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RESEARCH FACILITIES CUT PLANE COSTS

USAF Cites Need For Top Talent

The aircraft industry must attract and retain the best managerial talent, or the United States will face the likelihood of a second class Air Force which invites "catastrophe," Dudley Sharp, Assistant Secretary of the Air Force, declared.

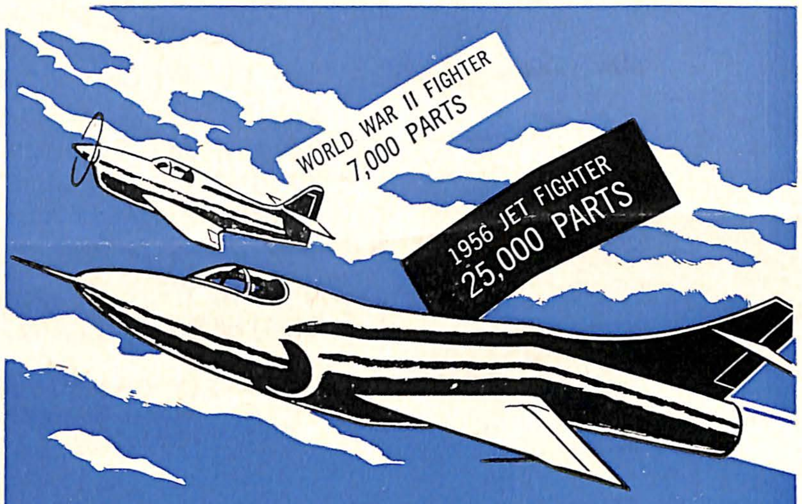
In a recent address before members of the National Security Industrial Association in Washington, Secretary Sharp, who directs USAF's huge multi-billion dollar materiel program, said that the Air Force considered the industry profit structure and compensation of aircraft executives both necessary and just. Both items have been subject recently to debate on Capitol Hill.

"In negotiations with industry," he said, "the Air Force gives detailed consideration to all elements of cost, including profits. The experience USAF has gained throughout the years in aircraft production is used to measure costs and to estimate as accurately as possible what the cost of an aircraft should be. Air Force officials have developed sound statistics, such as the 'learning curve,' for estimating and negotiating costs, and constantly review, evaluate, and modernize these yardsticks to further adapt them to the even more complicated aerial weapons of the future.

"In our negotiations," Secretary Sharp explained, "we do not attempt to establish the profit factor by formula. We believe that the profit allowance of each contract must be negotiated in relation to the value of the particular job to be done. We encourage use of the profit factor in such manner as to induce the contractor to perform more efficiently than he otherwise might, by affording him an opportunity to earn more profit thereby. Since costs represent the greatest portion of price, use of the profit incentive to exert pressure on costs results in the greatest savings to the Government.

"Flat rates of profit, or preconceived percentages," he declared, "must be avoided, for, in the long run, such concepts tend to increase costs, penalize the efficient, and reward the marginal producer. We consider that our incentive approach is responsible in great part for industry's cost reduction programs, from which we benefit significantly.

(See SHARP, Page 3)



BUILDING PERFORMANCE

Performance requirements of modern military fighter planes involve the design and engineering of more than 3½ times as many parts as did World War II fighters. But aircraft industry "know-how" and greatly increased scientific and engineering staffs have held engineering lead time from "prototype go-ahead" to first flight, to slightly less than two years.

—PLANES

Aircraft Industry Continues To Show Progress In Development Of Jet Engine Suppressors

Confirming the old proverb "silence is golden," the U. S. aircraft industry is investing considerable effort, time and "gold" to achieve noise reduction in today's powerful jet engines—and with encouraging results.

One aircraft company, for example, has embarked on a specific program to develop a noise suppression device for their jet transports, involving several coordinated tests programs with both small and full-scale nozzles.

The jet engine nozzle is the opening at the rear of the engine through which the tremendously expanded gasses developed within the engine escape. These expanded gasses ejected outward through the nozzle, give the engine "thrust" power.

A series of acoustical and thrust tests conducted by the aircraft company indicated that considerable engine sound abatement could be achieved by modifying the shape of the nozzles.

In the first small-scale tests, greatest noise reduction appeared to be associated with deeper grooves or greater periphery at the nozzle exit.

Several scale-model nozzles were then made which increased the periphery and to which many bars or wedges were added to further increase the rate of mixing the jet exhaust. Tests with these nozzles showed that considerable noise reduction had been achieved.

Further tests with full-size nozzles on an actual engine, set up in a test cell, revealed the need for refinement of the nozzle shape at the plug. Additional nozzles to accomplish this are now under construction.

When the "silencing nozzles" were tested with a jet transport prototype airplane, the results showed reduction in maximum noise up to 15 decibels over-all and 20 decibels in the lower frequencies. This reduction in the low frequencies was very

(See SUPPRESSOR, Page 4)

New Wind Tunnels Prime Need

Qualitative superiority of U. S. airpower, the keystone of our national defense program, is maintained through three major activities of the aircraft industry:

1. Substantial research and development programs.

2. Incorporation of changes in production aircraft to boost performance.

3. Production of new models to replace older production aircraft.

The basis of qualitative superiority in airpower is research and development, and the battle of the laboratories will be 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.

Despite this record, more and more research and development facilities are needed to meet Russia's technological challenge.

The cost 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 these facilities. 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 mounted 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. A combination of greater engine thrust, extraordinary stresses, thinner wings and new configurations permit vastly increased speeds. But the speed in turn generates a host of problems, such as disintegration of aircraft skins due to high temperatures, greater difficulties in controlling and stabilizing the plane in flight and preventing structural break-up while maneuvering at high speeds.

The solutions to these problems must be found as early as possible. They can be solved by analytical

(See RESEARCH, Page 4)

PLANES

Planes is published by the Aircraft Industries Association of America, Inc., the national trade association of the manufacturers of military, transport, and personal aircraft, helicopters, flying missiles and their accessories, instruments and components.

The purpose of *Planes* is to:

Foster a better public understanding of Air Power and the requirements essential to preservation of American leadership in the air;

Illustrate and explain the special problems of the aircraft industry and its vital role in our national security.

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The Immutable Factor

America has always relied upon the genius of industry and labor to produce in gigantic quantity all the things it needed to enjoy its present and ever increasing peacetime standard of living. In wartime, with equal reliance, it has depended upon industry to produce weapons and materials needed by our military forces in such abundance that we have even been able to supply much of the equipment needed by our allies.

However, we forget that it took the aircraft industry and other major industries of this nation more than two years to divert, expand, gird and marshall its productive efforts to meet the war emergency.

In industrial parlance the immutable factor of productive effort from design to quantity production is *lead time* — the time it takes to get something done after the decision is made to do it. Time then is the priceless ingredient. Time is the common denominator for all activities in peace or war — here, and in Russia.

The Soviet Union is challenging and may be expected to continue to challenge the technical position on which our aeronautical first line of defense is based. They have cut lead time required for aeronatuical weapons *development* by exploiting four basic concepts of operation unique to Soviet philosophy and economic policy.

First, their development program is dictated solely by military expediency with complete disregard for the requirements of a free economy. They can and do make unilateral decisions at the highest level without fear of political consequence.

Second, they can devote any desired amount of their budget to military programs.

Third, Russian policy is to design and standardize one weapon for one specific purpose.

Fourth, the Soviets definitely hold the initiative in starting a war and, therefore, are free to concentrate their efforts on specific programs required by their war planners.

In light of these sobering facts, the United States must make an all-out effort to maintain our still existing technical predominance. Next, we must improve our research and development capabilities by improving our nation's educational facilities and stimulating in youth the desire to pursue scientific careers.

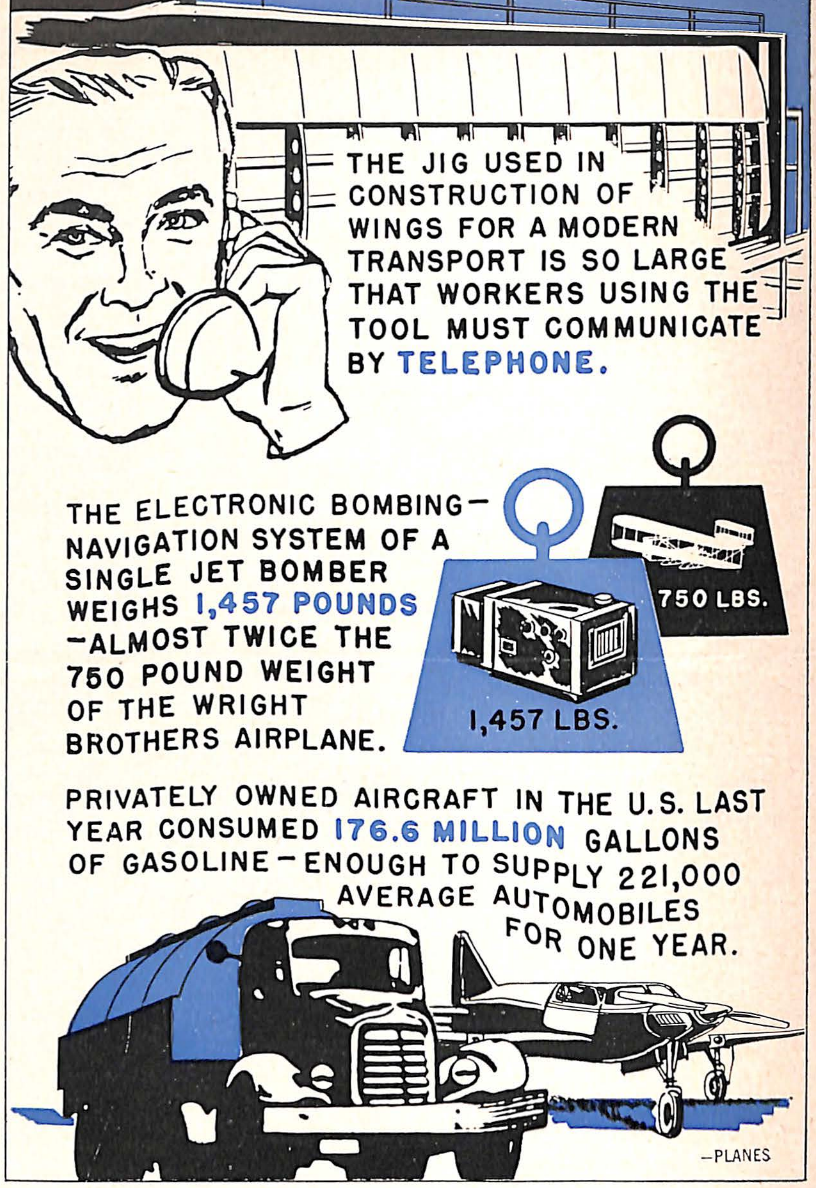
Thanks to the efforts of the aircraft industry, this nation, so far, still possesses qualitative *and technological* superiority in aircraft. This has been stated repeatedly by our military leaders. But of grave importance to our national security these days is the incredible *rate of progress* being made by the U.S.S.R. in achieving a capability to design, develop and mass produce superior air weapons.

The United States has clear warning that it can no longer be complacent in going about research and development of new and radically improved aerial weapons. Only by continually advancing the state of the art and by an aggressive development program utilizing the latest findings of basic research, will the aircraft industry be able to maintain technological superiority.

But to achieve these ends, the aircraft industry must expand research and development of its current programs and be given more latitude in exploration of radical and revolutionary weapons.

This can only be accomplished by the enlightened support of the American public and its representatives in Congress. To maintain aeronautical supremacy will cost money. But if we do not face up to the reality that Russia is fast closing the gap, we may soon be outdistanced by them in the race for technological supremacy.

Plane Views



New 'Brain' Takes Over Bomber Guidance

A new electronic brain of unprecedented reliability will be installed in America's heavy jet bombers to assist Air Force crews in their complex bombing and navigation problems.

A product of Air Force-industry efforts to meet the exacting demands of America's military requirements, the new "seeing eye" will be employed to guide the bomber to its destination, after which the system will automatically carry the plane through the bomb run.

The system has been subjected to one of the most thorough-going test programs in Air Force history, with the computers and related equipment sent to environmental chambers to be attacked by fungus, shaken by explosions, exposed to sleet and heavy rains, whipped by dust, and subject to extreme altitude conditions in temperatures ranging from 65 degrees below zero to 180 degrees Fahrenheit.

The device resembles the giant computers used in industry and research, only on a smaller scale. Each unit weighs 1,457 pounds and employs more than 300 electronic tubes. It will cost approximately $300,000 and will occupy 30 cubic feet of space.

PLANE FACTS

- Despite the great surge in air travel, its potential has barely been tapped. Department of Commerce estimates that 90 per cent of the U. S. public has never flown in a commercial airliner.

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- Aerial weather reconnaissance saves lives. Between 1936 and 1940 there were 25 lives lost for every $10,000,000 in property destroyed by cyclonic storms. Since early warnings through aerial reconnaissance became available, the death rate has dropped to 4 persons for every $10,000,000 of damage.

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- Business aircraft get around. One twin-engine executive aircraft has painted on its cabin the colorful flags of 72 countries, a listing of 5 ocean crossings, 8 seas, 8 gulfs and the English Channel.

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- A new aircraft engine test facility, completely financed by private funds, will simulate Mach 3.5 (three and a half times the speed of sound) at 60,000 feet. Engines can be evaluated at inflight speeds as high as 2,300 miles per hour.

Sharp Describes High Reinvestment Of Industry Earnings In Facilities

(Continued from Page 1)

"At the same time," Secretary Sharp continued, "the Air Force is deeply concerned with what the industry does with its profits, since substantial reinvestment of profits reduces the facility and financing burden of the Government. Although the Air Force cannot inject itself actively into corporate management, it does exercise considerable influence on utilization of profits.

"Aircraft companies are expected to be prudent and conservative in their treatment of dividends and the record will show this to be the case," he said. "Dividend payments have averaged 30 to 40 per cent of earnings for the past several years, with 60 to 70 per cent of earnings being reinvested. Facility, working capital, and research and development investments have been significant. Further improved trends in this area are already apparent, as evidenced by the fact that aircraft companies are planning to make substantial investments in research and production facilities."

In connection with the salaries and fringe benefits accorded top aviation executives, the USAF's top materiel executive stated: "One of the areas in which we have sometimes been criticized is that of executive compensation in the aircraft industry. Here we have a very real problem, because the Government is almost the exclusive customer. At the same time, we must recognize that it is vital that aircraft companies be in a position to attract and retain top flight executive personnel to plan, direct and execute courses of action which will give us the complex weapons we require to maintain air supremacy. Aircraft are just about the most technically complex articles in production in this country today.

"For this reason, we need the very best available brains to perform the research, engineering and production of these complicated items. Unless the aircraft industry can attract and retain the best managerial talent, we are faced with the likelihood of a second class aircraft industry, manned by second rate people, producing second class aircraft. And a second class Air Force invites catastrophe. Initially, at any rate, each company must determine for itself what amount must be paid to attract the calibre of executive talent necessary to provide successful production of such an important product. To a very great extent, we are forced to rely on the operation of our competitive economic system to establish generally, the levels of executive compensation in the aircraft industry."

Gun Camera Adjusts Like Human Eye

Shutter bugs will envy a new motion picture gun camera developed by the aircraft industry for fighter pilots.

The camera is capable of automatically adjusting itself to varying light conditions much like the human eye to control the amount of light reaching the film. Correct film exposure is insured.

The new camera automatically compensates for light changes during combat through the use of a neon light which shines at a constant intensity on the camera shutter which is coated with selenium. The reaction of the light on the selenium sets up an electrical impulse. At the same time, sunlight enters the camera lens and shines on the selenium-coated shutter producing a second electrical impulse. A miniature computer inside the camera picks up the two impulses and compares them 64 times per second. If the impulse set up by the sunlight varies from the neon-produced impulse, the computer adjusts the lens opening until the two impulses match. When the two impulses match, the correct amount of sunlight is entering through the lens.

Adjustments can be made through the seven lens openings — f 2.8, 4, 5.6, 8, 11, 16 and 22 — to an accuracy of within one-half stop in just 1.8 seconds.

Research and development programs of the aircraft industry are constantly producing better, more effective equipment that relieve the pilot from numerous mechanical functions.

Gun cameras are standard equipment on fighter aircraft. They are used to record the effects of gunfire and the maneuvers of enemy aircraft in combat. They start with the firing of the guns and are generally located in the wing or on the gunsight.

Everything Goes Up —Except The Fares

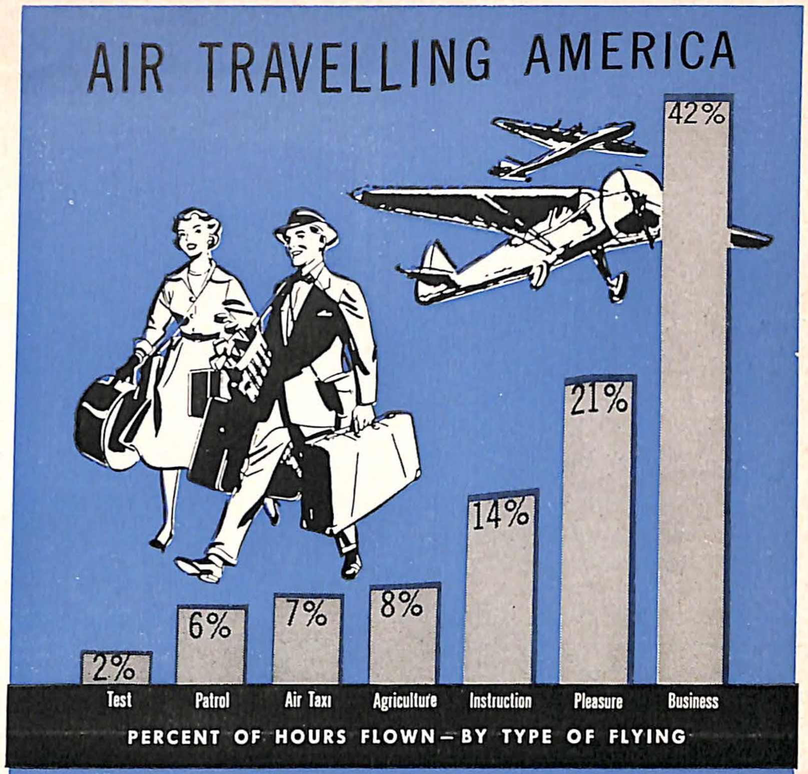
Commercial air travel, which soared to new highs during 1955, dropped in one important aspect — ticket costs to passengers.

The level of average air fare in 1955 remained just about where it stood in 1938, but in terms of 1938 dollars the average air fare was slashed by about 60 per cent.

The traveling public's ability to spot a bargain is indicated by the phenomenal gain of almost 10,000 per cent in revenue passenger miles since 1933.

During 1955, the nation's scheduled domestic airlines passed the billion dollar mark in total operating revenues, and the airline industry offered four times as many available ton miles last year as in 1946.

The aircraft industry has provided the airlines with a series of new transport models that carry more passengers at greater speeds over longer distances. Jet airliners are scheduled for delivery in 1958.



Owners of 61,300 general aviation aircraft in the United States flew a combined total of 8,963,000 hours during 1954.* In the same year, the combined fleets of the nation's scheduled airlines flew 3,222,332 revenue hours. Thus, the general aviation fleet was about 44 times larger than the airline fleet and flew three times as many hours.

**Latest year for which complete statistics are available*

—PLANES

Pilot Survival At Supersonic Speeds Is Challenging Task Before Industry

Man's survival at supersonic speeds and stratospheric altitudes is one of the most challenging tasks facing the aircraft industry.

Certain conditions are necessary for man's comfort. Without clothing or housing, he is adapted to a temperature of about 85 degrees Fahrenheit. He is most comfortable at about 68 degrees when clothed and working. The air he breathes is composed of approximately 78 per cent nitrogen and 21 per cent oxygen. He is accustomed to 14.7 pounds per square inch of air pressure at sea level. When these basic conditions are removed or altered, man loses his sense of well-being and confidence.

High aircraft speeds produce tremendous heat. Just below the speed of sound, the temperature inside the cockpit reaches 150 degrees when the outside temperature is zero. At Mach 2 (twice the speed of sound) the temperature rises to 280 degrees. Lack of oxygen at high altitudes causes loss of coordination, unconsciousness and death.

The aircraft industry, which spends a high proportion of its earnings on research and development, is constantly engaged in projects to produce superior airpower. And progress in one area of aeronautics produces additional problems in another.

The problem is complicated because there is no means of obtaining cool air for air conditioning because of the high temperature air around the aircraft. The solution for cooling today's aircraft is the jet engine—the machine which makes high speed possible in the first place.

High-pressure, high temperature air is taken from the engine compressor for the power to provide cooling to combat high-speed heat. The device is the air cycle refrigeration system. It takes high pressure air from the engine at a temperature much higher than the air around the aircraft. The air around the aircraft, therefore, is used as the "heat sink" to which heat can be conducted. A heat exchanger, similar to an auto radiator, transfers the heat from the engine air to the air around the aircraft. The cooler high pressure air is then expanded through a turbine where the temperature is further reduced by giving up energy in the form of work. This work is used by the turbine to drive a fan that pulls air through the heat exchanger. The cold air from the turbine is then used to cool the aircraft cabin and the occupants.

The problem of low air pressure is solved by cabin pressurization.

But today's cooling systems will not be able to cope with the rapidly rising speeds and altitudes of tomorrow.

One possiblity of providing cooling in the future is the use of liquid oxygen—"lox." It is proposed to spray lox directly into the cabin to provide, not only cooling, but a breathable atmosphere and pressure level.

Research Spending Gains Rapidly

(*Continued from Page* 1)

means in laboratories or through flight testing, and the cost of developing aircraft will vary geometrically with the time required to obtain the solutions. Even the analytical method requires expensive items, such as electronic computers — and their ability to provide a complete solution is limited. Wind tunnels are used to obtain further results, and the problems that are not solved through analytical and laboratory methods must be worked out in development flight testing.

A development program cannot be delayed until complete data is available. Decisions must be based on the best data available, and each key decision affects other decisions as the program moves along. If early decisions are wrong, this means that expensive changes must be made later in the program. This procedure wastes money, material and valuable engineering man-hours.

Many of the expensive, time-consuming changes would not be necessary if proper facilities were available to the aircraft industry. There is a shortage of wind tunnels capable of tests in the supersonic ranges. For example, the testing of one high speed model was delayed 4½ months after the model was ready, because of the lack of a wind tunnel. Although the tests could not be completed, they revealed that changes had to be made in the wing and the vertical fin. If these changes had been discovered sooner, the substantial loss of engineering manhours and the delay in the program could have been avoided. A similar problem developed on the stabilator, not because the wind tunnel testing was delayed, but because a transonic tunnel was not available during the development period, and the trouble was not discovered until the aircraft was built and flown at Mach .95, or 95 per cent of the speed of sound.

A 10-month delay in wind tunnel availability made it necessary to start the redesign of a section of the fuselage without complete data at supersonic speeds, and similar delays in tunnel programs needed to solve other problems slowed development of the aircraft. The planes involved would have been brought to combat-readiness many months sooner, and the development cost reduced, if adequate laboratory facilities had been available.

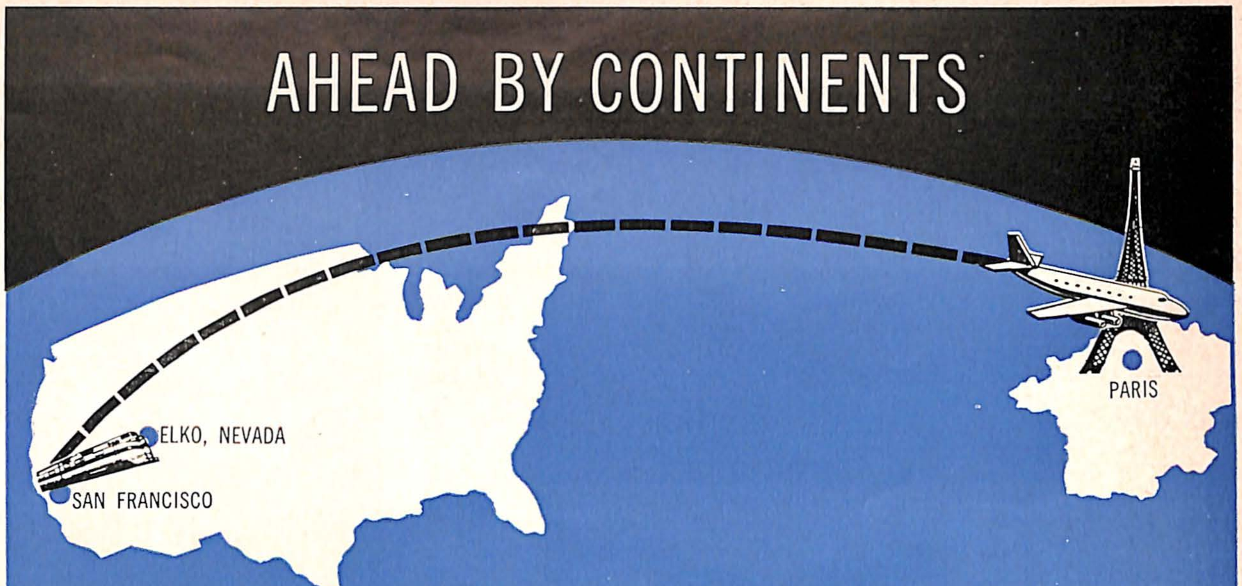
This particular research tool, the wind tunnel, is able to pinpoint on the ground weaknesses that previously were obtainable only through expensive and hazardous flight testing.

Another example of saving money and lives through research facilities is the use of a flight simulator for new aircraft, which enables engineers to "fly" the plane under development. The simulator duplicates the full scale control system of the aircraft. At an early stage in the development program, the simulator detected a control deficiency in the supersonic plane under development. Correction of this problem prevented the probable loss of an expensive aircraft and possibly the life of the pilot.

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 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 airpower in being, and the resulting relative stabilization of the procurement rate, has enabled the aircraft industry to program substantial expenditures for facilities. One major airframe company has programmed a plant and equipment expenditure during 1956-1958 of $73,500,000.

It is conservatively estimated that the aircraft industry in the past five years has reinvested more than $1 billion of their sales dollar into brick and mortar for research and development projects.



America's turbojet commercial transports, which have been ordered by the world's leading airlines, offer this contrast to travellers: A passenger boarding a jet transport at San Francisco, California, will be arriving in Paris, France, while another traveller, leaving San Francisco by train at the same time, is nearing Elko, Nevada. The aircraft industry continues to meet the challenge for aircraft that will provide speedy, safe and economical transportation to the travelling public.

PLANES

Suppressor Test Program Reveals Jet Sound May Be Less Than Piston Level

(*Continued from Page* 1)

encouraging, as this meant that at greater distance the over-all noise should be further reduced. High-frequency noise is weakened more rapidly than low-frequency noise, both by distance and interference of building walls.

To give an illustration, a deep-voiced, low-frequency fog horn may be heard much farther than a shrill high-frequency whistle, though both may measure the same in over-all decibels at the source.

As to weight penalties which might be expected from these weird shapes — the full-scale test nozzles weighed about 100 pounds more than the standard nozzles. These were so-called "boiler plate" test articles, not suitable for flight.

On the positive side of the weight problem are: 1. Structural benefits which are experienced on the underside of the wing in the region of jet exhaust. 2. Probable reduction of amount of sound-proofing material for the aft end of the passenger cabin.

Although still not complete, the test program has even now reduced the noise by an amount which could result in jet aircraft considerably quieter than present piston-engine transports.

This is just one approach to the problem of sound abatement being made by one aircraft company. The entire industry is hard at work on a solution—and one will be found. The experts are far enough along toward a solution to assure that when giant jet transports join the nation's airlines, their engines will be equipped with practical and efficient noise suppressors.

'The Ultimate Decision'

"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*

Riveting Today Needs Fine Tolerences

Probably no other job in airplane manufacture has come to typify the aircraft worker more than the riveter. But most people don't really know the finer points of the job.

Riveting is not only of first importance in aircraft building, it is also a constantly changing job. Today's job is as different from that of 10 years ago as rockbreaking is from watchmaking.

For one thing, tolerances are much finer — as little as .0015 of an inch. Fifteen ten-thousands is to an inch what eight feet are to a mile, what one parking space is to 45 city blocks. This is exacting work considering the fact that more than 900,000 rivets are needed in the manufacture of a single U. S. jet bomber.

Today's sleekly lethal jets are crammed with all manner of combat equipment to aid the crewmen in their mission. And, to crowd extra miles in range into these giants, the aircraft designer placed the fuel tanks within the wings. Then, to save weight, the designers decided to use the wings themselves as fuel storage tanks. As a result, riveting engineers had a design problem all their own — how to rivet metal wing skins which would be fuel-tight.

But scientific ingenuity figured a way. So in riveting today, the innovation that commands the most attention is the method of making air-tight rivet joints. A rounded head rivet is inserted into a counter sunk hole from the inside and the blunt end is pounded until the countersink is filled. Fit in this area is so critical that special precautions must be taken during the process to keep the metal absolutely clean. Even the riveting guns are allowed only two drops of lubricant since grease on a rivet would break its sealing quality.