U.S. AIRCRAFT ENGINES CAPTURE WORLD LEAD

Engine Industry Overcomes Development Lag Caused By Wartime Production Effort

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

Recent developments in both military and civil aviation have served to bring more sharply into focus the tremendous advances made by the American aircraft engine industry in the decade since World War II. Almost monotonous has become the procession of American combat aircraft through the sonic barrier and into the age of supersonic flight and associate air services. More lately, the impact of this progress of power has been felt in the announcements by America's airlines of vast new equipment programs involving both turboprop and jet transports, with airframes and engines built in this century.

A major milestone in American jet engine progress was marked recently when a speed of 823 miles-per-hour was made over a measured course established by a standard Air Force jet combat fighter. This achievement reflects great credit on both the airframe and engine manufacturers. The power plant of this great plane, designed and produced in the U.S., delivers more than 25,000 engine horsepower.

The newly established 823 miles-per-hour speed record gives new evidence that the "Made-In-U.S.A." label on jet engines is the worldwide standard for quality, reliability and efficiency.

The pressures of winning World War II had dictated that America concentrate its engine production genius on manufacturing the tremendous quantity of piston engines needed to insure victory over the Nazi Axis Powers. No other nation among the allies could even approach the piston engine production requirements of World War II.

As a result of this wartime occupation, the British were able to devote a markedly greater effort toward the development of jet engines than were American aircraft engine manufacturers. The Germans, with their Me-262, proved the worth of the jet engine for modern aircraft, at the same time sounding the death knell of the piston engines for military combat operations.

U.S. OVERCOMES BRITISH LEAD

It was not until America emerged victorious from World War II that the scientific talent of America's engine industry could be given free reign in creating the jet transport and jet combat airplanes. That they successfully met the challenge and overcame a head start of several years, is evidenced by the fact that the most powerful and most successful production engine in the world today is of American design and manufacture.

In the past few years American manufacturers designed and produced jet engines of ever increasing performance and efficiency. Not only were they challenged by entirely new concepts in engine design, (See 85,000 ENGINES, page 4)

Sonic Plane Equipment Heat Poses Serious Problems To Research

The aircraft industry, striving constantly to improve the quality and performance of American aircraft and equipment, is now waging a battle to find materials and structures that will withstand the heat and stress caused by the increased use of electronic equipment in modern supersonic planes.

One rack of electronic gear in a large jet airplane, for example, generates enough heat to keep two five-room houses comfortable in a North Dakota winter. But it makes the inside of the airplane cabin about as comfortably cool as a Finnish steam bath.

Airborne electronic equipment is usually cooled by apparatus which runs cold air around it and dumps the heated air overboard. However, as the size and complexity of the electronic gear in aircraft have gone up, so have their heat output, and, unfortunately, the volume and weight of the cooling apparatus have climbed right along. Therein lies the problem—for if there's one industry that must watch its weight more than any other, it is the business of building airplanes.

Aircraft manufacturers are all engaged in advanced research to find an improved cooling system for supersonic airplanes. Simple ram-air cooling, research engineers know, can do the job at speeds up to 900 mph. However, a supplemental cooling system must be carried for higher speeds. Applied research has indicated that it will probably be done with a mechanical refrigerator, a water evaporative system, or a fuel heat-sink system, but at the present time, each of these methods still present some knotty problems.

Apart from the integrated with equipment conditioning is the study of personnel conditioning. Efforts are being concentrated on the man and to a lesser degree on the cabin. Cooled, ventilated flying suits for crew members are now being considered.

Aerodynamic heating, the high skin temperature caused by a supersonic airplane's friction against (See HEAT POSES, page 4)
Qualitative Quality

In terms of urgency of current production and work in progress, no industry in America, in a sense not even that at Oak Ridge or its satellites, is more important to the freedom of the free world than the U. S. aircraft industry.

The members of the nuclear bomb family, of course, represent the acme of the destructive power of U. S. weapons. There was a time when the naked threat of the U. S. to “drop” the bomb might have been sufficient to ensure a safe peace. But since the secret is no longer safe alone, the prospect of retaliatory atomic warfare subtly shifts the emphasis to the ability to “deliver” the bomb with rapidity and precision. Henceforth, the potsherd of strategic war will still be afraid to strike only as long as he respects and fears the quality and efficiency of the vehicles that transport our explosives to critical targets.

The United States aircraft industry—airframe, engine, electronics and associated components and accessory manufacturers—more than ever before is concerned with the quality and efficiency of their aviation products and how they perform in the aerial weapons system. This concern is generated by two considerations. First, that the increasing cost and complexity of equipment demands exceptionally high levels of quality and reliability. Secondly, the vastness of the aircraft industry supply system itself makes it extremely difficult to keep an eye on quality.

In the aircraft industry the process which assures “built-in quality” is called quality control. Quality control doesn’t begin at the end of an aircraft company’s production line, nor even at the beginning of it. It begins in the aluminum and steel mills in Pennsylvania and Nevada, in the rubber factories in Ohio and electronics labs in New Jersey. The superior quality required in the highly complex fighter craft and civil transports today, has to be built into the equipment during the entire aircraft manufacturing and assembly operation.

The very complexity and independence of all components of modern aircraft means that quality must be kneaded into an airplane at every stage of its component making and cannot be bestowed with a rubber stamp after the plane is finished. Today an army of quality control men, armed with pressure gauges, reflectoscopes, torque meters, and many other intricate devices of high accuracy, test and check from the time the raw material comes out of the ground until the airplane flies away, and even after.

As an example, one large aircraft manufacturer is now spending $5 ½ million on quality control annually in one production plant alone, and this corporation has three other divisions in two other states.

“How to do it” experts at this typical plant take the engineers’ drawings and determine how to form sheets of aluminum to difficult contours without compromising material strength; how to evenly heat treat large pieces of highly tempered steels to increase their reliability; how to drill a hole at tolerances of two ten-thousandths of an inch, etc.

Another group of the quality control team prepares and continually updates inspection directives to see that the processes worked out by the “how” people are complied with.

A third group—the working inspection team—do the actual measuring and testing. These experts have the run of the aircraft plant. They poke their noses into everything, and if they don’t like what they find, they order instant corrective measures.

Today we fly at speeds measured in Mach numbers instead of mere multiples of hundreds of miles per hour. To get to Mach one (the speed of sound), a fighter must have an engine that will develop upwards of 10,000 pounds of thrust. Or, in the case of 600-mile-per-hour jet bombers, multiples of engines developing as much as 100,000 equivalent horsepower. In addition, these planes must perform faultlessly at altitudes where, save for artificial protection, the pilot’s blood would boil and his body would explode like bubble gum.

And every foot of altitude, every new knot of speed, every new mile of range adds to these stresses and strains. Yet, we must not fail; for on the quality of our aircraft will depend much of this nation’s ability to withstand the great stresses and strains of international relations.
AOPA Claims General Aircraft Owners Will Number 100,000 By 1965

General aviation, which accounted for some 93,000 airplanes last year and flew more than 8.7 million hours, is just beginning to come into its own, according to the Aircraft Owners and Pilots Association.

These aircraft engage in all the flying that is done with the exception of the scheduled airlines and the military, and last year they were in the air almost three hours for each hour flown by the big commercial transports.

After researching the status of general aviation today and its prospects 10 years hence, AOPA says that one light aircraft manufacturer expects to have at least 6,000 of its twin-engine models in operation in 1965. Another estimates a total of 2,500 of its twin-engine type will be flying at the end of the decade and another set will figure in these three types from only three manufacturers account for 10,000 planes, nearly seven times that of the scheduled airlines combined.

This figure doesn’t include the tens of thousands of other types of light planes that will be flying at the time. One manufacturer of popular four-place aircraft says his company will have as many as 18,000 of these single-engine aircraft in operation during this period and another sets a figure of 12,000 for the year total.

Since the precision and skill that goes into the manufacture of these planes, plus the completeness of maintenance required by the Civil Aeronautics Administration, gives light aircraft unlimited years of useful life, the number of planes engaged in general aviation in 1965 should easily exceed 100,000.

Ben Franklin’s Kite Aids Air Industry

Instruments sensitive enough to measure electrical current as low as 1/10,000 of a millionth of an ampere are being used by aircraft industry research scientists to probe electrical secrets in the stratosphere. Scientists temporarily loaned to USAF’s Research and Development Command, elaborating on Benjamin Franklin’s famous kite and key experiment, have started launching special electronic “field strength meters” soaring aloft with huge plastic balloons from a Florida Air Base.

These meters, designed by research engineers of a large aircraft electronics company, are capable of measuring electric current as low as 1/10,000 of a millionth. Roughly speaking, one hundred million million times as much current would be needed to momentarily light a pencil flashlight. They are being used to measure the electrical charges set up by thunderstorms. The mid-Florida site was chosen because it is the scene of frequent summer thunderstorms.

The electronic instrument, hanging about 300 feet below the balloon, records such things as the change in voltage, the presence of invisible clouds (charged masses of air) and the electrical characteristics of thunderclouds. The moment the meter picks up electrical measurements, it simultaneously radiates the findings to a ground recording station.

Data gathered will be invaluable to American researchers in learning more about the nature of the electrical current constantly flowing toward the earth. This alone is a mystery scientists have been trying to fathom for a half-century, although they do know that at sea level the electric field may be equal to something like 50 volts per foot, tapering off to about ½ volt per foot at 100,000 feet up.

The stratospheric explorations are preliminary research in the 60,000 to 100,000-foot altitude. The research project is also expected to have great impact on building the world’s best jet engines to power America’s military aircraft requires infinite engineering skill and ingenuity. One new jet engine now in production produces 50 per cent more power than its predecessor, yet the size of the engine frame is the same. This clean, efficient design saves not only time and money in building superior air power, but also conserves precious pounds of hard-to-get materials.

Air Quotes

We need the strongest, healthiest possible domestic and international airline system. Time after time in emergencies our commercial airline crews, equipment, and staffs have helped to contribute to a crucial military margin, as in the early days of the Korean conflict.

The aircraft and airline industries are not a luxury for America. They are not simply another business which we may blithely watch lagging or encountering difficulties.

America’s free enterprise airline industry today requires enormous stockholder and bondholder investments, simply for necessary constant modernization, let alone for expansion. Every effort to encourage sound modernization and sound expansion needs to be made.

Meanwhile, we can ill afford an arbitrary “stop and go” military aircraft production system, alternately expanding overnight, then being slashed overnight. I realize that as the world situation changes, our military plans change, but surely we can provide greater continuity in our planning. Similarly, mass inductions of our cadets and mass release of trained pilots doesn’t make sense. Meanwhile, the mighty civilian aircraft and airline industries remain as mainstays—mainstays of the very life of this nation in an age strung with peril.—Honorable Alexander Weyer, Republican from Wisconsin, United States Senator, July 16, 1955.

Computer Lops $29,970 Off Taxpayers’ Bill

Electronic computers used in engineering America’s jet aircraft save the taxpayers many thousands of dollars every year.

As an example, mathematical problems which would cost $30,000 for every million operations by a clerk using a desk calculator are now done on these complex computers at a cost of only three dollars per million operations. And, further, it is estimated that in the future through wider uses of the electronic wonders, the cost for the same purpose of operations may be reduced to as little as 30 cents.

Not only behind the closed doors of aircraft engineers and scientists are these revolutionary new machines paying for their keep, but they have also added enormously to the operational ruggedness and reliability of modern supersonic military aircraft and commercial transports.

Devices Aid Other Industry

The development of electronic units capable of withstanding extreme changes in temperature and severe pressures and shocks encountered at jet speeds and altitudes has also been essential in manufacturing the delicate electronic components. Ultra-premium tubes are capable of withstandin temperatures as high as 350 degrees Fahrenheit. Borrowing from the control principles used for aircraft and missiles, these electronics are now being used in many industrial processes.

long-range military and civilian communications and weather forecasting.

Airline Subsidy Doesn’t Amount To Peanuts

The cost of air transportation to the people of the United States doesn’t amount to peanuts, and the only big thing about airline subsidy is the return which the country gets for its money.

These facts were disclosed at the 10th Anniversary General Meeting of the International Air Transport Association (IATA) in New York by Sir William Pickard, director-general of the organization.

It was recently announced that the U.S. government estimates that it will pay out during the new fiscal year approximately $30 million in subsidies for overseas and territorial carriers.

Sir William points out that this is less than one third the amount American youngsters spend each year for comic books, and is a good deal less—nearly $15 million less—than the government spent in 1945 on price support for peanuts.

The low cost of modern air travel to the world’s governments is further emphasized in the report by the fact that the $60 million paid annually by the French government for its own subsidy is much greater than that paid for the public support of transport costs.

Also, the capital cost of London’s airport is equal to only 10 per cent of the subsidies being paid to British agriculture in the course of a year. By contrast, 340,000 tourists arrived in Britain last year and spent upwards of $98 million.
U.S. Aircraft Engine Builders Have Delivered 85,000 Jet Engines

(Continued from page 1)

but whole new fields of science had to be developed in advance of the reciprocating engine. Jet engine research had to be supported by the development of new machines of new design. Entirely new manufacturing techniques had to be perfected and elaborate test facilities constructed.

During World War II, "fast" 400 mile-per-hour fighters had engines which produced about 1 horsepower for every 1.5 pounds of engine weight. Today, U.S. supersonic jet fighter engines produce 1 horsepower for every 4 ounces of engine weight. The best engine of World War II delivered 85 pounds per square inch of thrust, but as a result of advanced U.S. aircraft engine research, engineering, and manufacturing techniques, we are now developing engines with a thrust output substantially in excess of 25,000 equivalent horsepower.

The aircraft engine manufacturers invested tens of millions of dollars of their own money to supplement federal funds in hastening new engine research and development, as well as in building these new facilities and production equipment. The magnitude of these privately invested funds of the aircraft engine manufacturers was the driving force which put jet engines primarily for military use is unique in the annals of modern industry, and within the past 15 years was the most significant factor in jet propulsion. Until recently, jet engines were used only on military aircraft, but now they are finding their way into commercial and airliner engines.

Reliability Saves Millions

Paralleling tremendous advances in performance and in the weight power ratio, have been the increasing reliability and economy built into our jet engines. This is best illustrated by the fact that the government was recently able to cancel an order for only 1,600 jet engines, representing a savings of more than 56 million dollars of the taxpayer's money.

This economy did not result from any reduction of the combat capabilities of the military services; rather it resulted from the fact that engine reliability had increased to such an extent that they are reaching the service life number of turn back the threat of Communist air power in the Far East. The 14,000-mile service record set by the United States F-86 over the Mig-15, left no doubt as to the superiority of American made aircraft and engines.

Air Fireman

For the first time on record, a forest fire has been put out by spraying water from an aircraft. The fire covered 50 acres near Wenatchee, Washington. As the fire party arrived, the aircraft had completely suppressed the fire.

Heat Dissipation Poses Research Problem

(Continued from page 1)

the air, is another heat source which will require additional cooling equipment.

At twice the speed of sound, or about 1,500 miles per hour at sea level, friction generates heat on airplane surfaces as high as 215 degrees F. At this temperature strength characteristics of the aluminum in an airplane begin to decrease. At three times the speed of sound— Mach 3, or about 2,500 miles per hour—the temperature reaches a sizzling 600 degrees F, where aluminum loses practically all of its strength. Other metals, such as titanium or stainless steel, are required for these speeds. But even the present commercial grade of titanium begins to lose its strength at a point between 800 and 900 degrees F.

Aircraft engineers are working on another approach to the heat problem—that is, to install equipment which will operate efficiently under very high temperatures.

Instead of cooling parts to keep the grease in them from melting, researchers seek a grease that won't melt. Instead of cooling tires to keep them from blowing up, the need is for tires that won't blow up. Instead of cooling airplane skins to keep them from melting, materials that won't melt are sought for skins.

One major aircraft company has already partly whipped the problem by the development of aircar bearings which will operate at high temperatures and high altitudes. Fantastic as it sounds, bearings have been built which will operate dry at temperatures of 100 degrees F.

The aircraft industry is progressing steadily in finding new ways to beat the heat. There is no doubt that they will succeed, if past performance in maintaining American aircraft superiority is any indication.

Pictured above is a striking example of the extremes of motive power needed in the building of American air superiority by the United States aircraft industry. Shown at left is the assembly under a magnifying glass of a tiny, electric, servo motor weighing one and two-tenths ounces. It develops one one hundredth horsepower and is used in military aircraft to control electric motors, which drive electric pumps. Each motor weighs 25,000 pounds, and electric motors of this type are required to start the two big motors. Combined horsepower rating of all four is 216,000 horsepower. The entire installation occupies space as long as two football fields,