U.S.) Record .... No official record.

TOKYO, JAPAN TO LONDON, ENGLAND
International Record .... 101.193 mph.
Masaaki Linuma and Kenji Tsukaloshi, Japan, Kamikase monoplane, type *Karigane*, Mitsubishi *Nakajima* 550 hp engine, Apr. 6-9, 1937. Elapsed Time: 94 hr. 17 min. 56 sec.
National (U.S.) Record .... No official record.

ROME, ITALY TO RIO DE JANEIRO, BRAZIL
International Record .... 137.923 mph.
Attileo Bisco, Magg. Amedeo Paradisi, S. Ten. Giovanni Vitalini Sacconi, pilots; Ubaldo Ardu, mechanic; Giovanni Cubeddu, radio operator; Italy, S.79 I-Bise airplane, 3 Alfa Romeo 126 RC.34 750 hp engines, Jan. 24-25, 1938. Elapsed Time: 41 hr. 32 min.
National (U.S.) Record .... No official record.

ROME, ITALY TO ADDIS ABABA, ETHIOPA
International Record .... 242.938 mph.
M. Lualdi, G. Mazzotti and E. Valente, pilots; S. Pinna, radio telegrapher and G. Guerrini, mechanic; Italy; Fiat BR. 20 L airplane, 2 Fiat Asso 80 1,000 hp motors, Mar. 6-7, 1939. Elapsed Time: 11 hr. 25 min.
National (U.S.) Record .... No official record.

BERLIN, GERMANY TO NEW YORK CITY, N. Y., U.S.A.
International Record .... 158.759 mph.
Alfred Henke and Rudolf Freiherr von Moreau, pilots; Paul Dierberg, radiomecanicien and Walter Kober, radiotelegraphiste; Germany, Focke-Wulf FW 200 Condor airplane, 4 BMW 132 L motors, 750 hp each, Aug. 10-11, 1938. Elapsed Time: 24 hr. 56 min. 12 sec.
National (U.S.) Record .... No official record.

NEW YORK, N. Y., U.S.A., TO BERLIN, GERMANY
International Record .... 199.409 mph.
Alfred Henke and Rudolf Freiherr von Moreau, pilots; Paul Dierberg, radiomecanicien, and Walter Kober, radiotelegraphiste; Germany; Focke-Wulf FW 200 Condor airplane, 4 BMW 132 L motors, 750 hp each, Aug. 13-14, 1938. Elapsed Time: 19 hr. 55 min. 1 sec.
National (U.S.) Record .... No official record.

BERLIN, GERMANY TO TOKYO, JAPAN
International Record .... 119.494 mph.
Alfred Henke and H. R. Freiherr von Moreau, pilots; P. Dierberg, radiomecanicien; W. Kober, radiotelegraphiste, and G. Kohne, mechanic; Germany, Focke-Wulf FW 200 Condor airplane; 4 BMW 132 L motors, 750 hp each, from Tempelhof to Tachikawa, Nov. 28-30, 1938. Elapsed Time: 46 hr. 18 min. 19 sec.
National (U.S.) Record .... No official record

BERLIN, GERMANY TO HANOI, FRENCH INDO-CHINA
International Record .... 151 mph.
Alfred Henke and H. R. Freiherr von Moreau, pilots; P. Dierberg, radiomecanicien; W. Kober, radiotelegraphiste, and G. Kohne, mechanic; Germany, Focke-Wulf FW 200 Condor airplane; 4 BMW 132 L motors, 750 hp each, from Tempelhof to Gia Lam, Nov. 28-30, 1938. Elapsed Time: 34 hr. 17 min. 27 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO PARIS, FRANCE
International Record .... 617.702 mph
Squadron Leader Trevor S. Wade, DFC, Great Britain, Hawker P-1052, Rolls Royce Nene jet engine, May 13, 1949.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO CAIRO, EGYPT
International Record .... 426.607 mph.
John Cunningham, D.S.O., D.F.C., Great Britain, de Havilland DH-106 Mark I Comet, 4 Ghost D. Gt. 3 jet engines, Apr. 24, 1950. Elapsed Time: 5 hr. 6 min. 58.3 sec.
National (U.S.) Record .... No official record

CAIRO, EGYPT TO LONDON, ENGLAND
International Record .... 385.887 mph.
John Cunningham, D.S.O., D.F.C., Great Britain, de Havilland DH 106 Mark I Comet, 4 Ghost D. Gt. 3 jet engines, May 11, 1950. Elapsed Time: 5 hr. 39 min. 21.7 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO COPENHAGEN, DENMARK
International Record .... 541.417 mph.
Janusz Zurakowski, Great Britain, Gloster Meteor Mk. F8 V2468, 2 Rolls Royce Derwent V jet engines, Apr. 4, 1950. Elapsed Time: 1 hr. 5 min. 5 sec.
National (U.S.) Record .... No official record.

COPENHAGEN, DENMARK TO LONDON, ENGLAND
International Record .... 500.670 mph.
Janusz Zurakowski, Great Britain, Gloster Meteor Mk. F8, 2 Rolls Royce Derwent V jet engines, Apr. 4, 1950. Elapsed Time; 1 hr. 11 min. 17 sec.
National (U.S.) Record .... No official record.

GIBRALTAR TO LONDON, ENGLAND
International Record .... 435.886 mph.
Group Capt. A. C. P. Carner, Great Britain, de Havilland Hornet F Mark III, 2 Rolls Royce Merlin 130, 2,030 hp engines, Sept. 19, 1949. Elapsed Time: 2 hr. 30 min. 21 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO LA VALETTE, FRANCE
International Record .... 387.896 mph.
Lt. Commander W. R. MacWhirter, Lt. P. C. S. Chilton, Lt. D. A. Hook and Lt. D. W. Morgan, Great Britain, Hawker XI Sear Fury, Bristol Centaurus XVIII 2,560 hp engine, July 19, 1949. Elapsed time: 3 hr. 20 min. 49 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO KHARTOUM, EGYPT
International Record .... 179.984 mph.
Air Commodore Hassan Akef Bey, ADC, Egypt, Curtiss 646A, 2 Pratt and Whitney Wasp, 2,000 hp engines, May 1, 1950. Elapsed Time: 17 hr. 1 min. 28 sec.
National (U.S.) Record .... No official record.

BELFAST, IRELAND TO GANDER, NEWFOUNDLAND
World "Class" Record .... 481.099 mph.
Roland P. Beamont, pilot; D. A. Watson, navigator; R. Rylands, radio operator, Great Britain, English Electric Canberra B. Mark 2, WD 940 aircraft, two Rolls Royce Avon RA 3 jet engines, Aug. 31, 1951. Distance: 2,071.7 mi.; Duration: 4 hr. 18 min. 24.4 sec.
National (U.S.) Record .... No official record.

OFFICIAL NATIONAL TRANSCONTINENTAL AND INTER-CITY RECORDS

WEST TO EAST TRANSCONTINENTAL (JET PROPELLED)
Col. W. H. Councill, USAAF, Lockheed P-80 jet-propelled monoplane, Allison J-33 engine, from Municipal Airport, Long Beach, Cal. to La Guardia Airport, L. I., N. Y., Jan. 26, 1946. Distance: 2,453.807 mi. Elapsed Time: 4 hr. 13 min. 26 sec. Average Speed: 580.935 mi.

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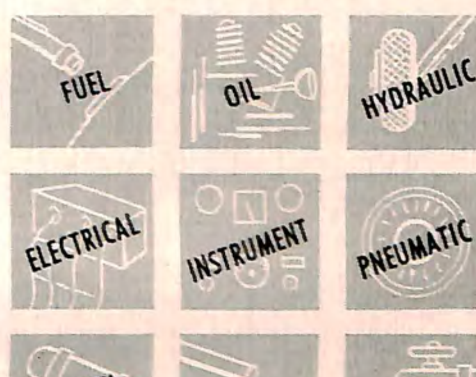

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WEST TO EAST TRANSCONTINENTAL (MULTI-ENGINE MILITARY AIRCRAFT)
Col. C. S. Irvine, pilot; Lt. Col. G. R. Stanley, co-pilot; Lt. Col. F. J. Shannon, Maj. K. L. Royer, Capt. W. J. Bennett, Capt. R. A. Saltzman, M/Sgt. D. E. West, T/Sgt. J. F. Broughton, crew; USAAF; Boeing B-29 monoplane, 4 Wright R-3350-23A engines; from Burbank, Cal. to Floyd Bennett Field, Brooklyn, Dec. 11, 1945. Distance: 2,457 mi. Elapsed Time: 5 hr. 27 min. 19.2 sec. Average Speed: 450.385 mph.

LOS ANGELES, CAL. TO MEXICO CITY, D. F.
A. Paul Mantz, North American F-51 monoplane, NX-1204, Packard built Rolls Royce Merlin 1,450 hp engine, from Lockheed Air Terminal, Burbank to Mexico City Airport, Mar. 8, 1950. Distance: 1,560.767 mi. Elapsed Time: 3 hr. 34 min. 45 sec. Average Speed: 436.070 mph.

WEST TO EAST TRANSCONTINENTAL (SINGLE RECIPROCATING ENGINE-SOLO)
A. Paul Mantz, North American F-51 monoplane NX-1204, Packard Merlin 1,650 hp engine, from Lockheed Air Terminal to La Guardia Airport, L. I., N. Y., Jan. 22, 1950. Distance: 2,453.805 mi. Elapsed Time: 4 hr. 52 min. 58 sec. Average Speed: 502.543 mph.

WEST TO EAST TRANSCONTINENTAL (COMMERCIAL TRANSPORT AIRCRAFT)
Capt. Fred E. Davis, pilot; Capt. H. Lloyd Jordan, co-pilot; and Flight Engineer, E. L. Graham; Eastern Air Lines' Lockheed Constellation, 4 Wright R-3350 2,500 hp engines, from Lockheed Air Terminal, Burbank, Cal. to La Guardia Airport, Jackson Heights, L. I., N. Y., Feb. 5, 1949. Elapsed Time: 6 hr. 17 min. 39.4 sec. Distance: 2,453.805 statute mi. Average Speed: 389.847 mph.

EAST TO WEST TRANSCONTINENTAL (SINGLE RECIPROCATING ENGINE-SOLO)
A. Paul Mantz, North American P-51 monoplane, NX-1202, Packard Merlin 1,650 engine, 1,450 hp, from La Guardia Airport, Jackson Heights, L. I., N. Y., to Lockheed Air Terminal, Burbank, Cal., Sept. 3, 1947. Distance: 2,453.805 mi. Elapsed Time: 7 hr. 00 min. 4 sec. Average Speed: 350.488 mph.

EAST TO WEST TRANSCONTINENTAL (MULTI-ENGINE MILITARY AIRCRAFT)
Capt. Boyd L. Grubaugh, pilot; Capt. J. L. England, co-pilot; and M/Sgt. R. R. Pierron, M/Sgt. D. H. Atkins, M/Sgt. T. L. Wolfe, T/Sgt. D. B. Smith, crew; USAAF, Boeing B-29 monoplane, 4 Wright R-3350-23A engines, from La Guardia Airport, L. I., N. Y., to Lockheed Air Terminal, Burbank, Cal.. Aug. 1, 1946. Distance: 2,453.805 mi. Elapsed Time: 7 hr. 28 min. 3 sec. Average Speed: 328.598 mph.

LOS ANGELES, CAL. TO WASHINGTON, D. C.
Lt. Col. H. F. Warden, pilot; Capt. G. W. Edwards, co-pilot; Douglas XB-42 monoplane, 2 Allison V-1710-129 engines, 1,820 hp each, from Long Beach Municipal Airport to Bolling Field, Anacostia, D. C., Dec. 8, 1945. Elapsed Time: 5 hr. 17 min. 34 sec. Distance: 2,295 mi. Average Speed: 433.610 mph.

LOS ANGELES, CAL. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
Frank J. Bennett, pilot; John D. Scott, co-pilot; J. Jerram, flight engineer; and six passengers; Eastern Airlines' Lockheed Constellation, NC-104A, 4 Wright 2,100 hp engines, from Lockheed Air Terminal, Burbank, Cal. to 36th Street Airport, May 28-29, 1947. Elapsed Time; 6 hr. 24 min. 8 sec. Distance: 2,337.590 statute mi. Average Speed: 365.236 mph.

LOS ANGELES, CAL. TO JACKSONVILLE, FLA. (TRANSPORT AIRCRAFT)
Charles H. Dolson and Frank O. Boyer, pilots, thirty-seven passengers, including twc stewardesses, Delta Airlines' Douglas DC-6, 4 Pratt and Whitney R-2800-CA-15 1,800 hp engines, from Clover Field, Santa Monica to Thomas Cole Imeson Airport, Oct. 4, 1948. Elapsed Time: 6 hr. 43 min. 10 sec. Distance: 2,154.448 statute mi. Average Speed: 320.600 mph

LOS ANGELES, CAL. TO TAMPA, FLA. (TRANSPORT AIRCRAFT)
G. T. Baker, pilot; J. Bailey, co-pilot; and 17 passengers; Northwest Airlines' Douglas DC-6, NC-90891, 4 Pratt and Whitney 2,100 hp engines, from Clover Field, Santa Monica to Drew Field, June 3, 1947. Elapsed Time: 6 hr. 5 min. 10 sec. Distance: 2,157 mi. Average Speed: 354.413 mph.

LOS ANGELES, CAL. TO ATLANTA, GA.
Capt. Charles Dolson and William H. Davis, Jr., Delta Airlines Douglas DC-6, 4 Pratt and Whitney R-2800-CA-15 1,800 hp engines, from Clover Field, Santa Monica to Atlanta Municipal Airport. Oct. 23, 1948. Elapsed Time: 6 hr. 11 min. 42 sec. Distance: 1,944.01 mi. Average Speed; 313.803 mph.

LOS ANGELES, CAL. TO CHARLESTON, S. C. (TRANSPORT AIRCRAFT)
Capt. T. P. Ball and Capt. John Van Buren, pilots, six passengers; Delta Airlines' Douglas DC-6, 4 Pratt and Whitney R-2800-CA-15 1,800 hp engines, from Clover Field, Santa Monica to Charleston Municipal Airport, Nov. 6, 1948. Elapsed Time: 6 hr. 24 min. 32 sec. Distance: 2,203 mi. Average Speed: 344.192 mph.

LOS ANGELES, CAL. TO MEXICO CITY, D. F. (TRANSPORT AIRCRAFT)
Leland S. Andrews, Vultee V-1-A monoplane, Wright Cyclone 735 hp engines, Mar. 6, 1935. Elapsed Time: 8 hr. 6 min. 15 sec. Distance: 1,563 mi. Average Speed: 192.864 mph.

LOS ANGELES, CAL. TO MEXICO CITY, D. F.
A. Paul Mantz, North American F-51 monoplane NX-1204, Packard built Rolls Royce Merlin 1,450 hp engine, from Lockheed Air Terminal, Burbank to Mexico City Airport, Mar. 8, 1950. Elapsed Time; 3 hr. 34 min. 45 sec. Distance: 1,560.767 mi. Average Speed: 436.070 mph.

MEXICO CITY, D. F. TO LOS ANGELES, CAL.
A. L. Rodriques, North American P-51 monoplane, NX-33699, Rolls Royce Merlin, 68 engine, from Mexico City (Balbuena) Airport to Clover Field, Santa Monica, Dec. 17, 1946. Elapsed Time: 4 hr. 24 min. 30 sec. Distance: 1,557.5 mi. Average Speed; 353.308 mph.

LOS ANGELES, CAL. TO DENVER, COLO.
Miss Dianna C. Cyrus, Douglas A-26, 2 Pratt and Whitney R-2800 engines of 2,000 hp each, from Lockheed Air Terminal, Burbank to Stapleton Airport, June 20, 1947. Elapsed Time: 2 hr. 18 min. 58 sec. Distance: 836 mi. Average Speed: 360.949 mph.

SAN FRANCISCO, CAL. TO LOS ANGELES, CAL.
Capt. R. D. Creighton, USAF, North American F-86A monoplane, General Electric J-47-A jet engine from San Francisco International Airport to Los Angeles International Airport, May 20, 1950. Elapsed Time: 32 min. 56 sec. Distance: 339.121 mi. Average Speed: 617.932 mph.

SAN FRANCISCO, CAL. TO SALT LAKE CITY, UTAH
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Salt Lake Municipal Airport, Apr. 20, 1939. Elapsed Time: 2 hr. 9 min. 44 sec. Distance: 598.5 mi. Average Speed: 276.799 mph.

SAN FRANCISCO, CAL. TO SEATTLE, WASH.
Frank W. Fuller, Jr., Seversky monoplane, NR-70Y, Pratt and Whitney Twin Row Wasp 1,100 hp engine, from San Francisco Airport to Boeing Field, May 25, 1938. Elapsed Time: 2 hr. 31 min. 41 sec. Distance: 684.5 mi. Average Speed: 270.261 mph.

SAN FRANCISCO, CAL. TO SAN DIEGO, CAL.
Earl Ortman, Marcoux-Bramberg Special, Pratt and Whitney Wasp Jr., 1,195 hp engine, from Oakland Airport to Lindbergh Field, June 1, 1938. Elapsed Time: 1 hr. 48 min. 1 sec. Distance: 447 mi. Average Speed 248.295 mph.

SAN FRANCISCO, CAL. TO PORTLAND, ORE.
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp engine, from San Francisco Airport to Pearson Field, Jan. 16, 1938. Elapsed Time: 2 hr. 13 min. 53 sec. Distance: 553 mi. Average Speed: 247.828 mph.

SAN FRANCISCO, CAL. TO PHOENIX, ARIZ.
Frank W. Fuller, Jr., Seversky monoplane, NR-70Y, Pratt and Whitney Twin Row Wasp engine, from San Francisco Airport to Sky Harbor Airport, Jan. 16, 1939. Elapsed Time: 2 hr. 11 min. 58 sec. Distance; 650.5 mi. Average Speed: 295.757 mph.

SAN FRANCISCO, CAL. TO BOISE, IDAHO
Frank W. Fuller, Jr., Seversky monoplane, NR-70Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Boise Municipal Airport, May 4, 1939. Elapsed Time: 1 hr. 47 min. 26 sec. Distance: 525.5 mi. Average Speed: 293.484 mph.

SAN FRANCISCO, CAL. TO DENVER, COLO.
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Denver Municipal Airport, June 7, 1939 Elapsed Time: 3 hr. 22 min. 26.8 sec. Distance: 954 mi. Average Speed: 282.741 mph.

SAN FRANCISCO, CAL. TO WASHINGTON, D. C. (TRANSPORT AIRCRAFT)
Capt. Scott Flower, pilot; 1st officer R. E. McDonald, co-pilot; crew of seven and nine passengers; Pan American Airways Boeing B-377 Stratocruiser, 4 Pratt and Whitney Wasp Major 4,360 engines, from San Francisco Airport to Washington National Airport, Mar. 3, 1949. Elapsed Time: 6 hr. 22 min. 25.4 sec. Distance: 2,436.917 statute mi. Average Speed: 382.338 mph.

NEW YORK, N. Y. TO ATLANTA, GA. (TRANSPORT AIRCRAFT)
H. T. Merrill and Clifford Zieger, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3,350 engines, 2,500 hp each, from La Guardia Airport to Atlanta Municipal Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 36 min. 20 sec. Distance: 759.707 mi. Average Speed: 330.068 mph.

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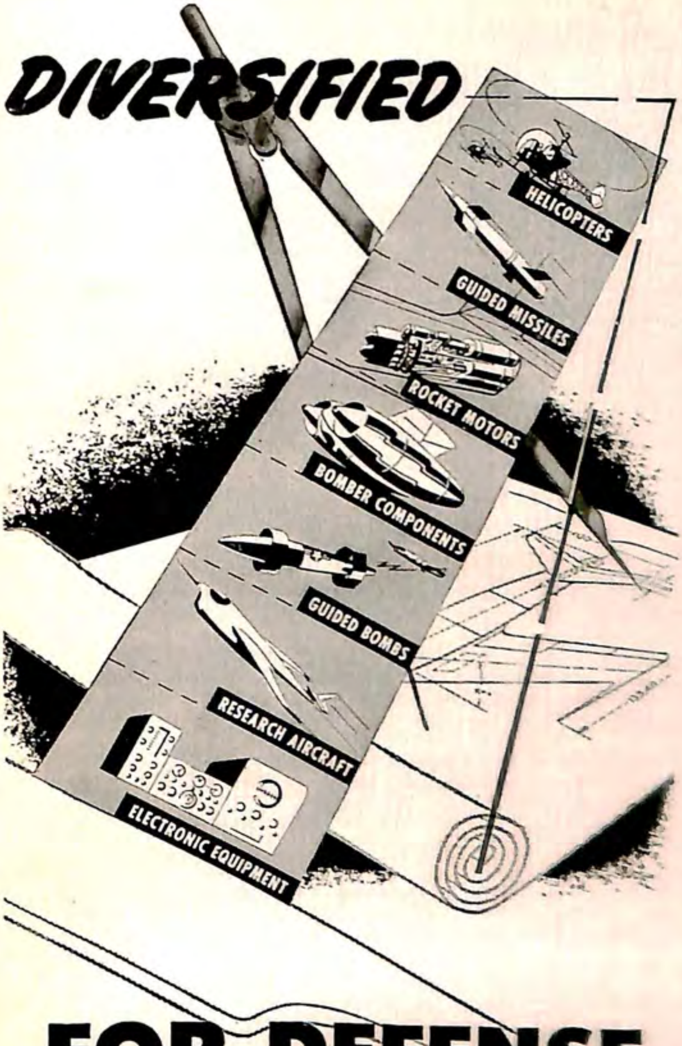

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ATLANTA, GA., TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)
H. T. Merrill and Clifford Zieger, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Atlanta Municipal Airport to La Guardia Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 36 min. 20 sec. Distance: 759.707 mi. Average Speed: 291.572 mph.

NEW YORK, N. Y. TO HAVANA, CUBA
Col. A. P. de Seversky, Modified Seversky P-35 monoplane, powered with a Pratt and Whitney 1830-9 850 hp engine, from Floyd Bennett Field to Camp Columbia, Havana, Dec. 3, 1937 Elapsed Time: 5 hr. 3 min. 5.4 sec. Distance: 1,307 mi. Average Speed: 258.735 mph.

NEW YORK, N. Y., TO HOUSTON, TEX.
Henry T. Merrill, pilot, J. D. Scott, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright 2,100 hp engines from La Guardia Airport, Jackson Heights, L. I. to Houston Municipal, June 6, 1947. Elapsed Time: 4 hr. 39 min. 3 sec. Distance: 1,425.5 mi. Average Speed: 306.504 mph.

HOUSTON, TEX. TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)
Henry T. Merrill, pilot, J. D. Scott, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright 2,100 hp engines, from Houston Municipal to La Guardia Airport, June 6, 1947. Elapsed Time: 4 hr. 41 min. 35 sec. Distance: 1,425.5 mi. Average Speed: 303.746 mph.

NEW YORK, N. Y. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
E. R. Brown, pilot; E. H. Parker, co-pilot; Eastern Airlines' Lockheed Constellation, 4 Wright engines, 2,100 hp each, from La Guardia Airport to 36th Street Airport, May 28, 1947. Elapsed Time: 3 hr. 58 min. 41.2 sec. Distance: 1,096.427 mi. Average Speed: 275.615 mph.

MIAMI, FLA. TO NEW YORK, N Y. (TRANSPORT AIRCRAFT)
E. R. Brown, pilot; E. H. Parker, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright engines, 1,200 hp each, from 36th Street Airport to La Guardia Airport, May 28, 1947. Elapsed Time: 3 hr. 29 min. 11.4 sec. Distance: 1,096.427 mil. Average Speed: 314.477 mph.

NEW YORK, N. Y. TO NEW ORLEANS, LA. (TRANSPORT AIRCRAFT)
H. T. Merrill and E. R. Brown, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from La Guardia Airport, L. I., to Moisant International Airport, July 23, 1947. Elapsed Time: 3 hr. 52 min. 29.8 sec. Distance: 1,182.466 mi. Average Speed: 305.157 mph.

NEW ORLEANS, LA. TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)
H. T. Merrill and E. R. Brown, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Moisant International Airport to La Guardia Airport, L. I., July 23, 1947. Elapsed Time: 3 hr. 35 min. 10.8 sec. Distance: 1,182.466 mi. Average Speed: 329.714 mph.

NEW YORK, N. Y. TO WASHINGTON, D. C.
Capt. Martin L. Smith, USAF, Lockheed P-80 jet-propelled monoplane, Allison J-33-11 engine, from La Guardia Airport, Jackson Heights, L. I. to Washington National Airport, Apr. 21, 1946. Elapsed Time: 29 min. 15 sec. Distance: 214 mi. Average Speed: 438.974 mph.

MEXICO CITY, D. F. TO NEW YORK, N. Y.
Francisco Sarabia, Gee Bee monoplane, X-BAKE, Pratt and Whitney Hornet 980 hp engine, from the Military Airport, Mexico City to Floyd Bennett Field, May 24, 1939. Elapsed Time: 10 hr. 47 min. 46.8 sec. Distance: 2,087.5 mi. Average Speed: 193.353 mph.

HONOLULU, HAWAII TO NEW YORK, N. Y.
Lt. Col. Robert E. Thacker, pilot; 1st Lt. John M. Ard, co-pilot; North American P-82 monoplane, 2 Rolls Royce V-1650 engines, 2,250 hp each, from Hickam Field, Honolulu to La Guardia Airport, Jackson Heights, L. I., Feb. 28, 1947. Elapsed Time: 14 hr. 31 min. 50 sec. Distance: 4,968.852 mi. Average Speed; 341.959 mph.

CHICAGO, ILL. TO ATLANTA, GA. (TRANSPORT AIRCRAFT)
H. T. Merrill and S. A. Bell, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Chicago Municipal Airport, to Atlanta Municipal Airport, Aug. 5, 1947. Elapsed Time: 1 hr. 48 min. 20 sec. Distance: 590.281 mi. Average Speed: 326.925 mph.

ATLANTA, GA. TO CHICAGO, ILL. (TRANSPORT AIRCRAFT)
H. T. Merrill and S. A. Bell, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Atlanta Municipal Airport to Chicago Municipal Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 1 min. 55 sec. Distance: 590.281 mi. Average Speed: 290.501 mph.

CHICAGO, ILL. TO LOS ANGELES, CAL.
Howard R. Hughes, Northrop Gamma monoplane, NR-13761, Wright Cyclone engine, from Chicago Municipal Airport to Grand Central Air Terminal, Glendale, Cal., May 14, 1936. Elapsed Time: 8 hr. 10 min. 29.8 sec. Distance: 1,734.5 mi. Average Speed; 212.172 mph.

CHICAGO, ILL. TO MIAMI, FLA. (COMMERCIAL TRANSPORT)
Capt. Jack Roth, pilot; First Officer, A. C. Bonner, co-pilot, 2 stewardesses and 37 passengers, Delta Air Lines, Douglas DC-6, N-1905M, 4 Pratt and Whitney R-2800 engines, from Midway Airport to Miami International Airport, Mar. 2, 1950. Elapsed time: 3 hr. 8 min. 48 sec. Distance: 1,183.422 mi. Average Speed: 376.087 mph.

CHICAGO, ILL. TO WASHINGTON, D. C. (TRANSPORT AIRCRAFT)
Jack Frye, TWA, Northrop Gamma 2-D monoplane, NR-13758, Wright Cyclone 710 hp engine, from Chicago Municipal Airport to Washington-Hoover Airport, S. Washington, Feb. 18, 1936. Elapsed Time: 2 hr. 22 min. Distance: 599 mi. Average Speed: 253.098 mph.

VANCOUVER, B. C., CANADA TO AGUA CALIENTE, MEXICO
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,100 hp engine, from Vancouver Airport to Agua Caliente Airport, Nov. 4, 1937. Elapsed Time: 4 hr. 54 min.

MIAMI, FLA. TO CHICAGO, ILL. (TRANSPORT AIRCRAFT)
Henry T. Merrill and P. L. Foster, pilots; Eastern Airlines' Lockheed Constellation, NC-105A, 4 Wright 3350 engines, 2,500 hp each, from 36th Street Airport to Chicago Municipal Airport, July 16, 1947. Elapsed Time: 3 hr. 56 min. 22 sec. Distance: 1,183.368 mi. Average Speed: 300.390 mph.

VANCOUVER, B. C., CANADA TO OAKLAND, CAL.
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,100 engine, from Vancouver Airport to Oakland Airport, May 28, 1938. Elapsed Time: 3 hr. 8 min. 43 sec. Distance: 792.5 mi. Average Speed: 251.965 mph.

MARCH FIELD, CAL. TO MITCHEL FIELD, N. Y.
Lt. Ben S. Kelsey, USAF, Lockheed XP-38 airplane, 2 Allison liquid cooled 1,000 hp engines, Feb. 11, 1939. Elapsed Time: 7 hr. 45 min. 36 sec. Distance: 2,425 mi. Average Speed: 312.5 mph.

WICHITA, KAN. TO LOS ANGELES, CAL.
Paul Mantz, Lockheed Orion NR-12222, from Wichita Airport to Union Air Terminal, July 4, 1938. Elapsed Time: 7 hr. 11 min. 5 sec. Distance: 1,201 mi. Average Speed: 167.160 mph.

DETROIT, MICH. TO AKRON, O.
Louise Thaden, Beechcraft biplane, NC-15835, from Detroit City Airport to Akron Municipal Airport, Jan. 21, 1937. Elapsed Time: 40 min. 43 sec. Distance: 123.5 mi. Average Speed: 181.989 mph.

DETROIT, MICH. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
H. T. Merrill and F. Bennett, pilots; Eastern Airlines' Lockheed Constellation, NC-113A, 4 Wright 3350 engines, 2,500 hp each, from Willow Run Airport to 36th Street Airport, Aug. 7, 1947. Elapsed Time: 3 hr. 36 min. 29 sec. Distance: 1,150.455 mi. Average Speed: 318.857 mph.

TAMPA, FLA. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
G. T. Baker, pilot; J. Bailey, co-pilot; and passengers; National Airlines' Douglas DC-6, NC-90891, 4 Pratt and Whitney 2,100 hp engines, from Drew Field to 36th Street Airport, June 3, 1947. Elapsed Time: 39 min. 13 sec. Distance: 204.429 mi. Average Speed: 312.769 mph.

OFFICIAL FEMININE NATIONAL TRANSCONTINENTAL AND INTER-CITY RECORDS

WEST TO EAST TRANSCONTINENTAL RECORD
Jacqueline Cochran, modified Seversky pursuit monoplane, Pratt and Whitney Twin Row Wasp engine, from Burbank, Cal. to Brooklyn, N. Y., Sept. 3, 1938. Elapsed Time: 10 hr. 27 min. 55 sec. Average Speed: 234.776 mph.

EAST TO WEST TRANSCONTINENTAL RECORD
Louise Thaden and Blanche Noyes, Beechcraft, Wright 420 hp engine, from Floyd Bennett Field, Brooklyn, N. Y. to Los Angeles Municipal Airport, Cal., Apr. 19-20, 1935. Elapsed Time: 13 hr. 33 min.

MEXICO CITY TO WASHINGTON, D. C.
Amelia Earhart, Lockheed Vega monoplane, Pratt and Whitney Wasp 550 hp engine from Central Airport, Mexico City to Washington-Hoover Airport, S. Washington, Virginia, May 8, 1935. Elapsed Time: 13 hr. 1 min. 51 sec.

MEXICO CITY TO NEW YORK, N. Y.
Amelia Earhart, Lockheed Vega monoplane, Pratt and Whitney Wasp 550 hp engine from Central Airport, Mexico City to Newark Airport, Newark, N. J., May 8, 1935. Elapsed Time: 14 hr. 19 min.

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