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# planes

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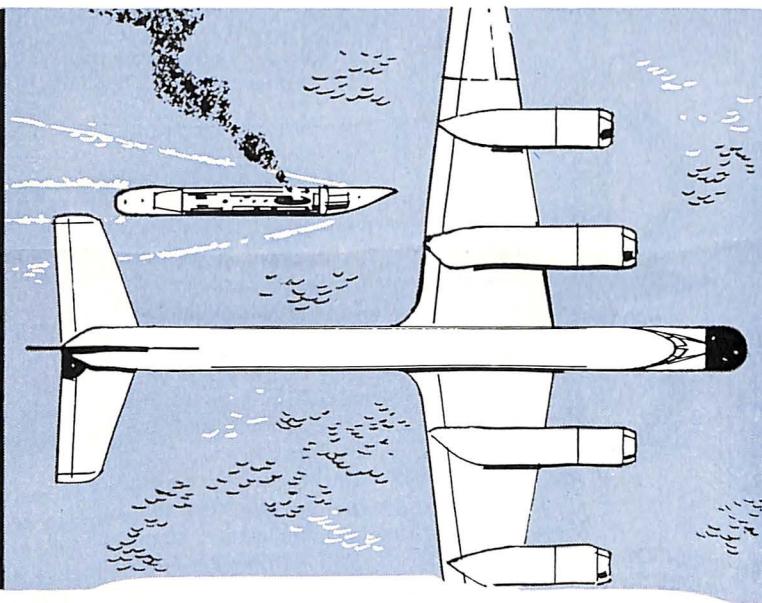
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## VITAL AIR-SPACE BILLS FACE CONGRESS

### THE BIG LIFT

Turbine-powered aircraft now on order by the world's airlines will provide as much new passenger transport capacity as 160 ships of the *Queen Mary* class, and next year it is expected that the airlines operating on the North Atlantic route will carry more passengers than the ocean liners. The increasing growth of airline traffic is largely due to the series of high-performance transports developed and produced by the aircraft industry.

'PLANES'



### Mach 2 Aircraft Entering Military Inventories in Quantity, Replacing Subsonic Models

Operational Mach 2 Aircraft today are entering military inventories in quantity, representing another major step forward in providing modern air power.

Air Force wings and Naval air units are now taking delivery of these very high speed planes and they will be in service within the next few months, replacing aircraft in the subsonic and even supersonic speed ranges.

The first bomber capable of speed in the Mach 2 range soon will be delivered to Strategic Air Command. The bomber carries a missile which can be fired miles away before reaching the target. This weapon system represents a highly desirable combination of man's judgment, an aircraft's reliability of operation and the advantages of a guided missile. The plane can also be used for other missions such as reconnaissance. At the time the Mach 2 bomber is entering service, another bomber capable of speeds beyond the Mach 3 range is progressing well into the development stage.

Fighters capable of Mach 2 speeds are in operational units today, and during 1959 the Air Force will have at least three fighter models in this speed category and the Navy will have three fighter types capable of similar performance.

In less than ten years, the aircraft inventory of the military services has

changed drastically from World War II propeller-driven types, to subsonic turbojets, to supersonic jets, and now the age of planes operation at multiples of the speed of sound is at hand.

Formerly, performance gains of a relatively few miles per hour and an increase in operating altitudes of a thousand feet were considered major accomplishments. Today speed increases are measured in Mach increments—about 660 miles per hour at operating altitudes—and altitudes increases of several thousand feet.

Meanwhile, the aircraft industry has continued to modify and perfect the subsonic bomber fleet, increasing its performance and combat capability. The long-range bombers now being delivered to SAC units, although they carry the same numerical model designation, are actually a far superior weapon to those first delivered.

Along with these aircraft performance jumps, the aircraft and missile industry has placed in production intercontinental and intermediate range ballistic missiles and a wide variety of missiles designed for air defense and offense.

The avalanche of discoveries from the research laboratories of the aircraft and missile industry are being rapidly transferred to the assembly lines to insure this nation's superiority in air, missile and space power.

### Electronic Power Steering System Is Developed for Supersonic Fighter

An electronic power steering system designed for a new supersonic fighter-bomber makes steering the jet—which takes off and lands at speeds between 150 and 200 miles an hour—as easy as steering the family car.

More than 2,000 hours of engineering time and pilot reaction studies went into the final design of the system to tailor-make it to match the average pilot's physical reaction characteristics.

Developed by two aircraft companies, the assembly consists primarily of two potentiometers, a transistorized amplifier, a servo-mechanism and a hydraulic unit and structural linkages.

When the pilot nudges the rudder pedal, this signal is picked up by one potentiometer, amplified and fed to the servo that turns the wheel. The other potentiometer measures the change and relays the information back to the servo when it is time to "close the loop." The entire sequence is accomplished within thousandths of a second.

Conventional mechanical steering systems were too slow to cope with the high-speed landing and takeoffs of the supersonic aircraft. A half-second delay in responding to the pilot's signal, or an infinitesimal amount of "play" in the steering arrangement could mean the jet would plunge off the runway.

The new system guarantees complete control of the jet on the ground.

### Procurement Law Change Proposed

The U. S. aircraft and missile industry today has responsibilities unparalleled in industrial history. This industry has the same obligations to stockholders as all other manufacturers, but more than corporate success hinges on its actions—the effectiveness of our national defense program, our role in space exploration is directly involved.

This places a vital premium on the necessity for prudent, imaginative decisions by management in the aircraft and missile industry. In addition, technological progress in the industry is so rapid that a sound decision made six months earlier on the basis of available knowledge can be nullified by a major technical discovery. And even the best decisions can be hamstrung by administrative rules not geared to a fast-moving technology.

#### Set By Congress

Approximately 80 per cent of the gross sales of the aircraft and missile industry are made to the Government. The detailed regulations are established by skilled procurement personnel in the Department of Defense, but much of the basic policy direction and, in many cases, actual procedures are set by the Congress. Consequently, the aircraft and missile industry is vitally concerned with Congressional actions since they are major factors in management determinations of weapon project investments.

The new congress which convened this month will take up new legislation effecting the industry, and will consider changes in existing laws. One major bill—introduced during the closing days of the 85th Congress and scheduled to be introduced in the 86th Congress—contains amendments to the act governing defense purchases. The broad purpose of the bill, according to its sponsor, is to achieve efficiency and economy in the procurement process through the use of the free competitive industrial system whose potential can be realized only if adequate incentives are offered.

The exact nature of changes will not be known until the new bill is introduced, and hearings are held with both Government and industry witnesses offering opinions on the

(See AIA, Page 7)

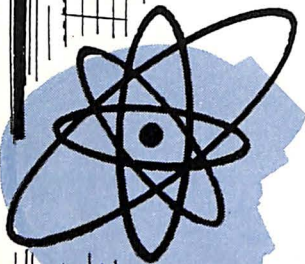
## Plane Views

ONE HUNDRED JET BOMBERS WITH NUCLEAR WEAPONS CAN DELIVER 300,000 TIMES MORE EXPLOSIVES THAN 700 WORLD WAR II AIRCRAFT.

100 JET BOMBERS  
300,000 TIMES  
MORE EXPLOSIVES



A STRUCTURE THE SIZE OF THE EMPIRE STATE BUILDING WOULD BE REQUIRED TO HOUSE THE ELECTRONIC COMPUTERS NECESSARY TO EQUAL THE PROCESSING CAPACITY OF THE AVERAGE PILOT'S BRAIN.



INITIAL COST OF THE AIRCRAFT IN A MODERN JET FIGHTER WING IS \$122 MILLION COMPARED WITH THE \$22 MILLION COST FOR A WORLD WAR II FIGHTER WING.

'PLANES'

### AIR QUOTE

"There is always a great temptation to lean heavily on tradition. You will recall that when the aircraft was first invented, very few men recognized its military potential. Those who did, were partially stymied by traditional thinking, and the usefulness of the aircraft as a weapon was not fully exploited. Thus when World War I began, the United States was far behind other nations in aircraft and engine performance.

"Today, the Air Force's traditional weapon—the aircraft—is being challenged by unmanned vehicles. But with us in the Air Force, mission performance is the answer. If the unmanned vehicle can do the job better, it will be used. If the manned vehicle can do the job better, it will be employed.

"... Thus far, examination of the various possibilities before us indicates that Air Force weapon systems of the future will be mixed—that is, we will need a force of both manned and unmanned vehicles. By exploiting the best features of both systems we feel we can increase the rate of application of firepower."—*Gen. Thomas D. White, Chief of Staff, USAF, Oct. 4, 1958.*

### NAEC Offers Booklet for Primary Grades

For educators eager to provide students with learning experiences from our world of flight, the National Aviation Education Council has published the booklet *Aviation Units For The Primary Grades*.

Made available to teachers by the Materials of Instruction Committee of the NAEC, the booklet contains units for grades one, two and three, which should provide a solid foundation in aviation age education.

Each unit includes concepts to be developed, suggested activities, books and materials needed for carrying out these activities, field trips to be taken, methods of correlating aviation with science, language arts, arithmetic, art, etc. The aviation education program should lend considerable enrichment to other parts of the curriculum. The booklet also contains a comprehensive bibliography.

*Aviation Units For The Primary Grades* may be obtained by writing to Dr. Evan Evans, Executive Director, National Aviation Education Council, 1205 Connecticut Ave., N. W., Washington 6, D. C. Cost is 50 cents per copy. Also available is the booklet *Aviation Units For The Intermediate Grades*, price 50 cents.

## PLANES

*Planes* is an official publication of the Aircraft Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

The purpose of *Planes* is to:

Foster public understanding of the role of the aviation industry in insuring our national security through development and production of advanced weapon systems for our military services and allies;

Foster public understanding of commercial and general aviation as prime factors in domestic and international travel and trade.

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Editor: Gerald J. McAllister Art Director: James J. Fisher

## Progress and Programs

Little more than 15 months ago, the USSR hurled a satellite into orbit around the Earth and brought into sharp focus the great advances Russia has made in technology.

Reactions in the United States and in other countries of the Free World were varied, ranging from a "so what" attitude to thorough alarm. The official response of the U. S. was immediate. Congress moved promptly to establish a national space agency, and provided nearly a billion dollars to this agency and the Department of Defense for carrying out space programs.

During the past year we placed into orbit five satellites, including one weighing more than four tons. In addition, two probes were thrust into space to heights greater than any other man-made objects had reached. An experimental, rocket-powered aircraft was rolled out, and preparations are well under way for man's first flight to the fringes of space. Most of these accomplishments were largely based on experience with long-range ballistic missiles, which entered production during the year.

While this dramatic progress was being made in space and missile programs, the aircraft industry prepared to deliver to operational units the first Mach 2 bomber and six fighter models in the same speed range.

There is no question that record of achievement in the past year is outstanding and, more important, has set the stage for even more dramatic progress.

But achievement carries with it the danger of national self-satisfaction to the point of neglect. There is an inclination to coast after initial successes are gained and even to read success into failure. There is no surer formula for losing a slim technological lead. The pace of technical advances today is so swift that we could well find that no amount of money or effort could regain a lead once lost.

Dr. William H. Pickering, Director of the Jet Propulsion Laboratory of the California Institute of Technology, recently said that one of the greatest problems facing the nation today is the "psychology of failure" which seems to be gaining a foothold. He warned against this negative thinking. There is certain knowledge acquired from testing whether it is a success or failure, but Dr. Pickering says we must "set success as our goal and be content with nothing less."

This noted scientist points out that a missile is a very complicated device. "But so is an airplane," he says. "An airplane has many more parts than a missile and I, at least, am certainly glad that airplanes were not developed in an atmosphere of expected failures. The problem comes back to the fact that we have tried to move our developments ahead faster than engineering experience or the state-of-the-art dictated as prudent. We have tried to run before we could walk.

"Today the industry is facing a crisis in missile development, particularly in its space programs. . . . We need sound engineering, reasonable flight test objectives and a careful evaluation of the real national program needs. Our engineers and firing crews are gaining experience; we can do the job right."

This analysis is fully appreciated by the aircraft and missile industry which has historically urged that aeronautical and space programs be backed by continuous, well-supported funding.

Today's technology will not permit fitful starts and stops. We cannot afford the expensive crash solutions, forced upon us in a sort of international "keeping up with the Joneses" approach to national defense programs. The Russians apparently know what they want to do. The U. S. must be sure of its programs and move forward with all deliberate speed.

GEN. ORVAL R. COOK, (USAF-RET.)



served as the Air Force's Deputy Chief of Staff for Materiel, with over-all responsibility for USAF industrial planning and procurement matters, from July 1951 to February 1954. He became President of the Aircraft Industries Association in January 1957, and immediately prior to his retirement from the Air Force in May 1956 he served as Deputy Commander in Chief of the United States European Command. Prior service in the procurement and production field included the position of Director of Procurement and Industrial Mobilization Planning, Deputy Commanding General for Operations and Director of Procurement and Industrial Planning, all at the Air Materiel Command. During World War II he served with the Far East Air Forces in the Southwestern Pacific.

# Revolution in Evolution

## **Technology Dictates Change in Industry**

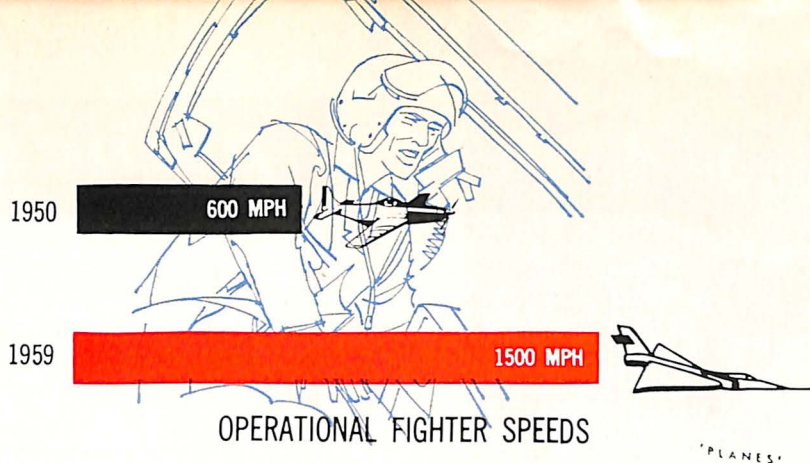
By Orval R. Cook

*President, Aircraft Industries Association*

**T**HE start of any new year is a time for summing up, and any review of the activities and achievements of the aircraft industry in the year just ended makes one point very clear: it was a year of marked change as regards the status of the industry, its roles and its responsibilities.

Change is nothing new to the aircraft industry. It has been a standard condition among manufacturers of aeronautical equipment since the earliest days of their existence. The history of the industry has been one long saga of adjustment and readjustment to changing times and changing requirements. In recent years, however, the *degree* of change has become ever more evident.

The changes in industry's status extend across the wide canvas of manufacturing activities, from the type of product being built to the type of facilities needed to build it, from research through production, from know-how in the shops to forceful and imaginative leadership on the part of top management. They are changes dictated by a variety of factors, from the demands of a modern system of commercial air transportation to the fantastic requirements of modern weaponry for defense



against aggression and the support of a global foreign policy.

These changes are perhaps best illustrated by considering not just the year past nor the new one on which we are embarking, but the whole decade. We are entering the final year of a calendar decade which started on January 1, 1950, a decade of incredible accomplishments in aeronautical progress which even the most advanced prognosticator could not have predicted.

At the start of this decade, we had achieved supersonic flight only in experimental aircraft. Turbojet planes were in production for the military, but they were subsonic aircraft and they were very much in the minority relative to the total equipment inventories of the armed services. Some commercial aircraft had reached the 300-mile-per-hour speed level; they, too, were in the minority.

**T**HE guided missile as a weapons system was still "on the horizon." The industry had, of course, been conducting research in this area for a great many years, some of it even prior to World War I, but the missile did not come into its own until a series of breakthroughs permitted small-package nuclear warheads. At the start of 1950, there were a handful of missile types in various stages of flight test and other, more advanced types on the drawing boards, but no missile had reached operational status.

Today, each of the services has a number of missiles of operational capability and even the extremely sophisticated hydrogen-warheaded missiles of intercontinental range have reached an advanced degree of development. Manned military aircraft, even long-ranging bombers, have speed capabilities of more than twice the speed of sound. Even in-service passenger-carrying aircraft have attained performances which at the start of this decade were the sole province of the latest military equipment.

Man-made objects now are penetrating space beyond the atmosphere with regularity and preparations are being made to put man himself in space.

In this era of incredible technological progress, however, we have little time to stop and marvel at what we already have accomplished. Before we could adjust to the idea of manned Mach 2 aircraft, development programs were started for planes which will fly at three or more times the speed of sound. The current crop of missiles, themselves masterpieces of automation, have become obsolete in the minds of the men whose job it is to stay abreast or ahead of foreign progress in weapons systems. And, while the Space Age is still in its infancy, scientists and engineers are

devising new space projects, for reasons scientific or military, which would have made even Jules Verne gasp in astonishment.

Perhaps the single most important step in the advancing technology was the breakthrough in nuclear power applications which permitted small-size atomic and hydrogen warloads. The vastly greater destructive capability of a single nuclear weapon brought about a gradual but steady trend away from the mass application of force by numbers toward a greater reliance on the individual weapon, either a missile or a manned airplane, or a combination which weds the advantages of both.

From the standpoint of modern defense, this new approach resulted in a more efficient utilization of available manpower without reducing over-all effectiveness. But it brought with it a series of other trends. It demanded extremely high performance, and this brought a far greater emphasis on research and development. To achieve the required performance, complex equipment was needed, and complexity brought with it a spiraling climb in weapon costs.

The dynamic technology which changed military tactical concepts in turn produced widespread changes within the aircraft and missile industry, the bulwark of defense pro-

duction. The primary change was the assignment by the Department of Defense of greater responsibilities for development of weapons systems to industry, which produced corollary changes in the methods employed in building these weapons, in financing them and in managing the programs.

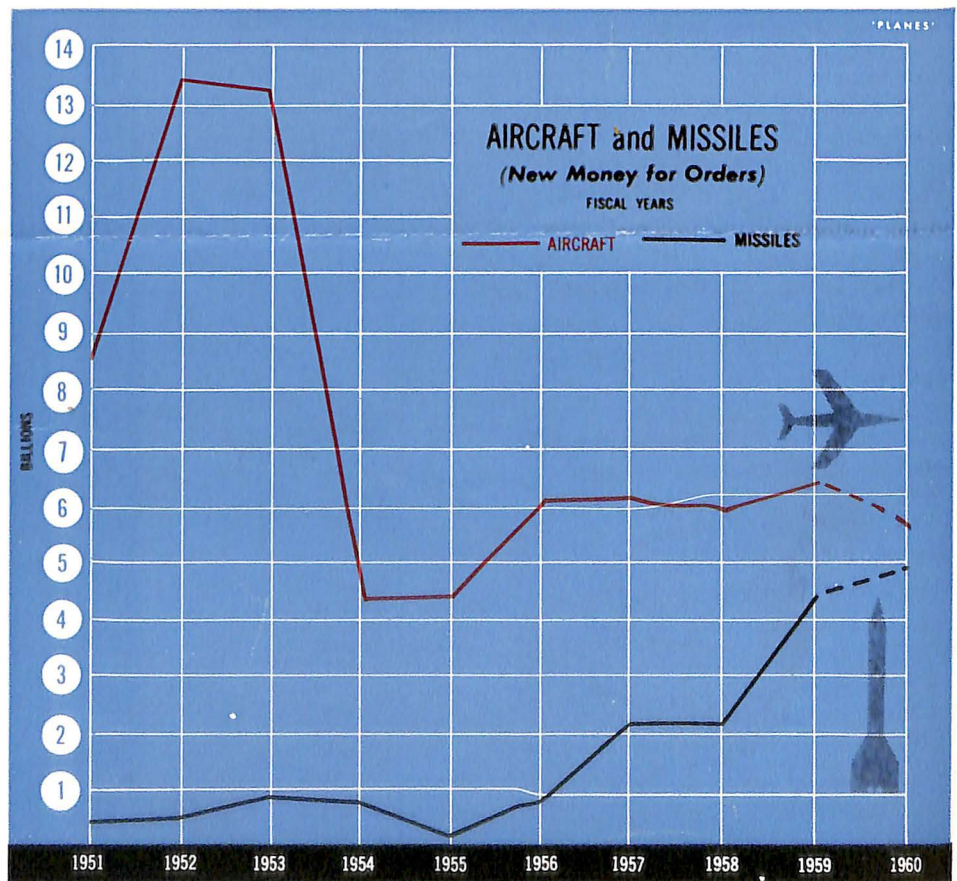
As these modern weapons began to reach operational status in the early 1950's, there came about a sharp decline in quantity requirements. The mass production techniques of World War II were no longer applicable. Short production runs became the order of the day.

**A**T the same time, rising costs dictated by performance and complexity had a separate impact. During the Korean War and for some time thereafter, it was the custom of the military services to build several types of equipment for the same job—two or three fighter-bombers, two or more interceptors, etc. This was a form of insurance, both from the standpoint of the performance of the aircraft and the producibility of its builder.

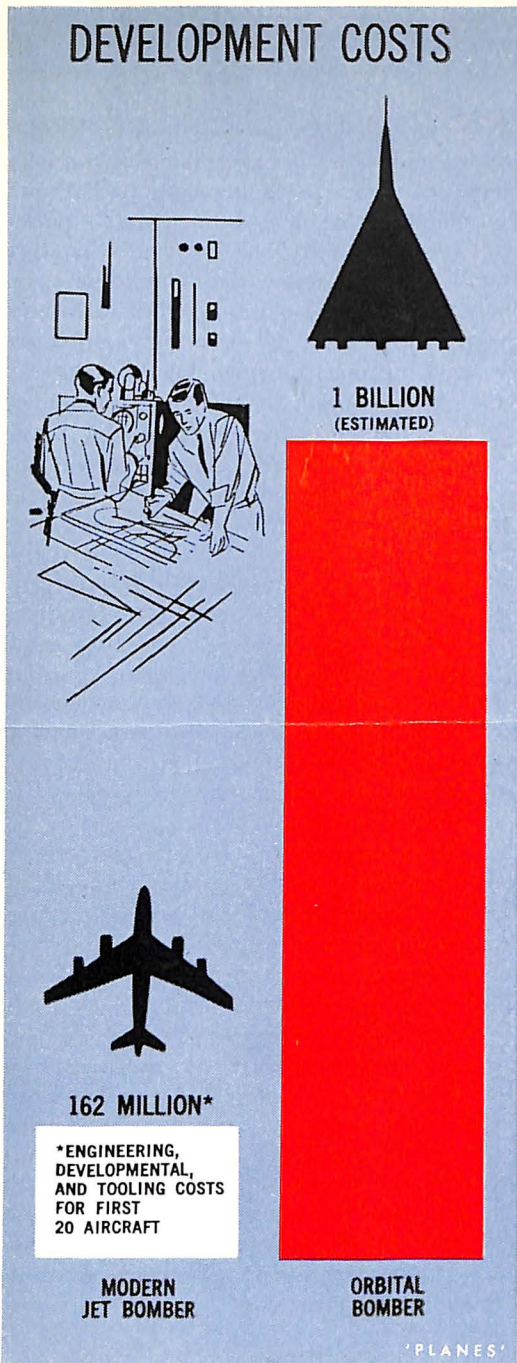
Except in a few cases where the technological challenge was so great as to warrant parallel developments, this approach disappeared with the emphasis on individual, high performance, highly-complex weapons.

All of these factors, overlapping and inter-related as they are, were translated into changes within the aircraft and missile industry.

First, there was the competition for military business. With fewer projects and fewer units in each production order, competition became more intense. This called for a shift in personnel emphasis ranging from the shopworker to top management. Scientific and engineering talent became extremely valuable, and the proportion of scientists, engineers and other highly skilled technicians to the over-all company payroll went up sharply because of the demands of complexity.



## DEVELOPMENT COSTS



Similarly, as costs became more and more important, the demand increased for stronger managerial teams to combat costs through productive efficiency. Fresh, imaginative thinking became increasingly important in all phases of the manufacturing process.

Competition also had its effect on company product lines, starting at the same time a trend toward diversification and specialization. As systems became more complex, the field of specialization broadened. Where previously companies had specialized in major aircraft components, they now found a need for expanding their electronic, mechanical and chemical laboratories. Some companies concentrated on one of these main areas, or even sub-areas within them. Others decided on product diversification and companies known for years as solid, efficient builders of airframes, for instance, suddenly branched out into guidance, propulsion and other areas of importance to the new type of product.

Within the new tactical concepts, time became more important. In the leap-frogging technology, there had to be an attempt to produce weapons more rapidly despite their increased complexity. This meant that com-

petitions for new programs had to be decided earlier. There was no time to order a few prototypes and choose between them after a long evaluation of their capabilities. Competitive designs were evaluated before they were ever translated into hardware in some cases.

In this connection, managerial, scientific and engineering talent is again an important factor because the competence of the management-technical team must necessarily be a leading consideration in the selection of a contractor. But the demonstrated competence of any team is secondary to the designs they produce and the manner in which they produce them.

Herein came a new requirement for industry: facilities, not only for production of the end item, but for the intricate research, development and test work which must precede its acceptance. Thus, an industry whose earnings rate has traditionally been the lowest among American industries was faced with the necessity of diverting larger portions of its meager income to construction of facilities. The alternative was to lose competitive standing.

At one time, the Government supported to a large extent a facilities expansion and construction program. At that time, it was militarily expedient to do so, because there was a need for wartime producibility.

The explosive technology of the past decade also had its influence in this area. The tremendously increased destructive potential of modern weapons leaves little room for the hope that we can produce a retaliatory arsenal *after* the first blow is struck. Current thinking is to the effect that an all-out war must be fought with the resources on hand at its outset, obviating the need for a vast complex of stand-by manufacturing facilities.

The Government is still financing facilities construction to some extent, but there is an increasing degree of reliance upon use of privately-owned facilities. Advancing technology has dictated large-scale building programs because existing facilities are not adequate for research, development and production of the new weapons. Industry finds itself in the paradoxical position of having to finance this new construction at a time when a number of plants designed for earlier weapons are being retired, because it is usually less expensive to

build a new facility than to attempt to modify an existing one.

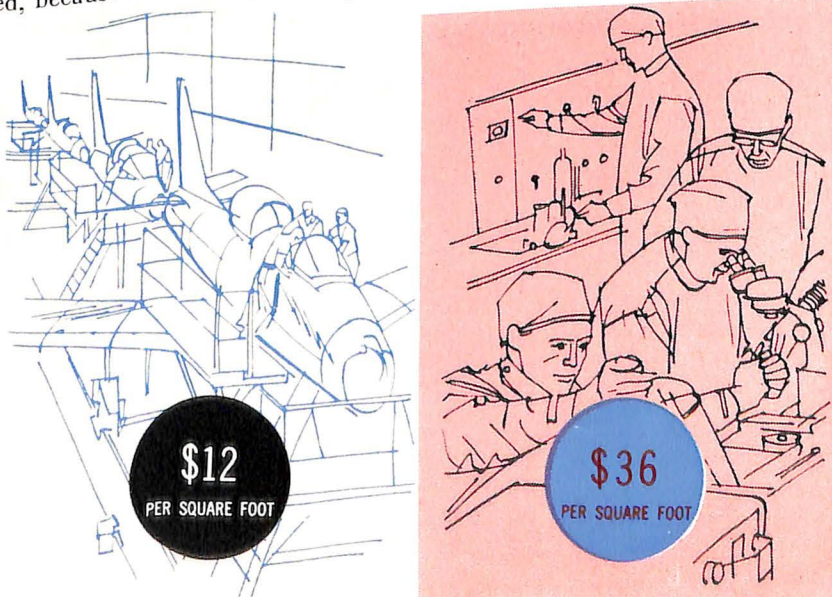
These new facility requirements for the most part stemmed from the elimination of man in automated weapons. Man's brain and muscle power represent the most efficient guidance and control system ever developed. Human functions can be duplicated to a large extent by electronic, hydraulic and mechanical devices, but these devices must be provided with an extreme degree of accuracy and reliability if the substitution is to be effective. These requirements translate directly into facility needs. To illustrate, consider a recently-constructed typical facility designed for the manufacture of a complex missile component.

**T**HE assembly of this component must be accomplished in a vibration-free area. This demanded special foundations to still vibratory effects from an adjacent factory and from street traffic. The assembly room must be surgically-clean, which required installation of several types of equipment to prevent dust particles from entering the area. Parts must be assembled under rigid temperature and humidity control, so such control measures and equipment had to be built into the facility. Even the ceiling of this assembly area had to be specially designed to permit external replacement of defective lighting equipment, since workmen cannot enter the room during operations. To get parts into the room, special air locks had to be devised.

Outside the final assembly room, elaborate test equipment had to be installed, since test has become an integral part of the manufacturing operation from start to finish. This automated test equipment, together with the equally complex computer-operated manufacturing tools, also needed special foundations.

This is only a brief sample of the facilities and equipment requirements for modern weapons, but it should serve to point up the fact that conversion of old facilities designed for completely different purposes is not generally feasible.

Construction of this type of facility did not begin last year or even the year before, but has been under way on an increasing scale for several years. Again, the point is the *degree* of change, which has heightened with every year of this decade.



FACILITIES COST INCREASE

'PLANES'

It follows logically that the degree of financing required for such facilities has similarly increased. In the post-World War II 10-year period, for instance, the industry invested about one billion dollars, but in the last half of this Decade of Technology an additional billion was required. The rate of investment therefore doubled and it is quite probable that it will stay at least at this high level over the next few years because of the "curve of complexity" which shows no inclination to flatten out.

**WE** HAVE been talking until now about defense weaponry, but while on the subject of investment we might consider the parallel investment programs needed to finance development and production of new commercial equipment. It was advancing technology which permitted construction of the fleet of turbine-powered airliners now entering commercial service. Such planes will provide faster and much more comfortable transportation to the traveling public; they will provide increased revenue to their operators; they assist the defense effort in larger and speedier airlift available for emergency use.

To the manufacturers and their many suppliers, they also mean an increased business potential. This potential was achieved, however, only through a large-scale financing program. The five companies building the turbine fleet estimated that, among them, they had to put out \$1,595,300,000 in research, development, testing, facilities, production and other miscellaneous costs before the first airplane was delivered to an airline.

This investment, huge as it is, does not by any means represent the total financing required for the commercial turbine fleet. There were, in addition, the engine manufacturers who had to foot their own bills for similar purposes, and there were more than 5,000 individual suppliers, subcontractors and vendors who had to invest funds in development of new articles particularly adapted to the new high performance aircraft.

This large scale financing program imposed a considerable strain on industry. It required diversion of substantial sums from prior and current earnings. Funding from earnings alone, however, made up only part of the investment. The balance had to be provided through large scale borrowings.

This brings up one of the most important problems thrust upon the industry by the decade of explosive technology: how to acquire the capital needed to finance the products of this technology.

There are three ways in which any industry may acquire capital: by reinvestment of earnings, by borrowing, or by sale of securities.

The aircraft and missile industry already has the highest reinvestment rate of any major manufacturing industry. Approximately 60 cents of every dollar earned is reinvested in research, facilities and equipment.

As for borrowings, there is a definite limit to the amount of credit extendable to any person, company or group of companies. At the start of this decade, 15 major aircraft industry companies had total borrowings of \$25,000,000. At the start of 1958, those same

companies had increased their combined borrowings to \$563,000,000, or 23-fold. Figures for 1958 are not yet available, but it is almost certain that this figure climbed again. The industry may be approaching the limit of its borrowing capacity.

Finally, as to sale of securities, we must remember that there is great competition in the money markets for risk capital, and the investor wants reasonable assurance of a return on his investment before committing his money. An extract from a recent report of the Aviation Securities Committee of the Investment Bankers Association of America speaks eloquently on that subject:

"Free competition in the investment market has reduced aircraft manufacturers to a low priority for new capital investment," it states, and adds that "due to shifts in Defense Department policy as much as to historic industry problems, the investment community has

judged aircraft manufacturers' stability inadequate for the risks involved."

The shifting defense policies referred to by these investment bankers are to some extent due to technological progress, insofar as they are dictated by changing tactical concepts. They are also due to fluctuating budgetary considerations which bring on cutbacks, stretchouts, cancellations, arbitrary expenditure limitations and curtailment of progress payments. These factors, together with overstringent processes of renegotiation imposed by the Government, compound the industry's task of coping with the dynamic technology, for it follows logically that a sound industry financial structure is a prime requisite for continued exploitation of our scientific giant steps.

Now we are entering the final year of this Decade of Technology and with it comes still greater responsibility for the aircraft and missile industry. As its background in aircraft development led logically to industry's assignment to build missiles, the combined backgrounds of both products have provided the industry with a new inheritance, that of building the vehicles and equipment to take man into space.

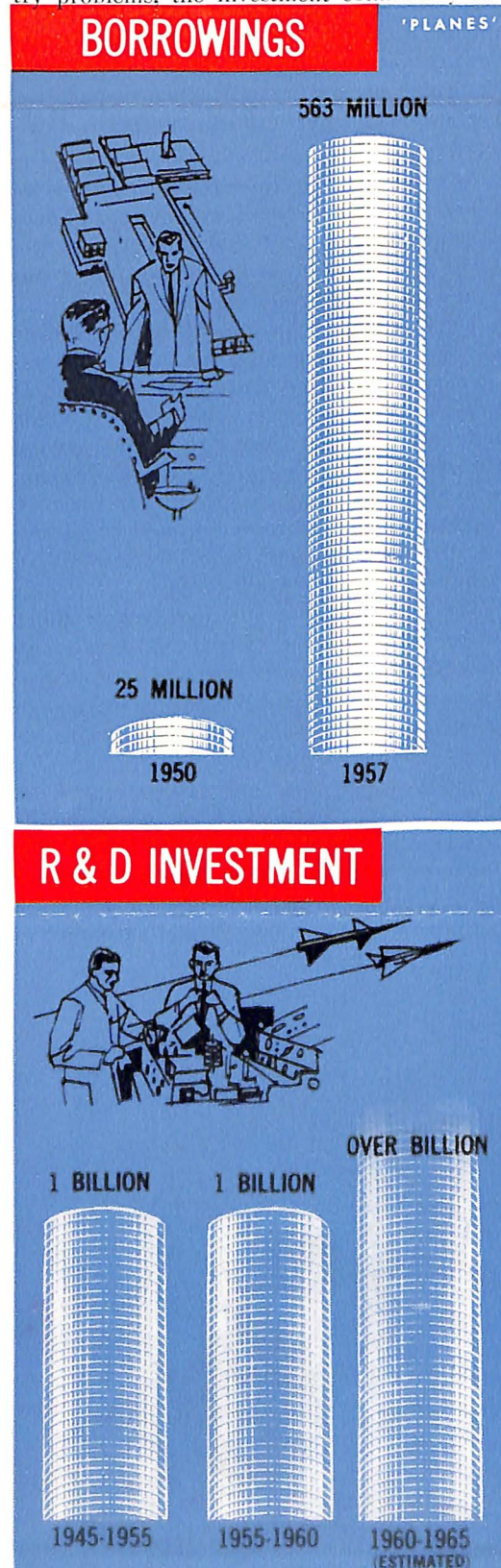
**T**HE achievements of the International Geophysical Year, wherein man-made objects left Earth's atmosphere for the first time, are fantastic in recounting. Yet they are just baby steps when we consider the vastness of the universe we plan to explore.

The hardware needed for the space mission, whether it be for defense or scientific exploration, will not differ basically from the products the industry has been turning out for years. Any flying vehicle, whether it is unmanned or manned, whether it flies within the atmosphere or beyond it, consists of a structure, a propulsion system, and a method of guidance, together with the accessory equipment required for the specific mission of the vehicle.

This hardware will, of course, differ in specifics. The turbojet engines on which the industry has amassed years of experience must give way to newer forms of propulsion, and even the newer forms, like the chemical rocket, will give way to still more advanced systems. The external shapes of the vehicles will change considerably; new methods of guidance will come along. The equipment needed to sustain human life in the space environment will differ from the stratospheric pressurized cockpit.

It remains for our scientists and engineers to show us to what extent this space hardware will differ from our current products, and it remains for our military leaders to decide what changes in defense concepts such hardware will bring about. One thing, however, is quite obvious: the degree of complexity will be greater. With this complexity will come an acceleration of the degree of change within the industry and hence a compounding of all the problems listed herein.

Technologically, the industry is prepared to cope with the challenge. It needs to be freed from unessential restrictions that slow it down; it needs support which will enable it to perform more effectively the extremely important job it has been given.



# AIA Will Testify On Renegotiation

(Continued from Page 1)

effect of the legislation. Any procedure as carefully governed as procurement requires a thorough examination, and it is expected that the hearings will discover possible flaws and provide a basis for correction of any sections that might work against its broad intention.

## Renegotiation Act Concern

High on the list of industry's concern with legislation is the Renegotiation Act. The act was due to expire last December, and legislation for a two-year extension was proposed in the 85th Congress. However, action on the extension occurred too late in the session to permit extensive hearings. The Congress approved an extension of the act until June 30, 1959. The plan is to hold hearings during this period so that the effects of renegotiation can be explored by Congress. The Aircraft Industries Association plans to testify at the hearings.

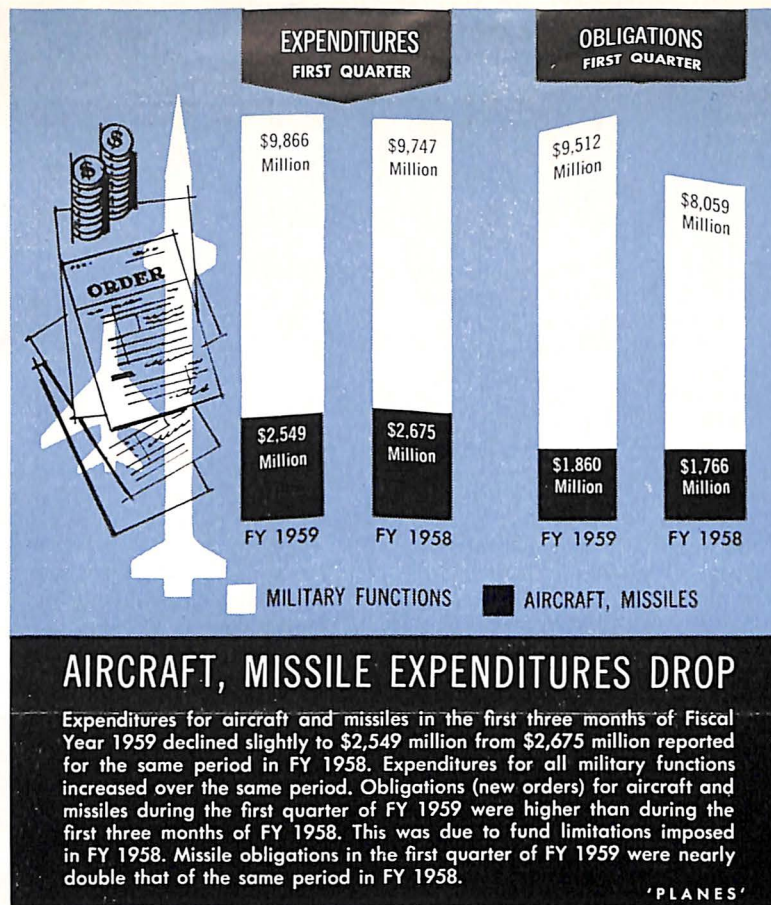
The basis of the aircraft and missile industry's objection to the present administration of the Renegotiation Act is the definition of excessive profits. The industry's earning rate is less than half that of comparable manufacturing enterprises, but the Board has ruled in many instances that company earnings, even though falling within this low level, are "excessive."

One amendment backed by AIA would require that recognition be given to the validity of contracts resulting from negotiation between the military services and contractors. Specifically, the amendment would declare that earnings, as profits falling within the terms of the initial contract negotiation, are not to be considered excessive. This amendment would recognize the integrity and ability of military service representatives engaged in contract negotiation.

Another vital legislative proposal directly affecting the industry is the provision for indemnification of contractors against unusually hazardous risks arising from the Defense Department's weapons programs. Congress has already provided such legislation for financial protection of the public against the hazards of nuclear material used by the licensees and contractors of the Atomic Energy Commission.

## Indemnification Bill

A bill providing such indemnification for aircraft and missile contractors was introduced in the last Congress, but never came to a vote. The need is obvious. The air weapon industry risks its corporate neck every time a weapon system is tested. Despite an outstanding safety record, there is always the possibility that a major accident could occur resulting in damage claims far exceeding the assets of the largest companies. There is no insurance available from commercial sources to take care of several areas of great risk in missile and other weapon programs.



The 85th Congress passed a law creating the National Aeronautics and Space Administration. The NASA has moved promptly in accelerating this nation's space efforts, but there is need for an amendment to change provisions concerning patent rights. The present section states that any invention, with minor exceptions, made in the course of work under a NASA contract, is the exclusive property of the Government. This restrictive provision clashes with the rules governing inventions made under Defense Department contracts. These regulations permit the company to keep title to the invention. The Government, however, retains license rights.

## Patent Differences

The aircraft and missile industry is responsible for development and production of most of the key elements in spacecraft. The wide difference in patent provisions can only hamper contractors in their dealings with Defense Department agencies and NASA. Congress is expected to look into this section of the act and others that require modification.

The budget submitted by the President, the subsequent hearings, floor debate and final conference are followed closely by the aircraft and missile industry since these detailed determinations are the basis of the product mix. Management makes its decisions on investment in projects on the basis of funds appropriated in various weapon categories.

There is other legislation, certain to be introduced, which will have varying degrees of effect on the industry. The aircraft and missile industry is ready to provide any cooperation which would assist Congress in providing equitable, efficiency-producing laws.

## Hardware Trains Boost Production Efficiency

A tremendous increase in production efficiency has been achieved by an aircraft and missile manufacturer who installed "hardware trains" on the assembly line to supply 5,300 different kinds of nuts, bolts, screws, washers, rivets and gaskets used to manufacture surface-to-surface guided missiles.

The trains consist of a tractor pulling three trailers carrying several hundred trays, each holding one or more types of "hardware" items. Six trains are now on timetable schedules.

Their use has cut down tremendously the paper work and leg work previously required to draw such items out of general stores. By eliminating writing, posting, checking and tabulating of some 40,000 requisitions a month, the new distribution procedure saves an estimated 15,720 man-hours a year.

Other advantages of the new system include reduction of flooded hardware, leveling of stock balances where shortages exist, reducing factory aisle traffic, eliminating congestion and time-wastage at main stores stock windows.

## Passenger Gain Seen

A bumper year for air transport in 1959 is forecast by the International Air Transport Association.

The world airline organization estimates that the number of passengers on scheduled airlines will approach the 95,000,000 mark in the new year, an increase of about 6,000,000 passengers over 1958.

## Fluoroscope Tells Inside Story

One aircraft manufacturer literally gets the inside story on electronic and hydraulic components which are test-operated shortly after arrival from subcontractors. New equipment that makes this possible is a fluoroscope.

Unlike an X-ray machine which is largely limited to "still" pictures, the fluoroscope in effect produces "movies" of what is going on inside a component while it is in operation. An operator watches the show on a screen similar to that of a television set.

The newly installed equipment not only insures against faulty components getting by, but also gives a faster and better diagnosis in case of malfunctioning.

A convenient feature of the rig is the turntable to which the part under scrutiny is attached. The operator can rotate the table and tip it to any position. Also, there is an "image intensifier," (like a magnifying glass) which can highlight any particular inside part.

Lead-glass windows and lead shielding protect the operator from radiation, and, as a special precaution, the same key that locks the door of the fluoroscope room is used to unlock the controls. The door must be closed before the equipment will operate.

## New Jet Transports Use Liquid-Cooled Brakes

A revolutionary new liquid-cooled brake system, which utilizes a heat exchanger developed by an aircraft company, will further increase efficiency, comfort and safety of jet transports. This is the first application of the heat exchanger in the braking system of an aircraft.

The heat exchanger uses liquid-to-liquid heat transfer and is essentially a water boiler. In this system a common anti-freeze mixture of ethylene glycol and water is circulated behind the friction surfaces of the brakes, picks up the heat and transports it to the heat exchanger where it is transferred to water.

The transport fluid is cooled and returned to the brakes to absorb more heat and repeat the cooling cycle. The unit is designed to have a peak rejection rate of 5,000 BTUs (British Thermal Units) of heat per second. It absorbs millions of foot-pounds of energy, keeping the tires cool enough to touch.

Temperature buildup in the critical wheel and brake area is reduced by as much as 1500 degrees. Operating at low temperatures reduces the possibility of tire blowouts and brake failures. Brake noise, vibration and chatter are eliminated.

# High Speed Camera 'Stops' 600-mph Hailstone Effect Test

An aircraft and missile company is using a high-speed motion picture camera to "slow down" fast-acting laboratory tests so they can be observed with the naked eye. Film can travel through the camera at over 140 miles an hour.

Current project of the company's motion picture section is to "stop" the flight of 600 mile-per-hour hailstones fired from air guns at exposed surfaces of a jet transport now being tested.

Past projects have included shots during "chicken-firing," seat impact, and head impact tests for the jet; performance of ballistic missile components; canopy and seat ejection and missile firing of two fighter planes, as well as rocket sled tests.

In the hailstone destruction test two 16 mm cameras shoot 100-ft. of film in a half-second to capture faster-than-eye action. Developed movies then expand the half-a-second of action to three minutes to give observers a detailed account of the motion.

In the slowed-down views, the hailstones, with speed reduced by 200 times, seem suspended in air. From the films it can be easily seen if they are of proper frozen consistency or if they are disintegrating into soft snow, too weak for valid tests which determine structural weakness of parts before they are accepted for installation.

By snapping the flight of hailstones, or other fast-moving objects, across a lined grid, the speed can be calculated accurately from the movie shots. Timing marks, called "light pips" are registered along the length of the film at 100, 120, or 1,000 marks a second as another

timing device to tell just how fast an object is moving or the length of time of an event.

"Chicken-firing" tests for the jet transport are conducted on different types of transparent material to find out which kind will stand up best under actual flight conditions when unlucky birds are dashed against the plane's windshields. Live chickens, of about 4 lbs. in weight, are chloroformed and fired through compressed air guns to simulate impact of live birds in flight.

One camera is positioned to catch speed of the birds as they shoot across the white-lined grid while a second camera in the cockpit snaps the windshield at instant of impact to show pattern of cracks or breakage.

The high-speed photographic technique has also been used with remarkable success to iron out problems in development of new cutting tools. Slowed down movies of the new higher-speed tools which revolve at 3600 rpm—faster than the eye can see—clearly show just how the chips are falling and from what angle.

Defective blades are detected instantly when the action is slowed on film to one revolution in every two seconds. Information gained in a single test and flashed on the movie screen is often enough to guide re-design of cutters for perfect operation.

## '59 Aircraft Year Book Off Press in February

The 1959 Aircraft Year Book, a profusely illustrated record of aviation events during the past year, will be off the press next month.

An official publication of the Aircraft Industries Association, this 40th edition utilizes the same format as last year with a page size of 8 by 11 inches.

The book includes a review of individual company accomplishments; an illustrated listing with specification of aircraft and engines in production; a report on missile activities; historic and current chronologies; research and development by both civil and military agencies; listing of official records established during the year; a roundup of International Geophysical Year accomplishments; report on activities of individual airlines; and a review of operational activities of the military services and other Government agencies.

The 434-page book contains about 1,000 illustrations, and is published by American Aviation Publications, Inc., 1001 Vermont Ave., N. W., Washington 5, D. C. Price is \$6.00.

## Electric Blanket Bonds Delicate Jet Parts

An ingenious aircraft components manufacturer is now using an "electric blanket" to speed the bonding of 60 to 70 delicate parts which make up each panel of a jet transport.

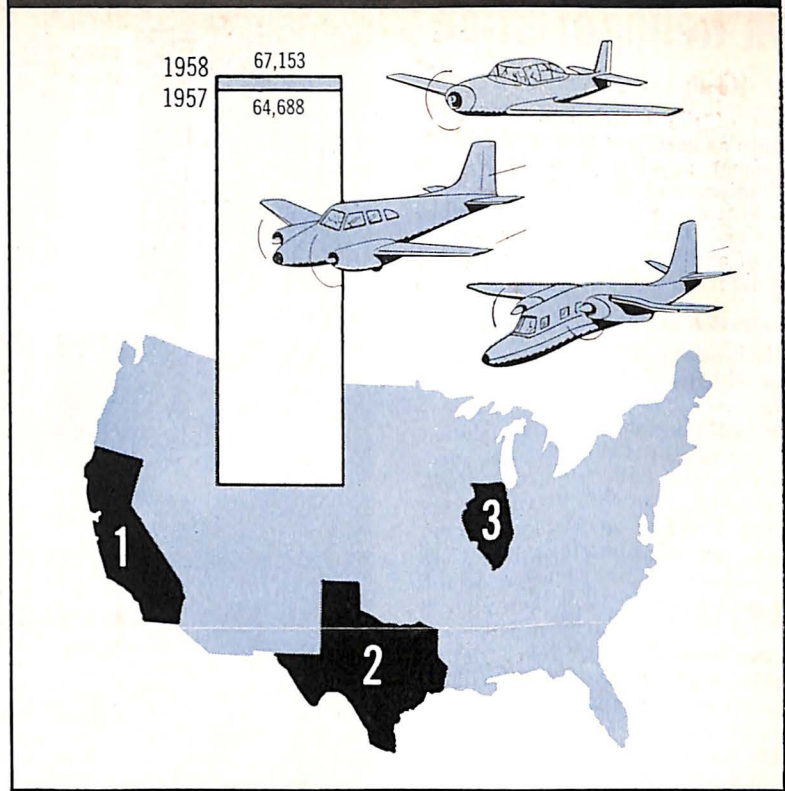
The electric blanket bonding method operates on the same principles of heat and pressure as in conventional autoclave bonding. The honeycomb panels are bonded at 350 degrees Fahrenheit under 50 pounds of air pressure, for one hour.

Tiny thermistors, no larger than grains of salt, act as the "brain" to direct power to the electric blankets. Up to 35,000 watts of power is necessary to maintain control during baking period, and as many as 25 individual control circuits are connected to blankets to keep the temperature within 10 degrees, minus or plus, of the 350-degree baking heat.

The bonding fixtures, resembling huge steam presses, were designed and built in various sizes to accommodate the large aileron panels and smaller trim and control tabs of the plane.

The electric blankets will bond up to 80 pieces before they need replacing. As a safety precaution the blankets have built-in elements in sections so that the voltage at any one point is never more than 110 volts. Only one man is needed to monitor the entire operation.

## CIVIL AIRCRAFT INCREASE



Active aircraft registered with the Civil Aeronautics Administration at the beginning of 1958 totaled 67,153, an increase of 2,465 aircraft over the previous year. Leading state in registrations was California with 7,970 active aircraft reported; Texas was second with 5,552 and Illinois third with 3,782. Civil aviation has grown rapidly in the U. S. with a gain of 21 per cent in active aircraft registrations in the last 4 years.

'PLANES'

## Power System With No Moving Parts Developed for Missiles, Spacecraft

An electrical power system—with no moving parts—has been pioneered by an aircraft and missile company for use in aircraft, spacecraft and missiles.

Called a static power system, the unit will eliminate all the hazards inherent in moving parts—where malfunction and breakdown usually occur.

The system is made possible by the use of semiconductors—a material somewhere between a good conductor and an insulator. (A modern transistor is a good example.) Semiconductors are crystalline in structure and can be made from such elements as germanium and silicon, as well as various chemical compounds, such as gallium arsenide.

The properties of semiconductors permit them to change direct to alternating current, amplify voltages, transform heat to electrical energy, serve as "on-off" switches without moving contacts, and generally replace control functions formerly handled by relays, circuit breakers and vacuum tubes.

A static electric power system has high reliability, long life, low weight and fast response—all specific requirements for high-altitude rockets and space vehicles. Since no moving parts exist, components can be imbedded in plastic potting materials to protect them against vibration and

shock. There are no contacts to burn and fuse, no vacuum tubes to fail, no brushes to wear, and no bearings to wear except on brushless dc and ac motors.

This remarkable new development is one more result of industry ingenuity in achieving higher performance, greater reliability.

## Ingenious Packaging Used for ICBM Parts

Considerable detailed planning goes into transporting intricate ICBM components and parts from manufacture to final assembly, and subcontractors have come up with some ingenious packaging ideas which frequently reflect the nature and value of the items they contain.

For instance, long "pipelines" that feed fuel to the ICBM engines (and look to the layman like plumbing fixtures) are packaged in what appears to be a king-sized suitcase, complete with handles and snaps. These all-metal containers are almost 40 feet long but are so lightweight they can be carried by two men.

Another container that houses a sensitive part of the missile's guidance system comes packaged like a priceless jewel.