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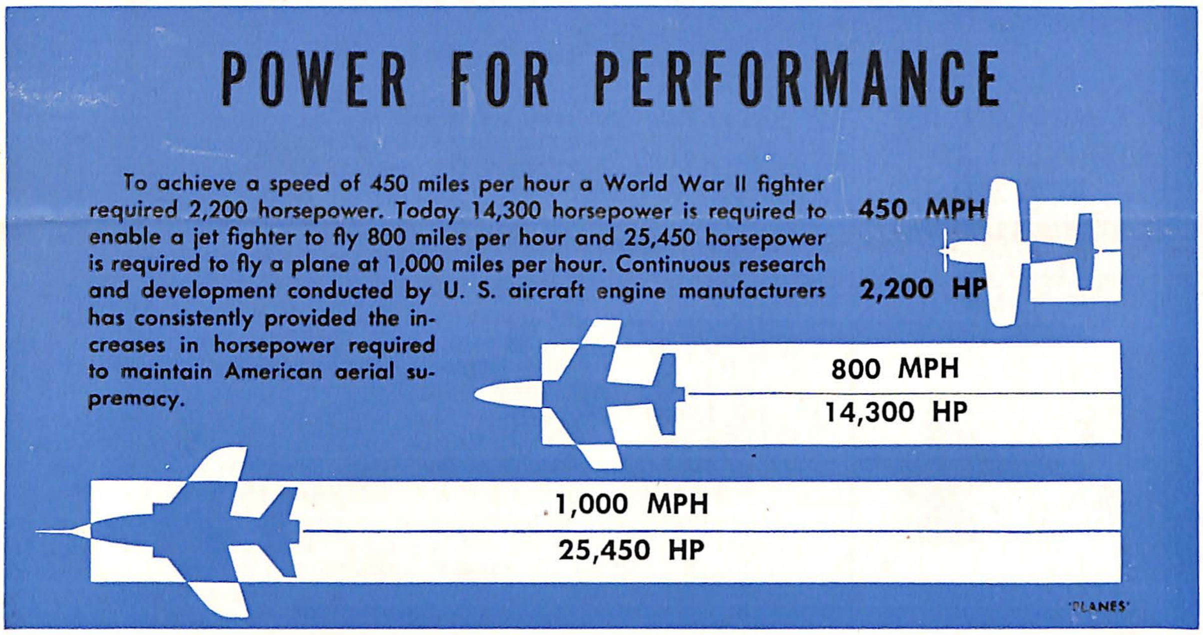
GOALS OUTLINED FOR NEW PLANE MATERIALS



AIA Committee Cites Needs

By V. G. Mellquist, Secretary
Aircraft Research and Testing Committee
Aircraft Industries Association

Ever increasing speeds of both piloted and pilotless aircraft are generating friction temperatures so high that it has become one of the most serious aerodynamic problems facing the aircraft industry.

The aerodynamic heating in an automobile moving 60 miles an hour, for example, causes the outside body temperature to rise only six-tenths of one degree. Yet, an aircraft moving 300 miles per hour generates a skin friction temperature rise of 16.1 degrees, while the metal skin of a missile flying 3,000 miles per hour will experience a temperature rise to a fantastic 1,613 degrees.

The solution to the problem of aerodynamic heating, as well as the other technological problems facing the aircraft industry, requires huge investments of both private and military funds in research and development programs. The industry reinvests a high percentage of its earnings in research to maintain our qualitative lead in air power.

Aerodynamic heating is caused by frictional forces between the moving vehicle and still air. Even at high altitudes where the atmosphere is thin, the friction temperature problem remains a great one. At 40,000 feet with 64-degree-below-zero air, the surface of an airplane flying at twice the speed of sound would be 250 degrees. Mach 3.5, or about 2,500 miles an hour, is considered to be the critical point beyond which conventional equipment as we know it today cannot fly for more than brief periods. Aluminum, the most common airframe material used today, becomes soft and loses most of its strength at this point.

The Aircraft Industries Association's Aircraft Research and Testing Committee recently completed a survey of the airframe industry trends and requirements for both structural and special materials and also best methods of fastening these materials together. The manufacturers were asked to indicate their requirements five and ten years from now. Temperature goals for materials in 1961 were forecast at between 500 and 1000 degrees Fahrenheit. For the first five-year period specific trends and recommendations from the air-

(See ULTRASONIC, Page 8)

Aircraft Metals Kept In Deep Freeze To Safeguard Against 'Spoilage'

The freezer has become just as important to America's great aircraft industry as it has to milady's American household—and, for precisely the same reason—protecting perishables against spoilage.

But, while the housewife uses her kitchen freezer to preserve vegetables and other foodstuffs against spoilage, these super-cold refrigerators are used in the manufacture of a giant bomber to safeguard aluminum against spoilage.

Aircraft aluminum, prior to machining, is as perishable in its own way as a market basket of vegetables. Time is the most important factor concerning aircraft aluminum prior to its being machined and shaped into airplane parts. If allowed to remain in storage in its raw state for more than four days, even at room temperature, the metal becomes age-hardened to a point where microscopic fractures occur during the forming process.

On arrival at the aircraft plant, to insure that the aluminum remains in a "fresh from the market" condition until time for its use, it is first heated and then stored immediately in a freezer at a temperature of ten degrees below zero.

This process literally preserves the aluminum in a fresh and workable condition. However, just as the housewife knows perishables can only be preserved just so long even in "deep freeze," this is true also in the case of aluminum. If aluminum remains in cold storage beyond 30 days, age-hardening again takes its toll. If it must be stored beyond that time limit, the aluminum is returned to the manufacturer for remelting.

What is of even more importance in the precise and careful handling of the aluminum slated for one of

(See BIG FREEZERS, Page 8)

Molten Glass May Be Used As Lubricant

Molten glass may solve the problem of providing a lubricant for use in the hot forming process of titanium and other alloys.

The aircraft industry, which has pioneered the use of new metals in providing superior aircraft and missiles, found that conventional lubricants were inadequate to withstand the temperatures required in the hot forming of titanium alloy parts. The parts are ruined by galling and even the dies are severely scorched.

Intensive studies, involving more than 30 types of glass composition, showed that porcelain frits (material of which enameling glasses are made) have satisfactory lubricating properties when used in titanium sheet metal forming operations above 800 degrees Fahrenheit.

Miniature Radar Storm Warning Device Built For Personal Aircraft

Science and engineering have produced a miniature early warning weather-avoidance radar to enable pilots of America's personal aircraft to avoid bad weather as easily as do the nation's commercial airliners.

The new radar system, weighing only 50 pounds, has been designed specifically for the "flyweight" requirements of the more than 59,000 business and private aircraft owners and operators. It will enable the pilots of small planes to "see" and avoid storms and turbulent areas up to 50 miles ahead.

Formerly, light plane pilots have had to scurry for cover at the slightest hint of bad weather. The new weather-avoidance radar will provide these pilots with a continuously changing picture of weather conditions in ample time to change course to avoid storms.

This weather penetration system is typical of the way science and the U. S. aircraft industry team together to make air travel safer and more comfortable.

"I think most military authorities will now agree that in order to carry out ANY military operation you must first have air superiority; in other words, the first task now is to defeat enemy airpower."

—Gen. Curtis E. LeMay

Plane Views

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

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

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

—PLANES

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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So Little Time

"Our programs must meet the needs of today. To build less would expose the nation to aggression. To build excessively under the influence of fear, could defeat our purposes and impair or destroy the very freedom and economic system our military defenses are designed to protect."

—President Dwight D. Eisenhower

The building of adequate strength to meet our needs of today, and over the long pull, without overtaxing our national economy, is a continuing problem which calls for the exercise of the greatest ingenuity and cooperative effort on the part of the entire American public.

The United States aircraft industry, perhaps more than any other industry in the nation, recognizes its great responsibility in this regard. For, in the final analysis, it is this industry which is responsible for the provisioning of the nation's first line of defense—air power.

Unfortunately, as technology advances, the aerial weapons of defense become more complicated and expensive. During this fiscal year, for example, the Defense Department estimates that it will spend approximately $5,200,000,000 in the process of developing and testing of new weapons and most of these funds will be spent in aeronautical research and development activities.

Modern air weapons have become so complicated that the military specialist in air strategy and tactics cannot do much more than point out his requirements in basic terms of ability and performance. It is then up to the men of management, science and engineering in the aircraft industry to satisfy the military requirement.

Today, satisfying the military aviation requirements is complex to say the least. Need, of course, dictates the design of a new fighting plane, rocket or guided missile. The aircraft engineer must always keep *at least* one jump ahead. Speeds three and four times that of sound soon may be commonplace, and already design engineers are talking about speeds far higher.

Airplanes which are already a "reality" on the drawing board will fly so fast that outer skin temperatures will be generated in the 300 degree to 1,100 degree range (the sun's surface is a bare ten times hotter). Aluminum alloys are useless at even the lower end of this range. Man loses his efficiency at 100 degrees. Organic rubber melts at 250 degrees, and at 1,000 degrees iron glows red hot.

Some of the new materials are ready for the aircraft industry to mold into aircraft to meet the ever increasing demands of the military requirements. Titanium alloys and stainless steel are new and will suffice—for current requirements—in withstanding pressures and temperatures produced at three and four times the speed of sound.

But, these new metals can't be worked like aluminum. They often become inexplicably brittle during forming operations. Fastening parts made of these metals presents another problem. While welding seems to be the answer and will undoubtedly supplant the riveting method of fastening in use today, so far there aren't spot welding machines in existence large enough to handle big wing and fuselage skins.

Tooling problems to work these new metals are enormous. Hundreds of thousands of new tools will have to be built and new techniques of manufacture developed.

The cooling of men and equipment is basically an engineering problem. But from the manufacturing standpoint, it introduces new problems of sealing and installation. Today, much of the military plane's equipment is located in the wings. In the future this equipment will have to be moved to the "controlled temperature" area within the fuselage.

These are but a few of myriad problems with which the aircraft industry is faced and which it is slowly but surely overcoming. The task is difficult and very costly in time and in dollars. But history is being compressed at an alarming rate and evolution is being speeded up. The United States aircraft industry has much to do in such a little time. "To build less would expose the nation to aggression."

Chemicals May Solve De-Icing Problem

Chemical compositions that effectively prevent ice accumulation are under study by the Air Force and the aircraft industry and may soon replace conventional de-icing equipment on wing and tail surfaces of certain types of military aircraft.

Ice accumulation on the leading edges of a plane's wing and tail surfaces in the early days of flying was often a flight hazard. But the aircraft industry soon had the problem under control with a number of effective means of preventing ice which often accumulated as planes flew through stormy skies. Today all the big luxurious airliners are equipped with these devices, as indeed are most of the smaller privately owned craft. The de-icers on today's planes are most easily recognized by the black rubberized cover running along the front edges of the aircraft wing, tail and rudder fin.

However, weight in a military aircraft is very costly and new and better ways of reducing weight and therefore increasing performance are hotly sought by the aircraft industry and the military services. The new chemical de-icers which can be sprayed or painted on critical areas, are expected to point the way to significant cost and weight reduction in certain combat aircraft.

PLANE FACTS

- A large modern air transport carries enough fuel on one flight to furnish a passenger automobile with gasoline sufficient to drive it more than 165,000 miles.

- **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 Farenheit.**

- 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.

- **Total flights by all passengers in two commercial transport models made by a single manufacturer in the past ten years would equal the great task of flying the entire population of the United States from New York to Chicago.**

planes AIA

By Charles E. Wilson

America's NOT-SO-SECRET Weapon

CHARLES EDWARD WILSON, one of the nation's leading authorities on U. S. industry, was first called to Washington in 1942 to serve as Vice Chairman of the War Production Board, and Chairman of the Aircraft Production Board. His services in mobilizing the United States were called upon again in 1950 when he was named Director of the Office of Defense Mobilization. Mr. Wilson started his business career in 1899 when he became an office boy with the General Electric Company, rising to the position of President of the company in 1940. He is the recipient of several Government awards and numerous honorary degrees. Mr. Wilson most recently served as Chairman of the Board of W. R. Grace & Co.

IN the current re-examination of American air power, the least attention has been paid to the best weapon we possess in the race for air supremacy. This weapon is neither very secret nor very new. It has been on open demonstration for everyone to see during the entire life of our Republic. It has been subjected to microscopic examination by friends and enemies alike. I am referring to our free competitive system.

I am convinced that the full potential of this weapon is incapable of being measured in advance. For example, an assessment of American air power today—whether it be made in terms of the production of planes and missiles, the available aircraft plants and facilities, or research and development of new air weapons—cannot offer us more than the most remote inkling of how far the industry could go if the wraps were taken off in an all-out effort. Certainly, no one in 1939 who had surveyed the current production, plants, and facilities or the current status of research and development could have possibly dreamed that the aircraft industry could increase its rate of output by *fifty times in five short years.* Monthly military aircraft production rose from 180 in March, 1939 to more than 9,000 in March, 1944.

Aircraft Industries Association of America, 610 Shoreham Building, Washington 5, D. C.

Today this same industry is incalculably stronger research-wise, production-wise, facility-wise. That the industry can outstrip its former achievements — which in themselves are still almost unbelievable—is clearly evident. But how far and how fast it can outstrip them can only be guessed. The power of competition is literally unlimited.

Nowhere is the proof of this statement more apparent than in the recent history of the aircraft industry. Three times in less than two decades the American people have challenged the aircraft industry to do the incredible. And each time the aircraft industry has responded magnificently.

The Challenge of World War II

DURING the period from September, 1942 to September, 1944, as Executive Vice Chairman of the War Production Board and Chairman of the Aircraft Production Board, I was treated to an intimate and almost daily revelation of the astounding prowess inherent in the teamwork between our military forces and the private competitive aircraft industry. But even before we were gearing to our total war effort in 1942, the industry had already been credited with man-wrought miracles.

To appreciate fully just how wonderful these miracles really were, we must consider the position the industry started from in 1939. The entire volume of business during the 1930's consisted of two hundred or three hundred of the larger type commercial planes and a few hundred each for the Army and Navy. The aircraft industry was clearly not a mass production business; planes were very much tailor-made.

Then in 1939 the war of nerves which had brooded over Europe during the '30's suddenly became a shooting war. The allies needed planes, hundreds of them. The nationalized French industry collapsed. British industry was unable to fill the gap. Orders came in from abroad so fast that some American companies not only had their hands full building planes, but they were building buildings in which to build planes. One company doubled its facilities in just seventy-seven days. Planes were coming off the production line in one end of the factory while the other end was still being built.

When President Roosevelt sounded the alarm in his defense message on May 16, 1940, many aircraft manufacturers, disregarding the possibilities of financial loss, proceeded immediately to expand their facilities even further. They ordered materials in quantities which experience had taught them they would need for an even more-intensive effort. They sent agents all over the country negotiating with sub-contractors, pending the actual receipt of expected orders. Huge plant expansion programs, orders for machine tools, intensive personnel training programs, new methods of quantity production were initiated. Wheelbarrow factories, garages, shooting galleries were leased to get the space for aircraft production.

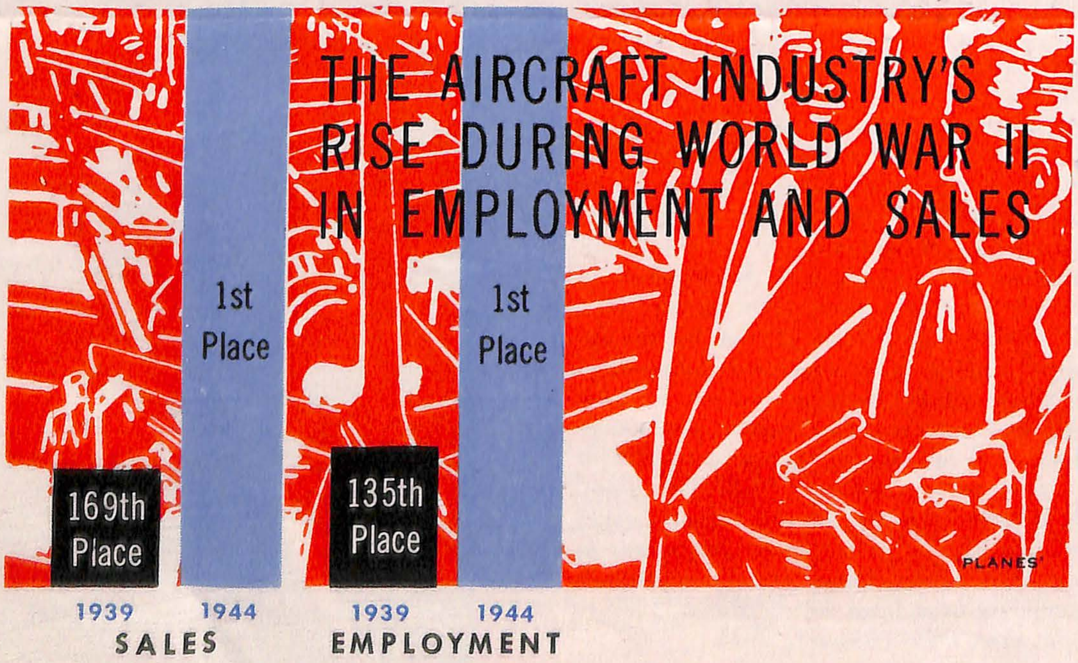
And the production did come at a rate that no one believed was possible. In just one year, from 1939 to 1940, American output of military planes increased nearly three times. "The aviation industry," said Assistant Secretary of War Louis Johnson, "is the one bright spot."

BUT this was only the beginning. For President Roosevelt was already asking the industry to aim for fifty thousand planes a year. This target was exceeded on an annual rate before 1942 was over.

Even this latest miracle was still not thought to be enough to overcome Hitler's Luftwaffe. In 1943 President Roosevelt called me to the White House and said he was going to make the aircraft production goal 100,000 planes a year and that he wanted us to meet that goal by late 1944. When this was announced to the American people, there were many who said that here was one miracle the aircraft industry could not perform. There were those who offered the private opinion that the whole idea was "crazy." But the records will show that we did produce planes at a rate of 100,000 a year in 1944. There is no question in my mind that this rate could have been boosted even further if the aircraft industry had been called upon to do so. Instead, in anticipation of an early end to the war, orders were cut back just as we reached our peak.

In 1936, the aircraft industry ranked 135th among American industries in employment and 169th in sales. During World War II, it grew to first place in both categories. It produced more than 300,000 aircraft—twice as many as Russia and three times as many as either Germany or Great Britain. In that one fabulous year of 1944, the American aircraft industry turned out more planes than had been produced in the history of aviation by all of the nations of the world combined prior to World War II.

It was clear that American aircraft workers were making no idle boast when on factory walls throughout the land, they posted this famous slogan: "The difficult we do right now—the impossible takes a little longer."



The Challenge of Korea

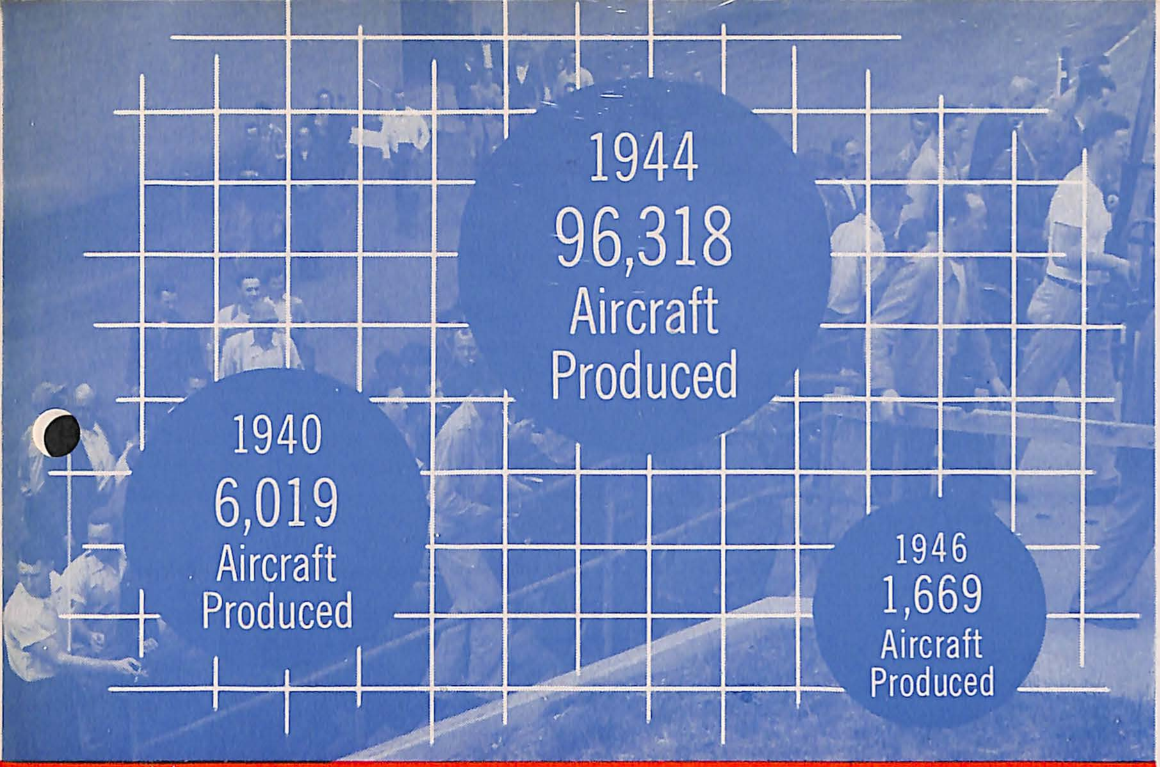
WITH the outbreak of the Korean War, I was called to Washington to the post of Director of the Office of Defense Mobilization and once again was privileged to be a daily witness to the spectacular resiliency and enterprise of the American aircraft industry.

The industry was forced to mobilize from a standing start. At the end of World War II, the military market for aircraft all but vanished. This was consistent with the historic attitude of a free people toward war. We have never been a war-like nation. When the wars are over, we want to forget them. Despite repeated warnings of far-sighted authorities like General Hap Arnold and many others, the merits and the need for adequate air power became matters largely of political debate instead of productive action.

Reductions in aircraft military orders began in 1944 and continued through 1945. On August 14, 1945, contracts for $9 billion worth of aeronautical equipment were abruptly canceled. In 1946, the Air Force and the Navy combined were taking an average delivery of only 139 aircraft per month, a figure below the 1938 rate. Thus began a period which can only be described as the nightmare of the industry. Some of the biggest and best producers of World War II found themselves shriveling up. Employment in the industry dropped from a peak of more than 1,300,000 in 1943 to a low of about 237,000 in 1946.

In an effort to maintain a nucleus of scientific and management manpower, many companies turned to commercial ventures and literally lost their shirts—in such unlikely pursuits as casket-making, aluminum boats and wheelbarrows. They dismantled their facilities and consolidated their multi-plant operations into small units. Commercial airliners were built without orders, and money was lost in a market glutted with surplus military transports. During the first two postwar years, losses in the aircraft industry were upwards of $50 million.

When the North Korean troops crossed the 38th parallel in 1950, the aircraft industry was little more than a ghost of what it was during World War II. That it had not dematerialized even further is largely attributable to the foresight of the aircraft manufacturers—and to their courage in backing that foresight with dollars. Fortunately, the great management teams, at least, had been held together.



THE POST-WAR SLUMP

Meanwhile, the Russians had not been idle. While watching Americans disarm and their industry decline, the Russians speeded their research and development and were turning out jet fighters and light jet bombers in quantity production during most of these years. At the beginning of the Korean War, the Communist air forces outnumbered those of the United Nations by four to one. In the early months, the bulk of American aircraft in Korea were the same piston engined type fighters and bombers that we had used at the close of World War II.

Once again, the aircraft industry was called upon for a miracle. Once again, the aircraft industry came through. Within two years, the industry had tripled its rate of output of far more complex, far heavier, and far more advanced aircraft than it had been called upon to produce in World War II. American pilots with their powerful, new United States Sabre-jet fighters swept the Korean skies clear of the enemy with a plane-kill ratio that eventually reached fourteen-to-one in our favor.

The Challenge of an "Age of Peril"

As the Korean War dwindled to a halt, it became apparent that we would for many years be living in what President Eisenhower has called an "age of peril." The peril is actually a double one. On the one hand, we would imperil our freedom if we should attempt to keep our society under wartime controls for generations to come. On the other hand, we would imperil our survival as a nation if we should fail to maintain enough strength in being in our military force.

Consequently, we decided that we could no longer afford an economy solely devoted to either guns or butter. Instead, as a matter of national policy, we had to have both. We lifted wartime controls on everything but a few strategic materials. We asked the aircraft industry for the first time in history to build an air power second to none while bidding in the open uncontrolled market for the managerial, scientific, and production manpower, for the facilities, and for most of the materials it needed for this enormous task.

In short, we asked the American aircraft industry to do a better job in a free economy than the Soviet industry could do with the total and absolute powers of a police state.

The objective was not to match the Russians plane for plane in a race for *numerical* supremacy. In the first place, we know from experience that if the need should ever arise, the United States can outproduce the Russians numerically. In the second place, the historical importance attached to *quantities* of weapons went out the morning one B-29 and two observation planes took off from an island in the Pacific to drop the atom bomb on Hiroshima. Prior to that, hundreds of planes were involved in a typical mission over Japan. Today one plane can carry as much destructive power as all of the planes carried during World War II.

The primary assignment of the aircraft industry since Korea has been to maintain its qualitative leadership, and to produce the superior weapons in quantities, as determined by the government, to assure victory in the event of war.

It is to the lasting credit of the industry that this assignment has been carried out with distinction.

While increasing the unit combat strength of American air power 160 per cent, the United States has replaced a striking force built around the piston engine with aircraft powered by turbojets. Today, American jet engines set world-wide standards for quality, reliability, and efficiency.

The performance of American aircraft has soared. In 1950, supersonic flight was only possible in specialized research planes. It is now a normal pattern for Air Force and Navy fighter operations. One production fighter today is capable of operating speeds in a range twice the speed of sound, while today's heavy bomber has near-sonic speed, with a supersonic bomber—the B-58—soon to make its first flight.

While bringing about a revolution in air power, adventurous research has put us on the threshold of such exciting new frontiers as nuclear-powered aircraft, earth satellites, overcoming thermal limitations (terrific heats created by air friction) and new power sources in the pull of gravity.

In the meanwhile, that splendid team of the American military forces and the private competitive aircraft industry has added a new weapon—the guided missile—to our air power inventory. Although development had been started on this weapon prior to the Korean War, there were no operational missiles when the war began. Today there are at least nine operational missiles ranging from the small air-to-air missile to the huge surface-to-surface missile.

More important than any recitation of statistics on the quality of our air power today is the fact that the Communist bloc has not attacked us despite its numerical superiority in both air power and manpower. The Communists have obviously been restrained by the fear of retaliation in which our air power would play the dominant role.

What is equally significant for the future of a free society is that we have developed a first-rate military air power without resort to wartime controls. The aircraft industry has proved that the guns-and-butter philosophy *is* sound—that a free society *can* endure through an age of peril without destroying freedom. To me, this achievement towers over all of the other noteworthy accomplishments of this remarkable industry. For if it had failed under a system of freedom, our survival would most certainly have demanded that we alter that system. If the aircraft industry had failed, we might today be already rushing headlong toward the totalitarianism we abhor.

The Role of Competition

Why was the American aircraft industry capable of piling miracle upon miracle in World War II? Why was it able to survive through those painfully thin post-war years and come back to unfold still another miracle during the Korean War? Why is it able today in a peacetime economy to excel the Russians at their own warlike games? Why can we be sure without the slightest doubt that on any equal assignment American aircraft manufacturers can outdistance their Russian rivals?

The answer is that the American aircraft industry has a weapon for which the Russians can never hope to find the right design so long as they maintain a police state. That weapon is free competition—the fierce, risk-taking drive for better values in the hope for better profits that marks a free industry in a free economy.

The amazing record of the American aircraft industry over the last twenty years has repeatedly demonstrated that competition gives us a big edge over the Russians in three crucial ways.

(1) Competition speeds progress

Time and again when lack of political foresight or government funds has threatened our progress in air power, competition has come to our rescue.

We must never forget it was American competition for foreign orders which delivered the goods when the French nationalized air industry failed in 1939. Again in 1940, nearly six months elapsed between the time our own government announced an air expansion program and the time quantity orders were received by the industry. When the orders finally came, American industry was found ready because competition in the meanwhile had spurred the aircraft manufacturers into a scramble for plants, facilities and manpower.

The fact that the industry stayed alive at all during the difficult years between 1945 and 1950 can be credited almost solely to competition. In the hope of maintaining their organizations to compete for military orders which they confidently expected would come *sometime*, American aircraft manufacturers continued limited research and development by supplementing the limited government funds with their own money.

Since 1950, we have seen many times how the public comes out the winner when competition lures a private company into taking risks on its own foresight. We can credit competition for one of the most significant developments in the ability of American bombers to span oceans and continents in a single flight. Aerial refueling by jet tanker is directly attributable to one company's development of a jet transport at the cost of more than $16 million when neither the government nor the airline industry was seriously interested in the project. Obviously, the development would never have been undertaken in an industry controlled by the government. The decision of one private enterprise to go ahead on its own saved the Air Force priceless time and an estimated $50 million when the refueling possibilities of the transport were officially recognized.

COMPETITION sustains air progress when the government lacks foresight or funds. Competition makes progress come faster when the government issues a call to break through the unknowns to the future.

This competition in creativeness is what German Reichsmarshall Hermann Goering found missing in German World War II industries when he said, "I envy the allies nothing more that the financially independent, private, competitive aircraft industry and its ability thereby to develop new models."

With more than one company striving to develop a *new* product to meet some new problem, the United States has a far greater chance to come up with the best answer before any other country which restricts competition. You cannot legislate progress.

But even after a firm does get a government order for quantity production of some new model, that does not mean that competition is over. Instead, in an industry built on innovation a firm can survive only by obsoleting its own products. If it does not quickly obsolete its current production model, both the model and the firm will be quickly obsoleted by some alert competitor.

(2) Competition cuts costs

While competition in creativity is producing for the American people the most advanced air power in the world, competition in cost cutting assures American taxpayers of getting the most for their money. Cost cutting competition begins with research and development and continues through the production of an accepted model.

Through relentless research and development efforts to obsolete its own products, one company increased the life of its jet engine from 300 hours to 1400 hours. As a result the government was able to cancel orders for 1600 jet engines. The company lost business, but the taxpayers saved about $56 million. On the production side, one company made its organization so cost-conscious that it turned out aircraft at more than $100 million less than had been estimated in the original contract.

IT is instructive to review just a few of the myriad ways such savings have been realized. They point to both the imagination and industry with which aircraft manufacturers pursue their low-cost objectives.

The use of a kit similar to a child's erector set to build many temporary assembly fixtures for aircraft control instruments has cut the cost of a $360 fixture to less than $100.

The use of electronic computers in engineering problems has reduced the cost of calculations from $30,000 per million operations to $3 per million.

A redesigned air conditioning unit cut the cost of one plane by $6,000; a redesigned coupling drove down the price of another plane by $17,000; and the substitution of a high-voltage electric system for a low-voltage system saved $121,000 on just one jet bomber.

The cost-cutting activities of the aircraft manufacturers have succeeded so far beyond expectations that the industry has saved the government hundreds of millions of dollars. For example, one company alone recently sent the government a check for 25 million dollars. This picture of American companies sending refunds to the government is in vivid contrast to the situation we find elsewhere where nationalized industries are snatched from disaster only by ever-increasing government subsidies.

(3) Competition preserves freedom

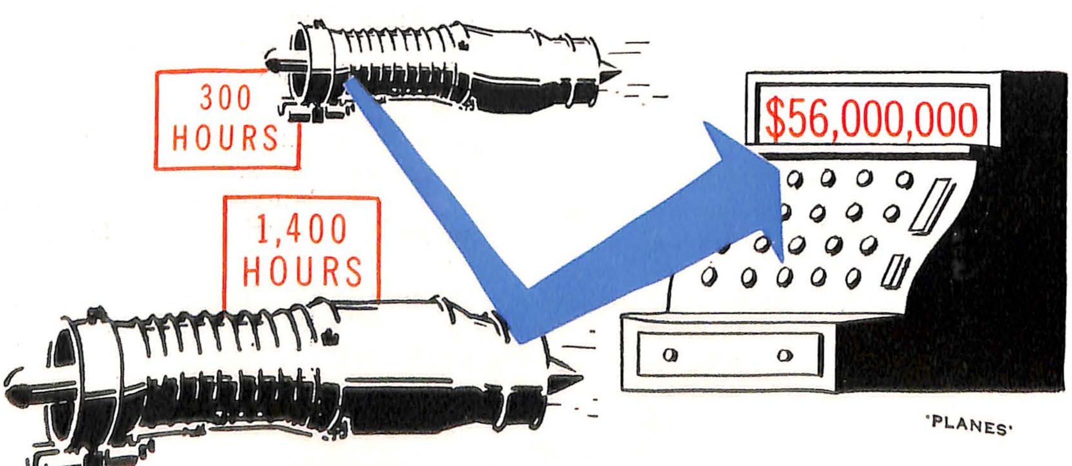
PERHAPS the most revealing chapter on the power of competition in the aircraft industry has been written since the Korean War. We have already seen how Russia gained five years on us in research and development by keeping them on a wartime footing after 1945. Since Korea, Russia has continued to assign a major part of her budget, her materials, her scientists, engineers, and skilled manpower to war industries, while we have been enjoying a booming civilian economy.

Yet with all of these drawbacks, the American aircraft industry has succeeded in maintaining a qualitative lead over Russia.

By this attainment, the industry has offered living proof that freedom is still the best way to make men's dreams realities. This is a monumental feat at a time when much of the world is still debating the merits of our way of life. To our friends and enemies alike who question the virility of freedom, let us point to the aircraft industry.

When they glorify the welfare economics of "production for use," let us tell them how production for profit kept our aircraft budget within such manageable proportions that the civilian economy surged to new high levels. When they argue that modern society is too complex and too interdependent to work without socialist controls or communist police power, let us explain the sub-contracting system in the aircraft industry. Let us describe how prime contractors break up big jobs into thousands upon thousands of small jobs which are undertaken by some 50,000 subcontractors and suppliers who produce their highly intricate components to the most exacting specifications and then deliver them in the right quantities at the right places and on the right time schedules. Let us remind our critics that it is the competition of free enterprise—not the master plans of the socialists or the Siberian work camps of the communists—that makes this system operate with reliability and precision.

And then let us remind ourselves that in an age of peril we cannot afford to do less than subject our air power to continuous and painstaking reappraisal—that in the end it is up to us as citizens to decide how much strength in being we want now and how much we want to plan now for the future. But let us remember, too, that with competition on our side, we have a big edge on the Russians in gaining and maintaining whatever strength and quality of air power we decide we want. For that, we Americans — and free people everywhere—should be eternally grateful.



THROUGH RESEARCH, ONE AIRCRAFT ENGINE COMPANY INCREASED THE SERVICE LIFE OF ONE OF ITS JET ENGINES FROM 300 TO 1,400 HOURS. SAVINGS TO TAXPAYERS—$56,000,000.

Electron Device Seen As Big Advance In Aircraft Radio Beam Control

Have you ever heard of a "retarding field oscillator"? If not, here's a clue: Several rare metals are used in its manufacture, including gold, silver, tantalum and tungsten. And what is more, sapphire jewels, nylon gloves, and microscopes.

Answer: a new electron tube developed for the aircraft industry and considered one of the most significant research contributions in the field of electronics in recent years.

The Air Force believes that the new tube will go farther toward solving exacting requirements of the aviation electronics industry for generating high radio frequencies than any other electronic device now available.

For example, the highest frequency at which an average television tube operates is 890 megacycles (a megacycle is a million cycles). World War II airborne radar frequency operated at 10,000 megacycles. The new retarding field oscillator tube operates well at 70,000 megacycles and can operate at 100,000 megacycles.

Construction of the tube requires trained hands and the finesse of a watchmaker. Technicians, to build the tube, must wear nylon gloves for cleanliness and assemble its minute parts with a microscope because some of them are not visible to the naked eye.

In manufacture of the tube, gold is used as solder; silver is used extensively because it has a lower electrical resistance than many common metals; sapphires are used as bearings; and tungsten and tantalum are also used in the tube because they have very high melting points.

Development of the new tube represents another step taken by science, the military and industry, as a team, to assure American aerial supremacy. Use of the very high frequency retarding field oscillator will permit far more accurate radio beam control while adding more channels to the available frequency spectrum.

Pressurized Rooms Used for Plastics

The type of unique facility needed by the aircraft industry in producing qualitative air power is illustrated by the internally pressurized working areas used in plastics fabrication by one manufacturer.

The pressurization is necessary because dust causes distortion in the contact-formed parts of the plastic molds, and metal dust reduces radar transmission of radomes. Specks of oil also reduce the bond strength of plastic parts. Various radomes, instrument panels, wing leading edges and fin tips are typical of parts manufactured from plastic materials.

It is absolutely necessary that entrance of outside air be held to a minimum. Vacuum-type dust collectors pick up dust created during the manufacturing process. One feature of the plastics operation is a dust-free forming area where the ovens open directly into the room to prevent contamination during the forming process. The controls are in the walls, and racks hold the material while it is being heated. With the ovens opening directly into the room, the heated material will not crack because of thermal shock of moving the material from an oven to a cold room.

The pressurization of working areas is only one of the special requirements the industry must provide in keeping U. S. air power in the number one position.

Scientists Making Re-Entry Study

Guided missile re-entry into the atmosphere—a problem which has plagued scientists since the intercontinental ballistic missile (ICBM) program first got underway—is now being solved in aircraft industry labs.

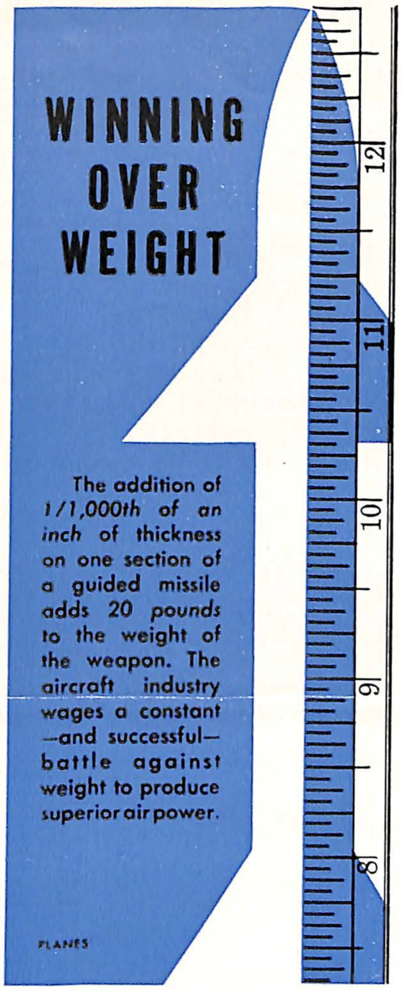
Re-entry is the point at which the missile would re-enter the atmosphere and plunge to its target after traveling thousands of miles at supersonic speed through space. The problem under study is to overcome the enormous air friction which would burn up the missile in the same way that most meteors burn up and vaporize as they fall toward the earth.

Aircraft industry scientists are conducting experiments with shock tubes which permit them to study simulated extreme speeds and temperatures *considerably higher than the heat at the surface of the sun.* The speeds and temperatures involved are of the same order as those that will be encountered by an intercontinental missile nose cone at the end of its journey through space. They also approximate conditions that must be overcome in launching a satellite into an orbit around the earth.

This research involving almost every field of science, ranging from high temperature gas dynamics to aerothermodynamics and metallurgy, is saving huge amounts of time and money that would be required for actual missile flight tests.

Helicopter TV Stations Aid Assault Landings

Flying TV stations may be built for helicopter use during major naval operations. The airborne television, already developed and undergoing tests, is said to provide excellent operations over line-of-sight distances of more than 50 miles. Systems of this type would prove of great value, Navy believes, in the control of amphibious landings.



Biggest Skis Made For Navy Plane

One of America's major aircraft companies is equipping its patrol bombers for duty in the Antarctic with the largest skis ever ordered for a jet-powered aircraft.

Measuring 5 feet wide and 16 feet long, the skis made of composite aluminum alloy and steel will be attached to the two-wheel main landing gear. A smaller ski will be mounted on the airplane's nose landing gear.

Provisions are being made for the wheels to remain stationary while the skis can move up or down, thereby permitting landings on either skis or wheels. When the wheels are retracted the skis serve as landing gear doors.

Industry Potential Due To Subcontracting

The aircraft industry's comprehensive program of subcontracting has broadened the nation's production potential and provided a solid basis for rapid expansion in emergencies.

The integration of subcontractors into the over-all effort has been accomplished through the aircraft industry's program of assistance. The scope of the program is illustrated by the fact that the industry has used more than 50,000 subcontractors and suppliers located in every state, and in 1954 paid them $4.7 billion or 54 per cent of all disbursements. 43 per cent of the contracts went to small businesses—firms employing 500 or less workers.

'Rock'n Roll' Tests For 'Racy' Planes

The environment of a supersonic plane is not exclusively at 50,000-foot altitudes.

High-speed aircraft also must be able to operate on the ground where they take some of their hardest punches. The roughness of runways makes heavy, flexible aircraft literally "rock and roll," setting up vibrations which tend to tear an airplane apart.

The aircraft industry, working with the Air Force's Air Research and Development Command, has developed an apparatus which takes a profile of the runway that shows its dips and flat portions.

The profile apparatus projects a high-intensity beam along the length of the runway, and a recording vehicle is towed along this beam. The photo-electric cells "lock" onto the light beam and ride it to the end of the runway. The data obtained is processed through computers and a curve or "profile" is obtained. This profile is actually a plot of runway power versus frequency or the runway's tendency to create aircraft vibrations. The amount of damage caused by the runway vibrations to an aircraft is already known.

When this responsiveness is compared to the runway's tendency to cause vibration, the forces produced on and within the airplane's structure can be determined.

English To Be World Aviation Tongue

Just as American-built aircraft dominate the commerical airlines of the world, our nation's language is becoming the universal aviation tongue.

English has become the language of the air traffic controllers all over the world as a result of the work of the International Civil Aviation Organization (ICAO) in producing standardized airways throughout the world, with facilities every airman can use, and a language every airman can speak and understand. Among the many standards already adopted by the 57 member nations of ICAO is the use of English in airways traffic control centers and airport traffic control towers.

The variety of English pronunciations can be imagined, but the fact that it works, and actually contributes to safety is a testimonial to the value of standards in world aviation.

Study To Lower the Boom On Sonic Plane Booms

Sonic "booms" caused by supersonic flight are being investigated by a science team at Armour Research Foundation, Illinois Institute of Technology. While the booms, which sound like a clap of thunder, probably cannot be eliminated, the scientists hope to be able to specify altitudes and speeds for certain meteorological conditions at which the effect may be reduced.

Air Travel, Plane Orders Soaring

During 1955, according to figures just released by the International Air Transport Association, 51,721,000 passengers travelled on scheduled aircraft of its 73 member airlines.

These passengers represented 85 per cent of all air travellers flying aboard commercial aircraft throughout the world. Of the 51,721,000 passengers, 9,350,000 were international travellers between nations of the world. Of interest, the association said, is that although the international travellers represented only 18 per cent of the member airlines' business, this group flew the longest distances and accounted for 29 per cent of the passenger miles flown.

Indicative of the soaring acceptance of air travel by world travellers, as well as the airline industry's belief that air travel will continue to climb, is the fact that 1,485 new transport aircraft for delivery before 1960 have been ordered by the world's airlines.

U. S.-built aircraft continue to have an overwhelming acceptance from the world's airlines. Of the approximately 5,000 transport aircraft in service throughout the world, an estimated 85 per cent were built by U. S. manufacturers. Of the 1,485 new transport aircraft on order, 64 per cent (948 aircraft) are U. S.-built aircraft. The balance of the new transports for the world's airlines have been ordered in England, France and The Netherlands.

Today, most of the U. S. airlines use piston powered transports which have been constantly improved over the years. The first U. S.-built turbojet transports are scheduled to start airline operations in 1959, although the piston powered transports will remain in operations for some years.

The dollar value of all turbojet and turboprop aircraft ordered for delivery by commercial airlines through 1960 — on a world-wide manufacturing basis — is estimated at approximately $2.4 billion. The value of piston powered planes scheduled for delivery through 1958, by the world's aircraft manufacturers, is estimated at approximately $1.1 billion.

Big Freezers Assist Bomber Building

(Continued from Page 1)

America's giant bombers is that once the metal is removed from the freezer it must be shaped within 15 minutes. Beyond that time it loses its workability. Once shaped on huge stretch hydro-presses, however, the metal's "spoilage" is no longer a factor. Age-hardening thereafter works to the good of the airplane in that the metal just becomes more durable.

These freezers in use by the aircraft industry to guard the quality of aluminum going into America's big bombers are a little large if you're thinking in terms of one for your kitchen—they're 20 feet long, three feet wide and four feet deep.

The original Wright Brothers' Kitty Hawk airplane weighed only 750 pounds — puny by today's standards. A single-place private airplane now in production weighs in at 200 pounds less, yet flies nearly five times faster than the Wright aircraft and over vastly greater distances. Lighter, more powerful engines and streamlined airframe designs — a product of design and engineering know-how of the United States aircraft industry — are responsible.

'PLANES'

Ultrasonic Plane Speeds Are Posing Serious Problems To Industry

(Continued from Page 1)

frame companies included:

- Development of new honeycomb-type cores for sandwich materials. This would include new materials like foamed metal, more efficient shapes of existing materials, etc.
- The development of inorganic adhesives as a high temperature bond for sandwich construction. This is also needed, especially for contoured surfaces.
- Sealants for hydrocarbon fuel systems and compartment sealing to 600 degrees F.
- Improved glass and other optically clear surfaces for high temperature windows and reinforced laminates for other portions of the aircraft.
- Development of enclosure materials including pyrex glass, interlayer materials, and transparent plastics to 600 degrees F.
- Better design data for plastic materials for use in laminated articles, insulators, and enclosures. Temperature and erosion resistance together with attractive dielectric properties and strength/weight ratios are desired. A temperature goal of 700 degrees F. for laminated plastics and insulators is desired.
- Development of rapid, effective and economical methods for treatment of the surfaces of steel alloys used as exterior surfaces of airframes for the purpose of improving oxidation resistance.
- The temperature goal is 700 degrees F. for use in fuel, hydraulic, and pneumatic systems, and aerodynamic seals.
- Fuel containers (plastic or otherwise) for temperature range 500-800 degrees F.
- Development of electrical insulating materials especially for wires for temperature range of 500-800 degrees.
- Development of materials and constructions for radomes for temperature ranges of 500 to 800 degrees F.

Although the problems relative to the materials needed for aircraft design and construction ten years from today cannot be clearly defined, recommendations from the airframe companies surveyed by the AIA Aircraft Research and Testing Committee emphasized the need for research on the high temperature problems of materials. Goals of from 1000 to 3500 degrees F. were forecast. The committee declared that particular emphasis should be placed on the development of protective coatings and cooling systems.

Information for designing aircraft with improved performance characteristics was not too difficult to obtain a few years ago. But the very rapid advance in aircraft performance has far exceeded the rate of development of materials. It is not enough for the state-of-the-art in the materials field just to keep up with the state-of-the-art in the aeronautical field. It must stay well ahead, for across-the-board advances are not possible without the availability of advanced materials.

Ever since all-metal construction of aircraft began, engineers have sought the *ideal* aircraft structural material—something that would have infinite strength at no weight whatever. Today even more is expected of this hypothetical material: Retain its properties and strength in temperatures ranging from 100 degrees below zero up to thousands of degrees Fahrenheit; be absolutely immune to the effects of extremely corrosive environments; withstand G-forces (multiples of gravity) high enough to crush conventional metals; and be unaffected by strong thermal and nuclear radiation. Besides all these ideal properties, this super metal should be abundant, and easy to work, yet nearly indestructible. Although a material with all these wondrous qualities may remain hypothetical, research and development for materials to meet as many of these requirements as possible continues at aircraft and metal companies throughout the country.

Air Industry TV Aids Public

The ease with which the people of America have peered into crowded hotel rooms and lobbies and closely eyed participants roving the floors of the recent national political conventions, is due entirely to the ingenuity of the United States aircraft industry.

The television camera—the world's tiniest—was originally developed by one of the nation's major aircraft companies to flight-test new aircraft. The tiny television camera weighs 24 ounces and measures 5 inches by 1 and 3/4 inches by 2 inches.

It had been designed by the aircraft manufacturer so that engineers could observe "out-of-sight" operations of an aircraft in flight — the landing gear in action during landing procedures, for example; or operations of the tail surfaces or ailerons under certain maneuvers.

Today the camera has been adopted by the television networks—made available by the aircraft manufacturer—as a public service so that the nation's voters may achieve a more thorough and intimate picture of their politics and politicians in action.

The microminiature television can go wherever a television cameraman can walk. Fitted with a special pistol-grip, the camera can be held and aimed like a revolver.

Electronics Guard Federal Airways

The Civil Aeronautics Administration, guardian of the nation's more than 81,000 miles of Federal airways, will purchase 445,994 electronic tubes during the next nine months for the airways system.

Contracts totaling over $1.5 million have already been awarded by the Civil Aeronautics Administration to 39 U. S. manufacturers of electronic tubes.

The tubes vary in price from 22 cents to $1,530 each. The Federal airways are an invisible network of aerial highways serving the nation's more than 60,000 civilian aircraft and thousands of the nation's military planes.

Jet Turbine Blades Hold Up Under 20-Ton Pressures

Turbine blades, mounted on rings, which whip air into and through a jet engine are subjected to temperatures ranging up to 1,500 degrees Fahrenheit—hot enough to melt nearly two-thirds of the elements known to man—yet these blades can take that great heat and still withstand pressures of over 20 tons per square inch.