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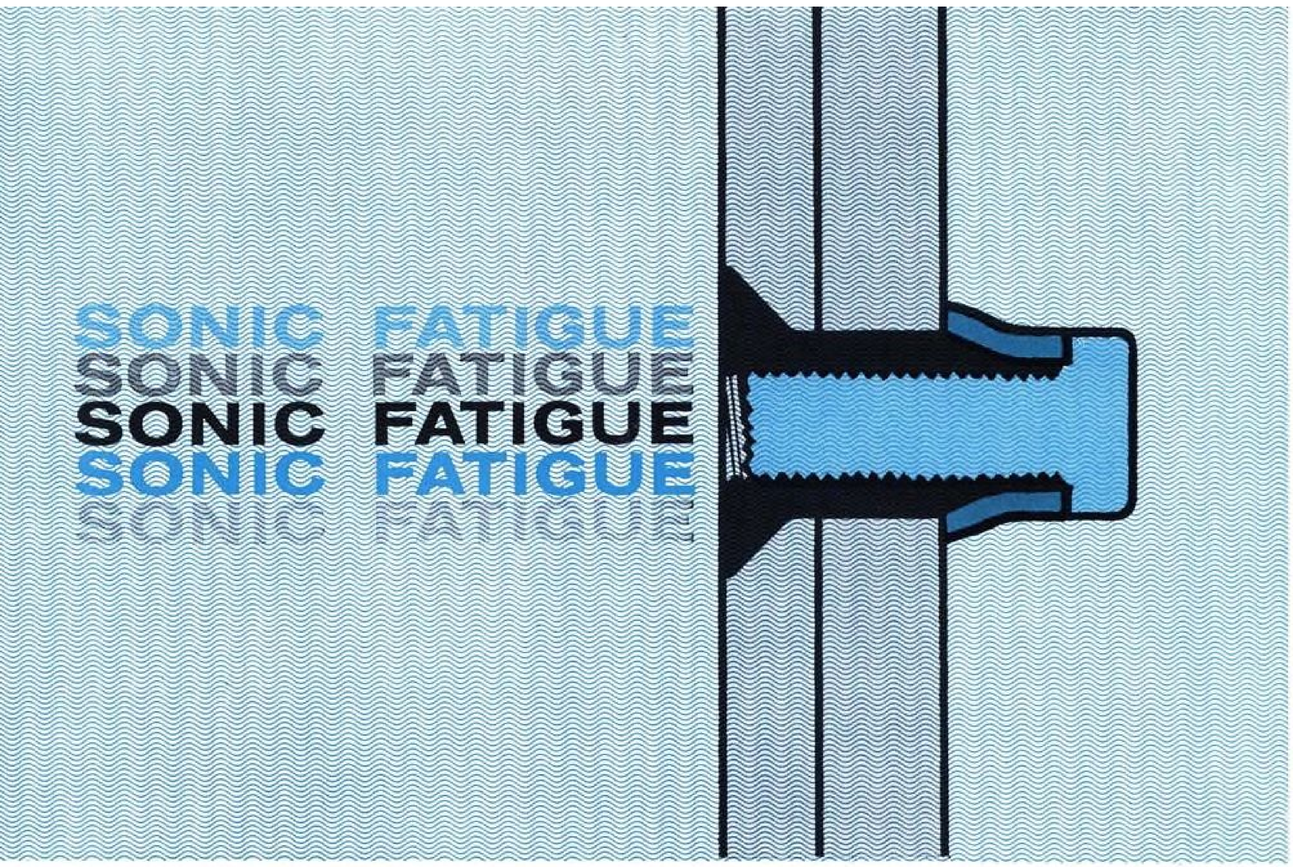
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July 30, 1962

Growth Key To F4H Success

Photo Plane's View Of Saturn SA-1 Launch



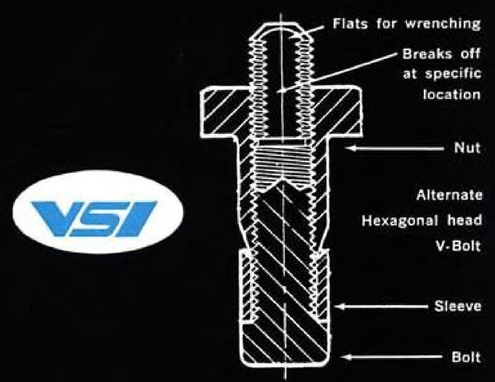


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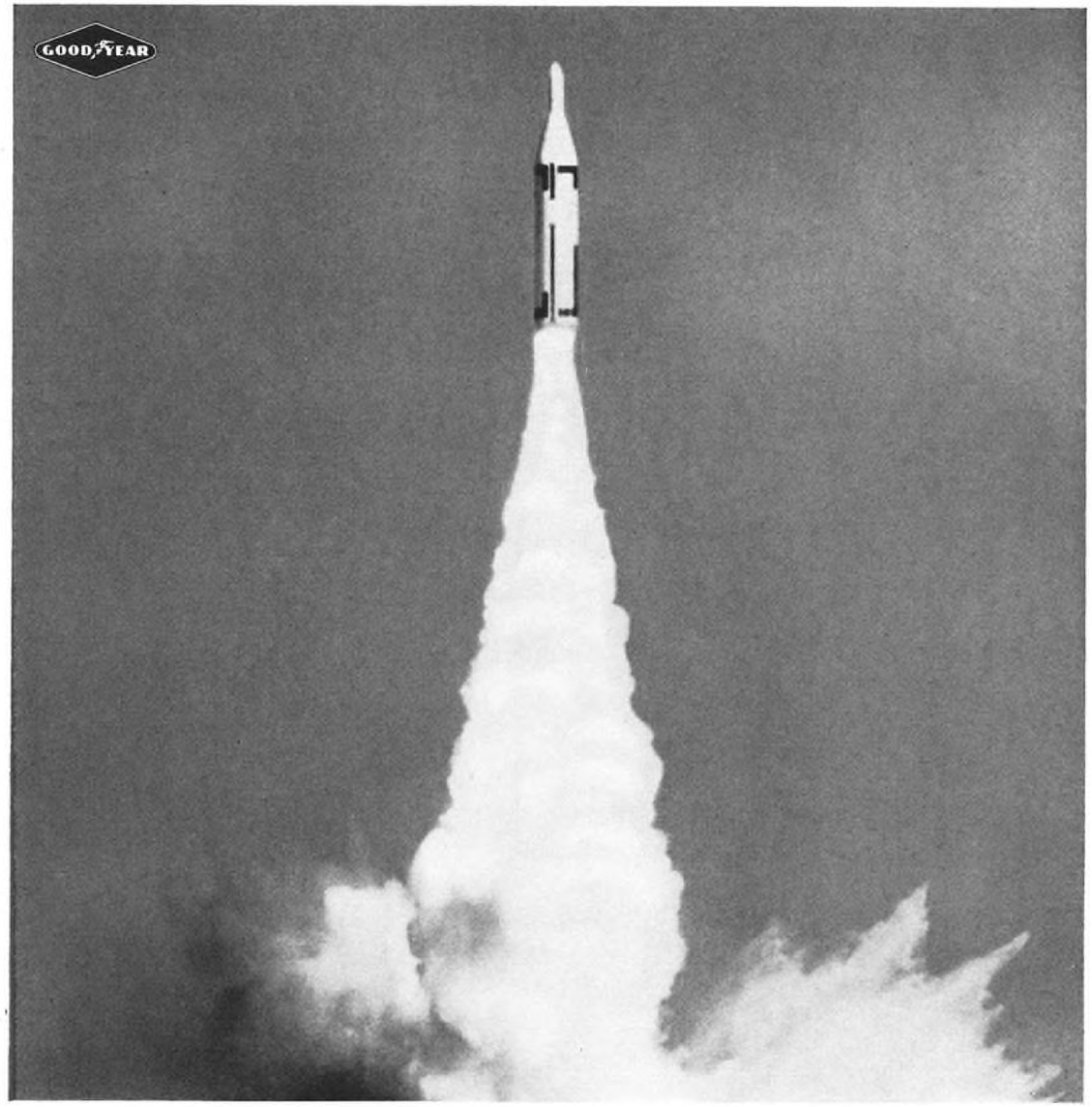
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AEROSPACE CALENDAR

Aug. 6-10—7th Annual Technical Symposium, Society of Photographic Instrumentation Engineers in cooperation with the Air Force Systems Command, Statler Hilton Hotel, New York, N. Y.

Aug. 7-9—Low Level Wind Conference, Texas Western College, El Paso, Tex. Sponsors: American Meteorological Society; U. S. Army Signal Missile Support Agency. (Aug. 9 session in Dallas.)

Aug. 7-9—PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method) Seminars, ITT Data Processing Center, Paramus, N. J.

Aug. 7-9—57th Meeting, National Aerospace Standards Committee, AIA, Benjamin Franklin Hotel, Seattle, Wash.

Aug. 8-10—1962 Standards Laboratory Conference, National Bureau of Standards' Boulder Laboratories, Boulder, Colo.

Aug. 10-11—IAS National Specialists Meeting, Man-Machine Competition, Olympic Hotel, Seattle, Wash.

Aug. 11-Sept. 3—Sixth World Parachuting Championship, Orange, Mass. Sponsors: National Aeronautic Assn.; Parachute Club of America.

Aug. 13-16—Pacific Energy Conversion Conference, American Institute of Electrical Engineers, Fairmont Hotel, San Francisco.

Aug. 13-16—Seventh Symposium on Ballistic Missile and Space Technology, U. S. Air Force Academy, Colorado Springs, Colo. Sponsors: USAF; Aerospace Corp.

Aug. 14-16—Cryogenic Engineering Confer-

(Continued on page 6)

AVIATION WEEK and Space Technology

July 30, 1962

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AEROSPACE CALENDAR

(*Continued from page 5*)

ence, University of California of Los Angeles, Los Angeles, Calif.

Aug. 14-17—International Conference on Precision Electromagnetic Measurements, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

Aug. 15-17—Nuclear Propulsion Conference, Monterey, Calif. Joint Meeting: Institute of the Aerospace Sciences; American Rocket Society; American Nuclear Society. (Classified.)

Aug. 15-17—Third International Electronic Circuit Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 18-19—Lafayette Escadrille, Lafayette Flying Corps and Americans of the French Foreign Legion, 1st Reunion Airshow, Battle Creek, Mich.

Aug. 19-25—Annual Meeting and Conference, Airport Operators Council, Princess Kaiulani Hotel, Honolulu, Hawaii.

Aug. 20—Technical Symposium, Precision Potentiometer Manufacturers Assn., Statler Hilton Hotel, Los Angeles, Calif.

Aug. 21-24—Western Electronics Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.

Aug. 21-24—International Symposium on Far Infrared Spectroscopy, Sheraton Gibson Hotel, Cincinnati, Ohio. Sponsor: Materials Central, Aeronautical Systems Division, Air Force Systems Command.

Aug. 21-Sept. 17—14th Session, International Civil Aviation Organization Assembly, Rome, Italy.

Aug. 23-24—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Westward Hotel, Anchorage, Alaska.

Aug. 23-24—Conference on Thin Films, Colorado Hotel, Glenwood Springs, Colo. Sponsor: Solid State Electronics Laboratory, University of Denver's Research Institute.

Aug. 27-29—AIME Technical Conference on Advanced Electronic Materials, Benjamin Franklin Hotel, Philadelphia, Pa.

Aug. 27-Sept. 1—Third International Congress, International Council of the Aeronautical Sciences, New Congress Hall, Stockholm, Sweden.

Aug. 27-Sept. 1—Second International Congress, International Federation of Information Processing Societies, Munich.

Aug. 28-30—Fourth Conference on Maintainability of Electronic Equipment, Electronic Industries Assn. (in cooperation with Department of Defense), University of Colorado, Boulder, Colo.

Sept. 3-7—National Advanced Technology Management Conference, Institute of Radio Engineers, Seattle, Wash.

Sept. 3-7—International Symposium on Information Theory, Institute of Radio Engineers, Brussels, Belgium.

Sept. 3-9—1962 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-7—National Advanced-Technology Management Conference, Opera House, Seattle World's Fair grounds, Wash. Sponsors: University of Washington, professional engineering groups and technologically oriented business firms.

Sept. 5-7—Symposium on Measurement of

(*Continued on page 7*)

AEROSPACE CALENDAR

(*Continued from page 6*)

Thermal Radiation Properties of Solids, Biltmore Hotel, Dayton, Ohio. Sponsors: Aeronautical Systems Division, USAF; National Bureau of Standards; NASA.

Sept. 5-7—Seminar on Automatic Checkout Techniques, Battelle Memorial Institute, Columbus, Ohio. Co-sponsors: Aeronautical Systems Division, USAF; Columbus, Ohio, Research Center.

Sept. 10-14—Fourth National Conference on Applied Meteorology, American Meteorological Society, Hampton, Va.

Sept. 10-14—Annual General Meeting, International Air Transport Assn., Dublin.

Sept. 13-14—10th Annual Engineering Management Conference, IRE, Hotel Roosevelt, New Orleans, La.

Sept. 17-18—Hydrofoil & Air Cushion Vehicles Meeting, Institute of the Aerospace Sciences, Shoreham Hotel, Washington.

Sept. 18-20—Ordnance Environmental Research Symposium, El Tropicano Hotel, San Antonio, Tex. Sponsor: Environmental Research Office of the Office of the Chief of Ordnance. Arranged by Southwest Research Institute.

Sept. 18-23—16th National Convention & Aerospace Panorama, Air Force Assn., Las Vegas, Nev.

Sept. 19-20—Technical Manpower Utilization Meeting, Institute of the Aerospace Sciences, Hotel Commodore, New York.

Sept. 19-20—Operations & Maintenance Symposium, Airwork Corp., Millville, N. J.

Sept. 19-21—Sixth National Conference on Tube Techniques, Western Union Auditorium, New York, N. Y. Sponsor: Advisory Group on Electron Devices.

Sept. 19-22—Second International Agricultural Aviation Congress, National Superior Agronomy School, Grignon, France.

Sept. 24-28—13th International Astronautical Congress, American Rocket Society, Sofia, Bulgaria.

Sept. 24-Oct. 12—International Air Transport Assn. Traffic Conferences, San Marcos Hotel, Chandler, Ariz.

Sept. 25-28—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.

Sept. 26-Oct. 2—1962 General Conference, Federation Aeronautique Internationale, Athens, Greece.

Sept. 28-29—Society of Experimental Test Pilots' Sixth Annual Awards Banquet & Symposium, Beverly-Hilton Hotel, Beverly Hills, Calif.

Oct. 1-3—Seventh Annual Exposition & Symposium, Air Traffic Control Assn., Flamingo Hotel, Las Vegas, Nev.

Oct. 2-4—Third Symposium on Advanced Propulsion Concepts, Cincinnati, Ohio. Co-sponsors: AFOSR, General Electric.

Oct. 2-4—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Fontainebleau Hotel, Miami Beach, Fla.

Oct. 8-12—National Aeronautic & Space Engineering & Manufacturing Meeting & Display, Society of Automotive Engineers, The Ambassador, Los Angeles, Calif.

Oct. 15-17—ASW Meeting, Somerset Hotel, Boston, Mass. Sponsors: Institute of the Aerospace Sciences; U. S. Navy.



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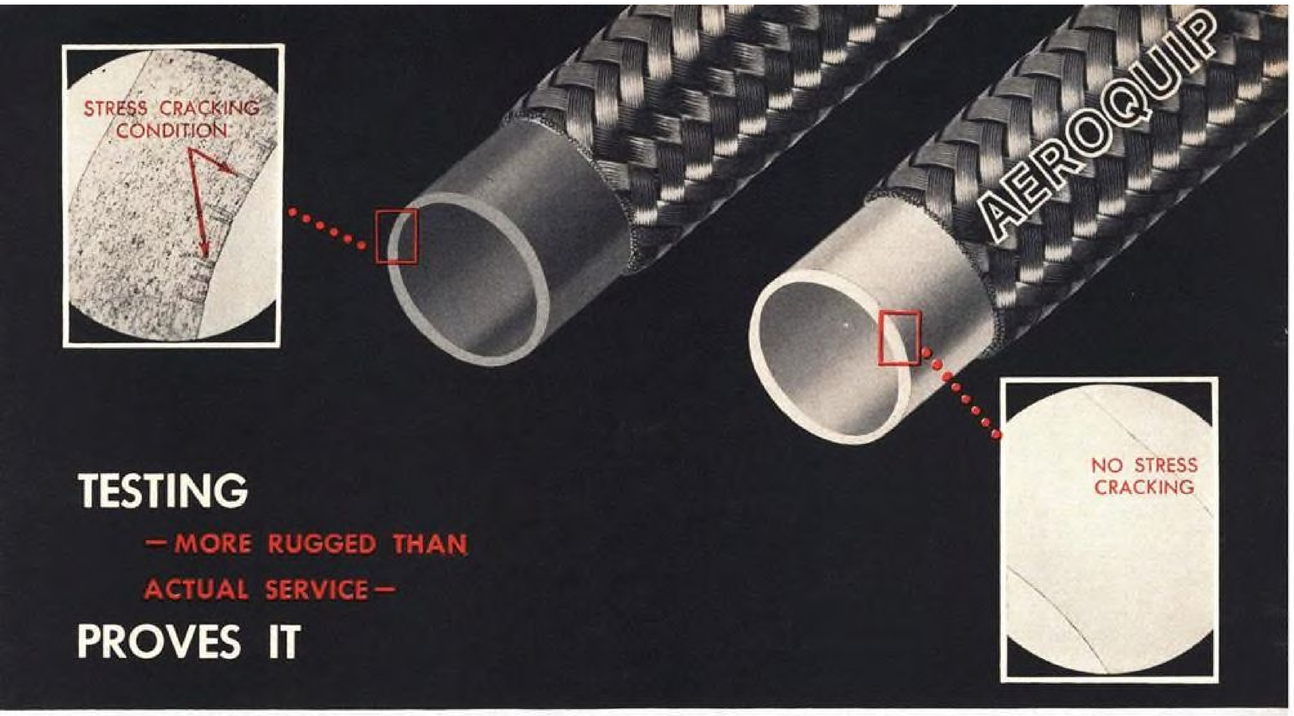
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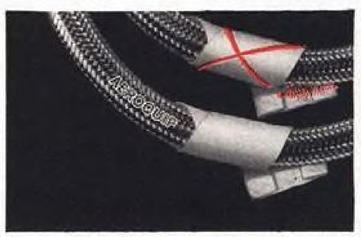
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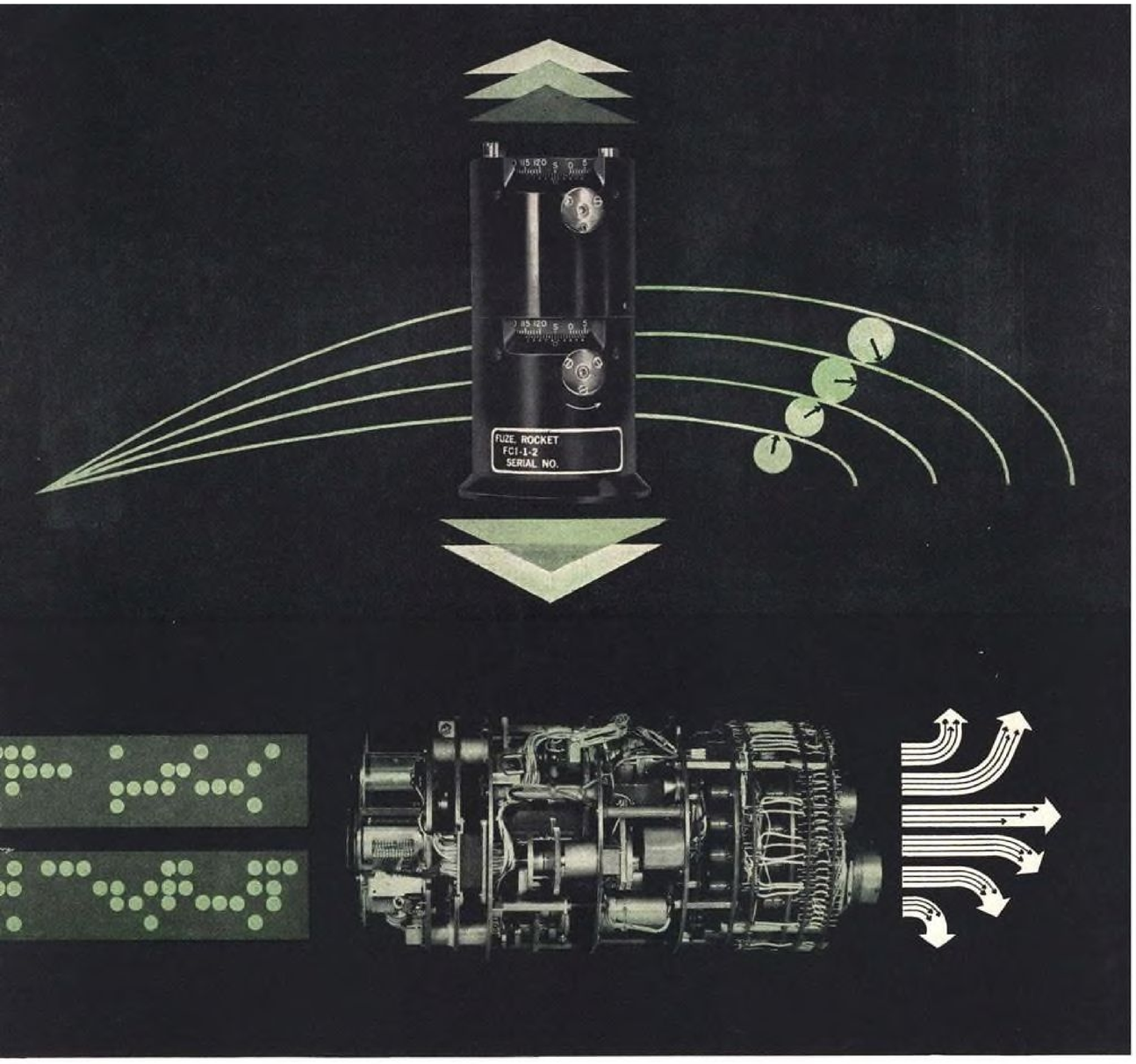
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COVER: Test firing of the Saturn SA-1 booster from Cape Canaveral is photographed from above during early flight stages. Photo was made from a Navy Douglas A3D flying at about 40,000 ft. Photo coverage by the aircraft, based at the Naval Air Station, Jacksonville, Fla., was requested by the National Aeronautics and Space Administration for the flight.

PICTURE CREDITS

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EDITORIAL

Expanding the Airline Market

(Dr. Paul W. Cherington, Harvard Business School professor and author of the Cherington report on airline jet re-equipment, discusses the air transport market in a report for the Connecticut General Life Insurance Co. Because of its pertinence to current airline problems, significant excerpts from it follow.)

A variety of airline commentators have developed a new "conventional wisdom" for the airline paradox. It is claimed that the failure of traffic growth to keep up with capacity is essentially a failure of marketing. This general line of argument takes a variety of forms. Some claim that all that is needed is a lowering of fares; some that market research will identify new markets; others that bigger and better advertising and promotion is the solution. Those who hold these views might be described as "marketing activists."

These marketing "activists" are confronted by what might be described as the economic "passivists" who claim that the airline industry has now reached a state of maturity where about all that it can expect is to grow at a rate about equal to that of the economy (3%); the "passivists" concede that a good product and hard work might achieve a 5% rate.

A favorite charge of the marketing "activists" is that only about 7% of U. S. citizens travel by airline in any one year and that only about 25% have ever flown by airline. These figures are usually cited to show that air travel is not living up to (a) its market potential or (b) its social potential.

The basic reason for this high concentration of air travel is the fact that a high proportion of air travel (at least two-thirds) is for business reasons and is composed of executive, professional and technical personnel who are required to travel frequently in conjunction with their business. Their travel is done on an expense account or at least is tax deductible. This means that frequency of travel and destination are dictated by business or economic factors. There is some reason to suppose first, that this segment of the airline market is approaching saturation and second, that it is increasingly sensitive to general cyclical factors.

One phenomenon of the last few years has been the switch of many business travelers out of first-class into coach or tourist accommodations at the behest of their employers (government, industry or themselves). This switch, while not surprising, reflects the wide differential between first and coach class tickets (about 25%) and the fact that on long trips a price differential of $45 buys only the following:

- **A seat that is three inches wider.**
- **Five extra inches of leg-room.**
- **Four ounces of free liquor,** estimated maximum retail value: $2.00.
- **A meal that costs about $1.25 more** than that received in coach.
- **Less risk of being exposed** to itinerant children.
- **Less risk of having** to sit in the "middle" seat.

The federal government, many corporations and numerous individuals have concluded that this list of goodies is overpriced. Some airlines have attempted, so far unsuccessfully, to narrow the gap by raising coach fares.

The generation of additional trips by existing business air travelers appears to be largely a matter of product and service. Increased speed, reliability, and convenience of travel can be expected to result in a few more trips that would otherwise not be made, the business at hand being handled by letter, phone or simply put off. It is almost impossible, however, to measure what these service improvements might yield in the way of increased traffic. When nonstop transcontinental service was introduced, the transcontinental market the first year thereafter appears to have grown about 2% faster than might otherwise have been expected. The inauguration of jets appears to have added another 2-3% to the expected market. In the short-haul markets, the air shuttles along the East coast appear to have increased total business travel by about 5-10%. There is little indication that price, at least within limits of 15-20%, will appreciably affect total market expansion although it may cause shifts between classes of service . . .

The part of the airline market that is not traveling for business is on the move for a variety of purposes—vacations, visits to family, personal emergencies and the like. Whereas business travelers average about seven air round-trips a year, non-business travelers average two; and while as a group non-business travelers are more numerous, they account for considerably less total annual air travel than business travelers.

The economics of a long distance trip by common carrier pose a basic market deterrent here. Consider a family with two children in Chicago who want to spend 10 days in Arizona. What is the minimum that they can expect to spend. Assuming that they leave their children behind with friends and relatives at no cost their minimum expenses are in the vicinity of $700 including plane fare ($390); hotel ($220); and other expenses at destination ($100). (If they take their children add another $500-$600). This is the equivalent of a year's depreciation on their new car; more than a color TV set; about the cost of having their house painted or fourteen cases of medium-priced bourbon, all established and accepted expenditures in our culture. And what is the attraction of Arizona? The weather is warm, if not hot, and certainly superior to Chicago; there is scenery (for which a rental car is needed) and there is a suggestion in the advertisements of beautiful girls in scanty bathing suits, making the wife nervous and leaving the husband torn between desire and guilt. Surely purchasing the color TV is easier and safer and next summer the whole family can drive to some nice lake 100 miles into Wisconsin.

If the foregoing is in any way a brief prototype of a real vacation travel situation, consider its implications for the airlines. They can cut their fares in half and still only reduce the total price to $500. They can provide hourly service between Chicago and Phoenix in the fastest aircraft, but this will mean nothing to the family if it has decided not to go to Phoenix.

It is often objected that there are not enough people with enough money to travel for pleasure, even if there were enough attractive destinations. The facts indicate otherwise. In 1959, there were 13.5 million families and unattached individuals (about 25% of the total) who had after-tax personal income in excess of $7,500. If we deduct $5,000 as minimum living expenses for food, shelter and clothing, and then reduce the remaining balance by 50% for other fixed obligations, we find that these 13.5 million families have a total of $48 billion of "discretionary" funds. If 10% of these families were to take a two-person trip (or an extra trip) of 1,000 mi. (one-way) it would saturate the present ability of the airlines to handle the business, involving, as it would, 5.4 billion passenger miles or an 18% increase in total air travel.

Yet the air fare portion of these trips would absorb less than 2% of these discretionary funds. Penetration of 10% of these upper-income families sounds like a modest enough figure but consider the competition for these discretionary funds . . . houses, cars, gardens, racing, spectator sports, etc., etc. It will be hard to capture these 1¼ million families for air transportation. But to say that the market does not exist . . . is to ignore the facts.

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WHO'S WHERE

In the Front Office

David S. Lewis, president and chief operating officer, McDonnell Aircraft Corp., St. Louis, Mo., succeeding **James S. McDonnell, Jr.,** who continues as board chairman, chief executive officer and chairman of the executive committee. Also: **Thomas G. Rutledge,** vice president and general counsel. **Vice Presidents Dolor P. Murray** and **Sanford N. McDonnell** elected directors, increasing the board to thirteen.

A. V. Leslie, vice president-finance, Douglas Aircraft Co., Santa Monica, Calif., (AW May 21, p. 39). Also: **John L. Sigrist,** vice president and director of programs, Douglas Missile and Space Systems Division.

Richard W. Harbison, president, Lear Siegler Service, Inc., a subsidiary of Lear Siegler, Inc., Santa Monica, Calif.

Dr. Richard M. Bissell, Jr., president, Institute for Defense Analyses, Washington, D.C., succeeding **Garrison Norton,** resigned.

Gen. E. B. Garland (USAF, ret.), a vice president and head of the TechRep Division of Philco Corp., Philadelphia, Pa., succeeding **Vice President R. F. Herr,** now responsible to the president for long-range planning and over-all corporate-government relations. Also: **H. E. Hockeimer,** general manager of the newly formed Communications and Electronics Division; **F. E. Stehlik,** assistant to the president.

L. G. Burnard, S. E. H. Lefever and **N. Sims,** appointed special directors of Vickers-Armstrongs (Engineers), Ltd., London, England.

William E. Bartling, vice president-flying and ground operations, Flying Tiger Line, succeeding **Frank Lynott,** resigned. Also: **James McLachlan,** vice president-maintenance and engineering.

R. B. Bonney, executive vice president, Electronic Engineering Co. of California, Santa Ana, Calif., and **W. R. McQuiston,** vice president-sales.

Harry A. Sosnoski, vice president-planning and requirements, Piasecki Aircraft Corp., Philadelphia, Pa.

Texas Instruments, Inc., Dallas, Tex., has named **Vice President Cecil P. Dotson** as manager of the Transistor Products Division, succeeding **Vice President James R. McDade,** on leave of absence to work on his Ph. D.

Charles F. Dworshak, vice president-traffic, Slick Airways, a division of The Slick Corp.

Honors and Elections

Commemorating the 10th anniversary of the founding of the Advisory Group for Aeronautical Research & Development, the AGARD Twelfth General Assembly presented a Gold Medal to **Dr. Theodore von Karman** for "his dominant role and guiding genius in developing AGARD as a powerful force within NATO . . ."

Robert R. Gilruth, director of National Aeronautics and Space Administration's Manned Spacecraft Center, will receive the President's Award for distinguished federal civilian service, the government's highest award to its employes.

(*Continued on page 87*)

INDUSTRY OBSERVER

► Air Force has revived its SOR 189 requirements for a search, rescue and retrieval vehicle system and is revising and adding to the specifications. Basic design still envisions a mother-daughter concept, with V/TOL capability in the daughter plane. Among the proposed missions is missile site security, calling for an aircraft capable of carrying six armed troops at a speed of 350 kt. to thwart attempts at sabotage.

► **General Electric Defense Systems Department is conducting an in-house study of a multi-purpose rocket-launching platform designed to maintain its position in deep ocean locations within 20 ft. Sonar techniques using a fixed, ocean-floor sound transmitter would provide the necessary accuracy, but radar, star tracking and other navigation devices also would be used. The platform would be self-powered and could keep its position in Sea State 6 (winds between 41 and 47 kt., and waves between 12 and 20 ft. high).**

► National Aeronautics and Space Administration's Syncom communications satellite, scheduled for launch early next year, may be used to provide a reliable telephone link between the U. S. and the South African Deep Space Tracking facility. Current link is high-frequency radio communication. Hughes Aircraft has completed a non-flight model of Syncom which soon will be subjected to extreme environmental tests.

► **Apollo command and service module dimensions have been fixed by NASA now that the lunar orbit rendezvous technique has been chosen. The command module will be 151.5 in. dia. and 141.25 in. high. The service module will be 154 in. dia. and 124 in. high.**

► Cornell Aeronautical Laboratory, which now is studying the effect of base heating during launch on a Saturn booster model with six nozzles, will begin similar studies using a model of Centaur. National Aeronautics and Space Administration-funded study is precautionary. Actual stage separation of the Atlas-Centaur launch vehicle has not yet been accomplished.

► **Wankel rotating combustion engine being developed by Curtiss-Wright for future applications to aircraft is now running in an air-cooled version producing close to 600 hp.**

► Launch schedules for the Atlantic Missile Range are so crowded that USAF has requested NASA permission to fire Blue Scout rockets from the Wallops Island facilities. The move would force Ford's Aeronutronic Division even farther out of the Blue Scout program, because Vought does the work for all Wallops rail launches, while Ford modifies the Vought-built Scouts for vertical launches elsewhere.

► **NASA will conduct its Little Joe-2 flights, planned to qualify the Apollo command module design and service module propulsion system, from the White Sands Missile Range because of the crowded schedules at Atlantic Missile Range. Final decision has been made to scrap plans to modify Redstone Pad 5 at AMR, originally scheduled for the Little Joe-2 tests (AW June 25, p. 23).**

► Hamilton Standard Division of United Aircraft Corp. and International Latex Corp. have been selected by National Aeronautics and Space Administration to develop the spacesuit design for the Apollo crew. Hamilton Standard has also been selected to develop the back-pack which will be worn by the crew during its exploration of the lunar surface.

► **Physiological monitoring system for measuring such parameters as heart beat, skin resistance and respiration rate will be developed for NASA by Gulf Aerospace Corp., a recently organized Houston, Tex., company which intends to specialize in bio-medical and radiation instrumentation and ground support equipment.**

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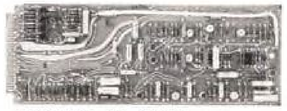
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GAIN RANGE
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Washington Roundup

MMRBM Contracting

Air Force recommendations on Phase 1 contractors for the mobile medium-range ballistic missile (MMRBM) were scheduled to go to Defense Department late last week for approval. At one time the plan was to have two or more competing contractors for each subsystem during the initial program definition phase, but Air Force was expected to propose only one for most categories. An exception is the re-entry vehicle, where both Avco and General Electric were strong candidates. Leading contenders in other areas were believed to be Martin-Sylvania for command and control; Norair for integration and checkout; AMF for transporter-erector-launcher, and Thiokol for propulsion. A decision on guidance contractors already is overdue (AW June 25, p. 29).

Need for a counter-insurgency close-support aircraft (Coin) for use in areas such as Vietnam (AW Mar. 26, p. 13) has jelled into a specific operational requirement that is being circulated in industry prior to a request for proposals. It calls for a 17,000-lb. aircraft with short takeoff and landing capabilities and turboprop engines. One engine manufacturer states that a 1-to-1 thrust to weight ratio could be obtained by creating a 13,000-lb. thrust exhaust and gaining the rest of the thrust from the propeller.

Titan 3 Go-Ahead Near

Document officially approving the release of funds for the beginning of Titan 3 development, effective Aug. 1, was on Defense Secretary Robert McNamara's desk awaiting his signature late last week. One major consideration that has helped delay approval is the proposed Space Technology Laboratories-Arma guidance system. The argument is being made that the AC Spark Plug-IBM guidance system used on the Titan 2 would be satisfactory and its use would save the cost of developing a new system. Release of funds for Titan 3 might result in a definitive contract by Aug. 15 for United Technology Corp.'s development of the 120-in.-dia. solid propellant boosters. Work is now being done under a 45-day fixed-price contract which covers program planning, including resolution of interface problems with Martin, the integration contractor for the vehicle.

Newest presidential aircraft, a Boeing VC-137C, was rolled out at the company's Renton, Wash., plant on July 20. The specially-fitted version of the 707-320C, largest of the Boeing jet transports, is painted light blue and white with a gold trim. The aircraft will supplement the three VC-137s, which are modifications of the 707-120, now used by the White House. Because of the special communications equipment, cost of the new aircraft is difficult to estimate. The Air Force's budget requests this year included $8 million for a new presidential plane. A commercial 707-320C sells for $6,738,000 with the standard airline interior and minus engines, which cost $264,985 each.

Army Caribou Flap

Army is in hot water with the director of defense research and engineering for announcing that de Havilland had won the STOL transport competition (AW July 23, p. 26) without consulting the research office or even asking for release of the development funds. The research office feels there is insufficient coordination between Army's top research and development echelons and the Transportation Corps. development group at Ft. Eustis, and that the evaluations done at Ft. Eustis for the STOL competition were unsophisticated. Army still had not specified the engine for the winning Caribou 2 late last week, although there was little doubt that de Havilland's preference—the General Electric T64—would be chosen.

House space committee hearings on solid propellants, scheduled for Aug. 1 and 2 (AW July 23, p. 17), have been postponed until Aug. 8-9.

Earth Orbit Rendezvous

Watch for National Aeronautics and Space Administration to expand the rendezvous aspects of the Gemini spacecraft program to take up some of the slack created when the decision was made to use lunar orbit rendezvous for the Apollo mission instead of earth orbit rendezvous. NASA is fully aware that if it neglects investigation of earth orbit rendezvous, Air Force will ask for the mission.

Pentagon may take consolation from the fact that the troubles of officialdom aren't limited to one continent. After the recent shakeup of the British cabinet, new Minister of Aviation Julian Amery gave Parliament a glimpse into the hazards of second-guessing: "Last Friday morning I was . . . discussing with some of the air marshals the slippage of deliveries of some aircraft. In a moment of impatience I allowed myself to say, 'If I were minister of aviation, what I would do is this . . .' Hardly were the words out of my mouth when the skies darkened and the ground began to tremble and we embarked on the convulsions of the weekend . . . When the dust subsided I found that I was minister of aviation and that the usual channels, with their usual foresight, had arranged matters so that I had an opportunity to express my view on aviation policy within less than 24 hr. after entering my own office."

—Washington Staff

Air Force Still Limited on Space Studies

Defense allows renewal of advanced systems studies but has approved no offensive space war concepts.

By Larry Booda

Washington—Defense Department's approval for the Air Force to resume contracting for studies of future weapon systems after a year's suspension still has not been extended to offensive space warfare systems.

During the year's suspension period (AW May 14, p. 26) Director of Defense Research and Engineering Harold Brown took actions which assured tighter civilian control in the origination of new system concepts and ordered the Air Force to centralize its machinery for establishing objectives, assessing advanced technology and planning development.

Two key actions mark the change. One is that Advanced Development Objectives (ADOs) can now be written only at USAF headquarters. Formerly they came from scattered sources in headquarters, operational commands and divisions of Air Force Systems Command.

The other is that all research-oriented units of Systems Command will be placed under centralized control except those in the field of aerospace medicine. Last week the command's Research and Technology Division, which will be the focal point for applied research and advanced technology, became operational at Bolling AFB here. Commander is Maj. Gen. Marvin C. Demler.

Some Development Planning Studies (DPSs) have been approved for contracting to industry and private laboratories and others will be done in-house by the Air Force (AW June 18, p. 23). They were formerly called SRs, for Study Requirements, and identified by a number. In general, the Air Force can fund studies costing less than $200,000 without higher-level approval. When the sum is higher, permission must be obtained from Defense Research.

The following studies have been approved:

• **Command and Control** of Limited War Forces. Systems Command's Electronic Systems Division at Hanscom AFB, Mass., has cognizance of this effort, which was initiated because of current Administration interest in counter-insurgency actions and limited war. It combines requirements of all the services. Project number is 799022.

• **Advanced Packaging Concept** for Ballistic Missiles. This is being conducted by the command's Space Systems Division because it has responsibility for boosters. Project number is 799043. Development cognizance probably would be under the Ballistic Systems Division.

• **Aerospace Surveillance.** ESD will monitor this integrated concept for detection and tracking from the surface of the earth upward. Project number is 799021.

• **Global Test Environment** (Range Instrumentation Study). ESD has cognizance.

• **Electromagnetic Warfare.** Aeronautical Systems Division has cognizance of this concept, which includes use of laser (optical maser) beams. Project number is 799014.

• **Extended Range Strike** Aircraft Study. ASD has cognizance. Project number is 799012.

• **Survivable and Effective** Air-Breathing Defense. ASD has cognizance. Project number is 799013.

One concept has gone beyond the feasibility study and planning stage and has been approved for component development. Its title is Recoverable Orbital Launch System. This is what was once called Aerospace Plane, a vehicle which would take off from airfields carrying a full load of liquid hydrogen and a partial load of liquid oxygen, go into a low orbit, gather more oxygen, liquefy it and then embark on higher orbital missions or super-orbital missions. This concept was first revealed by AVIATION WEEK on Oct. 31, 1960 (p. 26). ASD has cognizance. Project number is 799001.

Closest approach to space warfare is contained in one proposed system for defense against orbital systems. This SSD project, numbered 799041, probably would embody current satellite inspector concepts (Saint), combined with some means of rendering a hostile satellite inoperable. It has not yet been submitted for approval.

Another proposed system would make use of satellites as part of a military communications network. It would use more advanced technology than the canceled Advent communications satellite of the Army.

In 1960, the Air Force, through a long-range planning group at what was then the Ballistic Missile Division of the Air Research and Development Command and is now Space Systems Division, proposed a wide variety of space systems (AW Dec. 5, 1960, p. 26).

Dr. Herbert F. York, who was then director of defense research and engineering, took the first steps to control these studies. By the time Dr. Harold Brown took his place on May 1 of last year, a complete moratorium on advanced system studies was in effect while the entire military weapon systems spectrum was reviewed to prevent overlapping of effort.

In many instances, the military services and especially the Air Force had let large numbers of study contracts which then almost automatically entered the development phase. Brown initiated management concepts during this period which emphasized clear definition of a system and a thorough understanding of its eventual cost before it was committed to development.

Here is the way the Air Force now plans to handle the life cycle of a future weapon system:

Ideas will be gathered from a wide variety of sources within and outside the Air Force. The Deputy Chief of Staff for Research and Technology then determines what to recommend for further study.

Study Purposes

These studies can identify anticipated and current scientific and technological advances which can be applied to military systems; investigate concepts for weapon and other systems for future use, and determine their feasibility.

These proposed studies must follow general guidelines laid down by Brown's office. Once approved, they are turned over to Systems Command for execution. The various divisions and centers let contracts for the studies or perform them in-house. In some instances, multiple contracts may be let. Command headquarters approval must be obtained if more than three contractors are to be involved.

When studies are completed, the Advanced Development Objectives are written. Again Systems Command enters the picture to write a Development Plan. The new Research and Technology Division will play a larger role in this phase as it gains control of laboratory efforts.

A special committee at USAF headquarters then approves or disapproves the Development Plan. If approved, the plan then goes to the Air Force Systems Review Board. After approval and funding at this level, a Development Directive is issued and placed under the Deputy Chief of Staff for Systems and Logistics. This office acts as the headquarters monitor for the program. Then the directive and funds are turned over to Systems Command for action.

It will take until July 1 of next year for the Research and Technology Division to gather under its wing every activity that it will be responsible for. It will be focal point for more rapid decisions that until now have had to filter through administrative strata from lower echelons. All laboratory directors will report directly to Gen. Demler.

The division will serve as a central point in AFSC for scientific and technical liaison with universities, scientific advisory boards, the National Science Foundation, Office of Aerospace Research and the nation's scientific community. It will assign specific areas of development responsibility to the laboratories.

It will be primarily responsible for the conduct of applied research. Basic research will remain under the Office of Aerospace Research.

The following activities and their areas of interest will be coordinated by the division:

• **Rome Air Development Center,** Griffiss AFB, Rome, N. Y. Electromagnetic energy conversion, signal detection and processing, computation and display, command and control system application, test and evaluation.

• **Directorate of Research,** Air Force Special Weapons Center, Kirtland AFB, N.M. Nuclear weapons applications, effects, ballistics, delivery techniques and safety.

• **6593rd Test Group (Development),** Edwards AFB, Calif. Rocket propulsion components, systems, propellants, along with associated ground equipment.

• **Directorate of Material and Processes,** ASD, Wright-Patterson AFB, Ohio. Materials sciences, metals and ceramics, non-metallic minerals, manufacturing techniques and also materials applications.

• **Directorate of Avionics,** ASD, Electronic techniques, optics and photographic materials, navigation, guidance, vehicle defense, electromagnetic warfare, communications and reconnaissance as applied to aerospace systems.

• **Directorate of Aeromechanics,** ASD. Flight vehicle dynamics, performance, control, launching, alighting, structures, crew stations, environmental control and escape, aerodynamic escape; air-breathing, electric and advanced propulsion; fuels and lubricants, flight vehicle power and site support.

• **Directorate of Targets and Armaments,** Detachment 4, ASD, Eglin AFB, Fla. Non-nuclear weapon warheads, components, effects, ballistics, delivery techniques, safety and associated ground equipment.

Conferees Agree on $362 Million for RS-70

Washington—House-Senate conferees last week agreed on a $48.1-billion defense budget for Fiscal 1963—a net $229 million more than the Administration asked. The main controversial issue—funds for Air Force's RS-70 reconnaissance-strike aircraft—was compromised with a $362-million allocation.

The RS-70 funds will provide for a total of six test aircraft. Defense Secretary Robert S. McNamara recommended a $171-million Fiscal 1963 program for three aircraft (AW Mar. 12, p. 310).

The House added $52.9 million to fund a program of three aircraft, plus development of advanced components to give the former XB-70 a reconnaissance and missile strike capability (AW Apr. 16, p. 26). The Senate increased the House-approved program to the $491 million recommended by Air Force (AW May 21, p. 39).

In approving the $362 million for RS-70, the House-Senate conferees noted that if additional financing is warranted it will be available from the $150-million emergency fund of the secretary of defense.

The conferees also voted to limit the indirect or overhead costs on research grants to 20% of the total grant. The House had set a 15% limit. After strong protests from Defense Department, the Senate removed the ceiling.

The conferees version, apparently non-controversial, quickly cleared the House, and was expected to have been approved by the Senate and sent to the President by early this week.

Kennedy Panel Appointed in Labor Dispute

Los Angeles—Three-man fact-finding panel appointed by President Kennedy began discussions here Saturday in an attempt to break up deadlocked contract negotiations between four California aerospace companies and two large labor unions.

International Assn. of Machinists and United Auto Workers locals at Lockheed Aircraft Corp., North American Aviation, Ryan Aeronautical Co., and General Dynamics plants and at missile sites had been scheduled to strike a week ago.

The strikes have been postponed for 60 days at the request of the President to see if the panel can solve the disputes. They are expected to make recommendations by the first week in September.

Unions at a fifth company, Aerojet-General Corp., were to reach a decision last Thursday on whether or not to accept the services of the panel. Aerojet was not included in the original group because negotiators had appeared to be near a settlement.

The panel is headed by Dr. George W. Taylor of the University of Pennsylvania. Other members are Charles C. Killingsworth of Michigan State University and Ralph T. Seward, labor relations consultant. While the panel only has the power to make recommendations, such recommendations will be reinforced by the prestige of the presidency which is calculated to place any party which opposes them on the defensive. If the panel fails to bring an end to the disputes, the government can still invoke Taft-Hartley injunctions requiring 80-day cooling off periods. The strikes can thus be delayed a total of 140 days beyond the original July 23 strike date.

Central issue in the disputes has become organized labor's demand for union shops in the aerospace industry. Companies are firmly opposed to any such "compulsory unionism." Before negotiations began, IAM and UAW leaders had admitted that there was "only a moderate chance" of obtaining union shop contracts this year and referred to them as a long-term goal.

Agency shop conceded by Douglas Aircraft Co. is quite similar to the union shop and has raised union hopes of obtaining such concessions from the rest of the industry. Official IAM and UAW position still calls for a union shop. Aerojet had a union shop under the terms of its previous contract, so the point is not an issue there.

Right-to-work laws make union shops illegal in 17 states including Florida, Georgia, North Carolina, Louisiana, and Texas, where important aerospace activities exist. Recently, the Sixth U. S. Circuit Court of Appeals ruled in General Motors Corp. vs. National Labor Relations Board that an employer cannot be required to bargain on the subject of the agency shop where a right-to-work law exists.

Later passage of a right-to-work law by a state conceivably could invalidate existing contract terms that are contrary to the new law, according to an IAM official. In the Douglas contract, unions insisted on a clause requiring the company to renegotiate the issue wherever the agency shop is found to be illegal.

All of the companies are offering the unions economic gains approximately equal to those agreed upon in the Douglas settlement (AW July 23, p. 26) but without the agency shop and with no mention of supplemental unemployment benefits, another strong demand made by the unions.



DASSAULT Balzac VTOL testbed, scheduled to begin tethered flight tests this week, is a converted Mirage 3C jet fighter.

Dassault Rolls Out Balzac, Speeds Tests

By Cecil Brownlow

Paris—France's Dassault Balzac VTOL testbed, a converted Mirage 3C fighter with a total of eight Rolls-Royce RB.108 lift-thrust turbojets installed in the fuselage, is scheduled to begin tethered flight tests sometime this week.

The transonic Balzac was rolled out last week as forerunner of the larger Mirage 3V Mach 2-plus interceptor. Tethered tests are being pushed through on a rush basis by Dassault in an effort to achieve positive results before Aug. 7.

That is the deadline date for the ad hoc selection committee within North Atlantic Treaty Organization to make its final recommendations to the organization's armaments committee for a standard NATO VTOL strike fighter under terms of the present fiercely fought NATO BMR-3 competition (AW May 14, p. 30).

A total of 12 entries originally were submitted, and informed observers here now believe the committee recommendation will call for production of two prototypes each of the Mirage 3V and Britain's competing Hawker P.1154 to evaluate both design concepts. As opposed to the lift-thrust plus conventional powerplant principle of the Mirage 3V, the P.1154 design embodies a 27,000-lb. version of the variable-thrust Bristol Siddeley BS.53 powerplant which can be used in both vertical and horizontal flight regimes.

Transonic testbed of the P.1154, the Hawker 1127, already is flying, but Dassault claims it can have operational versions of the Mirage 3V ready by mid-1966, a full two years, it says, before the P.1154 can be available in quantity.

The company also claims the first prototype of the 3V will be rolled out by next July and flying three months later, after extensive ground tests.

Further boost to the Mirage 3V program within and outside NATO has come from the French government decision to fund production of the first two prototypes. This is the evaluation quantity envisioned by NATO.

France also has declared that the 3V is a national defense project and, if successful will be ordered into quantity production whether or not it is NATO's final choice for a standard multi-nation strike fighter.

Britain's Decision

Britain apparently has made a similar decision regarding the P.1154. A national competition within the United Kingdom for a VTOL strike fighter-interceptor to fit requirements of both Royal Air Force and the Royal Navy air arm has been under way for the past several months. The P.1154 reportedly has been selected over several competing designs. To meet Royal Navy requirements, a single-place aircraft will have to be reconfigured to accept a two-man crew.

A formal announcement of the decision is expected sometime this fall.

A third design under serious consideration by the ad hoc committee, the variable-sweep, Mach 2.5 Republic-Fokker D.24 Alliance, seemingly lost out in BMR-3 consideration last week when it became clear that the U.S. will lend neither moral nor financial support to the project within NATO.

In view of the British and French stands, support of one kind or the other was considered necessary before the Alliance could be proposed to NATO's armaments committee by the ad hoc selection group. The latter committee began its final discussions on BMR-3 last week.

Although not a 3V, tethered flight by the Balzac before the Aug. 7 deadline is considered a "must" by Dassault. Although the firm closed down after the roll-out last week for its annual vacation for almost all employes, personnel directly connected with the Balzac project were told to remain at the firm's Melun-Villaroche facility near Paris until the first flight of the aircraft has been achieved.

The major purpose of the Balzac will be to test bleed-air roll, pitch and yaw stabilization systems planned for the 3V under the nose, tail and wings of the aircraft during minimal speed ranges in the VTOL regime. The Balzac system already has undergone extensive wind tunnel testing and, if successful in actual flight, will be adapted without change to the Mirage 3V.

The Balzac system contains a louvered bleed-air outlet on either side of the black nose radome and two beneath the tail section for pitch control.

Another two positioned under the rear of each wing just outside the redesigned fixed landing gear are for roll corrections. A third set, with one outlet on either side of the rear of the fuselage, controls yaw.

Air for the stabilization system is bled from all eight RB.108s, which have thrusts of 1,900 lb. each, and is funneled into a common ducting unit for all outlets. The ducting contains three valves, one each for pitch, roll and yaw control.

The system can be manually operated by the pilot through two selection panels, although pitch and roll are automatically monitored and compensated for by the Dassault-designed autopilot connected to the vertical control column within the cockpit.

Within the testbed cockpit, the pilot has three control levers for starting the vertical lift powerplants, each one actuating engine pairs, one engine of each pair on either side of the fuselage for balance. In addition, there is a lift throttle, which also has thumb grip to regulate thrust of the horizontal engine during transitional phases.

Dassault officials say the lift-thrust engine principle, as such, already has been proved by performance of the Short SC.1 in Great Britain and that testing of the stabilization system is essentially the only step needed before progressing to use with the Mirage 3V. The 3V will outwardly resemble the present testbed although, to gain space for additional fuel, its fuselage will be stretched, and maximum gross weight will grow from under 20,000 lb. to 28,000 lb.

Fuel, normally 572 Imp. gal. in the Mirage 3C, has been trimmed to 400 gal. in the testbed to permit installation of the lift thrust engines. Major tank is in the middle of the fuselage at the center of gravity. Four auxiliary tanks are split, one in each wing and two others in the fuselage.

Dassault engineers estimate fuel aboard will permit 12 min. of hover or, during later transitional phases, 15 min. in the air, allowing 20-40 sec. for each VTOL and landing phase.

Inlet ducting for the horizontal propulsion system in both the Balzac and the Mirage 3V is diverted by an S-shaped ramp into the fuselage to permit positioning of the lift engines just aft of the inlets in the intake fairings.

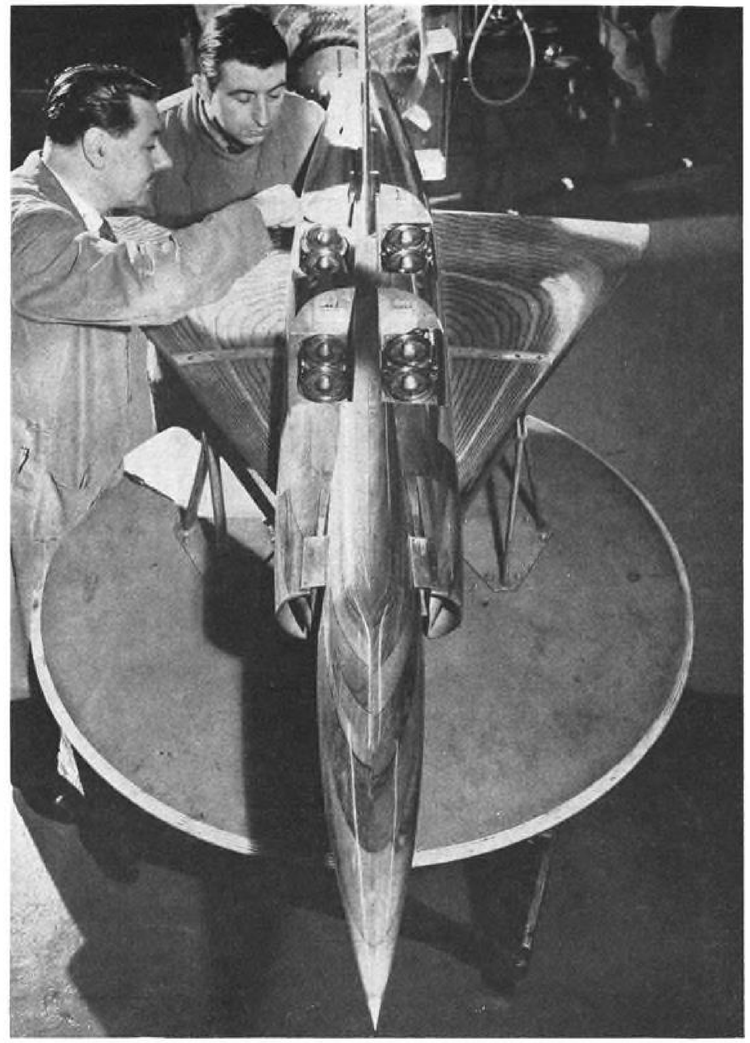
For the lift engines, a hinged slotted door rises vertically in front approximately 18 in. and louvers on top of the door are opened for the initial takeoff phase. Lower, non-louvered doors for the RB.108 lift engines swing to either side. As speed increases, the spring-loaded louvers are closed and, after transition is completed, the door itself is closed to a flush position.

Powerplant installation is essentially the same for the Mirage 3V and the Balzac, four engines behind each air intake. As in the Balzac, two lift engines will be installed in the 3V in parallel slightly aft of the cockpit and another two in the same configuration 3 ft. behind.

The other four will be arranged in identical fashion in the other fuselage inlet fairing.

Dassault says it decided to go ahead with the Balzac testbed rather than a 3V prototype primarily because the planned lift engines for the 3V—Rolls-Royce RB.162s—will not be available before 1963. Dassault wanted to evaluate the over-all principle at the earliest possible date. The RB.162, with a thrust-to-weight ratio of 16:1, will deliver about 4,400 lb. thrust—its present rating in test stand trials—in initial 3V installations. Growth, however, will be into the 6,000-lb. class.

Development of the RB.162, which has been running in a test stand since last November, is being financed by Britain, France and Germany. Rolls for the past year has been wind tunnel testing the engine's performance in model configurations of the 3V primarily to evaluate basic intake design for lift-thrust engines.



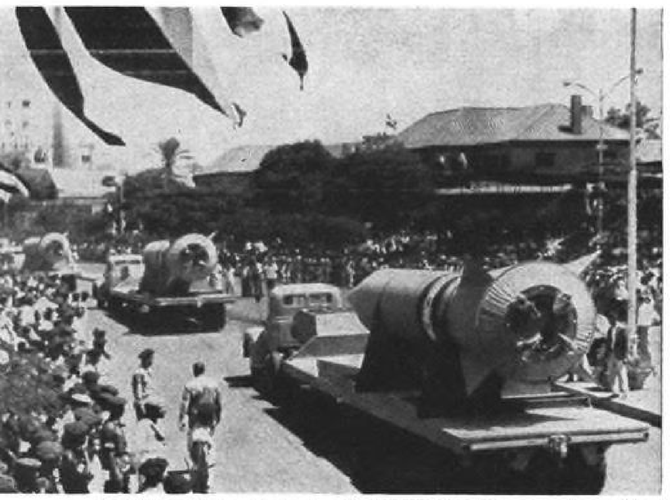
MODEL of the Dassault Balzac VTOL prototype undergoes wind tunnel testing at Rolls-Royce research and development test facility at Hucknall. Engines are four pairs of Rolls-Royce RB.108s. Dassault Mirage 3V follow-on will be powered by eight Rolls RB.162s.

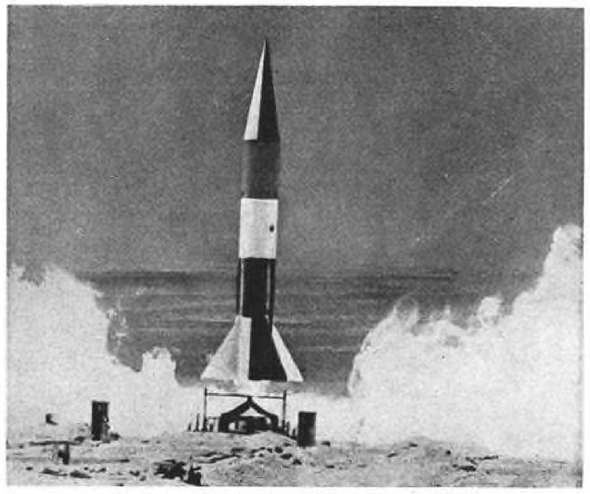
Horizontal powerplant for the 3V will be the Snecma TF106 of 19,845 lb. thrust with afterburner as opposed to 13,225 lb. thrust of the Snecma Atar 9 powering the Mirage 3C. Bristol Siddeley Orpheus 7 in the Balzac, installed without afterburner, is rated at approximately 5,000 lb. thrust. The TF106 is a growth version of the Pratt & Whitney JTF10 turbofan.

Mirage 3V will retain the same type vertical fin as that of the Mirage 3 and the Balzac. Although somewhat larger, the delta planform of the Mirage 3C will be retained in the 3V.

Fuselage also will follow general layout of the Mirage 3 (AW July 24, p. 50), although the area rule configuration has disappeared in the Balzac as inlets have been swollen to accept the lift engines and will be missing in 3V for the same reason. Dassault says that, with increased thrust, change in fuselage configuration will have no effect on 3V performance which is to match that of the 3C.

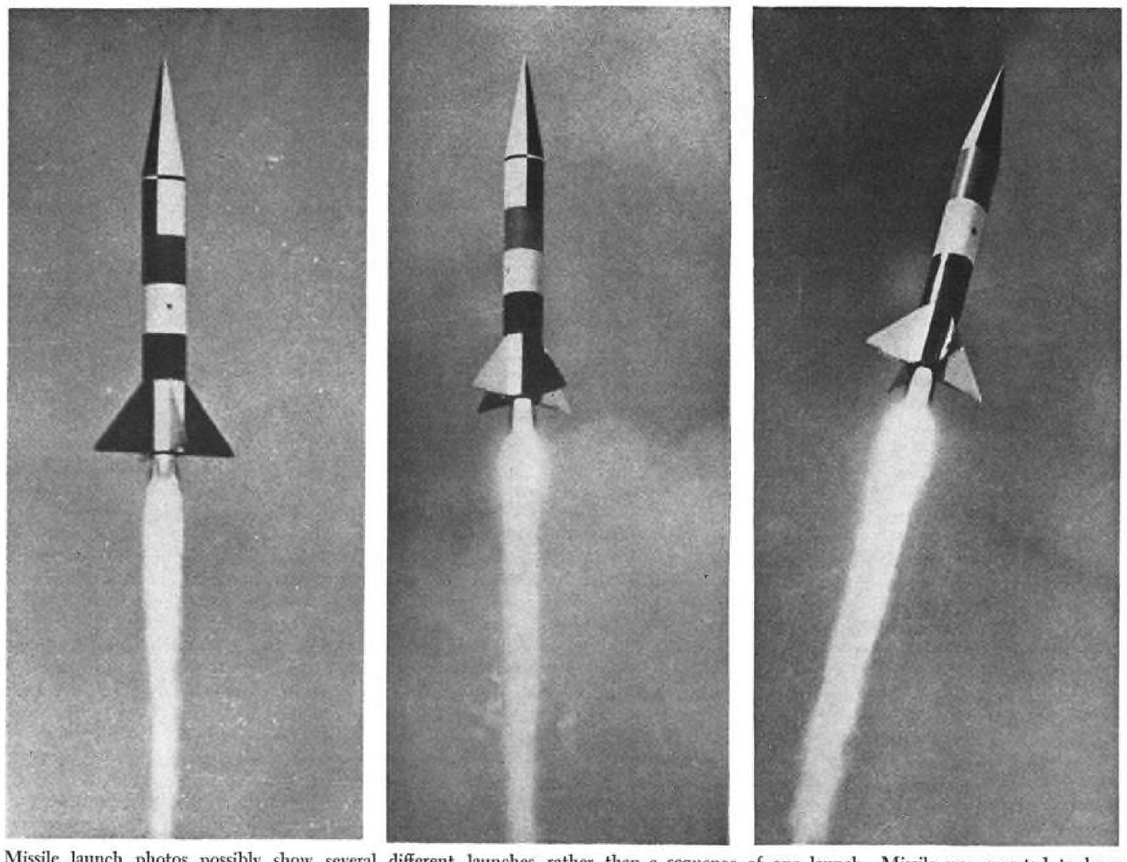
Fuselage of the 3V will be manufactured under partnership agreement by Sud Aviation. British Aircraft Corp. and Boeing Co. also have license production rights should the aircraft be ordered by either Britain or the U.S. Chances now appear slim in Britain, but Boeing still is hopeful that the 3V or a derivative may be accepted in the U.S.





Egyptian military rockets were displayed last week in a parade marking the 10th anniversary of the overthrow of King Farouk. United Arab Republic announced it had successfully fired several of the missiles. Missile on truck appears to follow design of World War 2 German V-2, with some resemblance to later model Russian T-1 medium-range ballistic missiles. Control vanes are positioned in the nozzle flow in V-2 fashion and missile has either a flaring skirt similar to Soviet designs, or a protective covering over rocket nozzle.

Egypt Fires Missiles; Claims Range of 360 mi.



Missile launch photos possibly show several different launches rather than a sequence of one launch. Missile was reported to have struck a target several hundred miles away. Egyptians say the missile is about 36 ft. in length and has a range of approximately 360 mi. UAR President Nassar also announced the opening of a jet aircraft manufacturing facility last week. Factory will manufacture jet engines and aircraft for Egyptian trainers, fighters and troop transports.

Defense Fights Move to Broaden GAO Role in Negotiated Contracts

By Katherine Johnsen

Washington—Defense Department has launched a major offensive against legislation extending General Accounting Office's authority to veto its negotiated contracts.

Approval by the secretary of defense, or a service secretary, is now final on all negotiated contracts—unless the contract is clearly illegal. GAO has authority to withhold money payments on any illegal government contract.

The legislation that has aroused the Defense Department would subject 60% of the procurement dollar volume going into negotiated-type contracts to possible invalidation by GAO, according to Thomas D. Morris, assistant secretary of defense for logistics.

The measure—sponsored by Rep. Carl Vinson (D.-Ga.) and Rep. Edward Hebert (D.-La.) and supported by GAO—was passed by the House, 362 to 0, and is now pending before Senate Armed Services Committee (AW June 18, p. 28). It would also require contractors on incentive type contracts to certify that their cost data is "current, accurate, and complete."

Sponsors of the legislation place a far narrower interpretation on the proposed GAO veto authority than does the Defense Department. Vinson told Senate Armed Services that it would give this authority to GAO "in only the very rare case."

Procurement Law

Defense procurement law requires formal advertised bid contracts, but authorizes 17 justifications for negotiated contracts. Approval by the secretary of defense of any contract negotiated under any 17 of these justifications is now final.

Under the Vinson-Hebert proposal, the contract determination of the secretary of defense under 6 of the 17 justifications would be final "unless same is clearly erroneous or is not supported by substantial evidence."

This proviso would apply to these classes of negotiated contracts:

- **Research** and development work.
- **Contracts** which "should not be publicly disclosed."
- **Contracts negotiated** to assure standardization and interchangeability of equipment.
- **Contracts negotiated** because they involve a substantial initial investment or an extended period of preparation for manufacture.
- **Contracts negotiated** after collusion among bidders was indicated under formal advertised bidding procedures.
- **Contracts negotiated** in the interest of maintaining an industrial mobilization base for an emergency.

Morris protested to the committee that under the Vinson-Hebert proviso, General Accounting Office would share with Defense judgments on whether contracts negotiated under these classifications were justified—with the authority to invalidate Defense Department decisions by withholding payments. He said it would be a case of "shared authority without shared responsibility" for national defense.

"Contractors could never be certain that contracts, made in good faith with the government, would not be voided on the basis of disagreements within the government on . . . matters of judgment, with resultant heavy losses," Morris told the Senate committee. "Government would similarly be faced with the prospect of serious program slippages because of re-procurement actions to replace . . . voided contracts."

Morris said the proviso would authorize GAO to pass on such military procurement questions as when a contract is in the area of research and development, when a contract should be classified, whether there should be standardization of equipment, or the importance to the mobilization base of a particular plant or manufacturer.

According to John Courtney, counsel of the House Armed Services Committee and adviser to Vinson and Hebert on the legislation, the proviso does no more than allow GAO to veto a contract which was awarded on the basis of false or unreliable information in the cost and pricing area and would do nothing whatever to bring GAO into the area of military decisions.

Veto Proviso

In his appearance before the Senate Armed Services Committee, Vinson minimized the significance of the GAO veto proviso and directed his testimony to a strong plea for enactment of the proviso requiring certification of cost data by incentive type contractors.

Although Defense Department has issued a procurement regulation requiring that incentive contracts include certification of cost data by the contractor, Vinson said it is not being applied. He reported that a study of the 364 contracts awarded since the regulation was issued a year and a half ago shows that 121 of the contracts included no cost data certification.

Morris later assured the committee that this situation is being corrected. He opposed the inflexible provision advocated by Vinson that an incentive-type contractor certify his cost data is "current, accurate, and complete." Morris suggested language similar to the Defense regulation that a contractor certify that "to the best of his knowledge and belief all actual or estimated costs of pricing data . . . have been considered . . . and made known to the contracting officer for his use in evaluating the estimate. . . ."

The first order of business, Vinson stressed, is to end over-estimating and undeserved profits on incentive contracts. "Let us close the door on this once and for all," he urged, with a law providing for "truth in negotiating."

Venus Mission Fails; New Mariner Readied

Cape Canaveral—Second attempt to send a Mariner spacecraft on a Venus flyby mission will be made by the National Aeronautics and Space Administration about mid-August, at the earliest, after an unsuccessful attempt to launch an identical payload here July 22 (AW July 23, p. 20).

The Atlas-Agena launch vehicle was fired at 4:21 a.m. EST from Pad 12 in what appeared to be a normal launch. But approximately 3½ min. later it began to deviate in pitch and yaw from the intended trajectory. Approximately 290 sec. after lift-off, and roughly 10 sec. before scheduled cut-off of the Atlas booster, the Air Force Missile Test Center range safety officer ordered the vehicle destroyed.

A detailed analysis of telemetry was under way to determine the basic cause of the trajectory deviation.

The fact that the booster deviated from desired trajectory gradually over a period of more than 1 min., rather than a sharp, sudden departure, suggested to some observers that the fault might have been in the flight path equations used in the General Electric/Burroughs command guidance system computer.

Another Atlas-Agena and Mariner spacecraft, which have been at the Cape for a month, were immediately readied for erection on Pad 12.

The original plan called for launching both spacecraft within a 30-day period on slightly different trajectories so that both would arrive near Venus within a nine-day period, Dec. 8-16.

NASA has until Sept. 10 to launch the second Mariner. The next time that Venus approaches close enough to the earth for a Mariner launch will be January, 1964. The cost of the two Mariner spacecraft—designed and built by Jet Propulsion Laboratory under a 10-month crash program—and launch vehicles is approximately $32 million.



Cessna Model 411, largest aircraft in the Cessna line, is in initial stages of flight testing at the company's Wichita, Kan. factory. Shown above with a 310G, the 411 is in the 6,000 lb. plus category and will carry 6-8 persons. Span is approximately 40 ft., height to tip of fin exceeds 11 ft. and length is about 33 ft. (AW July 23, p. 27).

Supercharged Cessna 411 Begins Flight Testing



Model 411 prototype is powered by two Continental GTSIO-520 turbo-supercharged, fuel injection engines, rated at approximately 360 hp. each. Oval windows and air scoop at base of vertical fin indicate the aircraft is designed for eventual pressurization. Integral steps are contained in the lower section of the two piece door. The top half swings up to provide easy access.



Gen. Taylor to Head Joint Chiefs; Lemnitzer Named to Head NATO

Washington—Reinforced emphasis has been placed on the ability of the U.S. to wage less than all-out nuclear war by President John F. Kennedy's nomination of Gen. Maxwell D. Taylor, an outspoken advocate of stronger conventional forces, as chairman of the Joint Chiefs of Staff.

At the same time the President nominated Army Gen. Lyman L. Lemnitzer, present JCS chairman, to relieve Air Force Gen. Lauris Norstad as commander-in-chief of the U.S. European Command. The North Atlantic Treaty Organization permanent council also named Gen. Lemnitzer to replace Gen. Norstad as supreme allied commander of European forces.

Gen. Taylor has been President Kennedy's special military adviser since June of 1961. Gen. Taylor retired in 1959 as Army chief of staff in a disagreement with former President Eisenhower over size and modernization of the Army. He has favored a single chief of staff for the armed forces rather than the joint chiefs system.

One key reason for Gen. Taylor's selection is to provide forceful leadership of the joint chiefs which is composed of USAF Gen. Curtis E. LeMay, Navy Adm. George W. Anderson, Army Gen. George H. Decker and Marine Gen. David M. Shoup.

Gen. Lemnitzer has been doing an increasing amount of traveling with Secretary of Defense Robert S. McNamara to U.S. and foreign bases. When he is absent from a meeting of the joint chiefs, Gen. Decker presides as senior in terms of service as a member of the joint chiefs. There has been an increasing lack of agreement in such meetings.

Gen. Decker will be replaced as Army chief by Gen. Earle G. Wheeler, who is now Gen. Norstad's deputy as USEC. Both Decker and Norstad will retire. All of the changes will take effect on Sept. 30.

If Gen. Taylor finds over a period of time that there is continuing disagreement within the JCS, he probably will use this to support his argument for a single chief of staff, some Pentagon observers believe.

The nomination of Gen. Lemnitzer dispelled printed reports that he was in disfavor with the Administration. President Kennedy came to his defense in a news conference last week, saying that he had informally determined that the NATO nations would accept another American as supreme allied commander. "We then sent in the name of Gen. Lemnitzer, who is our senior military officer, and a distinguished one."

A high Administration source told AVIATION WEEK that false stories about Gen. Lemnitzer were circulated after the Cuban invasion failure in the spring of 1961. These stories said in effect that Gen. Lemnitzer and the joint chiefs had failed to support the invasion.

These impressions held credence because Gen. Lemnitzer made no attempt to refute them. By January of this year it was determined that he had had nothing to do with the planning of the invasion, although the joint chiefs were called in at the last minute. When asked by the President why he had not protested about these stories, Gen. Lemnitzer said he had a job to do which did not include reacting to criticism.

Gen. Norstad originally asked to be relieved last February, but stayed on at the request of the President until the top-level shifts were determined. Of the many problems facing NATO, one of the most difficult that Gen. Norstad has had to deal with is the proposed mobile mid-range ballistic missile.

When the concept was first proposed, it called for a 13,000-lb., truck-mounted missile that would be fired from points in the NATO countries.

By last summer, however, strong objections had been registered by most of the NATO nations about having nuclear weapons traveling over their roads. The ability of Russia to fire ballistic missiles with 100-megaton warheads lent strength to the arguments of elements within each country which favored disengagement and said that nuclear weapons would automatically make their countries Russian targets.

All NATO countries but Germany were said to have rejected the road-based version of the MMRBM and favored a sea-based version instead. Their voices were made stronger by U.S. demands that they pay for a greater share of the cost of this new weapon system. If they had to pay, they wanted a greater say in the employment of the system.

Gen. Lemnitzer will be faced with the task of persuading the NATO nations to pay for a greater share of all weapon costs. This is dictated by the continuing unfavorable balance of trade being experienced by the U.S. He already has been active in this effort, having accompanied Secretary McNamara to Europe for several conferences.

Other top-level shifts face the U.S. military services. It was indicated that Gen. Barksdale Hamlett, Army vice chief of staff, would be replaced and would be sent to fill the post vacated by Gen. Wheeler. Army Gen. James E. Moore, chief of staff to Gen. Norstad in the NATO command, is due to retire this fall.

In the Navy, Vice Adm. Robert B. Pirie, deputy chief of naval operations for air, has requested retirement effective Nov. 1. He has held the post for more than four years. Rear Adm. Thomas H. Moorer, head of the Navy's Long-Range Objectives Group, probably will be ordered to command the U.S. Seventh Fleet in the Western Pacific. Vice Adm. William A. Schoech, now Seventh Fleet commander, has been mentioned as the replacement of Adm. Pirie.

Rear Adm. Paul D. Stroop, chief of the Bureau of Naval Weapons, is slated to become commander, Naval Air Force, Pacific Fleet. He probably would be relieved by Rear Adm. Kleber S. Masterson, his present deputy.

Adm. Robert L. Dennison, NATO supreme commander, Atlantic, and commander of the U.S. Atlantic Fleet, is scheduled to retire next April. He will probably be replaced by Adm. H. Paige Smith, commander of U.S. Naval Forces, Europe, who in turn would be replaced by Vice Adm. David L. McDonald, commander of the Sixth Fleet in the Mediterranean.

Yeager Appointment

Col. Charles E. Yeager, first man to fly supersonic in the Bell X-1 in 1947, was named commandant of the USAF Aerospace Research Pilot School on July 24. Col. Yeager succeeds Lt. Col. Robert M. Howe who has been reassigned to the Pentagon in the office of the director of systems acquisition, DCS/Systems and Logistics.

As commandant, Col. Yeager heads the Aerospace Research Pilot School with the mission of training selected pilots to monitor and conduct flight tests of research, experimental or production type aerospace vehicles.

Man's Mission

Man's role in USAF's future aerospace missions will be investigated by Aeronutronic Division of Ford Motor Co. under a small, one-year contract from Aerospace Medical Division's Behavioral Science Laboratory at Wright-Patterson.

Company will examine and codify skills to be required by both ground-based and aerospace crews and pinpoint the tasks they are to perform in an effort to define the role of man in aerospace missions. Typical advanced systems to be reviewed include recoverable boosters, strategic orbital systems, space planes, and space logistics and rescue systems.

New Soviet Nuclear Test Series May Force More U.S. Experiments

Washington—Soviet Russia's decision to conduct another series of nuclear weapons tests could in turn force the U.S. into more testing, President Kennedy said last week.

Russia said the current U.S. test series has made it "inevitable" that new Russian tests be held, particularly since the U.S. had "extended to outer space the arms race" by exploding a nuclear device at a very high altitude.

Two days later Russia also announced that its Northern Fleet and rocket and air forces will test modern weapons in the Barents and Kara seas between Aug. 5 and Oct. 20. These exercises undoubtedly will incorporate nuclear warhead tests—probably including operational testing of nuclear warheads for Polaris-type, submarine-launched missiles.

Premier Nikita Khrushchev inspected the Northern Fleet and on July 21 witnessed the launching of rockets from submerged, nuclear-powered submarines, the official news agency Tass said. Russia has claimed to have this type of weapon before but has never publicly referred to underwater launchings until now.

AVIATION WEEK revealed last Apr. 2 (p. 15) that Russia had completed its first submerged test launchings of a solid-propellant missile from a nuclear-powered submarine. U.S. Navy officials at that time were still saying publicly that Soviet missile subs had to surface in order to launch rockets.

Premier Khrushchev awarded medals to Rear Adm. Petelin, commander of the Submarine Fleet of the Northern Fleet; Captain Second Class Zhyltsov, commander of an atomic submarine; and Engineer Captain Second Class Timofeyev, commander of "an electromechanical combat section of an atomic submarine," Tass said, "for successfully carrying out a special task set by the government."

This special task is believed to be research and development firings of Polaris-type missiles in the White Sea area.

Russia ended a three-year voluntary U.S.-USSR nuclear test moratorium last September to begin a series of more than 50 nuclear tests on the continent and on the Arctic island of Novya Zemlya, which lies between the Barents and Kara seas. The series included one device with a yield of more than 50 megatons.

President Kennedy noted that "in this constant pursuit, everyone desires to be last." He said the U.S. "will not test again unless we are forced to or unless our security is threatened, or because as a result of the new Soviet tests we find ourselves unable to meet our commitments to our own people and those who are allied with us. We will therefore have to wait."

Meanwhile, the U.S. failed again July 25 in its attempt to explode a device of less than one megaton yield at an altitude of 30 to 60 mi. above Johnston Island in the Pacific when the Thor booster caught fire on the launching pad.

This means at least a two-week delay for preparation of the pad and another booster.

First high-altitude thermonuclear device, in the megaton range, was exploded at about 200 mi. altitude last July 9. In earlier attempts, one Thor had been destroyed because of a false tracking signal and another had disintegrated due to aerodynamic overheating caused by the special test configuration (AW July 9, p. 27).

Technical Data Shows Telstar Status Perfect

Washington—First technical details on the performance of the Bell System Telstar after 150 orbits indicate that the communication satellite is in excellent internal condition and operating "perfectly normally," according to Bell Telephone Laboratories (AW July 16, p. 26).

The satellite, whose orbit kept it continuously exposed to sunlight up to July 21, will spend increasing period in the earth's shadow until Aug. 10, after which the cycle will reverse.

Use of the satellite, which could be operated for up to 3 hr. 50 min. per day without discharging its batteries while in full sunlight, will be gradually reduced to slightly less than 2 hr. per day until Aug. 10, when allowable operating time will begin to increase.

The satellite, which was set to spinning at 177 rpm. at launch for attitude stabilization purposes, is slowing down, as expected, at the rate of about 0.35% per day due to damping from earth's magnetic field. This should provide sufficient stabilization for at least a year, based on present rate, BTL said.

Telstar is within range of the Andover, Me., station during four or five of the nine daily orbits, and during two or three of these it is also visible to the stations in Britain and/or France. The satellite has been used for communications and television experiments during an average of two passes per day, but is tracked and its internal performance telemetry data is monitored by Andover for all passes within range of the station.

Maximum visibility time to Andover per day has been 250 min., with up to 102 min. per day of mutual visibility for U.S. and European stations. Due to satellite orbit precession, the mutual visibility interval will change, reaching a maximum on Aug. 29, then slowly decreasing, with the cycle repeated every 190 days.

Telemetry data indicates that internal satellite temperature is as expected. Deterioration of solar cells used to measure Van Allen radiation effects is within 2% of expected value, based on solar cell currents.

The satellite functioned perfectly last week during several live transatlantic telecasts. During one telecast, the audio portion of the program was lost briefly, but this resulted from an error in switching on the ground.

Quantatron Offer

Allied Chemical Corp. was considering an offer from Union Carbide Corp. last week for the purchase of its subsidiary, Quantatron, Inc., Santa Monica, Calif., a research and development firm heavily involved in optical maser activity. Should the offer be accepted, Quantatron would become part of Union Carbide's Linde Co., an optical maser materials supplier. Quantatron's optical maser effort, headed by Dr. Theodore Maiman, is one of the largest in the country, partly funded by the three services.

Other aerospace companies including Marquardt, Aerojet-General, and General Precision Laboratory are interested in acquiring the Santa Monica company.

Defense Salary Policy Explained by Brown

Washington—Defense Department's policy on contract allowances for executive salaries is already in line with the program recommended by the Kennedy Administration in April (AW July 9, p. 18), Dr. Harold Brown, director of defense research and engineering, told the House military operations subcommittee last week.

He pointed out that Defense regulations provide for reimbursement of "reasonable" salaries and other compensation, and that the reasonableness be judged by the comparability with the compensation paid for a similar job responsibility in private business.

Brown noted that these two criteria—"reasonableness" and "comparability"—are also recommended in the report drawn by the Bureau of Budget (AW May 7, p. 33) and submitted by the President to the Congress.

Lunar Bug Contract Due by Mid-October

By Edward H. Kolcum

Washington—Precise definition of many of the major subsystems in the Apollo lunar landing vehicle which will take two astronauts to the surface of the moon will be made in January when a joint industry-National Aeronautics and Space Administration Phase 1 design study of the bug will be completed.

Contractor competition for development and fabrication of as many as 12 lunar landing bugs began July 25, when 11 airframe companies received proposal requests from NASA's Manned Spacecraft Center in Houston. A bidders' briefing will be held in Houston Aug. 2 and bids will be due Sept. 4. NASA hopes to award the two-part contract to a single company by mid-October.

First phase will be a 90-day joint study with NASA to specify design parameters and the major subsystems, according to John Disher, assistant director for the Apollo spacecraft in NASA's Office of Manned Spacecraft and Flight Missions. Second phase will be hardware production.

NASA's initial bidders list (AW July 23, p. 18) consisted of Boeing, Douglas, General Dynamics/Convair, Grumman, Ling-Temco-Vought, Lockheed, Martin and Northrop. These companies also competed for the lunar orbit rendezvous study contract, which was won by Ling-Temco-Vought. McDonnell, North American and Republic later requested and received bug proposal requests.

It is understood that North American disqualified itself at NASA's request because the company's Space and Information Systems Division has the prime Apollo command and service modules contract, and will integrate the bug with the remainder of spacecraft system. It is understood the firm received the request for proposal only for information.

McDonnell is prime contractor for the three-orbit, six-orbit and 24-hr. Mercury mission capsules, and for the Gemini spacecraft. Congressional pressure for spreading the NASA contractor base could eliminate McDonnell. Republic and seven of the original eight firms on the list do not have sizable NASA contracts.

Boeing is booster contractor for the Saturn C-5 vehicle.

Boeing has formed a 300-man team under Harlowe Longfelder for the project. Longfelder is former head of the company's Space Systems Department and also worked for the Advanced Research Projects Agency.

NASA Headquarters manager for the lunar lander will be Maj. Richard C. Henry, who also is Apollo guidance and navigation manager. Project chief at Houston, not yet named, will work under Apollo Project Director Charles Frick.

Several of the general vehicle requirements are described in the proposal request, but most of the subsystem designs will not be made final until the company-NASA study is completed. In order to provide a safe margin within the Saturn C-5 launch vehicle capability, bug weight will be limited to 24,000 lb., and NASA would like to reduce this weight to 20,000 lb. (AW July 9, p. 25).

Exterior structure will be of maximum strength-weight ratio but must be able to withstand the extremes of the lunar surface temperature, which vary from ±250F on the sunlit and dark sides. Although the bug will undergo no aerodynamic loads, NASA looks on the extreme cold as a structural problem.

Because the bug will not be constrained by drag, its configuration will be idealized to the lunar landing-takeoff mission. Present general configuration (AW July 23, p. 40) provides maximum crew visibility, but whether this will be achieved with ports, panels or a bubble has not been determined.

About half the vehicle weight at the time it begins its lunar landing will be fuel required to touch down on the moon's surface. This means if the bug weighs 20,000 lb. fully fueled, its lunar landing weight will be 10,000 lb. It is anticipated that lunar landing gear, some fuel tanks and perhaps an engine will be jettisoned on the moon. These items weigh about 2,000 lb. Lunar takeoff weight would be 8,000 lb., half of which would be fuel consumed to effect a rendezvous with the orbiting command module mother craft. Of the 4,000 lb. remaining just before rendezvous, about 50% will be structure and the remainder astronauts, systems and instruments.

The bug will be designed with enough fuel so that it will be the chaser in the rendezvous, but the command module will be able to reverse its role as target and become the chaser.

The legs on the bug will provide 3.5 ft. clearance between the bottom of the bug structure and the lunar surface. The method of landing shock attenuation is still undecided, but it is expected to be based on a hydraulic or pneumatic system (see p. 68).

The throttleable propulsion system will operate over a full thrust range of about 1,500 lb. to 10,000 lb. if a single landing engine is used. If multiple engines are selected, they will probably be stepped over different thrust ranges. Propellant will be specified as an ammine combination, which is an earth-storable hypergolic. The vehicle will have a 16-engine reaction control stabilization system, probably fueled by a bipropellant hypergolic mixture of nitrogen tetroxide and hydrazine.

As batteries are expected to be too heavy and fuel cells too complex, there is a good chance that power on the moon will be generated by a small reciprocating engine fueled from the same tanks that fuel the lunar landing engine.

Environmental control system probably will be patterned after the system presently used in the Mercury capsule. Supercritical liquid oxygen will provide the breathing oxygen and cooling probably will be by boiling water. Carbon dioxide removal will be accomplished with lithium hydroxide and charcoal will be used to remove odors.

Drinking water will be generated by the command module fuel cell system. Present estimates are that this system will generate about 230 lb. of water during the mission. This will be augmented by an emergency supply for use at the start of the mission, and in the event the fuel cell malfunctions.

The lunar landing astronauts will don lunar surface pressure suits (see p. 13) before they enter the bug. During the translunar flight, all three crewmen will wear pressure suits essentially the same as those used for Project Mercury flights. Plan is for only one crewman to be operating outside the bug at any one time.

Lunar Bug Guidance

Washington—Massachusetts Institute of Technology will develop the guidance and navigation system for the Apollo lunar landing bug as a part of its contract with NASA to develop the translunar guidance and navigation system.

Original MIT Apollo guidance contract generated a furor in the avionics industry (AW Jan. 8, p. 23), but NASA feels justified in extending the job to the lunar landing module because both systems will be designed to use common components, reducing the types of spares to be carried on board.

Life Sciences Contract

Washington—Lovelace Foundation for Medical Education has been awarded a $243,920 contract to compile a definitive store of information on all areas of life sciences as its pertains to manned space flight. The National Aeronautics and Space Administration contract will be in effect through June, 1965.

NASA May Dictate Economy Measures

Washington—Space industry contractors may be required to follow fairly detailed fabrication techniques which the National Aeronautics and Space Administration considers best for more economical hardware production.

NASA's Marshall Space Flight Center already is insisting that contractors in some cases employ production techniques which are "well-known to be best," according to Dr. J. C. McCall, assistant to Wernher von Braun, Marshall director.

Dr. McCall's statement came during hearings by the House Committee on Science and Astronautics on what NASA and the Defense Department are doing to reduce the growing costs of space research and development. While both agencies agreed that research and development does not lend itself to highly competitive contracts, spokesmen insisted that economies are being effected in their contracts.

Defense Department methods, according to Dr. Lawrence L. Kavanau, special assistant for space to the director of defense research and engineering, is to be highly selective in systems for development, and then to standardize as many of the components as possible. D. D. Wyatt, director of NASA programs, said his agency is attempting to obtain economy through advanced approaches to business methods, manufacturing techniques, launching methods, spacecraft utilization, use of Defense Department resources, and integration and checkout prior to launch.

Some committee members objected to what they considered generalities in Dr. Kavanau's testimony, and Rep. Ken Hechler (D.-W. Va.) insisted that the witness—if he could—give concrete examples of standardization in the Defense Department. Dr. Kavanau responded that Agena B, Atlas and Titan 3 are the first three standard launch vehicles, and studies are now being made to make major subsystems in these vehicles.

The toughest problem, he said, is that economy dictates standardizing a system, while project scientists want each system tailor-made for their own experiments.

Dr. Kavanau said he feels the NASA space program is valid and the civilian agency has made the proper selection of launch vehicles for its program. He said that the fundamental responsibility for economy in space programs rests with the integrity of managers and those who work on the jobs.

He said it is imperative that extreme caution be used in selecting systems for development because the quality of management in both government and industry has "tended to decline." He traced this to the "exploding technology" of space exploration, which has grown faster than the supply of experienced and competent professionals in this field.

Dr. McCall's testimony included a summary of these advanced fabrication techniques, some of which may be made mandatory for Marshall contractors:

- **Modular, or soft,** tooling in which flexible backup bars, local clamps and seam trackers are used for welding instead of rigid and heavy fixed welders.
- **High-energy forming** techniques, using electrical discharges, magnetic discharges and explosives (AW July 2, p. 83).
- **Hydraulic bulge forming,** in which hydraulic pressure is applied directly to a sheet or plate to push it into a die cavity. This system is said to eliminate the need for large hydraulic presses.
- **Numerical control** machining, using pre-punched tape to control the movement of a cutting tool.
- **Welding machine** automation and programing in variables such as voltage, current, speed, tilt angle of the weld head and feed wire rates.

Wyatt told the committee that cost overruns should not be considered synonymous with wasteful practices. Cost increases, he said, stem primarily from discovery of sub-tasks which were not known when a contract was let originally.

He said NASA has instituted a program of cost reporting in five of its largest contracts. Concept is to break the prime contract into identifiable components of $10-$15 million values. One of NASA's greatest strengths, he said, is the availability of business and technical people who are able to monitor this cost system.

Ernest W. Brackett, NASA procurement chief, said he knows of no profit windfalls by space agency contractors, and he implied the only way profits could become excessive would be if both NASA and the contractor grossly over-estimated the complexity of a project.

As an example of new techniques aimed at economy in launch operations, Maj. Rocco Petrone, NASA chief of heavy launch vehicles at the Atlantic Missile Range, compared the vertical assembly concept for the Saturn C-5 vehicle (AW Feb. 12, p. 31) with the pad assembly the agency is using in launching the Saturn C-1. Petrone said Complex 39, with a six-bay assembly shed and four pads, can launch 36 advanced Saturns annually, and they can be of a variety of stages and configurations. Complex 39 will cost $430 million and can accomplish the 36-per year launch rate with a force of 2,200 men, he said.

Pad assembly technique, as is used at Pad 34, would require nine launch pedestals which would cost $900 million to construct and require a manpower force of 3,700, Petrone told the committee.

Petrone noted that Complex 39 is being designed to accommodate solid-propellant first stages.

Minuteman Facilities

Two new Air Force manufacturing facilities—Plant No. 78 at Brigham City, Utah, and Plant No. 81 at Magna, Utah—were officially dedicated last week to mark the start of full-scale production of Minuteman ICBM solid-propellant stages in these facilities.

Plant No. 78 is operated by Thiokol Chemical Corp.'s Wasatch Division, for building the Minuteman first stage, the largest solid-propellant rocket motor put into production thus far in the U. S. Plant No. 81 is operated by Hercules Powder Co.'s Bacchus works for production of Minuteman third stage.

Minuteman second stage is produced by Aerojet-General in the company's own facilities at Sacramento, Calif.

Aircraft Designations

Washington—Directive establishing a common system for designations for all military aircraft has been published by the Defense Department. The provisions are essentially the same as reported in Aviation Week, June 11, p. 26.

In one minor change, the directive made no mention of an exception in the series designations of fighter aircraft which had appeared in the original draft. This exception would have made the McDonnell F4H-1 the first fighter to be designated under the new system.

The directive does not list the manufacturers' symbols which appeared in the first draft. Publication of this list is left to the Air Force, which is the executive agent for administration of the designation system. When the list is eventually published as an appendix to the directive, it will contain the symbols of several airframe manufacturers not included on the original list.

Directive No. 4505.6, issued July 6, is entitled "Designating, Redesignating and Naming of Military Aircraft." It has not yet been decided if the system will apply to current aircraft. Air Force will decide when the new system goes into effect.



ARTIST'S DRAWING shows BAC 111 transport in Mohawk Airlines' markings. Mohawk purchased four of the jet aircraft from British Aircraft Corp., and has taken an option on four more. Short-range transport is powered by two Rolls-Royce Spey turbofan engines.

Mohawk to Use Private Financing In Purchase of Four BAC 111 Jets

Washington—Purchase of four British Aircraft Corp. (BAC) 111 transports by Mohawk Airlines will be handled through private financing without the use of the Civil Aeronautics Board guaranteed loan plan, Robert E. Peach, the carrier's president, told AVIATION WEEK last week.

About 50% of the financing will be through long-term bank and insurance company loans, Peach said. The balance will be handled through equity financing, he added. Cost of each aircraft, to be powered by Rolls-Royce Spey 2 turbofan engines will be $2.5 million.

Mohawk has taken an option on four more 111s to supplement the initial fleet, which represents the first firm order for jet aircraft by a local service carrier. Deliveries will begin early in 1965.

Initially, the BAC 111s will operate from Mohawk's major terminals at New York, Pittsburgh, Cleveland, Detroit, Buffalo, Boston and points within New York state. Hartford and Burlington, Vermont will also receive the new service. Peach stressed that scheduling at this time is tentative and added:

"We expect that there may well be changes in our routes . . . we anticipate continuing improvement in traffic. We will constantly re-evaluate markets between now and 1965 for optimum jet scheduling."

Peach said that one of the carrier's prime goals in route planning is establishing Washington, and later Chicago, as terminal points.

Mohawk is making no effort to enter the trunk airline field, Peach said. He also said that mergers within the local service industry will inevitably be essential to placing these carriers on a subsidy-free basis.

Peach is noted for his stand against the subsidy principle as well as for his opposition to the guaranteed loan plan. He believes that purchase of aircraft through guaranteed loans denies a carrier the privilege of "selectivity" in bargaining for new aircraft. Peach is also opposed to the recent Assn. of Local Transport Airlines' action in calling for research into third-level carrier operations (AW June 18, p. 38).

Peach said he decided to by-pass the turboprop aircraft because models now available do not fit Mohawk's needs. "On the other hand," he said, "performance guarantees assure us that the BAC 111 will be economically feasible on our routes, with a seat mile cost less than the piston fleets of Convairs and Martins."

Mohawk will continue to operate its five Convair 440s, 14 Convair 240s and 10 Martin 404s with the BAC 111, which will be equipped with 65 passenger seats. At maximum temperatures, the aircraft will operate fully loaded with 1,000 lb. of cargo over typically short-haul ranges of 155 mi.

The aircraft will be equipped with self-contained air-stair doors, one forward and one aft, and a self-contained power unit. An auxiliary turbine power unit will provide power for engine starting and air conditioning.

British Aircraft Corp. has sold six BAC 111 transports to Braniff Airways, with an option for an additional six; eight to an unidentified buyer, and 10 with an option for five more to British United Airways.

News Digest

House-Senate conferees last week authorized a $3.7-billion Fiscal 1963 program for the National Aeronautics and Space Administration—$43 million less than the Administration requested (AW July 16, p. 33). Appropriations still must be approved by Congress.

Caleb air-launched probe lifted a 120-lb. instrumentation payload to an altitude of 1,000 mi. over the Pacific Missile Range in Project Hi-Ho to measure ion density at extreme altitude. Payload was devised by Naval Research Laboratory. Core of the instrumentation was a magnetic mass spectrometer. Caleb is a two-stage rocket developed and built by Naval Ordnance Test Station, China Lake, Calif. In Project Hi-Ho it was launched by a McDonnell F4H.

Lockheed Propulsion Co., Redlands, Calif., has fired a 12-in.-dia. solid rocket motor loaded with 250 lb. of Polycarbutene 545 propellant at a temperature of −75F.

Soviet Pulkovo Observatory claims it has obtained the first infrared photographs of the lunar surface. They are said to show extreme relief clarity. The observatory says it took 20 photographs with a semiconductor television tube in the 0.9 to 2.3 micron range.

Air Force-Martin Titan 2 ICBM, launched July 25 from the AMR on a planned 5,000-mi. flight, fell several hundred miles short of the target area. Air Force said the test flight still accomplished many of its objectives.

Marshall Space Flight Center has begun static test firings of the Pratt & Whitney RL-10 engine to familiarize personnel with liquid hydrogen engines. Cold flow tests preceded the center's first hot firing July 21, which ran 9 sec. and generated 15,000 lb. thrust.

Soviet Speed Claims

Moscow—Soviet Union has aircraft capable of beating the absolute world speed record of 1,663.3 mph. which Russia claims Lt. Col. G. K. Mosolov set in a single-jet E-166 fighter over a 15-25 km. course July 7, according to the newspaper Sovetskaya Rossiya.

The newspaper quoted Mosolov as saying after his flight (AW July 23, p. 25): "We have aircraft which even today are ready to crack both the new average speed mark (1,663.3 mph.) and the top speed of over 3,000 km. per hour (1,863 mph.)"—which Mosolov achieved on one of his approach runs.

Opposition Seen to Jet Fare Experiment

Latest Continental plan would create new class for business travelers, reduce coach fares by 20%.

By L. L. Doty

Washington—Second bid by Continental Air Lines to the Civil Aeronautics Board for authority to experiment with new reduced fares on jet flights over major routes appears to be drawing strong carrier opposition.

As of late last week, most carriers were still studying the plan and declined to take an official position on the proposed tariff, which calls for the introduction of a new class of service in air transportation. However, enough airline officials expressed disagreement with the plan to suggest that open resistance to the experiment will soon emerge.

Continental's first attempt to experiment with lower jet fares was rebuffed by the Board last October (AW Oct. 9, p. 37).

These are the features of the tariff:

- **New category**—business class—will be introduced with fares 12 to 15% below present deluxe first-class, which will be retained at present rates. Jet economy coach fares will be about 20% below present jet coach rates.
- **Three Boeing 707** transports will be converted for use in the experiment. Forward cabin, with 20 seats two-abreast, will be used for first-class deluxe service. Middle cabin, with 50 seats two-abreast one side of the aisle and three-abreast on the other, will be for business class. Rear cabin, with 62 seats three-abreast on both sides of the aisle, will be used for economy coach class.
- **Deluxe first-class** cabin will be equipped with a television set and passengers will be served complimentary cocktails and meals. Seat spacing will be 39-40 in. between rows. Each seat will be 19-in. wide.
- **Business class** will include complimentary meals, but they will be less elaborate than those for first-class. Cocktails may be purchased. Space between seats will be 37-38 in. Seats will be 19-in. wide.
- **Economy coach section** will have no meal service. Seat spacing will be 34 in. and seat width will be 16¼ in.
- **Experiment will be conducted,** if approved by the CAB, between Aug. 24 and Jan. 1 on two daily round trips between Chicago and Los Angeles, one daily Chicago-Kansas City-Denver-Los Angeles round trip, one daily Chicago-Denver-Los Angeles round trip and one daily Kansas City-Los Angeles round trip.

Carrier protests centered around the belief that the proposed reduced rates provide too low a yield to offset operating costs. One carrier said that the 20% reduction on a Los Angeles-Chicago economy coach ticket represents a $19 rate drop. It added that the only saving that appeared to justify the lowered rate was in the elimination of meal service and liquor, which, with overhead, amounts to between $5 and $7.

Continental argues that an increase in passenger revenue miles, which it expects the lower fare would generate, will increase revenues per passenger mile. The airline states that in June, it averaged $3.07 in passenger revenue for each mile of jet flight with operating expenses totaling $2.92 per mile for an operating income of $0.15 per mile.

The airline added that a 25% gain in coach traffic would boost passenger revenues to $3.59 per mile, while operating expenses would show an increase to $2.94 per mile to produce an operating income of $0.65 per mile, a gain of 333%.

One carrier termed the Continental proposal a "rate-cutting" move. It said that to be economically efficient, fares should be based solely on the cost of producing service.

Capacity Increase

Another complaint was that Continental will be increasing capacity from 120 passenger seats per plane to 132. The airline, it was charged, is producing more capacity "when the industry already has too much."

One official expressed doubt that a third class of service—a middle class—could survive. It cited the experience of North Atlantic operators when three classes were provided: first-class, tourist and economy. The economy section, he said, drained so many passengers from the tourist section that the latter class was eliminated from all services.

Continental argues that its proposed jet economy rates will divert travelers from commercial surface transportation. It states that the economy fare it proposes will amount to $85 for a Chicago-Los Angeles ticket, which compares with a rail coach fare of $69.59 and a rail plus Pullman fare of $117.80.

The airline told the CAB that jet bookings on its Chicago-Los Angeles routes last fall had dropped 30% below comparable 1960 reservations when its first proposed economy fares were announced in October. Within a week after the announcement, bookings were up to 94% of the previous year, up to 105% within two weeks and, at the time the CAB suspended the tariff, had reached 115%.

Passenger Reaction

When the suspension was announced, some 16,000 passengers holding economy reservations in December were telephoned. Total of 21% canceled upon being notified, 27% canceled later. Continental estimates that, had the economy fare remained in effect, its traffic would have been 10 to 25% higher than it actually was.

Continental says that the three basic purposes of the proposed rates are to broaden the air travel market, compensate the airlines more adequately for services and prevent further transfer of business travel to lower cost services.

In a letter to the CAB announcing the carrier's intention to file the rate, Continental President Robert F. Six had this to say on marketing:

"Broadening markets by using mass production to lower prices long has been the cornerstone of the American free enterprise system. There is no reason to believe that this time-tested principle will not work just as well in air transportation as it has in other industries. The airline industry will do far better financially by tailoring its products to fit the public desire and the public purse . . . than by arbitrarily telling the public which services it can buy."

Six admitted that a "strong group" of Continental's competitors believe that the air travel market cannot be expanded through lower fares and that the market will grow only as fast as the general economy. He noted that there have been recent surveys to bear out these contentions. But he added, "Frankly, Continental cannot agree with these conclusions or with the negative attitude toward the growth potential of air transportation. It would be a frightening prospect . . . to accept the proposition that nothing the airlines can do themselves will speed that growth."

Pan Am Reaches Engineers Agreement

New York—New contract agreement between Pan American World Airways and its 500 flight engineers was reached Wednesday, with final approval pending ratification by the union's individual members.

The pact, accepted by Flight Engineers International Assn. negotiators, follows the lines of the contract signed June 21 by TWA and its 625 flight engineers. Vote on the TWA contract is complete, but results have not been announced.

Both contracts provide for eventual three-man jet crews represented by the Air Line Pilots Assn. through a merger with the flight engineers union. Incumbent engineers will be given pilot training and have priority for the third cockpit seat. Until the program is completed, engineers will retain representation by FEIA.

Government Pressure Increases To End Eastern Engineer Strike

By James R. Ashlock

New York—Eastern Air Lines continued its resistance last week to mounting Administration pressure to settle the flight engineers strike that has grounded the airline since June 21 on the basis of a formula proposed by Secretary of Labor Arthur J. Goldberg.

Malcolm A. MacIntyre, Eastern president, met late last week with Secretary Goldberg in Washington to renew discussion of the Goldberg formula which MacIntyre had rejected twice earlier.

In the interim, Eastern continued to maintain its stand that those flight engineers who did not report back before a July 25 midnight deadline were suspended. Flight Engineers International Assn. (FEIA) said only 30 of Eastern's 575 engineers returned. Company spokesmen said the number was higher, but refused to give the total.

Goldberg was pressing for an Eastern settlement similar to that attained by Pan Am and TWA with their flight engineers. But Eastern held its ground in spite of the personal meeting between Goldberg and MacIntyre.

Wage Increases

The airline said that flight engineers returning under the deadline could expect wage increases up to 41%, company-financed pilot training and priority for the pilot-engineer post on jets.

Any striking engineer rehired after the deadline would be restricted to piston flights, Eastern held, and those not reporting back at all would be fired.

Eastern's determination to make the strike breaking bid was prompted in part by a conviction that no acceptable help was forthcoming from federal quarters. The move was already partially in effect, with Eastern giving flight engineer training to 80 of its co-pilots.

It was evident in discussions with Eastern officials that the airline is disappointed with Goldberg's settlement formula. The airline is also chagrined at the continued lack of White House intervention through either a presidential labor message to Congress or an endorsement of Sen. Mike Monroney's Railway Labor Act amendment bill.

Eastern viewed Goldberg's proposal as a "half-a-loaf" formula, as it suggested settlement on economic issues now and later negotiation on the jet crew complement controversy. Eastern wanted things settled altogether and at once, including assurance that the Air Line Pilots Assn. would buy any agreement reached.

Eastern also balked at Goldberg's proposal that arbitration include provision for retroactive pay to the engineers.

One Eastern official said bluntly that the airline disfavors retroactive compensation to a union that has, by striking, disrupted the welfare of the company's 17,000 employes three times in less than four years.

The airline made no prediction of how long it would take under the training program to reinstate all its 1,424 daily flights. Some pilot-engineer trainees attain qualification faster than others, Eastern officials said. However, they emphasized that it would not take so long as might be imagined, as numerous flight engineers already had private or commercial flying licenses, some with instrument ratings.

On July 22, Eastern resumed limited service with four DC-8 flights daily between New York and Miami. The flight engineers aboard were among those who had responded to the airline's offer to individual members of its FEIA contingent. Three pilots made up the rest of the four-man cockpit crew.

Eastern's primary purpose in resuming service was to break the ice toward renewed operations and to begin shaking the cobwebs out of its reservations offices by attracting a few advance bookings.

Two side benefits of resuming service envisioned by Eastern were creation of favorable public opinion that the airline was doing the best it could under handicap, and also to test any FEIA reaction.

The FEIA countered by applying for a Federal restraining order against the flights, but the application was rejected. Federal Judge Dudley B. Bonsal of the Southern District Court of New York set July 31 as the hearing date on an FEIA application for an injunction.

The FEIA asked the court for continued requirement of a ground mechanic's license by flight engineers, and also to stop Eastern's dealings with individual engineers as a violation of the union's collective bargaining rights.

As Eastern was upset with federal efforts to settle the strike, Goldberg was likewise outspoken against the rebuff of his offer. "It is an extremely serious matter for this opportunity to be rejected," Goldberg said.

Since the strike began, Eastern has been whipping up public interest in the cities it serves by visits to newspaper editors and encouragement of letters to congressional representatives.

United Records Profit In Second Quarter

United Air Lines second quarter profit, which to a great extent wiped out an $8,069,169 first quarter loss, leaves United with a $638,076 first half loss but with greatly improved prospects for a profitable year.

Blame for the first quarter losses was laid by United to bad weather in the Great Lakes region, a critical traffic center for the airline; non-recurring expenses of moving from Midway to O'Hare airport in Chicago; continued absorption of the Capital merger costs, and continued costs of introduction of the Sud Caravelle twin-jet transport.

For the second quarter reversal, United credited increased traffic coupled with the first full quarter of the 3% fare increase, improved cost control, improvement in operating performance and dependability, and, to a lesser extent, traffic diversion because of the flight engineer strike threat.

Third quarter results are expected to be moderately good, and substantially better than a year ago, according to United President W. A. Patterson. Second quarter earnings this year—totalling $6,982,000 excluding a gain of $1.1 million for sale of aircraft—were almost $3 million ahead of the second quarter of 1961 when profit was $4,102,428.

The reversal illustrates the highly leveraged nature of airline earnings—a principal more demonstrated in the breach than by example in recent years. Highly leveraged companies are those with relatively heavy debt structures such as the airlines whose earnings can show remarkable gains with comparatively small revenue increases once fixed charges are covered.

FAA Presses Work on New ATC System

By David H. Hoffman

Washington—Laboratory model of the total air traffic control system recommended by the Project Beacon report will be functioning at Federal Aviation Agency's experimental center in Atlantic City, N. J., by Jan. 1, 1964, according to the agency's Research and Development Service.

As envisioned by the Project Beacon task force (AW Nov. 13, 1961, p. 34), the new ATC system would obtain most position data by using radar to track aircraft equipped with altitude-reporting transponders. Implementation of the report's recommendations is expected to consume five years and cost an estimated $500 million. A 758-page report now circulating within FAA details a six-step data processing and display development program the agency plans to follow.

A major portion of this report deals with how to speed the flow of traffic through congested terminal areas, where a substantial majority of current ATC delays now occur.

Key instrument at the FAA center/approach control complex responsible for moving traffic through certain busy terminals would be a workhorse, state-of-the-art computer. Actual and forecast track of arrivals and departures within the facility's assigned area would be observed by controllers on a pictorial display fed by radar returns and by the digital computer.

Aircraft Identification

An alpha-numeric readout beside each target would identify the flight and list its altitude. For example, the following symbol might appear near the target generated by American Airlines Flight 411 while it cruised at 7,000 feet: A411-70.

On the display, American 411's forecast track over the ground would appear as a line of light overlay on a skeletal, radio map of the local area. As the aircraft progressed, the light line behind it would disappear. Projection of the flight track across the display would depend on the scale employed by the controller.

If a controller observed the flight drifting off-course, he could ensure it safe separation from other traffic by:

• **Ordering the computer** to institute an immediate conflict search. To issue this command, the controller probably would aim a light gun at the aircraft's blip and press a button to interrogate the computer. The computer would then respond by displaying a new forecast track based upon the flight's present position. If this new track was in conflict with the forecast track of another flight, the computer would sound a warning.

• **Giving the pilot** a vector that would return him to the desired track. To hold down the volume of air-ground position reporting, FAA would much prefer what it calls "negative control," a concept that calls for giving vectors only when a conflict is indicated. As a result, the agency plans to develop internal rules that would prescribe how far a flight could stray off course before a corrective vector would become mandatory.

Data display for flights outside the range of radar would be less precise and less timely. However, non-radar flight tracks would be computed and displayed, if necessary, on the basis of pilot position reports.

Under Beacon report recommendations, controlled aircraft inbound to an airport would be given estimated times to land when they reached their holding fixes. Initially, these estimates would be predicted on relatively straight-in approaches involving optimum descents and use of an appropriate ramp down to the active runway. Tentative landing sequence would be displayed by the computer.

The report recommended that path-stretching maneuvers be employed to establish minimum safe separation during the final stages of an approach.

Within these guidelines, the FAA system design team charged with implementing the Beacon report is aiming at a system that will allow one IFR flight to land on an instrument runway every 90 sec. A corollary goal is that the flow of inbound traffic, despite its landing rate, should not delay departures at the airport.

To accomplish this, pilots would be instructed to arrive at a "gate," or approach fix, within ±10 sec. of a specified time. Three standard arrival paths probably will lead from the holding fix serving a particular runway to its gate. When an aircraft departs the holding fix, it would be cleared to follow one of these on the basis of a rough assessment made by the controller.

As the flight nears the gate, however, a precise time of arrival over that gate would be ensured by path-stretching or shortening maneuvers. Each basic path from holding fix to gate would have three variations, each slightly different in length, for precise spacing.

As a safeguard in the event of radar failure at the installation, the basic paths could be navigated solely by reference to ground-based radio facilities.

Under this basic system, controllers working a given center sector would have access to a display tailored geographically to that particular sector. A major advantage of this feature is that during slack traffic periods, displays could be expanded. As a result, one controller-group could cope during the early morning hours with a large area that would be subdivided as traffic began to peak later in the day.

The system design team's implementation report covering these procedures is being studied internally by FAA and other governmental agencies. FAA hopes it can be made public in mid-August, but prior to that time changes may be inserted and major recommendations altered.

One important question that FAA has yet to answer is how much of the Data Processing Central hardware will be usable in the new system. At least $51 million has been invested in DPC—a semi-automatic traffic control system that would have relied primarily on pilot reports and flight progress strips for position data—since the project was conceived under the old Airways Modernization Board.

Northeast Conducting Merger Discussions

Washington—Northeast Airlines said it has renewed its interest in a possible merger last week in testimony before a Civil Aeronautics Board examiner, who ruled that any further testimony on the subject will be withheld from the public during the current Northeast Florida Renewal Case hearing (AW July 16, p. 40).

Northeast President James W. Austin told Examiner Walter Bryan that "merger talks of one form or another are in progress" but declined to identify the possible merger partner and objected to any open testimony on the talks.

Austin, explaining the airline's financial problems and its need to retain the New York-Florida route, blamed excess competition from Eastern and National airlines, both of which are "dedicated to see us go out of business." He added that the airline also suffered from insufficient funds to advertise the Florida service.

To overcome the "very, very bad publicity" which gave Northeast the reputation of being a "prostrate airline," Austin said the company recently spent $250,000 for a brief advertising campaign to inform the public that the CAB had approved control of Northeast by Howard Hughes, majority stockholder of Hughes Tool Co. (AW June 25, p. 19).

Examiner Denies All Applications For Washington Helicopter Service

By Robert H. Cook

Washington—Proposals for a subsidized Washington area helicopter service received an initial setback last week when a Civil Aeronautics Board examiner rejected eight applications on grounds that subsidy for the service is unwarranted and that the applicants' traffic forecasts were "too optimistic."

"The expansion of the helicopter experiment to Washington is not justified," Examiner Ralph L. Wiser stated. He noted that certification of a subsidized line to service the Washington area airports of Washington National, Friendship International and Dulles International would cost the government $2 million a year in subsidy. Neither the Defense Department nor the Post Office Department supported the proposals, he said.

However, the examiner recommended that should the CAB overrule his decision in later deliberations, New York Airways—one of the applicants—should be selected for the service on the basis of its 10-year operational experience, ability to establish the new service faster and need for less subsidy.

The fact that NYA is already established in New York would give it the advantage of cost savings in overhead expense and fleet utilization over the other applicants, he said.

Applicants in the case, all of whom are expected to file exceptions to the examiner's decision, are: Allegheny Airlines; Chesapeake & Potomac Airways; D. C. Helicopter Airways; D. C. Transit System; NYA; Piedmont Aviation; Pilgrim Helicopter Services and Washington-Baltimore Helicopter Airways.

Wiser found "little likelihood" of any significant traffic development for the 30 mi. Friendship-National segment, where the applicants' traffic predictions ranged from 180 to 42,250 passengers annually, or the 45-mi. route between Dulles and Friendship, where traffic estimates reached 20,874.

Seven fixed-wing carriers now provide 57 flights daily between Friendship and National at a first-class fare of only $6, as compared with proposed helicopter fares ranging from $6.70 to $9.50, he said, and it is doubtful that the public would choose the slower and more expensive helicopter service.

A similar situation exists over the proposed Friendship-Dulles segment, Wiser said, pointing out that the helicopter will be at an even greater disadvantage on this longer route in expected competition from fixed-wing aircraft.

Helicopter applicants hope that the government will prohibit fixed-wing operations between all three airports on the premise that they will contribute to traffic congestion and endanger safety, Wiser said, but the Federal Aviation Agency has testified that there is no apparent reason why such service cannot be conducted safely between National and Dulles.

Wiser considered the 23-min. Dulles-National route as the most promising for inter-airport helicopter traffic growth, but questioned the applicants' traffic forecasts and their ability to compete against convenient and less costly ground transportation. Forecasts submitted range up to 98,185 annual helicopter passengers over the proposed route, although none of the airlines has submitted evidence on which their estimates are based, he said.

Helicopter fares for the 23 mi. between Dulles and National would be about $8 for the 10 to 26 min. trip, as compared with only $2.50 for a ground coach service requiring 40 to 60 min. of travel time, he pointed out.

The examiner made similar comparisons of travel times and costs between Dulles and downtown Washington and Washington to Friendship Airport. He also cautioned that future highway plans for the Washington area, emphasizing high-speed freeways to expedite auto travel into the city center, will further reduce the advantages of helicopter service.

While the larger, twin-engine helicopters now available may permit lower available seat mile costs, the Washington area will not generate sufficient traffic at this time for service without large amounts of subsidy, he said.

Operating costs of the most economical helicopters now in production are about 15 cents per available seat mile for twin-engine aircraft and 25 cents for single engine helicopters operating over 20-mi. stage lengths, Wiser noted. In comparison, he pointed out, local service carriers averaged only 4.89 cents expense per available seat mile last year.

In particular, Wiser emphasized that while the local service airlines had achieved a low cost per available seat mile, their operations have been conducted over the past 15 years "and there is no prospect of subsidy-free operation in the near future."

Aloha Will Buy 2 Viscounts, Sell 2 F-27s

Honolulu—Aloha Airlines' directors have authorized replacement of two of its six Fairchild F-27 turboprop transports with two Vickers 745-D Viscounts, one of which will be purchased from Philippine Air Lines.

Decision to acquire the larger Viscounts was based on the need for increased payload and stemmed from talks with United Air Lines cost accountants and Vickers engineers on the operating costs of the Viscount. Aloha has taken an option on the Philippine Viscount at a purchase price of $475,000, and is now negotiating with a U. S. carrier for a second at about the same price.

The airline is carrying its six F-27s at a book value of $563,000 each, but expects to get between $600,000 and $650,000 for each of the two it plans to sell. The F-27 originally cost Aloha $700,000 without electronic equipment and modification.

Since the F-27s were purchased in increments of three each under Civil Aeronautics Board guaranteed loans of $2.29 million and $2.2 million, CAB approval of the transaction will be required. Aloha President Hung Wo Ching said carrier still owes $3.58 million on both loans under the 10-year financing arrangement.

Kenneth F. C. Char, Aloha executive vice president, has estimated that the seat mile operating cost of the Viscount will amount to 2.2 cents compared with 2.65 cents for the F-27. Latter's costs are expected to drop to 2.5 cents by the end of the year.

He said that the greater seat capacity of the Viscount—56 versus 44 on the F-27—will enable Aloha to "keep abreast of our market." In addition, the Viscount will increase Aloha's freight and mail capacity. The Viscount, he said, can handle 400 cu. ft. of cargo compared with less than 200 on the F-27. Char said the Viscount can operate into all major island airports except Kona without payload restrictions.

National Post for Swim

National Air Lines last week named Dudley Swim to the newly created post of chairman of the board of directors' executive committee. Swim recently purchased 100,000 of the 198,138 shares National President Lewis B. Maytag bought from George T. Baker, the airline's founder and presently its board chairman (AW July 16, p. 38).

Three new directors were named last week. They are: Gen. Albert Wedemeyer, chairman of the board of Academy Life Insurance Co.; David Packard, president of Hewlett-Packard Co.; and Dr. Alton Ochsner, president of Ochsner Clinic.

Trunkline Industry Profit Hopes Still Dim

Washington—U. S. domestic trunklines are expected to show a 5% increase in revenue passenger miles this year, compared with 1961's gain of 1%, but chances are still slim that the industry will end the year with a profit.

Because a series of labor strikes during the first five months of 1961 make any comparison of the two six-month periods unrealistic, airline statisticians have found it extremely difficult to gage the actual progress made by the industry this year. Conclusions that have been drawn are discouraging: traffic growth is not yet sufficient to move the industry out of the red.

Industry results do not necessarily reflect the status of individual carriers. The majority of the trunklines will end the year with net earnings, but the substantial losses anticipated for the remaining airlines will undoubtedly wipe out these gains on an industry scale. This was the pattern set in 1961, when seven of the 11 carriers showed a profit but the industry recorded a total loss on domestic operations of $34 million.

It was hoped that June would serve as some indicator of current traffic activity, but the flight engineers' strike against Eastern Air Lines beginning June 23 again clouded statistical findings. Because Eastern has furloughed all but a few of its personnel, traffic figures for the three weeks of June before the strike have not been fully compiled.

Revised Total

Assuming that Eastern, under normal operating conditions, would have experienced a traffic growth comparable with the rest of the industry, domestic trunklines probably would have shown a 5% gain in revenue passenger miles in June rather than the estimated 4% actually reported (AW July 16, p. 47).

This compares with the 11% or more increase reported in each of the seven months from November through May, a figure well below the monthly 13-16% increase registered regularly during much of the 1950 decade.

Traffic growth may dwindle slightly throughout the balance of the year. Annual gross national product has not shown as healthy a climb this year as was originally indicated by the Kennedy Administration. Since the airline traffic growth rate closely parallels fluctuations in the gross national product (AW Feb. 29, 1960, p. 38), the slower economic recovery from last year's national recession could depress airline business during the next six months.

Nevertheless, traffic gains maintained during the first five months of 1962 will bolster the year-end figure so that the prediction of a 5% increase appears safe even in the face of a poor second six-month period. This can hardly be termed a spectacular rise and, in fact, is a cause for deep concern.

In addition, industry load factors continue to tumble and have failed to move above 60% in any of the past 22 months. In June, the load factor did jump to 57.8% from 54.4% in May, but this can be attributed to the absence of strike-bound Eastern's services during the last seven days of the month.

Each of the big four carriers—American, Eastern, TWA and United—experienced a load factor decline in June. During the month, TWA's revenue passenger miles in both first-class and coach categories declined.

The industry coach load factor in June dropped to its lowest level in years. Indications are that the trunklines, so far this year, have lost a large number of non-business travelers—generally coach passengers—to other forms of transportation, and that the proportion of business travelers to the total number of passengers is increasing markedly.

Nevertheless, coach service accounted for 62.9% of total revenue passenger miles during the first six months of the year, compared with 53.9% in the same 1961 period. Many observers are concluding that many business travelers are continuing to switch to coach service. This change, coupled with a loss of non-business travelers, will cut deeply into 1962's gross revenues.

First-class revenue passenger miles fell to 1 billion in June, 13.8% below the 1.18 billion generated in June, 1961. The industry has suffered a consistent decline in this class of service for the past two years.

Monthly first-class load factor in June rose slightly over May to 50% from 46.3%, but the figure was 5.4 points below the June, 1961, level. In only two of the past 12 months has the first-class load factor reached or surpassed 50%.

Trunklines have curtailed first-class available seat miles in hopes of restoring a profitable load factor in this classification. The volume of seat miles offered rose slightly during the first part of 1962, but with this exception, first-class seat miles have regularly shown a decline each month since June, 1960.

Available coach seat miles, however, have increased rapidly to meet the growing demand. In May, available coach seat miles passed the 3 billion point for the first time, a 33% increase over the previous May. The volume declined a little in June but was still 20% higher than that offered in June, 1961.

Revenue passenger miles, in both categories of service, totaled 31 billion for the 12 months ending June 30, a 7.6% increase over the previous 12-month period. Industry available seat miles for the 12 months reached 57.3 billion, an 11.6% gain.



YS-11 Readied for First Flight in August

First flight test of Japan's YS-11 turboprop transport, developed by Nihon is scheduled for late August from Komaki Airport of Mitsubishi Heavy Industries. Initial flight was originally scheduled last May (AW Mar. 12, p. 295), but fatigue tests are still being conducted at Tokyo's National Aeronautical Laboratory and static tests at Komaki.

North Atlantic Scheduled and Charter Traffic—1961

(Summary)

SCHEDULED OPERATIONS	Eastbound	Westbound	Both Ways	% Change over 1960
Flights				
Economy	1,103	1,250	2,353	−10.4%
Mixed	13,917	13,916	27,833	+15.5%
Total Passenger	15,020	15,166	30,186	+11.6%
Cargo	2,126	1,910	4,036	+27.4%
Total	17,146	17,076	34,222	+13.3%
Seating Capacity				
First	326,508	327,202	653,710	+12.4%
Economy	1,538,460	1,555,282	3,093,742	+44.9%
Total	1,864,968	1,882,484	3,747,452	+36.7%
Revenue Passengers				
First	122,947	121,923	244,870	−20.0%
Economy	799,125	875,439	1,674,564	+15.9%
Total	922,072	997,362	1,919,434	+ 9.0%
Average Load Factor	49.4%	53.0%	51.2%	−13.0%
Cargo (tons)				
Passenger Flights	18,129	17,055	35,184	+33.0%
Cargo Flights	15,943	11,724	27,667	+41.1%
Total	34,072	28,779	62,851	+36.5%
Mail (tons)	12,496	7,632	20,128	+25.0%
CHARTERS				
Flights	1,347	1,386	2,733	+28.6%
Passengers	127,280	129,198	256,478	+52.5%
Cargo (tons)	713	1,077	1,790	+126.9%
Mail (tons)	7	4	11	+57.1%
ALL OPERATIONS				
Flights	18,493	18,462	36,955	+14.3%
Passengers	1,049,352	1,126,560	2,175,912	+12.8%
Cargo (tons)	34,785	29,856	64,641	+38.0%
Mail (tons)	12,503	7,636	20,139	+25.0%

Economics & Statistics Section
IATA Financial Department

Ethiopian Jet Order

New York—Ethiopian Airlines has reinstated its Boeing 720B order and will take delivery of two aircraft later this year. It plans to inaugurate jet service Jan. 15, 1963.

Ethiopian's jet acquisition has been delayed by lags in airport development at Ethiopia's two principal cities, Addis Ababa and Asmara. Altitude of the airports, exceeding 7,000 ft., necessitated runway extensions for jets.

The two 720Bs replace two ordered earlier by Ethiopian, but which went to Saudi Arabian Airlines when Ethiopian delayed acceptance. The aircraft are being financed by the Export-Import Bank, while the Development Loan Fund of the State Department is extending long-term loans for airport and facilities development.

Ethiopian will use the jets on long segments, such as between Addis Ababa and Monrovia on Africa's West Coast and to Frankfurt on Ethiopian's European route.

KLM Loss Increases During First Quarter

The Hague—KLM Royal Dutch Airlines, already under financial stress, has reported losses of $11.2 million for the first quarter of 1962 as compared with a $5-million deficit for the same period of 1961.

Total revenues were placed at $34.3 million, $2.2 million below the $36.5 million registered during the first quarter of last year. Operating expenses were down slightly, showing $39.2 million compared with $39.5 million for the 1961 period.

A KLM official said at least part of the decline below the 1961 levels could be attributed to the revaluation of the Dutch guilder in March, 1961.

The airline, with estimated 1961 losses of approximately $20 million, has asked for government subsidy to help overcome its present difficulties and complete planned equipment orders (AW Jan. 8, p. 41). The government, in turn, recently asked parliament to authorize loan guarantees for KLM of up to $104.6 million between now and the end of 1965, plus direct loans for the airline of $10 million over the same period.

Alitalia, meanwhile, reports that it is joining the select group of North Atlantic carriers who showed a profit during 1961. Final figures show the carrier edged into the black with a net profit for the year of $10,880.

AIRLINE OBSERVER

► Watch for purchase of two de Havilland Trident 121 jet transports by Kuwait Airways. Negotiations were in final stages last week, with funds for the aircraft already made available by Kuwait government. Sale will be first outside Great Britain; 24 have been ordered by British European Airways. Kuwait Airways also is talking to British Aircraft Corp. about possible purchase of three BAC 111 twin-jet transports.

► **Top gross weight for the Boeing 727 has reached 152,000 lb. Aircraft was originally designed for maximum gross weight of approximately 138,000 lb., but weight increased as added range and payload were requested by purchasers. Standard 727, without extra fuel capacity, has gross weight of about 145,000 lb., but most orders are for heavier model.**

► KLM, Royal Dutch Airlines, has signed an interline agreement with the Red Chinese airline, CAAC (Civil Aviation Administration of China). Under the agreement, both carriers will recognize transport documents and passenger tickets and will reserve through space on connecting flights. KLM connects with CAAC at Rangoon.

► **Russian Tu-114, which arrived in Havana recently on a survey flight from Moscow (AW July 23, p. 30), made the 10,000-mi. trip in about 21 hr. flying time. The run from Moscow to Conakry, Republic of Guinea, took approximately 11 hr.**

► Republic of Guinea has announced construction of its new airport at the capital city of Conakry is complete. The field, described as one of the most modern in Africa, was built with Soviet aid and was officially opened with the landing and takeoff of Russian Tu-114 Moscow-Havana survey flight. Russian press hailed completion of the field "precisely on schedule." It quoted Guinea officials as stating that activation of the new airport "refuted lying, malicious assertions in the American press purportedly indicating that construction had bogged down."

► **CAT (Civil Air Transport), Republic of China's flag carrier, has ordered two de Havilland of Canada DHC-4A Caribou STOL transports for immediate delivery. The two aircraft are the first of the Caribou model to be purchased by a civil air carrier.**

► United Air Lines will review overhaul procedures for the Douglas DC-8 and Boeing 720 aircraft at the carrier's San Francisco maintenance base. United wants to reduce work load and cut expenses.

► **Boeing 727 turbofan transport will be equipped with wide-angle lens peephole in the cockpit door to provide crews with a view of the passenger section. Device was initially proposed to guard against passengers at the forward drinking fountain being struck by the opening door, but was made standard equipment following series of aircraft hijackings.**

► Eastern Air Lines' contention that failure of the Civil Aeronautics Board to act on renewal of the Mutual Aid Pact is one reason it applied for subsidy application (AW July 16, p. 38) is being discounted by Board sources. CAB spokesmen point out that strikebound Eastern's strongest competitors –Delta, National and Northeast–are not parties to the pact, and are not required to share with Eastern any profit they gain from the walkout. While nominal payments could be expected from American and United, National and Delta are the principal beneficiaries of the strike and recorded traffic gains of 35% and 26%, respectively, in June.

► **Foreign air travelers visiting the United States are primarily affluent businessmen unconcerned about U. S. prices, according to a recent survey by the Commerce Department. Of 222 travelers interviewed at Idlewild International Airport, 56% were here on combined business-pleasure trips, and 25% were visiting U. S. relatives. Only 4% of those interviewed thought prices were too high, but 12% complained about the quality of services, facilities and food.**

SHORTLINES

► **Allegheny Airlines** has asked the Civil Aeronautics Board for authority to operate flights from Lexington and Louisville, Ky., to Pittsburgh and points in W. Va. and Ohio. Allegheny's present services southwest of Pittsburgh terminate at Huntington-Ashland. The airline's plans call for the use of Convair 440 and Martin 202 aircraft on the proposed routes.

► **American Airlines** will add six Convair 990 Astrojet flights to its schedule on Aug. 1. As a result, American will be using 990s on half of its daily New York-Chicago round trips.

► **Bonanza Air Lines'** said its January-June passenger traffic rose 31% and passenger revenues increased 27% over the same period last year.

► **Cuban government** said it plans to resume domestic air transport service, with first flights from Havana's Rancho Boyeros Airport. Schedules call for three daily round trips to the Isle of Pines, four to Camaguey, and five to Santiago de Cuba.

► **Delta Air Lines** will increase its California-New Orleans-San Juan jet service from four to five flights weekly effective Aug. 13. The additional flight will operate Mondays with tourist and first class accommodations on Convair 880 aircraft.

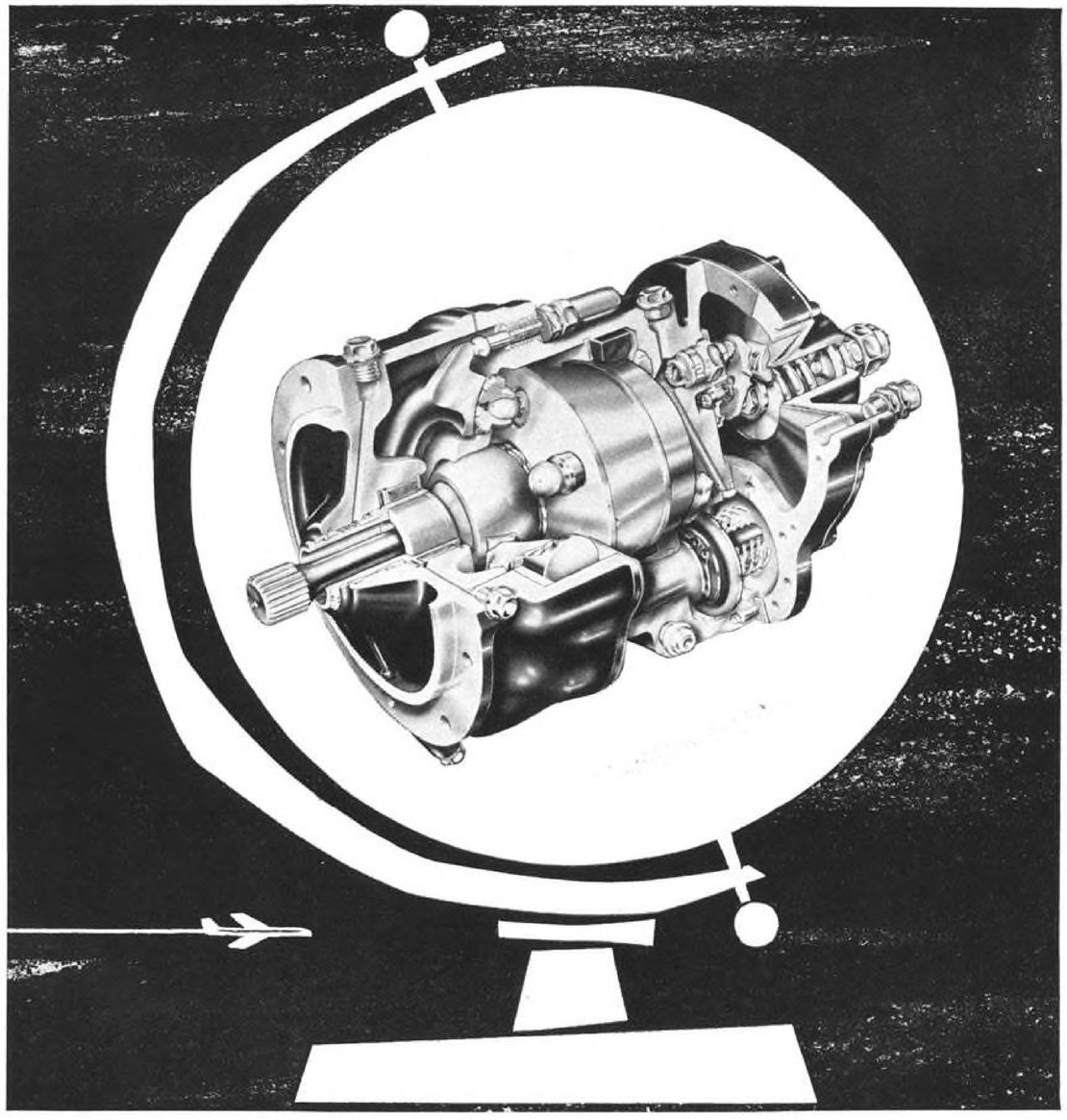
► **Four African nations** have become members of the International Civil Aviation Organization. They are: Republic of the Upper Volta, Malagasy Republic, Tanganyika and Republic of the Congo (Brazzaville). Total membership of ICAO group currently stands at 97.

► **Northeast Airlines** has operated 323 extra flights on routes to Florida since the Eastern Air Lines flight engineers strike began. Northeast reported that all of its extra flights were filled to "near capacity."

► **Trans World Airlines** last week began experimental passenger telephone service (AW June 18, 1962) aboard one of its jetliners operating between Chicago, St. Louis, and the East Coast. The rates are similar to conventional telephone charges plus a $1.50-$4.00 air-ground fee.

► **White House** sent to the Senate last week the nomination of Alan S. Boyd for reappointment to the CAB. President Kennedy is expected to re-name him Board chairman.

Throughout the world—



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In the finest aircraft, throughout the world, Lucas fuel pumps give outstanding performance. Over 100,000 of these fuel pumps are in operation in today's civil and military aircraft. The civil pumps have completed a total of 19,500,000 hours' operation. In many instances Lucas pumps on the North American continent are giving over 3000 hours' service between overhauls. Proof, that from the tremendous care Lucas takes in the manufacture of these pumps, stems the achievement of world-wide confidence.

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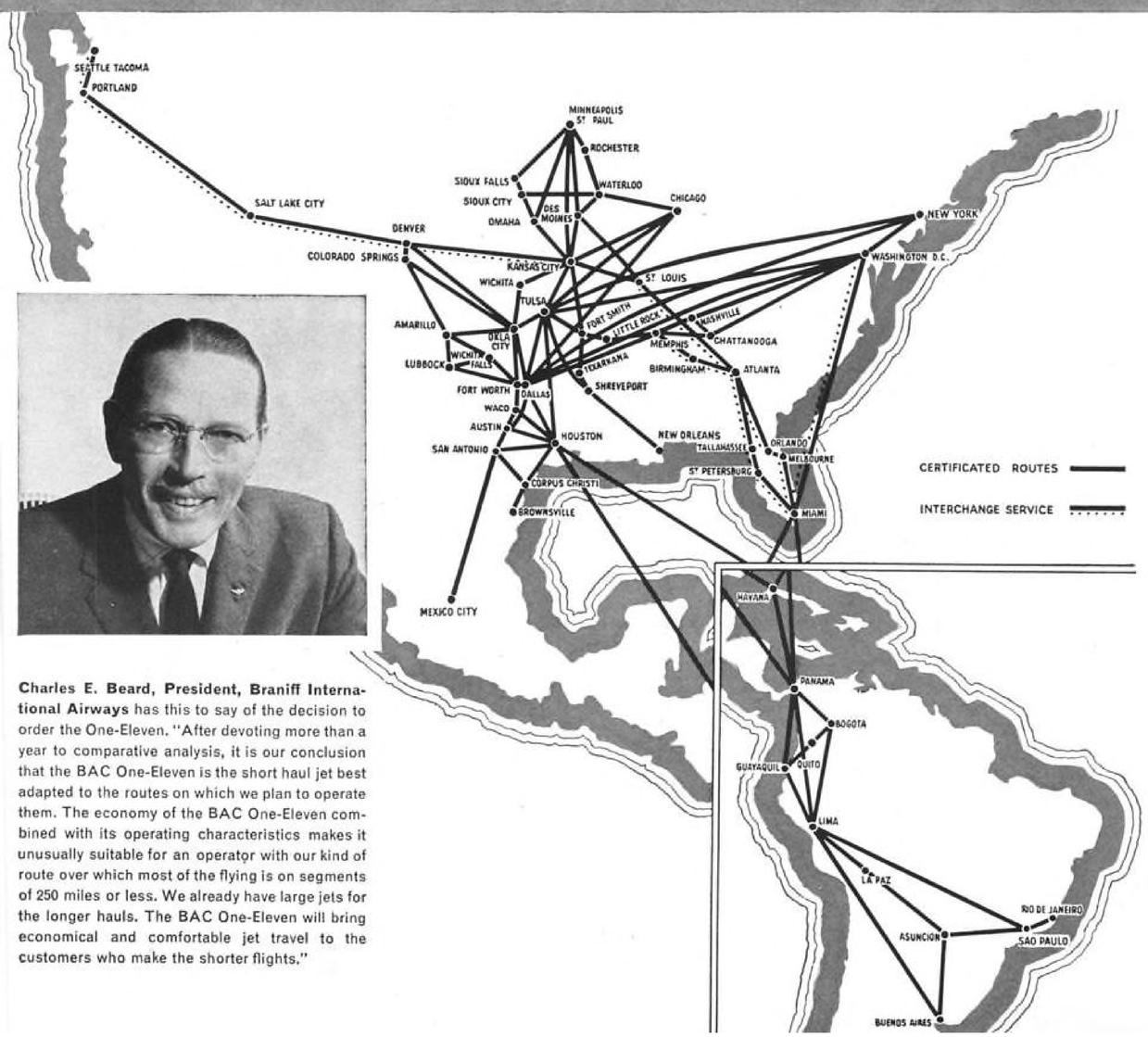
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BRANIFF *International* AIRWAYS

CHOOOSES BAC ONE-ELEVEN

THE SHORT HAUL JET



Charles E. Beard, President, Braniff International Airways has this to say of the decision to order the One-Eleven. "After devoting more than a year to comparative analysis, it is our conclusion that the BAC One-Eleven is the short haul jet best adapted to the routes on which we plan to operate them. The economy of the BAC One-Eleven combined with its operating characteristics makes it unusually suitable for an operator with our kind of route over which most of the flying is on segments of 250 miles or less. We already have large jets for the longer hauls. The BAC One-Eleven will bring economical and comfortable jet travel to the customers who make the shorter flights."



BAC **ONE-ELEVEN**

TWO ROLLS-ROYCE SPEY TURBOFAN ENGINES

THE SHORT HAUL JET

WITH EVEN BETTER THAN VISCOUNT ECONOMICS

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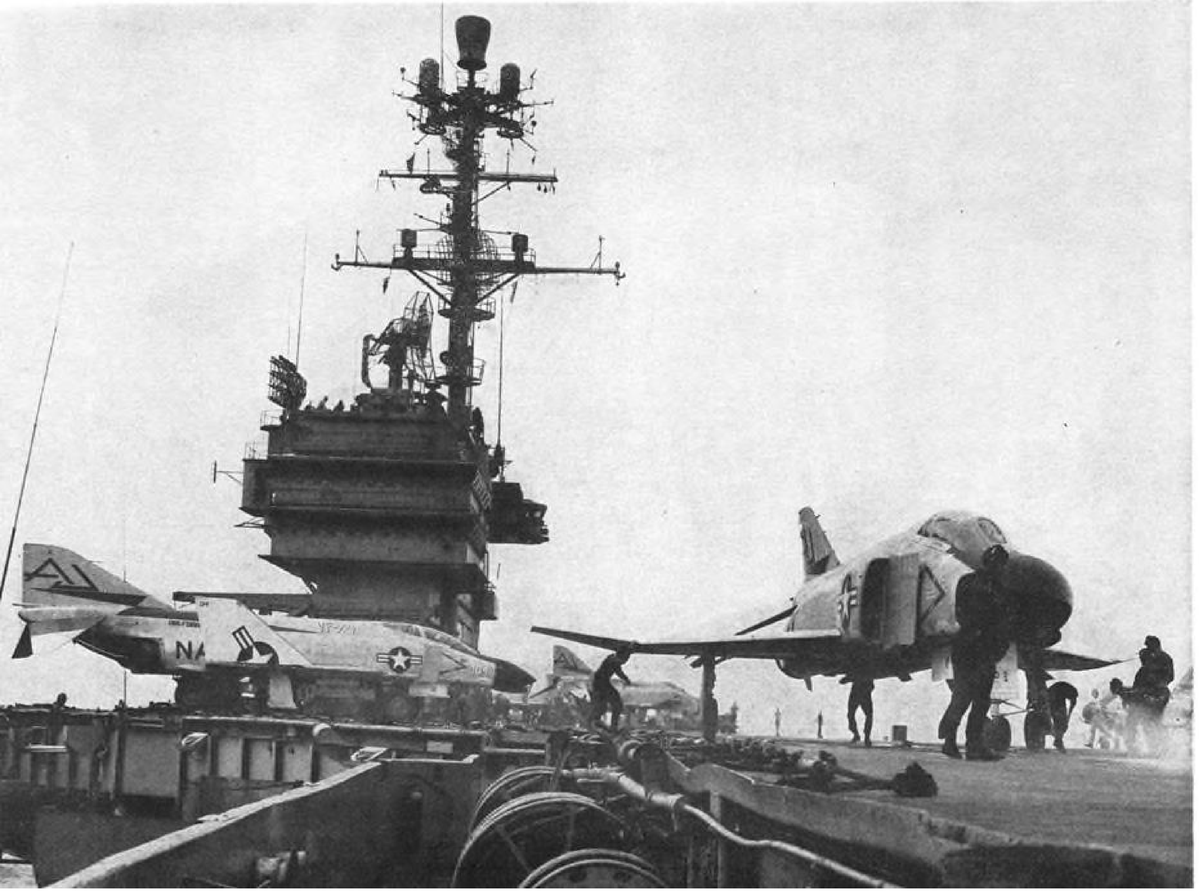
MCDONNELL AIRCRAFT CORP. F4H-1 Navy fighter has been ordered by USAF, which has obtained two for test and evaluation.



BOUNDARY LAYER CONTROL permits F4H to make tighter turns in combat than any other U.S. supersonic fighter aircraft.

McDonnell Gearing Effort to Handle Tripled Order for F4H

F4H IS NOW DEPLOYED aboard aircraft carriers of the Navy's Sixth Fleet in the Mediterranean and the Seventh Fleet in the Pacific.



By Larry Booda

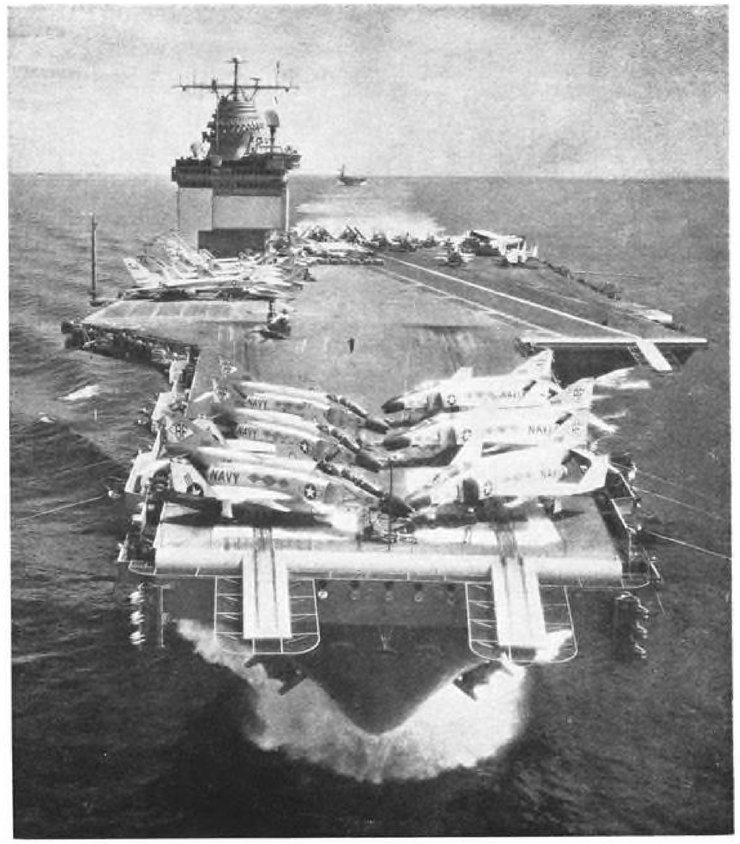
St. Louis—McDonnell Aircraft Corp. is expanding its production base to meet tripled demand for the F4H-1 Phantom 2 high performance fighter as a result of acquiring a new customer. The Air Force will spend more than twice as much in Fiscal 1963 for the F4H as the Navy, for which it was originally developed.

Orders for the twin-engine, two-seat Mach 2.5 combination fighter-attack aircraft will stand at almost 500 units when Fiscal 1963 defense money becomes available, creating a backlog of more than $1 billion. McDonnell will accelerate its program through increased employment, intensive use of existing facilities and acquisition of subassemblies through subcontracting.

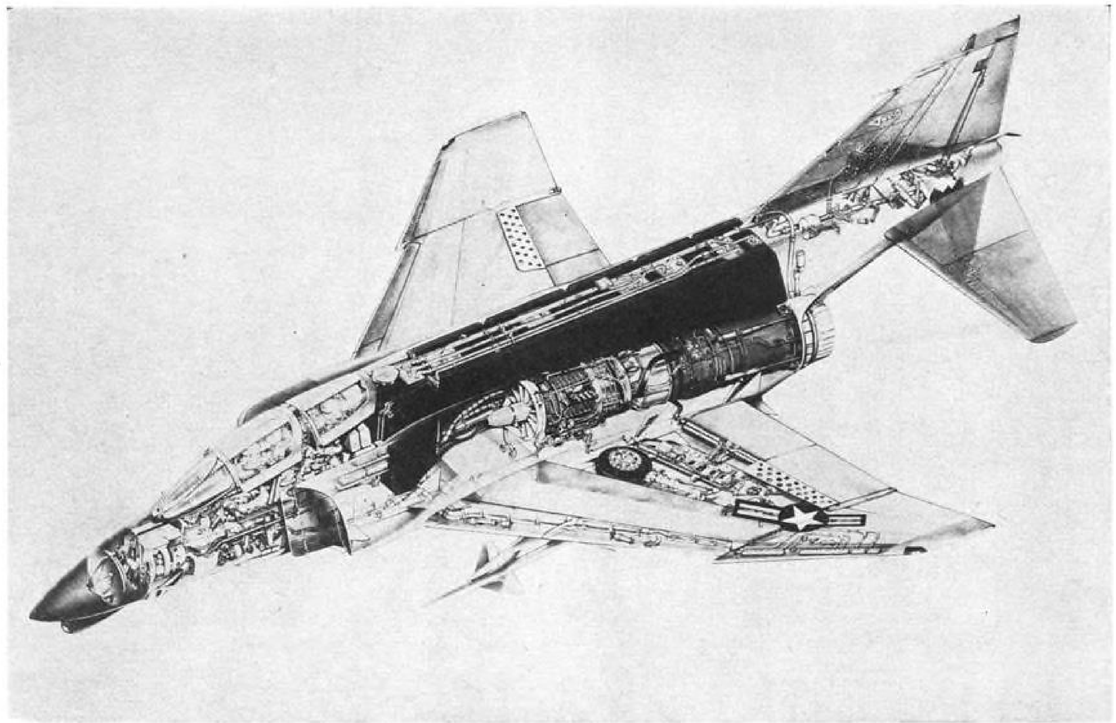
High performance of the F4H, which is powered by two General Electric J79 engines, is proven by a string of records involving high and low altitude speed, altitude, time-to-climb, cross country speed, closed course speed and sustained altitude. This performance was achieved even though Navy requirements demand relatively low landing speeds.

It was more than aerodynamic performance that sold the weapon system. Radar, navigation and fire control systems also proved to be superior and maintenance manhours required for upkeep of the whole system were lower than those of the competitors.

The Air Force was ordered to buy



NAVY'S NUCLEAR-POWERED aircraft carrier, the USS Enterprise, will deploy to the Mediterranean next month with a squadron of F4H aircraft. North American A3Js are parked ahead of the island.



CUTAWAY VIEW OF F4H shows APQ-72 radar and infrared detector in the nose section, landing gear stowage system, leading edge and trailing edge flap systems, boundary layer control ducting system, wing folding system and engine installation.

the F4H. About a year ago the Director of Defense Research and Engineering ordered Air Force to investigate the possibility of comparing the F4H with one or more of its own interceptors. This culminated in Project Highspeed, in which comparative performance, economy of operation and maintenance costs of the F4H and the Convair F-106 were intensively investigated during an accelerated operational period.

Results of the tests, which were conducted under the direction of the Air Defense Command, were overwhelmingly in favor of the F4H. Radar range for acquisition and tracking of targets exceeded that of the F-106 by more than 25%. Greater payloads could be carried longer and farther. Maintenance manhours were about 70% of the F-106.

Air Force is temporarily calling the aircraft the F-110, following its own designation system. Under a new joint designation system, which is expected to be approved soon, it will be called the F-4H-MC (AW June 11, p. 26).

These comparisons were conducted while the Fiscal 1963 defense budget was being completed. Adjustments were made to include the F-110 in the 1963 Air Force buy and Fiscal 1962 funds were reprogramed for the purchases.

The Air Force provided $147.8 million from Fiscal 1962 funds for the purchase of 30 F-110s. Another $50 million went for development of two reconnaissance prototypes. For Fiscal 1963, procurement will be increased to $694.1 million for 280 F-110 models and $97.5 million for 24 reconnaissance configurations.

Added to this are Navy purchases of $301.1 million for 118 F4H-1s in Fiscal 1962, and $314.3 million for 150 F4H-1 and $29.7 million for 12 F4H-1P (reconnaissance) models in Fiscal 1963.

For the two fiscal years, the two services will fund $1,624.5 million for the purchase of 498 aircraft. Not all of this goes to McDonnell, however, because some of the weapon system equipment, such as the radar, is furnished by the government.

McDonnell will meet this increased demand without actual expansion of plant facilities, but employment will increase from 23,500 to 26,000 in the next few months. The company will accelerate its tooling, parts manufacture and final assembly, along with outside procurement of parts and assemblies.

Eight major subcontract packages for Fiscal 1963 have been made to provide sub-assemblies for the program. Five have been announced while three are still in the process of negotiation. They are as follows:

- **Republic Aviation Corp.** has received contracts amounting to $18.678 million for packages one and two covering the aft fuselage, fin, rudder, tail cone, stabilator and engine doors.
- **Douglas Aircraft Co.** was awarded package three which includes the outer wing and outer wing flaps in the amount of $5.6 million.
- **Beech Aircraft Corp.** will make the wing leading edges, inner wing trailing edge flaps, ailerons, speed brakes, spoilers, main landing gear doors and nose wheel doors. Amount is $5.563 million.
- **Package five** for canopies and windshield, package six for external tanks and package seven for missile racks and pylons have not yet been announced.
- **Litton Industries, Inc.** will make the Air Force inertial navigation system. Contract is for $28.583 million.

Nearly 200 aircraft have been manufactured so far, mostly for the Navy, and another 50 are now being assembled. Parts for the Air Force version are beginning to feed into the assembly line.

Air Force is buying the aircraft for the Tactical Air Command, rather than the Air Defense Command, and in addition to its role as an air superiority fighter, it will have broad interdiction and close support mission capabilities.

Navy version of the F4H is strictly a one-pilot aircraft, with the second cockpit being occupied by a radar officer. This second cockpit can be converted by use of a kit to provide rudder pedals, stick and throttle. Navy wants it as a carrier interceptor, with the attack mission secondary.

Marine Corps operations also will emphasize the air interceptor mission. They will include flying from short, unimproved airfields, called Short Airfield for Tactical Support (SATS). In the SATS system, aircraft are arrested by portable gear on landing. For takeoff, a portable catapult is under development (AW July 9, p. 59).

Air Force will make it a two pilot aircraft, with stick, rudder pedal and a throttle in the rear cockpit. Throttle operation will not include cutoff or afterburner control.

This is done in the interest of simplicity. The second cockpit is designed principally for a radar operator. For pilot checkout and rest relief of the first pilot, only basic controls are needed.

In addition, the Air Force version will have larger tires and wheels for operations from relatively rough fields, a cartridge starter system instead of an air impingement turbine system and inflight boom receptacle refueling in place of the Navy's probe and drogue. The boom receptacle will be behind the second cockpit, where the tanker boom operator can "fly" the boom into place. The navigation system will be inertial instead of a dead reckoning computer. The second cockpit instrument panel will be lowered to provide better visibility. The same radar will be used.

Last February, McDonnell proposed a growth version of the F4H, which could be called the F4H-2 or F-110B. This version would incorporate two Allison-Rolls-Royce AR-168 turbofan engines. It was shown that specific fuel consumption (SFC) at sea level and at operating altitudes would be substantially less. Speed at low level would be slightly higher, Mach 1.3 instead of Mach 1.2, and would be Mach 2.5 instead of Mach 2.4 at operating altitude. Ferry range would be greater and longer range or time on station would be available for various missions. It could fulfill roughly 80% of the mission requirements of the TFX tactical fighter which is now the subject of a design competition (AW July 9, p. 26, June 25, p. 23).

The F4H first entered the fleet in 1961 as part of the inventories of the Replacement Air Groups (RAGS) which are located on each coast. Pilots are given transition training in the RAGS in aircraft they will fly in the fleet. By October, 1961, active squadrons of F4Hs replacing Douglas F4D-1s were aboard carriers deployed with the Sixth Fleet in the Mediterranean and the Seventh Fleet in the Western Pacific. Eventually, they will also replace the F3H series.

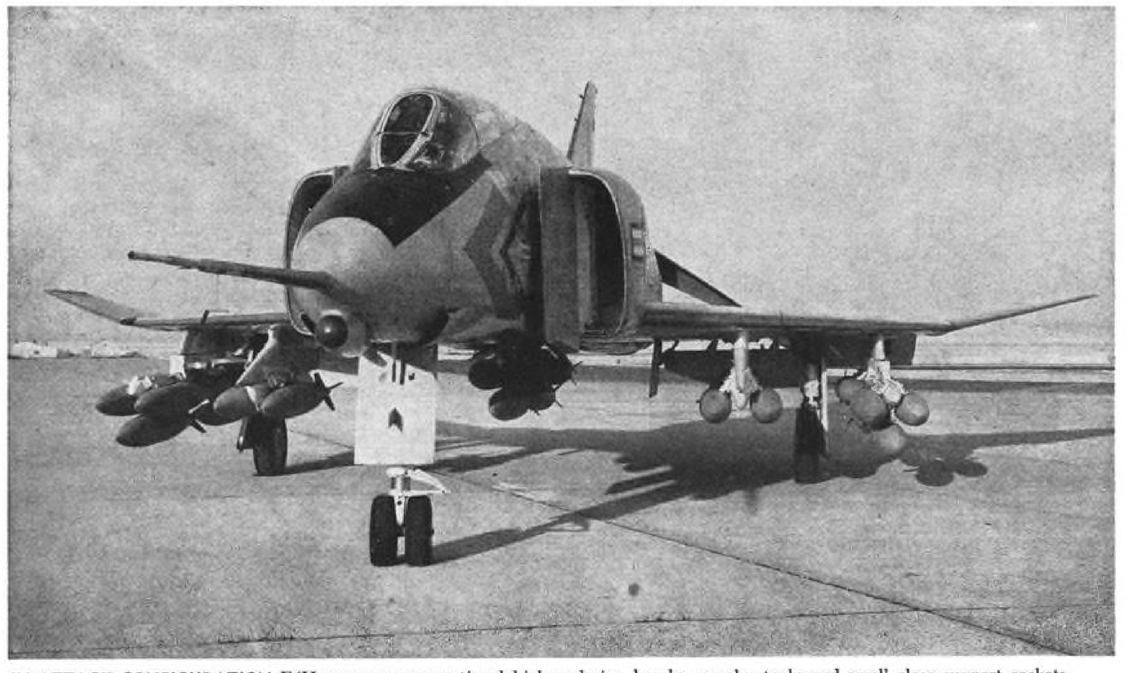
The Marine Corps will soon have an operational squadron which will be deployed in the Western Pacific after the pilots and maintenance personnel are qualified.

At this point, the Air Force has only two F4Hs, which have been re-painted with USAF markings, for purposes of test and evaluation. Production models will not be received until next year.

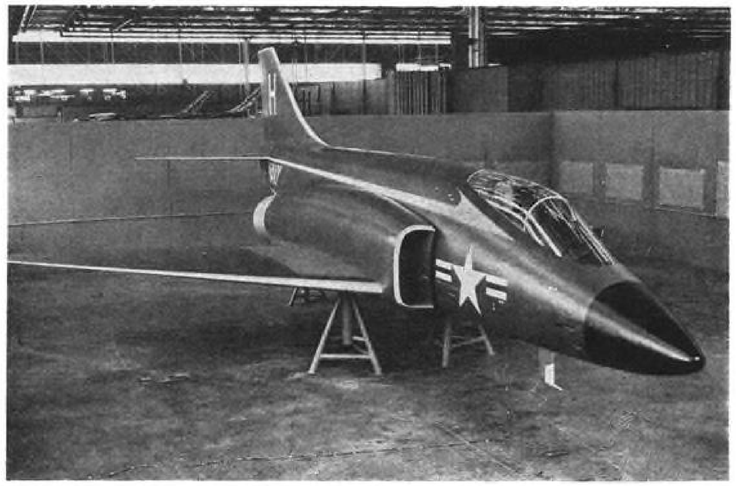
As an interceptor, the F4H can carry either Sidewinder infrared seeking missiles or Sparrow 3 radar homing missiles. The Sparrow type missiles are semi-submerged—that is, carried with part of the missile fitted into a depression in the aircraft. The Sidewinder is carried on pylons.

For a typical interceptor fighter mission, the F4H might carry four Sparrow 3s. With this loading, the aircraft would have a gross weight at takeoff of 46,000 lb. and would be capable of a speed of Mach 2.2, if no other external stores were carried. For another fighter mission, it might carry four Sidewinders, plus external fuel tanks, and have the same gross weight at takeoff. If external fuel tanks were dropped before the intercept, the speed capability would be Mach 2.4 for this configuration. Maximum operating altitude with full fighter payload is over 60,000 ft. With precompressor cooling, the aircraft can fly at 71,000 ft. This is done by spraying water into the compressor section to cool it, permitting it to produce more compressed air for the combustion section. Air-to-air missiles can be launched at subsonic and supersonic speeds.

As an attack aircraft, the F4H-1 can carry a great variety of stores, including large and small high explosive bombs, large rockets, pod-launched rockets and napalm tanks. Several nuclear weapons can also be carried. In the attack configuration the maximum gross weight can be as high as 54,600 lb. The maxi-



IN ATTACK CONFIGURATION F4H can carry conventional high-explosive bombs, napalm tanks and small close support rockets.



MCDONNELL AIRCRAFT CORP. produced this early F4H mockup, which featured straight wings and elevator tail surfaces. Now, wing tips are turned up and elevators droop.

mum externally carried load is 13,320 lb.

The Westinghouse APQ-72 radar, which is also called the Aero-1A Missile Control System, has a reflector which operates inside the aircraft's nonmetallic nose. Its frequency range is in the X band. It can pick up targets at more than 50 naut. mi. The control system operates in such a manner that the pilot need only keep the target on his radar scope within certain limits and the system launches the missiles automatically. An infrared detection system is also carried in the nose.

Standard carrier operating conditions call for launching by catapult. Ship forward speeds can be adjusted to provide a minimum wind speed over the deck of less than 15 kt. For light intercept loads, the takeoff is made without afterburners lighted. For heavy load missions such as long combat air patrols or attack missions, the afterburners provide a measure of safety in climbout immediately after leaving the catapult.

During normal carrier landings, a speed of 145 to 150 kt. is held in the downwind portion of the race track pattern. Final approach and touchdown are made at 130 kt. with engine rpm. set between 85% and 88%. In the event the tail hook fails to engage an arresting wire, engine rpm. is immediately increased to 100% and both afterburners are fired simultaneously to permit safe climbout. Normally, afterburners are fired one after the other.

For a combat air patrol mission, the F4H-1 can loiter at greater distances from the ship for a longer period of time than earlier fighters, then perform combat intercept before having to return.

For aerial combat maneuvers, the aircraft can turn in a smaller circle than any other U. S. supersonic fighter. This is made possible by the use of boundary layer control.

The F4H has a ferry range of 2,000 naut. mi. unrefueled in a little more than 4 hr. With one refueling, this range can be extended to 3,130 naut. mi. in 6½ hr.

This AVIATION WEEK pilot was given a demonstration ride here in the F4H radar operator's seat. Aircraft gross weight was 46,000 lb. By limiting the altitude, an ordinary flight suit could be worn in place of a pressurized suit and normal breathing of 100% oxygen was possible instead of pressure breathing.

After takeoff permission was granted, the engine power was advanced to 100% rpm. Brakes were then released and the two afterburners fired one after the other.

Acceleration was stronger than any other experienced by this pilot for a field takeoff and approached the acceleration of a steam catapult shot. At 14 sec. and an indicated airspeed of 130 kt., the aircraft was rotated rapidly and was airborne at the 2,100-ft. runway mark. For three more seconds the nose was held at the takeoff angle until 290 kt. was indicated.

A climb angle of 72 deg. was then set and held until leveling off at 20,000 ft. in 58 sec. Afterburners were then cut off, and the navigation and automatic flight control systems were demonstrated.

Mach 2 speed was demonstrated over a sparsely settled region extending southeast of the Lake of the Ozarks in central Missouri. The run was begun at 40,000 ft. by increasing engine rpm. to 100% and lighting both afterburners.

It took 3 min. 30 sec. to accelerate from Mach 0.92 to Mach 2.05. True airspeed was 1,120 kt. (1,290 mph.). The ride was smooth throughout the acceleration period and at top speed. Only a flicker of the altimeter needle and the airspeed indicator needle marked passing the transonic range.

When the afterburners were cut off and the engine rpm. reduced to 85%, the deceleration caused forward pressure against the safety belt and shoulder harness of about 1.5g, similar to an arrested landing on an aircraft carrier. It took 1 min. 5 sec. to go from Mach 2.05 to Mach 0.9.

When the Phantom 2 first took shape as a mockup in the McDonnell plant located at Lambert-St. Louis Municipal Airport here, the aircraft had few distinguishing features. The wings were swept back and extended straight out from the fuselage with no dihedral added. The empennage surfaces were swept and extended from the fuselage at right angles to the longitudinal axis. The nose was streamlined in the conventional manner.

The story of how the flying prototype gained its unusual appearance—upturned wing tips, drooping elevators and a relatively blunt nose—between the time of the first mockup in 1955 and the first flight in 1958 includes more than 5,000 hr. of wind tunnel tests, during which more than 100 tail designs and 75 wing designs were tried. Many problems relating to the transonic and Mach 2.5 speed regimes were solved in that time.

The pitchup problem proved to be the most serious. With swept wing aircraft there is a tendency for stall to occur on the outboard upper surface of the wing at high angles of attack, both at low speeds and at high speeds.

This stall, or disturbed flow of air, decreases the lift of this portion of the wing. Since it is at the swept back

Phantom 2 Records

Speed, 15-25 km. straightaway course—1,606.505 mph., Nov. 22, 1961. (For Soviet claim on record, see AW July 23, p. 25.)

Speed, 500-km. closed course—1,216.76 mph., Sept. 5, 1960.

Speed, 3-km. straightaway course at altitude below 100 m. (328 ft.)—902.769 mph., Aug. 29, 1961.

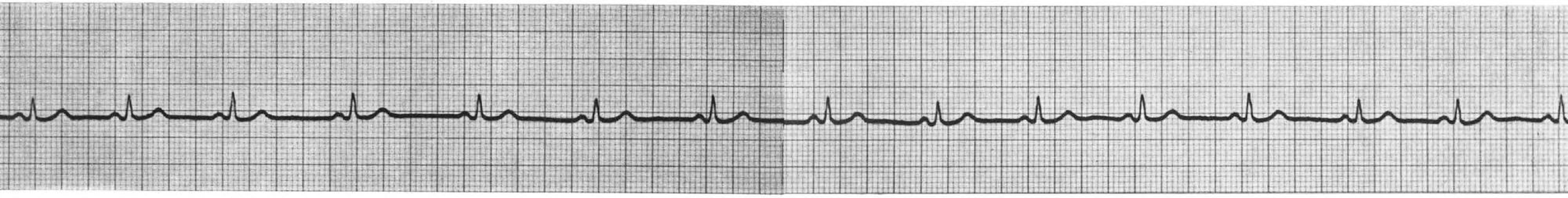
Altitude, sustained—66,443.8 ft., Dec. 5, 1961.

Time to climb—to 3,000 m. (9,842.5 ft.), 34.52 sec., Feb. 21, 1962; to 6,000 m. (19,685 ft.), 48.78 sec., Feb. 21, 1962; 9,000 m. (29,527.5 ft.), 61.62 sec., Mar. 1, 1962; 12,000 m. (39,370 ft.), 77.15 sec., Mar. 1, 1962; 15,000 m. (49,212.5 ft.), 114.54 sec., Mar. 1, 1962; 20,000 m. (65,617 ft.), 178.5 sec., Mar. 31, 1962; 25,000 m. (82,021 ft.), 230.44 sec., Apr. 3, 1962; 30,000 m. (98,425 ft.), 371.43 sec., Apr. 12, 1962.

Speed, 100-km. closed course—1,390.24 mph., Sept. 25, 1960. Exceeded by a Russian P-166 Oct. 7, 1961, flying 1,491.9 mph.

Speed, Los Angeles to New York—2 hr. 50 min., with three refuelings. Exceeded since by Convair B-58 in 2 hr. 1 min.

Altitude—98,557 ft. Dec. 6, 1959. Since exceeded by a Lockheed F-104, a Russian E-66A and the North American X-15 rocket-powered research aircraft.



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The reason? A tiny electronic device called the *cardiac pacemaker*, which is implanted by surgery inside the patient's body. Through wires connected directly to the heart, it transmits electrical impulses — impulses which trigger the heart into a sure, steady beat.

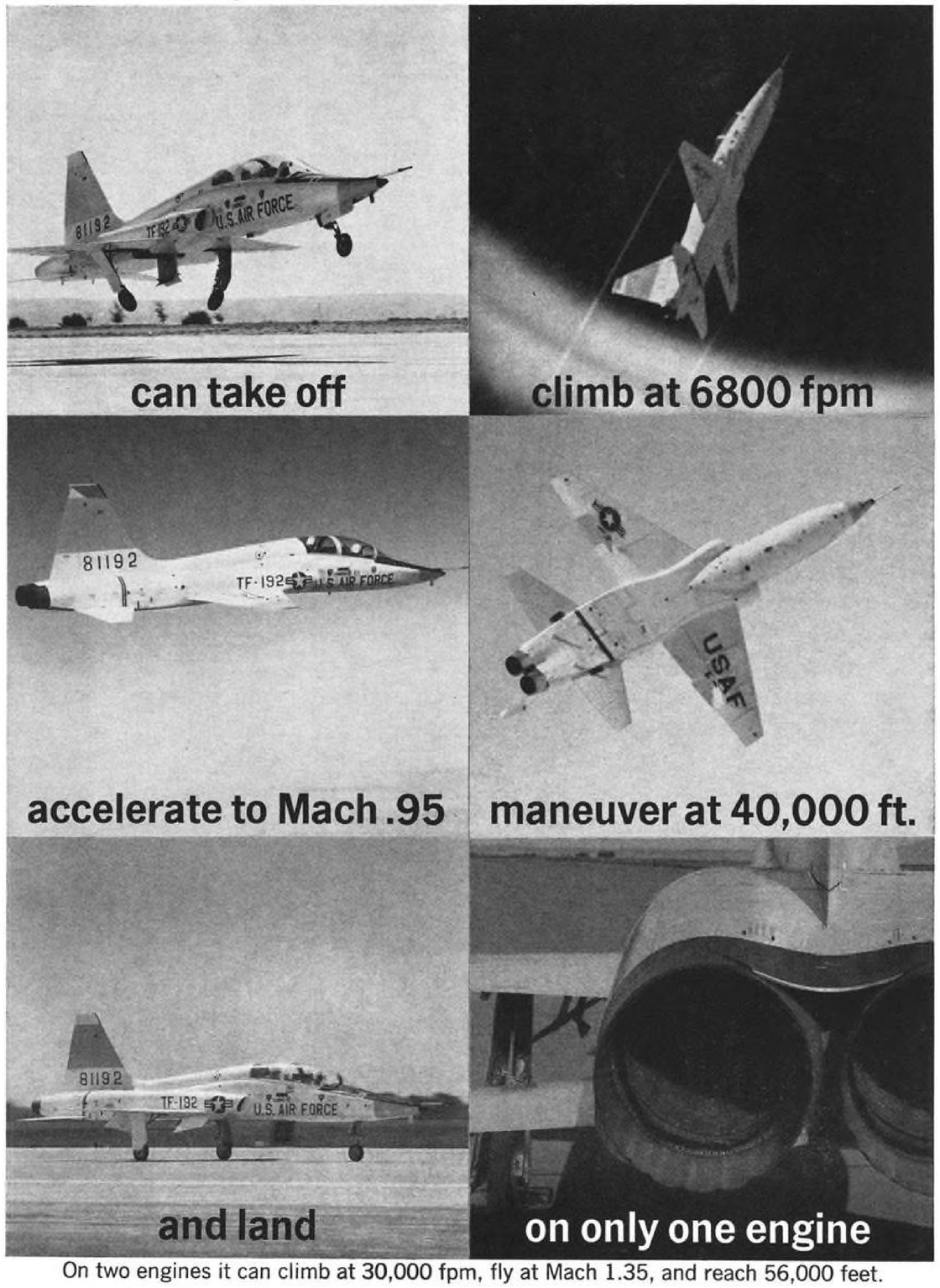
Fairchild transistors are at work in many of these pacemakers. (In fact, one leading manufacturer relies on them exclusively.) So far, they've accumulated more than *three million hours* of service.

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The twin-engine Northrop T-38



On two engines it can climb at 30,000 fpm, fly at Mach 1.35, and reach 56,000 feet.

portion of the wing, the center of pressure, or lift of the wings, shifts forward, making the aircraft tail heavy. In many flight conditions this could cause loss of control leading to a crash.

As the aircraft approaches transonic speeds, downwash from the wing creates a blanketing effect on the stabilator (combination elevator and horizontal stabilizer). With a normal configuration this only aggravates pitchup conditions.

Roll Coupling

Also associated with high performance swept wing aircraft is the phenomenon of roll coupling. This involves a combination of instabilities about both the roll and yaw axes.

These solutions were devised after thousands of wind tunnel hours:

- **Outboard leading edge** of the wing was extended 10% to retain smooth air flow over the upper surface at angles of attack as high as the inboard portion. This corrected the change of center of pressure problem.
- **Stabilators were given 23 deg.** of negative dihedral to make them effective for control despite the wing downwash.
- **Positive dihedral was needed** in the wings to correct the yaw axis deficiencies. If the whole wing were given 3 deg. of dihedral it would have made engineering complications in the design of the landing gear and parts of the wing. The solution was to put 12 deg. dihedral into the outer panel from the wing fold line.

In designing an aircraft without long tail pipes and shrouds, a heat problem was encountered along the lower empennage area. Flow tests in wind tunnels solved this one.

The drooping nose was made mandatory because of visibility conditions encountered in carrier landings when the pilot must have a full view of the deck.

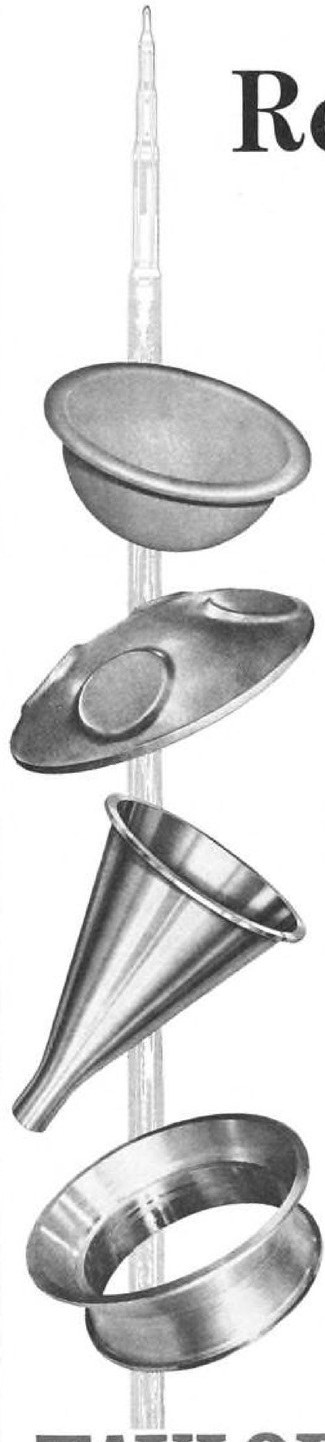
Brute Power

Only slight attention to the area rule, which was developed to permit aircraft to pass through the transonic region more easily, was included in the F4H design. The F4H has so much brute power that it can go through the transonic speed region with only a little help from the area rule.

The F4H ailerons are non-standard in that they operate only downward. To produce the opposite reaction for lateral control there are spoilers on the upper side of the wing near the trailing edge. To lower the left wing, the left spoiler would go up and the right aileron down.

A Central Air Data Computer (CADC), receives all data on air pressures and feeds it to the armament control—or fire control—system, pilot and radar officer cockpit indicators, the engine inlet ramp control, and the navigation computer.

In order to assure subsonic air flow



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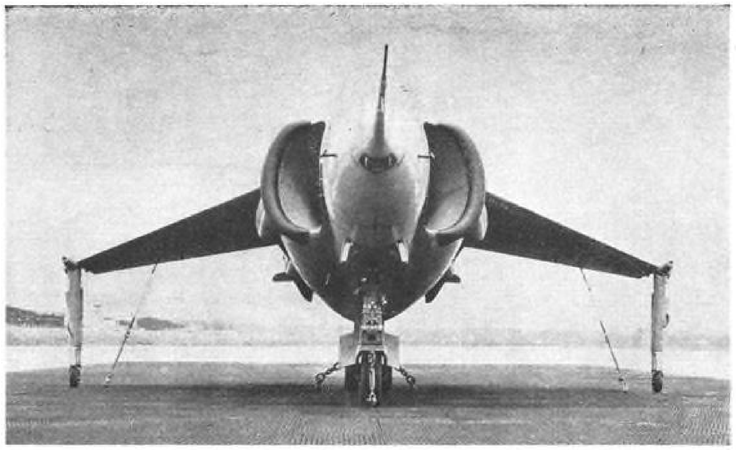
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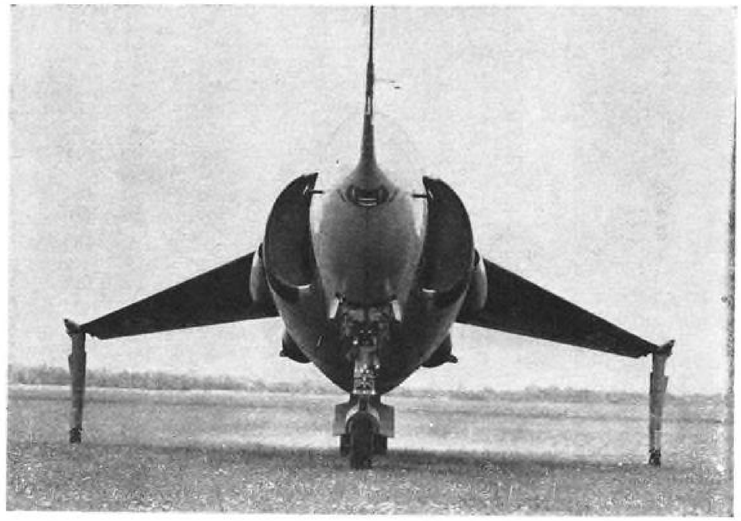
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P.1127 Inflatable Intake Lips Shown

Third prototype Hawker P.1127 VTOL aircraft shows inflatable lips on intakes to its Bristol Siddeley BS.53 Pegasus turbofan engine (top). Inflating the lips changes the contour from the sharp-edged layout needed for minimum drag at high speed to a rounded-edged shape, approaching the classical "bell-mouth" design, which is more efficient in hovering conditions. Lip section is made of long-life rubber material, and is featured on first batch of nine P.1127s in production for Britain, West Germany and the U. S.



into the engine inlets at supersonic speeds, a variable ramp was designed to properly position the shock wave to avoid the inlet on each side. The forward part of the ramp is fixed, while the rear ramp is variable between 10 and 14 deg.

F4H Characteristics

These are some of the measurements and characteristics of the F4H:

- **Wings are swept back 45 deg.** at 25% of the wing chord. Wing aspect ratio is 2.82 to 1. The thickness ratio is 5.1% average over the span.
- **Main wing panels** are also fuel tanks, or "wet wings." There are also six fuselage fuel cells.
- **Entire leading edge** of the wing is drooped for low speed flight, while the inboard trailing portion of the wing is a flap. Boundary layer control blowing is accomplished by bleeding air from the engine compressors through ducts along the leading edge seal and the trailing edge flap seal when both are drooped. The blowing begins automatically when the landing configuration is set. This feature permits lower landing speeds and greater maneuverability in combat where tight turns must be made.
- **Landing gear wheels** are 17 ft. 10.5 in. apart. Wing span is 38 ft. 4.9 in. Length, nose to tail, is 57 ft. 7.3 in. Height of the empennage is 16 ft. 3 in. and the wing area is 530 sq. ft.
- **Parabrake stowage and release** is provided. The parabrake will cut landing roll 600 ft. on field landings.
- **Fuel probe extends** hydraulically from the right side of the fuselage in the Navy version. Fuel transfer rate is up to 1,700 gal. per min.

Extensive studies were begun in 1953 to determine the design parameters for a high performance fighter aircraft. As originally designed, it would be a single-place aircraft powered by two engines. It was to be equipped with the APQ-50 radar and armed with four 20 mm. cannons. It would incorporate 11 external store stations for the various ground attack weapons.

Configuration Changes

By the time the detail specification was signed in July, 1955, a number of changes were made in the configuration by the Bureau of Aeronautics. Since these changes altered the mission to one which emphasized all-weather capability and air superiority over the attack mission, the designation was again changed to the present F4H-1.

At this point the specifications were as follows:

- **Two J79-GE-8 turbojet engines,** producing 10,800 lb. of thrust dry each and 17,000 lb. with afterburner.
- **Sparrow 3 missile armament.** Provisions for the 20 mm. cannon were deleted, reflecting improvements in missile technology.
- **Improved airborne intercept** radar. This is now the Westinghouse APQ-72.
- **Simple, lightweight,** semi-automatic navigation device.
- **Visual ground attack** capability.
- **Maximum speed** of at least Mach 2 with missile armament.
- **Two-man crew.** As intercept systems involving close scrutiny of radar scopes were developed, it was determined that the task was too much for one man if he also had to fly the airplane.
- **Semi-submerged missile** installation.

Until the first flight on May 27, 1958, more than 6.8 million manhours had been expended on the design and construction of the first F4H-1. In the development effort, McDonnell has called on the services of 1,500 subcontractors and suppliers from 28 states.

At this time the F4H was in competition with the Chance Vought F8U-3, an improved version of the F8U-1 and 2.

The F8U-3 had a single engine and one crew member.

Although the two aircraft were comparable in performance, the principal factors which led to selection of the F4H were its two-man crew, two engines and ability to reach high speeds without rocket boost, which was a feature of the F8U-3. In addition, Air Force experience with the McDonnell supersonic twin-engine F-101 helped tip the scales.

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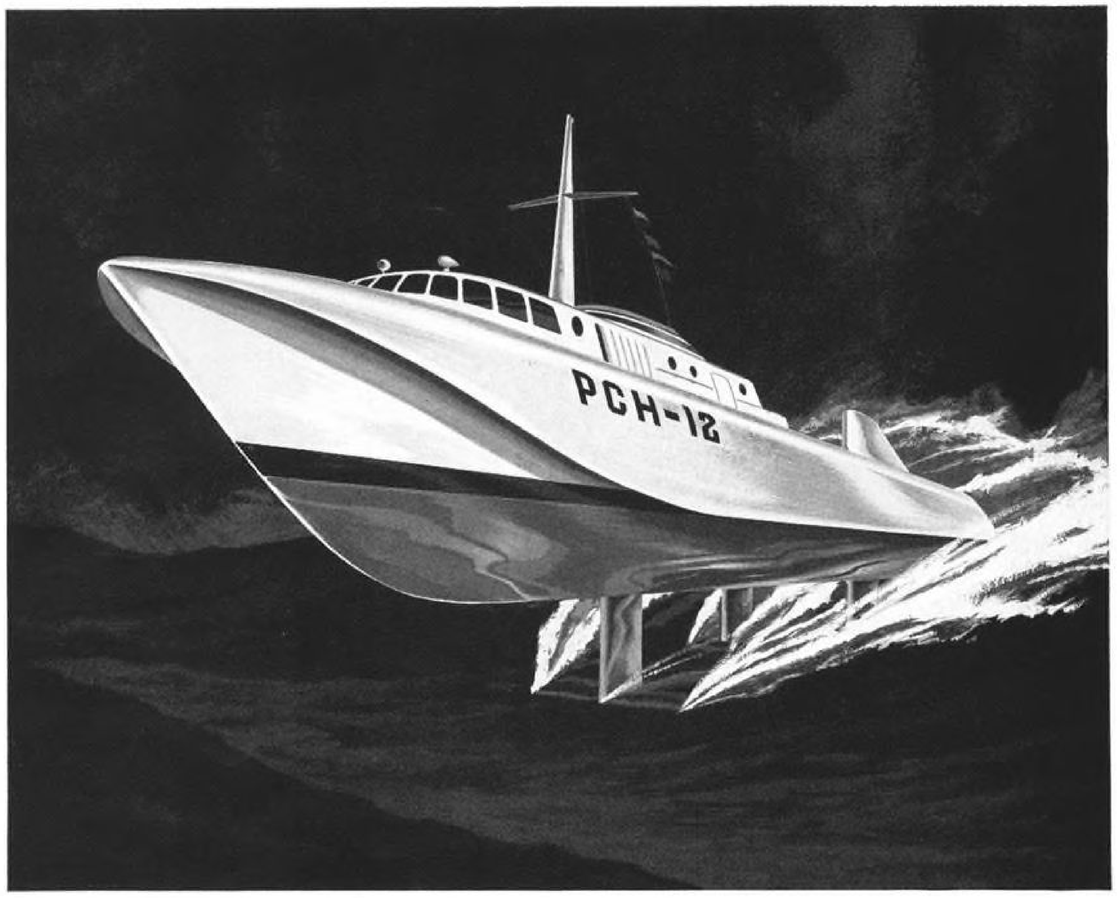
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CONTROL



How to keep a high-speed hydrofoil on an even keel?

To prevent hydrofoil ships from porpoising, a radar altimeter, capable of sensing height changes of as little as one inch, is now being built by Ryan Electronics. It will be used to anticipate wave action . . . automatically adjust underwater foils . . . and keep the ship running steadily—even in rough seas.

Ryan Electronics is designing and producing three types of radar altimeters (phase, FM/CW, and pulse) that bridge the broad spectrum of earth and space requirements. This total capability results from Ryan's 15 years' experience in the design and development of electronic systems and the company's present position as the leading producer of Doppler navigation systems for all types of aircraft.

Flexible and fast-moving, Ryan is also making significant contributions in other areas of aerospace progress. The company has major roles in two of the newest and most promising V/STOL aircraft designs—the Army VZ-11 and Tri-Service C-142 research aircraft. Ryan is the largest producer of jet target drones for the Armed Services. Other Ryan activities are Flex Wing programs, space structures and ground support systems.

Ryan Electronics includes the most modern and best equipped facilities for electronics development, manufacturing and testing. At Ryan Electronics and Ryan Aerospace, technical and management capabilities are designed to assure compliance with the most stringent standards.

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA



ANTI-SUBMARINE *defense is facilitated by Ryan Doppler Navigation Systems which make possible accurate, continuous, all-weather navigation over land or sea, anywhere in the world, without outside navigational aids.*



SURVEYOR SPACECRAFT—*Ryan Electronics was selected by Hughes Aircraft Company, Inc., to design, develop and fabricate the Radar Altimeter and Doppler Velocity Sensor equipments for NASA's Surveyor Lunar Soft Landing Spacecraft.*



RADAR ALTIMETERS *are being designed and built by Ryan Electronics for the Saturn launch vehicle. These short-pulse, high-altitude radar altimeters will be capable of recording altitude measurements up to 250 miles.*

RYAN
ELECTRONICS

FAA Stresses Proximity Warning Systems

By Philip J. Klass

Washington—Federal Aviation Agency, increasing its emphasis on airborne proximity warning indicators, expects to fund the development of one or more such systems during the current year.

This action stems from recent tests indicating the feasibility of a cooperative-type infrared proximity warning system, simulation tests which confirm the value of a proximity warning indication, the availability of increased funds and criticism by the airlines.

The FAA also is contemplating regulatory action which would establish a single standard for aircraft navigation lights, including mandatory use of a new type of tail light which should enable an overtaking aircraft at night to determine the relative heading of the aircraft ahead. This was disclosed here during the recent FAA symposium on collision prevention devices.

The agency also plans to evaluate the merit of using existing rotating anti-collision beacons to transmit aircraft altitude in a dot-dash type code, according to Dr. H. R. van Saun, Jr., of FAA's Systems Research and Development Service.

Extensive Tests

Extensive FAA-sponsored tests show that aircraft conspicuity can be increased by painting the underside a dark color, the topside a light color and the empennage with fluorescent orange-red. But the operational gain compared with cost is not sufficient to warrant regulatory action, van Saun said.

However, FAA will encourage aircraft operators to adopt the conspicuity marking techniques. Since a wide variety of dark and light fuselage colors can be used, an airline spokesman told Aviation Week that he expected that airlines would voluntarily adopt at least this portion of the technique.

The FAA's program in developing and evaluating anti-collision system techniques came under fire by airline spokesmen and others during the symposium. William Littlewood, American Airlines vice president for equipment research, said progress to date has been "disappointingly slow." He also was critical of FAA for devoting too little effort to development of a proximity warning indicator (PWI).

A PWI alerts a pilot to aircraft at or near his own altitude, giving their bearing, but without evaluating whether they are a collision threat. PWI is of value only in VFR weather since the pilot must visually evaluate the threat.

The more complex collision avoidance system would operate in all-weather conditions, could assess the hazard and would alert pilots only to aircraft that pose a threat. The system also would compute and indicate the required escape maneuver to avoid collision.

Air Transport Assn.'s Frank White also criticized the FAA for its "series approach" to the problem, urging that more parallel programs be carried on to accelerate progress. White also scored FAA for lack of funding in development of proximity warning indicators.

This criticism was directed at FAA officials who, critics charge, have supported anti-collision system developments only half-heartedly in the belief that the ultimate solution will come from an improved air traffic control system. As a result, FAA has allocated only limited funds for research and development in this area. The last FAA budget provided about $450,000 for this purpose, but this figure has been doubled for Fiscal 1963.

These limited funds have been used to evaluate feasibility of promising new techniques, largely in the field of collision avoidance systems (CAS). Funding available for PWI work has been limited to basic tests on infrared radiation conducted by Naval Ordnance Test Station, under FAA sponsorship, and an extensive simulator evaluation of the usefulness of PWI data, conducted by Sperry Gyroscope under FAA contract.

Carefully instrumented tests conducted by the Naval Ordnance Test Station (NOTS) confirmed that a self-contained infrared PWI is not feasible because of the low level of infrared radiation generated by smaller aircraft.

However, these tests suggest that a cooperative type infrared PWI, in which minimum-equipped aircraft would be outfitted with a combination optical-infrared rotating anti-collision beacon, is feasible. Joseph J. Adler of NOTS said that a standard rotating beacon radiates sufficient infrared energy, in addition to that in the optical region, to be detected at distances up to 6 mi. in daytime and up to 9 mi. at night.

With a more powerful infrared beacon source, greater ranges should be possible. Currently, NOTS is conducting detection range tests using a breadboard equipment built by Minneapolis-Honeywell. The infrared beacon radiates only one-half watt of energy, but this is adequate for measurement purposes. The tests are expected to be completed shortly, Adler said.

Extensive simulator tests conducted at FAA's National Aviation Facilities Experimental Center (Nafec) by Sperry have provided quantitative confirmation that a pilot can spot an intruder a great deal more quickly when he gets an approximate indication of its bearing and altitude, according to Dr. Lloyd Kaufman of Sperry.

The Nafec simulator tests, still in progress, are also being used to define the optimum accuracy with which a PWI should locate and indicate intruder bearing angle, Kaufman said. Based on the data accumulated to date, Nafec is now in a position to evaluate various types of PWI displays, he said.

Tests conducted by the FAA at Nafec and at Washington National Airport, using both models and live aircraft, were used to develop the recommended practices for increasing aircraft conspicuity. A variety of different colors and marking configurations were tried (AW May 7, p. 45).

When aircraft are painted with low-reflectance (dark) paint on the underside and high-reflectance (light) paint topside, tests showed that they were most discernible against a sky and terrain background. The best application of fluorescent paint to increase conspicuity is obtained when used on the empennage, the tests showed. Aircraft with a fluorescent orange-red empennage were visible on the average at distances of 2½ mi., van Saun said.

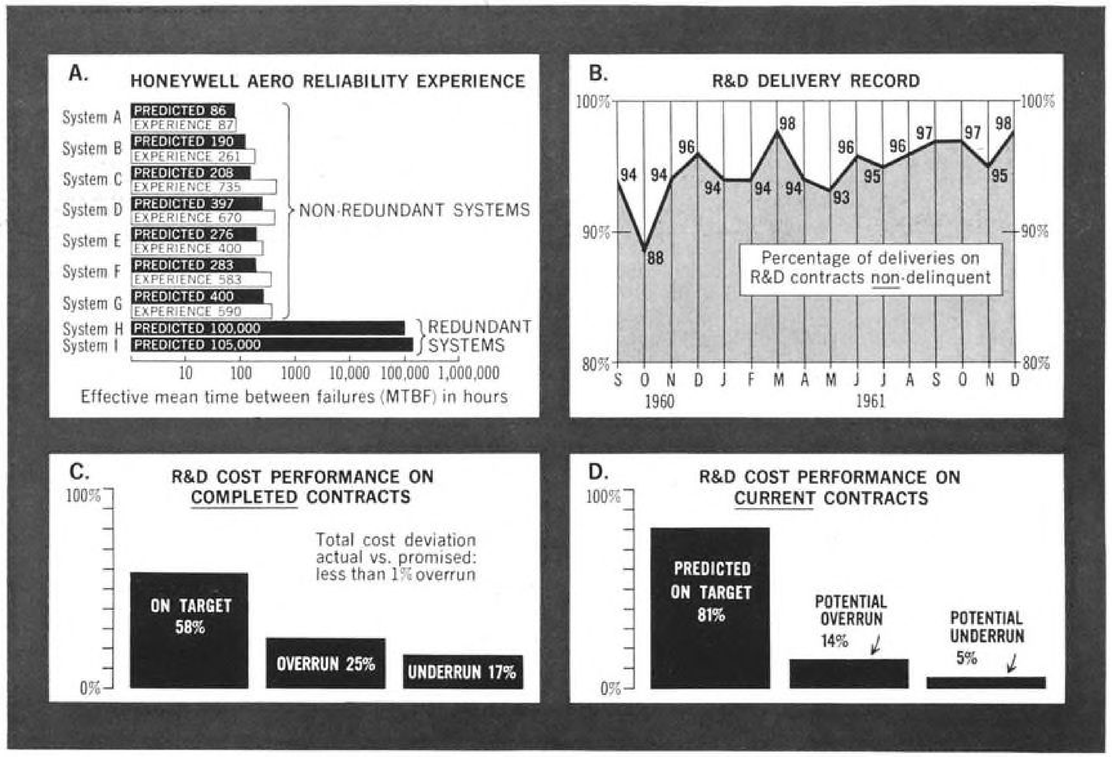
Painting Cost

However, the cost of painting the empennage of a Cessna 180 runs about $350, while a Fairchild C-123 runs nearly $5,000, van Saun said, and the surfaces need to be repainted at least once a year. The intangible anti-collision benefit makes it difficult to recommend regulatory action, he said.

The FAA tests showed the need to standardize on a single configuration of non-flashing navigation lights and to add a tail light which contains both blue and amber lights, separated by a shield, to give approaching aircraft four-sector information instead of the presently available three-sector information.

In the opinion of a number of observers who have followed the industry efforts to develop airborne anti-collision equipment, the availability of a workable system appears to be as far off today as it did five years ago. Progress has been made, but mostly in determining the basic shortcomings of the variety of proposed techniques and in understanding a complex problem which at first appeared deceptively simple.

ENGINEER-MANAGERS



HONEYWELL R&D PERFORMANCE proves the effectiveness of its Command Control systems. Charts above show (A) predicted vs. demonstrated reliability—Honeywell has equalled or bettered predicted reliability on all major aerospace systems; (B) delivery performance on R&D contracts at Honeywell Aero Division, Minneapolis; (C) cost performance on *completed* R&D contracts, and (D) cost performance on *current* R&D contracts. Note the cost performance improvement between charts (C) and (D).

PERT-Cost Tie-In

R&D Command Control at Honeywell is dynamic—improvements are continually underway. One of these improvements is the development of a standard relationship between Honeywell cost control techniques and recognized technical progress evaluation techniques like PERT (Program Evaluation and Review Technique). Basically similar concepts underlie both of these systems; consequently, they are highly compatible. Their marriage promotes simultaneous evaluation and control of cost and technical progress—a large step toward the ultimate goal: keeping performance and costs on target.

Application of these developments to Honeywell military and space programs is advancing the state of the art in R&D management and maintaining Honeywell's reputation for leadership in this field.

5 concepts are key to Honeywell R&D Command Control

Simply stated, these five basic ideas underlie the management systems that provide effective R&D control at Honeywell:

Creative work can be managed. R&D Command Control experience has convinced Honeywell engineers of this.

Control must be at the point of occurrence. The front-line supervisor is in the best position to correct problems *where they occur*.

Technical progress and cost control are inseparable. Command Control combines both cost and technical decision-making at the front-line level of supervision.

Tasks must be managed in total project terms. Supervisors must be given the total project picture to produce action consistent with over-all program objectives.

Problems must be detected early. Honeywell recognizes the high risks of R&D work and realizes that *all* levels of management, as well as the customer, must know of problems early enough to take corrective action. Only in this way can overruns be minimized and schedule slippages prevented.

KEEP R&D PROGRESS AND COST ON TARGET AT HONEYWELL

Unique approach controls costs and deliveries without inhibiting creativity

Five years ago Honeywell determined that conventional R&D management techniques would be unable to cope with the growing complexities of Honeywell's aerospace programs. The myriad of project tasks needed closer management control. Business managers were too far removed from their engineering counterparts to keep tabs on hundreds of daily problems.

The solution? Put business control tools and responsibility in the hands of the "front-line" project engineer—in short, *control at the point of occurrence!* Honeywell calls it R&D Command Control. The results? Honeywell's expanding Minneapolis aerospace operations:

- Reduced engineering burden rate 11% by the end of last year.
- Controlled costs to within 1% of the net amount quoted on R&D programs over the past two years.
- Achieved, or bettered, predicted system reliability on every major aerospace program.
- Improved delivery performance—delinquencies on R&D contracts were reduced to five per cent in 1961.

This indicates that contrary to popular belief, invention *can* be managed—without impairing creative performance—when engineers are given responsibility for the business management of their projects. And what's more, time and cost schedules are met!



Honeywell R&D control applied to these major programs

With the awarding of the Apollo contract, Honeywell is now a major contractor on the Apollo, Mercury, Gemini, and X-15 manned space programs.

Honeywell's space vehicle experience began with the inertial reference system for Vanguard. Subsequent assignments include the attitude stabilization and control system for Project Mercury; the 3-axis reference systems for Titan, Agena B, Thor Delta; guidance and control system for Scout; inertial platforms for Polaris; inertial guidance for Centaur; flight control systems for Apollo and X-15.

For more information concerning Honeywell's R&D management control techniques contact Honeywell, Military Products Group, Minneapolis 8, Minnesota. This advertisement is paid for by Honeywell, not from government funds.

Honeywell adds unique management techniques to conventional ones

To implement its Command Control concepts, Honeywell uses six management techniques. Three are fairly common:

1. Progress Measurement. (via Milestone, Line of Balance or PERT)

2. Reliability Engineering. (a staff operation, with specialists assigned directly to projects at their outset)

3. Value Engineering. (a combined educational-operational function where specialists guide committee appraisals of selective design cost problems)

Honeywell's experience in the simultaneous handling of many complex R&D projects has resulted in the evolution of three additional techniques, all unique with Honeywell:

1. Project Responsibility. Each front-line supervisor is held accountable for the success of his specific task—and the *total* project.

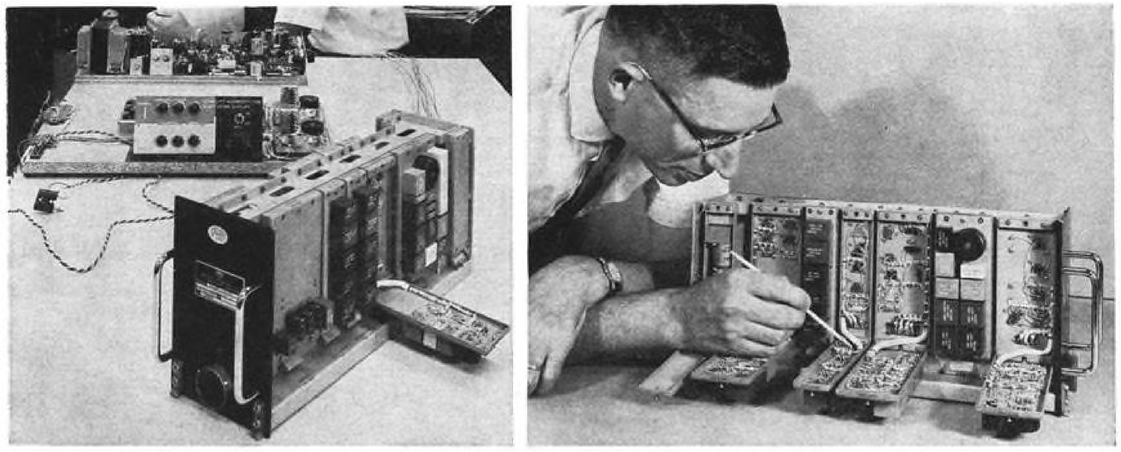
2. Project Cost Record. The front-line supervisor receives a running cost breakdown including predicted cost at completion vs. target *within two working days after costs are incurred*. This permits early prediction of problems and quick remedial action which assure overall benefits to the project.

3. Design Process. This is a standard orderly sequence, not of operations, but of decisions, communicated in a way that aims the full experience of the organization toward obtaining the highest probability of success.

Honeywell

H HONEYWELL *Military Products Group*

ENGINEERING ADMINISTRATORS: Explore new professional opportunities—write Honeywell, Minneapolis 40, Minn.



DUAL ADAPTIVE automatic flight control system developed by Sperry Phoenix Co. adjusts autopilot parameters to compensate for flight condition changes. Left, welded modules are mounted on metal clamshell; right, engineer checks a roll servo amplifier.

Autopilot Incorporates Dual Stabilization

By Barry Miller

Phoenix, Ariz.—Adaptive, automatic flight control system, fabricated with high-density welded packaging techniques to permit use of dual stabilization for each flight axis without adding excessive weight and size, is being developed here by the Sperry Phoenix Co.

The system is being proposed for a number of advanced aircraft and aerospace vehicles, including the Aerospace Plane, the TFX bi-service tactical fighter and the supersonic transport.

Dual damper channels give the system a degree of redundancy. Combined with other improvements in reliability, these are expected to yield a system mean-time-before-failure (MTBF) of 1,000 to 1,500 hr., according to Sperry. This compares with 500 hr. MTBF (at 70C operation) for a conventional automatic flight control system being manufactured by Sperry for a high-performance naval aircraft.

The adaptive feature adjusts autopilot parameters to compensate changing flight conditions which advanced vehicles, such as the Aerospace Plane, would experience.

Sperry engineers call this technique an energy balance adaptive control. It looks at the entire energy spectrum of control system error signals caused by disturbances or commands to detect the need for adjusting channel gains. It will automatically optimize control system gain, Sperry explains, to minimize control errors to the extent that this is in keeping with vehicle stability.

Large high-frequency instabilities to which the system would have to adapt need not be generated. But should these instabilities be present, the system will account for them. This is done by bandpass filters which, extending over the full aircraft frequency spectrum, recognize energy levels and form algebraic sums to raise and lower gains.

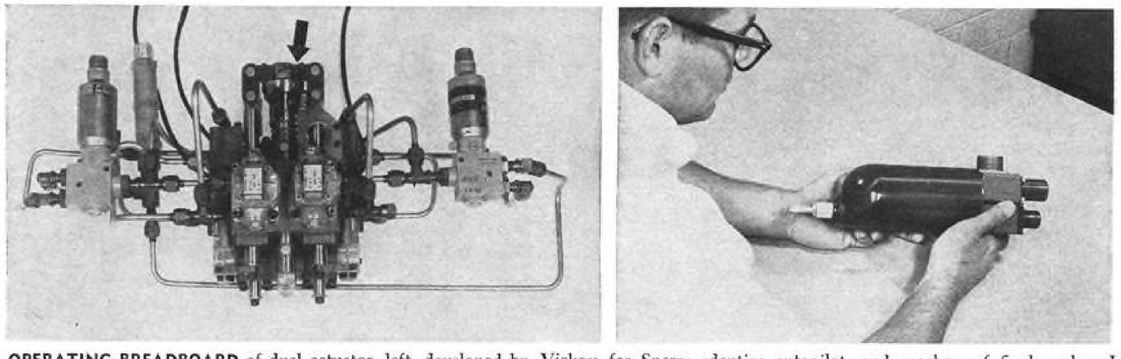
At present, breadboard versions of the system are being tested here, and environmental data is being gathered. Operating prototypes have been fabricated; a mockup of a non-operating system is being assembled.

As a measure of comparison of its adaptive system with nonadaptive flight control systems, Sperry cites these figures:

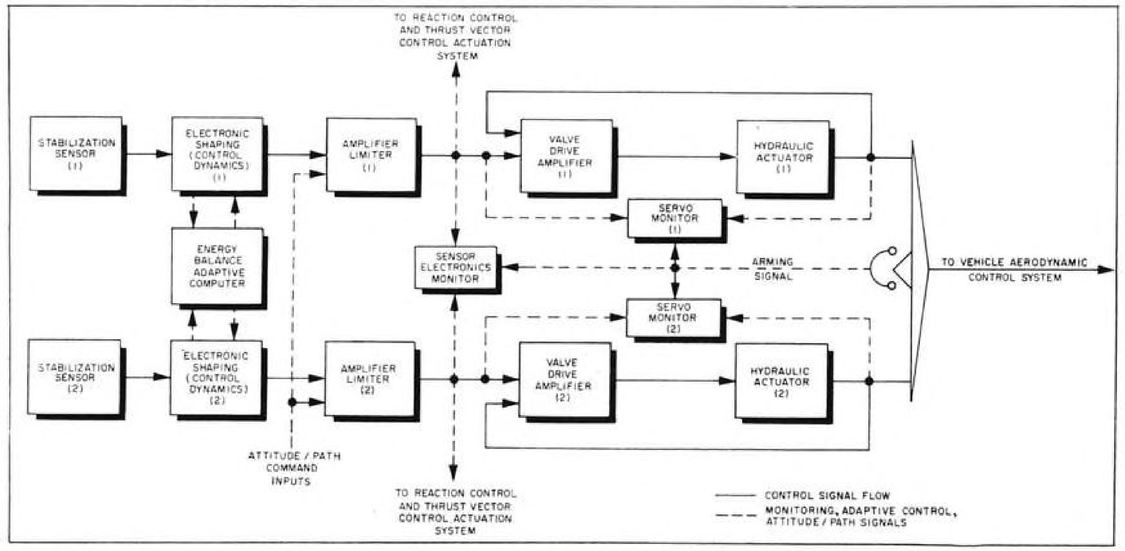
The electronics rack of a conventional system in production for a specific operational, high-performance aircraft weighs 27 lb., employs over 1,000 parts, is packaged into 1,400 cu. in. of volume, requires 100 w. and will withstand 2g. A miniaturized version of this system, employing the high-density, welded modules used in its adaptive system would shrink it to 11 lb., fewer than 800 parts and a volume of 350 cu. in., and cut power to 35 w.

In many ways, the electronics rack of the adaptive system almost doubles the functions of the conventional system because of the additional channel for each axis. Thus, there are, for example, six servo amplifiers—two for each axis rather than the single one per axis in the conventional system.

Consequently, the adaptive system's electronics rack runs about one third larger in most of its dimensions than the miniaturized version of the conventional system. It weighs about 14.6 lb., occupies 470 cu. in., requires about 47 w.



OPERATING BREADBOARD of dual actuator, left, developed by Vickers for Sperry adaptive autopilot, and mockup of final packaged actuator, right. Arrow points to rocker arm which rotates with malfunction in either of two of the axis damper channels.



BLOCK DIAGRAM of one axis of Sperry Phoenix Co. system shows how dual redundant channels provide stabilization for aerospace vehicle.

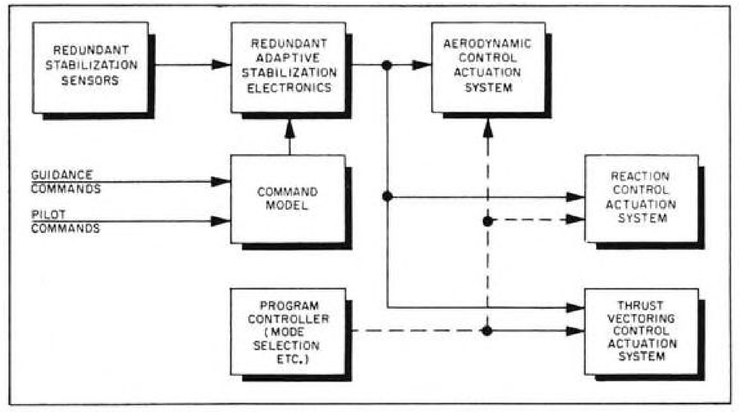
There are other differences between the two systems, in that the adaptive system employs six rate gyros (rather than three), an additional accelerometer and actuators specially designed and developed to accept inputs from dual channels.

The price of the redundant adaptive system, Sperry says, will run about 10% higher than a standard conventional system. This does not include the costs of the new actuators, which are about 50% higher than the cost of a complement of standard actuators. Sperry attributes the ability to hold the price to 10% higher than a conventional system, while adding three damper channels and adaptive features, to savings derived from compact construction.

The welded packaging technique used in the adaptive system is one of the simple forms of this packaging approach now becoming more common in space and missile avionic gear (AW Aug. 24, 1959, p. 104; Oct. 10, 1960, p. 73).

Each circuit module is assembled in a small common honeycomb-type of jig into which required components are inserted by following "road map" instructions. When this step is completed, the module assembly is encapsulated, leaving component leads protruding from the assembly. Leads are then interconnected and the entire module encapsulated again. Specific circuits fabricated this way are used in other Sperry equipment which has successfully passed military evaluation and is going into production.

All of the autopilot electronics, with the exception of calibration units, are synthesized from 16 different types of the module circuits. Typical circuits include an amplifier-limiter, demodulator-modulator, solid-state relay, amplifier-switch and power supply.



CONTROL SYSTEM mode is selected by program controller, as shown in simplified block diagram of the adaptive flight control system developed for aerospace vehicle.

Individual modules are inserted into outside faces of small metal structures which are mounted around the equipment rack. Each of the metal structures, which resemble and open like clamshells, can be unscrewed from the rack, if necessary. This type of assembly permits easy access for maintenance.

Should a complete clamshell, which might represent a circuit function such as a servo amplifier, have to be replaced, it can be unscrewed from the rack. There are 13 clamshells on the rack—six servo amplifiers, two adaptive couplers, two synchronizers, two adaptive computers and an interlock.

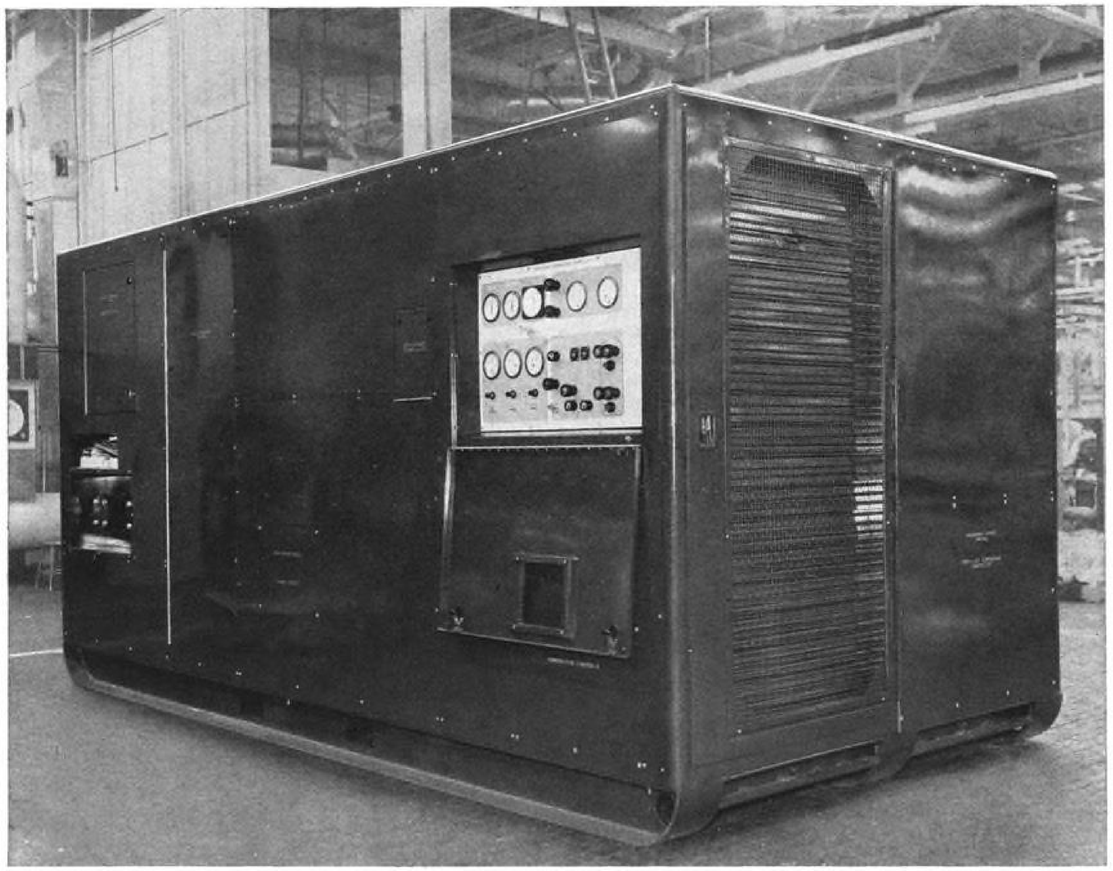
Metal clamshells enable heat to conduct away from the circuit and permit 125C operation without forced-air cooling. Individual modules are color-coded and have various shaped bases which mate into holes in the clamshells to ensure against maintenance errors. Parts density for the adaptive system is about 3,940 parts/cu. ft., compared with 1,300 parts/cu. ft. in the standard system previously cited.

Welded module packaging, increased protection, better heat sinking and the use of repetitive module circuits combine to account in large measure for the significant anticipated improvement in MTBF for this system as opposed to its conventional predecessor, according to Sperry engineers.

An MTBF greater than 1,000 hr. for the complete control system, including autopilot actuators, is one objective of the adaptive autopilot development.

Other features of the system cited by Sperry include:

- **Redundant dampers** provide full-time stabilization even though individual parts may malfunction.
- **Attitude and path computation** are



Automatic temperature control GSE for Titan II missile propellant

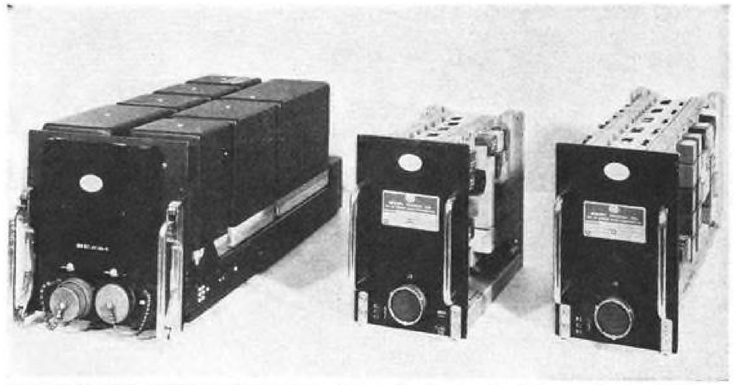
This new environment control package was designed and produced by Hamilton Standard for the Air Force's Titan II missile, made by Martin. It automatically stabilizes propellant temperature at 60 ± 5°F within a 20,000 gallon storage vessel. The unit electrically heats or mechanically cools a glycol and water heat transfer liquid, and then circulates it to the storage vessel heat exchanger. It is built to perform reliably in ambients of −35° to +115°F, and from sea level to 6,000 feet.

The Titan II Propellant Temperature Controller is evidence of Hamilton Standard's ability to meet environment control GSE assignments. It typifies the results attainable when engineering capabilities in pneumatics, hydraulics, electronics, and packaging, are combined with specialized manufacturing skills.

A NEW BROCHURE describing Hamilton Standard's environment control GSE capabilities for aircraft and missiles is available. To learn how this solid foundation of experience can be your key to dependable GSE, write: Sales Manager, Ground Support Equipment Department, Hamilton Standard, Windsor Locks, Connecticut.

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

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COMPARATIVE SIZES of electronics packages for three autopilots are shown. Left, production model of system designed for high-performance Navy plane; center, miniaturized version of same system using welded modules; right, adaptive system which also uses welded modules in order to reduce the size and weight.

separated from the redundant dampers.

• **In-flight failures** are indicated on control panel to alert the pilot.

• **End-to-end** pre-flight self-test indicates ready status of the system. This involves an unusual self-test for the rate gyros. Normally, a gyro test might be a two-step operation, one for the wheel and another to check gimbal restraints and pickoff.

In this case, small electromagnets facing the spinning surface of the wheel cause eddy currents to be generated on the wheel (if it is spinning) which, in turn, cause reaction torques to bend the output axis.

A signal generated in the gyro will pass through the stabilization channel and permit checkout of actuator response.

Dual Channels

Dual operation of two channels for a typical axis can be illustrated by reference to the block diagram on p. 55. If the two channels are functioning properly, and therefore have equal gain, the rocker arm on the actuator does not rotate.

If the two are not equal, the arm bends, giving an indication of failure.

When this happens, servo monitors automatically initiate two-stage logic inquiring whether either servo loop is improper with respect to input command. If either loop is improper, it will shut off the improper loop and center-lock that end of the actuator.

Gyro signals of the channel with the malfunctioning loop will be fed into the properly-functioning loop and the gain restored.

If the arm rotates due to a failure in a gyro or subsequent network, the monitors again first check the servo loops and find them functioning properly. Then, the outputs of the gyro networks would be cross-switched so that each is fed to both servos. If the failure is due to a zero output from one gyro, the output from the second now would be feeding both servos, so that system performance is restored.

If the gyro failure is not the more likely zero signal situation, a process which Sperry calls a "test of reasonableness" is invoked. If one signal is excessively large with respect to the other, a hard-over condition is presumed to prevail, and that gyro is removed from its channel.

It takes the system ¼ sec. to detect and re-center the rocking arm for a hard-over failure.

The system does not account for the unlikely condition of a large gyro signal from one channel and a passive failure in the other.

A dual actuator suitable for the adaptive system was designed by Vickers Division of Sperry Rand Corp., El Segundo, Calif., to system requirements laid down by Sperry Phoenix. An operating breadboard of the actuator with external plumbing is shown in an accompanying photograph on p. 54 along with a mockup of the final packaged actuator.

Other Features

Sperry is reluctant for proprietary reasons to discuss details of the adaptive features of its system. It says other features of the energy balance adaptive control include:

• **Gain adjustment** is insensitive to level of disturbance and/or command inputs to the vehicle.

• **Internal feedbacks** normalize speed of adaptation and change energy balance criteria as a function of vehicle condition.

• **Calibration** of the computer requires information on the form of vehicle dynamics, not precise aerodynamic data.

• **Speed of adaptation** capability is five times the gain decrease in 1 sec., five times the gain increase in 5 sec.

LEWIS

SELECTOR SWITCHES for

- Resistance Thermometers
- Thermocouple Thermometers

THERMOCOUPLE SWITCHES



Flanged Cases in 2 inch 3 inch 4 inch dia.

Engineered to give years of service in test work as well as in permanent installations, LEWIS switches have heavy, low-resistance contacts; positive detent action and sturdy terminals for easy wiring.

The cases are splash proof and dust tight, of close fitting bakelite. Husky black-finished aluminum indexing knobs are used to turn the stainless steel shaft supporting the rotating brushes.

RESISTANCE BULB SWITCHES

A companion line of the same construction except that they are fitted with a common-terminal ring for three-wire bulb connections.

THE 9S SERIES
THE SPACE SAVERS

FOR AIRCRAFT RESISTANCE THERMOMETERS

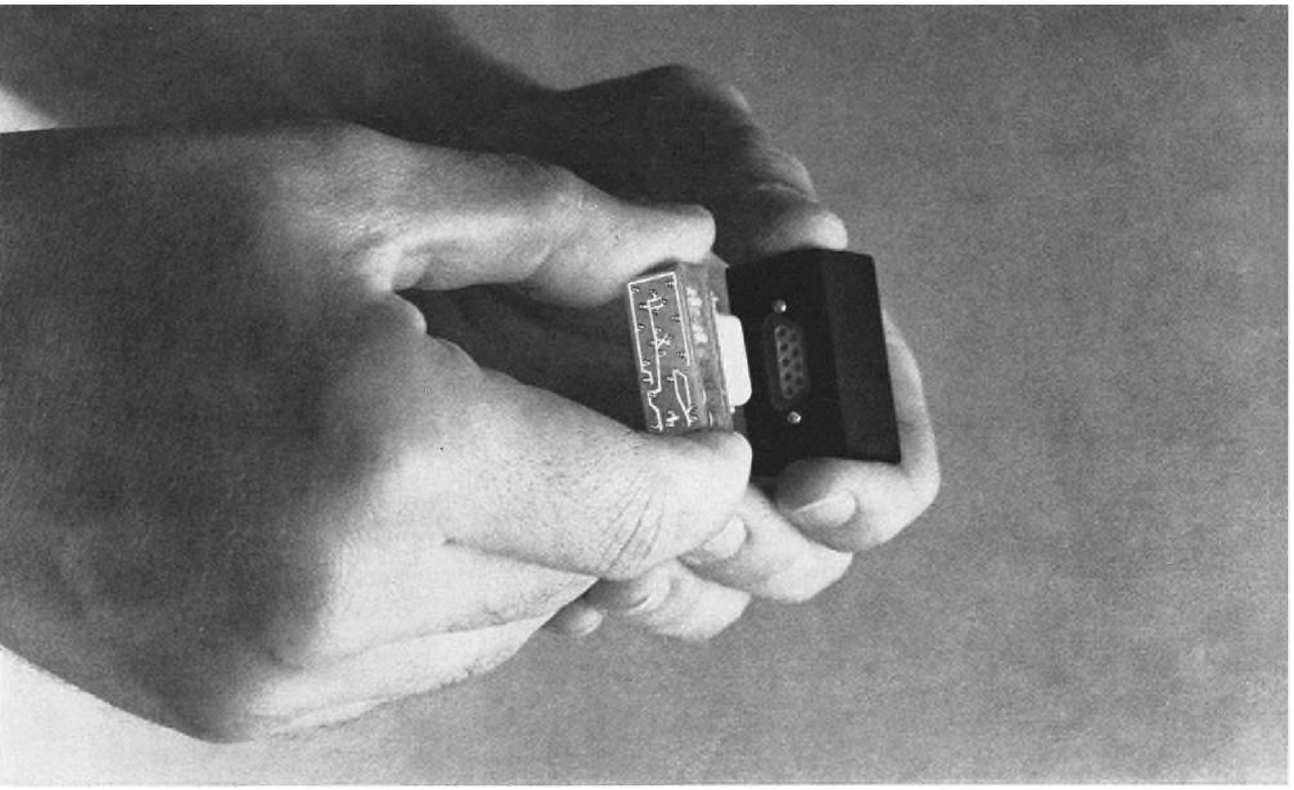


Small, sturdy, steel-cased switches 1¼ inches in diameter, 2-9/32 inches total shaft length, one hole mounting with ½-32 NS-2A threaded bushing. Designed especially for connecting two or more resistance temperature detectors to one instrument, now flying in the modern jets.

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Amphenol Connectors + Intercon® prefabricated circuitry = the first full-scale interconnection service available to the electronics industry

Now one man can give you full-scale interconnection service. He's your Amphenol Sales Engineer.

Reason: he now offers Intercon pre-fabricated circuitry plus a complete line of Amphenol electrical connectors.

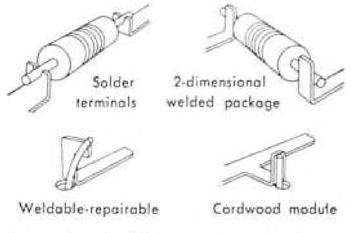
Let's say that you're responsible for the design of an airborne computer which will use micro-miniature components. By contacting an Amphenol Connector Division Sales Engineer, you can now expect these services:

1. You will be provided with recommendations for interconnecting components using weldable and solderable Intercon pre-fabricated circuitry. The Amphenol Sales Engineer will work with you in determining circuit lay-out, tailoring his recommendations to your production facilities. He will supply prototype Intercon boards and continue to work with you through test and final approval.

2. If the individual modules are to be pluggable, he will also recommend methods to accomplish this. He may, for example, suggest Amphenol micro-miniature Wire-Form* contacts and Strip Connectors* for this purpose.

3. He will also make recommendations for inter-system connections. If your project involves cable harness assemblies, he will work with you in determining and recommending the best and most economical method, utilizing Amphenol's background in the design and manufacture of cable assemblies.

This new full-scale service means that you will be able to conserve time, avoid duplication of effort and be assured of uniform quality levels by dealing with one interconnection specialist rather than many.



Tabs make the difference. Intercon's 3-D tabs allow maximum miniaturization with minimum monkey-business. Circuitry lifts up off the board, making terminations almost easy—especially helpful in multi-layer modules. And, because Intercon saves assembly time (up to 80% or more) costs go down, profits up.

*T.M. Amphenol-Borg Electronics Corp.

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FILTER CENTER

▶ **Moon-Bounce Used for Ship-to-Shore**—Navy has successfully used the moon as a passive communication satellite to transmit and receive 60 words-per-min. teletype messages between its moon-bounce terminal near Washington and the USS Oxford in the South Atlantic. USS Oxford is outfitted with a 1-kw. transmitter and 16-ft. antenna; ground terminal at Stump Neck, Md., uses 10-kw. transmitter, 60-ft. dish.

▶ **Sperry Demonstrates Laser Doppler**—Using a helium-neon continuous-wave gas laser, Sperry Gyroscope engineers have successfully demonstrated the feasibility of a Doppler radar operating at optical frequencies, the company reports. The laboratory experiment used a movable mirror as the target. Operating at optical frequencies should permit Doppler measurements equivalent to a velocity as low as one ten-thousandth of an inch per sec., Sperry says.

▶ **RCA Adds Doppler to AN/FPS-16**—The FPS-16 monopulse radar, widely used as a precision tracker by Air Force and National Aeronautics and Space Administration, can be modified to determine target velocity to an accuracy of 0.1 ft. per sec. using Doppler shift measurement techniques, according to Radio Corp. of America. The new technique was developed by RCA, which builds the FPS-16, under sponsorship of Army Signal Research and Development Laboratory.

▶ **Rough-Landed Lunar Transponder**—Lightweight transponder, not exceeding 10 lb., and sufficiently rugged to survive rough landing on the moon's surface, will be developed by General Dynamics/Astronautics for USAF's Electronic Systems Division.

▶ **Long-Range Secure Communications**—System for accurately locating the position of a forward artillery observer who may be well behind an enemy's lines will be delivered to the Army at Ft. Belvoir late this year by Cubic Corp. Called Point Locator, or Polo, the system will use an unusual modulation technique to permit the observer to radiate a signal with a high degree of security. Basically, Polo uses range and range difference techniques to pinpoint the observer. Two radio stations separated by a known distance in friendly territory twice will measure range to an aircraft above the battle line, then the position of the observer, identified by signal emissions, can be computed by the Army's Field Army Data Acquisition Computer.



GIANNINI CONTROLS CORPORATION

LOOKING FORWARD

by Julian Hartt

DUARTE, CALIFORNIA: Sometime next year, if all goes well, the world will learn a new meaning for the third sign of the zodiac. Newspaper headlines will relate Gemini not to the twin stars of the northern constellation but to NASA's Project Gemini, the two-man spacecraft.

Right now, as you read this column, NASA, flushed with the success of Project Mercury, is shaping up for the final gruelling rounds of design and re-design, test and re-test of the Gemini program. Simultaneously, interest mounts concerning selection of the Gemini crew.

One thing is sure, minutes after these silver-clad, twin astronauts have safely rocketed into the awakening Florida sky, the tension felt by thousands of contributing engineers will slacken.

Ironically, a band of engineers here at Giannini Controls, no less relieved, will hopefully have seen months of painstaking design and development go for naught. With a successful launching, the product of their efforts will not be used. Theirs was the task of producing a complete package called the "Malfunction Rate Detection System" for the Martin Co., builders of the modified Air Force Titan II which will be used as the launch vehicle.

When the Gemini vehicle lifts off, there will be narrow limits of safe rate of pitch, yaw and roll. If these rates are exceeded the astronauts will want to get off the bird.

If excessive rates should occur, the system will instantly send a signal to the crew who will then be able to take emergency steps. The package, alert and vigilant during both first and second stage firing, will be in the booster, not the spacecraft.

The malfunction system is typical of so many safety measures that are built into either spacecraft or booster. They are testimony to the value that we as a nation place upon the lives of these two men, the soloists who went before them, and in fact, all human life. The costs in terms of time and material are themselves astronomical.

Such would be the enormity of the loss that there literally is no room for error in this equipment.

As Ed Brastow, Ass't. Chief Engineer of Giannini Controls' Gyro Division emphasizes: "The design, like the constellation, must be 'twins.'

"Redundancy—a second path of operation if the first fails—is the rule. Instead of three rate gyros in the system, there are six. These gyros actuate emergency switches.

"The system also has duplicate wiring—instead of three power leads to each gyro there are six, instead of one output wire, there are two."

This is not simply a case of safety in numbers, redundancy has not been substituted for effective design.

A graduate electrical engineer, Brastow is a gyro specialist whose practical skill was shaped on the solid foundation of a job working alongside famed Dr. Draper at Massachusetts Institute of Technology.

One of the projects to which Brastow contributed resulted in the hermetically sealed, integrating (HIG) gyro. For more than a dozen years since, he has been working exclusively on gyros, and during that time he has been credited with numerous successful design innovations, including his own design of what he describes as "the world's smallest gyro."

As if the twin design of the "Malfunction Rate Detection System" were not enough, Brastow then goes on to describe its self-test features which insure even greater safety.

"Each gyro has its own rotor speed monitor which reports whether or not the rotor is spinning at the required rate of 24,000 rpm. Also there's a gimbal torquing device. With this, by closing a circuit you can magnetically or electrically turn the gimbal to see if there's an output from the gyro or if the gyro is free to move."

This package has been designated a critical item by the Air Force Space Systems Division. Thus Giannini Controls engineers had to analyze carefully the design of the critical parts in the package, as well as subject the individual components to torturous testing.

The project has been a high priority program. The go-ahead was ordered last January. Brastow and his project engineers made the first delivery on schedule in June although it meant months of working around the clock.

Certain though they are that their system will insure survival of the American astronauts if a malfunction should occur, these engineers earnestly hope it will never have to be used.

Perhaps shortly after the sun enters Gemini in the summer of 1963, we shall witness another successful retrieval of a much travelled spacecraft.

For the opportunity to design even more demanding systems for projects beyond Gemini—for the men to follow Shepard, Grissom, Glenn and Carpenter—there are many engineers like Brastow at Giannini Controls who are eagerly... Looking Forward.

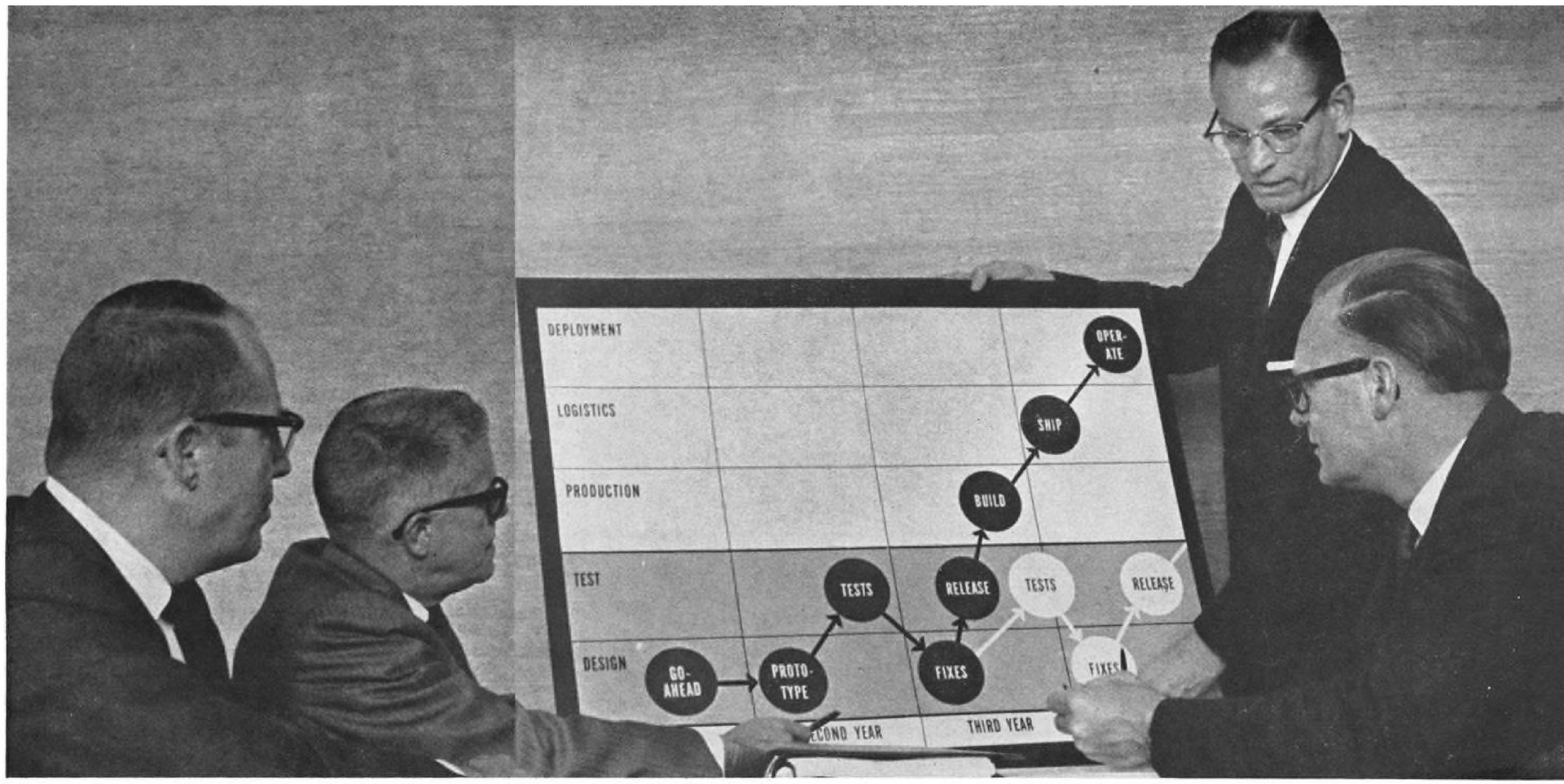
Giannini Controls Corporation
1600 South Mountain Avenue, Duarte, California

Instrumentation & Systems for Aerospace & Industry.

THE BIG PICTURE

at Lockheed Missiles & Space Company

The urgency of today's major weapon and space projects has given rise to a new science of management. Its basic premise: in order to meet an absolute deadline, manufacturing must get underway while research, engineering, and testing are still going on. This management philosophy has been employed with notable success at LMSC on critical Air Force, Navy, and NASA programs.



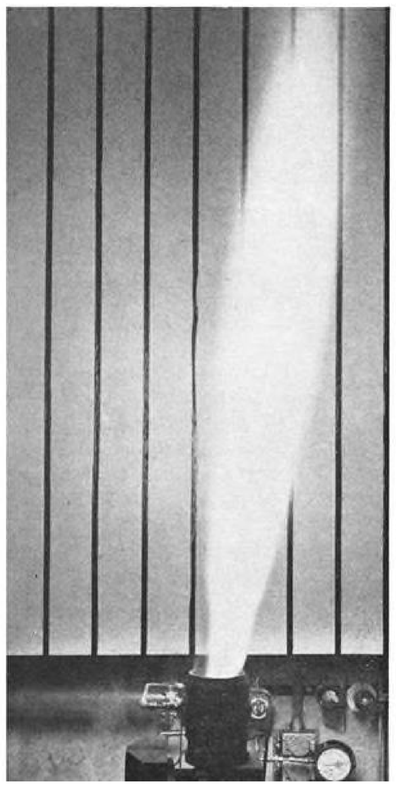
Complex projects are carefully preplanned by LMSC management (right). Schedules can be shortened by starting several phases of a program at the same time instead of in sequence.

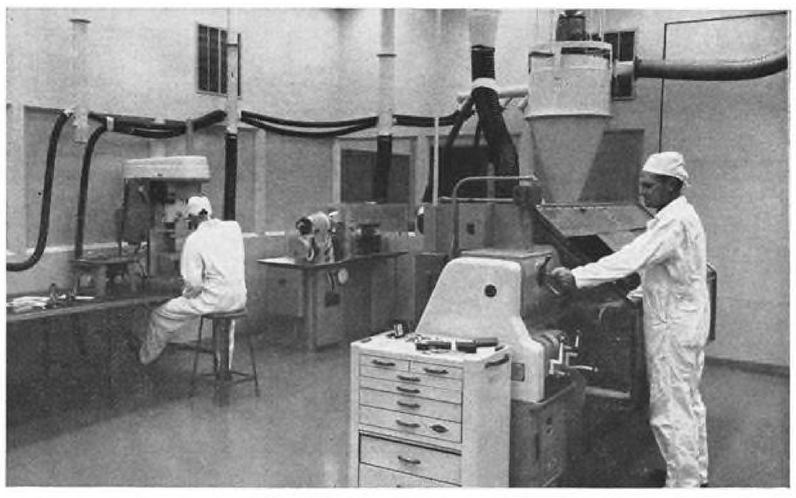


Lockheed project planners (above) can accurately predict the cost of future weapon and space systems, both in dollars and in elapsed time, by applying these new management techniques.



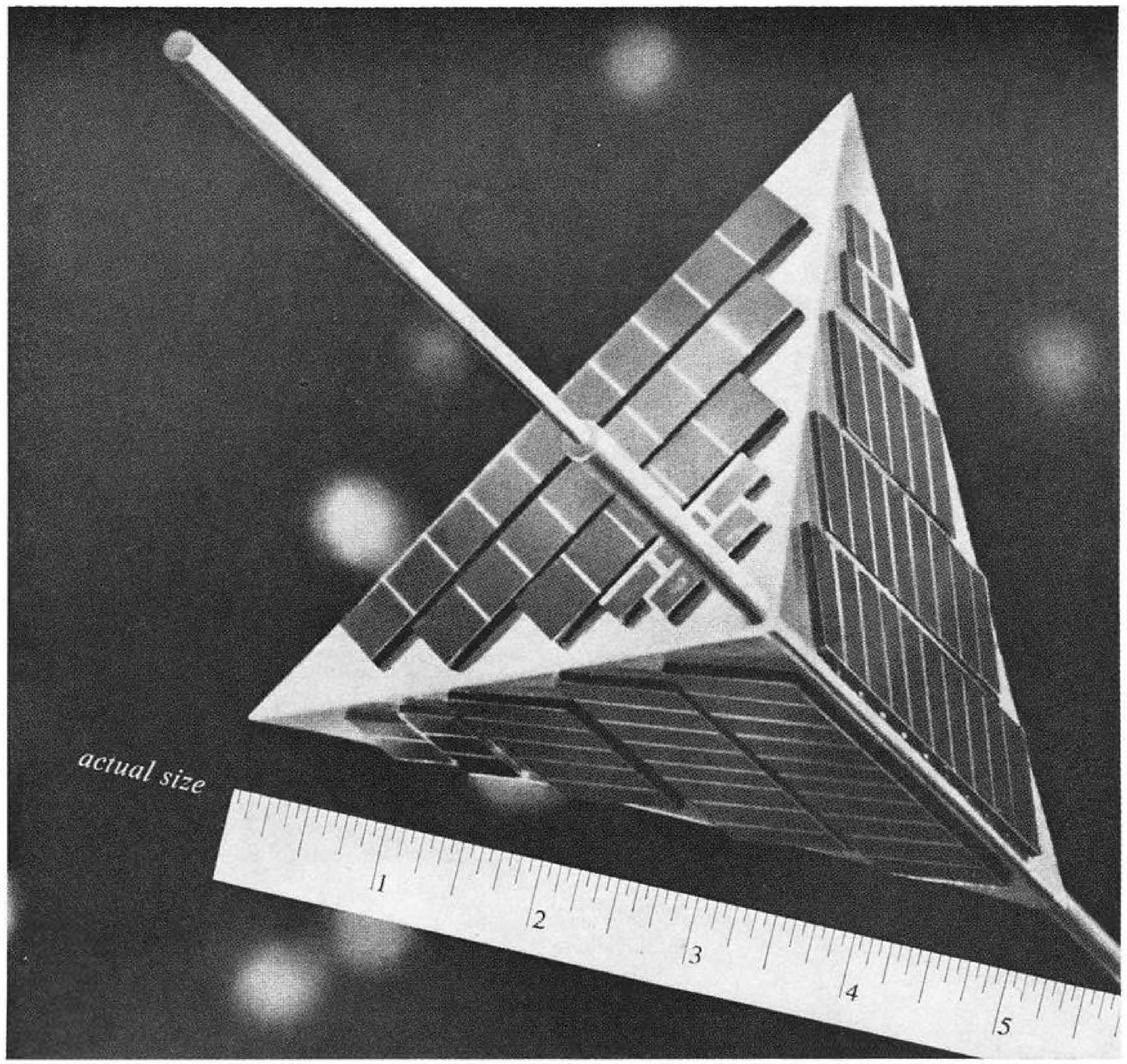
New management methods compress paperwork. Before-and-after photo (right) shows how number of reports required from a typical subassembly section in one 6-month period was reduced.





Swift pace of major programs requires research problems to be solved on schedule. Typical of the scores of R&D projects at LMSC are the processing of high temperature Space Age materials such as beryllium and pyrolytic graphite (above) and steering a missile by deflecting its rocket exhaust with a fluid injection of cold gas (left).

Lockheed Missiles & Space Company, Sunnyvale, California is a group division of Lockheed Aircraft Corporation.



The world's smallest satellite has been developed by Space Technology Laboratories. Its shape will be different from all other satellites before it. STL engineers and scientists have used a tetrahedral configuration to bring about some remarkable characteristics in a space vehicle. There will be no need for batteries nor regulators in flight. The satellite will have no hot side, no cold side. It will require no attitude control devices. No matter how it tumbles in space it will always turn one side toward the sun to absorb energy, and three sides away from the sun to cool instrumentation and telemetry equipment inside. It can perform isolated experiments in conjunction with other projects. Or it can be put into orbit by a small rocket to make studies of its own, up to five or more separate experiments on each mission it makes.

STL is active on hardware projects such as this and as prime contractor for NASA's OGO and an entirely new series of classified spacecraft for Air Force – ARPA. We continue Systems Management for the Air Force's Atlas, Titan and Minuteman programs. These activities create immediate opportunities in: Space Physics, Radar Systems, Applied Mathematics, Space Communications, Antennas and Microwaves, Analog Computers, Computer Design, Digital Computers, Guidance and Navigation, Electromechanical Devices, Engineering Mechanics, Propulsion Systems, Materials Research. For So. California or Cape Canaveral opportunities, please write Dr. R. C. Potter, Dept. A. One Space Park, Redondo Beach, California, or P. O. Box 4277, Patrick AFB, Florida. STL is an equal opportunity employer.

SPACE TECHNOLOGY LABORATORIES, INC.
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Sublimating Ablative Compounds Tested

New York—New approach to thermal control systems developed by Emerson Electric Mfg. Co. uses specially formulated sublimating compounds for thermostatic control of structural temperatures beneath the compounds.

Use of sublimation techniques for temperature control is not new; some existing ablative materials are sublimators. But the Emerson contribution to this complex technology is a series of developed compounds that sublimate at fixed and constant temperatures. This permits the designer to select a temperature limit for structure or equipment below the heat-shield material with confidence that the limit will not be exceeded.

Currently available material, which is called Thermo-lag, is designed for a range of sublimation temperatures between 230F and 2,200F.

The compounds have been tested in laboratories, under simulated re-entry conditions using plasma arc jets, and on actual rocket-propelled vehicles. Current applications include heat shields around the Saturn first-stage motors, Honest John rocket motor nozzles, Wanderer, Trailblazer, Argo and Javelin nose cones, and Scout vehicles. Results of the flight tests have confirmed the theory of Thermo-lag operation, Emerson says.

Sublimation is a fundamental physical process in which a solid changes to a gas without going through the usual liquid phase between. Classical example of this is solidified carbon dioxide ("dry ice") which goes through a phase change from solid directly to gaseous.

The process is endothermic; it absorbs heat during the phase change. Any process that absorbs heat suggests application to cooling systems or to thermal protection systems.

The development of thermal control systems for ballistic missile payloads has shown one route for the evolution of such systems. Starting with a heat sink, which was simply enough available copper to absorb the amount of heating without melting or vaporizing, the temperature-control system evolved to ablation, currently the favored protection method.

Ablation works by a combination of chemical reactions, such as dissociation, and heat transfer to protect the material underneath the ablating layer. It is most successful when the heat flux is high and when the heat pulse—the rate of application of the heat flux—is short. Moderate, long-term heat fluxes are not handled best by ablative materials.

Emerson's argument, stated by Rubin Feldman, chief of the company's Thermodynamics-Chemistry Division, is that ablative materials require additional insulation to protect the structure or equipment underneath. This is because the ablation temperature varies directly with that of the heat input; the higher the heat flux, the higher the ablation temperature.

Thermal conductivity also rises with increases in temperature, so that the final temperature sensed by the surface under the ablative layer increases with time as ablation occurs. This, says Feldman, is what creates the need for additional insulation under the ablation layer.

Thermo-lag compounds are inorganic, and some of them—which sublime at relatively low temperatures—include materials to produce a debris layer.

This debris performs four useful functions to increase the heat blocking capability of the base material: It insulates against heat by virtue of its physical properties; it re-radiates heat because its outer layer is at a higher temperature than the virgin material below it; it provides an area of increased temperature where the subliming gases can dissociate more readily and therefore absorb more heat, and it provides a region for transpiration cooling by passage of the subliming gases through the porous debris layer.

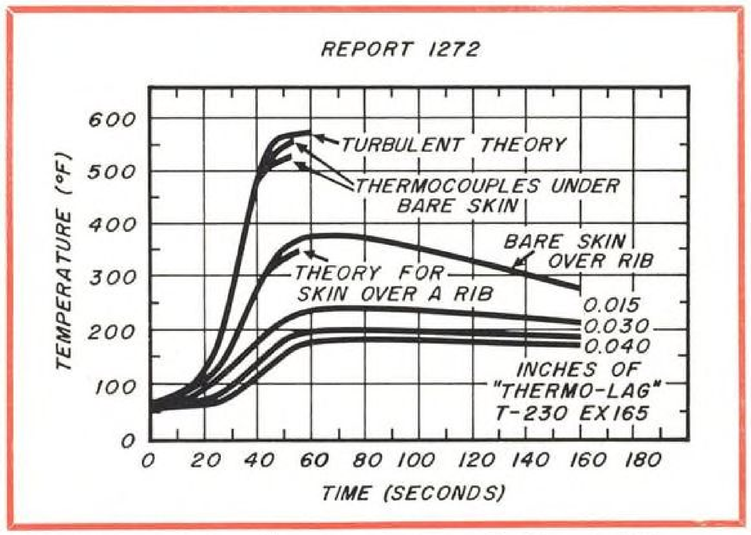
These four increments of cooling, added to the basic process of sublimation, provide a total thermal control system with a pre-determined temperature level. Feldman says any vehicle using Thermo-lag as a protection system can show appreciable weight savings over one protected with organic ablatives because the skin thickness can be determined only by structural requirements and not by the need to serve also as insulation.

The company points out that Thermo-lag compounds can be designed to match "within reasonable limits" a desired set of mechanical and thermal properties. Thermo-lag can be painted on with spray, brush or dip techniques, molded to shape, or applied with a trowel. It can be impregnated or laminated with other materials. Once it is formed, it can be machined to a final contour so that any excess of material can be removed.

Density of the compounds varies from one type to the other, with typical values of 80, 90 and 100 lb./cu. ft.

Thermal conductivity approximates 0.1 Btu-ft./hr.-sq. ft.-F. The materials are essentially transparent to radio frequencies in the X-band region.

One of the lower-temperature Thermo-lag materials—T-230, which indicates that it sublimes at 230F—was tested on NASA Scout vehicles. The material was applied in three thicknesses —0.015 in., 0.030 in. and 0.040 in.— on the fin of the second and third Scout vehicles, and on a portion of the heat shield on Scout 4. Telemetered tem-



TELEMETERED DATA shows Thermo-lag performance on fin of Scout 2 vehicle.



Main Rotor Transmission — one of three Foote Bros. transmissions in the HU2K-1 Utility Helicopter

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FOR TOTAL CAPABILITY

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When Kaman Aircraft Corporation's high speed, long-range HU2K-1 utility helicopter was in the design stage, Foote Bros. was chosen to build the Main Rotor, Intermediate, and Tail Rotor transmissions. In choosing Foote Bros., Kaman knew it could count on the experience, skill, and facilities that have served the aero/space industry for more than two decades. The performance of Seasprite's transmissions have justified Kaman's confidence.

Foote Bros. offers coordinated facilities in these areas:

DESIGN
A completely staffed Design Engineering Group with a solid record of achievement in systems and component design and development.

DEVELOPMENT MANUFACTURING
Long experience in working with many prime contractors gives us the ability to move quickly and surely to successful completion of preliminary development

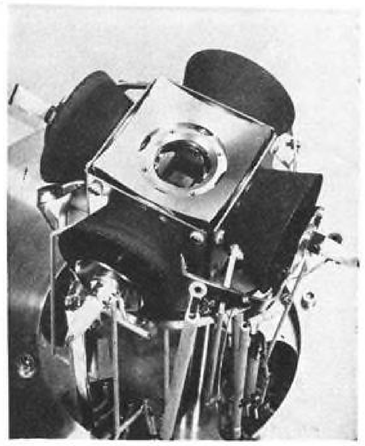
TEST PROGRAMMING
Extensive test facilities plus test stand design and procedure experience ensure to-the-letter compliance with specifications.

PRODUCTION
Foote Bros. production facilities and craftsmen are keeping pace with the ever-increasing demands of the aero/space industry for greater product reliability.

Foote Bros. total capability is at your service. Your inquiry is invited.

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POWER TRANSMISSION DRIVES



Thermionic Converter

New 100-watt thermionic converter, consisting of five cesium diodes electrically connected in series, is mounted in support so that back side of emitters forms a cubic cavity. Solar radiation enters from sixth side (top). Converter was developed by Thermo Electron Engineering for Thompson Ramo Wooldridge which is building solar-thermionic system for USAF's Aeronautical Systems Division.

perature histories showed the material to perform in accordance with its predicted properties.

Other tests under more extreme temperature conditions were made in the University of Chicago's Midway Laboratories, using a plasma jet from an air-stabilized electric arc facility. The material tested was T-500, sublimating at 500F. Internal temperature was measured for a large number of conditions which included stagnation temperatures as high as 17,740F with a corresponding stagnation enthalpy of 20,900 Btu./lb.

Internal temperatures measured with thermocouples stayed well below the 500F mark. In some cases where the stagnation temperature was 10,300F, the internal temperature reached only 150F after about 90 sec. of exposure to the plasma.

Thermo-lag is a proprietary material and has recently been allowed 39 patent claims related to its performance.

Goldwater Urges Plan For Military in Space

Washington—Sen. Barry Goldwater (R.-Ariz.) said recently the time has come to enlarge the military role in space, declaring "the armed forces should already be planning the development as soon as possible of a completely integrated space warfare system."

Sen. Goldwater, a brigadier general in the Air Force Reserve, said "space is a medium for three-dimensional mobility for good or evil . . . So in examining our military space capabilities, the U.S. would do well to make absolutely certain that we will never be surprised technologically in space."

He said it was disturbing that national policy statements indicate the bulk of U.S. space activity is under the National Aeronautics and Space Administration. "I do not think this is so," Sen. Goldwater said, "and I do not think we should say it is so." He said the military responsibilities should be spelled out in a new national policy statement on space (AW June 18, p. 26).

"The time has come," Sen. Goldwater said, "to put more trust in the lessons of history which teach us that every broad, new field of technology produces a wealth of military applications . . . Our armed forces must pursue and prepare to conduct military space missions as rapidly as these can be recognized and defined."

He said it appears at present that "the Pentagon is not sure where or how fast it is going in the direction of a military space program." He said the peaceful exploration of space cannot be assured unless the U.S. also provides itself with the necessary military capability in space.



LYCOMING'S T53 FUEL NOZZLE

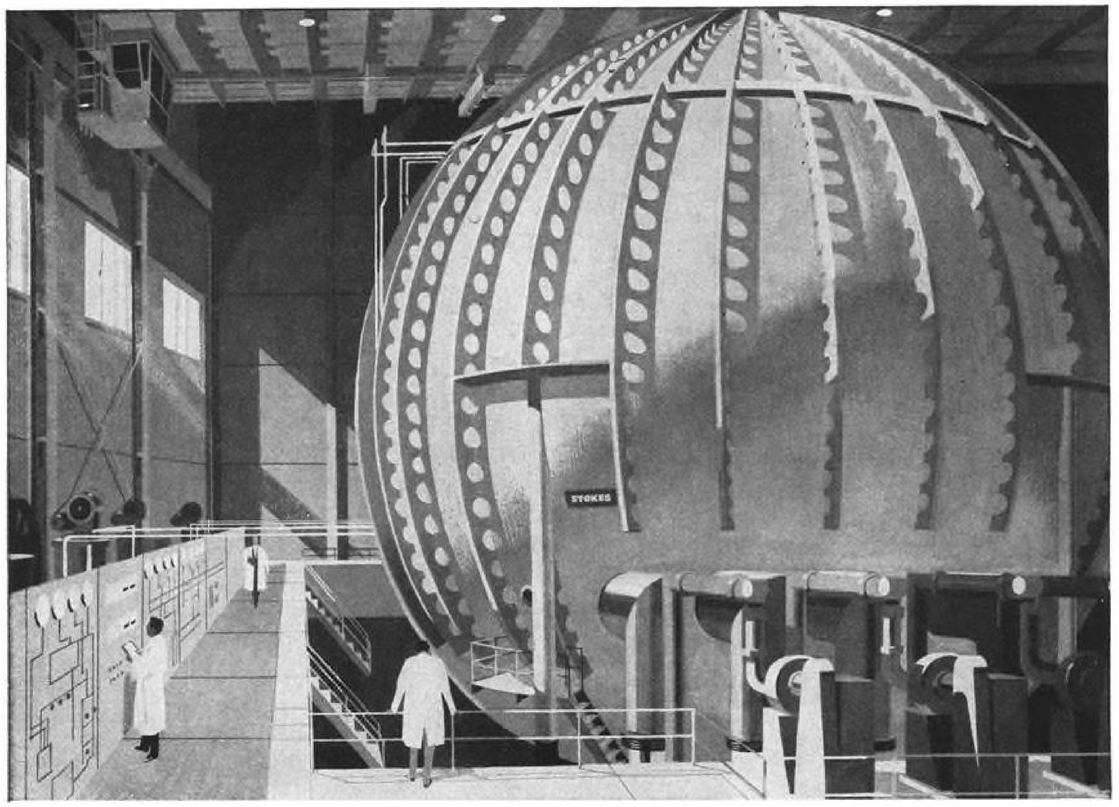
A PRODUCT OF DELAVAN EXPERIENCE

The Lycoming T53 small gas turbine engine is currently in use on helicopters, observation aircraft and in Marine and industrial applications. This is the fuel injection nozzle developed by Delavan for the T53.

If one word were chosen to sum up the reason for Delavan's success on this fuel nozzle program, that word would have to be experience. Experience in designing highly functional, reliable fuel delivery and metering devices; experience in large scale manufacturing of the intricate and precise parts that make up a fuel nozzle, and experience in controlling the quality and performance of these devices on a mass scale.

Add this experience to Delavan's willingness to react quickly to the urgent needs of a dynamic industry and the results are always the same . . . excellent quality, a good delivery record, and reasonable prices. Be sure Delavan is a part of your engine program.

DELAVAN Manufacturing Company
WEST DES MOINES, IOWA



For General Electric's Valley Forge Space Technology Center, Stokes designed and is currently installing three space environmental test chambers like the one shown above in an artist's sketch. The chambers, 38'6" in diameter, will be cryogenically pumped to ultra-high vacuum, and reproduce a variety of conditions encountered by satellites making lengthy missions into space.

EXPERIENCE IS WHAT COUNTS IN SPACE SIMULATION

While space simulation is a new and rapidly changing art, experience in designing and building equipment for its full-scale accomplishment is of the utmost importance. That is because no inaccuracies, no approximations are possible; reliability proving depends on ascertaining absolute values.

F. J. Stokes offers an impressive backlog of experience in supplying major space test facilities. The installation described above and others for General Electric, the vacuum and cryogenic systems for facilities at NASA's Goddard Space Flight Center, the test chamber for Bell Telephone Laboratories' Telstar project, reliability testing facilities for space-borne electronic components, and pumping systems for various aeronautical research centers stand as benchmarks in Stokes' progress in this specialized area.

Behind this specific activity stands half a century's experience as one of the world's leading manufacturers of high-vacuum industrial systems. Since vacuum is the common denominator of all space test equipment, it follows that Stokes' high-vacuum experience, unique engineering capabilities in this field, and extensive, heavy-duty fabrication facilities can be successfully applied to problems of space simulation.

If you are engaged in any phase of space test work, we will gladly explore the possibilities of putting Stokes space simulation and high-vacuum experience to work for you, on a project management, single-source, turnkey, or any other basis. **Space Systems Department, F. J. Stokes Corporation, Philadelphia 20, Pa.**

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NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

HEADQUARTERS, WASHINGTON:

Rand Corp., Santa Monica, Calif.—$159,000 for research on scientific utilization of meteorological satellite data, implications of new techniques and measurements to meteorological satellite development.

Space Technology Laboratories, Inc., Redondo Beach, Calif.—$64,000 for theoretical and experimental studies of swirling wave phenomena.

General Mills, Inc., Minneapolis, Minn.—$74,000 for research to determine existence and identity of viable micro-organisms in stratosphere.

Ford Motor Co., Newport Beach, Calif.—$52,000 for experimental studies for detection of protein in trace amounts.

Republic Aviation Corp., Farmingdale, N. Y.—$162,000 for research on medical, physiological, psychological and microbiological effects of prolonged exposure of humans to pure oxygen atmospheres.

General Electric Co., Philadelphia, Pa.—$115,000 for research on recovery of oxygen by catalytic disassociation of carbon dioxide at low pressure.

American Meteorological Society, Boston, Mass.—$75,000 for abstracting and publishing articles gathered from space sciences literature.

Air Force Systems Command, Wright-Patterson AFB, Ohio—$116,000 for experimental studies to determine tolerance and effects of vibration on human subjects.

University of Arizona, Tucson, Ariz.—$68,000 for research in planetary and stellar spectroscopy.

Florida State University, Tallahassee, Fla.—$75,000 for study of polarization of decameter-wave radiation from Jupiter.

Dartmouth College, Hanover, N. H.—$50,000 for investigation of effects of plant growth hormones on plant development in absence of gravitation.

Commonwealth Scientific & Industrial Research Organization (CSIRO), Chippendale, Australia—$172,000 for studies to determine structural, electrical and radio performance characteristics of the CSIRO 210-ft. telescope at Parkes, New South Wales.

Research Triangle Institute, Durham, N. C.—$240,000 for probabilistic modeling study for National Aeronautics and Space Administration astronautical systems.

General Electric Co., Schenectady, N. Y.—$275,000 for research and development of an electrostatic gyro system.

Geophysics Corp., Bedford, Mass.—$216,000 for laboratory and theoretical studies in vacuum ultraviolet; $332,000 for study of winds, diffusion and expansion of gases in upper atmosphere.

Booz-Allen Applied Research, Inc., Bethesda, Md.—$92,000 for reliability study of equipment for Orbiting Astronomical Observatory spacecraft.

General Electric Co., Syracuse, N. Y.—$100,000 for over-all integration, checkout and reliability of Apollo space vehicle system.

Ling-Temco-Vought, Dallas, Tex.—$250,000 for Apollo rendezvous simulator study.

Atomic Energy Commission, Germantown, Md.—$680,000 for development of hydrogen turbopump system in support of KIWI-B reactor experiment.

Navy Bureau of Weapons, Washington, D. C.—$204,000 for satellite battery evaluation program.

AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.:

Berkeley Steel Construction Co., Inc., Berkeley, Calif.—$57,000 for fabrication of fuselage and tail for aerodynamic testing model.

LEWIS RESEARCH CENTER, CLEVELAND, OHIO:

H. R. Miller & Sons, South Euclid, Ohio—$200,000 for services and materials for construction of second floor addition to procurement and supply building.

Hubbell, Benes & Hoff, Cleveland, Ohio—$140,000 for architect-engineering services for design of development engineering building.

Union Carbide Corp., New York, N. Y.—$675,000 for services and materials to manufacture, deliver, install, test and place into initial operation equipment to modify existing space environment tank and associated liquid helium system.

General Dynamics Corp., San Diego, Calif.—$60,000 for research program on carbides as cathodes for thermionic space reactors.

Nuclide Analysis Associates, State College, Pa.—$84,000 for multipurpose 12-in.-radius mass spectrometer.

Controls for Radiation, Inc., Cambridge, Mass.—$98,000 for services incident to operation of Plum Brook nuclear reactor.

Pfaudler Permutit, Inc., Rochester, N. Y.—$55,000 for services, labor and materials for fabrication and delivery of evaporator system at Plum Brook.

General Services Administration, Washington, D. C.—$58,000 for disbursing motor vehicles to Cleveland, Ohio.

LANGLEY RESEARCH CENTER, LANGLEY FIELD, VA.:

Jered Industries, Birmingham, Mich.—$289,000 for service and materials for designing, fabricating, installing and making necessary building modifications and test-operating a space vehicle rendezvous docking simulator facility.

Ling-Temco-Vought, Dallas, Tex.—$156,000 for performance of design studies, preparation of design specifications, and preparation of long lead-time item procurement list for the velocity package subsystem, Project Fire.

Martin Marietta Corp., Baltimore, Md.—$50,000 for service and materials to conduct studies and experimental investigations to determine whether confinement in restricted environment and reduced physical activity influence ability of spacecraft crew to perform critical mission tasks during lunar landing, rendezvous and re-entry.

MANNED SPACECRAFT CENTER, HOUSTON, TEX.:

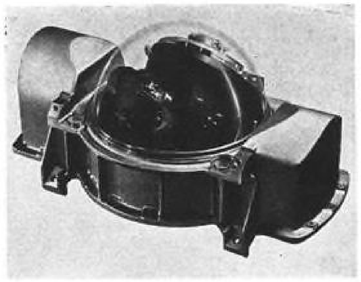
Northrop Corp., Van Nuys, Calif.—$87,000 for test program for glidesail parachutes.

Air Force Air Rescue Service, Orlando AFB, Fla.—$500,000 for air rescue support for Project Mercury.

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.:

Air Products & Chemical Corp., Allentown, Pa.—$430,000 for fabrication, installation and checkout of liquid hydrogen servicing system for Saturn complex.

Defense Electronics Co., Rockville, Md.—$75,000 to design, develop and fabricate telemetry pre-detection recording system.



OAO Star Tracker

Star tracker, one of six to be used in Orbiting Astronomical Observatory (OAO), is now in production at Kollsman Instrument. The six trackers will be mounted on spacecraft so that three of them always can view the celestial sphere, providing signals for precisely orienting the OAO telescopes (AW Jan. 22, p. 62).

PROBLEMATICAL RECREATIONS 129

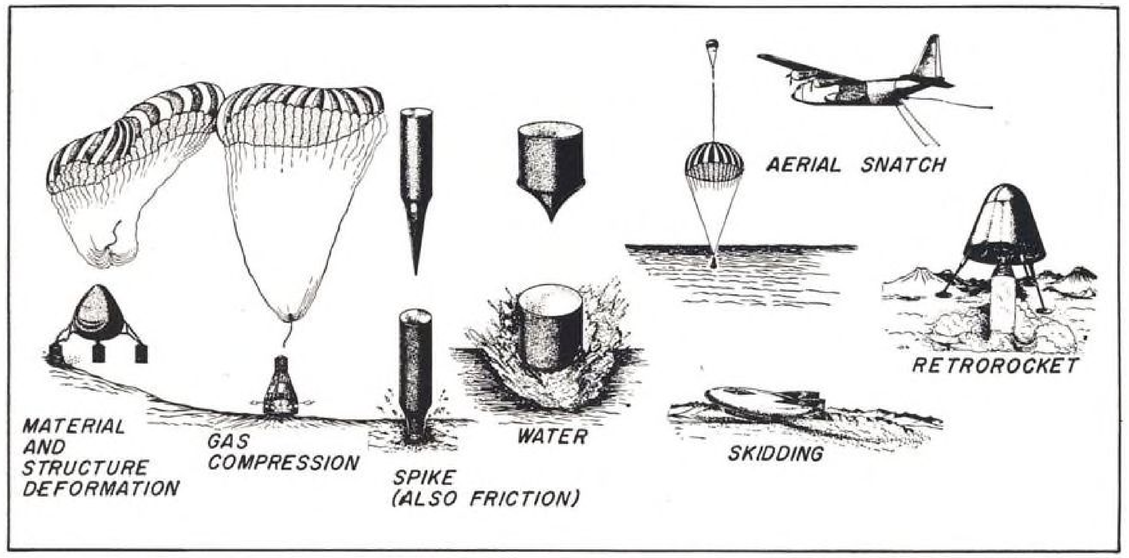


Prove that the product of 4 consecutive positive integers cannot be a perfect square. —*Contributed*

Profiling the ocean's bottom can be detailed and precise with the help of three new transistorized precision depth recorders, products of the Westrex Division of Litton Systems. The most sophisticated model of the group, PDR Mark X, provides 12 recording scales from 100 to 6,000 fathoms on a paper width of 19⅛ inches. For more on Model Mark X plus news of PDR's Mark XV and Mark XI, write to Westrex Company, 540 West 58th Street, New York 19, New York.

ANSWER TO LAST WEEK'S PROBLEM: 3.7 dollars. If the total weight amounts to 60 ounces, then the grocer from whom I did not purchase a packet gives short weight. If the total weight is 59¾ ounces, then the grocer from whom I purchased one packet gives short weight, etc.

LITTON INDUSTRIES, INC.
Beverly Hills, California



ARTIST'S CONCEPT shows various methods for cushioning space vehicle impact, as reviewed in NASA Lewis Research Center study.

Space Vehicle Impact Cushioning Studied

By Edward H. Kolcum

Washington—Retrorockets are the only energy-absorbing devices rated excellent for cushioning the impact of space vehicles landing on lunar or planetary surfaces, according to a National Aeronautics and Space Administration survey. The study urges a full program of research into several promising deceleration devices.

The survey, compiled by Jack B. Esgar of NASA's Lewis Research Center, compares the major characteristics of landing systems incorporating material deformation, gas bags, collapsible shells, retrorockets, aerial snatch, skidding and burrowing. Conclusions (see chart) of the survey indicate:

- **Material deformation**—use of collapsible or frangible material—is simple and reliable, but its most pronounced disadvantage is its high rate of onset—the initial impact force.
- **Gas bags,** used in the Mercury landing system, are easily stored and provide excellent deceleration-onset rates. A disadvantage would be poor performance if landing were non-vertical or made on an uneven surface.
- **Collapsible plastic shells** have characteristics similar to gas bags, but can absorb more energy and have less tendency to bounce. Storage is a problem with this method.
- **Aerial snatch,** although impractical for non-earth landings, has excellent weight, onset-rate and stowage characteristics, but reliability depends entirely on the accuracy of landing point prediction. The method involves mid-air retrieval of the spacecraft by another vehicle.
- **Skidding** systems cannot be used without a prepared landing strip, since terrain must be even.
- **Burrowing,** or spike systems provide excellent stability after impact, but they have a high onset-rate and must impact on even terrain.
- **Retrorockets** have no velocity limitations and can provide controlled onset-rates. Storability is the biggest disadvantage of this system.

Esgar feels this comparison indicates no single system is superior for all applications, and it may be advantageous to combine several devices. He suggests that future research should concentrate in these areas:

- **Methods of combining** heat generation with material deformation, and reduction of the high onset-rates of systems which incorporate material deformation.
- **Weight reduction.**
- **Methods for reducing** lateral loads to acceptable limits for gas bags, frangible tubes and material deformation.
- **Simple pressure controls** for gas bags to eliminate or reduce bounce.

Space Vehicle Landing Systems

	Material deformation	Gas bags	Collapsible shell	Retrorocket	Aerial snatch	Skidding	Burrowing device
Weight	E	G	G	G	E	E	F
System reliability	E	G	E	G	P-F	F	E
Velocity limitations	F-G	F-G	F-G	E	F	E	F
Stability after impact	F-G	F	F	F-G		G	E
Storage	F-G	E	P-F	F-G	E	E	P-F
Onset-rate	P-G	G-E	G-E	E	E	E	P
Terrain limitations	F	F	F	G	E	P	P
Non-earth landing	G	G	G	E	P	P	P-F
Non-vertical descent	F	F	F	G	G	E	F
Over-all rating	G	G	G	G	P-G	P-G	F

E—excellent; G—good; F—fair; P—poor

- **Methods for obtaining stability** after impact.
- **Thrust initiation,** variable thrust control and improved reliability in rocket systems.
- **Combinations of energy-absorbing** systems, and methods of incorporating these systems into the vehicle structure so that they may serve a dual purpose.

Materials Field

Esgar has analyzed the materials field for potential energy-absorption devices and he concludes that frictional heating—which increases energy aboard—has the greatest potential, and is probably the most unexploited, of any method under study. Aluminum can absorb 15,000 ft./lb. per lb. energy for each 100F it is heated, and can feasibly be heated 200F by frictional means.

Other energy absorbers included in the survey are balsa wood, with a capability to absorb 9,000 to 24,000 ft./lb. per lb., depending on the orientation of the wood grain; fabric bags, 1,000 to 6,000; metal fabrics, 8,000 to 11,400; plastics, 8,000; paper honeycomb, 700 to 2,300, and foamed plastics, up to 4,500.

Retrorocket energy absorption depends upon velocity of the vehicle just before deceleration. The higher the velocity, the more efficient the rocket.

Other Considerations

Energy-absorption properties, however, are only one of the many considerations the designer must incorporate into the landing system, the survey said. Among other major considerations are maximum deceleration and onset-rate, weight and reliability, stability, lunar and planetary landing surface and atmosphere and soft-landing limitations.

If the vehicle is manned and has been through a prolonged weightless mission, maximum deceleration should be 4 to 8G, according to the survey. This limit could be raised to 35G if the zero gravity period has not been prolonged.

Onset-rate for man should be kept in the 1,500G/sec. rate, but this load may be much greater than a delicate instrument such as an inertial guidance system can survive.

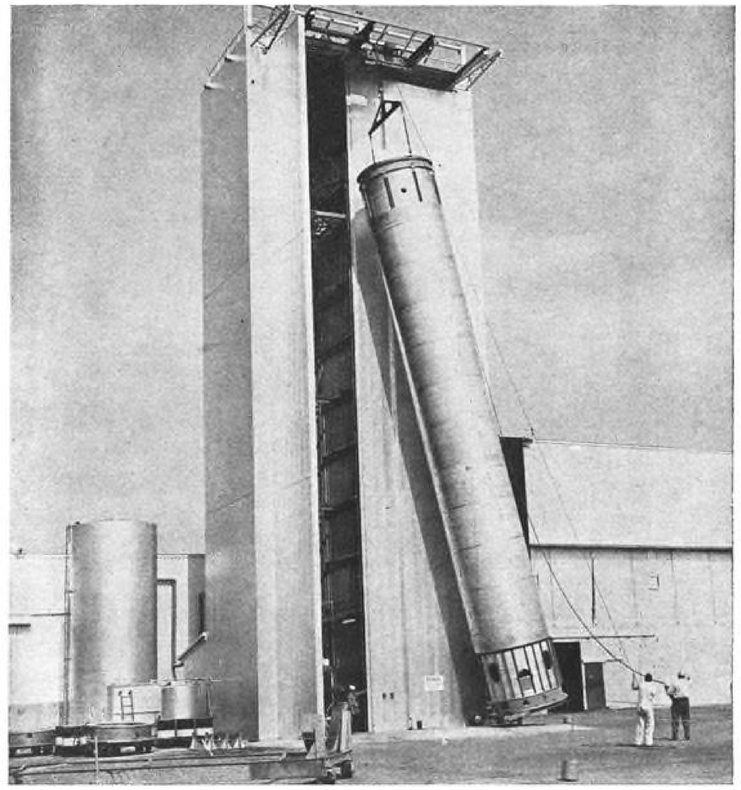
Europe Launch Group Selecting Officers

London—Renzo Carrobio di Carrobio, an Italian diplomat, has been offered the post of secretary-general of the European Launcher Development Organization (ELDO) when it comes into formal existence upon ratification of a convention by seven participating nations (AW July 25, p. 31).

The ELDO preparatory group, now meeting in Paris, also has offered the post of technical director to W. H. Stephens, director-general of ballistic missiles for the British Ministry of Aviation, and that of administrative director to H. Costa, a senior civil servant of the Federal Republic of Germany.

Appointments will be subject to confirmation by the member nations. Di Carrobio has ambassador rank and now holds a senior post in the Italian ministry of foreign affairs at Rome.

Earlier, France announced plans to use its home-developed solid-propellant intermediate-range ballistic missile now under development to place a satellite in orbit by 1965. Satellite and launch will be a purely national affair and will not come under ELDO auspices, although France continues as a member of the ELDO group and will furnish the second stage that will be used in the joint effort.



Vought Delivers Saturn Tank

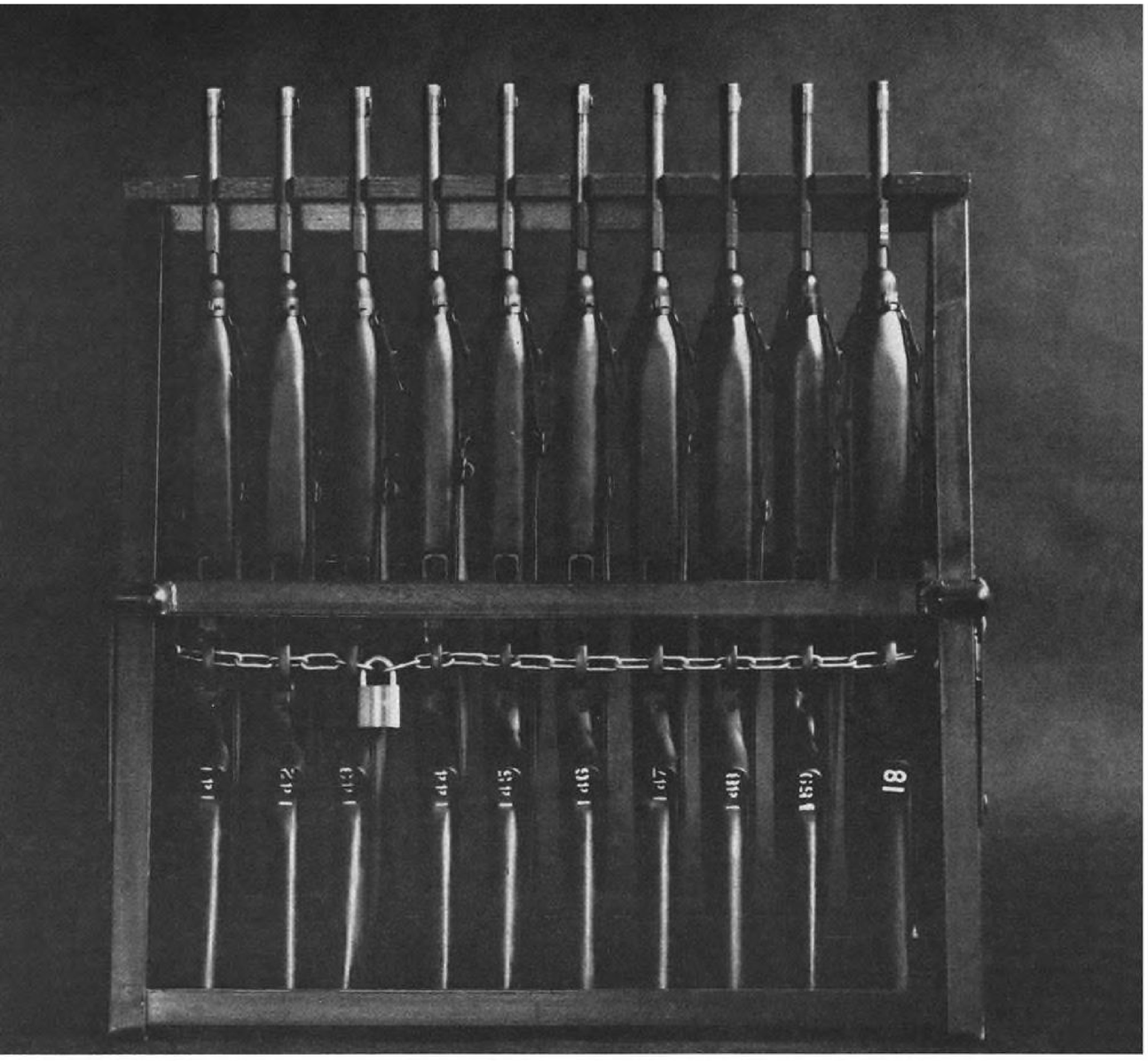
105-in.-dia., 62-ft.-long liquid oxygen container built by Ling-Temco-Vought's Astronautics Division, Dallas, Tex., for S-1 stage of Saturn C-1 is removed from hydrostatic test tower at the plant prior to shipment to National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Ala. The company is building six of the 105-in. LOX containers and 42 70-in.-dia. LOX and RP-1 tanks for Saturn C-1's first-stage (AW May 21, p. 54) under contracts totaling more than $5.5 million. S-1 tankage consists of four 70-in. LOX tanks and four 70-in. RP-1 tanks, each with a capacity of approximately 10,000 gal., clustered about a 105-in. tank with 25,000-gal. capacity. Tanks are shipped in special steel and aluminum containers equipped with air springs to hold tanks at four lift points and protect them against shocks of up to 5g in any direction.

Two-Nozzle Rocket Aids Ablation Studies

Midget rocket motor which fires from both ends simultaneously is being used by United Technology Corp.'s Development Laboratory, Sunnyvale, Calif., to analyze ablative effects on conventional and tubular rocket nozzles.

Conventional and tubular nozzles containing materials with high ablation rates are fitted to opposing heads of the rocket motor, nicknamed Janus. The motor provides identical conditions of chamber pressure and internal ballistics because it has a single common combustion chamber for its two nozzles.

Materials with high ablation rates are used during short-duration firings to provide accurate measurements of any differences in the ablating rates of the two nozzles.



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Industry Welcomes Depreciation Policy

Washington—Aerospace manufacturers are welcoming the Administration's new program for accelerated depreciation write-offs as a long-needed initial step, but believe it will have only a mild effect on spurring plant and equipment modernization in the industry.

The impact is expected to vary rather widely from company to company.

Airline executives expect little, if any, effect on their industry. But in principle, they applaud the Administration's move offering tax incentives for speedier replacement.

The new program (AW July 16, p. 30), effective as of July 12, establishes an eight-year norm for the equipment life of aerospace manufacturers. The total cost of equipment can be deducted on tax returns within eight years.

A firm can claim this norm—without question by Internal Revenue Service—for a period of three years. At the end of the three-year period, IRS will determine if another provision of the new program has been deserved: the company must also have an eight-year replacement cycle.

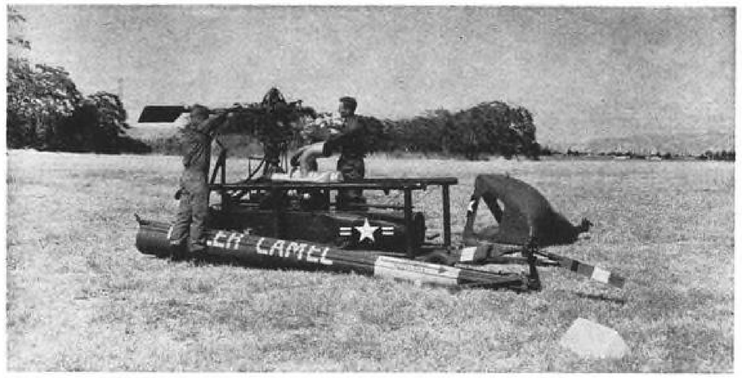
In the past, IRS has established varying lifetimes for different types of equipment, based on outmoded historical performance. These varied not only between types of equipment, but from company to company for the same general type of equipment. Treasury Department says the industry's depreciation span has averaged out at 10 years.

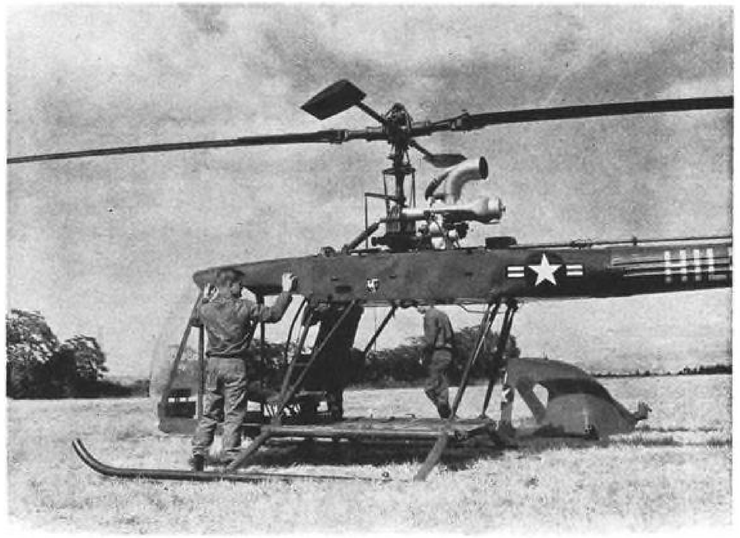
There is no compulsion to adhere to the new eight-year norm. Aerospace Industries Assn. anticipated that companies that already have established shorter depreciation spans with IRS will continue them. AIA also said that some companies, unable at the end of three years to meet the requirement for an eight-year replacement cycle, may want to continue the longer depreciation spans they have established with IRS.

For airlines, the new program will accelerate the possible depreciation deduction by an average 19% and, as pointed out by Treasury Department, make possible a $20 million a year saving in taxes for the air industry.

Airline executives apparently agree that the industry is not in a financial position to take advantage of this possible saving. It would mean that at the end of the three-year period, they would have to be on a six-year cycle of aircraft and aircraft equipment replacement—the norm set for the industry under the new program. The depreciation span for new jets now runs up to 12 years.

Airlines in a poor earning position are



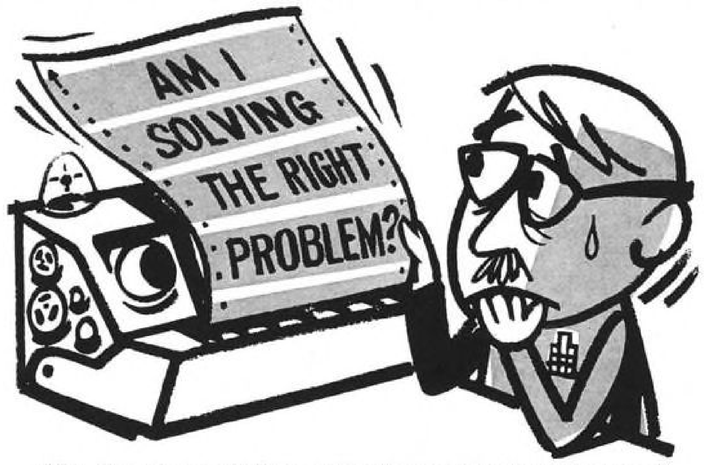




Hiller Camel Mockup Assembled

Mockup of Hiller Aircraft Corp.'s Camel, battlefield assembly helicopter, forms compact package which can be paradropped or carried on small truck. Two-man crew begins assembly, which can take as little as 12 min., by folding out rotor blades. Tail boom is then attached and used as lever, with folded-down cargo platform as fulcrum, to jack up main section. Landing skids are folded down and locked in place. Cockpit canopy and side panels are attached and helicopter is ready for flight. Powered by 500 shp. PT6 Pratt & Whitney gas turbine, Camel carries six combat equipped troops or a 1,000 lb. payload. Range is 300 naut. mi. at about 100 kt. Developed as a company project, Camel flying model is currently undergoing evaluation by the Army.

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also expected to be inclined to forego tax benefits in order to make a more favorable public presentation.

For example, if a company with a gross income of $100,000 deducts $20,000 for depreciation and $30,000 for other expenses, it shows a net income before taxes of $50,000 and a net income after taxes of $26,000. If the company were to deduct $30,000 for depreciation, it would show a net income before taxes of only $40,000 and a net income after taxes of only $20,800.

F. L. Frain, vice president and treasurer of Lockheed Aircraft Corp., expressed general aerospace industry reaction to the new depreciation program:

"It is generally a step in the right direction. It is primarily important because it acknowledges at long last that depreciation practices have been thoroughly inadequate—giving no consideration to the increasing cost of equipment or to technological advances requiring new equipment."

Frain said that further incentives for equipment replacement in the aerospace industry are urgently needed—although there appears to be no general panacea. He said that in the past Lockheed and other companies had been forced to invest in modernization without the new tax benefits to meet competition and military requirements.

The Administration also looks on the new depreciation program as only a first step in stimulating industrial modernization to accelerate the country's economic growth and to meet foreign competition.

The next step in the Administration's program is a 7% tax credit for investment outlays. This has been approved by the House and the Senate Finance Committee. It is included in the Administration's over-all tax revision bill. Enactment of the measure is in some doubt because of other controversial features.

In announcing the accelerated depreciation program, Secretary of the Treasury Douglas Dillon observed that "it reflects an administrative policy dedicated to a continuing review and updating of depreciation standards and procedures to keep abreast of changing conditions and circumstances." Dillon acknowledged that "our depreciation practices have not been realistic for a great many years. Based essentially on taxpayers' past replacement practices, they have inadequately reflected the fast-moving pace of economic and technological change."

Even with the new depreciation program, Dillon reported, the tax incentives for U. S. firms to invest will still be "far short of equality" with the incentives offered by Japan and European governments. He emphasized that the additional 7% credit is needed to place U. S. firms in a favorable position.

GAO Urges Tighter Engine Supply Control

Washington—General Accounting Office has recommended that the Defense Department establish a central office to manage the supply of aircraft engines to avoid the type of waste it says it uncovered in examining Air Force and Navy procurement of spare parts.

A GAO report filed with Congress said the Air Force and Navy spent $2 million for aircraft engine parts which could have been obtained by disassembling excess engines already on hand. Nearly $4 million still could be saved if the two services canceled plans for additional orders and took the parts from engines.

Paul H. Riley, deputy assistant secretary of defense for supply and services, told GAO that Defense would try to remedy the deficiencies cited by the agency and also would strive for "uniform controls and procedures to ensure optimum interservice utilization of available assets."

GAO's review of spare part procurement was made between Dec. 1, 1960, and Aug. 1, 1961. The agency, in citing one instance of waste, said the Air Force and Navy from January, 1959, to February, 1961, spent $1,236,000 for parts which could have been obtained by disassembling excess Allison J33-A-20 engines held by the Navy. Other waste stemmed from similar lack of coordination between the Air Force and Navy, GAO said.

PRODUCTION BRIEFING

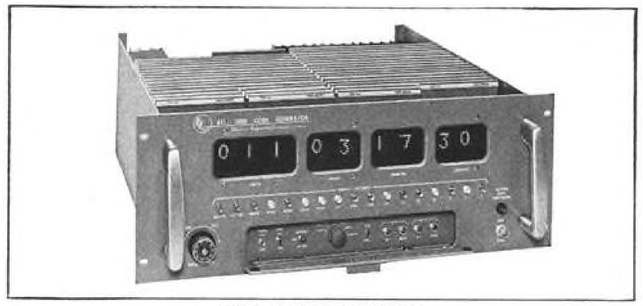
Boeing Co.'s Vertol Division, Morton, Pa., has received a $1,710,787 Air Force contract to conduct a test program aimed at extending the time between overhauls of dynamic components on its HC-1B Chinook helicopter, being purchased by the Army through the Air Force's Aeronautical Systems Division.

Aviation Traders, Ltd., London, has sold two Carvair ATL-98 car-passenger ferries to Interocean Airways of Luxembourg. The airplanes, Douglas DC-4 conversions (AW Apr. 9, p. 45), are the first sold outside of Great Britain. They are freight-only configurations and will be used in the Congolese Republic on United Nations work.

Northrop Corp.'s Ventura, Calif., Division has received a $3,426,480 Army contract to continue responsibility for air launch, flight control and tracking, and maintenance and repair of RP-76 rocket-powered targets used

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by Army Air Defense Command in practice firing of Nike Ajax and Hercules missiles at McGregor Range, Ft. Bliss, Tex.

General Dynamics Corp.'s Pomona Division has received a $21,202,343 Army contract to continue research and development of the Mauler anti-air defense missile.

Avco Corp., Wilmington, Mass., has received a $505,637 National Aeronautics and Space Administration contract for further development of an advanced design 30-kilowatt arc jet engine, for use on deep space probes.

A. M. Kinney, Inc., Cincinnati, Ohio, under $113,000 contract, will design a high-pressure water system for cooling the Saturn C-5 static test stand now under construction at National Aeronautics and Space Administration's Marshall Space Flight Center.

General Dynamics Corp. has received a $204,000 National Aeronautics and Space Administration contract to expand its study on the effects of nuclear radiation and cryogenic temperatures on materials to be used in nuclear-powered space vehicles.

Maurice H. Connell and Associates, Inc., Miami, Fla., has been awarded a $110,000 contract to design a dynamic test tower for the Saturn C-5 lunar vehicle at National Aeronautics and Space Administration's Marshall Space Flight Center.

Quantic Industries' Pelmec Division, San Carlos, Calif., has received a $260,000 contract from Thiokol Chemical Corp. for production of standardized safe-arm igniter mechanisms for engine ignition on all three stages of the Minuteman missile.

Systron-Donner Corp., Concord, Calif., has been awarded a $142,800 contract by Thiokol Chemical Corp. to build an automatic data system to be used in the environmental test program of the first stage of Air Force's Minuteman ICBM at Thiokol's Brigham City, Utah, test facility.

Electronic Associates, Inc., Long Branch, N. J., has been awarded a $679,000 Air Force contract to build an analog computer system which will be used to train X-20 (formerly Dyna-Soar) pilots at Edwards AFB.

H. L. Eskew and Sons, Birmingham, Ala., will construct a support building, under a $47,300 contract, for National Aeronautics and Space Administration's C-1 dynamic test facilities at the Marshall Space Flight Center.

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*United States Patent No. 2931532. Qualifies under NAS Specification 1400 and meets Standard Pages NAS 1398 and 1399. For technical data on the Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

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Cuban Spray Plane Pilots Seek Asylum

Three employes of Fidel Castro's National Agrarian Reform Institute recently flew this Russian An-2 single-engine biplane, used as a spraying aircraft, to Miami and requested political asylum. The An-2 was loaded with insecticide.

USAF Contracts

Air Force Office of Scientific Research recently awarded 48 grants and contracts valued at more than $2.9 million to universities and non-profit and industrial research laboratories. The awards included the following:

Massachusetts Institute of Technology, Cambridge, Mass.—$75,025 for study of high speed viscous and reacting flows; $75,720 for research on aerothermoelasticity; $30,000 for research in numerical analysis.

Purdue Research Foundation, Lafayette, Ind.—$100,600 for parametric study of rocket instability.

American Society of Mechanical Engineers, New York, N. Y.—$10,000 for applied mechanics reviews.

Stanford University, Stanford, Calif.—$32,620 for research on learning theory for response continua; $94,562 for study of natural and man-made VLF phenomena; $140,200 for radio astronomy research; $99,500 for study of interaction of microwaves with matter.

National Academy of Sciences, Washington, D. C.—$15,000 for Twenty-second International Congress of Physiological Sciences.

Princeton University, Princeton, N. J.—$26,632 for study of physiological stress in relation to innate daily rhythms; $62,588 for study of fundamental concepts of theoretical physics.

Sao Paulo University, Ribeirao Preto, Brazil—$12,000 for research on role of various brain structures on physiological function; $25,000 for research on deuteron and proton reactions at 3.5 mev.

Unidad de Investigacions Cerebrales, Mexico City, Mexico—$10,500 for study of sleep-inducing mechanisms.

Universidad Catolica de Chile, Santiago, Chile—$23,257 for studies on synaptic mechanisms; $10,000 for research on peptide neurohumors in the brain.

University of Chile, Santiago, Chile—$12,280 for study of role of cerebral cortex in conditioned reflexes.

University of California, Berkeley, Calif.—$4,560 for conference on verbal learning and verbal behavior; $71,084 for study of cosmic ray variations at high altitudes in polar regions; $31,128 for research on characteristic behaviors of leaders and non-leaders under conditions of group support and non-support.

Boston University, Boston, Mass.—$6,492 for study of nonparametric statistics.

Carnegie Institute of Technology, Pittsburgh, Pa.—$58,763 for research on conformal and variational methods.

Instituto de Matematica Pure e Aplicada, Rio de Janeiro, Brazil—$10,150 for research on structural stability and differential topology.

University of North Carolina, Chapel Hill, N. C.—$11,637 for research on non-parametric analysis of variance.

Washington University, St. Louis, Mo.—$31,585 for research on problems in mathematical analysis; $70,000 for research in theoretical physics; $40,000 for study of composition and time variations of primary cosmic radiation; $190,000 for experimental nuclear physics research; $96,562 for research on the application of magnetic resonance to solid state physics.

Pomona College, Claremont, Calif.—$50,410 for study of physics and application of low energy X-rays and beta rays in the 100 to 1,000 v. range.

University of Oklahoma, Norman, Oklahoma—$88,584 for study of atomic transition probabilities.

University of Puerto Rico, Mayaguez, Puerto Rico—$12,834 for sporadic E investigation by scatter sounding techniques.

University of Washington, Seattle, Wash.—$87,000 for research in cryogenic physics.

California Institute of Technology, Pasadena, Calif.—$95,124 for research in geophysics.

Colorado School of Mines Research Foundation, Golden, Colo.—$22,128 for studies in lunar topography, petrology and minerology.

Syracuse University, Syracuse, N. Y.—$69,196 for theoretical studies of quantum field theory and elementary particles.

Universidad Mayor de San Andres, La Paz, Bolivia—$25,900 for studies of cosmic ray variations and asymmetries.

University of California, Los Angeles, Calif.—$42,890 for theoretical study of nuclear structure, nuclear models and elementary particle interactions.

University of Chicago, Chicago, Ill.—$89,978 for nuclear emulsion studies of the properties of hypernuclei.

University of Illinois, Urbana, Ill.—$112,920 for study of dislocations in solids.

Pennsylvania State University, University Park, Pa.—$353,945 for preparation, physical measurements and collation of properties and structures of crystals.

University of Colorado, Boulder, Colo.—$100,695 for study of magnetic interaction of electrons and nuclei in solids.

Wayne State University, Detroit, Mich.—$74,720 for research on ultrasonic attenuation in metals near absolute zero.

Giannini Scientific Corp., Santa Ana, Calif.—$66,008 for study of electrothermally accelerated plasmas.



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ARTHUR A. NICHOLS

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► **Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven.**

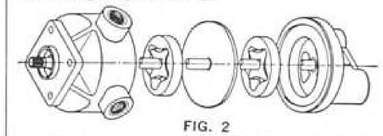


FIG. 1

The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See Figure 1).

► The designer thus has the advantage of several variables to secure a given capacity within his space limitations: *Gerotor diameter*—which governs the area of the pumping chamber—*Gerotor thickness* which, taken with area, determines chamber volume — *Gerotor RPM*, since this is a positive displacement pump. Thus, it is possible to vary the diameter, the length and the speed of the pump within certain overall limits to secure the wanted capacity.

► **Unlike conventional gear pumps the Gerotor needs only a *single shaft* — both elements are substantially concentric to it. These are mated to provide continuous, fluid-tight engagement without the crescent structure necessary in other internal gear pumps. Further, Gerotor elements can be stacked along a single shaft and mounted on a single AN pad to perform multiple pump functions: lube, scavenge, boost, etc. (See Figure 2). Such compactness allows the pump to be "submerged" in a gear box or sump and frequently the sump may be part of the pump housing.**


FIG. 2

► *Technical data is available and your inquiry is invited. Write:*

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SIMMERING-GRAZ-PAUKER M.222 Flamingo third prototype, in foreground, shows contrast to second prototype in rear.

Austrians Aim for German Twin Market

By Edith Walford

Vienna—Simmering-Graz-Pauker A. G. (SGP) is going into series production on its fourth version of the twin-engine, four-passenger M.222 Flamingo. First production model of the aircraft is soon scheduled to begin flight tests.

Designed primarily for the business and sport flying market, the production model was evolved through the previous manufacture and flight test of three prototype versions. Confident that its final design will be granted Federal Aviation Agency certification, the company plans to build a first production series of 25 to 30 aircraft by the end of next spring, although, if required, its workshops could handle twice as many.

Market Forecast

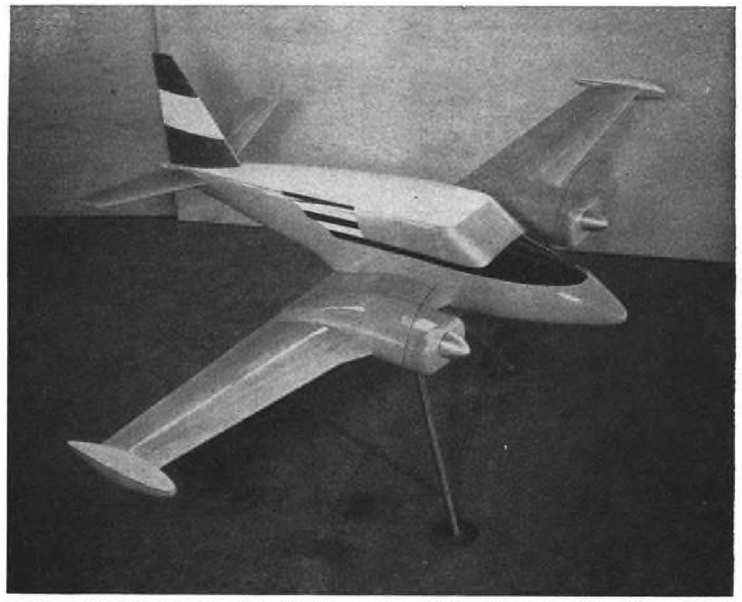
The company says it expects West Germany to become its best initial European market area. Inquiries for the M.222 have been received from potential West German buyers, particularly during and following demonstration of the second and third prototype models at the Hanover air show this spring (AW May 14, p. 56).

Firm sales price for the production model of the Flamingo has yet to be determined, but the company says it should ultimately work out to between $32,945 and $36,821, with full blind flying instrumentation as an optional extra.

Like the previous three prototypes, the M.222 production version is still basically of composite wood-metal-plastic construction, but the firm is now using increasing amounts of steel and polyester fiber skin produced in its own new plastics factory. For example, wings and tail unit are made of wood, whereas the steel-tube fuselage has polyester fiber replacing the aluminum-alloy covering on the three previous models. The former plastic canopy roof is now steel as is the connecting fixture for the wing-tip tanks.

Fuel load has been increased to 100 gal. from 68.6 gal., primarily through installation of a tank in each mid-wing section. Tip tanks, however, are slightly smaller than those used on earlier prototypes.

To improve aerodynamic characteristics of the aircraft, the vertical fin has been squared off at the tip, and an earlier fairing into the fuselage has been eliminated. Horizontal stabilizer has dihedral and the rounded fuselage of earlier prototype models has been converted to a box construction.



WIND TUNNEL MODEL of production version of the Simmering-Graz-Pauker M.222 Flamingo, to 1/6 scale, shows changes from prototypes. Company plans to build an initial batch of 25-30, first of which is due to fly soon.

The production version can be powered at the customer's option by either two 180-hp. Lycoming IO-360-B1A or 200-hp. Lycoming IO-360-A1A fuel injection engines, although SGP thus far has received only provisional official approval to install the 200-hp. powerplant.

M.222 Performance

Maximum speed at sea level with the 200-hp. powerplants will be 205 mph. as compared with 186 mph. for the 150-hp. third prototype; cruise speed with 75% power increases to 184 mph. from 168 mph., whereas cruise ceiling of the production version is 20,000 ft. as opposed to 21,000 ft. for the third prototype. Landing speed is 65 mph. compared with 69.5 mph. of the third prototype.

Gross weight on the production model has been increased from 3,850 lb. of the third prototype to 4,180 lb., while payload is up from 1,320 lb. to 1,430 lb. and empty weight from 2,530 lb. to 2,750 lb.

Corresponding increases in dimensions include a 39-ft. span from 36 ft. and a length of 29 ft. from 28.5 ft. While the third prototype has an over-all height of 10.4 ft. with landing gear extended, the production version will stand only 10 ft. above the ground.

First prototype M.222, powered by two 140-hp. Lycoming engines and fitted with variable-pitch propellers made by Germany's Hoffmann & Co., was developed and built in slightly over one year, flying for the first time in May, 1959. It was lost in August of the same year when it crashed after a series of flight maneuvers.

Findings in the subsequent official accident investigation concluded that the crash was not due to any structural weakness, and the company accelerated construction of an identical second prototype (AW Nov. 30, 1959, p. 89), which was completed toward the end of 1959.

Third prototype has two 150-hp. O-320-A Lycoming engines and features U. S.-built Hartzell constant-speed propellers as well as a door on either side of the cabin, in place of the sliding plastic roof canopy and variable-pitch Hoffmann propellers of the first two prototypes.

Employes of Simmering-Graz-Pauker's aircraft division at Vienna-Neustadt total about 50. The plant has its own airfield plus one 984 ft. x 1,312 ft. hangar, and there is ample room still available for further expansion if needed, the company says.

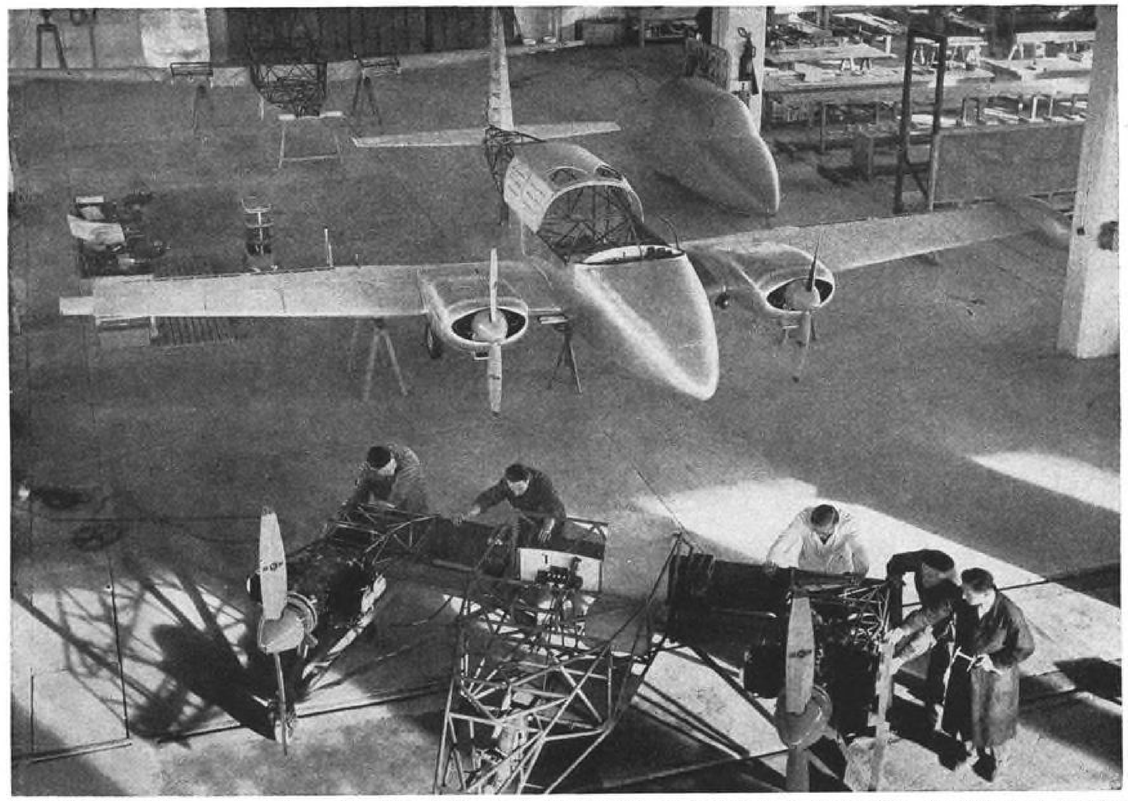
Aircraft development and production is, however, a relatively small and recent branch of the firm's activities. Its initial venture began with the development of the first M.222 prototype late in the 1950s.

Vienna Offices

Established about 125 years ago, the firm first became known for the manufacture and export of locomotives and a wide variety of diesel-powered vehicles. Over the years, cables, cable cars, conveyor belts, steam boilers, cranes and, more recently, plastics have been added to its production program.

Head administrative offices are located in Vienna together with three of its five factories, in addition to one in Graz and the Vienna-Neustadt aircraft plant.

SGP's total labor force is about 10,000, but, with the upswing in all branches of industry in Austria in recent years, particularly in the building industry, the company's technical director, Karl Zach, says the general manpower shortage is having its affect on SGP's activities and lack of skilled labor continues to present a major problem.



FRAMEWORK of the second prototype of the SGP M.222 shows combination wood-metal-plastic construction. Increasing use is being made of steel and polyester fiber skin in the production version to reinforce the structure. In foreground is an engine test rig.



Second Potez 840 Modified Before U.S. Tour

Second Potez 840 executive turboprop, being readied for a fall demonstration tour in the U. S., is being flown in France with an extended nose housing a Collins weather radar installation as well as providing extra baggage room. A window has been added on each side of the cockpit to comply with Federal Aviation Agency regulations.







Gross weight of the Potez 840 has been increased to 18,700 lb. Auxiliary power unit access point has been shifted forward and the intake vent for avionic equipment cooling has been installed on the starboard nose section. The 840 will be produced in Ireland with the first units scheduled to roll out in early 1964 (AW Feb. 5, p. 69).



INTERNATIONAL AIR TRANSPORTATION ISSUE SEPTEMBER 10, 1962

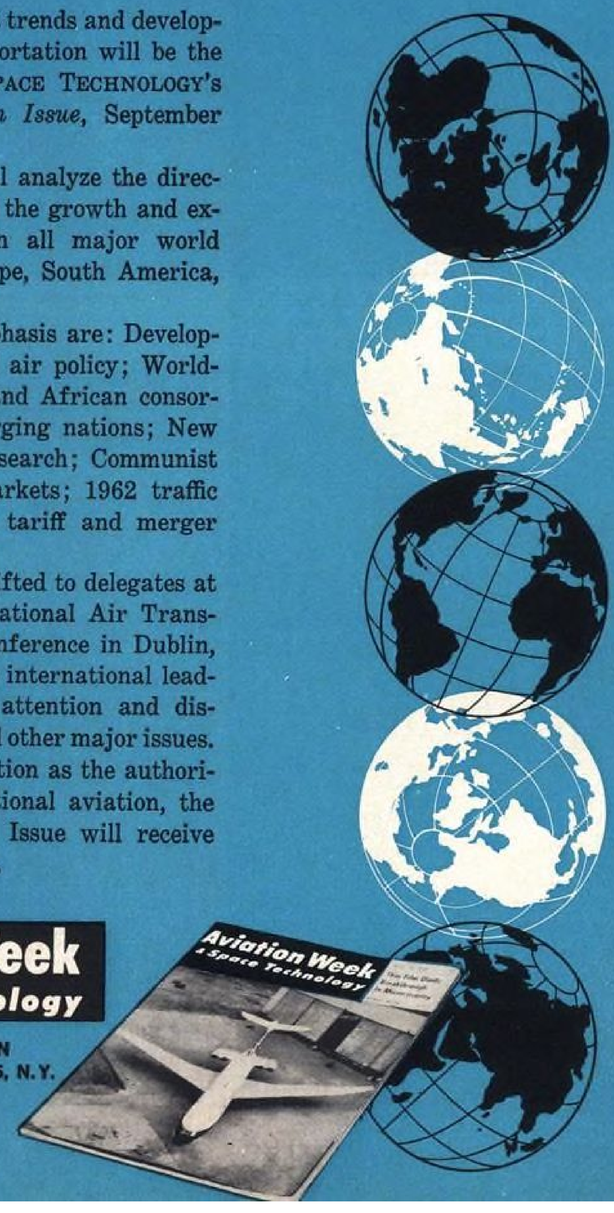
The impact and challenge of recent trends and developments in international air transportation will be the subject of AVIATION WEEK & SPACE TECHNOLOGY's *International Air Transportation Issue*, September 10, 1962.

This major editorial effort will analyze the direction and problems associated with the growth and expansion of air transportation in all major world markets including Atlantic, Europe, South America, Africa and Asia.

Subjects slated for special emphasis are: Development of a new U.S. international air policy; Worldwide impact of common market and African consortiums; New flag carriers of emerging nations; New trends in supersonic transport research; Communist bloc penetration in world air markets; 1962 traffic trends; and future international tariff and merger problems.

Copies of this issue will be airlifted to delegates at the opening session of the International Air Transportation Association (IATA) Conference in Dublin, Ireland. Here will be gathered the international leaders of air transportation whose attention and discussions will be focused on these and other major issues.

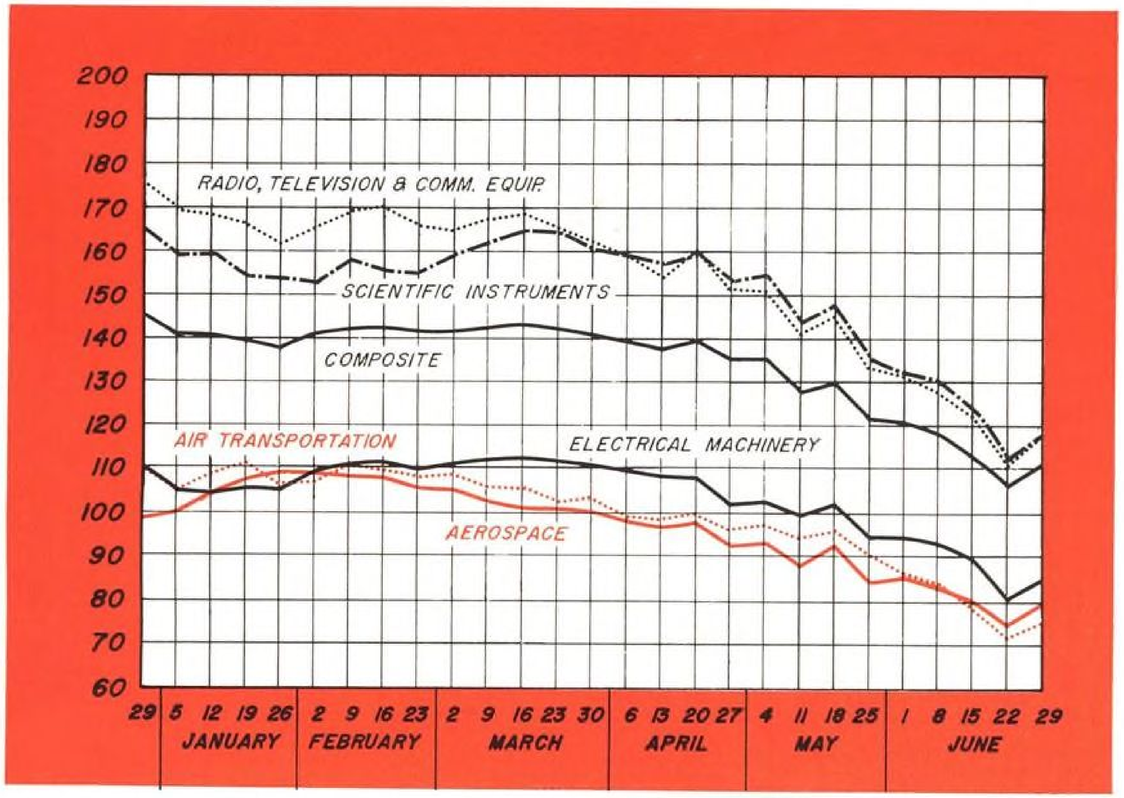
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Aerospace Common Stock Performance



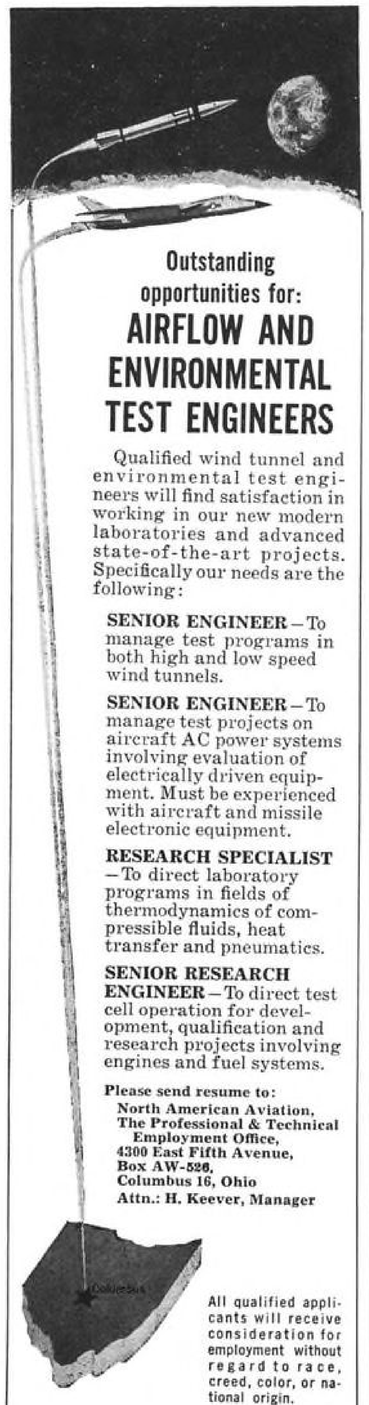
Performance of common stocks of aerospace companies and airlines on the New York Stock Exchange during the first six months of 1962 shows that both groups had begun a gradual slide two months before the major market break in May. The chart is based on the Securities and Exchange Commission's index of weekly closing prices of stocks on the exchange, and 1957-59 stock averages are equivalent to 100. Aerospace industry stocks are compared with those of companies in the electrical machinery, communications and instrumentation fields—which includes companies with business in the defense area and in commercial fields as well—and with the average for all stocks. Decline in the instrumentation and communications groups including many of the so-called "glamour" or growth stocks, whose prices rose steeply more on the basis of projections rather than current business, showed a relatively steeper decline.

New Offerings

The Foxboro Co., Foxboro, Mass., engaged in the manufacture of industrial instruments for indicating, recording and controlling temperature, pressure, flow, humidity, liquid level and other process variables. Offering is $12,209,000 for convertible subordinated debentures, due 1982, for subscription by common stockholders at the rate of $100 of debentures for each 20 shares held. Of the proceeds, $1,000,000 will be used to construct and equip a new research and development building at Foxboro; $400,000 to construct new facilities for warehousing, servicing and sales support for products at branch locations; $1,400,000 to expand the plant facilities of the company's British and Dutch subsidiaries; $150,000 to construct and equip a plant for its new French subsidiary, and $2,000,000 will be used to repay short-term bank loans.

Mechmetal-Tronics, Inc., Rochelle Park, N. J., engaged in the design and manufacture of miniature metal bellows and other miniaturized products utilizing "Mech-metal," a high nickel alloy produced by a metallurgical process of the company. Offering is 150,000 shares of 8% convertible cumulative preferred stock at $3 per share. Mechmetal was invented by Victor Hamren who formed Mechtronics Corp. in 1957 for the purpose of developing and fabricating the product; he was subsequently joined by Philip Horrigan. In 1958 the company contracted to purchase the invention for $1,225,000 and, for an additional $18,000, all of the stock of Mechtronics Corp., which became the company's manufacturing subsidiary. Of the proceeds, $113,000 will be used to complete payment of the purchase price of the invention; $100,000 for research and development; the balance of the proceeds will be used to pay a bank loan.

Schlumberger Limited, Houston, Tex., which, in addition to its electrical logging and related services, is engaged in the manufacture of electronic and electro-mechanical equipment, components and systems. (The company recently acquired Daystrom, Inc.) Offering is 700,000 outstanding common shares by the present holders.



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Airlines File Officers' Salaries, Bonuses and Expenses With CAB

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, 1961, as reported to the CAB:

Pan American-Grace Airways, Inc.—A. B. Shea, president, $3,004 expenses; **E. Balluder**, vice president; **E. Farrell**, vice president; **D. Campbell**, vice president and general manager, $27,400 salary, $5,000 bonus and indirect compensation, $8,432 expenses; **T. J. Kirkland**, vice president, $27,400 salary, $4,500 bonus and indirect compensation, $2,928 expenses; **L. H. Clifton**, vice president and comptroller, $26,250 salary, $1,112 expenses; **A. J. Phelan**, vice president and comptroller, $16,500 salary, $1,500 bonus and indirect compensation, $3,145 expenses; **C. S. Collins**, vice president, $20,000 salary, $2,000 bonus and indirect compensation, $3,521 expenses; **J. T. Scholtz**, asst. vice president, $19,500 salary, $900 bonus and indirect compensation, $1,047 expenses; **R. de Murias**, asst. vice president, $15,350 salary, $750 bonus and indirect compensation, $2,165 expenses; **R. V. Rowe**, asst. vice president, $1,964 expenses; **G. M. Oxley**, secretary, (held office through June 5, 1961.); **J. S. Woodbridge**, treasurer; **J. Macy**, asst. secretary; **W. F. Lewis**, asst. treasurer, $14,500 salary, $516 expenses; **E. E. Spencer**, asst. treasurer, $13,200 salary, $7,813 expenses; **W. A. Morris**, secretary; **W. L. Morrison**, director; **E. E. Larkin**, director; **R. Lewis**, director; **K. A. Lawder**, director; **J. C. Pirie**, director.

The following firms received $5,000 or more for services rendered during 1961: **Covington & Burling**, legal services, $14,379; **S. Kip Farrington**, sales promotion, $21,549; **Price Waterhouse & Co.**, accounting services, $3,000; **Reid & Priest**, legal services, (from Dec. 22, 1960 to Dec. 20, 1961) $10,073.

Flying Tiger Line, Inc.—S. B. Mosher, chairman of the board, $300 salary, 30,607 shares of common stock, 818 shares of preferred stock; **R. W. Prescott**, president and director, $60,000 salary, $17,724 expenses, 3,062 shares of common stock; **A. T. Chase**, director, $300 salary, 1,000 shares of common stock; **H. Rehrig**, director, $300 salary, 115 shares of common stock; **N. L. Meyers**, director and assistant secretary, $300 salary, 54 shares of common stock, eight shares of preferred stock, $200,000 debentures; **J. C. Cosgrove**, director, $300 salary, 1,078 shares of common stock; **A. G. Linkletter**, director, $300 salary; **C. Luckman**, director, $200 salary, 1,102 shares of common stock; **J. C. Tyler**, director, $300 salary, 1,130 shares of common stock; **R. Axe**, director, $300 salary, $668 expenses, 1,000 shares of common stock; **B. Gresov**, director, $200 salary, $630 expenses, 26 shares of common stock in the name of others, $50,000 debentures; **F. Benninger**, executive vice president, treasurer and director, $35,000 salary, $9,162 expenses, 3,000 shares of common stock; **F. B. Lynott**, executive vice president, $32,000 salary, $3,415 expenses; **W. E. Bartling**, vice president, $20,400 salary, $3,226 expenses, 1,405 shares of common stock; **G. T. Cussen**, vice president, $14,000 salary, $4,734 expenses, 600 shares of common stock; **L. S. Kimball**, vice president, $14,400 salary, $9,129 expenses; **J. L. Higgins**, vice president, $25,000 salary, $7,147 expenses, 600 shares of common stock; **G. S. Oberdorf**, vice president, $18,000 salary, $479 expenses, 500 shares of common stock; **R. B. Stump**, assistant secretary, $15,050 salary.

The following firms were paid $5,000 or more for services rendered during 1961: **Arthur Andersen & Co.**, accounting, $24,515; **Blum, Jolles, Halmoff, Szabad & Gersen**, legal services, $16,337; **S. Brewer**, professional and technical services, $17,209; **Hixson & Jorgensen**, advertising, $34,955; **Myers & Bratzell**, legal, $123,346; **Signal Gas & Oil Co.**, promotion, $40,584; **Chase Manhattan Bank**, corporate services, $27,044.

Seaboard World Airlines, Inc.—R. M. Jackson, president, $33,600 salary, 4,540 shares of common stock; **J. J. Mahoney**, senior vice president-sales, $27,000 salary, $13,699 expenses, 102 shares of common stock in the name of others; **S. I. Fondiler**, senior vice president-finance, $23,333 salary, $996 expenses; **W. P. Neth**, vice president and secretary, $20,062 salary, $6,543 expenses, 1,800 shares of common stock in the name of others; **R. A. Fitzgerald**, vice president (since Sept. 1, 1961), $6,667 salary, $219 expenses; **C. D. Brell**, senior vice president-operations, $23,333 salary, $1,674 expenses. The following firms were paid $5,000 or more for services rendered during 1961: **Joel Fischer**, legal services, $27,479; **Cahill, Gordon, Reindel**, legal, $31,780; **Cahill, Gordon, Reindel**, refinancing services, $43,584; **Miller Assoc.**, legal services, $5,637; **Arthur Young & Co.**, auditing fee (1960), $15,000; **Arthur Young**, refinancing, $17,500; **Dixon Speas**, aviation consultants, $17,823.

Slick Airlines, Inc.—E. P. Slick, chairman of the board, $732 expenses, 164,983 shares of common stock, $1,367,000 debentures; **T. B. Slick**, director, $852 exepnses, 84,543 shares of common stock; **L. J. Moorman, Jr.**, director, $139 expenses, one share of common stock; **C. F. Urshel, Jr.**, director, $409 expenses, 8,501 shares of common stock; **D. E. Bright**, director, $1,041 expenses, 20,170 shares of common stock; **S. R. Milbank**, director, $284 bonus and indirect compensation, 200 shares of common stock, $25,000 debentures; **J. E. Parker**, director, $19,002 salary, $5,243 expenses, 10,750 shares of common stock, $50,000 debentures; **W. E. Miller**, secretary and director, $213 expenses, 5,000 shares of common stock; **A. L. Butler, Jr.**, director, $73 expenses 300 shares of common stock; **D. A. Edwards**, vice president-finance and director (since Aug. 16, 1961), $13,367 salary, $561 expenses, 10,000 shares of common stock, $50,000 debentures; **J. A. Frates**, director, 250 shares of common stock; $15,000 debentures; **W. E. Hollan**, director, $411 expenses, two shares of common stock, $5,000 debentures; **H. P. Huff**, executive vice president and director, $26,074 salary, $6,602 expenses, 1,000 shares of common stock, $15,000 debentures; **A. W. Johnson**, president and director, $31,291 salary, $7,413 expenses, 3,500 shares of common stock, $35,000 debentures; **D. W. Rentzel**, director, $15,000 bonus and indirect compensation, 2,450 shares of common stock, $50,000 debentures; **R. G. Woods**, director, one share of common stock, $50,000 debentures; **J. H. Malone**, assistant treasurer, $14,558 salary, $3,354 expenses; **J. E. Gallagher**, vice president, $40,000 salary, $7,048 bonus and indirect compensation, $1,017 expenses.

The following firms were paid $5,000 or more for services rendered during 1961: **McKinsey & Co.**, consultant services, $30,000; **Price Waterhouse & Co.**, auditing services, $74,700; **Harold H. Wein**, consultant, $20,104; **Steptoe & Johnson**, legal services, $127,096; **Gartley & Associates, Inc.**, professional services, $14,758; **Standard Research Institute**, research services, $19,300.

Western Alaska Airlines, Inc.—A. W. Ball, president, $17,500 salary, $3,000 bonus and indirect compensation, $777 expenses, 238 shares of common stock, $3,900 debentures; **J. F. Ball**, assistant secretary, $12,000 salary, $3,000 bonus and indirect compensation, 100 shares of common stock, $2,500 debentures; **M. W. Moran**, vice president, $14,500 salary, $3,000 bonus and indirect compensation, 238 shares of common stock, $2,500 debentures; **R. R. Madson**, director, $13,100 salary, $3,000 bonus and indirect compensation, $536.70 expenses, 10 shares of common stock, $1,650 debentures; **C. Wren**, secretary and treasurer, 100‡ shares of common stock; **F. Wren-Hanson**, director, $619 salary, 100‡ shares of common stock.

The following firms were paid $5,000 or more for services rendered during 1961: **Lear and Scoutt**, legal services, $5,809.03.

Reeve Aleutian Airways, Inc.— R. C. Reeve, president, $16,500 salary, $7,560 expenses, 264 shares of common stock, $53,611.35 debentures $36,000 of which are held by Mr. Reeve as custodian for his three minor children); **R. L. Hanson**, vice president, $12,000 salary, $8,000 bonus and indirect compensation, $585 expenses, 50 shares of common stock; **M. Rutledge**, secretary-comptroller, $12,000 salary, $2,000 bonus and indirect compensation; **J. M. Reeve**, treasurer, $11,000 salary, $972 expenses, 264 shares of common stock, $17,611 debentures; **R. D. Reeve**, director and co-pilot, $5,893 salary, $36 expenses, $12,000 debentures; **J. S. Hellentha**, director, $900 salary. The following firms were paid $5,000 or more for services rendered during 1961: **Alaska Airlines, Inc.**, Link training services, $9,004; **Scott McMahen & Co.**, accounting service, $6,105.

Cordova Airlines, Inc.—M. K. Smith, president, $20,000 salary, $7,358 expenses, 18,050 shares of common stock; **R. R. Borer**, vice president, $200 salary, 200 shares of common stock; **A. L. Martin**, director, $100 salary, 2,500 shares of common stock; **A. C. Swalling**, director, $100 salary, 2,500 shares of common stock.

The following firms were paid $5,000 or more for services rendered during 1961: **O'Grady & Marshall**, legal services, $5,371.

Alaska Airlines, Inc.—J. J. Clark, director, $9,092 salary, $200 bonus and indirect compensation, $1,163 expenses, 1,155 shares of common stock; **D. M. Kendall**, director, $50 bonus and indirect compensation, 11 shares of common stock; **J. G. Larson**, director, $50 bonus and indirect compensation, 21 shares of common stock; **E. J. Rusing**, director, $200 bonus and indirect compensation, $720 expenses, 1,050 shares of common stock; **J. F. Walker**, director, $200 bonus and indirect compensation, $926 expenses, 115 shares of common stock; **R. Maass**, director, $200 bonus and indirect compensation, 105 shares or common stock; **H. W. Margolis**, director, $150 bonus and indirect compensation, 10 shares of common stock; **R. B. Atwood**, director, $100 bonus and indirect compensation, 2,100 shares of common stock; **H. H. Hansen**, director, $100 bonus and indirect compensation, $339 expenses, 1,000 shares of common stock; **C. F. Willis**, president, $56,667 salary, $200 bonus and indirect compensation, $14,960 expenses, 44,315 shares of common stock; **R. W. Gilbert**, vice president, $23,333 salary, $200 bonus and indirect compensation, $7,256 expenses, 1,050 shares of common stock; **C. L. Miller**, vice president, $12,667 salary, $3,000 bonus and indirect compensation, $2,888 expenses; **G. R. Sindt**, vice president, $13,333 salary, $1,133 expenses, 22 shares of common stock; **R. J. Wadsworth**, vice president, $13,333 salary, $4,434 expenses; **L. H. Peterson**, vice president, $13,333 salary, $5,375 expenses, 525 shares of common stock; **M. E. Sharp**, vice president, $6,250 salary, $485 expenses, five shares of common stock; **D. L. Ingells**, treasurer, $12,667 salary, $2,235 expenses, five shares of common stock; **H. W. Bierds**, asst. to president and asst. to sec.-treasurer, $14,000 salary, $528 expenses, 545 shares of common stock; **E. L. Sherman**, assistant vice president, $9,453 salary, $142 expenses; **D. B. Bowman**, assistant secretary, $6,333 salary, $675 expenses; **D. S. Williamson**, assistant secretary, $2,167 salary, $478 expenses.

The following firms were paid $5,000 or more for services rendered during 1961: **Broderick & Coleman**, advertising and publicity, $10,586; **R. T. Lamson**, engineering, $5,199; **Lybrand, Ross Bros. & Montgomery**; auditing services, $14,510; **Pogue & Neal**, legal services $23,674; **E. J. Rohrt**, engineering, $12,751; **Grant Advertising, Inc.**, advertising, $34,265; **Burke & Thomas, Inc.**, advertising, $31,573.

Just Published

Communications Satellites

June 1962, 202 pp., $7.00

This book contains articles by scientists who are actively engaged in satellite research with Bell Telephone Laboratories, Space Technology Laboratories, General Electric Missile and Space Vehicle Department, de Havilland Aircraft Company, British Aircraft Corporation, and U. S. Army Signal Research and Development Laboratory. The material is presented in terminology understandable to all engineers.

Descriptive literature is available from the publishers or your local bookstore, which has copies on display.

Other Books

Methods of Celestial Mechanics
By DIRK BROUWER and GERALD M. CLEMENCE
1961, 598 pp., $15.50

With the enormous increase in our capacity to explore the universe beyond the earth, celestial mechanics will be one of the most important bases on which our exploration must be built. This book, by two of the world's most distinguished astronomers, will undoubtedly remain basic in the field.

An Introduction to Astrodynamics
By ROBERT M. L. BAKER, JR. and MAUD W. MAKEMSON
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"The book will serve as a textbook for introductory undergraduate courses and as a reference and handbook of astrodynamical techniques for engineers and scientists involved in space technology." —*Journal of Applied Physics*

Introduction to Hypersonic Flow
By G. G. CHERNYI
Translated and Edited by RONALD F. PROBSTEIN
1961, 262 pp., $8.00

"The author and the translator have undoubtedly contributed an important source of information for hypersonic aerodynamics. The book should be particularly useful in a short course on hypersonic flow theory."
—*Quarterly of Applied Mathematics*

Hypersonic Flow Theory
By WALLACE D. HAYES and RONALD F. PROBSTEIN
1959, 464 pp., $11.50

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6. **Detonation and Two-Phase Flow**
May 1962, 368 pp., $5.25
7. **Hypersonic Flow Research**
April 1962, 758 pp., $10.50
8. **Guidance and Control**
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Engineering Employment Manager

THE Bendix CORPORATION

Bendix-Pacific Division
11602 Sherman Way, North Hollywood, Calif.

WHO'S WHERE

(*Continued from page 13*)

Changes

George W. Church, manager, Avionics Products, Radio Division, The Bendix Corp., Baltimore, Md.

Arthur F. Dickerson, manager-advanced engineering, Advanced Product Planning Operation, General Electric Co.'s Electronic Components Division, Schenectady.

Edward A. Anderstrom, director of manufacturing, LFE Electronics of Laboratory for Electronics, Inc., Boston, Mass., succeeding **Richard C. Sorensen** (AW Apr. 30, p. 23).

Maynard L. Pennell, director of the newly-established Military Transport Development Department, The Boeing Co.'s Transport Division, Seattle, Wash. Also: **Richard L. Rouzie,** director of engineering; **William H. Cook,** assistant director of engineering.

Roger Waterman, assistant Western Region armed forces liaison representative, Douglas Missile and Space Systems Division, Santa Monica, Calif.

M. L. Jofeh, deputy managing director, Sperry Gyroscope Co., Ltd., Brentford, Middlesex, U.K. Mr. Jofeh continues as general manager-operations for the company's six product groups.

William L. Young, division manager, Hayes-Weeksville Division, Hayes International Corp., Birmingham, Ala.

Charles L. Backus, Jr., corporate director, Western Region Office, North American Aviation, Inc., Los Angeles, Calif.

C. A. Papp, director, Plasma Chemistry Laboratory, Plasmadyne Corp., Santa Ana.

Austin Rising, manager of marketing planning, Beech Aircraft Corp., Wichita, Kan.

Link Division of General Precision, Inc., Binghamton, N.Y., has announced the following appointments in the Administration & Marketing Division: **Joseph W. Barron,** manager-advanced programs and operations; **Robert J. Campbell,** general sales manager; **John A. Scott,** executive assistant to the division vice president.

W. F. Springgate, manager-research and engineering, New Bedford Division, Aerovox Corp., New Bedford, Mass.

Richard U. Surbeck, director-international marketing, Defense Products Division, Fairchild Camera and Instrument Corp., Syosset.

Jerome Nathan, director of purchasing, Schaevitz Engineering, Pennsauken, N.J.

Air Vice-Marshal W. L. Freebody, managing director, RCA Great Britain, Ltd., Sunbury-on-Thames, Middlesex, U.K.

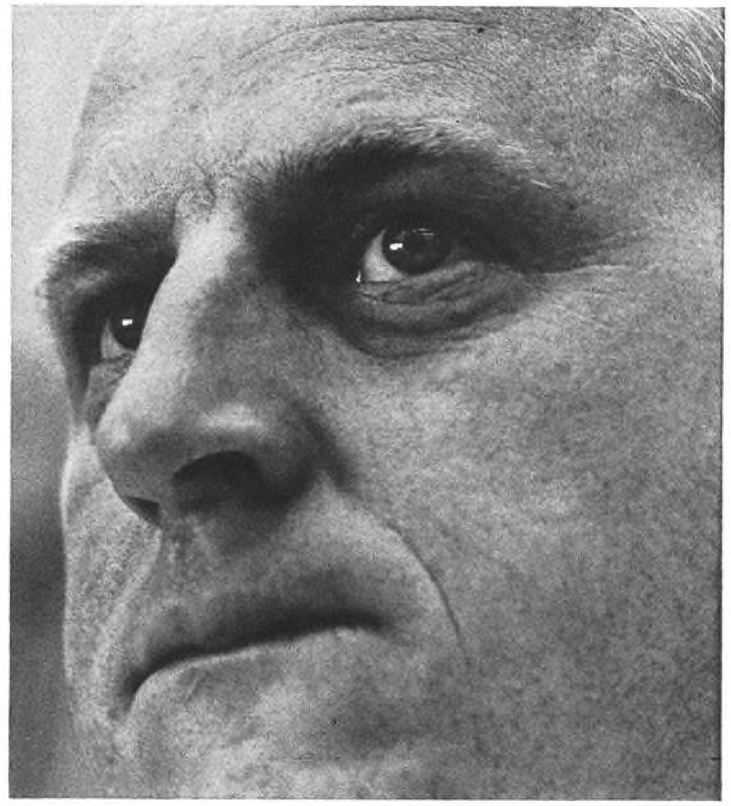
Barry R. Norman, reliability manager, Wyle Laboratories' West Coast Testing Division, El Segundo, Calif.

Wayne A. Burnett, director of technical planning, HRB-Singer, Inc., State College, Pa. **Robert L. Riddle** succeeds Mr. Burnett as head of the Electronic Systems Department.

Aerospace Corp.'s Systems Research and Planning Division, Los Angeles, Calif., has announced the following appointments in the Satellite Systems Group: **Dr. Harold S. Braham,** assistant group director; **Harold B. Coleman,** manager-satellite interception, office of Defense Systems Studies.

(*Continued on page 88*)

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Scientists, to perform research in nuclear and radio chemistry, and to conceive and carry out investigations in the fields of activation analysis, dosimetry, gamma ray spectrometry, surface phenomena, and numerous other areas.

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A plasma physicist, to join our growing program in the measurement of plasma properties, spectroscopy, diagnostics, accelerators, and power conversion devices.

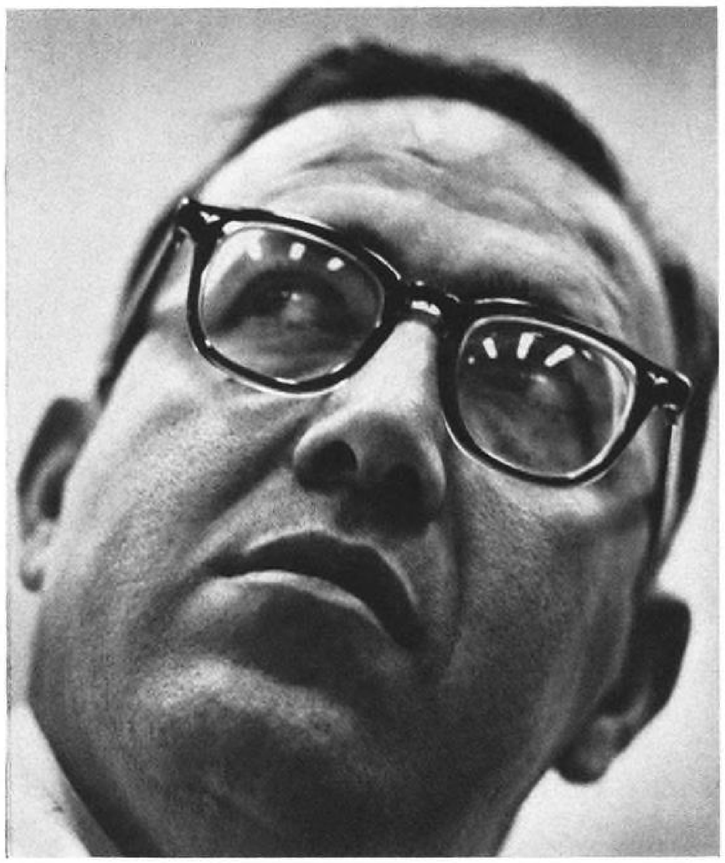
A mathematician-physicist, to concentrate on systems analysis and operations research applied to military and non-military space systems.

Physicists experienced in electro-optical imaging devices and laser theory; **engineering mathematicians** interested in detection theory, reconnaissance and tracking; **electronic engineers** who know their way around statistical communications theory and noise phenomena; for new and original work in satellite detection systems.

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Engineers to work in data reduction.
Scientists who know structures research and dynamics.
Scientists who have done supersonic aerodynamic research.
Scientists experienced in working with information and sensing systems, platforms, infrared, sensors, flight controls, airborne computing and data handling systems.
Engineers familiar with programming, operations, and instrumentation for ballistic missile flight test.
Reliability Engineers to assess the reliability and to optimize the configurations and mission profiles of space systems.
Chemical Engineers to work on the development and applications of structural adhesives for aerospace vehicles.
Metallurgical Engineers for research and development on materials and joining.

If you'd like more information about these opportunities and others that may be available by the time you read this, write and tell us about yourself. Contact Roy L. Pool, Engineering Center Personnel Office, 1001 East Broadway, Hawthorne, California. **NORTHROP**
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WHO'S WHERE

(Continued from page 87)

Changes

W. M. Silhavy, technical assistant to the president of Varian Associates, Palo Alto, Calif.

Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn., has announced the following appointments: **George B. Shaw**, factory manager; **Roy W. Fox**, general superintendent-limited production; **Richard P. Sprigle**, production control manager.

Robert J. Barrett, Jr., director of administration and finance, Northrop Corp.'s Nortronics facility, Anaheim, Calif.

Atlas Chemical Industries, Inc., Wilmington, Del., has announced the following appointments in the Aerospace Components Division: **Raymond M. Cotter**, director of production; **William H. Ruth**, director of marketing; **Donald M. Stonestrom**, director of product engineering; **H. Mack Truax**, director of quality and reliability engineering; **Thomas A. McCahon**, division controller.

W. Clifford Rhodes, sales manager, Astek Instrument Corp., Armonk, N.Y. Also: **Frank G. Daleo**, customer service manager; **George F. Sheridan**, director of quality assurance.

S. K. Ashby, manager-product planning, Sierra Electronic Division of Philco Corp., Menlo Park, Calif.

James J. Tesik, manager, Quality Engineering Department, Lockheed Electronics Co., Plainfield, N. J., a division of Lockheed Aircraft Corp.

Helmich W. Boessenkool, manager-international operations, Sanders Associates, Inc., Nashua, N. H.

John R. Hyde, general manager, Kahn and Co., Hartford, Conn. **Merritt E. Peck** succeeds Mr. Hyde as chief engineer.

C. L. Constantinides, director of contracts, Aircraft-Missiles Division of Fairchild Stratos Corp., Hagerstown, Md., and assistant secretary of the corporation.

Arthur E. Mahak, director of international operations for Motorola Semiconductor Products, Inc., Phoenix, Ariz.

E. Paul Coté, manager-special products marketing, Melabs, Palo Alto, Calif.

Herbert M. Wittmeyer, director of quality assurance and reliability, Huck Manufacturing Co., Detroit, Mich.

Jack J. Marcinek, director, Research and Engineering Department, Aerospace Division, Walter Kidde & Co., Inc., Belleville, N. J.

Virgil W. Jaenicke, manufacturing manager, Costa Mesa (Calif.) facility, Narmco Materials Division of Telecomputing Corp.

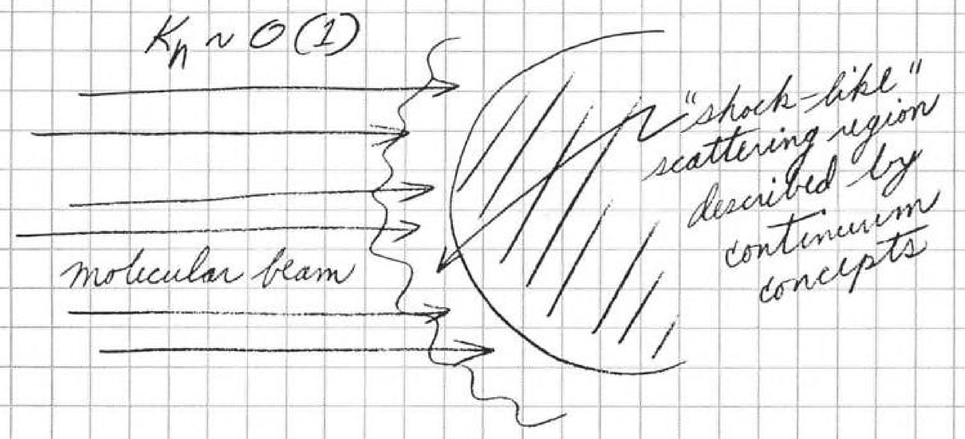
Frank Voltaggio, Jr., director of marketing, Warnecke Electron Tubes, Inc., Chicago, Ill. (AW June 4, p.23).

Edward L. Fensler, field service manager and director of training, Computer Measurements Co., San Fernando, Calif., a division of Pacific Industries, Inc.

Joseph J. Martus, engineering manager, Essex Electronics Division, Nytronics, Inc., Berkeley Heights, N. J.

Lawrence R. Keenen, Jr., marketing manager, Berkeley Division of Beckman Instruments, Inc., Richmond, Calif.

Of interest to engineers and scientists



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LETTERS

Arsenal Under Attack

Your editorial on "The New Arsenal Concept" (AW July 9, p. 13) really hits home—is timely. How about following it by a recital of some of the classic "blobs" of World War 2 for which the arsenals were clearly responsible, to wit:

1. The opposition to microwave radar, as exemplified by the Rad. Lab.
2. The design of the Grant Tank, a monstrosity.
3. "You can't put a turret on a tank."
4. "You can't build a self-leveling gun on a tank." (Westinghouse did.)
5. The BuOrd torpedo which wouldn't work.
6. BuOrd gun which wouldn't fire.

ad nauseam.

In each case it was the ingenuity and resourcefulness of the private company, the incentive of competition, that brought about solutions to these problems. Was it not Eisenhower who evaluated the 2½ ton tank and the bulldozer as the most effective developments of World War 2? The case rests.

C. L. Rouault
Consulting Engineer
Fayetteville, N. Y.

Thanks for your editorial in the July 9 issue ("The New Arsenal Concept," p. 13). I hope this will wake up a few people and put the fear of God into them. As indicated in your article on p. 18 ("U. S. Considers Industry Salary Control"), plans are afoot to completely nationalize all research and development connected with any vague reference to national needs. If the trend you point out continues, all research and development work will be conducted in National Laboratories or "State Science Institutions," and all projects will be managed in minute detail by "Public Trust Corporations" or "Quasi-Public Corporations" in such a manner that all profits are gone, all competition is gone, and much of the productivity will be gone, since most people will be writing reports or reading reports or looking over someone's shoulder who is writing a report or reading a report, and no one does any work.

Add to the mess a government approval required to change jobs, plus a government-fixed salary, and we have complete chaos.

Everyone seems to be concerned about the fact that defense industry jobs pay more than government jobs, so it is difficult to attract good people into the government jobs. Government salaries may be too low, but we should not be too concerned about attracting more people into government jobs, since we have too many bureaucrats now trying to take over management and technical jobs that should be performed by private industry. If the salaries of the defense industry are fixed, then the top-notch people will move into industries that do no government work, and our defense effort and national stature will suffer even more.

I recommend that your readers read the book "Atlas Shrugged" by Ayn Rand, so they can see the consequences of the established trend.

E. D. Sayre
Cincinnati, Ohio

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Reliability Advisers

Having been a "reliability type" for almost a decade now, I was glad to see your editorial on "Reliability in Space" in the 11 June issue (p. 21). I think your readers would be interested in knowing that GE's contract with NASA as technical adviser on reliability and quality control aspects of Apollo is but one of several such contracts. These contracts resulted from the third basic element of NASA's present reliability policy.

Since it may be of interest to your readers, the three basic elements of this policy are:

- **First:** It is a fundamental NASA policy to utilize every practical means of achieving high system reliability at the earliest possible stage of system utilization.
- **Second:** To accomplish this over-all policy objective, appropriate reliability program requirements shall be placed on contractors for major NASA systems.
- **Third:** Contractor performance in achieving system reliability will be monitored by the cognizant NASA Centers with the aid of specialized reliability contractors, as appropriate.

In addition to the Apollo effort mentioned in your editorial, specialized reliability contractors that have been selected by NASA to date and the corresponding major NASA systems are: Booz, Allen, and Hamilton for the Orbiting Astronomical Observatories (OAO); Planning Research Corp. for the Orbiting Geophysical Observatories (OGO); Arinc Research Corp. for Saturn; and Operations Research, Inc., for the Nimbus meteorological spacecraft. At this moment, similar contractual assistance from specialized reliability contractors on current and future NASA systems is under consideration.

Very briefly stated, each independent reliability contractor assists NASA by periodically making independent estimates of subsystem and system reliability, by aiding in the establishment of realistic system reliability goals, and by generally acting as a technical adviser to NASA in system reliability matters. For OGO, the PRC figure-of-merit approach is being utilized to assess spacecraft reliability. More meaningful than the classical "black or white" reliability approach, this approach establishes a measure of expected value of system performance that takes into account degradations as well as catastrophic failure influences on mission effectiveness. . . .

George R. Grainer,
Deputy Manager
Reliability, Maintenance, and Test Dept.
Planning Research Corp.
Los Angeles, Calif.

Environment Tests

Mr. John Maddock's letter "Just Engineering" (AW July 9, p. 94) can be condensed even further.

Over 80% of the in-flight malfunctions of our aerospace efforts are attributed to environmental effects. Yet the environmental engineer in most companies is considered an overhead expense required only because of the necessity to test to military specifications. The art of environmental testing requires years of experience. The reliability of the equipment is proven in the test chamber.

In few companies you will find the environmental test engineer consulted on the conceived design but too often you will find him on the carpet for breaking up a chief engineer's creation.

Donald J. Fox
President
Institute of Environmental Sciences

Insurance Limits

How many mass murders must we tolerate before something positive is done to deter airliner bombings?

Our courts can punish those who joke about explosives on airplanes, but the prospect of financial gain still exists for the beneficiaries of large airline trip insurance policies.

It is not idle to say that the profit motive has been a factor contributing to the death of hundreds of innocent passengers and crew members. And it should be apparent to everyone that companies which insure airline passengers for high rates—and only for the duration of the flight—are not only supplying the motive for murder in the air but are certainly the ones to profit by the sale of such high value policies.

How can we justify permitting anyone who considers a $10,000 policy sufficient under average circumstances to put a price tag of $225,000 on his loss to society in the event he is killed in an airplane accident?

I propose that it be made illegal for anyone to carry airline trip insurance in excess of a value equal to the policies maintained in effect for the preceding year; and that the passenger be advised that regardless of the amount of airline trip insurance he purchases the principal sum to be paid in the case of a fatal accident will be equal only to that of his normal policies. This would place some standard of value on airline trip insurance.

No responsible insurance underwriter would permit a client to purchase more life insurance than he can manage.

However, the sky is literally the limit when it comes to the purchase of airline trip insurance.

The recent wave of aerial piracy brought swift federal legislation that put an end to hi-jacking in the sky. Perhaps through the government we can demonstrate a similar concern for the safety of the flying public by placing a reasonable ceiling on airline trip insurance.

Earl Waggoner
Airline Pilot, LAX



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The system introduces new Bell BRIG gyros. Its accelerometers and digital velocity meters are already operational in missile and space guidance systems.

Hipernas — and many other systems such as the Air Force GSN-5 and the Navy's SPN-10 All-Weather Automatic Landing Systems — typify Bell's capabilities in the broad field of electronics. This diversity of activities offers an interesting personal future to qualified engineers and scientists.

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JUL. 31 1962



PHANTOM II . . . THREE SERVICE FIGHTER

Never before has one aircraft so indelibly marked the pages of military aviation history. It is appropriate that the Phantom II will now serve three air arms of our nation.

This multiple mission fighter, designated F4H-1, is already in service as an air defense interceptor for the United States Navy. With the same designation, the Phantom II will soon be delivered to the United States Marines for close support and air superiority missions. Designated the F-110A and the RF-110 by the United States Air Force, this versatile aircraft is now being built to augment the tactical strike and reconnaissance capability of that service.

RECORD FLIGHTS OF THE PHANTOM II:

16 kilometer straightaway	1606 mph
3 kilometer low altitude	902 mph
100 kilometer closed course	1390 mph
500 kilometer closed course	1216 mph
Sustained altitude (level flight)	66,443 feet
Los Angeles to New York	170 minutes
Altitude	Over 100,000 feet

Time to Climb (in meters):

3,000 . . . . 34.52 seconds	15,000 . . . 114.54 seconds
6,000 . . . . 48.78 seconds	20,000 . . . 178.50 seconds
9,000 . . . . 61.62 seconds	25,000 . . . 230.44 seconds
12,000 . . . . 77.15 seconds	30,000 . . . 371.43 seconds

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