
PLANE
VIEWS

PLANE VIEWS

AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, Inc.
610 Shoreham Building, Washington 5, D. C.

FOREWORD

The United States aircraft industry is vast and complex. It, and allied industries which have sprung from its loins, has become a major factor in the nation's economy. Products of the aircraft industry gird the world. "Made in America" aircraft, aircraft engines, systems and components, are *buy* words anywhere — wherever quality and dependability are prime considerations.

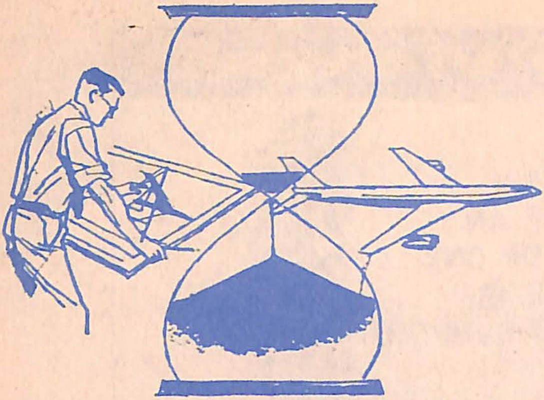
The unending contribution that the nation's aircraft industry makes to the national security, indeed to the free world, scarcely needs recounting. U. S.-designed and -built fighters and bombers, missiles, and many other types of aircraft, are poised along the ramparts of the free world, ready for instant defense of the nation.

The aircraft industry remains forever a challenge to youth, for it has no horizons and its frontiers are endless. The challenge of developing aircraft and missiles for the next decade embraces virtually every form of science and engineering. The aircraft industry represents a marriage of the highest skills and talents in these fields.

The drama and adventure in the scientific developments in the field of aeronautics provide a solid basis for youth interest. General Thomas S. Power, Commander, USAF's Air Research and Development Command, recently stated the case with wisdom and wit: "*We must stimulate the desire for scientific careers in our youth, and we must erase from their minds the pathetic picture of the impractical dreamer whose only rewards for accomplishment are the plaudits of other dreamers. Instead, we must create the picture of a 'Davy Crockett' of science, the modern pioneer fighting on the frontiers of human knowledge.*"

The illustrations and comments contained in this booklet are a collection reprinted from the official publication of the Aircraft Industries Association, *PLANES*. Published in response to many requests, it is hoped that this booklet of graphic facts will inspire many who aspire to aviation as a career.

ADMIRAL DEWITT C. RAMSEY, USN (RET.)
President, Aircraft Industries Association
October 15, 1956

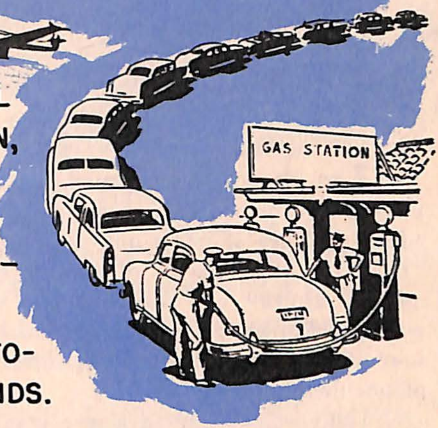


The "quiet room" where a person can hear his own heartbeat is used to isolate the sounds produced by mechanical devices in order to learn how to muffle them without interference from other noises. The room is designed on "anechoic" principles—it will not reflect sound. The walls are $4\frac{1}{2}$ to 5 feet thick.

No other major industry requires the highly specialized and expensive facilities and equipment used by the aircraft industry. The rigid reliability factors, the performance requirements constantly keep designers struggling to advance the state of the art. Manufacturers of consumer products market their products only after they are assured of a proven market. This means that they follow an evolutionary pattern in their research programs.

The aircraft industry, on the other hand, faces a situation that goes far beyond the hazards of commercial competition. It must set its sights for all-important breakthroughs in the state of the art—a gain that leap-frogs across the evolutionary concept and becomes revolutionary. Failure to maintain a substantial program of research and development—to build a "quiet room"—means loss of business to the company and, even more important, the potential loss of a valuable weapons system for our defense forces.

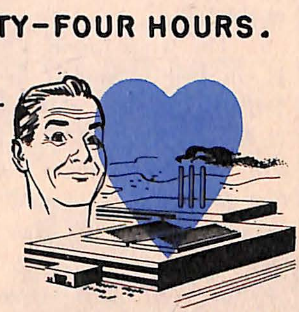
Plane Views



IN EACH USAF AERIAL REFUELING OPERATION, FUEL CAN BE TRANSFERRED AT 600 GALLONS PER MINUTE–ENOUGH TO FILL THE GAS TANKS OF 38 AUTOMOBILES IN 60 SECONDS.

A NEW U.S. SUPERSONIC RESEARCH PLANE, IF POSSESSING SUFFICIENT FUEL, COULD CIRCLE THE EARTH TWICE AT THE EQUATOR IN TWENTY-FOUR HOURS.

A "QUIET ROOM" USED IN REDUCING EQUIPMENT NOISE OF A U.S. AIRCRAFT MANUFACTURER IS SO SOUND PROOF THAT YOU CAN HEAR YOUR HEARTBEAT AS YOU WALK THROUGH IT.



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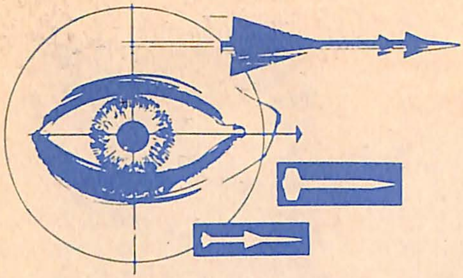


Guided missiles, which the aircraft industry has designed and produced, must function under a bewildering array of conditions. They must operate perfectly at ultrasonic speeds in the heavy atmosphere below 10,000 feet or in the rare air of high altitudes. The control surfaces of a guided missile are subjected to enormous stresses when they are manipulated at very high speeds to direct the flight. Without precise engineering, selection of the proper metal and exhaustive testing, the control surface would be ripped away from the missile in flight. The surface, which is about the size of an office desk top, is engineered to support the equivalent weight of six heavy automobiles.

The operational requirements of this single part of a guided missile is typical of the efforts of the aircraft industry in producing superior air power.

Engineers estimate that using only 100 components, which is a fraction of the actual number used, each component must have less than one chance in a thousand of failing if the missile is to achieve 90 per cent reliability. This demand for reliability is compounded by the complexity that is inherent in any modern missile or aircraft.

There are at least nine missiles that are with operational units of the military services and at least a score in various stages of development, including the Intercontinental Ballistic Missile (ICBM), which is being speeded toward completion as a military project of the highest priority.

The U. S. aircraft industry is charged with one of the heaviest responsibilities ever vested by the Government in private industry: designing and producing superior air weapons. The very existence of our nation depends on the ingenuity and skill of the aircraft industry in providing superior equipment to our military services. Technology has overwhelmed mere numbers as the decisive factor in air power.

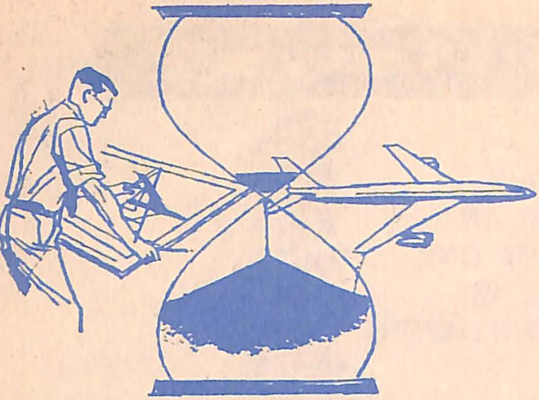
Plane Views

THE CONTROL SURFACE (ABOUT THE SIZE OF AN OFFICE DESK TOP) OF ONE U.S. GUIDED MISSILE IS STRONG ENOUGH TO SUPPORT SIX HEAVY AUTOS

WIND TUNNEL TESTING TIME FOR A MODERN JET BOMBER AMOUNTED TO 8,000 HOURS – 33 TIMES MORE THAN THE TUNNEL HOURS REQUIRED FOR A WORLD WAR II BOMBER

SIX OUT OF TEN OF THE MORE THAN 60,000 CIVILIAN PLANES IN THE U.S. ARE PRIVATELY OWNED, PERSONAL AIRCRAFT

–PLANES



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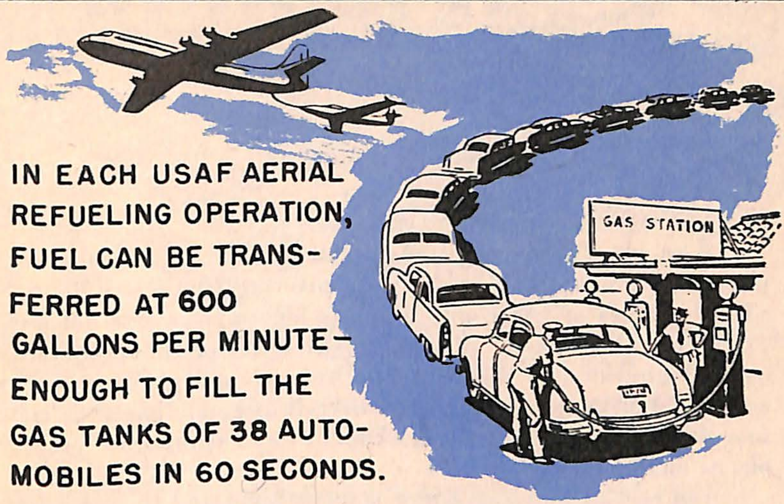

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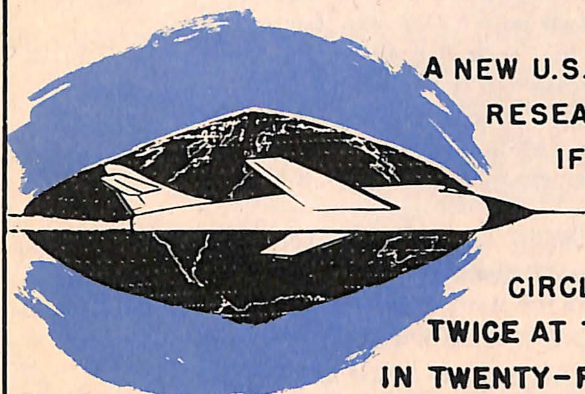

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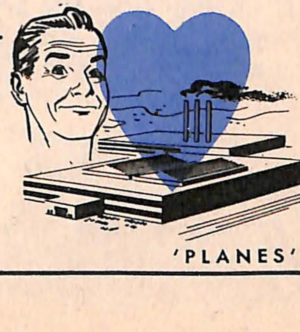

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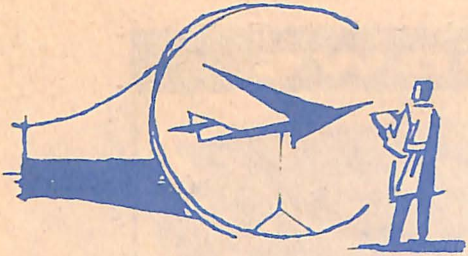


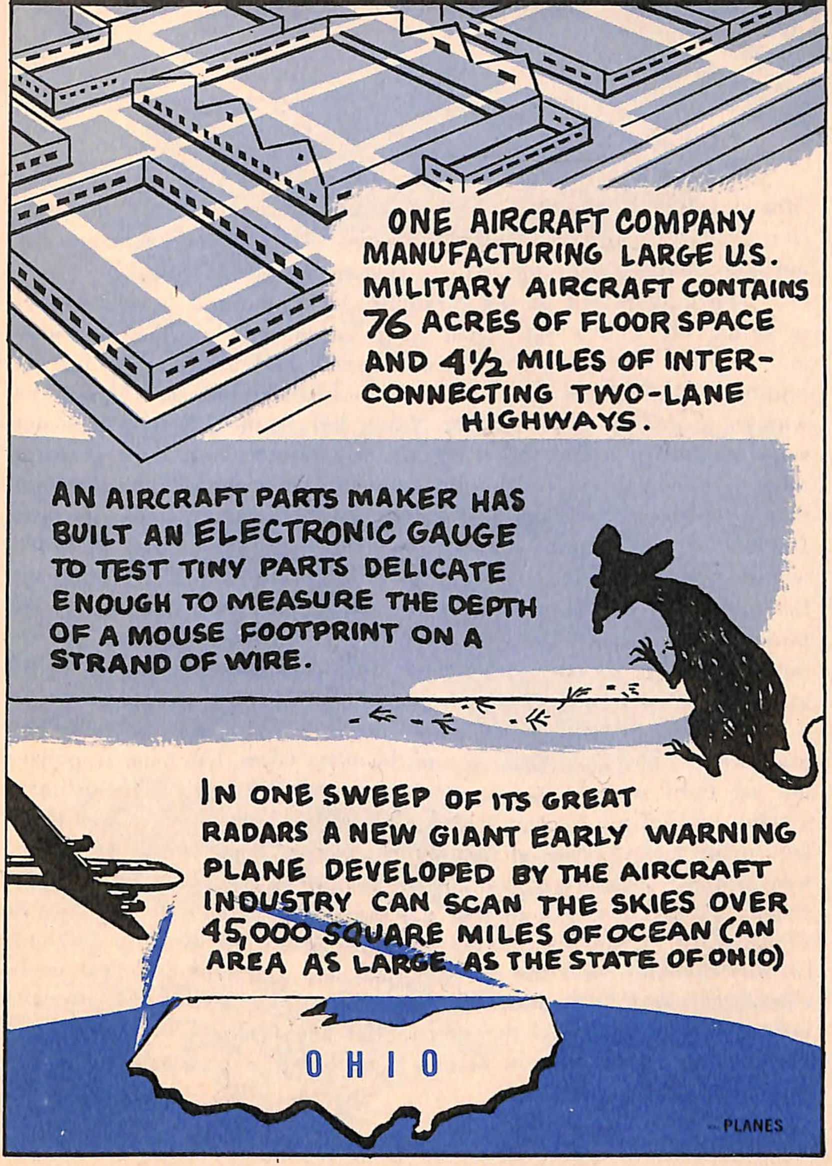
The plant areas required in the manufacture of aircraft are immense. The example of one plant covering 76 acres of floor space with 4½ miles of interconnecting, two-lane highways is not unique. There are other plants of similar size used in the production of modern aircraft and missiles. Not only do the plants cover great acreages, but in some of the huge aircraft assembly bays, the ceilings soar 125 feet above the floor. The size and complexity of today's planes dictate the plant sizes.

The cost of building a new plant is high, and is a contributing factor to the cost of air power. One manufacturer made a survey and found that construction costs had almost doubled since World War II. The company compared two buildings of the same size and used for identical purposes. One, built in 1945, cost \$1,233,629; the other, built in 1955, cost \$2,455,951. The two buildings have been combined in one structure, necessary in the production of today's larger planes.

The greatest facility expense, however, is for research and development. These structures, which never house the actual manufacture of planes, are the starting point for every aircraft or missile. Here the ideas for new aerial weapons are explored, tested and evaluated.

The wind tunnel used by one manufacturer to test World War II aircraft at speeds in the 300 mile-per-hour range was built in 1940 at a cost of about \$150,000. A new wind tunnel to test aircraft in the Mach 3 (three times the speed of sound) range costs about \$15,000,000. The \$150,000 tunnel was adequate for the planes under development at that time, but are totally useless in testing the hypersonic aircraft that are demanded today to meet the challenge for superior air power. This hundred-fold increase in facility expenditure is being met by the industry through a high reinvestment of earnings.

Plane Views


ONE AIRCRAFT COMPANY MANUFACTURING LARGE U.S. MILITARY AIRCRAFT CONTAINS 76 ACRES OF FLOOR SPACE AND 4½ MILES OF INTER-CONNECTING TWO-LANE HIGHWAYS.
AN AIRCRAFT PARTS MAKER HAS BUILT AN ELECTRONIC GAUGE TO TEST TINY PARTS DELICATE ENOUGH TO MEASURE THE DEPTH OF A MOUSE FOOTPRINT ON A STRAND OF WIRE.
IN ONE SWEEP OF ITS GREAT RADARS A NEW GIANT EARLY WARNING PLANE DEVELOPED BY THE AIRCRAFT INDUSTRY CAN SCAN THE SKIES OVER 45,000 SQUARE MILES OF OCEAN (AN AREA AS LARGE AS THE STATE OF OHIO)
OHIO
— PLANES

Aerial refueling has made U. S. air power truly global. The Strategic Air Command today carries out an aerial refueling operation every $3\frac{1}{2}$ minutes around-the-clock. Only a few years ago the aerial refueling technique was an interesting aerial "stunt."

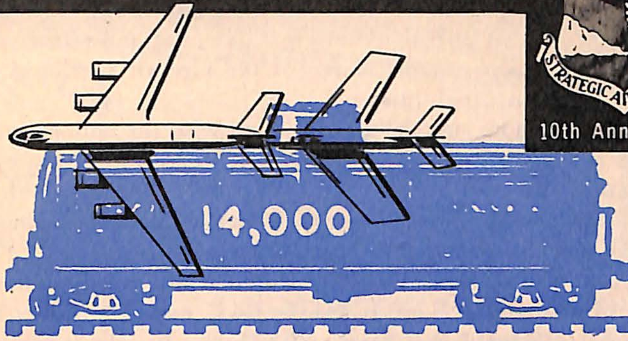
The tanker fleet of the Strategic Air Command is still piston-powered, but a new jet tanker is in accelerated production today and will be able to operate at the speeds and altitudes of the jet bombers and fighters they refuel. The aircraft industry blazed the way in providing a jet tanker. Long before there was a clear-cut requirement for a jet tanker, the aircraft industry was busy working on initial designs and tests. One company made the difficult decision to go ahead and produce a prototype of a jet tanker, using its own funds. There was no assurance from the Government that an order would be placed. The company spent approximately $16 million on the tanker project before the U. S. Air Force made its decision to purchase the plane in quantity. Because of this venture by the industry, the Air Force will have jet tankers in quantity far ahead of schedule. And America's defenses are that much stronger.

Historically, the Government has laid down the weapons requirements for military forces and, in many cases, has been responsible for their design, development and manufacture. The military airplane is unique in that it has been largely developed by civilian enterprise. The system of free enterprise is as basic to the American way as the Constitution itself. The aircraft industry works under a sternly competitive system that has produced qualitative air power. The quality of the aircraft and missiles produced goes far beyond careful checking that the correct materials are used and that each component has been properly fabricated. Quality in the aircraft industry embraces all of the elements of performance and suitability that insures superiority in actual operations.

Plane Views

STRATEGIC AIR COMMAND

10th Anniversary



BOMBER AND FIGHTER AERIAL REFUELING OPERATIONS OF THE STRATEGIC AIR COMMAND HAVE TRANSFERRED ENOUGH FUEL TO FILL 14,000 RAILROAD TANK CARS.

JET PLANES OF SAC HAVE TRAVELLED THE EQUIVALENT OF 22,374 TRIPS AROUND THE WORLD.

SAC'S GLOBAL OPERATION KEEPS ON AN AVERAGE OF 16% OF THEIR PLANES AIRBORNE DAY AND NIGHT.

'PLANES'

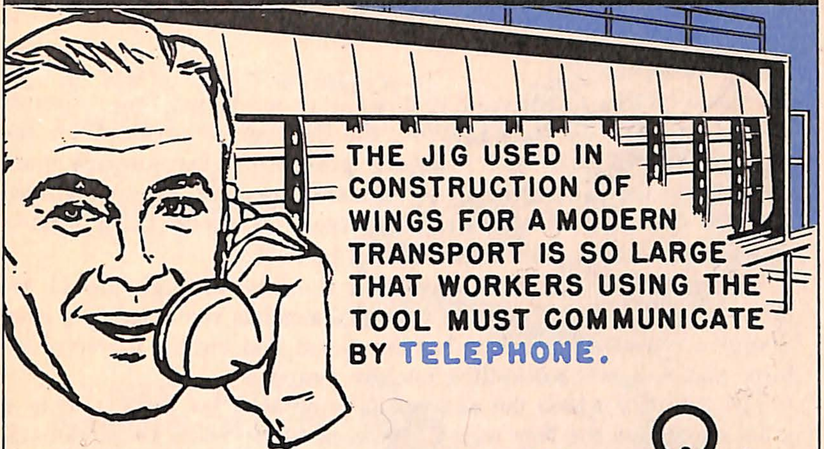
The surging progress of the aircraft industry has made the modern aircraft an instrument of great defensive and offensive power. But the rising performance curve of the aircraft produced another problem: human capabilities.

Human reactions are not able to cope with the split-second problems of fire control and precise navigation involved in the operation of a supersonic plane. Engineering and scientific teams of the aircraft industry came up with electronic devices capable of instantaneous and reliable operation at very high speeds.

The use of electronics has grown rapidly. The bombing-navigation system of a single jet bomber weighs 1,457 pounds, nearly twice the 750-pound weight of the plane in which the Wright Brothers made the first powered flight on December 17, 1903. Even during World War II, electronic equipment was limited in military aircraft. A fighter during World War II carried only one or two radios, used simple wire antennas and a visual gunsight. There was little use of airborne radar or guidance systems. Today's planes use several different radios, flush and internal antennas to cut down drag. Complicated electronic systems aim and fire the guns, rockets, missiles and bombs that make up the armament of a modern plane. An interceptor pilot closing on an enemy bomber cannot aim and fire his guns in the brief seconds permitted at high closure rates of speed. A complex electronic system takes over the entire function.

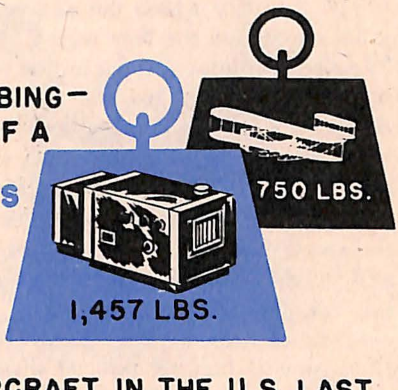
The design and development of these miraculous systems requires a constantly expanding rate of expenditure for research and development.

Plane Views

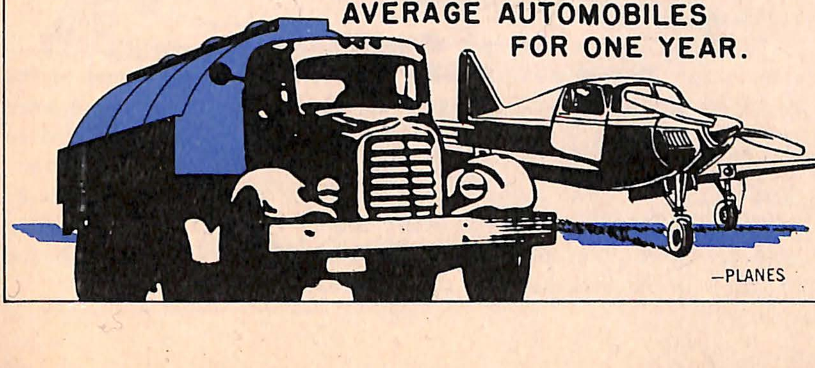


THE JIG USED IN CONSTRUCTION OF WINGS FOR A MODERN TRANSPORT IS SO LARGE THAT WORKERS USING THE TOOL MUST COMMUNICATE BY **TELEPHONE.**

THE ELECTRONIC BOMBING-NAVIGATION SYSTEM OF A SINGLE JET BOMBER WEIGHS **1,457 POUNDS** —ALMOST TWICE THE 750 POUND WEIGHT OF THE WRIGHT BROTHERS AIRPLANE.



PRIVATELY OWNED AIRCRAFT IN THE U.S. LAST YEAR CONSUMED **176.6 MILLION** GALLONS OF GASOLINE—ENOUGH TO SUPPLY 221,000 AVERAGE AUTOMOBILES FOR ONE YEAR.



—PLANES

Despite the fact that in 1950 we were producing fewer aircraft per month than we were in 1940, the floor space required for the manufacture in 1950 had increased greatly. Today, overall space required in the production of jet fighters, bombers, engines, guided missiles and civilian aircraft of all types is about 127.5 million square feet—about twice that required in 1950.

The year 1956 ended a decade of security through global air power. During these years the United States has remained safe even though a potential aggressor has developed and built a powerful air force and is busily stockpiling nuclear weapons.

This security which the nation has purchased for itself, and to a great extent for the free world, has been costly in terms of dollars. The annual outlay for the military air forces of the United States has topped $8 billion for the last several years. Nevertheless, these dollars are buying for us all the biggest bargain in history. Against a backdrop of the destruction of what just one day of modern global air war would cost this nation, these dollars are negligible.

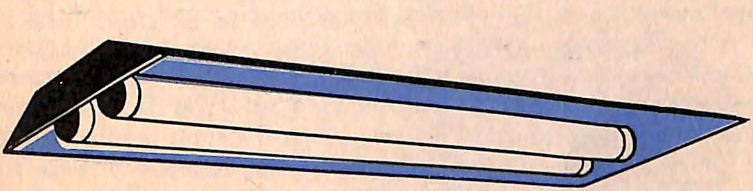
But the tremendous expenditures necessary to design and build the vastly complex aerial weapons are so great today that industry and government must work together to reduce the unit cost of military aeronautical products. For example, emergency facilities expansion of fifteen principal aircraft companies, during World War II, totaled $1,625,000,000, of which $1,450,000,000 was financed by the government and $175,000,000 by the companies. During the Korean and post-Korean expansion programs, these companies undertook $263,000,000 of gross capital expenditures out of their own resources.

The most economical and efficient method of financing production is for the customer (military or civil) to provide some of the financing needed for the performance of the contract. If such were not the case, and if the aircraft industry had to be capitalized to handle its infrequent peak production volume, it would be necessary during periods of low volume for the price of the end product to include *carrying costs* of the vastly higher capitalization needed to hold its production potential continually intact. Aircraft industry products would become truly astronomical in dollar cost.

Plane Views

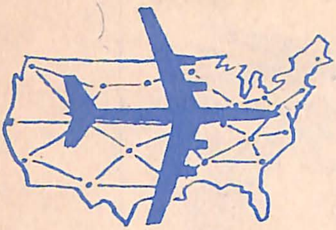
A NEW JET FIGHTER CARRIES 104 AIR-TO-AIR ROCKETS

TO MEET RIGID REQUIREMENTS NEW MILITARY AIRCRAFT ARE TESTED IN A HUGE "REFRIGERATOR-OVEN" HANGAR WHERE THEY ARE SUBJECTED TO TEMPERATURES RANGING FROM -65° TO 165° FAHRENHEIT.



72,000 FLUORESCENT LIGHTS ARE REQUIRED TO LIGHT PRODUCTION LINES OF ONE AIRCRAFT PRODUCTION PLANT. 32 CARLOADS OF LIGHTS ARE USED EACH YEAR.

'PLANES'



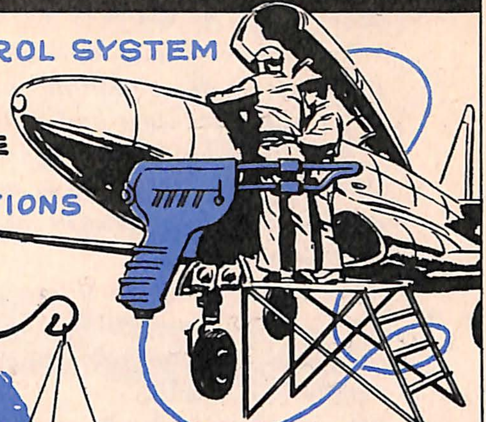
The greater size and weight of modern aircraft, brought about by the insatiable demands for greater performance characteristics, has been a main factor, along with inflation, for the increased cost of modern aircraft. Even a minor item of equipment on a bomber, such as the tires, are more costly because of their increased size. As an example, the rubber used in the landing gear system is sufficient to manufacture 100 automobile tires. The quality of the rubber must be high because failure of the tires on landing or takeoff could seriously damage or destroy a multi-million dollar aircraft.

The industry strives constantly to reduce the cost of air power to the taxpayer. It is simply good business. The efficient, low cost producer is the one who receives the contracts. And the contracts are written so that there is an incentive for the manufacturer to reduce his costs carefully. The military services, which are the principal customers of the industry, are demanding and careful buyers.

A recent survey on costs made by the Aircraft Industries Association showed that many of today's complex jet fighters and bombers cost less to produce than their simpler World War II predecessors, if inflation is discounted. This means that the efforts of the industry to improve production techniques and systems have kept pace with the rapidly progressing technical developments in aircraft.

Plane Views

THE FIRE CONTROL SYSTEM OF A MODERN COMBAT PLANE CONTAINS MORE THAN 70,000 SOLDER CONNECTIONS



THE ENGINES OF A NEW U.S. JET BOMBER, FLYING AT ONLY 375 MPH, DEVELOP MORE HORSEPOWER THAN 400 AUTOMOBILES OF 200 HORSEPOWER EACH

RUBBER USED IN THE LANDING GEAR SYSTEM OF A MODERN JET BOMBER IS SUFFICIENT TO MANUFACTURE 100 AUTOMOBILE TIRES

'PLANES'

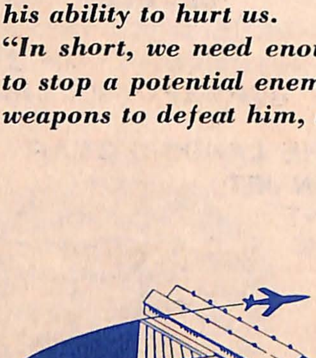
"The bomber production of a potential attacker is a factor in determining the number of air defense interceptors and radars we need. Whether he has 1,000 more or 1,000 fewer interceptors than we do is meaningless in our air defense problem because interceptors do not fight interceptors.

"The number of his *interceptors is important, however, in determining the number of offensive airplanes we would need for success in our retaliatory attacks.*

"We need enough offensive airplanes—fighter bombers, light bombers, and heavy bombers, to successfully penetrate the air defenses of a hostile nation and to attack the air bases that support strikes against us. We need enough to neutralize his military forces. We need enough to eliminate his ability to hurt us.

"In short, we need enough defensive weapons to stop a potential enemy and enough offensive weapons to defeat him, if he attacks."

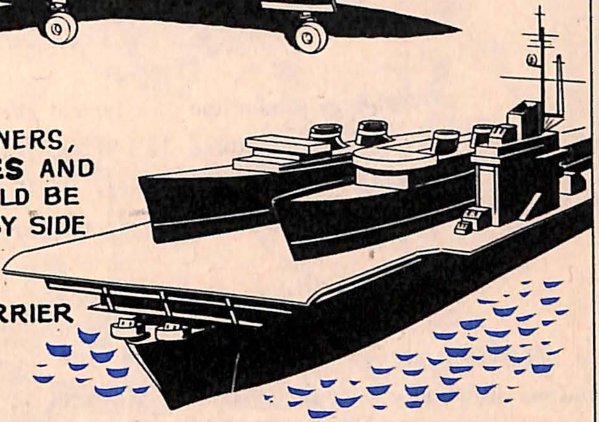
GENERAL THOMAS D. WHITE
Vice Chief of Staff, USAF

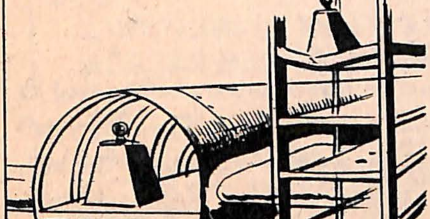


Plane Views

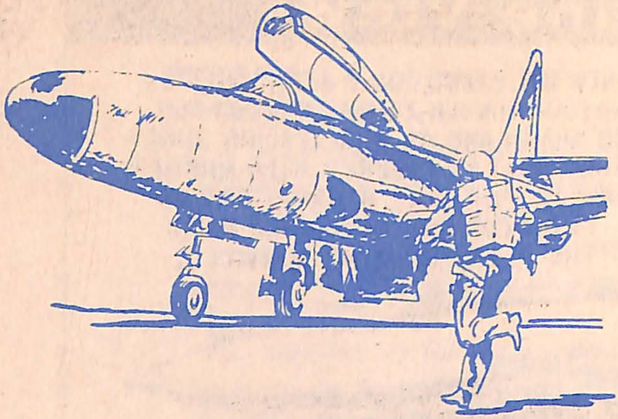
THE WINGS OF A NEW **U.S. SUPERSONIC JET FIGHTER** ARE PROPORTIONATELY THINNER THAN A DOUBLE-EDGED RAZOR BLADE. SO SHARP ARE ITS WING LEADING EDGES THAT THEY MUST BE COVERED WITH RUBBER "GLOVES" TO PREVENT GROUND CREWS FROM CUTTING THEMSELVES WHILE THE PLANE IS BEING SERVICED.

THE LUXURY LINERS, **UNITED STATES** AND **AMERICA**, COULD BE PLACED SIDE BY SIDE ON THE FLIGHT DECK OF NAVY'S AIRCRAFT CARRIER **FORRESTAL.**





THE **FLOOR** OF A NEW MILITARY TURBOPROP TRANSPORT WILL BE **STRONGER** THAN A MODERN SKYSCRARER'S **FOOT-THICK CONCRETE** FLOOR INTERLACED WITH REIN-FORCING STEEL!

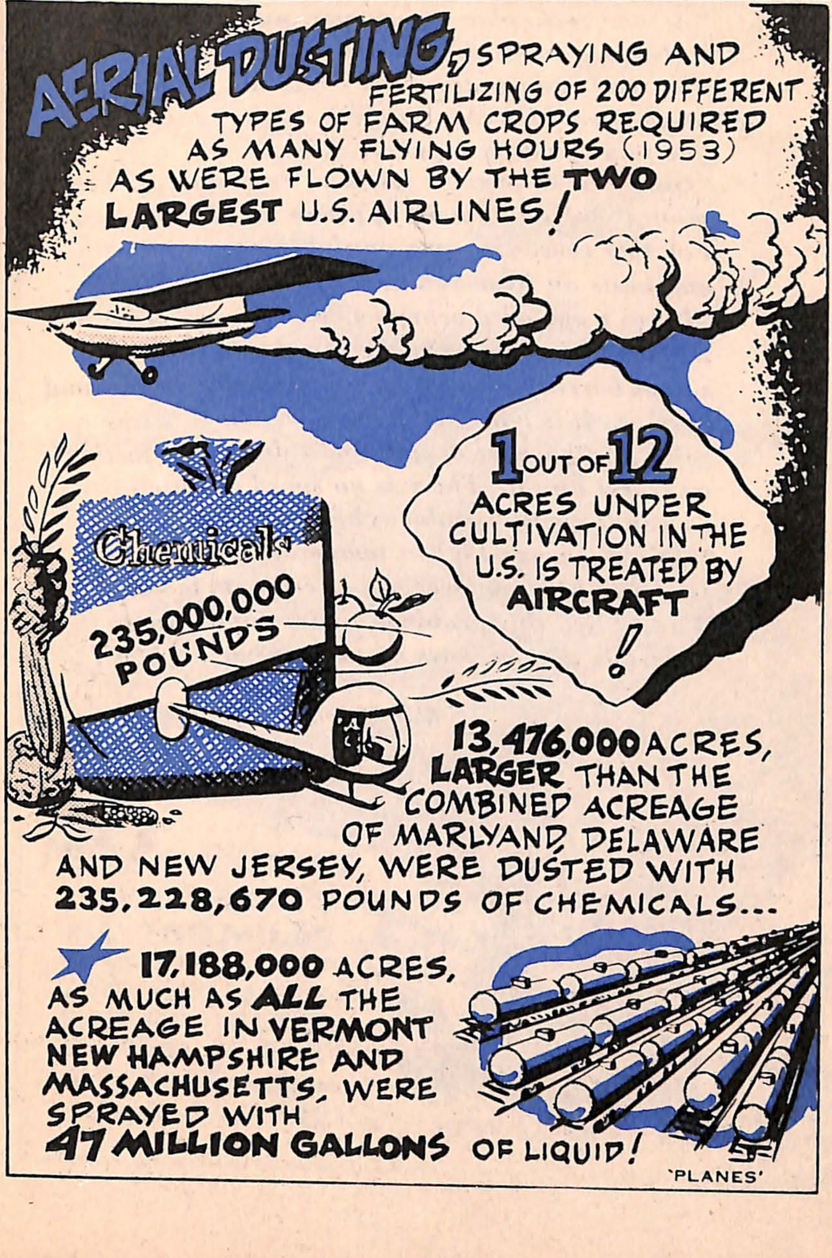


• Fighter production of a typical aircraft manufacturer, during 1954, required 12,140,000 pounds of aluminum, 1,517,000 pounds of stainless steel, 168,000 pounds of rivets, and 5,202 miles of electric wire.

• The first jet fighter to be equipped with an after-burner obtained a speed increase of 100 miles per hour over earlier versions without tailpipe burning.

• Thousands of production man-hours are being saved by a leading aircraft manufacturer with a two-story-tall drilling tool used in production of jet transports. The tool, which weighs 30,000 pounds, fabricates magnesium floor plates for a modern Navy transport.

Plane Views


AERIAL DUSTING, SPRAYING AND FERTILIZING OF 200 DIFFERENT TYPES OF FARM CROPS REQUIRED AS MANY FLYING HOURS (1953) AS WERE FLOWN BY THE TWO LARGEST U.S. AIRLINES!
1 OUT OF 12 ACRES UNDER CULTIVATION IN THE U.S. IS TREATED BY AIRCRAFT!
Chemicals
235,000,000 POUNDS
13,476,000 ACRES, LARGER THAN THE COMBINED ACREAGE OF MARLYAND, DELAWARE AND NEW JERSEY, WERE DUSTED WITH 235,228,670 POUNDS OF CHEMICALS...
17,188,000 ACRES, AS MUCH AS ALL THE ACREAGE IN VERMONT NEW HAMPSHIRE AND MASSACHUSETTS, WERE SPRAYED WITH 47 MILLION GALLONS OF LIQUID!
'PLANES'

"As our technology improves, our strength tends to become more dependent on quality. A thousand interceptors that could not fly as high as an enemy bomber would not be as good as one that could fly higher.

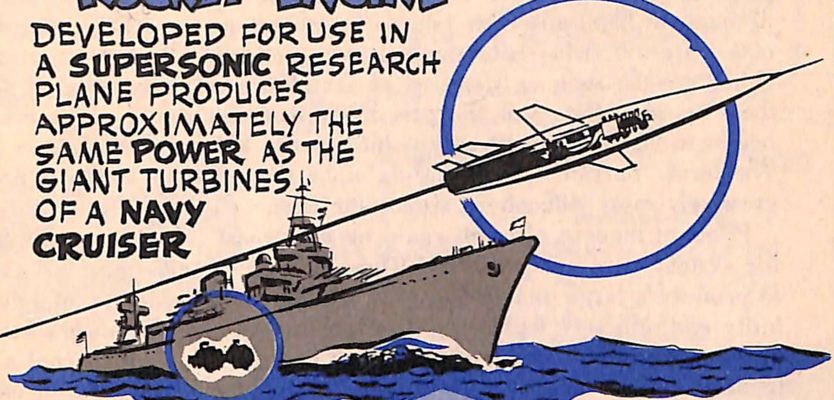
"Our most important job is to keep our Air Force planes and equipment superior to the Soviets. For this reason we are putting increased emphasis on Research and Development.

"It was a splendid achievement when we pierced the sound barrier. On the other side of the sound barrier we have found the so-called thermal barrier. It is not really a barrier, but it is like a swamp which gets deeper and thicker the farther we travel into it. There is no speed at which we can leave this problem behind, for as we go faster we cause higher temperatures from the friction of the air over the aircraft surfaces. We will lick this problem by developing new materials or new ways of using what we have."

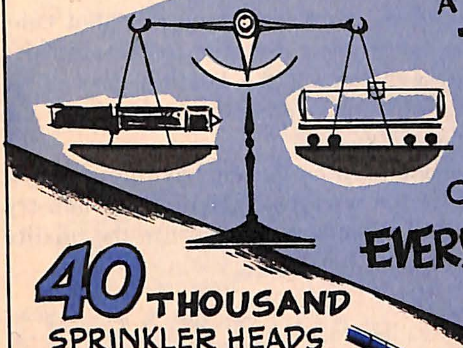
GENERAL NATHAN F. TWINING
Chief of Staff, United States Air Force
February 16, 1955

Plane Views

A **ROCKET ENGINE**
DEVELOPED FOR USE IN
A **SUPERSONIC** RESEARCH
PLANE PRODUCES
APPROXIMATELY THE
SAME **POWER** AS THE
GIANT TURBINES
OF A **NAVY**
CRUISER



A MEDIUM SIZED
TURBO-JET ENGINE
USED IN A MODERN
JET PLANE **BURNS**
IT'S OWN WEIGHT
OF PETROLEUM FUEL
EVERY 20 MINUTES
!



40 THOUSAND
SPRINKLER HEADS
AND **250 MILES**
OF SPRINKLER PIPE
ARE USED IN THE
FIRE PROTECTION
SYSTEM OF ONE
AIRCRAFT
MANUFACTURER...

NEW YORK *to* **WASHINGTON**

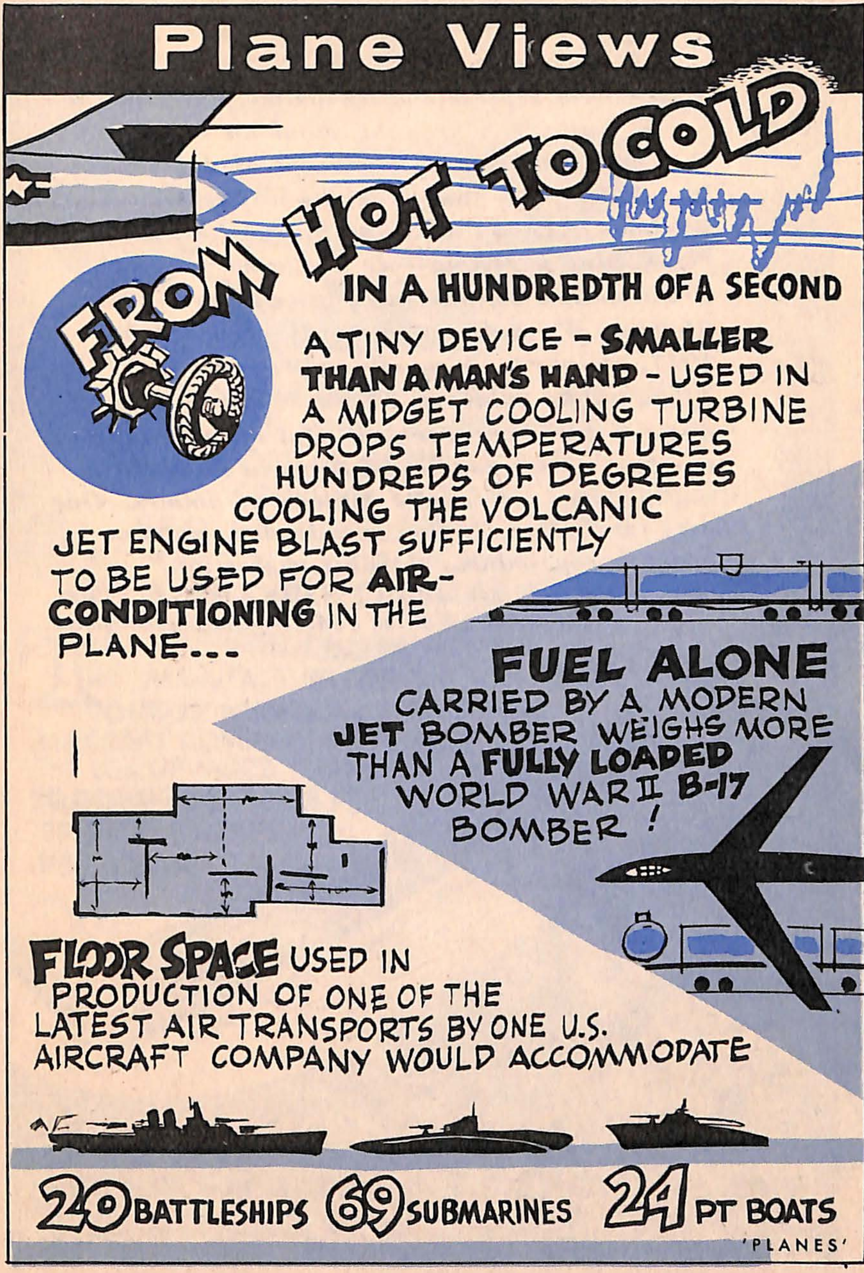
'PLANES'

The ultrasonic speeds of aircraft put aeronautical engineers up against another "barrier"—the thermal thicket. At twice the speed of sound, or about 1500 miles per hour at sea level, friction generates heat on airplane surfaces as high as 215 degrees F. At this temperature the strength characteristics of the aluminum in an airplane begin to decrease. At three times the speed of sound—Mach 3, or about 2300 miles per hour—the temperature reaches a sizzling 600 degrees F. where aluminum loses practically all of its strength. Other metals, such as titanium or stainless steel, are required for these speeds. But even the present commercial grade of titanium begins to lose its strength at a point between 800 and 900 degrees F. The term "barrier" is misleading since the problem becomes progressively more difficult as speeds increase.

Pilots of modern aircraft would literally roast if an air conditioning system were not provided. These cooling systems must be able to produce a large quantity of cool air, have a high degree of reliability and still stay within rigid weight limitations. Engineers have developed small cooling systems which can provide enough cool air to air condition several houses, and the turbine of the system can be held in one hand. The air for the system is "bled" from the turbojet engine, and the volcanic blast is cooled in a hundredth of a second.

The air conditioning system does more than keep the pilot comfortable. It cools many of the components essential to the aircraft's operations. In fact, the wheel wells where the landing gear is retracted during flight must be air conditioned at high speeds or the rubber would melt.

The development of components such as the air conditioning system requires a heavy expenditure for research. The aircraft industry invests huge sums in research and development to insure the quality and performance of our aircraft.

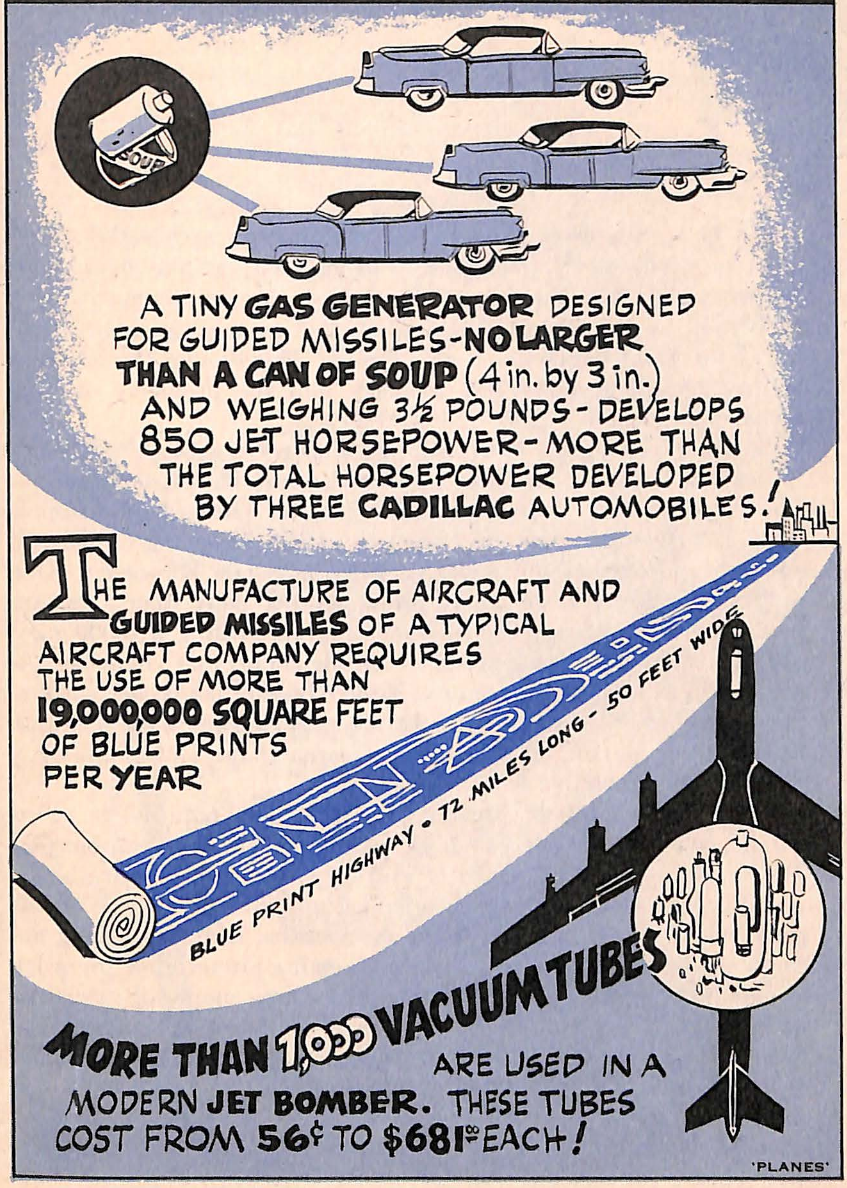

Plane Views
FROM HOT TO COLD
IN A HUNDREDTH OF A SECOND
A TINY DEVICE - SMALLER THAN A MAN'S HAND - USED IN A MIDGET COOLING TURBINE DROPS TEMPERATURES HUNDREDS OF DEGREES COOLING THE VOLCANIC JET ENGINE BLAST SUFFICIENTLY TO BE USED FOR AIR-CONDITIONING IN THE PLANE...
FUEL ALONE
CARRIED BY A MODERN JET BOMBER WEIGHS MORE THAN A FULLY LOADED WORLD WAR II B-17 BOMBER!
FLOOR SPACE USED IN PRODUCTION OF ONE OF THE LATEST AIR TRANSPORTS BY ONE U.S. AIRCRAFT COMPANY WOULD ACCOMMODATE
20 BATTLESHIPS 69 SUBMARINES 24 PT BOATS
'PLANES'

"The threat represented by the air power of the Soviet Union has brought about an important change in this country's concept of defense. **We realize today that weakness invites aggression.** ***We have learned that lesson the hard way. . .***

"One thing is certain—we are faced with a situation that we have faced twice before in our lifetime. We were not properly prepared in 1917, and we were equally unprepared in 1941. Then, unlike today, we were a relatively safe distance from our enemies. But despite that, our lack of preparedness cost us in excess of a million lives and untold billions of dollars. Our very survival as a nation now depends upon our instant preparedness to resist aggression."

GEN. CURTIS E. LEMAY
Commanding General, USAF Strategic Air Command
June 22, 1952

Plane Views


SOUP
A TINY GAS GENERATOR DESIGNED FOR GUIDED MISSILES - NO LARGER THAN A CAN OF SOUP (4 in. by 3 in.) AND WEIGHING 3½ POUNDS - DEVELOPS 850 JET HORSEPOWER - MORE THAN THE TOTAL HORSEPOWER DEVELOPED BY THREE CADILLAC AUTOMOBILES!
THE MANUFACTURE OF AIRCRAFT AND GUIDED MISSILES OF A TYPICAL AIRCRAFT COMPANY REQUIRES THE USE OF MORE THAN 19,000,000 SQUARE FEET OF BLUE PRINTS PER YEAR
BLUE PRINT HIGHWAY • 72 MILES LONG - 50 FEET WIDE
MORE THAN 1,000 VACUUM TUBES ARE USED IN A MODERN JET BOMBER. THESE TUBES COST FROM 56¢ TO $681.00 EACH!
'PLANES'

The requirements of today's aeronautical research and development programs are tremendous, both in facilities and manpower. Approximately 100,000 gallons of water per minute—as much water as is used by the city of Washington, D. C.—are required to cool the motors used in one giant wind tunnel. This typifies the immense facility requirements needed to delve into the problems of high speed, high altitude flight.

The rate of progress in the aircraft industry is directly related to the expenditure of effort and money in research and development. The very nature of research makes it a gamble. There is no assurance when a particular research program is launched that the results will equal or approximate the goal. Research seeks new knowledge. One program costing \$100,000 may prove nothing more than a certain idea not being practicable. Another program costing \$10,000 may open the door to a new concept of aerodynamics that could have a profound effect on the future of aviation. Despite the occasional disparity between cost and result, the aircraft industry must continue to vigorously pursue all aspects of research if the United States is to retain its qualitative lead in air power.

The second aspect of research—the manhours required to carry out a project — has soared along with the facilities requirements. The development of an engine of greater power simply creates additional problems in component equipment and airframe design if full performance is to be gained from the increase in power. Thus the entire research program assumes mushrooming proportions. In order to obtain the greatest utilization from the scarce supply of engineers and scientists, the aircraft industry uses the latest automatic computers which are able to solve complicated mathematical problems in a fraction of the time formerly required.

Plane Views

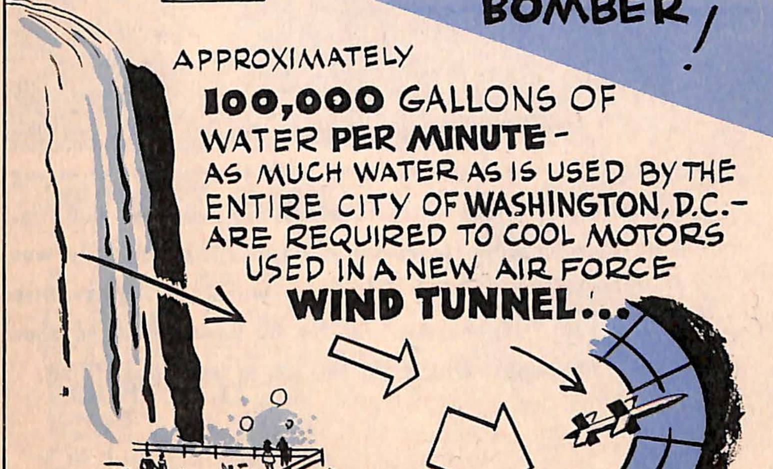
WHEN COMPLETED, THE TERMINAL BUILDING FOR INTERNATIONAL FLIGHTS AT NEW YORK'S **INTERNATIONAL AIRPORT** WILL COVER A SPACE EQUAL TO

ELEVEN CITY BLOCKS

1,500,000 miles

WERE FLOWN IN ENGINEERING **FLIGHT TESTS** LAST YEAR BY ONE TYPE U.S. MEDIUM **BOMBER!**

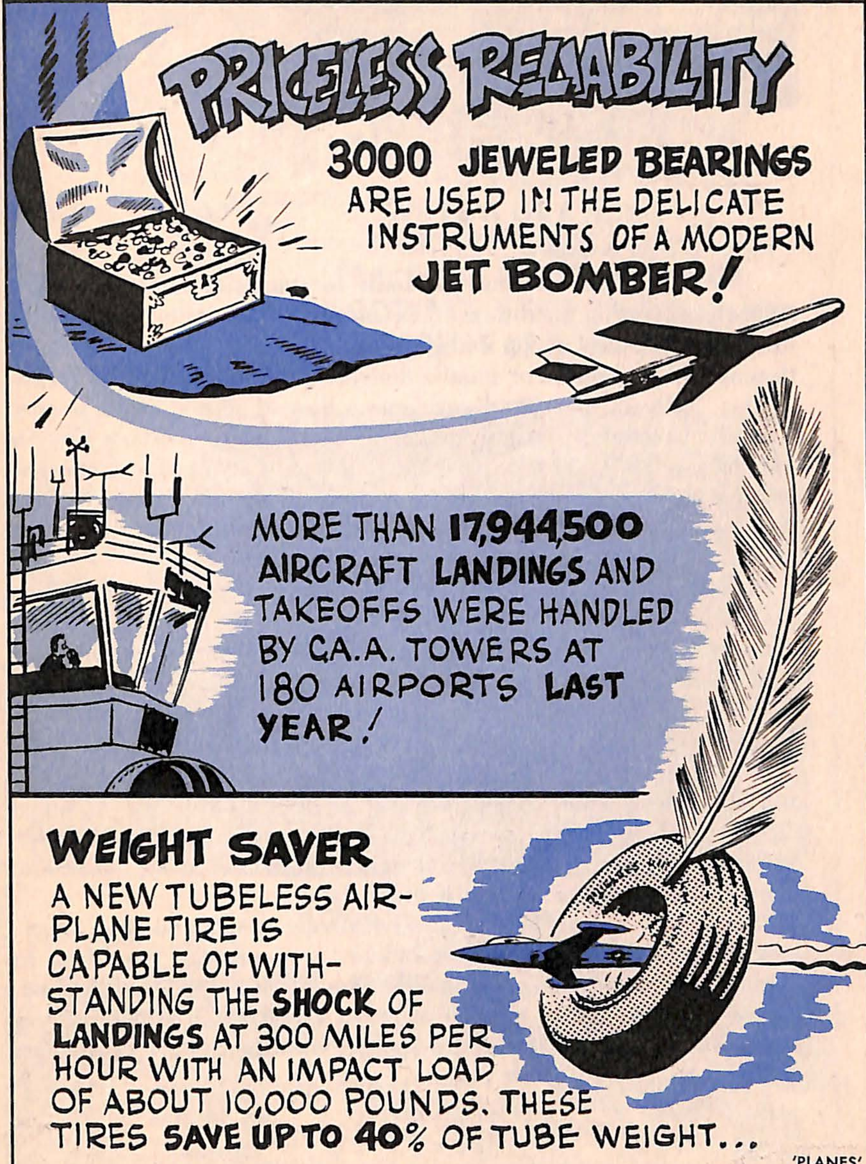
APPROXIMATELY **100,000** GALLONS OF WATER **PER MINUTE** - AS MUCH WATER AS IS USED BY THE ENTIRE CITY OF **WASHINGTON, D.C.** - ARE REQUIRED TO COOL MOTORS USED IN A NEW AIR FORCE **WIND TUNNEL...**



• A fuel-air combustion starter for jet planes can crank a jet engine up to starting speed in three and a half seconds. The unit develops 340 h.p. in 3.2 seconds.

• A Pacific telephone company literally took to the air recently when it was faced with the task of stringing two miles of telephone wire across rugged, hilly country. After spotting the poles on hill tops, the company was faced with weeks of laborious work, stringing wire through the treacherous country by hand. Instead they hired a helicopter which did the job in one hour's time.

Plane Views


PRICELESS RELIABILITY
3000 JEWELED BEARINGS
ARE USED IN THE DELICATE
INSTRUMENTS OF A MODERN
JET BOMBER!
MORE THAN 17,944,500
AIRCRAFT LANDINGS AND
TAKEOFFS WERE HANDLED
BY C.A.A. TOWERS AT
180 AIRPORTS LAST
YEAR!
WEIGHT SAVER
A NEW TUBELESS AIR-
PLANE TIRE IS
CAPABLE OF WITH-
STANDING THE SHOCK OF
LANDINGS AT 300 MILES PER
HOUR WITH AN IMPACT LOAD
OF ABOUT 10,000 POUNDS. THESE
TIRES SAVE UP TO 40% OF TUBE WEIGHT...
'PLANES'

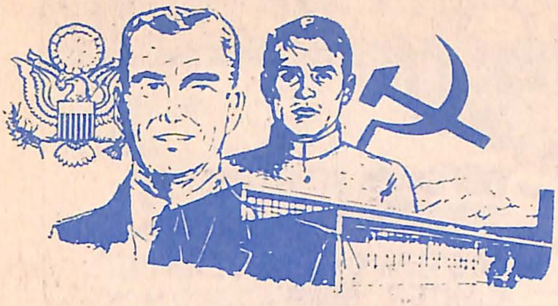
Military aircraft must be built to stand up under the most rigorous operating conditions. The success of a mission upon which our very existence might well depend is based on the perfect functioning of the aircraft or missile delivering the weapon to its target.

This "delivery insurance" produces a host of special requirements. The fire detection system, for example, of a modern military plane is able to "see" a 2,000 mile-per-hour bullet as it strikes the plane and smother a fire or explosion before it occurs. The development of the detection system was costly. But it plugs another gap that could mean loss of the plane and an unsuccessful mission.

Prototype aircraft are put through a lengthy series of tests before the model goes into quantity production. Just ten years ago manufacturers were able to fulfill the obligations of a flight test program with three prototype aircraft that demonstrated the structural, aerodynamic and powerplant characteristics of the aircaft. The entire program required about 250 flights, and a minimum of expensive instrumentation was required to obtain flight data. The complexity and high performance requirements of modern aircraft have changed this relatively simple testing system. Today more than 1,000 flights are required, and along with the larger flight test came more and more instrumentation to record flight data.

Even after a plane has been exhaustively tested and the "bugs" eliminated, the aircraft in production is constantly modified to extract the maximum performance capabilities. And each plane, before delivery to the military services, is given 40 different test flights and checks. This careful concern with the quality of product is the basis of superior air power.


Plane Views
OUT-BEFORE IT STARTS!
THE FIRE DETECTION SYSTEM ON A MODERN JET FIGHTER "SEES" A 2000 MPH BULLET AS IT STRIKES AND SMOTHERS A FIRE OR EXPLOSION BEFORE IT CAN HAPPEN...
FINAL TEST
OK
EACH NEW JET FIGHTER IS PUT THROUGH MORE THAN 40 DIFFERENT RIGOROUS TEST FLIGHTS AND CHECKS BEFORE ITS DELIVERY TO THE MILITARY...
A TYPICAL MODERN JET FIGHTER CONTAINS ENOUGH ELECTRICAL WIRING TO COMPLETE THE ELECTRICAL CIRCUITS OF 38 SIX-ROOM HOUSES!
FOR 1 JET FIGHTER OR 38 HOUSES
'PLANES'



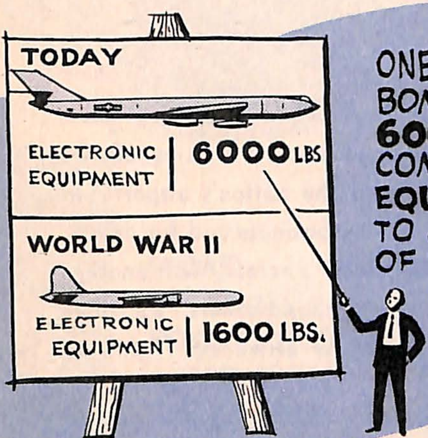
"I am confident that if we determine to do so we can stay ahead of the Soviet Union in the pursuit of scientific and technological knowledge. So long as we do, we can avoid an economically crippling all-out armament race that aims at out-producing the Soviet Union plane for plane. But here I must enter an important qualifier: we can pursue this policy successfully only while we continue to maintain a modern air force-in-being large enough to assure that a Soviet sneak attack will not be decisive, and capable of an immediate devastating counter-attack.

"Our production capacity is one of our great national assets. If we are to take full advantage of it in the future, we must devise and design now the equipment that we may wish to mass-produce five or ten years hence. If we do not exercise this foresight, we may some day find ourselves turning out large quantities of equipment that are technically inferior, probably unsuitable, and possibly worthless."

JAMES H. DOOLITTLE
April 18, 1953

Plane Views

AMERICA'S FLEET OF **UTILITY AIRPLANES** FLEW MORE THAN **ONE BILLION** PLANE MILES IN 1953, THE EQUIVALENT OF NEARLY **417,000** FLIGHTS FROM NEW YORK TO LOS ANGELES!



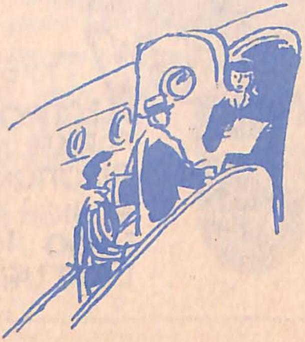
ONE MODERN USAF BOMBER CARRIES **6000** POUNDS OF COMPLEX **ELECTRONIC EQUIPMENT** COMPARED TO JUST 1600 POUNDS OF THE SAME TYPE OF EQUIPMENT CARRIED BY IT'S WORLD WAR II COUNTERPART...

NEW TYPE HARD GLASS **ELECTRON TUBES**, BUILT FOR U.S. MILITARY AIRCRAFT, FUNCTION UNFAILINGLY AT HIGH ALTITUDES FOR **1000** HOURS AT TEMPERATURES OF **572° F.**

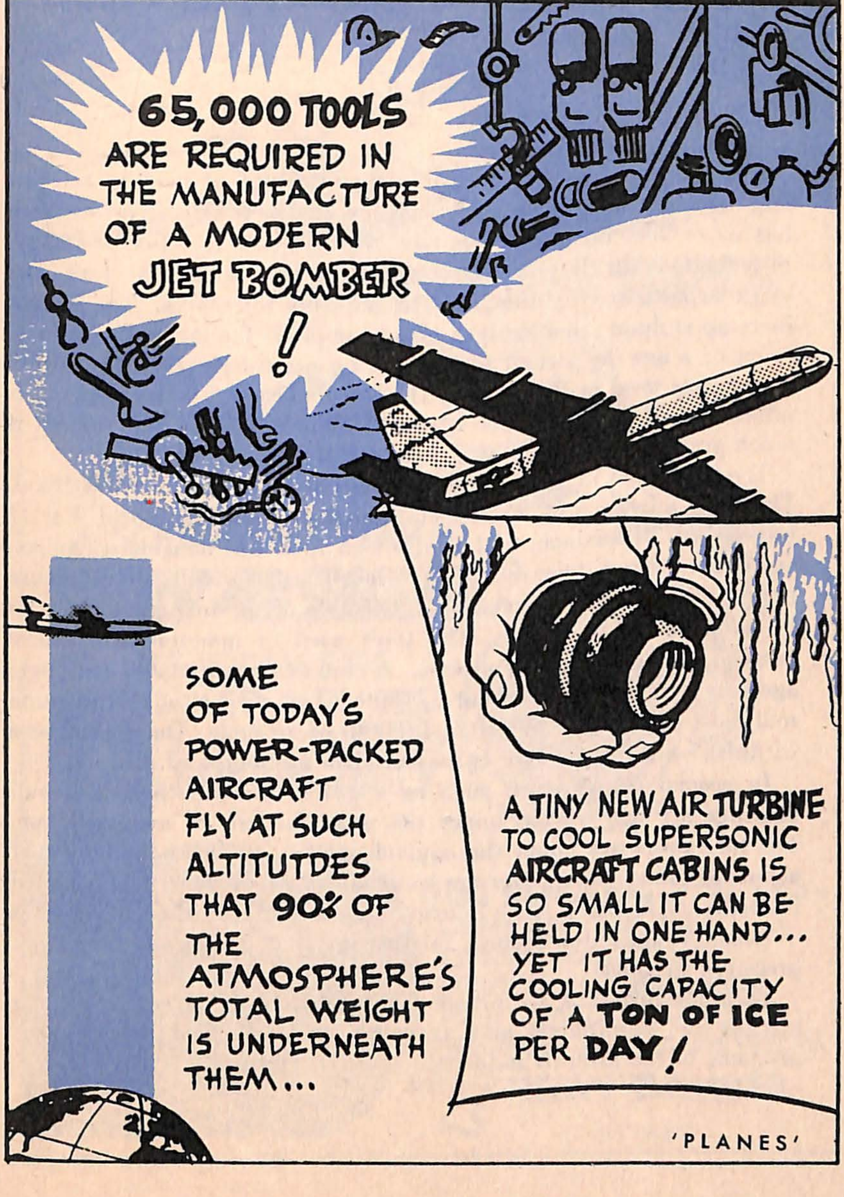
'PLANES'

• During 1954, 99.6 per cent of all employees of a major East Coast aircraft manufacturer worked nearly 56 million man-hours without a lost-time accident in production of aircraft.

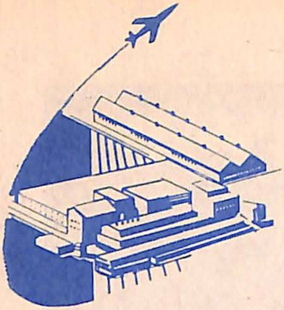
• Few Americans realize that, while there are about 1,450 multi-engined commercial aircraft making 30,000 arrivals and departures daily on the nation's airports, in addition there are in operation by business and for executive travel, more than 20,000 other aircraft, with another 10,000 in use by farmers, ranchers, and others. Each day more than 600 aircraft depart or arrive on flights to foreign lands.



Plane Views



65,000 TOOLS ARE REQUIRED IN THE MANUFACTURE OF A MODERN JET BOMBER!
SOME OF TODAY'S POWER-PACKED AIRCRAFT FLY AT SUCH ALTITUTDES THAT 90% OF THE ATMOSPHERE'S TOTAL WEIGHT IS UNDERNEATH THEM...
A TINY NEW AIR TURBINE TO COOL SUPERSONIC AIRCRAFT CABINS IS SO SMALL IT CAN BE HELD IN ONE HAND... YET IT HAS THE COOLING CAPACITY OF A TON OF ICE PER DAY!
'PLANES'



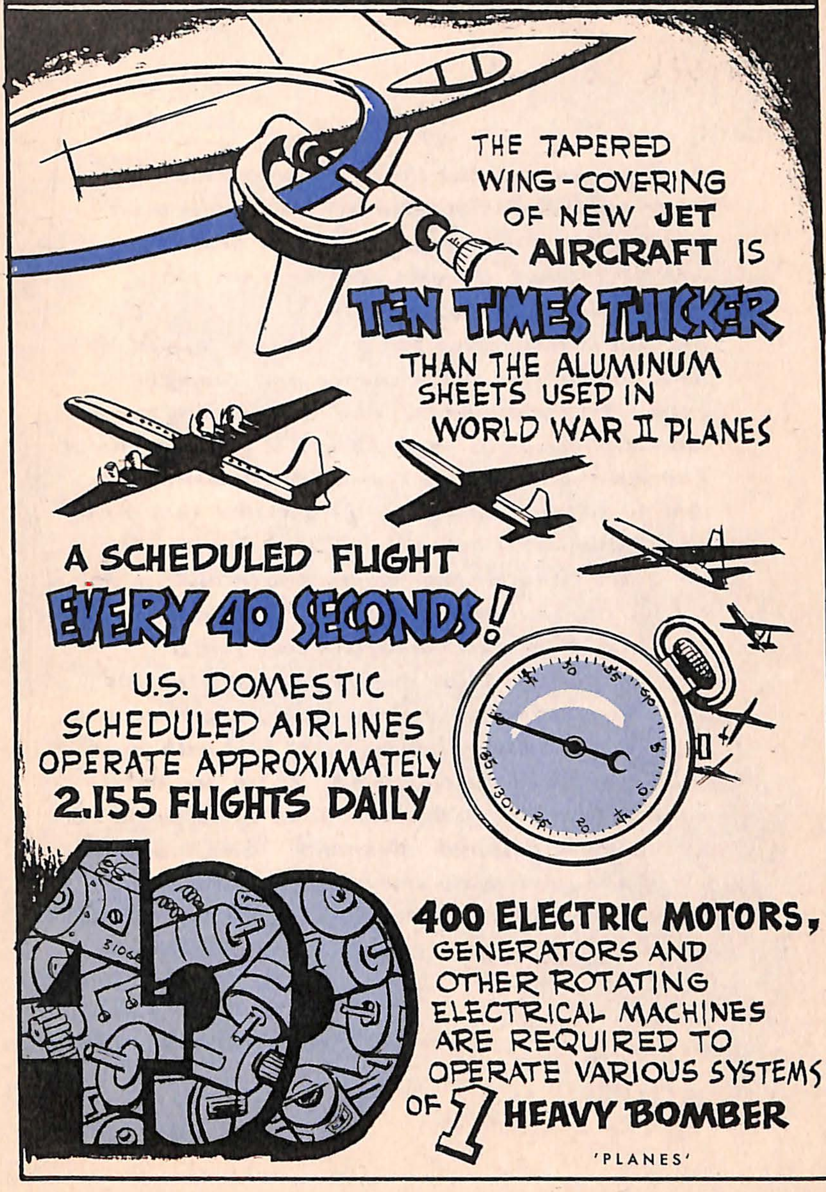
The precision that goes into manufacture of modern aircraft has increased manufacturing costs, but the increase in performance has more than offset the cost rise. An airplane is actually a study in contrast. It flies at high speeds, weighs over 200 tons and yet, the parts are manufactured to exquisite tolerances. The weight increase is due to new designs. An example is the tapered wing covering of a new jet aircaft which is ten times thicker than the aluminum sheets used in World War II. In some cases, the entire wing is milled out of a single piece of metal. The degree of smoothness is much greater, and the wing is stronger.

The tolerances in aircraft manufacture have become highly critical. The usual tolerance for sheet metal fabrication during World War II was 1/16th of an inch, and 1/32 of an inch was considered an exceptionally close tolerance. In aircraft and missile manufacture today, dimensional tolerances of 1/100th of an inch and 1/200th of an inch are necessary. The tools used in manufacturing have become even more rigidly precise. A common requirement ten years ago was a tolerance of about 1/100th of an inch; today the same tool must be accurate to within 1/500th of an inch. The smoothness of finish on a missile skin is measured in millionths of an inch.

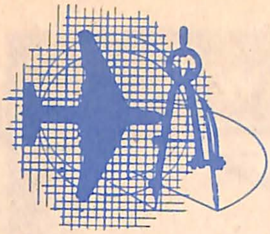
In special components, such as a gyroscope, the tiny steel ball bearings are con tructed under the powerful lens of a microscope. The tolerances are about the equivalent of 1/400th of the width of a human hair. Some parts are so small that they cannot be cleaned by ordinary methods. The industry uses a process called ultrasonics —"silent sound'—to remove microscopic but dangerous dirt from precision products.

The extraordinary requirements of modern air power are being met by the continuous and aggressive research and development progams of the aircraft industry.

Plane Views



THE TAPERED WING-COVERING OF NEW JET AIRCRAFT IS
TEN TIMES THICKER
THAN THE ALUMINUM SHEETS USED IN WORLD WAR II PLANES
A SCHEDULED FLIGHT
EVERY 40 SECONDS!
U.S. DOMESTIC SCHEDULED AIRLINES OPERATE APPROXIMATELY 2,155 FLIGHTS DAILY
400 ELECTRIC MOTORS, GENERATORS AND OTHER ROTATING ELECTRICAL MACHINES ARE REQUIRED TO OPERATE VARIOUS SYSTEMS OF 1 HEAVY BOMBER
'PLANES'



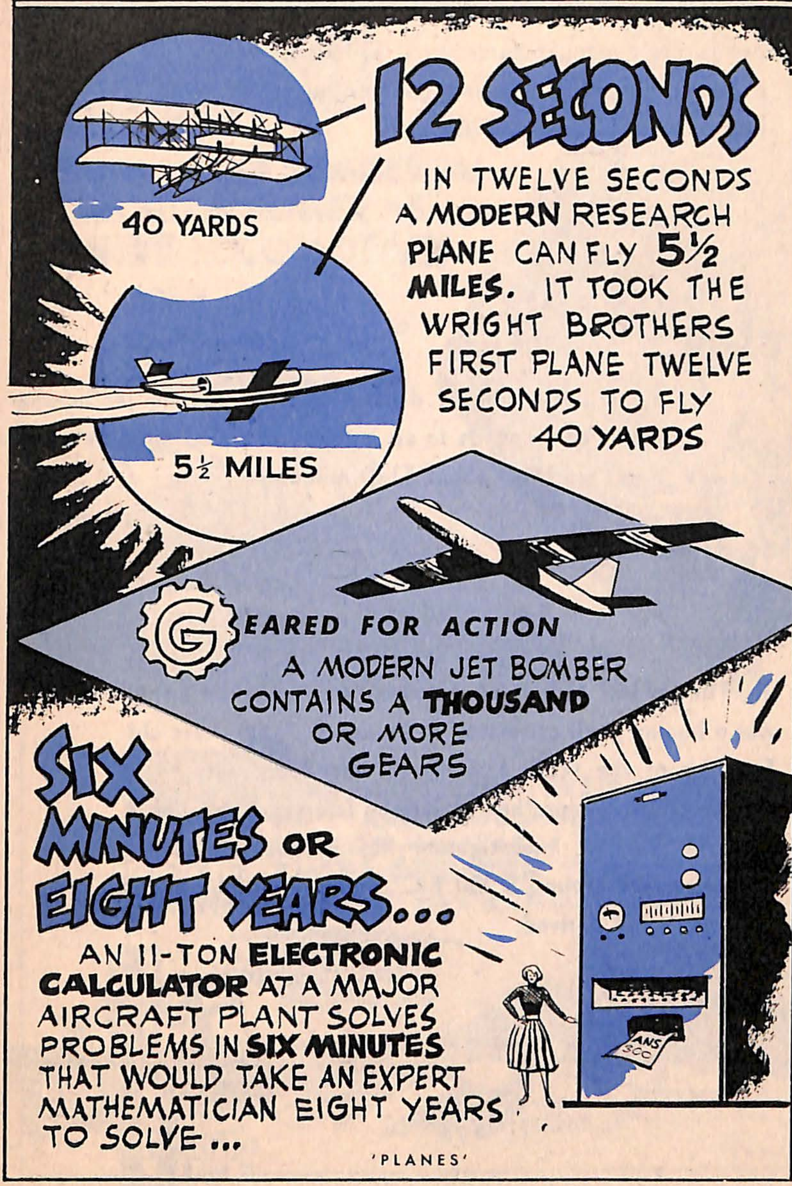
"It is important that those who have management responsibilities take seriously their obligation to use engineering manpower to the best advantage; not to waste engineers on jobs others can do, for example.

"It also is important for us to work toward national policies that enhance and conserve engineering manpower. The dilemma we are now in about drafting engineers is a case in point. There are good policy reasons for insisting that no young man escape the sacrifice that other young men must make in military service. On the other hand, engineers are scarce and, if we are to sustain a program that will keep us out ahead in this technological race **[with Russia]** ***our need for engineers and scientists must be expected to increase rather than decrease.***

"This is a problem that we must deal with on a strictly national-interest basis. If we are to win this race, our manpower must be disposed to our greatest national advantage. The military services require some specialists in the performance of their missions. Beyond this, we cannot afford to put engineers and scientists into uniforms."

DONALD A. QUARLES
Assistant Secretary of Defense (R&D)
October 11, 1954

Plane Views

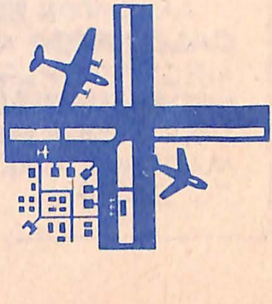


12 SECONDS
40 YARDS
5½ MILES
IN TWELVE SECONDS A MODERN RESEARCH PLANE CAN FLY 5½ MILES. IT TOOK THE WRIGHT BROTHERS FIRST PLANE TWELVE SECONDS TO FLY 40 YARDS
GEARED FOR ACTION
A MODERN JET BOMBER CONTAINS A THOUSAND OR MORE GEARS
SIX MINUTES OR EIGHT YEARS...
AN 11-TON ELECTRONIC CALCULATOR AT A MAJOR AIRCRAFT PLANT SOLVES PROBLEMS IN SIX MINUTES THAT WOULD TAKE AN EXPERT MATHEMATICIAN EIGHT YEARS TO SOLVE...
ANS
'PLANES'

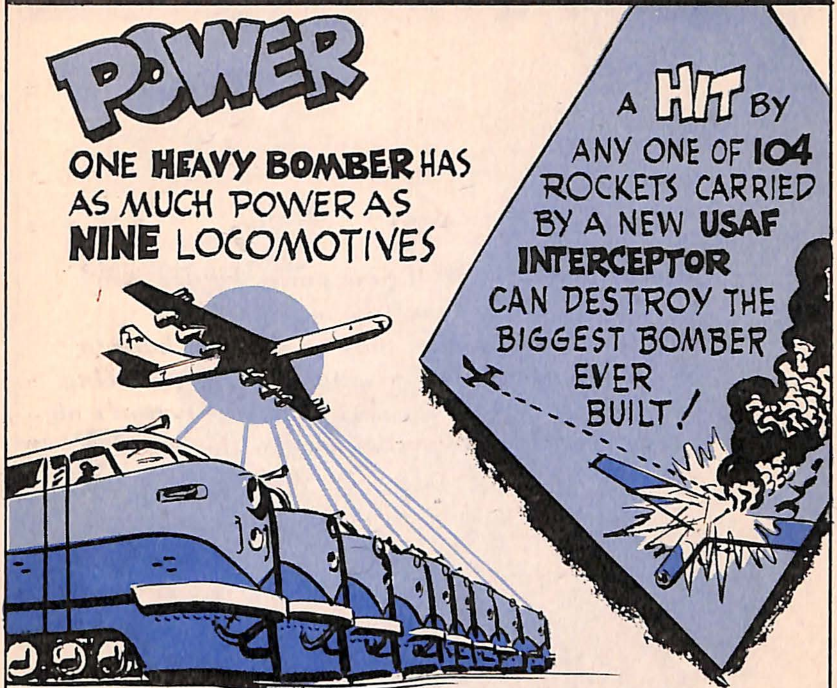
• A major aircraft manufacturer saved $32,500 through use of a plastic assembly (costing $30) in place of a sheet metal assembly (costing $76).

• A bombardment division of two medium jet bomber wings corresponds to an industry of 4,000 employees and a net worth of about $120 million.

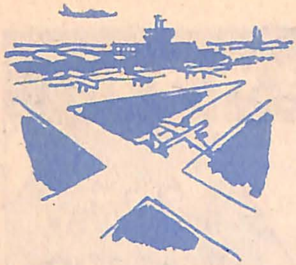
• The "oldest passenger" carried recently by an airline was a human skull estimated to be nearly 7,000 years old. Features of the skull, a woman's, had been restored in plaster. It was unearthed at Jericho last year, along with six other skulls. Investigation has produced evidence of a massacre around 5,000 B.C., from which the skulls were probably derived.



Plane Views



'PLANES'

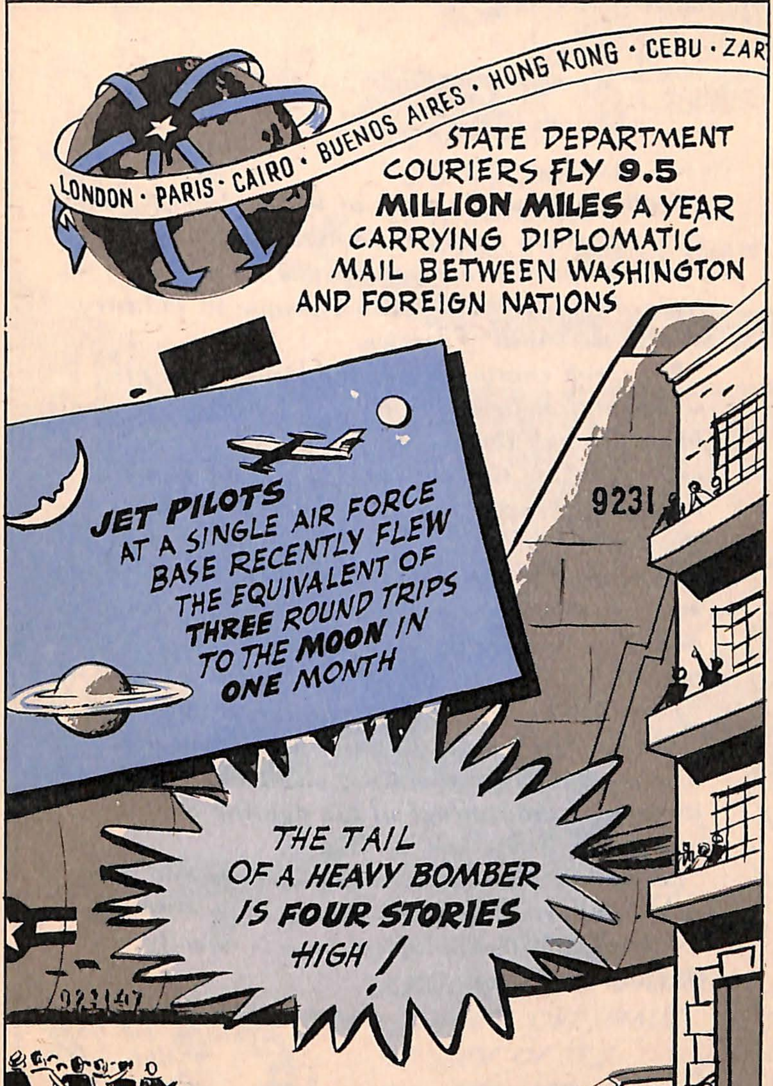


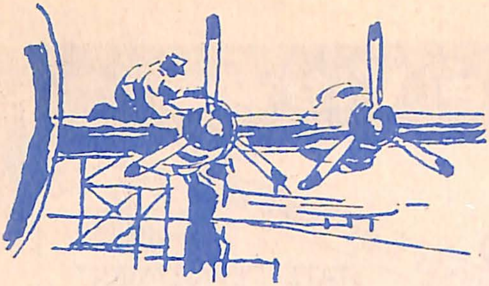
"Once you have won the air power battle, then there is no doubt about the outcome—the ultimate decision. You may or may not have to go on and destroy other military forces in being and resources, but the survival of one nation's air power over that of another decides the issue."

GEN. CURTIS E. LEMAY

• More than 44 per cent of the airframe weight of the giant transport built by one U. S. manufacturer is sub-contracted. Out of every tax dollar spent for these air-planes, USAF pays 28 cents directly to sub-contractors. Of the remaining 72 cents, the company pays out an additional 47 cents in sub-contracting. Only 25 cents remains with the company for its own operations.

Plane Views


LONDON · PARIS · CAIRO · BUENOS AIRES · HONG KONG · CEBU · ZAR
STATE DEPARTMENT COURIERS FLY 9.5 MILLION MILES A YEAR CARRYING DIPLOMATIC MAIL BETWEEN WASHINGTON AND FOREIGN NATIONS
JET PILOTS AT A SINGLE AIR FORCE BASE RECENTLY FLEW THE EQUIVALENT OF THREE ROUND TRIPS TO THE MOON IN ONE MONTH
9231
THE TAIL OF A HEAVY BOMBER IS FOUR STORIES HIGH!
'PLANES'



"While outstanding feats of test and development are important, I want to remind you once again that continued progress depends upon people, trained, experienced, skilled people in industry and in the military service.

"We speak continually of the importance of technological breakthrough. I know of no single breakthrough that I would trade for the assurance that the Air Force would get—and be able to keep—the skilled men it needs in the years ahead.

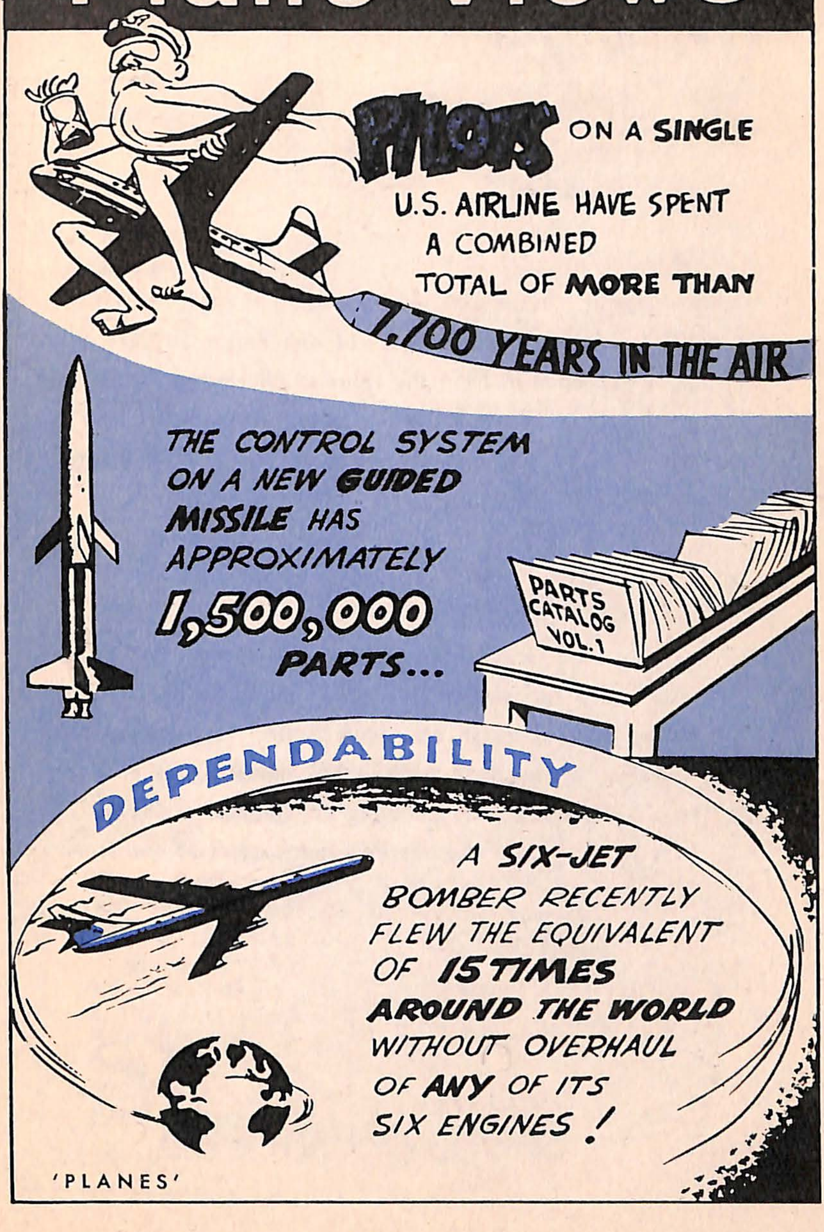
"However, I realize that the needs of the Air Force are only one part of the problem. The Army and Navy face similar difficulties. So does industry.

"The security of our nation in the years ahead depends as much on the wisdom and the skill of our engineers, scientists, and technicians, as its does on the courage of the fighting men in our Army, Navy, and Air Force.

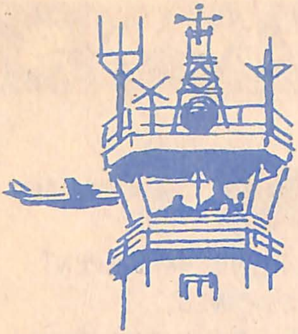
"Let us not have to learn the hard way an even more important lesson—that a broadening scientific and technological base is equally vital to continued peace."

GENERAL NATHAN F. TWINING
Chief of Staff, USAF
Aug. 3, 1956

Plane Views

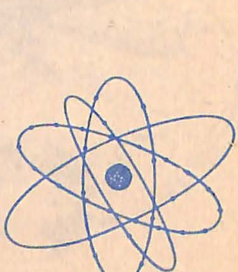


PILOTS ON A SINGLE
U.S. AIRLINE HAVE SPENT
A COMBINED
TOTAL OF MORE THAN
7,700 YEARS IN THE AIR
THE CONTROL SYSTEM
ON A NEW GUIDED
MISSILE HAS
APPROXIMATELY
1,500,000
PARTS...
PARTS
CATALOG
VOL.1
DEPENDABILITY
A SIX-JET
BOMBER RECENTLY
FLEW THE EQUIVALENT
OF 15 TIMES
AROUND THE WORLD
WITHOUT OVERHAUL
OF ANY OF ITS
SIX ENGINES!
'PLANES'

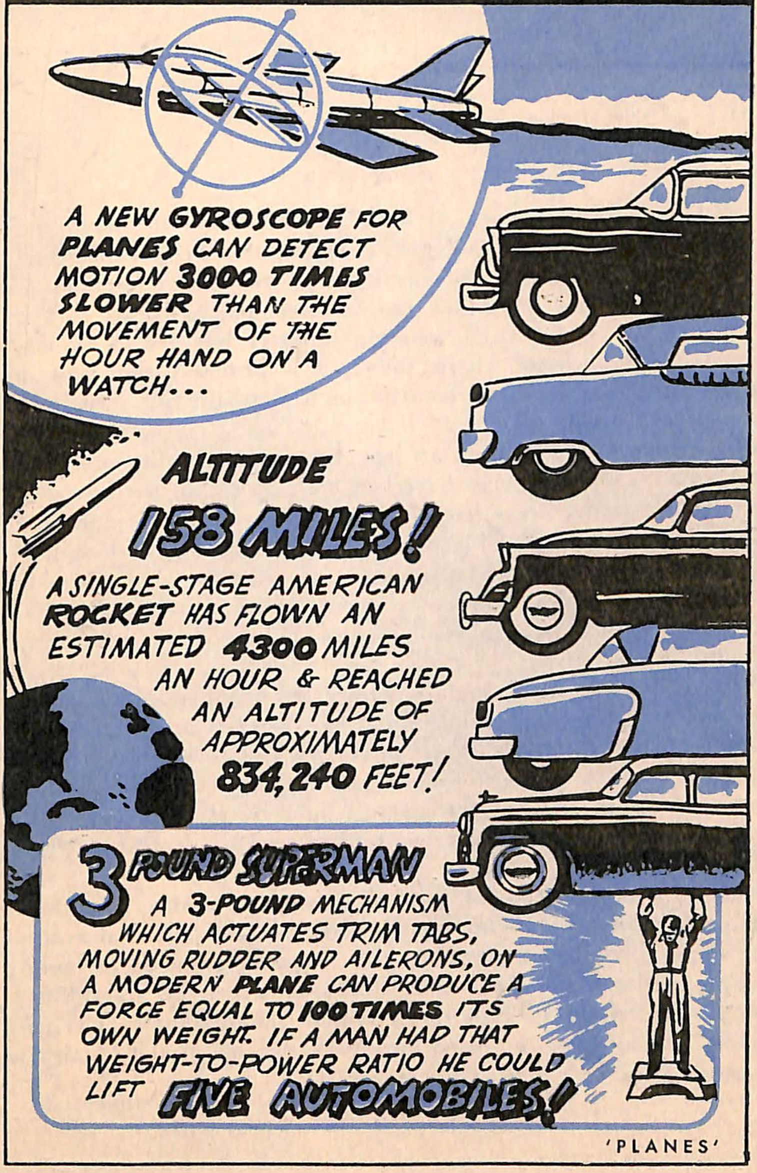


• Commercial airline sales of one major aircraft company exceeded in 1954 the value of all United States gold produced in 1954. Yet those sales represented only 12 per cent of that aircraft manufacturer's total business for the year.

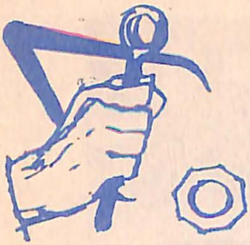
• The electrical circuits of a typical production guided missile are so complex that they must be checked out before delivery by an electronic brain. The device itself contains six miles of wiring, 423 panel lights and 641 switch positions, thus enabling an engineer to check 90 different points in the missile's mechanism at one time.



Plane Views



A NEW GYROSCOPE FOR PLANES CAN DETECT MOTION 3000 TIMES SLOWER THAN THE MOVEMENT OF THE HOUR HAND ON A WATCH...
ALTITUDE
158 MILES!
A SINGLE-STAGE AMERICAN ROCKET HAS FLOWN AN ESTIMATED 4300 MILES AN HOUR & REACHED AN ALTITUDE OF APPROXIMATELY 834,240 FEET!
3 POUND SUPERMAN
A 3-POUND MECHANISM WHICH ACTUATES TRIM TABS, MOVING RUDDER AND AILERONS, ON A MODERN PLANE CAN PRODUCE A FORCE EQUAL TO 100 TIMES ITS OWN WEIGHT. IF A MAN HAD THAT WEIGHT-TO-POWER RATIO HE COULD LIFT FIVE AUTOMOBILES!
'PLANES'



Though man dreamed of flight for centuries, it wasn't until the advent of the internal combustion engine that his dream became reality. Wilbur and Orville Wright harnessed the engine to man-made wings and drew men into a new era on December 17, 1903.

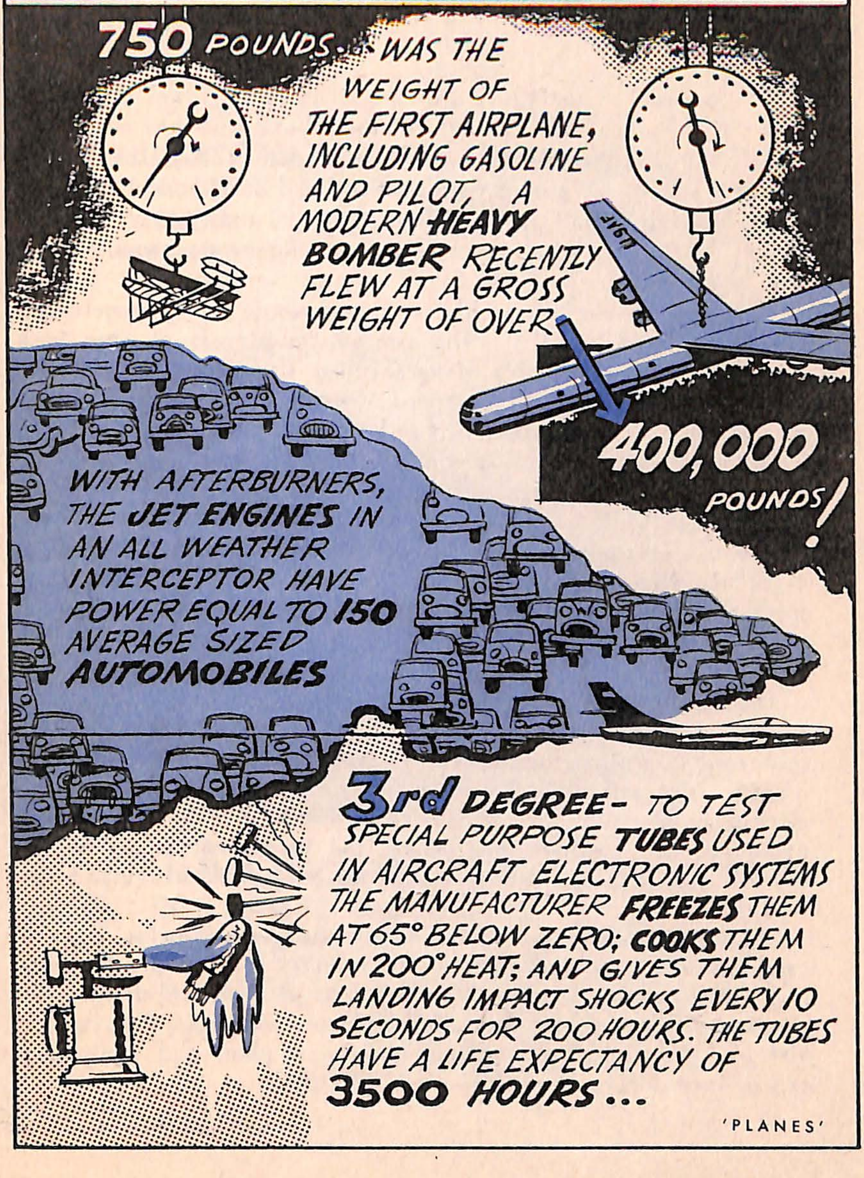
Since that time, the U. S. aviation industry has grown by leaps and bounds, to a point where, today, it is probably the most important facet of the national security, as well as a major contributor to the national economy.

As the state of the aviation art has advanced and military aircraft and civilian transport planes have become larger and more complex, the engine manufacturers have had to design larger, lighter, more powerful engines. By 1940 aircraft piston engines were able to drive planes through air at about 300 miles an hour. During World War II, aircraft engines were able to produce about 3,000 horsepower, or one horsepower for each pound-and-a-half of engine weight.

Today, aircraft engine manufacturers are building powerful turbojet engines with thrust ratings up to 25,000 equivalent horsepower, or one horsepower for each *four ounces* of engine weight. This remarkable gain in power-to-weight ratio is indicative of the vast number of hours spent by the aircraft industry in research to keep the United States ahead in the race for air power—commercially and militarily.

Estimates have placed the cost of developing a new high-thrust turbojet or turboprop engine used in today's giant planes at a minimum of $50,000,000—not counting the expense involved in tooling for mass production of the engine. Continuous research and development conducted by U. S. aircraft engine manufacturers has consistently provided the increases in horsepower required to maintain American air superiority.

Plane Views


750 POUNDS... WAS THE WEIGHT OF THE FIRST AIRPLANE, INCLUDING GASOLINE AND PILOT. A MODERN HEAVY BOMBER RECENTLY FLEW AT A GROSS WEIGHT OF OVER
400,000 POUNDS!
USAF
WITH AFTERBURNERS, THE JET ENGINES IN AN ALL WEATHER INTERCEPTOR HAVE POWER EQUAL TO 150 AVERAGE SIZED AUTOMOBILES
3rd DEGREE- TO TEST SPECIAL PURPOSE TUBES USED IN AIRCRAFT ELECTRONIC SYSTEMS THE MANUFACTURER FREEZES THEM AT 65° BELOW ZERO; COOKS THEM IN 200° HEAT; AND GIVES THEM LANDING IMPACT SHOCKS EVERY 10 SECONDS FOR 200 HOURS. THE TUBES HAVE A LIFE EXPECTANCY OF 3500 HOURS...
'PLANES'

The basis of qualitative air superiority in air power is research and development, and the battle of the laboratories has become as significant as armed battles were in the past. Today, the aircraft industry spends more money on research and development than any other segment of the U. S. industrial structure, and employs approximately 25 per cent of all research and development personnel working in all industries.

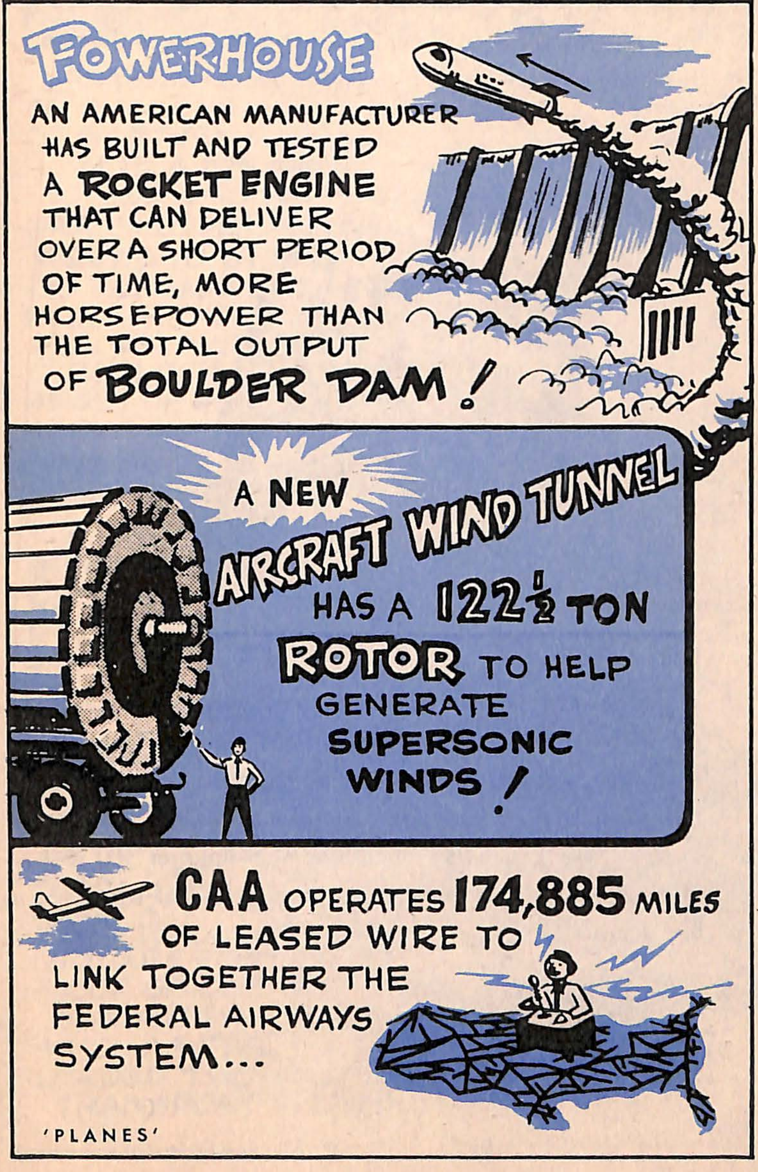
The cost of research is high. A supersonic wind tunnel costs approximately $1,500,000. The aircraft industry is plowing back increasingly large amounts of its earnings to finance facilities and equipment of this type. The record of one airframe manufacturer's expenditures on company-sponsored research and development illustrates the ever-increasing gains. In 1950, the company spent $537,000 on research and development; the expenditures in 1955 amounted to $4,800,000—an increase of 793 per cent in five years.

The use of research facilities, despite their high cost, produces eventual savings in the production of aircraft. The military requirement for high performance aircraft has created major technical problems to which the science and engineering teams of the aircraft industry are devoting full time in solving.

The aircraft industry, over the years, has attempted, to the extent consistent with sound management and availability of financial resources, to acquire the facilities to meet the research and development requirements. But it would be economically unsound for the aircraft industry to provide facilities estimated to be in excess of non-emergency requirements, unless the investment could be recovered during the period of demand for the products requiring the facilities.

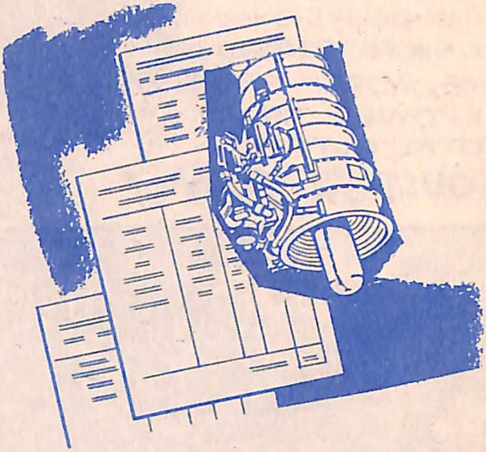
The shift in defense policy to maintain air power in-being, and the resulting relative stabilization of the military aircraft procurement rate, has enabled the aircraft industry to program substantial expenditures for research and development facilities. One major airframe company has programmed a new plant and equipment expenditure during 1956-1958 of $73,500,000.

Plane Views



POWERHOUSE
AN AMERICAN MANUFACTURER HAS BUILT AND TESTED A ROCKET ENGINE THAT CAN DELIVER OVER A SHORT PERIOD OF TIME, MORE HORSEPOWER THAN THE TOTAL OUTPUT OF BOULDER DAM!
A NEW AIRCRAFT WIND TUNNEL HAS A 122½ TON ROTOR TO HELP GENERATE SUPERSONIC WINDS!
CAA OPERATES 174,885 MILES OF LEASED WIRE TO LINK TOGETHER THE FEDERAL AIRWAYS SYSTEM...
'PLANES'

• A major engine manufacturer is developing a gas turbine powerplant for helicopters that is no larger than an automobile engine *but six to eight times as powerful.*

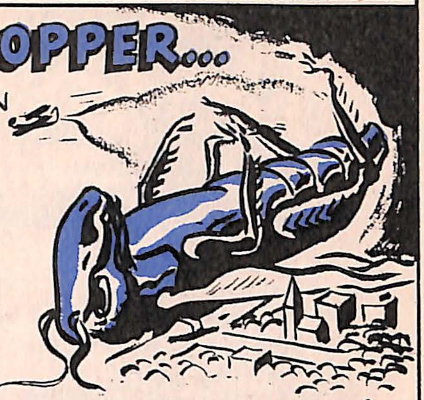


• Extended flight above 35,000 feet, now commonplace, would be virtually impossible without silicone rubber—a chemical product which remains flexible after long exposure to such extreme temperatures as 350° above zero or 67° below zero. One modern bomber requires 300 feet of extruded silicone rubber gasket just to seal its bomb bay doors.

Plane Views

'HOPPER STOPPER...

SPRAYING POISON BRAN ON 2,700,000 ACRES OF WESTERN RANGE LANDS, **AIRPLANES** KILLED ENOUGH GRASSHOPPERS IN **TWO WEEKS** TO WEIGH 175 THOUSAND TONS. PILED UP, THEY WOULD FILL AN AVERAGE CITY BLOCK TO A HEIGHT OF **400** FEET!



175 THOUSAND TONS!

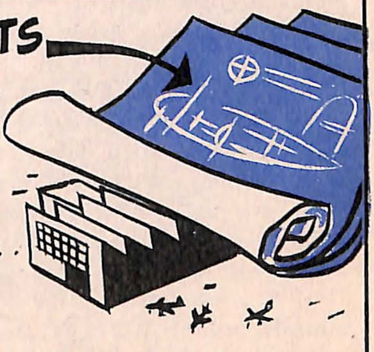
AIR SAFETY

A LEADING **LIFE INSURANCE** COMPANY QUOTES THE FOLLOWING EXTRA PREMIUMS PER $1,000 OF INSURANCE:

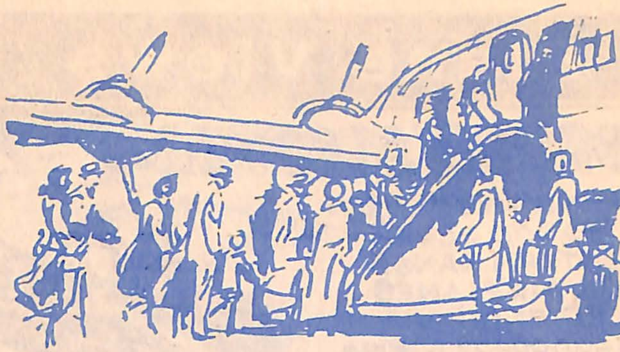
AIRLINE PILOT	$2.50
HOUSE PAINTER	$2.50
BRIDGE PAINTER	$5.00
RAILROAD DETECTIVES AND WATCHMEN	$5.00

BIG BLUEPRINTS

AN EAST COAST AIRCRAFT FIRM USES ENOUGH BLUEPRINT PAPER EVERY YEAR TO COVER EVERY SQUARE FOOT OF ITS FLOOR SPACE THREE TIMES. THE PAPER WEIGHS AS MUCH AS **FIVE** FULLY LOADED TWO-ENGINED TRANSPORT PLANES.



'PLANES'



In the United States at least 85 per cent of all who use the common carriers—rail, inter-city bus, or aircraft—to travel 1,500 miles or more, travel by aircraft.

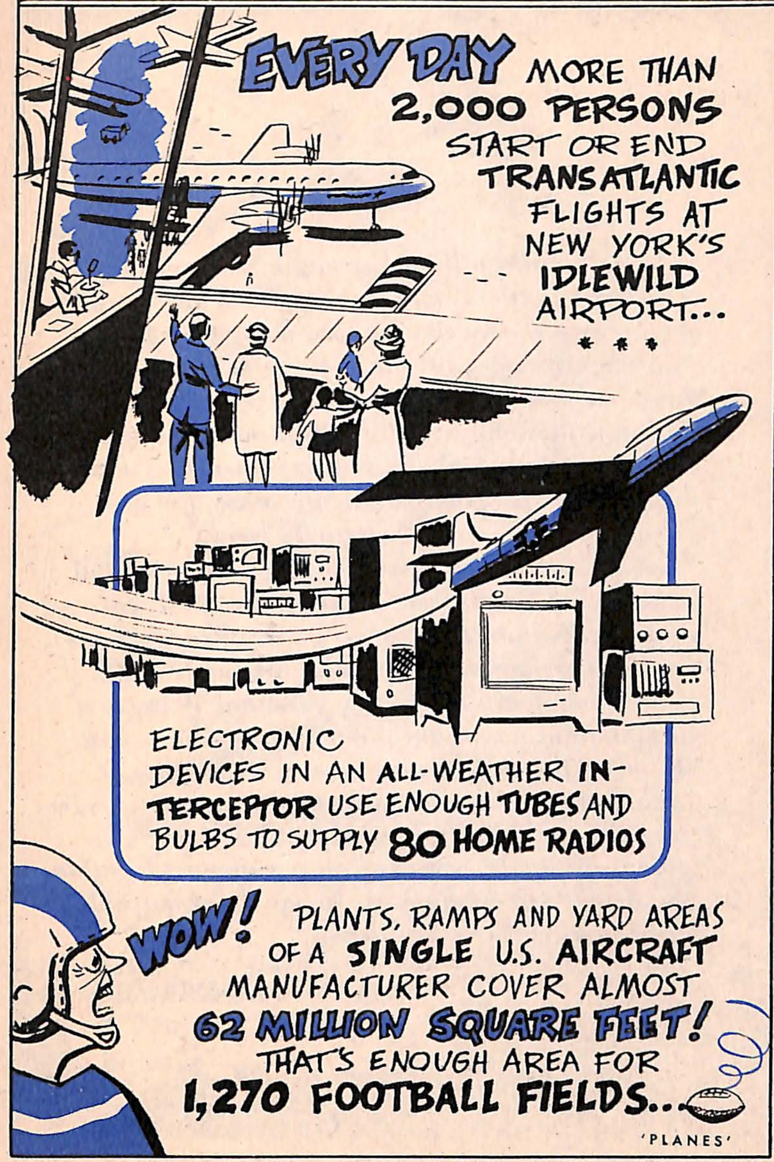
The U. S. Civil Aeronautics Administration has estimated that by 1960, domestic air carriers alone will be carrying 50,000,000 passengers yearly and flying them in excess of approximately 24 billion passenger miles. Since the end of World War II, the governments and airlines of some 60 nations have built a worldwide system of air transport services between more than 3,500 cities on all continents, linked across every ocean and over the top of the North Pole. Worldwide air travel has expanded 36 times in terms of passengers and 70 times in terms of cargo, over prewar levels.

The growth of U. S. scheduled domestic airlines during this same period has been equally impressive. The commercial airline fleet by year-end 1956 will have grown to 1,410 aircraft— an increase in numbers since 1946 of about 80 per cent. And, because of the greater size and speed of the newer planes, an increase in capacity of many times that amount.

Since December 1945, the airlines of the United States have invested nearly $1,000,000,000 in new equipment and facilities necessary to meet the demands of the air travelling public. Yet, despite this enormous expenditure, the price of the average domestic airline ticket is only 3.7 per cent greater than it was in 1939, and the average price of the international ticket is nearly *25 per cent less* than it was in 1939.

All this, of course, is a tribute to the fine quality of the transport aircraft produced by the U. S. aircraft industry. The aircraft operated by the nation's airlines are increasingly fast, dependable and luxurious. The fine safety record of the airline industry speaks for itself.

Plane Views


EVERY DAY MORE THAN
2,000 PERSONS
START OR END
TRANSATLANTIC
FLIGHTS AT
NEW YORK'S
IDLEWILD
AIRPORT...
ELECTRONIC
DEVICES IN AN ALL-WEATHER IN-
TERCEPTOR USE ENOUGH TUBES AND
BULBS TO SUPPLY 80 HOME RADIOS
WOW! PLANTS, RAMPS AND YARD AREAS
OF A SINGLE U.S. AIRCRAFT
MANUFACTURER COVER ALMOST
62 MILLION SQUARE FEET!
THAT'S ENOUGH AREA FOR
1,270 FOOTBALL FIELDS...
'PLANES'

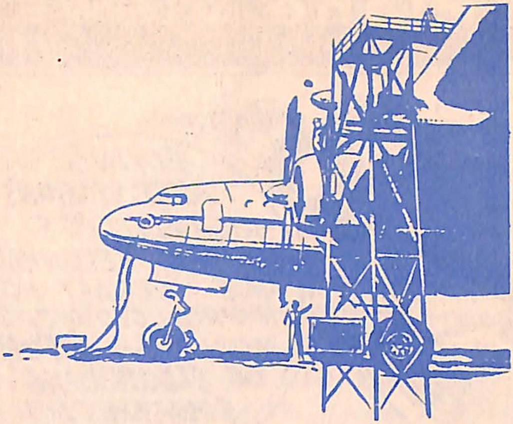
"The minimum military strength we can afford must give us the unquestioned ability to retaliate against any enemy that attacks us or our Allies. This requires, first of all, a force in being of the most modern aircraft—a force able to take the air with atomic bombs within minutes after an alarm is sounded. This force must be scattered over hundreds of bases, far too many for an enemy to paralyze with a single blow.

"Second, it requires research, development and industrial decentralization programs that will improve the effectiveness of our future weapons and reduce our vulnerability. Research and development are absolutely essential if we are to maintain maximum power at minimum cost. We need better accuracies, more reliability, faster missiles, smaller launching sites and a wider-spread economy. From now on, all of our planning should be based on a policy of locating important establishments, so far as practicable, outside of major target areas."

MAJOR GENERAL E. J. TIMBERLAKE
USAF Commander, Ninth Air Force
May 30, 1956

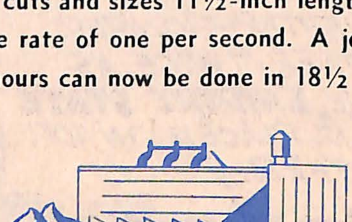
Plane Views

'PLANES'

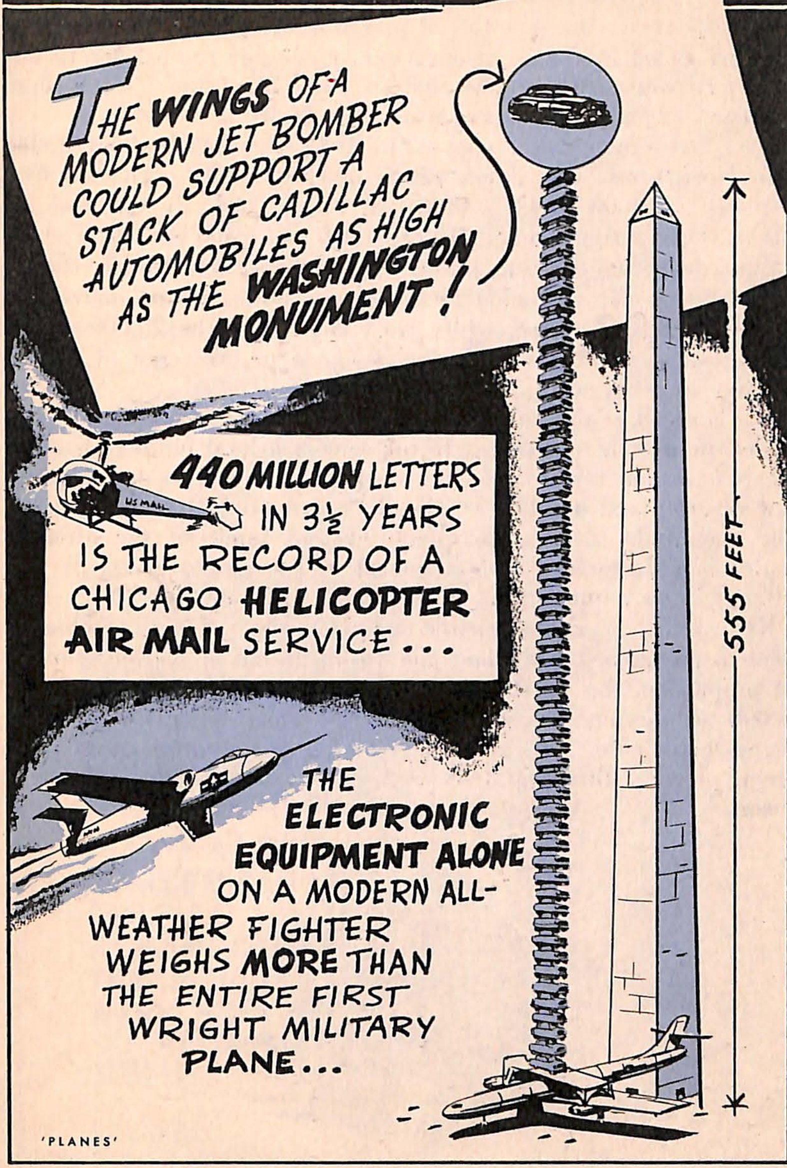


• The crew of one of this nation's strategic bombers has spent more than three months in the air during the last 12 months. During this time they have travelled 430,000 miles. Their plane has burned enough fuel to drive an automobile around the world 818 times. The oil used would fill the crankcases of 5,374 automobiles.

• A new machine developed by an aircraft manufacturer cuts and sizes 11½-inch lengths of .041 gauge wire at the rate of one per second. A job that formerly took 452 hours can now be done in 18½ hours.



Plane Views



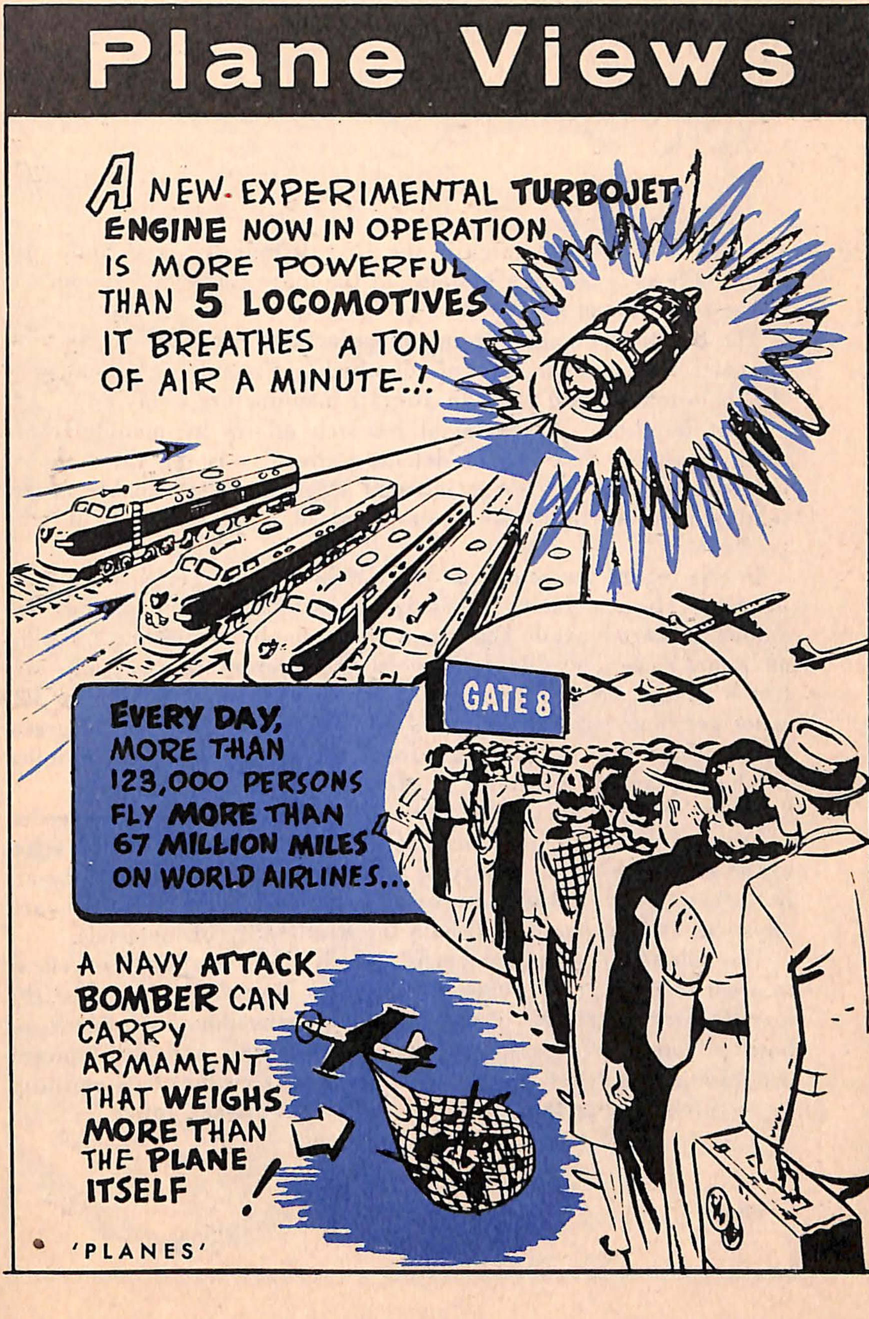
THE WINGS OF A MODERN JET BOMBER COULD SUPPORT A STACK OF CADILLAC AUTOMOBILES AS HIGH AS THE WASHINGTON MONUMENT!
555 FEET
US MAIL
440 MILLION LETTERS IN 3½ YEARS IS THE RECORD OF A CHICAGO HELICOPTER AIR MAIL SERVICE...
THE ELECTRONIC EQUIPMENT ALONE ON A MODERN ALL-WEATHER FIGHTER WEIGHS MORE THAN THE ENTIRE FIRST WRIGHT MILITARY PLANE...
'PLANES'

Aircraft engine development, particularly since World War II, has advanced at an amazing rate. While powerful new turbojet and turboprop engines for America's military aircraft and luxurious new transports are veritable jewels of precision design and manufacture, they are as yet in a stage of development roughly comparable to the 18-horsepower piston engine that in 1903 lifted the frail Wright Brothers' airplane off the sands of Kitty Hawk.

The first practical jet engine, in 1942, developed about 1,600 pounds of thrust. This power rating quickly yielded, less than five years later, to the 3,400-5,000-pound thrust class. By the time of Korea, thrust ratings had climbed to 6,000 and 6,500 pounds. Today, engines delivering 8,000 to 12,000 pounds thrust are virtually standard. Now in test and soon to follow are power plants delivering 15,000 pounds of thrust, while great engines in the 25,000-pound thrust category are already being designed to take care of future military and civil needs.

The aircraft engine manufacturers have invested tens of millions of dollars of their own money to supplement federal funds in hastening new engine research and development, as well as in building new research and development facilities and production equipment. The magnitude of these privately invested funds of the aircraft engine manufacturers for development of jet engines primarily for military use is unique in the annals of modern industry.

Record of U. S. aircraft engine manufacturers' production achievements is unmatched throughout the world. In the short-lived span of jet propulsion, the U. S. engine industry has delivered more than 88,000 turbojet engines, a great many of which are in the 10,000-pound thrust class. Yet, as recently as five years ago, engines producing power of this magnitude were scarcely more than a designer's dream.


Plane Views
A NEW EXPERIMENTAL TURBOJET ENGINE NOW IN OPERATION IS MORE POWERFUL THAN 5 LOCOMOTIVES! IT BREATHES A TON OF AIR A MINUTE.!.
GATE 8
EVERY DAY, MORE THAN 123,000 PERSONS FLY MORE THAN 67 MILLION MILES ON WORLD AIRLINES...
A NAVY ATTACK BOMBER CAN CARRY ARMAMENT THAT WEIGHS MORE THAN THE PLANE ITSELF!
'PLANES'

Metallurgical research in the aircraft industry is as hotly pursued today as is research into any of the more conventional concepts of the aeronautical field.

The fact that a single aircraft manufacturer processes 50,000 tons of materials each year, the bulk of which are metals, is indicative of the importance metal plays in aircraft manufacture today.

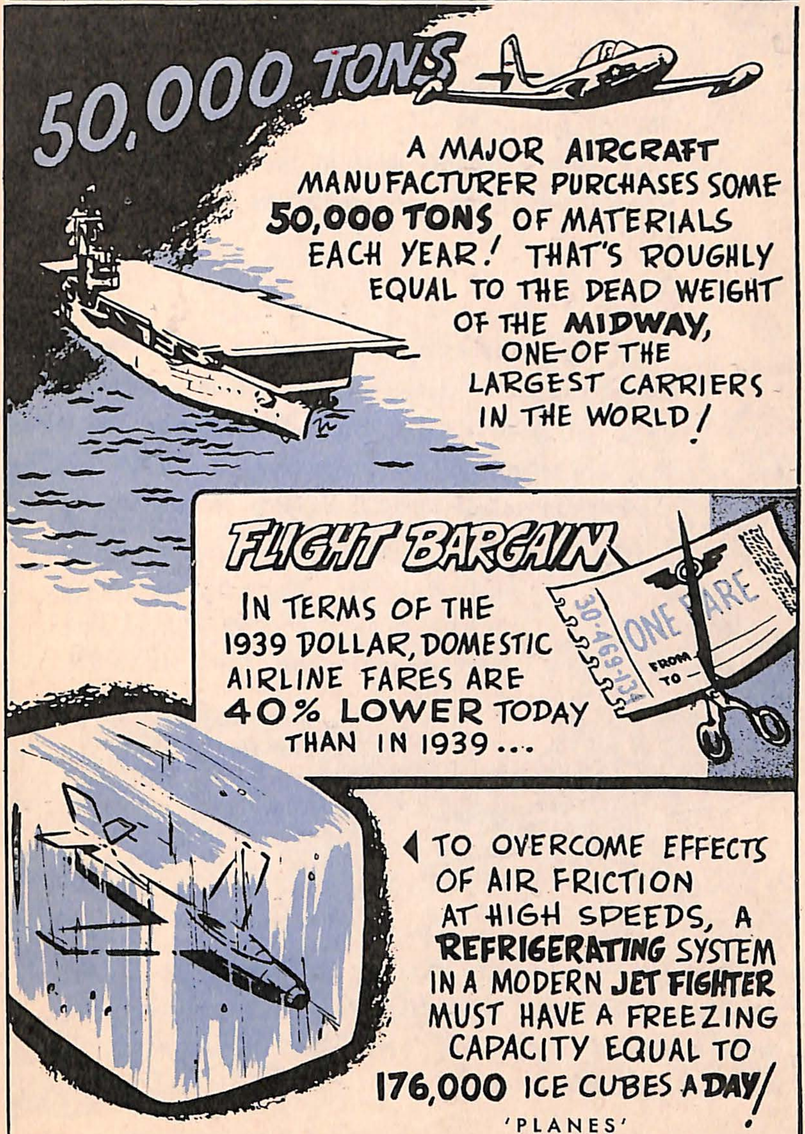
Most important in the metal research efforts by manufacturers of this nation's first line of defense—aircraft—is the research for lightweight metals of great inherent strengths, yet capable of retaining their strengths when subjected to great extremes of temperature.

In this regard the so-called "thermal barrier" is perhaps the most fearsome obstacle facing the aviation metallurgist today. For example, the aerodynamic heating in an automobile travelling 60 miles an hour, causes outside body-metal temperature to rise only six-tenths of one degree. An aircraft moving through the air at 300 miles per hour generates a metal-skin friction rise of 16.1 degrees. But a guided missile travelling through the atmosphere at 3,000 miles per hour develops a metal-skin friction heat of 1,613 degrees.

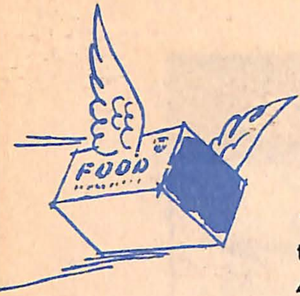
The very rapid advance in aircraft performance has far exceeded the rate of development of materials. It is not enough for the state-of-the-art in the metals field just to keep up with the state-of-the-art in the aeronautics field. It must stay well ahead, for across the board advances are not possible without the availability of materials.

The solution to the problem of aerodynamic heating, as well as to other technological problems facing the aircraft industry and the manufacturing materials it uses, requires tremendous investments of both private and government funds in research and development programs. The industry reinvests a large percentage of its earnings in research to maintain our qualitative lead in air power.

Plane Views

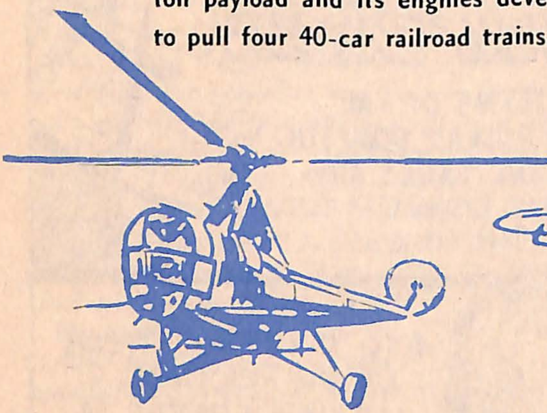


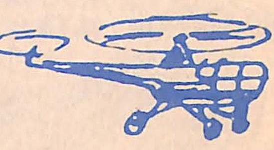
50,000 TONS
A MAJOR AIRCRAFT MANUFACTURER PURCHASES SOME 50,000 TONS OF MATERIALS EACH YEAR! THAT'S ROUGHLY EQUAL TO THE DEAD WEIGHT OF THE MIDWAY, ONE OF THE LARGEST CARRIERS IN THE WORLD!
FLIGHT BARGAIN
IN TERMS OF THE 1939 DOLLAR, DOMESTIC AIRLINE FARES ARE 40% LOWER TODAY THAN IN 1939...
ONE FARE
FROM
TO
30-469-134
◀ TO OVERCOME EFFECTS OF AIR FRICTION AT HIGH SPEEDS, A REFRIGERATING SYSTEM IN A MODERN JET FIGHTER MUST HAVE A FREEZING CAPACITY EQUAL TO 176,000 ICE CUBES A DAY!
'PLANES'



• Within 10 days after Hurricane Hazel struck Haiti, the U. S. Foreign Operations Administration rushed 462,700 pounds of relief food to the Caribbean nation. First relief shipments were in the air while the storm was still lashing the east coast of the United States.

• A new military air transport plane, which the United States Air Force classes as a "medium combat transport," has a clear cargo compartment longer and wider than a standard railroad freight car. It can carry a 20-ton payload and its engines develop enough horsepower to pull four 40-car railroad trains.





• Zoologists in Alberta, Canada, use helicopters to trace migratory habits of buffalo. Hovering low over herds, aircraft crew members "brand" the animals with squirts of paint from a gun.

Plane Views

182 TIMES AS FAST!

IT TOOK TWELVE SECONDS FOR THE WRIGHT BROTHERS' PLANE TO FLY 120 **FEET** ON DECEMBER 17, 1903.

IN **TWELVE SECONDS** A COMPLEX MODERN RESEARCH PLANE CAN FLY MORE THAN **4 MILES**

FOR PROTECTION AND EFFICIENCY IN COMBAT, MODERN **FIGHTER PILOTS** WEAR OUTFITS AND ACCESSORIES WEIGHING **144** POUNDS. SIR LAUNCELOT'S FULL ARMOR, INCLUDING HIS WEAPONS WEIGHED ONLY **84** POUNDS!

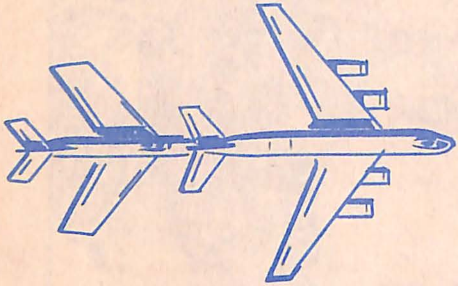
BIG PLANES FOR BIG BOMBS

IN AN INTERCONTINENTAL BOMBER, THE DISTANCE BETWEEN THE **PILOT** AND ENGINES EQUALS ONE-FOURTH THE LENGTH OF A **FOOTBALL FIELD**. AND THE TAIL OF THE PLANE IS OVER **HALF** THE LENGTH OF A FOOTBALL FIELD **BEHIND** THE PILOT!..

'PLANES'

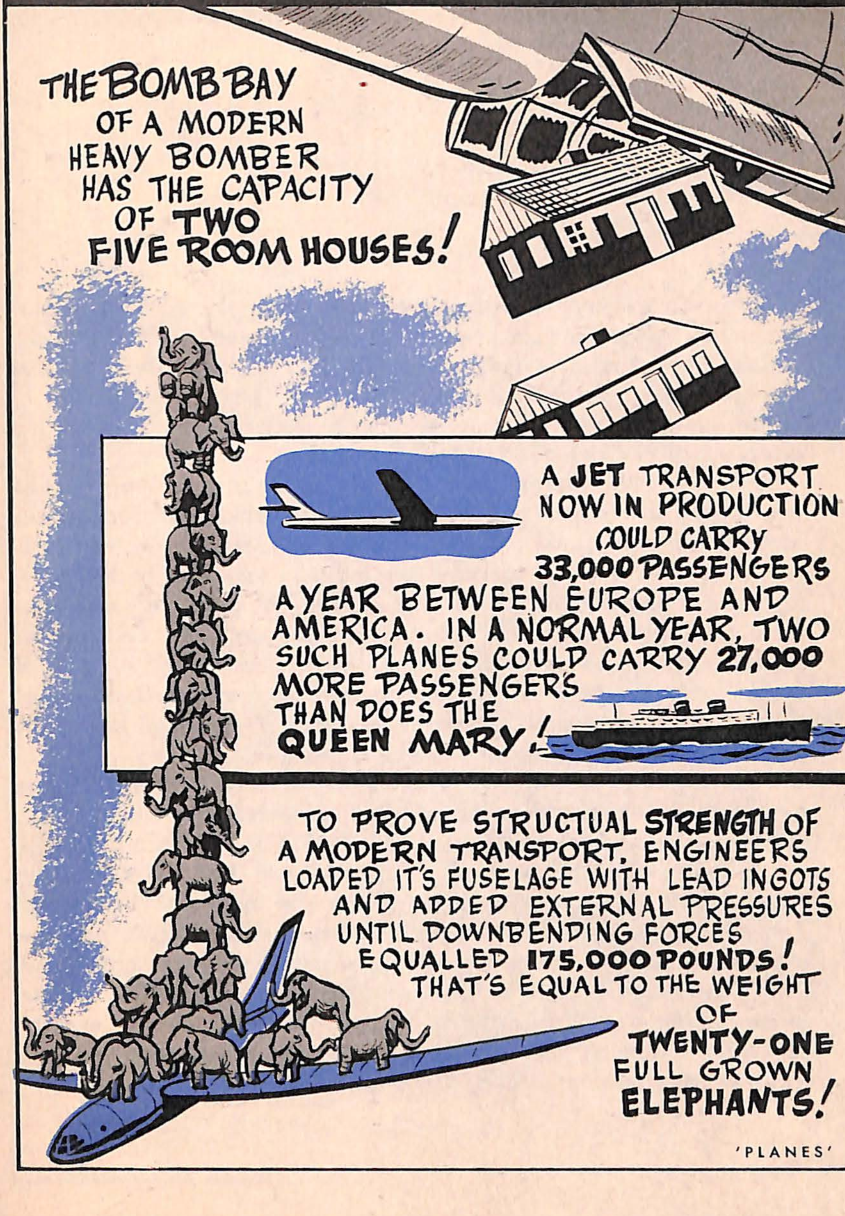
"Today air power is the dominant factor in war. It may not win a war by itself alone, but without it no major war can be won. As far as we are concerned, it is a primary requirement, both offensively and defensively, and in support of other forces."

ADMIRAL ARTHUR W. RADFORD
Chairman, Joint Chiefs of Staff

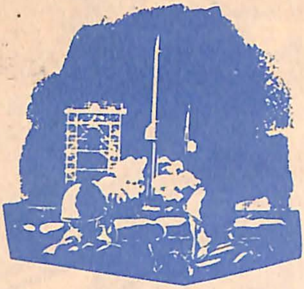


- **One Air Force flying tanker squadron transferred more aviation gas (563,273) gallons in sixteen flying days of aerial refueling operations than the average automobile service station would pump in three years. The same squadron has delivered 6,000,000 gallons of aviation fuel in aerial refueling operations to USAF bombers and fighters during the last four years.**

Plane Views



'PLANES'

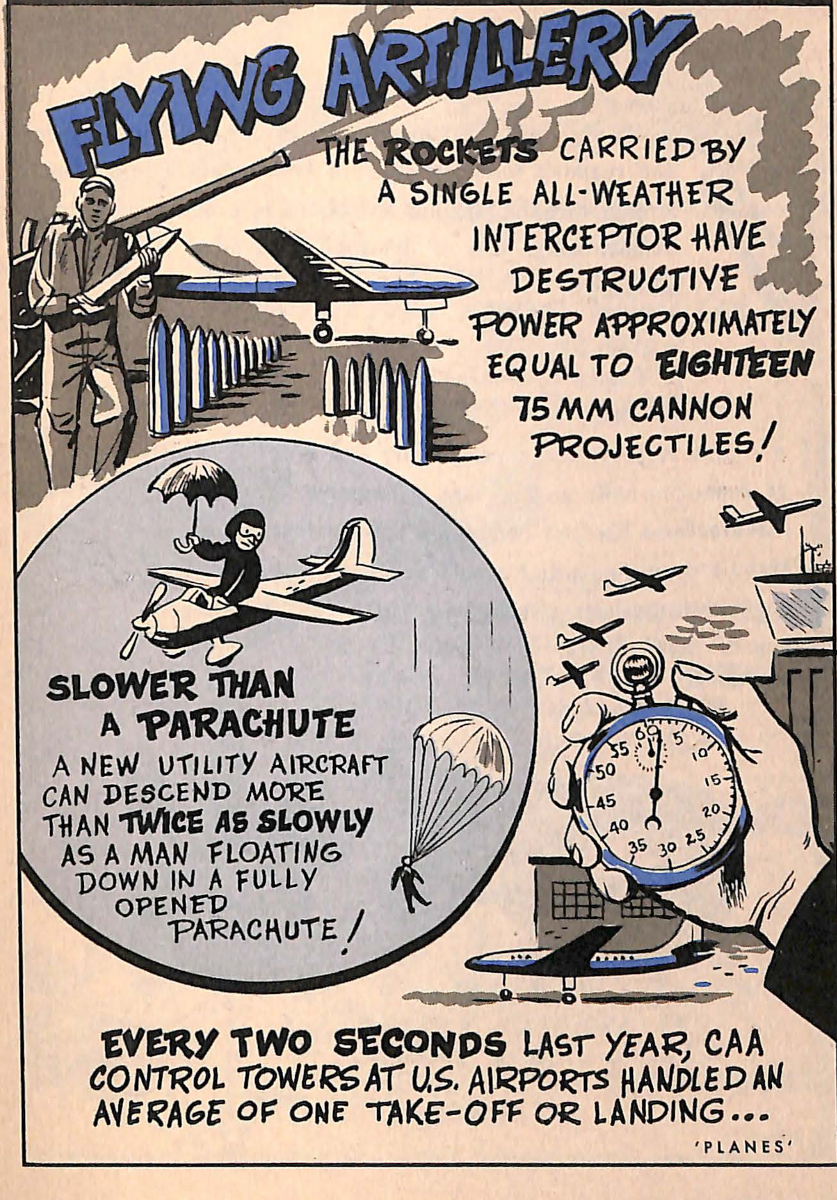


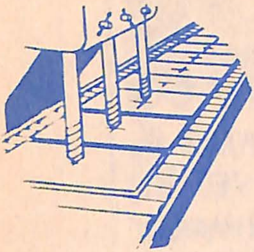
As the concept of war changes, so must the concept of our defenses. Today, in many cases, the only counter in combat is the rocket powered missile. This is becoming true particularly in combat air operations. As manned aircraft fly far beyond the speed of sound, bullets fired from guns become ineffective. Indeed there are aircraft that can already fly faster than bullets.

As a result, the aircraft industry is spending a great deal of time and money in research and development of various missile engine, airframe and electronic controls. Working in close liaison with military and other research agencies, the industry has already developed high thrust controllable missile engines, both air breathing and non-air breathing; it has developed very accurate electronic and inertial guidance systems, as well as electronic computers which can control the ballistic missile in flight; it has developed new techniques of airframe construction to withstand the great stresses and strains of ultrasonic speeds required by these new weapons.

Today, guided missile research and production efforts of the United States are directed and oriented in such a way as to assure American leadership in this aspect of national defense. But the day is approaching when the U. S. aircraft industry will take these tools of defense and apply them to peaceful causes of commerce. The guided rocket can do much to enhance this nation's and the world's standard of living through the rapid delivery of cargo and mail transcontinentally and internationally to even the most remote regions of the world. In different version, passenger aircraft eventually will be able to take off, fly a course and land, automatically, with the crew only monitoring the flight.

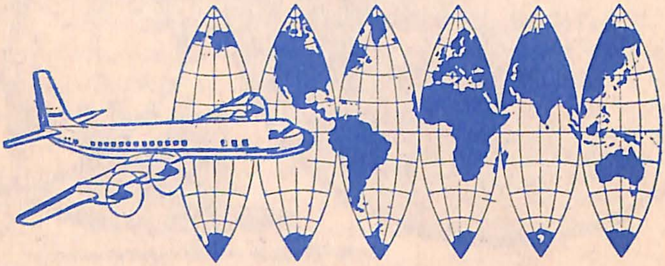
Plane Views


FLYING ARTILLERY
THE ROCKETS CARRIED BY A SINGLE ALL-WEATHER INTERCEPTOR HAVE DESTRUCTIVE POWER APPROXIMATELY EQUAL TO EIGHTEEN 75 MM CANNON PROJECTILES!
SLOWER THAN A PARACHUTE
A NEW UTILITY AIRCRAFT CAN DESCEND MORE THAN TWICE AS SLOWLY AS A MAN FLOATING DOWN IN A FULLY OPENED PARACHUTE!
EVERY TWO SECONDS LAST YEAR, CAA CONTROL TOWERS AT U.S. AIRPORTS HANDLED AN AVERAGE OF ONE TAKE-OFF OR LANDING...
'PLANES'

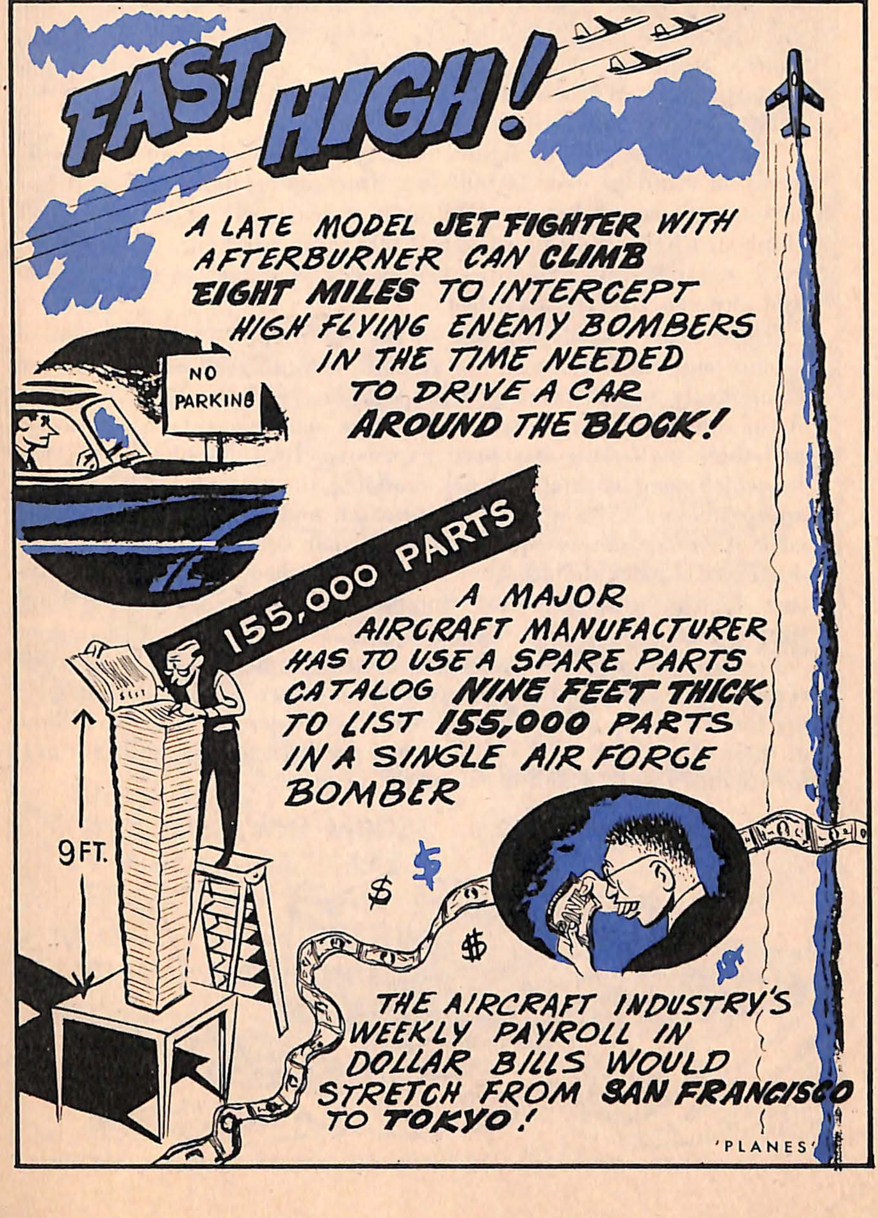


• A new drill (which performs in one operation, boring and reaming formerly done in two separate operations) now saves 8,000 drilling operations in production of a jet bomber wing. Use of the tool saves more than $14,000 annually.

• Tests to prove the dependability and superior quality of American-built engines are exhaustive. One engine manufacturer has just completed run-up tests on a new turbo-prop engine which would be equivalent to a twin-engined turbo-liner circling the earth four times non-stop.



Plane Views



'PLANES'

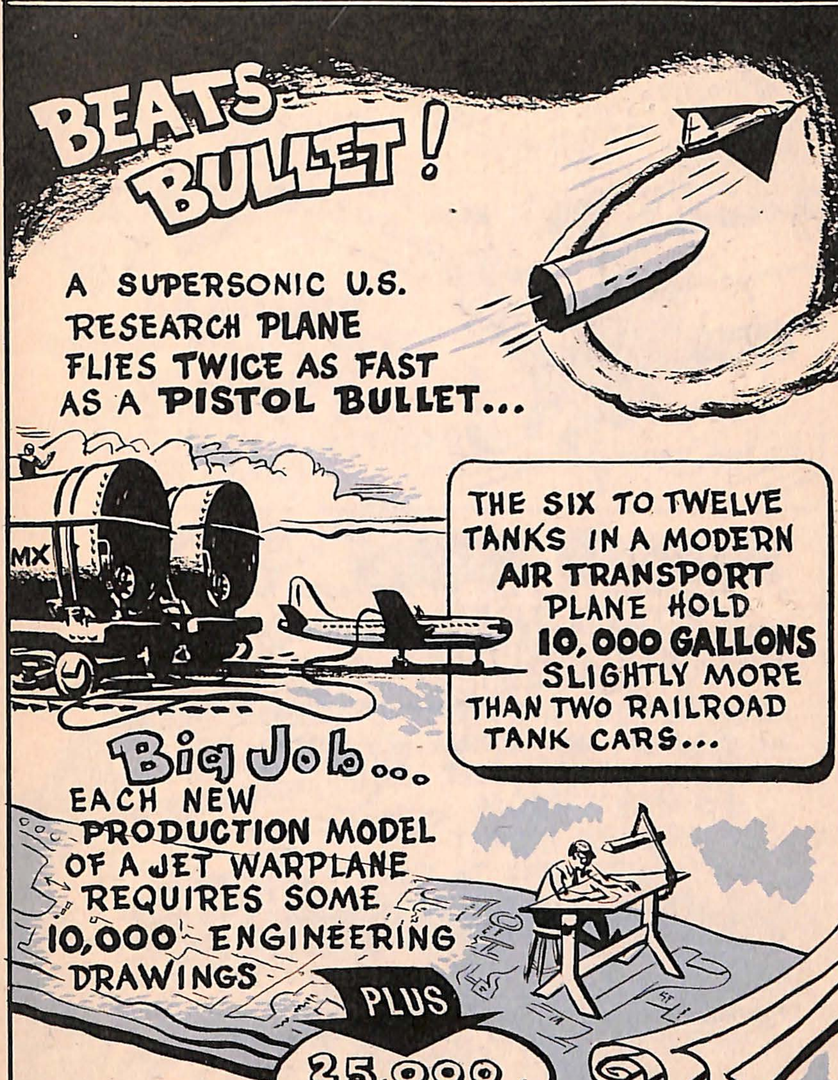
Although Twentieth Century civilization has long since come to expect industrial miracles, the speeds and altitudes attained by planes produced by the U. S. aircraft industry have increased at fantastic rates. World War II fighters had to be pushed to reach 450 miles per hour and altitudes over 30,000 feet.

Today's sleekly lethal fighters and great bombers maneuver faultlessly at altitudes over 50,000 feet. Interceptor fighters slip at will through the sound barrier (763 mph at sea level) and a new Navy shipboard fighter has flown over 1,000 miles per hour. Rocket powered research planes have reached speeds over 2,000 miles per hour and altitudes over 100,000 feet.

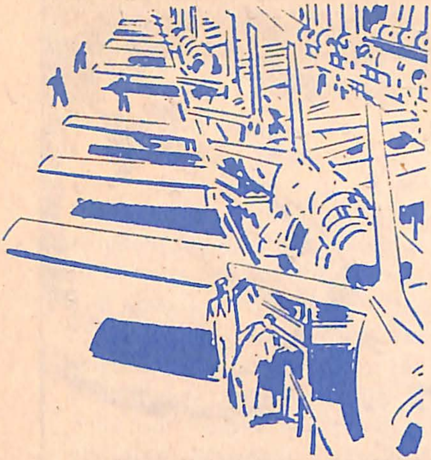
These achievements are due to the continuous efforts of men of science and engineering in the aircraft, aircraft engine, systems and components manufacturing area, working as a team to maintain American aerial supremacy. But these achievements are difficult and their realization has been expensive. In 1953, the latest year for which complete statistics are available, the aircraft industry spent approximately $758 million for research and on development projects. This amount is equivalent to 12 per cent of the aircraft industry total sales dollar. The national all-industry average expenditure during the same period amounted to only 2 per cent of total sales dollars.

Besides this expenditure by the aircraft industry, it is also conservatively estimated that the aviation industry of this nation during the last 5-year period has reinvested considerably over $1 billion of their sales dollar into building new facilities (brick and mortar) for various research and development projects.

Plane Views



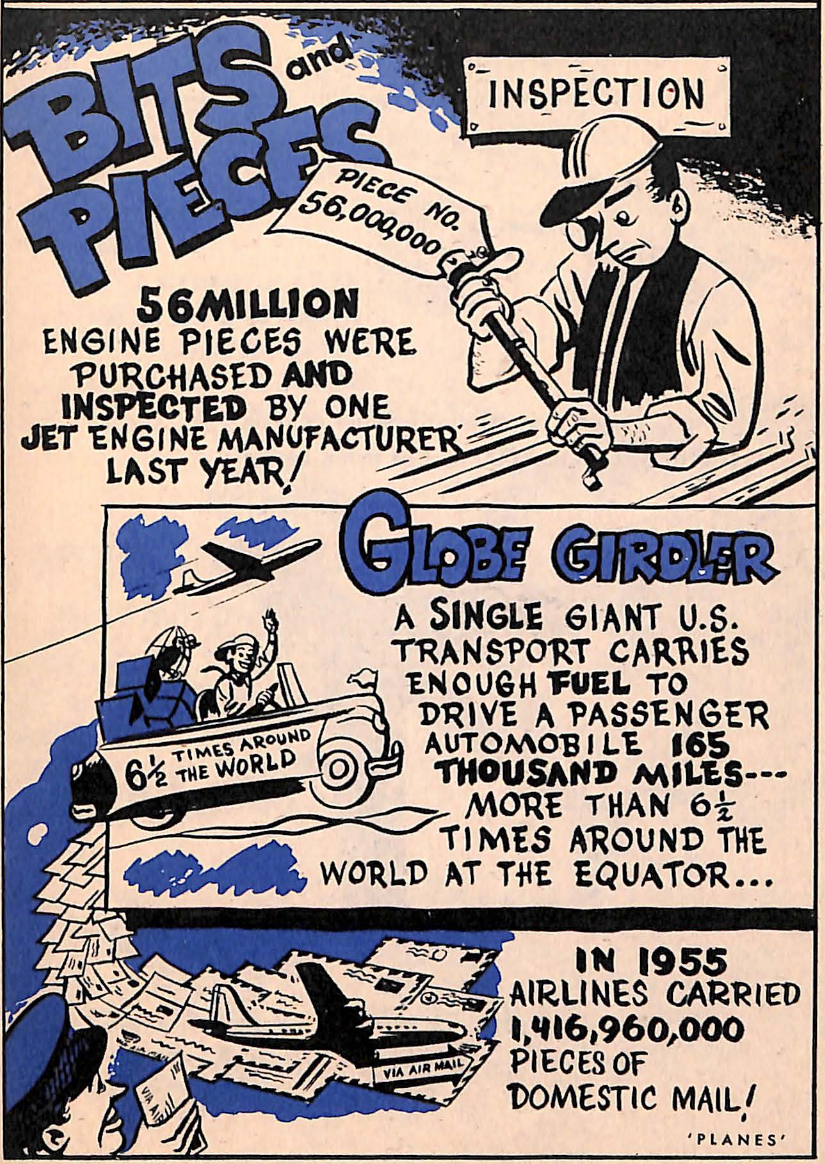
'PLANES'



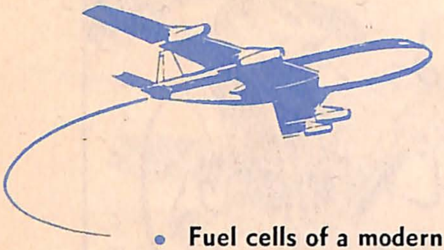
• The generator in a new jet interceptor furnishes approximately the same amount of electricity as is used in 20 average homes. The plane contains 750 radio tubes, about 3½ miles of electrical wiring—and its systems are operated by nearly 200 electrical switches.

• **A new hard-glass electron tube designed to withstand the high heat and stress conditions in modern aircraft can operate at a bulb temperature of 572 degrees Fahrenheit for a minimum of 1,000 hours.**

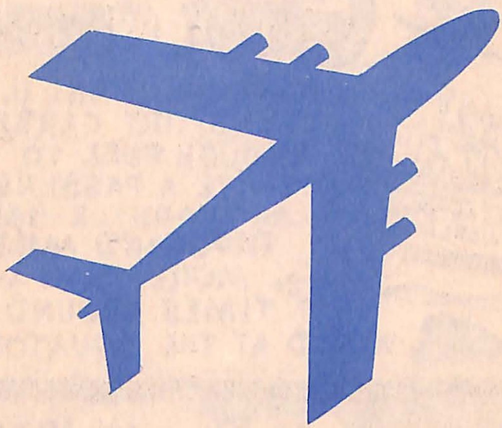
Plane Views


BITS and PIECES
INSPECTION
PIECE NO. 56,000,000
56MILLION ENGINE PIECES WERE PURCHASED AND INSPECTED BY ONE JET ENGINE MANUFACTURER LAST YEAR!
GLOBE GIRDLER
A SINGLE GIANT U.S. TRANSPORT CARRIES ENOUGH FUEL TO DRIVE A PASSENGER AUTOMOBILE 165 THOUSAND MILES--- MORE THAN 6½ TIMES AROUND THE WORLD AT THE EQUATOR...
6½ TIMES AROUND THE WORLD
IN 1955 AIRLINES CARRIED 1,416,960,000 PIECES OF DOMESTIC MAIL!
VIA AIR MAIL
'PLANES'

• Use of a commercial putty compound for molding dams when pouring molten metal and plastics in tool fabrication is making possible a savings of more than $3,500 annually at a Midwest aircraft plant.



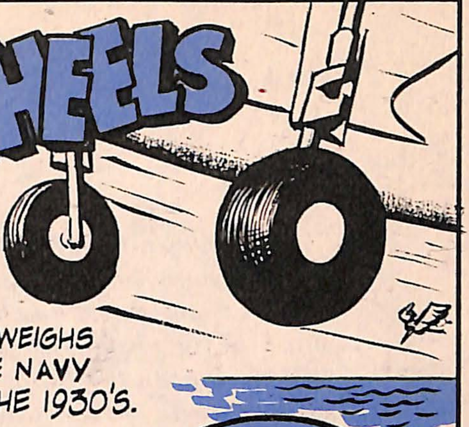
• Fuel cells of a modern jet bomber contain 1,500 square yards of nylon and 3,000 feet of nylon lacing.



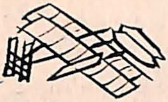
• Each swept-back wing of one of this nation's latest jet bombers contains 14,698 bolts and rivets.

Plane Views

BIG WHEELS



THE **LANDING GEAR ALONE** ON A MODERN NAVY CARRIER PLANE WEIGHS **MORE** THAN AN **ENTIRE** NAVY FIGHTER PLANE OF THE 1930'S.



LITTLE HERCULES

TINY MOTORS THAT MOVE THE **CONTROL SURFACES** OF A JET FIGHTER GENERATE **TWICE** AS MUCH **HORSEPOWER** AS WAS USED TO PROPEL THE WRIGHT BROTHERS' **FIRST AIRPLANE!**

THE SPACE PROBLEM

A SINGLE AIRCRAFT MANUFACTURER TODAY USES MORE FLOOR SPACE THAN THE **ENTIRE AIRCRAFT INDUSTRY** OCCUPIED WHEN WORLD WAR II BROKE OUT IN EUROPE.

"God has been merciful to us in that we have always been granted ample time to prepare. Distance and the Allies have absorbed the first shock of the onslaught, providing time for us to arm. But in the future we might be the initial target. All the world will now acknowledge that any aggressor nation seeking domination of the earth must defeat the United States and must defeat us before we can achieve our maximum strength. Therefore, if global war comes to us again, the first blow will be struck not at Warsaw but at Washington; not at London but at Los Angeles; not even at Pearl Harbor but at Pittsburgh. I have no means to see into the future, no more than you—but you and I can logically deduce that we must have an adequate defensive force in being on the day war begins—or we will have no need for any other."

DWIGHT D. EISENHOWER
February 19, 1947

THE AIRCRAFT INDUSTRIES ASSOCIATION

OF AMERICA, INCORPORATED