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# planes

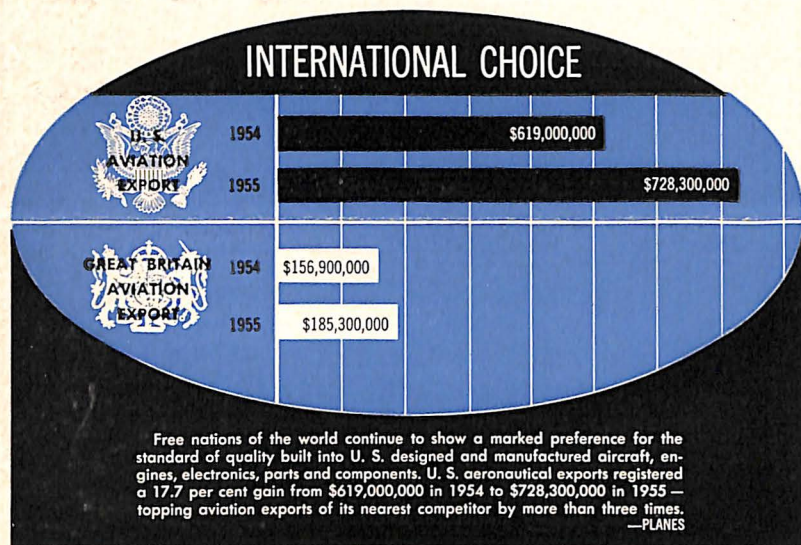
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## INDUSTRY ACCELERATES MISSILE PROGRAM

### USAF Will Spend 20 Per Cent of Funds For Missiles In Current Fiscal Year

By  
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### Conquest of Space Is Speeded By Down-to-Earth Wind Tunnel Which Duplicates High Altitudes

Man's conquest of the formidable frontier called space is now being advanced by a new, unspectacular-looking wind tunnel, 20 feet long and 3 feet high — which is bringing the high altitudes down to earth.

Developed by the U. S. aircraft industry in order to explore the upper reaches of the atmosphere and the threshold of space, the low-pressure aluminum-nozzle wind tunnel is operated by steam jet pumps which suck the air through the tunnel in much the same way a perfume atomizer or paint sprayer works—except the wind tunnel pumps propel the steam at 10 times the speed of sound.

Air, which is drawn into the wind tunnel through an aluminum nozzle, attains speeds up to Mach 6 (six times the speed of sound). The size of the carefully-machined nozzle determines the speed of the air.

Midway down the wind tunnel are two portholes through which the object in the tunnel can be seen and photographed. The air itself is at low pressure, duplicating the conditions which would be found at altitudes from 40 to 100 miles up. Researchers can excite the air electrically, introduce nitric oxide to produce a glowing gas which makes the flow pattern visible.

Experiments have already revealed some of the oddities of high-altitude flight. For one thing, the rarified air doesn't hit a shape in the tunnel with a solid force; instead the individual molecules of air spatter on small objects like rain.

Another strange effect is that a body traveling at an extremely high altitude gets hotter than it does at the same speed in a lower altitude—other conditions being equal. This is due to the fact that even though friction is greater at low altitude, friction heat cannot be conducted away as easily in high altitudes as in low ones.

Researchers have also learned that if the air is not pre-heated, then it will liquefy at speeds beyond Mach 6, and take on a fog-like appearance. Helium—which doesn't—will be used with a contemplated Mach 8 nozzle.

### Airborne Radar Beacon Finds Tanker Planes

A new high powered airborne radar beacon using a coded signal now insures that fuel-hungry Air Force planes will locate tanker aircraft for mid-air refueling.

Developed jointly by the U. S. aircraft industry and the USAF, the radar device enables long-range military aircraft to locate each other and pinpoint the exact position in space of tanker planes, regardless of darkness or weather.

This assured mid-air refueling can triple the effective reach of USAF's long-range aircraft, as well as extend the operational range of many other airborne missions.

The three military services and other agencies of the United States government, together with the aircraft industry, are exploiting every possible effort in speeding up research and expanding development of missile weapons.

Evidence of the great progress made in the development of this newest member in the military arsenal, as well as its impact on the U. S. military budget, can best be seen by an examination of the money one military service has spent in buying missiles. In 1951, the U. S. Air Force spent less than one per cent of its aircraft procurement money for missiles. In 1952, expenditures climbed to four per cent. By fiscal 1956, Air Force missile spending had climbed to 12 per cent of its aircraft procurement. During the current fiscal year 1957, Air Force estimates it will expend 20.3 per cent of its aircraft procurement dollars on missiles and by fiscal 1959 expenditures will climb to 35 per cent of the total.

Total Defense Department spending in the missile field during this current fiscal year is expected to reach \$1,276,000,000 — more than twice the amount spent by both the Air Force (then Army Air Corps) and the U. S. Navy for military aircraft and related equipment in 1941. Research and development in the intricacies of missile weaponry, from an almost negligible consideration during late World War II years, has climbed at an amazing rate. Today, research and development activities in this field are already in the same order as R&D spending for aircraft; and guided missiles, operationally speaking, are still in their infancy.

The transition in the development of aerial weapons and their completely automatic operations are definitely under way to pilotless aircraft, foreshadowing lethally precise, surface-to-surface guided missiles. But it will be a great many years, if ever, before the transition is completed and piloted combat aircraft are outmoded in military operations.

Nevertheless, as the threat of war changes, so must our defenses. Today, in many cases the only counter in combat is the guided missile. This is becoming increasingly true in combat air operations. As manned fighters fly far beyond the speed of sound, bullets fired from guns are ineffective. Indeed, there are aircraft already flying faster than bullets. But, the guided missile, while it is occupying an increasingly important place in military affairs, so far, cannot do the job alone. It is only a part of a balanced military arsenal.

While the history of rockets is long — dating back to the 13th century—the fearful portent of the rocket missile was not fully realized until World War II. In 1944, the Germans launched more than 3,000 V-2 rockets—the first long range ballistic missile — mostly against Great Britain. Although only 1,050 reached and exploded on English soil, they were far too fast for interception by Allied fighter planes and too small a target for radars of the era. The only defense was for the Allies to destroy the launching sites. History records the V-2 as one of the greatest technological developments of the war and that it very nearly became the decisive weapon that Hitler planned it to be.

Today's guided missiles are propelled by ramjet and turbojet engines or by rockets — or a combination of these devices. Each of these engines has one thing in common — the jet thrust concept. Equating from Sir Isaac Newton's third law of motion — "for every action, there is an equal and opposite reaction" — the jet-type engine utilizes a function discarded by men in their development of other engine devices. For most operations the *action* of an engine is required for operational activity. In the case of jet propulsion, the *reaction* is required.

Guided missiles, as we know them today, use liquid or solid propellants. The turbojet or ramjet powered engines burn their liquid fuels by using oxygen from the atmosphere. (See *PILOTED*, Page 3)

# PLANES

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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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## Key To Air Power

Soviet air weapons — backed by a massive scientific and industrial effort — are such as to give this nation and the free world cause for serious thought about the future.

The factors supporting this judgment include their emphasis on a thorough technical training of a large number of carefully selected personnel; the widening variety of advanced aircraft under development and in production; and the rapid rate of progress the Soviets have shown during the last few years along all fronts in aeronautical research and development.

The Zhukovskii Air Engineering Academy in Moscow, founded in 1918, is perhaps most illuminating of the emphasis placed by the Russians upon research and development. The student body is drawn directly from the officer ranks of the Soviet Air Force; and in standpoint of physical size and the breadth and depth of its curriculum *this Academy is unique among the world's professional military institutions*. The course lasts five years; the student enrollment is 2,500. The age-range for entrance is 24-32 years and candidates are required to have at least five years of prior service with the Air Force and the rank of First Lieutenant to Major.

Several things about this engineering academy are impressive. Besides the obviously good quality of their instructors is the equipment available for training. It is very good; there is a lot of it, and it is varied. Recently, visiting technical experts were surprised that the Soviet Air Force possessed the resources to put so much specialized equipment at the disposal of a training institution. They have an unusually fine collection of laboratory cameras for very high speed photography, and their metallurgy department compares favorably with the highest United States standards.

This Russian air engineering academy where the USSR trains its most promising talent in the air sciences and engineering, is but one of an extensive network of institutions, both within and outside the Soviet Air Force.

This academy, and other schools like it in Russia, provides the answer as to *how* the Communists have managed to make great strides in the improvement of their position in atomics, aeronautics and electronics. Through modernization of their entire educational system and emphasis on the physical sciences and industrial technology, they have geometrically increased their technical and scientific potential. As a result they are graduating engineers and scientists at more than twice the rate of this country.

Fortunately, our government has recognized this situation and action is being taken. President Eisenhower's recently established National Committee for the Development of Scientists and Engineers is even now searching for positive solutions to the problem. The establishment of the United States Air Force Academy is evidence by our government and nation of the increased specialization which is required to maintain U. S. superiority in the air sciences and engineering.

However, as currently regards the relative quality of aeronautical products in the United States versus those of the USSR, this nation can be reassured that our private, highly competitive, aircraft industry still leads in the race for, and development of, superior air weapons. But the United States must protect this qualitative lead by a continuing heavy investment in research and development.

Present spending on research and development, according to Air Force Chief of Staff, General Nathan Twining, is not only fully justified but increases are warranted both directly to the aircraft industry and to the nation's schools and universities. It is upon the latter and their student productivity that our civil air economy, our military air forces and our aircraft industry must depend heavily in the years to come to continue the development and production of superior air power.



## Runway Comes to Plane In Ice Landing Test

You've heard about the mountain coming to Mohammed. Now the versatile aircraft industry is bringing the runway to the plane in a series of experiments designed to insure the safety of our aircraft in icy Arctic climates.

The tests are being conducted in order to determine what material will best protect the underbelly fuselage of a cargo and troop carrier plane from ice mounds so common in the Arctic, as it operates off and onto short, unprepared fields.

An icy rough landing field is simulated by a 40-pound block of ice suspended from a steel brace on a speeding automobile. The automobile driven at 100 feet per second (to duplicate the landing speed of the plane) scrapes the ice against the underbelly fuselage of the plane.

The fuselage section is secured in a frame to maintain the exact angle it would have in a landing aircraft.

Before each test "landing," the fuselage sections are overlaid with such materials as fibreglass, teflon, and vinyl foam plastic. These materials are being tested singly and in combination to determine the best protective ice armor within the confines of limited weight restrictions.

## Air Quote

*"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.

# Piloted Combat Aircraft Not Outmoded by Progress of Latest Weapons

(Continued from page 1)

phers and are limited therefore to flights within the atmosphere up to approximately a 20-mile altitude. The rocket engine can use either liquid or solid fuel. Unique characteristic of the rocket engine is that it carries its own oxygen and therefore is independent of outside atmosphere for its operation.

By the end of World War II, the U. S. aircraft industry had applied electronic guidance to a series of simple airframes and had produced the *Loon*, the *Bat*, the *Pelican* and a series of glide bombs. After World War II, virtually the entire aircraft industry became involved in guided missile projects for one or more of the three military services.

Indicative of the long lead time required in the research, development and ultimate production of guided missiles is that several of the missile projects begun shortly after World War II have only recently come into operational use. Among them are the Navy *Regulus* and *Sparrow*; the Air Force *Matador* already deployed in Europe; and the Army *Nike* and *Corporal*, the latter also deployed in Europe.

This nation now has but nine guided missiles in operational status with Air Force, Army and Navy units, but many more are in final stages of development and their production tooling in our great aircraft, aircraft engine, electronic and components manufacture plants is well under way.

The military categorize combat missiles according to their combat mission. *Surface-to-air* missiles are designed to destroy enemy aircraft in flight. The Army *Nike* and Navy *Terrier* are currently operational for this task. Air Force also has *surface-to-air* missiles under development designed to supplement its fighter interceptors.

In the *air-to-air* category, because they are designed to comprise the armament of piloted fighters and bombers, missiles are smaller. But their mission, as with the *surface-to-air* missile, is anti-aircraft. In this area, Navy has a *Sparrow* family under development, one of which is already operational. Air Force has a *Falcon* series for the same *air-to-air* mission.

A third category of guided missiles is the *air-to-surface* group. These are weapons under development by both Air Force and Navy to carry lethal warheads to an enemy target making it unnecessary for the manned bomber to come under attack of heavily armed local defenses of the enemy.

A fourth category, *surface-to-surface*, is divided into two types—the “ballistic” which is rocket powered and possesses very high velocities, and the “cruise” which may use turbojet and ramjet engines. The ballistics family includes such missiles as the Army *Corporal* and the 5,000-mile *Atlas* and *Titan* missiles under development for the Air Force. The cruise type missiles include Navy's *Regulus* and Air Force's *Matador* and *Snark* and

others. Listed elsewhere on this page, by category, are the names of both operational missiles and those still in various stages of research and development, together with their sponsoring service, and which have been officially released by the Defense Department. All but two of these weapons have been designed and developed by the aircraft industry.

The aircraft industry has spent a great deal of money in private research of all aspects of the guided missile. The industry, working in close liaison with military and other government research agencies, has 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 flight; it has improved as well as developed new techniques of airframe construction to withstand the great stress and strains of ultrasonic speed capabilities of these new weapons.

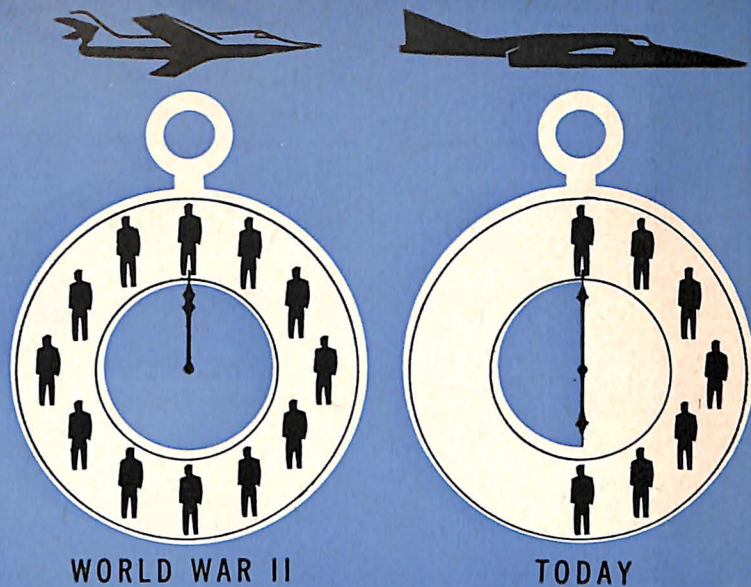
Armed with our rapidly accumulating knowledge, the government has recently initiated *Project Vanguard*, which charges the aircraft industry with developing a rocket capable of establishing an artificial orbiting satellite in outer space. It is currently planned to propel the tiny artificial moon to an orbital position by a three-stage rocket. Its orbit, according to the Defense Department, will be such that it will describe an ellipse varying from 200 to 1,000 miles from the earth. It will travel at an incredible speed of between 17,000 and 18,000 miles per hour, completely circling the earth in about 90 minutes. It is hoped to launch this mighty vehicle during the 1957-58 geophysical year.

With *Project Vanguard* “in the works” it is only natural that our research specialists and engineers are looking even farther ahead. Many are already talking and planning how to hurtle the next aeronautical frontier—establishment of a manned space station.

The aircraft industry's ability to build an object that flies through the air is not the main criterion on which its ability to build missiles is based. An equally important factor is its ability in managing systems. An airplane is a system. The aircraft manufacturer is given a basic job and starts to work. He often does not produce the aluminum, manufacture the engine, make the landing gear, communications equipment or hundreds of other components that make up an airplane. Yet he manufactures the airplane. This is not merely an assembly job. The skill involved is in his ability to make all these intricate elements work together to accomplish a specific task. This is the unique qualification in missile production.

As of now the guided missile program of this nation is directed and oriented in such a manner as to assure American leadership in this aspect of national defense. But the day is approaching when we can

## MODERN METHODS SAVE MAN HOURS



An analysis of production costs of two types of fighter planes—a World War II version and its sleek, modern jet counterpart—reveals that direct production manhours per airframe pound for today's plane is only one-half the manhours needed for production in World War II. This time and cost reduction is typical among the highly competitive U. S. aircraft manufacturing companies and is due to continual improvement in tools, methods, and production techniques. This is the nation's assurance of more air power per defense dollar.

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take these tools for defense and apply them to the peaceful causes of commerce. The guided rocket can do much to enhance the nation's—indeed the world's—standard of living through the rapid delivery of cargo, passengers and mail, transcontinentally and internationally to even the most remote regions of the world.

U. S. Operational Missiles	
Missile	Service
<i>Air-to-Air</i>	
Falcon	USAF
Sparrow	Navy
<i>Air-to-Surface</i>	
Petrel	Navy
<i>Surface-to-Air</i>	
Nike	Army
Terrier	Navy
<i>Surface-to-Surface</i> (air breathing)	
Matador	USAF
Regulus	Navy
<i>Surface-to-Surface</i> (ballistic)	
Corporal	Army
Honest John	Army
U. S. Research and Development Missile Projects	
Missile	Service
Atlas	USAF
Bomarc	USAF
Jupiter	USA-USN
Navaho	USAF
Nike B	Army
Rascal	USAF
Redstone	Army
Snark	USAF
Talos	Navy
Thor	USAF
Titan	USAF
U. S. Research Missile Vehicles	
Missile	Service
Aerobee	USN-USAF
Viking	USN

## Automatic Navigator Studies Jet Stream

Aircraft industry ingenuity has recently developed an automatic navigator which will be used by the U. S. Air Force in a new study of the “Jet Stream”—a high speed current of wind that flows from west to east at altitudes ranging from 25,000 to 40,000 feet.

The study is being conducted at Wright-Patterson AFB, Ohio, where the jet stream will be checked, charted and probed by a medium-range jet bomber equipped with the most modern instruments for investigating the atmosphere.

The navigator will be used to chart the speed of the winds in and about the jet stream, and will be of invaluable assistance to the Air Force in its efforts to obtain more data about the elusive river of air—the wind speeds in it, how it changes altitude, course and direction, and determining its future movements.

By attaining these goals, more accurate methods of forecasting the jet stream winds will be developed, and jet aircraft operating at these altitudes will be able to utilize these swift winds to increase their speeds.

By flying the jet stream, jet aircraft can actually extend the range or distance they can fly without refueling.

With the advent of commercial jet transportation, civilian air lines have expressed considerable interest in the project, since they too will be operating at altitudes where the jet stream exists.

## Piston Engines Are Aviation Mainstay

Despite the increasing use of turbojet and turboprop engines, the piston engine remains a mainstay in military, commercial and general aviation operations.

In Fiscal Year 1957, which started this month, the Air Force estimates that reciprocating engines will account for 57 per cent of the total flying hours. In front line bomber and fighter operations, however, the jet engines will account for 75 per cent of the time flown in Fiscal 1957.

Practically all U. S. airline operations are powered by the piston engine which has been consistently improved over the years. The first U. S.-built commercial jet transports are scheduled to start operations late in 1958, but the piston-engine aircraft will continue for several years to dominate the operations of commercial airlines. Airlines still are placing orders for piston transports at a high rate. In general aviation, for example, the jet engine only recently made its appearance, but piston-engine aircraft will be used for most of the private flying in the U. S. for many years to come.

U. S.-built aircraft continue to hold an overwhelming acceptance from the world's airlines. Of the 2,476 aircraft in service on world airlines, 86.6 per cent are built by U. S. manufacturers. This high proportion is solid proof of the competitive success of U. S. aircraft.

Air travel has grown spectacularly as the aircraft industry has provided faster and more luxurious aircraft capable of carrying larger loads over increasingly longer distances. In terms of passenger miles, the U. S. domestic and international scheduled airlines increased from 533,052,000 in 1938 to 24,463,158,000 in 1955, an increase of almost 4,500 per cent. And predictions all forecast even greater activity.

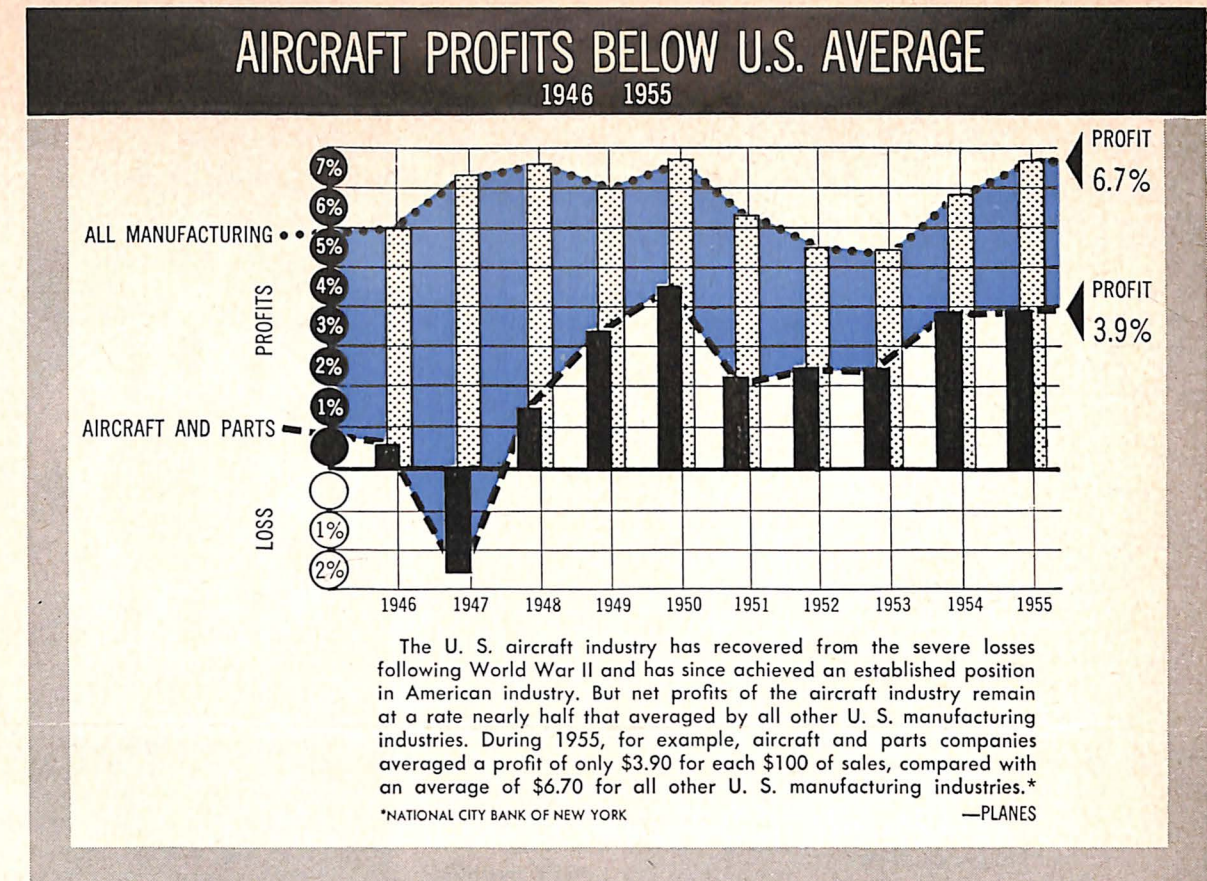
## Pilots May Use Slurry or Exotic If Proper Cermets are Developed

Aircraft technology is moving so rapidly that the English language is proving inadequate for the expression of ideas. As a result, new words are being coined and old ones are getting secondary meanings in the conversations and writings of scientific aircraft personnel.

Because the thermal barrier is proving a challenge to high-speed airplanes, frequently causing conventional metals to melt, industry engineers are seeking lightweight materials which can withstand high temperatures. But even some of these are proving unsatisfactory and ceramic materials are being tested too.

Some researchers are convinced that the best solution to the problem lies in a combination of ceramics and metals. Thus the word "cermets" is rapidly becoming accepted as the expression for ceramic-metal materials.

Similarly, experts working with



## Television Becoming 'Star Performer' in Building U. S. Air Superiority

Television is becoming increasingly important to the nation's aircraft industry in the manufacture of fighters and bombers as well as luxurious commercial transport planes.

One aircraft manufacturer uses a television camera installed inside an airplane wing so that engineers can see what is happening to the wing's structure while the wing is subjected to various stretches and bending. This means that the engineer can

get a close-up "on the spot" look at the structure without danger of injury in case of structure failure.

Another aircraft company is using a closed circuit television system specifically designed to help the company cut costs as well as to speed production of supersonic fighter-bombers for the USAF. This device basically is an improvement on an "optical tooling" system widely used by the aircraft industry in the making of aircraft production tools. This is an electronic "line of sight" technique which guides the workers as they make many identical copies of aircraft parts or sub-assemblies.

Still another company is using a television camera, reported to be the world's smallest, for aerial televising of planes undergoing flight test. For example, the camera, which is only 5 inches long and 2 inches wide, can be installed inside a landing gear housing and relay a continuous picture of action of a plane's landing gear during runway operations, as well as lowering and raising of the gear.

With these remotely controlled eyes, research and flight engineers are able to view operations which would be impossible to see without it. The camera can see into humanly inaccessible areas and give close-up views of tests which a man could not safely watch.

These uses of television are but one example of methods the aircraft industry is employing to maintain the built-in quality of American air power.

## 'Three-in-One' Plane New Bomber Bargain

One of the most expensive problems in U.S. military aviation until recently has been the modification of combat aircraft to meet certain specialized requirements — bombing, photo-reconnaissance, electronic mission, and others. Often the Air Force, for example, has had to purchase a separate airplane type to meet the specialized need.

Engineers of one large aircraft company have developed capsule-like devices for bombers which can be installed in the bomb bay, transforming in a matter of minutes, the capability of the plane to meet any of three vital military air missions.

The capsules, which can be inserted into the bomb bay almost as easily as a neon light is snapped into a fixture, are fully equipped for their special tasks, pressurized and air-conditioned. Manned by two mission experts, the capsules, depending upon whichever type is required, become a functioning part of the aircraft as long as they are installed. The photo-reconnaissance capsule has interior stations for the two-man crew, four camera positions, repair work benches, etc.

Thus, the research and development teams of the aircraft industry have come up with a device which, in effect, gives the Air Force three airplanes for the price of one.

Need for high speed, high altitude photo-reconnaissance and electronic mission planes became particularly evident during World War II. Photo-reconnaissance, for example, is essential both for locating targets and for the follow-up work of assessing bomb damage. Electronic mission aircraft fill a number of strategic military roles.