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planes

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TECHNICAL GAINS POSE PROBLEMS

Airborne Computer Speeds Solutions

A recently developed airborne digital computer is now solving in one second the same number of problems that would normally require nine man-hours, at the same time meeting the aircraft industry's requirements for compactness, light weight and reliability.

Designed for use aboard American jet fighters and bombers, the new computer materially aids this nation's growing air superiority. Made up of transistors instead of vacuum tubes, and "etched" circuits in place of conventional wiring, this computer has many advantages to assist combat crewmen in navigation as well as specialized combat techniques.

Extremely compact, it occupies only three cubic feet and weighs only 125 pounds, whereas a similar vacuum-tube computer with only one-half the capacity is four times heavier and would fill an average closet. The new computer also requires little power to operate.

Offering great operational reliability under service conditions, this "electronic brain" is specially designed to withstand rigorous environmental conditions experienced in present and future high-performance aircraft.

In mathematical terminology the computer's capacity is indicated by its ability to continuously integrate 93 quantities simultaneously. It can generate continuous solutions of differential and trigonometric problems. It automatically and continuously processes in-flight data.

Sky Tracks

The railroads are joining the ever-growing trend of American business of taking to the air.

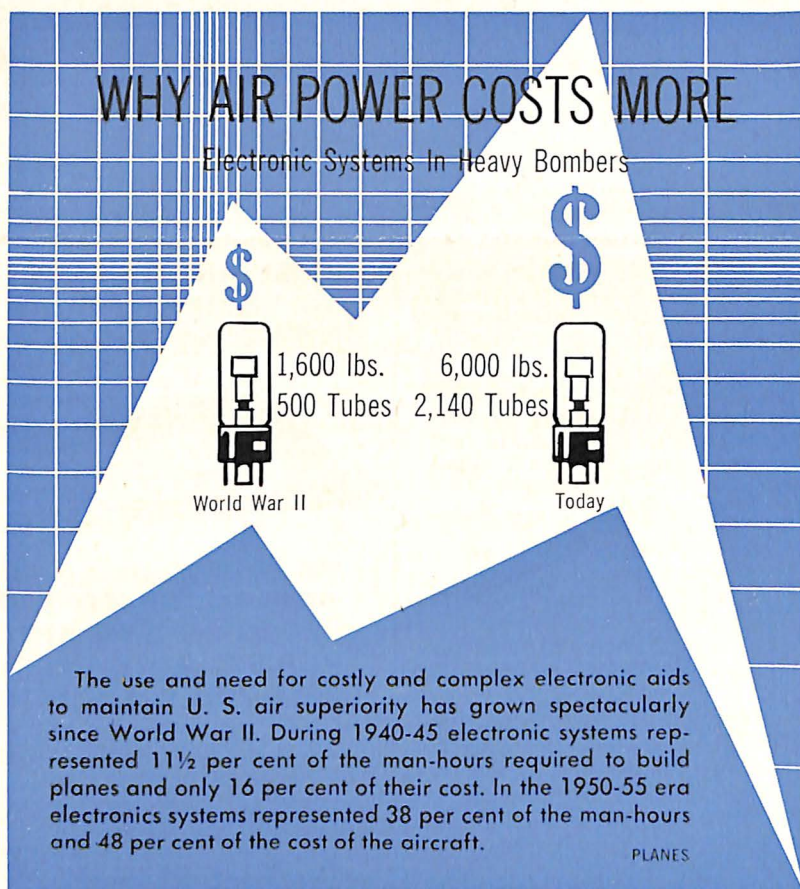
A railroad recently leased a twin-engine transport from an airline for the use of its executive officers on flying business trips.

The "flying office car" will accommodate 15 people and a crew of three. The plane's seating is arranged so that three conferences can be held simultaneously.

Business flying is the most rapidly growing segment of general aviation. In 1954 it accounted for 3,918,000 hours, 44 per cent of the total for general aviation, and has more than tripled since 1946.

WHY AIR POWER COSTS MORE

Electronic Systems In Heavy Bombers



Air Force Offers Recruits Opportunity To Learn One Of 174 Skills

The opportunity to learn one of the 174 different valuable skills offered in the U. S. Air Force technical training program is one of the greatest advantages offered to American youth today.

The new, superior air weapons now being produced by the aircraft industry would be ineffective without skilled men to operate and maintain them. The U. S. Air Force Recruiting Service, which was started July 1, 1954, is charged with the heavy responsibility of supplying the manpower to keep the Air Force at peak efficiency. It is assisted in its efforts through advertising programs of the aircraft industry.

Brigadier General Arno Luehman, commander of the Recruiting Service, says: "The young men of today are alert shoppers in choosing a job. They are practical and cannot be high-pressured. We put the cards on the table when we tell them about the Air Force. The best selling point is the fact that the Air Force will teach valuable skills to its re-

cruits—skills that will advance them in the Air Force or be of great value if at some time they decide to leave the service."

The Air Force has one of the largest "Help Wanted" signs in the world. The requirement for men without prior service is approximately 10,000 each month. The training available to them covers a vast range of skills, and the most modern systems of education are used.

In the jet engine field, an Air Force recruit can study the fundamentals of mechanics at Amarillo Air Force Base, Texas, with emphasis on the maintenance and inspection of the jet fighter engine. The course takes 75 days, based on a 5-day week.

A course for rocket propulsion technicians is given at Chanute Air Force Base, Illinois, where the airman becomes qualified for both aircraft and guided missile units in the maintenance of liquid propellant

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Competition Key To Progress

By DeWitt C. Ramsey
(Adm., USN, Ret.)

President, Aircraft Industries Association

The United States entered World War II with airpower that was almost untried and certainly not seasoned and consisted of a small industry and a few airplanes and pilots—not too greatly changed from World War I.

Just 20 years ago aircraft ranked 135th among American industries in employment and 169th in sales. But during World War II aircraft manufacturing jumped into first place in both employment and sales. It produced during the war more than 300,000 aircraft. In one year, 1944, it produced 96,000 aircraft—more aircraft than had been built by all of the nations of the world prior to World War II.

All during that late global war the popular conception of airpower was that the aircraft and crew, even though they worked sometimes in great numbers, were more or less independent agents. While they had communications of sorts, their battles were carried out at speeds far less than those of today, from distances far less than are conceived today, and with destructive power immeasurably less than today.

But during World War II, Germany, Britain and the United States were feverishly working on newer techniques. Germany was working to develop rockets and guided missiles; Great Britain was developing turbine power, jet propulsion, and postwar commercial potential; and the United States was working on the secret of the atom and on automatic flight control.

With the atomic flash over Hiroshima in 1945, the war ended. But the combination of all of these new elements—the atom, jet propulsion, guided missiles and automatic flight—moved all the thinking and planning of the military and the aircraft industry into a new dimension. Aeronautical science and the military had virtually annihilated time as a factor of delivery and space as a factor of distance.

With these tremendous advances made in the aeronautical sciences, however, came the problem of lead time for manufacture and increasing complexity and costliness of the air

(See FUTURE, 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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Science and Survival

A great airman, General Carl A. Spaatz, once said, "In today's world of air power the doctrine of massive retaliation cannot preserve the peace until and unless the free nations dominate the air as the British Empire once dominated the seas."

Unfortunately, the truth today is that the air is not dominated by American planes. The principal problem of the United States military air forces today is to stay ahead of the Soviet air force. This task becomes increasingly difficult because the Soviets have, in the years since World War II, made astonishing advances in aeronautical technology.

Not long ago General Nathan F. Twining, U. S. Air Force Chief of Staff, called Soviet air power "by far the biggest air force in the world. In numbers of combat planes it far exceeds the United States Air Force. In fact, the Reds have thousands more combat planes than the USAF, Navy, Marines and Army combined."

Quantitatively, then, we scarcely seem ready for the policy of overwhelming retaliation.

But what of qualitative superiority?

In 1945 the United States exploded its first atomic bomb. Four years later, in 1949, Russia detonated its first atomic bomb. In 1952 this nation announced successful development of the hydrogen bomb. This announcement was followed less than a year later by the blast of the Russian hydrogen bomb.

We also know that the Soviets in recent years have put substantial effort into the building of a *qualitatively* modern Air Force. Recent disclosures made by the Department of Defense indicate that turbine-powered aircraft—fighters, transports and bombers—have been observed in substantial numbers in flights near Moscow. Our engineers can only speculate as to the flight characteristics and performance capabilities of these aircraft; they all agree, however, that they are aircraft of *advanced* design.

We have little positive knowledge about Soviet capabilities in research and development and of their air weapons production schedules. However, based on the evidence given to us by our military leaders, so far we are still ahead in the technological race, but the gap is closing rapidly.

The United States is the one nation today which stands between the Soviet and the free world. True, we have allies, but the fact remains that the United States is the principal deterrent to Soviet ambitions of world domination.

In the few short years since World War II the Soviets, in their relentless march toward world domination, have extended their control from 200 million to over 800 million people.

Clearly this nation is faced by strategy and tactics of a high and ruthless order. It is basic then that if this nation is to have the strength to support a military policy of *qualitative* superiority, we must hold and increase our technological superiority. Only in this way can we compensate for Russia's quantitative lead in manpower, aircraft and weaponry.

It therefore follows that a strong national defense is of paramount importance, and it further follows that air power is the keystone of this defense. This being true, the United States aircraft industry must be in a position to meet the grave responsibilities assigned to it:

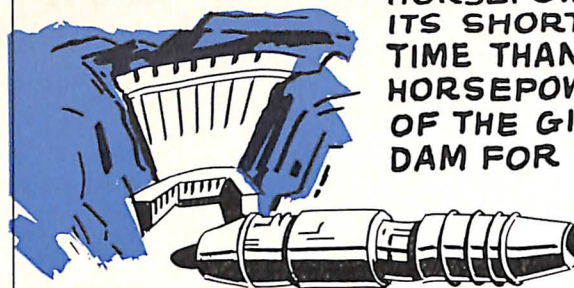
- (1) To develop and produce qualitatively superior aerial weapons.
- (2) To provide maximum air power at minimum cost.
- (3) To maintain flexibility and the readiness to meet any emergency.
- (4) To play a constructive role in the national economy.

The aircraft industry—airframe, engine, component and accessory manufacturers—however, has little to say in the matter of quantitative air superiority. This is controlled by the requirements of the military services and the allocation of dollars by our lawmakers in Washington.

The industry is dedicated to the development of superior aircraft and air weapons. It has on numerous occasions, when government funds were limited, financed its research in furtherance of military air projects in the interests of national security. The incredible progress of modern technology, both here and abroad, is such, however, that research and development in aeronautical and scientific fields must have top priority in planning by the military and in budgetary support by the Congress.

Plane Views

A SINGLE U.S. ROCKET ENGINE, NOW UNDER DEVELOPMENT, PRODUCES MORE JET HORSEPOWER DURING ITS SHORT RUNNING TIME THAN THE TOTAL HORSEPOWER OUTPUT OF THE GIANT HOOVER DAM FOR THE SAME PERIOD.



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'

Guillotine is Used To Test Aircraft

The guillotine is now helping to insure the safety of air travelling Americans.

In order to test the tear-resistance and damage limiting features of a plane's structure, one of this nation's aircraft manufacturers conducted a series of experiments in which a heavy arrow-shaped blade was used to pierce a full-scale pressurized fuselage section.

Engineers found there was no tendency for the cut to grow lengthwise beyond the original damage to the fuselage. The cut increased in width by the formation of a very small metal flap.

Simulating possible in-flight damage, the "guillotine tests" strikingly demonstrate the structural integrity of America's modern aircraft.

Nuclear Capability

One of the most significant developments in airpower is the potential ability of every offensive fighter and bomber aircraft of the theater air forces to deliver nuclear weapons of various sizes on tactical targets.

PLANE FACTS

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

- One of the electronic tubes used in a modern Air Force bomber is a foot and-a-half long and 10 inches in diameter. Another is only one inch long and one-fourth inch in diameter.

- One giant aircraft in production in the United States requires the use of 114 electric motors (exclusive of the automatic pilot), and its anti-icing wing and stabilizer equipment use 2,800,000 BTU's of heat per hour—enough to heat 56 five-room houses.

- More than 295,680 feet (56 miles) of electric wiring are required to connect the various electrical systems used in a current heavy jet bomber.

- A new turboprop cargo aircraft, the largest transport plane now in production, if parked on a football field with its nose on the goal line, would extend to a point just 2 feet short of the 50-yard line, and the wings would reach 10 feet over each sideline.

Future Airpower Progress Expected To Exceed Gains in Past 5 years

(Continued from Page 1)

weapons systems. Today's bomber, for example, is a vastly different weapon from its World War II counterpart. A box on page 3 shows the great increase in size and cost.

Research and development activities in connection with World War II's bomber, before a production contract was given, spanned two and one-half years. And today's heavy bomber required nearly eight years of research, development and engineering prior to production orders. It was not until the ninth year from the time the aircraft manufacturer began work on the plane that he began to realize profit from his labors.

There are some who think that since the aircraft industry is doing business primarily with the government, it is a *subsidized* industry and that there is no real interest in low cost, efficient operations. As a matter of fact, the aircraft industry is highly competitive, and the entire industry is vitally concerned with a low cost operation, as well as in quality performance.

Military contracts for aircraft are let as a direct result of competitions, in which any qualified aircraft manufacturer is able to enter, on design, performance and production costs. Competitions of this kind are standard military contractual procedure, whether the product is to be a supersonic fighter or a simple item of clothing to be purchased by the Quartermaster Corps.

It is true that once a competition is decided and an aircraft placed in production by a manufacturer, price competition in the normal sense may not be present. Nevertheless, as with any other industry, the aircraft industry knows that if it expects to obtain any additional business, it must operate efficiently to keep production costs low.

The aircraft industry, by and large, operates under a type of contract which provides an incentive to reduce costs. Most of its production contracts are of the fixed-price type and include an incentive clause which rewards efficiency of operations and cost reductions. For example, early in the production phase of a contract of any military aircraft, the manufacturer who has won the competitive bid negotiates with Air Force or Navy a cost estimate for the quantity of airplanes under that contract.

When the contract is completed, actual costs are computed and if the actual costs are less than the negotiated estimate, then the manufacturer shares in the savings to the government. Generally, the government receives approximately 80 per cent of the savings, and 20 per cent of the savings of the cost reduction goes to the manufacturer; thus effecting a substantial reduction in the price at which the airplane is sold to the government.

In its effort to reduce and control costs, the aircraft industry uses every available tool that is applicable to aircraft manufacture. It uses time

and method studies, budgetary controls, employee training programs, and employee suggestion programs.

The need for financial resources in the aircraft industry continues to grow by leaps and bounds, due in large part to the continually increasing demands of military requirements and civilian operations for aircraft of ever-greater performance and efficiency.

All indications are that the very rapid advancement in the state of aeronautical arts during the five years since 1950, if anything, will accelerate in the years ahead. We are well into the supersonic era, already attacking the thermal barrier, on the threshold of atomic powered aeronautical engines and beginning to reach beyond the envelope of atmosphere around earth. The limits of advancement today are beyond the realm of prediction.

During the late world war, the cost of development of an important combat aircraft and "its maze of complex systems" was only \$600,000. The bill to one aircraft manufacturer for the development of a single, new jet transport reached \$16,000,000 before production was a possibility.

Since World War II, the United States aircraft industry has invested more than a billion dollars in private research and development facilities and projects. As examples, chosen at random, indicative of rapidly rising investments in research and development, one aircraft engine company has recently ordered a privately financed \$75,000,000 expansion of its facilities in an effort to speed up research and development, as well as production of radically improved turbojet and turboprop powered engines for both military and civil use.

Another aircraft company is just completing the construction of its own \$2,500,000 supersonic wind tunnel, besides many other multi-million dollar facilities and equipment investments during the last few years.

Early British leadership in commercial jet transports was not due to superior technical knowledge or ability; it was due, rather, to the fact that our industry, until recently, had not built up sufficient financial strength to *privately* undertake the costly development of these very expensive, fast and luxurious aircraft.

Russia has had at least one advantage over us; namely, a consistent long-range research, development and production program in aeronautics given top priority emphasis and stemming from the urgency of a military economy. The United States, on the other hand, has thus far managed its aircraft programs on a budget which must provide for a dual economy—for the military and for the civil needs of the nation.

The United States makes its long term commitment to the development of superior quality a joint venture between a competitive private free-enterprise system and the military. It's an unbeatable combination.

MORE DEFENSE PER DOLLAR

Greater quantities of high performance planes for American military and civil air superiority result from stable long-range production programs. Production efficiency and know-how of one aircraft manufacturer have reduced man-hours required in the production of a medium jet bomber to only 7 per cent of those required for the first production model.

—PLANES

Air Force Requires 10,000 Men Each Month Without Prior Military Service

(Continued from Page 1)

rockets. The course lasts 25 days.

If the airman wishes to become a gun laying system mechanic for a jet bomber, a school at Lowry Air Force Base, Colorado, teaches the maintenance and repair of the turret system including the radar-controlled tail armament.

At Keesler Air Force Base, Miss., an airman can learn to become an air traffic control operator through a 70-day course. He is taught the theory of flight, aircraft identification, navigational aids, air traffic regulations, and radar traffic control.

The Air Force, during the last fiscal year which ended in June 30, 1955, recruited 153,679 persons. In the first eight months of the current fiscal year, approximately 78,000 recruits have joined the Air Force for a 4-year enlistment. Although this is less than the 10,000 per month goal, the recruiting service is optimistic about the prospects of equalling the quota through the June graduates from high schools.

During the current fiscal year the Air Force has been obtaining a greater number of high caliber men. In the previous fiscal year, 27 per cent of the recruits were in Category

4—the designation for men who make a grade between 10 and 30 in the Armed Forces qualification tests—and 50 per cent of these men were not considered trainable in Air Force skills. In the present fiscal year, only 18 per cent of the recruits are in Category 4 and all are considered trainable.

The Recruiting Service has been successful in its efforts to attract former airmen back into the Air Force. The airmen with prior service who have scarce and needed skills can choose the base to which they want to be assigned, in addition to retaining their former rank. Former airmen are returning at the rate of 3,000 each month. In the first eight months of the present fiscal year, sufficient former airmen have returned to the Air Force to man a combat wing each of the Strategic Air Command and the Air Defense Command. The benefits of returning to the Air Force are also extended to men in certain categories who have left the other branches of the armed services.

On a hard dollar basis, the value of training given to an airman during his enlistment is estimated at \$15,000, and the training program for specialists continues through subsequent enlistments.

Bomber Comparison

	World War II Bomber	Today's Heavy Bomber
Gross Weight	66,000 pounds	over 350,000 pounds
Top Speed	350 mph	over 650 mph
Horsepower	4,800	135,000
No. detail parts	30,000	100,000
Mfg. tolerances	1/32	1/500
Miles of wiring	5	60
No. of crew	10	5
Engineering man-hours to first production flight	558,000	7,415,000
Cost per plane in initial production phase	\$300,000	\$4,000,000

Nuclear Aircraft Program Gains

Progress of the aircraft industry in the development of a nuclear-powered aircraft is indicated by the scope of the effort which includes at least six companies working on engine development and four companies on airframes.

One company, which has been engaged in atomic engine research since 1951, recently reported that work has gone forward vigorously with significant increases in personnel and facilities. A new facility under construction, which is scheduled for completion in 1957, will employ from 2,000 to 3,000 scientists, engineers and technicians solely for the development of a nuclear power-plant.

The Atomic Energy Commission recently stated in a report to Congress that the aircraft nuclear propulsion program has been accelerated and the prospects for nuclear-powered flight continue to show promise."

A nuclear reactor has been flying in a bomber as part of the testing program. It is not used as a source of power at this time.

The almost limitless endurance and range of a nuclear-powered aircraft, according to General Nathan F. Twining, U. S. Air Force Chief of Staff, will make it a "priceless asset to our deterrent force, for it will enable us to keep more of our force in the air at all times. From this standpoint it represents a potent counterweapon even when the ICBMs (intercontinental ballistic missiles) come on the scene."

4-Point Air Traffic Program Launched

Civil Aeronautics Administration is moving vigorously to improve its air traffic control system.

CAA's four-point program includes:

Operation of an Air Force jet bomber and later a civil jet transport to study aerial and ground-handling problems of turbojet aircraft.

Installation of an electronic digital computer at the Indianapolis, Indiana Air Route Traffic Control Center.

Elevation of air traffic control to the status of a separate office within CAA.

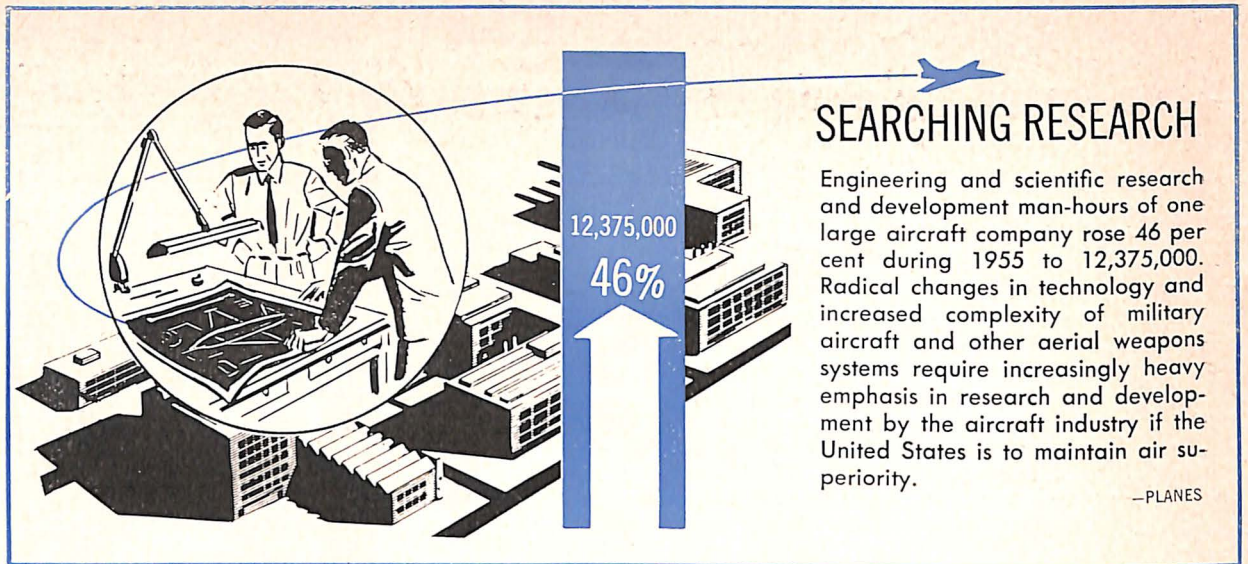
Control of all air space in the higher altitudes by CAA.

Charles J. Lowen, Administrator of Civil Aeronautics, said:

"I believe that American public opinion is awakening to the urgency of the problem; that there is a growing demand for an action program to maintain order on the skyways; and that we are going to get the tools we need to meet this great challenge."

Weather Eyes

Nearly 12,000 officers, airmen and civilians of Air Weather Service operate weather units in 25 countries, 3 territories and 4 major island groups of the world.



SEARCHING RESEARCH

Engineering and scientific research and development man-hours of one large aircraft company rose 46 per cent during 1955 to 12,375,000. Radical changes in technology and increased complexity of military aircraft and other aerial weapons systems require increasingly heavy emphasis in research and development by the aircraft industry if the United States is to maintain air superiority.

—PLANES

Radar Installations Will Track Flight of Missiles Along Vast Test Range

A chain of twenty-one new radar installations, capable of checking the flight of rockets and missiles over the Air Force's guided missile range, is nearing completion.

The radar tracking units are located on eight islands that extend like a vast ribbon from Grand Bahama Island off the coast of Cape Canaveral, Florida, to the South Atlantic. The islands linked into the test range by the radar installations include Grand Bahama, Eleuthera, San Salvador, Mayaguana, Grand Turk, the Dominican Republic, Puerto Rico and St. Lucia.

This comprehensive radar tracking system is typical of the progress being made by the aircraft industry to insure that America retains the lead in the technological race for superior air power.

The radar units are able to record and report back to the Flight Control Center at the launching area near Cocoa Beach, Florida, on the missile being tested to an accuracy within two one-hundredths of a degree.

From the instant the missile is fired from the launchers, the radars lock onto their "target" and keep it constantly under surveillance, tracking the position of the missile, its course, velocity and accelerations with no delays until the missile reaches its target or is destroyed.

The radars provide the precision data needed by the U. S. Air Force Air Research and Development Command and the scientists and engineers from the aircraft industry responsible for the missile's design. The data is used in tactical evaluations and studies of the missile's effectiveness and potential uses. The high degree of precision obtained through the new radar installations provides accurate information on the aerodynamic problems involved in missile development.

Each installation weighs five tons and is made up of thousands of small but complex electronic devices. The system is fully automatic. It responds to a push button and

only one man is required in the operation. The system must be fully automatic to function properly because the high speed of the missiles under test makes manual tracking impossible under many conditions of operating.

Mathematics Provides Cure for Shimmy

A mathematical formula is now providing a cure for the shimmy—but one of the aircraft industry's long-time headaches.

Typical of the team work between the military and industry in building quality planes, it was conceived by a U. S. Air Force scientist, and proved when applied that the basic cause of shimmy could be found in the structure supporting the plane's nosewheel.

Previously it had been generally believed that tire flexibility had been the cause. However, the scientist felt that the tire theory did not go far enough, because it took into account only three conditions: lateral sturdiness of tires, yaw sturdiness of tires and length of the arm from the pivot to the wheel. He evolved a mathematical formula which took into account 12 other conditions involving damping and variations on structural design. According to his theory any one, or a combination of the 15 conditions, could induce shimmy.

The formula was borne out in experiment. For this experiment a cargo plane was taxied with its regular landing gear. It began shimmying at 60 knots and the structure buckled causing an accident. After making modifications to the airplane in accord with the mathematical formula, the plane was taxied up to 120 knots and, although the nosewheel was repeatedly run over an obstacle on the runway, no shimmying developed.

Space Travel Tested—on the Ground

Looking more like a house furnace than a space-traveling rocket, the first piece of test equipment built specifically for outer-space human research has been delivered to the Air Force School of Aviation Medicine at Randolph AFB, Texas.

According to Dr. Hubertus Strughold who heads the Air Force project, the cabin will give aeromedical researchers most of the sensations that they would have on a flight in space. The "sealed cabin" does not fly. It was designed to investigate human factors inside the cramped quarters of a space ship far outside the limits of the earth's atmosphere.

Hermetically sealed, the cabin tells scientists what goes on inside a space ship where a careful balance of atmospheric conditions must be artificially maintained.

Conventional pressurized cabins cannot be used above 80,000 feet. There is so little air at that height that present-day compressors can't pump in enough to keep passengers safe from altitude sickness.

Also, the air above 80,000 feet contains ozone, a gas which is harmful in high concentrations.

Here are a few of the problems facing Dr. Strughold and his staff.

How little climatization can a human being stand? This is important since refrigeration and other protective measures add weight to the craft. (The average man uses up 26 quarts of oxygen an hour, exhales carbon dioxide—along with water vapor which raises the humidity. He also produces body heat which raises the temperature.)

How little air pressure can the human body stand without fear of bends? Total air pressure cannot be too great in a space ship or it will weaken the walls in the near-vacuum around the craft.

Dr. Strughold and his staff hope to have the answers ready when they are needed. When will men start needing the sealed cabin to edge into the outer space? Dr. Strughold thinks soon. He's working, he says, against time.