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# planes

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## STATE POWER PUSHES RED AIR PROGRAM

### THE EYES HAVE IT



A new jet photo-reconnaissance plane developed for Navy can fly non-stop across the United States, photographing a continuous 10-mile-wide strip of terrain in less than four hours. Indicative of the tremendous effort of research, development and production teams of the United States aircraft industry, this remarkable aircraft, based on a production fighter, was developed from wooden mockup to first flight in only eight months and six days.

'PLANES'

### Aircraft Industry Considers Starters of Greater Horsepower than 'Spirit of St. Louis' Engine

The engine that powered Charles E. Lindbergh's *Spirit of St. Louis* on its historic non-stop flight from New York to Paris produced 220 horsepower.

Today, the aircraft industry is considering starters for jet engines capable of producing 250 to 500 horsepower.

The jet engine forced a revolution in the starter design. The electrical starter has been standard equipment for many years for piston engines. Its output of four to five horsepower was equal to the job.

The turbojet engine is another matter. The modern jet turns from 10,000 to 14,000 revolutions per minute and must be operating at about 25 per cent of this speed before it will fire. It must be spun as high as 40 per cent of its operating speed before it will run without starter assistance. Reason is that the jet engine's compressor must be operating at a high speed before it can supply the great quantities of air needed to run the engine.

The challenge of providing efficient, light-weight starters is typical of problems confronted and solved by the aircraft industry in its research and development programs. Engineers turned to the pneumatic

starter to produce the power because of the weight penalties involved in using electrical means. A 30-pound pneumatic starter is capable of doing the job of a 200-pound electrical starter. Heart of the pneumatic system is the small turbine wheel similar to the big turbine on the jet engine. Compressed air from a ground source is directed against the turbine blades with a 1000 mile per hour blast that spins the turbine up to 50,000 revolutions per minute.

Gearing reduces the turbine revolutions to the proper drive speed and a clutch automatically engages to turn the engine. The starter shuts off automatically and the clutch disengages after the engine starts and attains sufficient velocity to keep going.

Self-contained starters, which eliminate the need for ground handling equipment, are producing encouraging results. Two types under development are the fuel-air and propyl-nitrate starter.

The fuel-air starter requires a supply of air at moderate pressure which is burned with fuels from the aircraft's fuel tanks.

Propyl-nitrate, like gasoline, can be ignited when air is added, but unlike gasoline, will continue to burn without air once it is ignited.

### Wartime Priorities Granted Military Production Under Russian System

By Admiral DeWitt C. Ramsey (USN-Ret.)  
President, Aircraft Industries Association

The U. S. public is properly concerned over the progress Russia has made in building its air power. The rapidity with which the Soviets designed and produced long-range turbojet and turboprop bombers, capable of delivering nuclear weapons on U. S. targets, calls for a careful examination of the various factors which have contributed to this accelerated effort on the part of the Russians.

### Industry Speeds Maintenance

Accelerated efforts are being made by the aircraft industry to simplify the problem of field maintenance of the complex aerial weapons and their supporting equipment.

The complexity of modern aircraft and missiles has been due to the demands for higher performance. This, in turn, has increased the problem of maintenance.

One important step has been the establishment of the position of "spare parts engineer." These engineers work for the spare parts department, but have their desks and drawing boards in the engineering department. In some cases the spare parts engineer is a specialist in a specific field such as hydraulics, and is concerned with every project under way in this field. Other aircraft companies assign the spare parts engineer as a project engineer who follows a certain aircraft.

Every drawing relating to the particular field of the spare parts engineer is referred to him for checking. He first checks the engineering drawing for effective maintenance and discusses suggestions to improve the maintenance factors with the design engineer. He also determines spare parts requirements and handles the administration of the spare parts order.

The Spare Parts Committee of the Aircraft Industries Association works closely with the military services and other government agencies on problems involving maintenance support of the industry's products. This includes planning for the timely delivery of special tools, ground handling equipment, training parts and equipment, as well as spare units and spare parts. The committee is composed of 100 representatives from airframe, engine and component manufacturers.

The end of World War II did not mark the termination of Russia's emphasis on air programs. The reverse, in fact, is true. Russian progress was stimulated by the absorption of large numbers of highly skilled scientific personnel from Germany. While this activity was in progress, we were in the process of tearing down our vast defense edifice. The avalanche of aircraft order cancellations, with the attending violent disruptions to the general state of health of the aircraft industry, severely limited its readiness to cope with the emergencies which followed.

Less evident is another factor bearing on Russian air strength which can be phrased as a question:

Why are the Russians reportedly able to compress the time span of conception, design and production of a high performance aircraft?

There is no particular magic in the Russian formula. It is based on the absolute power of the state under a totalitarian system. Russian leaders are not accountable to an electorate for their decisions. They are able to move promptly and decisively when need arises for the funds or manpower needed to support weapon projects. Apparently there is no attempt to maintain a balance between the civil economy requirements and their military programs. Russia simply and quickly tightens another notch in its civil economy if more money is needed for weapons projects.

The advantages of unilateral decisions are obvious. Lengthy administrative procedures are eliminated. Decisions are speedily made and clear directives to proceed, with the full force of the totalitarian state behind them, are issued. This absolute power in the administration of an aerial weapon project without regard for costs and with positive control of manpower is the Russian "secret" of compressing lead time. Such

(See SOVIET, Page 3)

## 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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## Air Power Economy

This year marks "A decade of security through global airpower." 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 this 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, well spent, are negligible.

Yet the U. S. aircraft industry in research and production efforts, and the military in procurement efforts, as a team, ceaselessly strive to make planes, engines, missiles and components ever better, more efficient and less costly per unit.

One of the more easily discernible examples of this teamwork in action to reduce the cost of aeronautical products are the great facilities used by the aircraft industry. In these, to a considerable extent, the government and private industry are in partnership.

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. Figures on government financed expansion during the same period are not available, but undoubtedly they again exceeded industry's contribution.

Thoughtful men of industry and government came out of World War II with a solemn conviction that the great aircraft production facilities built "in the nick of time" and at great cost during that war must be held intact against a future need.

Today the nation and its government know that the aircraft industry must at all times be able to maintain stability if its research, development and production efforts are to continue to produce superior air weapons to maintain the peace.

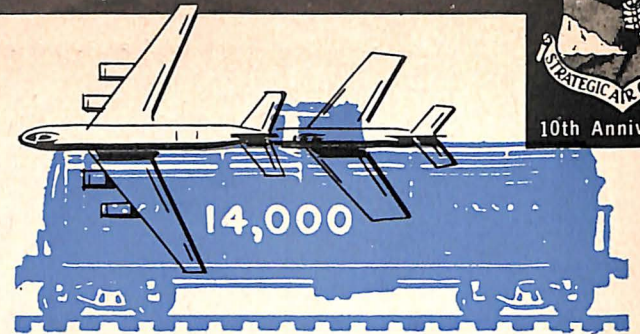
Because of the nature of its product, certain so-called government-owned facilities will always be essential, and as unexpected crises arise, there will never be sufficient private capital to provide all the industrial facilities to maintain an adequate defense establishment.

Furthermore, the most economical and efficient method of financing production is for the customer (whether civil or military) to provide some of the financing needed for the performance of the contract. If such were not the practice, and if the aircraft industry had to be capitalized to handle its infrequent peak production volume, it would be necessary during years 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.

However, every major aircraft company has made very substantial commitments toward capital improvements and research and development facilities. During this past decade of security through air power, the aircraft industry has reinvested upwards of \$1,000,000,000 in these activities. And fourteen companies have indicated that their current planning contemplates expenditures in excess of \$370,000,000 for capital improvements during 1956-1958.

Now the aircraft industry is in a position to make, and is making, a determined effort to provide with its own resources substantial portions of the facilities and equipment needed to sustain the costly weapons of defense for the national security.

## Plane Views



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'

## 1956 Facts & Figures Edition Published

The 1956 edition of *Aviation Facts and Figures*, an official publication of the Aircraft Industries Association, is off the press this month.

*Facts and Figures* is a standard reference work containing the latest available statistical information on the U. S. aircraft industry. The paperbound book contains eleven chapters on the principal segments of the industry, ranging from research and development to production and facilities. The book, for the first time, contains numerous illustrations for each chapter.

*Aviation Facts and Figures* can be ordered from Lincoln Press, Inc., 1143 National Press Building, Washington 4, D. C. Cost is \$1.00.

## 'The Dominant Factor'

"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.

## PLANE FACTS

- Airports with Civil Aeronautics Administration traffic control service have increased from 115 in 1946 to 174 in 1954. The number of commercial and other civil aircraft operations has tripled since 1946 at airports with CAA traffic control facilities. This is an average annual increase of 1,000,000 aircraft operations.

- Cost of developing a supersonic fighter is double the funds required for a jet fighter used in the Korean War.

- Turbojet engines, averaging 8,800 pounds of thrust, accounted for 77 per cent of all engines delivered to the Air Force in 1955, compared with 67 per cent turbojet types in 1954.

- Passengers carried by a scheduled helicopter service operator increased 300 per cent in 1955 over the previous year.

- Installation of turboprop engines on a transport that uses conventional piston engines increased its power 63 per cent and decreased empty weight by 5,000 pounds.

# Soviet Standards Less Severe

(Continued from page 1)

a procedure, of course, is unthinkable under the precepts of a free democratic society in peacetime.

Under present conditions, the U. S. aircraft industry does not feel the need for material and manpower priorities that are an integral part of the Soviet aircraft manufacturing system. Our military programs are the product of a careful balancing between the needs for defense and what our economy can support over an extended period.

The Russian aircraft industry, even in peacetime, operates on a wartime basis. For the first time in history, the U. S. aircraft industry during peacetime is operating at a high rate and under great pressures, but without any of the priorities which normally accompany such an effort. Aircraft manufacturers compete with every other segment of our industrial structure for materials and personnel. Television sets, automobiles, vacuum cleaners and other consumer products command the same rights for metal and men as defense products in the present free market.

There are numerous regulations governing the U. S. aircraft industry in the conduct of its business. However necessary many of the regulations may be, they inevitably increase lead time. The regulations govern such important functions as the selection of subcontractors and the amount of subcontracting. Detailed technical reports are required on each step of the design, manufacturing and test processes, all of them time-consuming, which dilute the technical effort.

There is no evidence that Russia has been able to shorten the functional aspects of design and manufacturing lead times compared with the U. S. aircraft industry. The U. S. aircraft industry retains the *capability* of outproducing any nation in the world. The production base, which has been broadened and perfected since the outbreak of the Korean War in June 1950 is geared to step up quickly our aircraft output.

There is evidence, too, to indicate that the Soviets, particularly in engine manufacture, concentrate on a limited number of types, and their standards and requirements are less severe. Their expectations of reliability and durability are of an easier order. Considerable effort is devoted in U. S. design and manufacture to pilot safety and comfort. Russia stops far short of the U. S. requirement in this field.

The Aircraft Industries Association recently completed a survey of the industry on lead time. The salient finding is that lead time probably will increase as complexity grows. This applies to Russian as well as U. S. efforts. The "make it simple" approach cannot apply to modern aircraft. Performance almost geometrically equals complexity.

The lead time for aircraft is inextricably bound up with the performance requirements which are

## AIR TRANSPORT SAVES TIME

The aircraft industry has revolutionized military logistics through the design and production of great cargo aircraft capable of supporting major military operations by air.

One new U. S. turboprop transport aircraft (1) can carry the load of five railroad freight cars; (2) has the cargo potential of a 7,000-ton ship through its ability to shuttle rapidly back and forth across the oceans; (3) can carry a 50-ton load for distances up to 1,000 miles and 25-ton loads for more than 4,000 miles.



crowding, and in many cases exceeding, the state-of-the-art knowledge. This requires large expenditures of effort in basic research, theoretical analysis and numerous tests to supplement the design effort. Design, in these cases, cannot be guided by known factors and each step must be thoroughly checked.

The controls on a World War II aircraft were simple and direct. The pilot furnished the physical power to operate the controls. At today's high speeds, the pilot could not control his plane without hydraulic and electrical boosters to supply the power to work the controls. This, in turn, eliminated the "feel" from flying and another system that produces an artificial "feel" had to be designed.

Planes operating at high speeds are subject to violent pitching and yawing effects. The pilot cannot correct these motions quickly enough, and a device called a dampener had to be developed and produced to handle the task.

These are only minor examples of the complexity that has come about because of the requirement for substantially higher speeds and altitudes.

It is obvious, too, that each major increase in performance produces a host of new problems, and even causes revisions in solutions to old problems. An aircraft that is capable of high supersonic speeds must also perform well at subsonic speeds. This multiplies the design and manufacturing problems. The number of wind tunnel hours for a Mach 2 (twice the speed of sound) aircraft is 10 times as much as required for a subsonic aircraft. The preliminary design hours for a fighter aircraft design prepared this year increased three times over the period required for an aircraft proposal completed two years ago.

There have been no publicly announced assessments by qualified authorities on the extent and character of the electronics systems used in

Russian combat aircraft. This essential segment of our air power vis-a-vis the Russians is purely conjecture. Our electronic systems, however, are highly advanced, carefully coordinated instruments which have greatly minimized the possibility of human error in bombing, fire control and navigation.

These electronic systems are understandably difficult to design and develop to a high state of perfection. The average lead time for the electronic system of a fighter-bomber is about three years. The system for a heavy bomber is even longer. It is highly unlikely that the Russians have uncovered any shortcuts in developing these systems. It is more likely that they lag behind the U. S. in this vital element.

U. S. leaders have determined that we will not get into a quantitative arms race with Russia. But we cannot afford to have anything less than superior air power. This means our deterrent air power must be based on a *qualitative* lead.

The quality of U. S. air power is our surest hope of maintaining world peace. There is only one method of keeping qualitative superiority: a continuous, well-supported research and development program. R & D is an assault against the unknown factors of the physical sciences. It can be dramatically productive or disappointingly futile. Many avenues must be painstakingly explored. But the sum of these investigations—the minor and the major breakthroughs are the essence of qualitative air power.

### Housewives Up In Air

The American housewife is putting aside duster and mop and lighting out for foreign shores—by plane.

According to a recent survey made by a U. S. airline of eastbound trans-Atlantic air travel, more and more housewives are up in the air. They constituted the largest single occupation category flying to Europe from the United States.

### Cathode Tube 'Freezes' Radar Picture

A cathode ray device that can make pictures "hold still" is the latest aircraft industry contribution to the wizard-world of electronics. Its immediate application will be in airborne radar, the system which permits pilots to view on a screen meteorological phenomena in the path of flight.

The main advantage of the picture tube that can "stop the action" is in the time it gives the pilot for careful study of what he sees on the screen.

With this tube a pilot need not take his eyes from the controls and peer into a hood to view pictures. He can see them at a glance, night and day, and he gets a continuous picture rather than fleeting blips. He controls the time it takes a picture to fade, holding it brilliant up to two or three minutes, or erasing it at will.

He will have an electronic map of the air around him, showing any storms ahead, or for navigational use he will clearly see mountains and the pattern of terrain.

The device, a five-inch, cathode-ray, half-tone, direct-viewing storage tube, produces half tones and has sufficient brilliance that it can be read in sunlight.

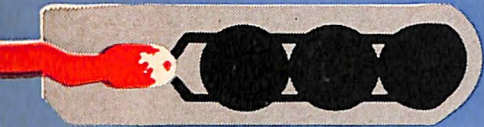
The tube was developed with weather radar in mind, for navigation and for airborne weapons systems, but its potential is broad in other military applications and in medical electronics.

### Heat and Speed

To fly at Mach 2, a plane must be capable of operation in a temperature of about 210 degrees, the temperature of boiling water. At Mach 3 temperature requirements go up to 500 degrees, and at Mach 4 the external surface must withstand a temperature of 1,000 degrees Fahrenheit.

# MISSILES...

## AIR POWER'S NEWEST WEAPON



ROCKET



TURBOJET



RAMJET

### MISSILE POWERPLANTS

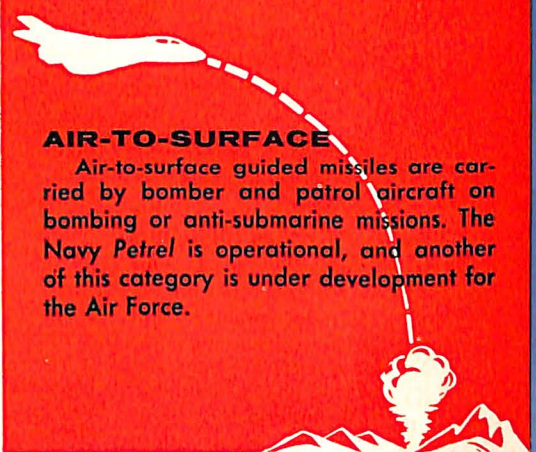
Powerplants vary as missiles and their missions vary. The three most widely used missile engines are rocket, turbojet and ramjet. Turbojet and ramjet power missiles are air breathing engines and do not leave the atmosphere. They are capable of ranges varying from a few hundred miles to intercontinental. Rocket powerplants use either liquid or solid fuels and are used in missiles that can go beyond the earth's atmosphere.

The U. S. aircraft industry today has nearly a score of missiles in various stages of development, and at least nine other missiles are with operational units. The aircraft industry is uniquely qualified to assume the leadership in the design and production of missiles. This is true, not only because the missile is a logical extension of manned aircraft, but also because of the aircraft industry's long experience in managing systems, the process of bringing together diverse talents and complicated components to build a practical aerial weapon. No other industry embraces the scientific and engineering skills necessary for the research and development, the design and production of missiles. These include aerodynamics, thermodynamics, powerplants, fuels, combustion, ceramics, meteorology, ballistics, electronics, nuclear physics, control equipment and many others.



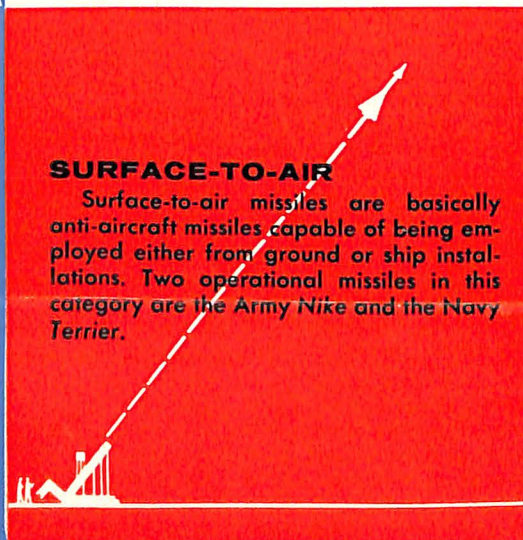
### AIR-TO-AIR

The primary mission of air-to-air missiles is the destruction of enemy aircraft in interception actions by fighter-type planes. The missiles are controlled by the aircraft or by electronic systems within the missile which guide them to invading aircraft. Both the USAF *Falcon* and the Navy *Sparrow* are part of the armament in operational squadrons.



### AIR-TO-SURFACE

Air-to-surface guided missiles are carried by bomber and patrol aircraft on bombing or anti-submarine missions. The Navy *Petrel* is operational, and another of this category is under development for the Air Force.



### SURFACE-TO-AIR

Surface-to-air missiles are basically anti-aircraft missiles capable of being employed either from ground or ship installations. Two operational missiles in this category are the Army *Nike* and the Navy *Terrier*.



### SURFACE-TO-SURFACE

The mission of surface-to-surface missiles is the destruction of enemy ground forces and installations. They can be fired from ground bases, surface ships and submarines. Four missiles are operational today: the USAF *Matador*, Navy *Regulus*, Army *Corporal*, and Army *Honest John*. The Intercontinental Ballistic Missile (ICBM) is a surface-to-surface missile capable of leaving and re-entering the atmosphere and having a range of 5,000 miles or more.

### GUIDANCE SYSTEMS

There are two general guidance methods: electronic and non-electronic. The non-electronic system is completely self-contained, does not emit signals and therefore avoids enemy electronic countermeasures. One basic system is inertial and the guidance information to carry the missile to the target is put into the missile before launching. However, these systems are sometimes monitored by other systems, such as celestial navigators, which take fixes on stars and feed corrective data into the missile's inertial system. The two most common electronic systems are radar types, one self-contained in the missile, and the other controlled by ground, ship or aircraft.



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