Aviation Week

Including Space Technology

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A McGraw-Hill Publication

June 2, 1958

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Amphibious Sikorsky S-62

AVIATION CALENDAR

June 9-11—Ninth Annual Symposium on Spectroscopy, Pick-Congress Hotel, Chicago, Ill. For details: H. J. Hettel, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

June 9-12—American Rocket Society Semi-annual Meeting and Astronautical Exposition, Hotel Statler, Los Angeles, Calif.

June 9-13—Fourth International Automation Exposition and Congress, Coliseum, New York, N. Y.

June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D. C.

June 16-18—12th Meeting, NATO Advisory Group for Aeronautical Research and Development, Aeromedical Panel, Palais de Chaillot, Paris, France.

June 19-21—Annual Meeting, Institute of Navigation, University of California Santa Barbara College, Goleta, Calif.

June 21-22—Dedication of Civil Aeronautical Center and observance of the 20th Anniversary of Civil Aviation, CAA Aeronautical Center, Oklahoma City, Okla.

June 22-27—Golden Jubilee Meeting, American Institute of Chemical Engineers, Philadelphia, Pa.

June 22-27—61st Annual Meeting, American Society for Testing Materials, Hotel Statler, Boston, Mass.

June 22-27—Summer General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Statler Hotel, Buffalo, N. Y.

June 23-24—Summer Meeting, Western States Section, the Combustion Institute, Dwinelle Hall, University of California, Berkeley, Calif.

June 24-26—31st Meeting, Aviation Distributors and Manufacturers Assn., Mount Washington Hotel, Bretton Woods, N. H.

(Continued on page 6)

AVIATION WEEK Including Space Technology

June 2, 1958
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AVIATION CALENDAR

(*Continued from page 5*)

June 27—First Water-Based Helicopter Symposium, sponsored by the Bureau of Aeronautics and Stevens Institute of Technology, Stevens Institute of Technology, Hoboken, N. J.

July 4-6—Northeastern States Championship Soaring Contest, Harris Hill, Elmira, N. Y.

July 8-11—The Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, Calif.

July 14-15—Triennial Inspection, National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

July 24-25—Fifth Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Colo.

July 24-25—Quarterly Regional Meeting, Assn. of Local and Territorial Airlines, Denver, Colo.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Jointly sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.

Aug. 17-23—Missiles Operations Research, Engineering Seminar, Pennsylvania State University, University Park, Pa.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 25-30—Ninth Annual Congress, International Astronautical Federation, Amsterdam, Holland.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 6-14—International Aviation Show, Coliseum, New York, N. Y.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 15-19—Annual Instrument-Automation Conference & Exhibit (International), Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

Sept. 22-24—Seventh Annual Meeting, Standards Engineers Society, Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 29-Oct. 3—National Aeronautic Meeting, Society of Automotive Engineers, Inc., the Ambassador, Los Angeles, Calif.

Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

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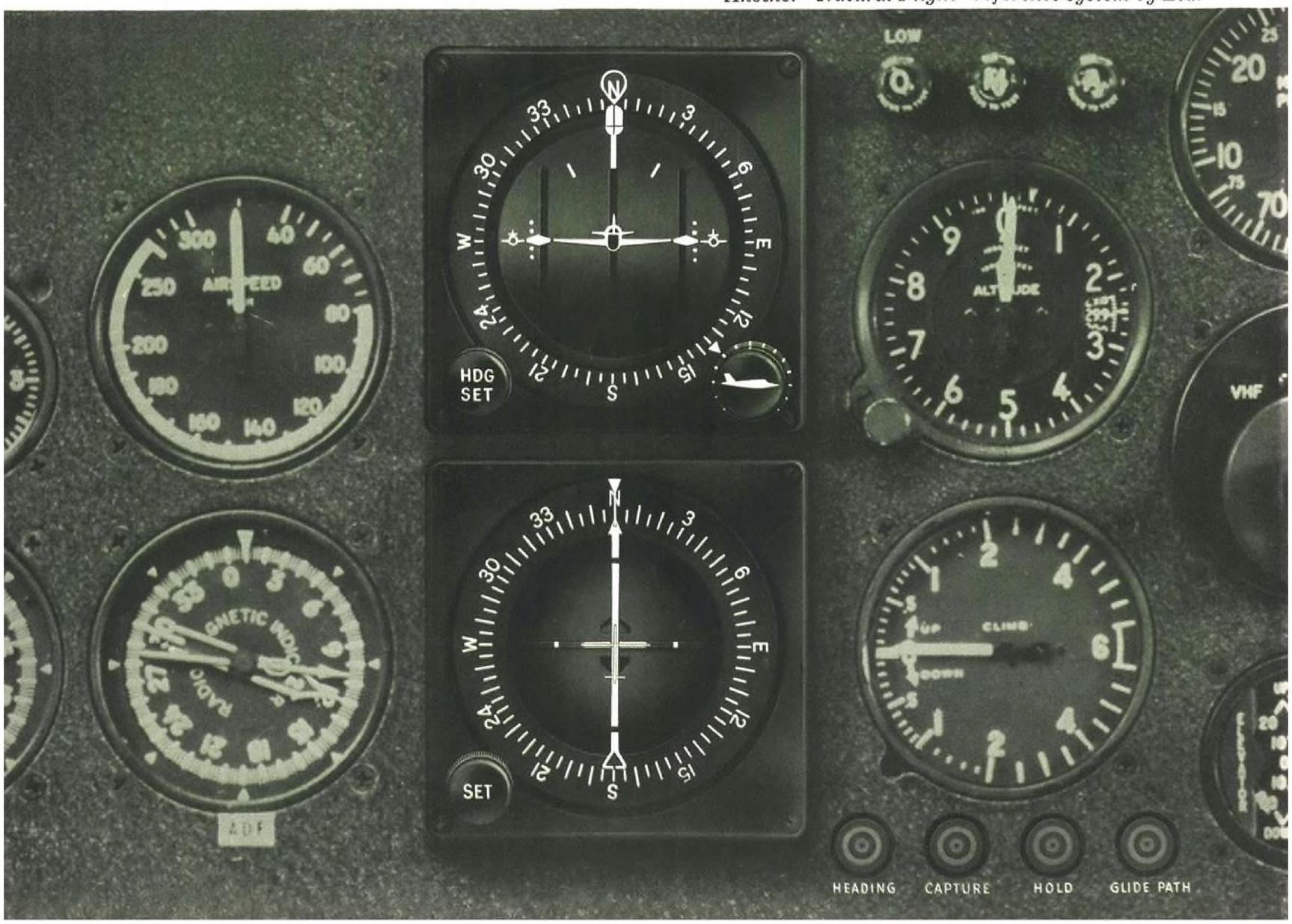

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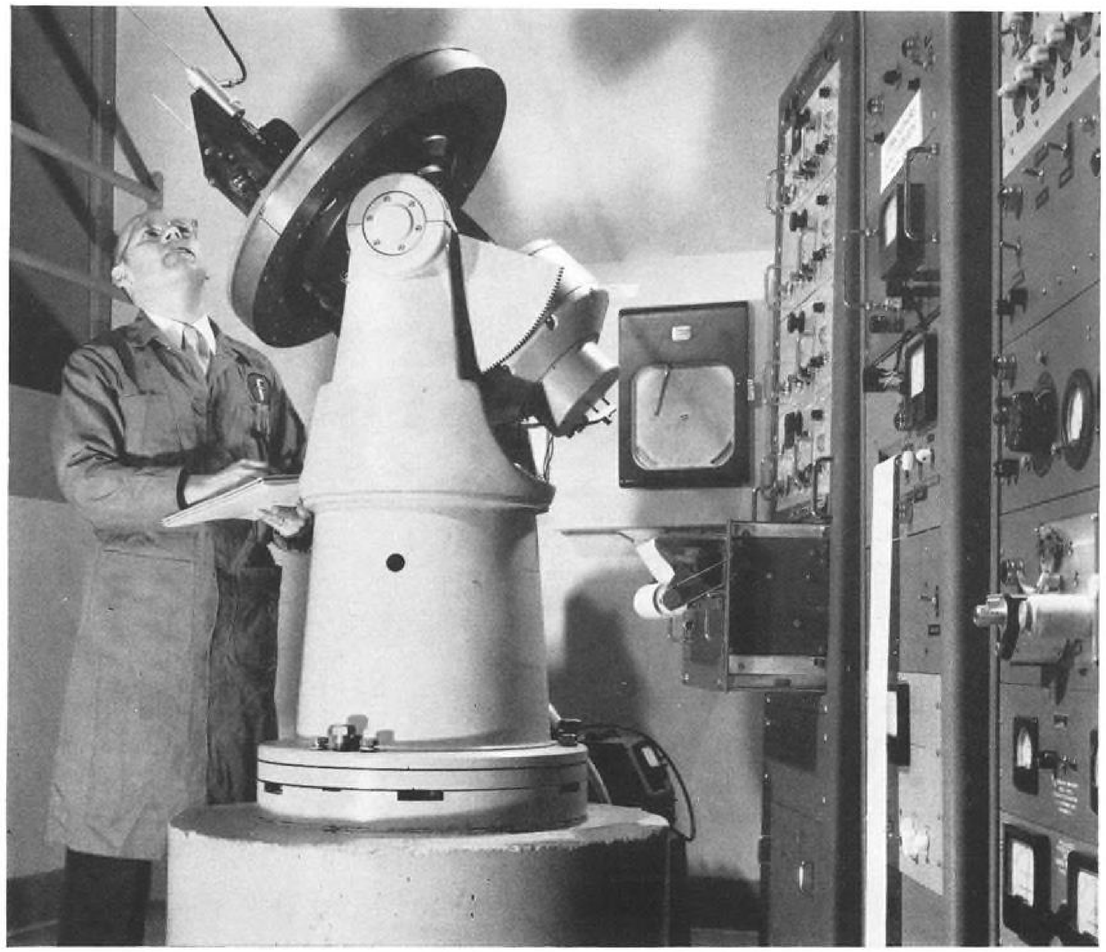

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COVER: First Sikorsky S-62 amphibious utility helicopter makes a water landing at 60 kt. in full autorotation during demonstration in Housatonic River, Conn. Flying boat hull's V bottom is designed to permit clean entry on touchdown in water. See page 74 for S-62 story and other photos.

PICTURE CREDITS

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EDITORIAL

A Study in Frustration

With congressional clamor for "emergency action" to solve air traffic control problems reaching a new peak in intensity and assininity as we anticipated a few weeks ago (AW April 28, p. 21), it might be well to review the long and frustrating history on some valiant postwar attempts to build a safe and efficient modern airways system. It also might be wise to examine the reefs on which these efforts foundered because they are still there and will again smash constructive efforts when the current high tide of public indignation over mid-air collisions subsides.

The air traffic control problem has been with us since the end of World War II and "emergency decrees" will not solve it. Such groups as the Air Transport Assn., the Air Line Pilots Assn. and the Radio Technical Commission for Aeronautics began strenuous efforts shortly after the war's end to build toward a sound solution. USAF's all-weather flying center at Wilmington, Ohio, also did yeoman service in this cause with little over-all USAF support.

This was the period of hope and promise for the future. By 1948, RTCA had provided a broad blueprint for the common future electronic airways pattern. A year later, the first Air Navigation Development Board was organized to monitor and spur development of the required electronic equipment. Avionic equipment manufacturers responded well and developed a wide variety of useful devices.

The villains in this era, who were shortly to emerge as the main actors in the 1950-55 period of disillusionment, were the Civil Aeronautics Administration, then a decade off the technical pace; the Air Force and Navy, who under a cloak of secrecy were developing their own systems and acting unilaterally on all military-civil aviation problems, and the Bureau of the Budget which couldn't then and still doesn't really understand the financial cost of air safety. This was the era when the Tacan-DME mess broke into the open, when then CAA Administrator Fred Lee was assuring us there really was no air traffic control problem and his superiors, Sinclair Weeks, Secretary of Commerce, and Louis Rothschild, Undersecretary of Commerce for Transportation, were all too willing to agree. This was the era when the first Air Navigation Development Board foundered and avionics manufacturers swore silent vows never to try to do business with CAA again.

This was also an era when people such as Milton Arnold, operations vice president of ATA, and his able air traffic control experts, Craig Timmerman and Frank White, with the combined support of airline chief pilots and operations vice-presidents, were unable to stir major interest in the problem from their own airline presidents.

This series of shennanigans produced a reaction in the right direction. We began hammering editorially on the gravity of the air traffic control problem, trying mainly to convince airline top management and both the executive and legislative branches of the government that disaster was impending for both military and civil aviation unless the problem was tackled hard. The study committee headed by William Barclay Harding was appointed and it delivered an accurately frightening appraisal of the situation that finally scared Messrs. Weeks, Rothschild and Sherman Adams out of their apathy. Fred Lee was fired as CAA administrator and replaced by the energetic team of the late Chuck Lowen and present CAA Administrator Jimmy Pyle. Ted Curtis was brought down from Eastman Kodak to serve as special aviation adviser to the President.

The work of the Curtis group stands as a monumental achievement in bureaucratic Washington. Its reports did not equivocate but stated the problems bluntly and recommended specific solutions. And its report was not filed and forgotten in the Washington tradition but still serves as a broad blueprint for specific action that has been taken and is planned to build a modern, efficient airways system.

Beginning in 1956 came a new era of hopefulness and some long delayed vital action. Pete Quesada, as the successor to Ted Curtis, finally got action on a jet airport for the Washington area and got the machinery in motion to turn Anacostia and Bolling Fields back to pasture and move the bulk of military operations to outlying airports. He also began drafting the vital legislation for creation of an independent Federal Aviation Agency to have both responsibility and authority for creating the proper climate to realize civil aviation's growth potential. CAA under Jimmy Pyle's leadership began acceleration of a five-year airways modernization program and avionic manufacturers again became interested in doing business at CAA. But even here the conservative hand of the Budget Bureau kept slashing at the program and urging a little less a little later. And the Commerce Department duet of Weeks and Rothschild echoed the song.

Civil Aeronautics Board under Jim Durfee's leadership also moved to adjourn the ineffectual debating of the Air Coordinating Committee on military-civil airspace problems. It exercised its legal right, over strong military protest, to assume control of all airspace and vested that control with the CAA. This recent action has ended the dangerous concept that there can be separate military and civil control of the same airspace. However, the action is so recent it cannot yet be effective in stemming the collision tide.

But against this background of new hope, we began to read the harvest of past lethargy, inaction and stupidity. The mid-air collisions that all of the responsible experts in the field predicted back in mid-1955 began to happen with increasing frequency. For the record, here are the tragic collisions that have occurred since then:

Trans World Airlines Martin 202A with an executive Douglas DC-3, Covington, Ky., December, 1955, 15 killed; TWA Lockheed 1049G with a United Air Lines Douglas DC-7 over the Grand Canyon, June, 1956, 128 killed; Douglas DC-7 on test flight with a Northrop F-89, Los Angeles, February, 1957, eight killed; MATS Douglas C-118 with a Navy Lockheed P2V, Long Beach, Calif., February, 1958, 48 killed; Air Force C-119 with a USAF C-124, Bridgeport, Texas, March, 1958, 18 killed; United DC 7 with an Air Force TF-100, Las Vegas, April, 1958, 49 killed; Capital Airlines Vickers Viscount with USAF T-33, Brunswick, Md., May, 1958, 11 killed. Total deaths: 277.

After each new tragedy Congress wants to "investigate" and grab some headlines. This ghoulish activity has been going on for 30 years on Capitol Hill, and we would like some legislator to cite one single contribution to air safety these investigations have made. Examining the current congressional approach to the recent collisions, we seriously question whether the long series of hearings have even contributed to the education of legislators on air safety problems. There are some sincere crusaders for air safety on Capitol Hill, but their efforts to date have been vitiated by the headline grabbers and the air safety budget slashers.

Building a modern, semi-automatic electronic airways system that can handle the needs of military and civil aviation is a tremendous technical, financial and executive task. But it is now going in the right direction and needs strong continued support plus a few wise top-level decisions to make maximum progress in minimum time. Further harrassment by congressional committees seeking headlines and personal prestige will retard this progress, not help it.

Thanks to past inaction, there is little that can be done now to solve the air traffic problems of today. But if we don't take decisive action now, the same problems will still be with us tomorrow.

—Robert Hotz

WHO'S WHERE

In the Front Office

I. Nevin Palley, senior vice president, Temco Aircraft Corp., Dallas, Tex. **Robert E. Galer** succeeds Mr. Palley as vice president-engineering.

Air Vice-Marshal Leigh F. Stevenson, board chairman, Okanagan Helicopters Ltd., Vancouver, B. C.

Joseph B. Elliott, president, Tele-Dynamics, Inc., Philadelphia, Pa. Mr. Elliott succeeds **Edward E. Lewis,** now chairman of the company's executive committee.

Knud Knudsen, president, and **George W. Oehlsen, Jr.,** general manager, Amphenol Electronics Corp.'s Danbury-Knudsen Division, Danbury, Conn. Also: **Richard Steiger,** general manager, Amphenol's IPC Division.

W. A. Meddick, president and general manager, The Elwell-Parker Electric Co., Cleveland, Ohio. Mr. Meddick succeeds Sheldon K. Towson, deceased. Also: **Sheldon K. Towson, Jr.,** vice president and assistant general manager.

Dan T. Buist, vice president-marketing, Turco Products, Inc., Los Angeles, Calif. Also: **Stewart B. Van Dyne,** assistant to the vice president-marketing, and **Archie K. Beard,** general sales manager.

Charles R. Lindsay, III, a director and vice president, American Potash & Chemical Corp., New York, N. Y.

W. H. Riggs, vice president-manufacturing, Avro Aircraft Ltd., Toronto, Canada.

Howard Holden, vice president-production, Central Electronic Manufacturers, Inc., Denville, N. J.

G. S. Massa, a director and vice president-operations, Hydrodyne Corp., North Hollywood, Calif.

Silas S. Cathcart, vice president, Illinois Tool Works, Chicago, Ill.

Donald B. Nason, vice president-sales, Reeves Instrument Corp., Garden City, N. Y.

Najeeb E. Halaby, vice president-finance and administration and a director, Servomechanisms, Inc., Hawthorne, Calif.

Arthur R. Weckel, vice president of Sperry Gyroscope Co., Great Neck, N. Y., will direct the newly formed Field Service and Repair Division.

C. L. Stewart, a vice president, Northwest Orient Airlines, Inc.

Ross H. Begg, Jr., assistant to the general manager, Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn.

George W. Hostettler, manager, Beech Aircraft Corp.'s Boulder Division, Boulder, Colo.

Honors and Elections

H. Leslie Hoffman, president of Hoffman Electronics Corp., has been awarded the electronics industry's 1958 Medal of Honor for his constructive leadership in the industry.

Sir Arnold Hall, Director of the Hawker-Siddeley Group, has been elected president of The Royal Aeronautical Society, London, England.

(*Continued on p. 83*)

INDUSTRY OBSERVER

► During record altitude runs of the Lockheed F-104 Starfighter (AW May 12, p. 27), some form of combustion was maintained in the General Electric J79 turbojet even at the maximum altitude of 91,000 ft. Afterburner flamed out between 60,000 ft. and 70,000 ft. and, after zoom to maximum altitude, cockpit instruments indicated that the J79 was getting more than windmilling rpm. and a tailpipe temperature that indicated some combustion was still taking place in the main power section. Full rpm. and normal engine operating tailpipe temperatures were reached again at about 70,000 ft. altitude on the way down.

► **Russians are now firing four intercontinental ballistic missiles per month in order to meet proposed operational dates.**

► First of three lunar probes allotted to Ballistic Missile Division was originally scheduled to be fired on Aug. 16 but may be delayed. Instrument payload will be 30 lb. Installation for tracking the probe is being erected in Hawaii. Probe transmission frequency of 108 mc. already has been cleared with Federal Communications Commission.

► **Preliminary briefing on nose cone for Minuteman multi-purpose ballistic missile project was given by Ballistic Missile Division on May 27 to Avco, General Motors, General Electric Co. and Aeronutronic Systems Inc. Companies will present formal proposal on nose cone to BMD by June 23.**

► Boeing B-52G will carry two North American Hound Dog missiles on a normal mission, one suspended under each wing. The Hound Dog, powered by a Pratt & Whitney J52 turbojet engine, can be used as a nuclear weapons carrier or as an electronic countermeasure device. Range is several hundred miles. B-52G will be able to carry a normal hydrogen bomb load internally in addition to the two externally mounted missiles.

► **Lockheed Missile System Division has proposed an air-to-ground ballistic missile utilizing the X-17 propulsion system for launching from the Convair B-58 supersonic bomber.**

► Bumbo is name of reactor for Project Rover nuclear rocket engine developed by University of California Radiation Laboratory at Livermore and its Los Alamos facilities. Reactor is scheduled to be tested soon in Nevada. Hydrogen will be the working fluid for the powerplant.

► **Most probable sequence for testing of the first manned satellite will be to send up a model first, then a full-scale, unoccupied, automatically controlled vehicle; next the same vehicle carrying a large animal, and finally the manned version.**

► Russian Farmer fighters are now flying operationally at altitudes of 65,000 ft. The aircraft also are being zero launched.

► **High-altitude sounding rockets will be launched by U.S. from sites located around the globe to check results of nuclear out-of-atmosphere explosions to be conducted at Eniwetok this summer during Operation Hardtack.**

► Thor-Vanguard combination vehicle used for re-entry tests and as an animal carrier is fired without the usual few seconds hold-down employed in Atlas and other missile firings in order to check initial performance. When engine is started, vehicle accelerates steadily.

► **Navy is discontinuing supersonic drone program for lack of funds. Present contracts with Radioplane and Temco are expiring and no new money is in sight.**

► Nuclear-powered turbojet engine under development by General Electric Co. turned over on its own chemical power for the first time in early March.

Washington Roundup

IFR: The Impossible 'Quickly'

Civil Aeronautics Administration has concluded from its forecasts of IFR flight volume during the next four years that "we need to do the impossible quickly." Annual percentage increase of instrument approaches recorded by the CAA has been about 20% since 1954, with an all-time high of 47.3% registered in Fiscal 1957. The agency has noted that if the 1957 rate of growth continues, a major upward revision of published forecasts will be necessary and increased requirements for men and material will result. The CAA also suggested that, as more segments and functions of the federal airway plan are implemented, "the level of IFR activity will be measured in millions rather than in hundreds of thousands." It added: "Looking forward, the 1963 IFR air traffic control job will be to handle three times as much volume as in 1957." That year, slightly more than one million instrument approaches were handled by the CAA.

Renegotiation Debate

Aircraft Industries Assn. is asking the House Ways and Means Committee to hold hearings on administration proposals for another two-year extension of the Renegotiation Act in hopes of having the legislation amended to at least protect profits earned within the framework of contracts agreed to by the Defense Department.

A proposed amendment to the bill approved by the AIA board of governors at its recent annual meeting in Williamsburg, Va., says profits should normally be free from Renegotiation Board investigation unless the aggregate of profits earned by a firm on defense contracts "exceeds the aggregate of the basic profits used by the contracting parties in establishing the basic contract prices." In order to renegotiate other profits, the amendment says, the board should be required to demonstrate that the excess of such profits over the basic profits did not result from efficiency on the part of the contractor or subcontractor.

Industry spokesmen charge that the bill as now written is so vague as to what excess profits are that it allows the board to make "arbitrary" rulings. To back their claim of the bill's "looseness," they point to a case involving Boeing Airplane Co. where the regional board found no excess profits. The statutory board in Washington, working with the same facts and under the same law, later ruled that $10 million of Boeing's earnings were excessive.

National Space Agency

Look for numerous amendments to be offered to the proposed bill to create a National Space Agency with the National Advisory Committee for Aeronautics as its nucleus. The bill is now scheduled to be taken up on the House floor early this week.

Because of strong bi-partisan support of the proposed legislation most of the amendments to be offered probably will be designed to strengthen or clarify the intent of the act rather than change its basic concepts. Several technical changes will be suggested by the House Committee on Astronautics and Space Exploration including a possible name change.

Another change may be the deletion of the section establishing a joint congressional committee in preference to an "across-the-board" standing committee. Represented on this committee would be at least one member of all other committees concerned with space technology, including those concerned with sciences, education and military services. A resolution to create such a committee was introduced by Rep. Carl Albert (D.-Okla.) with the approval of the House Space Committee leadership. Action on the Senate version is not quite so close at hand. Problem is that members of the Senate Space Committee are heavily burdened with work on other committees, making it difficult to schedule sessions. The committee staff originally had hoped to report out the marked up bill this week.

House Skepticism

House Armed Services Committee is still skeptical that the number of secretary-level officials at the Pentagon are adding to the red tape and confusion and promises a further study in its report on legislation reorganizing Defense Department. The measure is due for action on the House floor (AW May 19, p. 29).

The reorganization measure, as proposed by the President and approved by the committee, eliminates five of the present 29 Pentagon Secretaries: two Assistant Secretaries of Defense and one of the Assistant Secretaries of each of the services.

Rate of Return

Determination of a fair rate of return for local service carriers seems as far removed from solution as ever. Six carriers—Bonanza, Central, Frontier, Lake Central, Ozark and West Coast Airlines—last week filed a joint rebuttal opposing a 9.5% rate of return suggested by bureau counsel for the Civil Aeronautics Board. The carriers charged that the counsel's recommendation was based on a compilation of "statistical errors and faulty assumptions."

Key to the issue is the method of rate making, with the counsel suggesting a rate based upon investment as opposed to an operating margin. Weakness of the recommendation, opponents say, is evidenced by current CAB approval of an operating margin of two cents per plane-mile for local service carriers with a low investment base. The carriers favor retention of the operating margin and a change to provide one quarter to one third of a cent per available seat-mile which would be an increase of six and eight cents per plane-mile.

Hiring Costs

Defense Department is considering the "over-all" hiring costs of contractors in its efforts to evaluate legitimate charges against contracts. Perkins McGuire, Assistant Secretary of Defense for Supply and Logistics, explained to the House Appropriations Committee:

"We are trying to get this nailed down so that the over-all cost of hiring a man to work for us is a reasonable charge to the government. I think that would be the yardstick. You could say this ad is excessive, but, if that is the only expense the contractor incurs in hiring an employe as contrasted with others who are giving free trips and interviews at the plant, his cost may be much lower than the other fellow's. If it is reasonable over-all in his employment costs. I think that is a fair yardstick.

—Washington staff

Congress Demands Tight Traffic Control

Viscount–T-33 collision spurs new investigations; experts warn present airways already overtaxed.

Washington – Mounting congressional pressure for tighter air traffic control procedures last week prompted a flood of new proposals for crash programs designed to eliminate the collision hazard. Experts admitted that more rigid rules would help reduce the collision threat but warned that already overtaxed airways could not absorb a drastic increase in the control of flights.

Urged into action by the recent collision between a Capital Airlines Viscount and an Air National Guard T-33 jet trainer (AW May 26, p. 25), Congress launched three separate probes into the midair collision danger. Here are the main points of the interim measures at the Capitol Hill hearings:

• **Civil Aeronautics Board** last week authorized the establishment of three all-weather, positive control, transcontinental corridors between 17,000 and 22,000 ft and 40 miles in width. Civil Aeronautics Administration immediately advised the Board it would designate the specific routes to be used before June 15.

• **Air Coordinating Committee** drew a voluntary agreement from the military services that would restrict non-tactical military jet flights from taking off or landing under visual flight rules except those flights operating above 20,000 ft. or off federal airways.

• **Sen. A. S. Mike Monroney (D.-Okla.)** introduced a bill that would create an independent Federal Aviation Agency directly responsible to the President and Congress. The bill would transfer responsibilities now assigned to the CAA and the Airways Modernization Board to the new agency which would be headed by a single civilian administrator with authority to regulate both civil and military aircraft. Most observers felt the bill stood a good chance of approval during the present session of Congress.

• **Stuart G. Tipton,** president of the Air Transport Assn., called for adoption of a 10-point program that provides for the creation of an over-all agency to coordinate and regulate both military and civil air operations. Tipton asked for the acceleration of positive control on the airways, a review of local military training practices and the establishment of control zones at every airport equipped for instrument approaches.

• **David H. Baker,** president of Capital Airlines, asked that all military miscellaneous maneuvering and acrobatics be banned from the airways with court martial action against military pilots who violate the regulation. Baker also called for a single control agency as the third step in a three-objective program to reduce the collision problem.

• **So-called "five-point program,"** erroneously credited to the White House, called for immediate curtailment and stronger control of military operations. Actually, the five points were proposed by House Appropriations Subcommittee Chairman Prince Preston (D.-Ga.) to President Eisenhower following hearings on the collision problem. By last week, the President had made no formal comment on the proposals.

• **Scheduled airlines will begin flying IFR** under all conditions above 10,000 ft. beginning July 1. Original plans called for such action in 1959, but the program was advanced a year immediately after the Viscount collision.

Civil Aeronautics Administrator James T. Pyle has reaffirmed his previous stand that positive control of all aircraft at certain altitudes is the ultimate goal of the CAA and the only effective method of protecting all aircraft against the collision threat. He added, however, that positive control cannot be implemented for another three years at least.

"I want it clearly understood," Pyle told members of the Senate Aviation Subcommittee, "we will not solve this problem overnight." Any such optimistic impression would create a sense of "false security," he warned.

The CAA explained that the key to positive control is long-range radar and that lead time involved in procuring and installing equipment and in training personnel precludes any possibility of accelerating the agency's present airways program to any great degree. CAA's Fiscal 1959 budget contains $34.8 million for long-range radar in addition to $21.6 million for terminal area radar. As approved by a House Appropriations Committee, the agency's budget is an increase of $75.5 million over Fiscal 1958.

Pyle later told Senate members that, while the CAA would welcome a supplemental appropriation, "money is not the complete answer to the immediate problem. Just because we have a lot more money, the problem is not necessarily nailed down."

The administrator explained that additional funds would have the effect of expanding federal navigation facilities but would do little to shorten timetable for positive control.

Pyle said procurement and installation problems are a larger stumbling block than financing. CAA, wherever possible, attempts to use its own technicians in most projects involving conversion of existing facilities while contracting with private industry for the installation of new units.

Citing one of the timetable difficulties in dealing with private companies, Pyle told the House Committee that General Electric had estimated it would take its technicians at least 90 days to install an FPS8 long-range radar in the New York traffic control center. He said that, after a personal call to Ralph Cordiner, General Electric president, the time was finally whittled down to 31 days. Air Line Pilots Assn. also registered a strong complaint against time lag with Senate committee.

Warning against any moves designed to implement a solid IFR ruling for all aircraft, Pyle told the committee that such action would "wreck the entire system." CAA, he said, has made marked progress in absorbing IFR flights and currently handles 17,000 a day.

He pointed out, however, that daily VFR operations alone approach the 200,000 figure.

A lack of adequate manpower alone precludes any possibility of a greatly accelerated positive control program, Pyle said.

He added that the increasing complexity of equipment and volume of traffic requires a training period of almost two years for traffic controllers.

Manpower Problem

Compounding the problem, Pyle explained, is the annual loss of nearly 1,000 controllers and the transfers of experienced men from high-density traffic areas to smaller terminals. He said the mental strain on controllers, which would be intensified with an expanded system, is already so great that CAA is conducting studies of stress and strain upon personnel at the major terminals.

CAA's authority to implement the five transcontinental positive control airways stems from the Civil Aeronautics Board proposed rule that gives the CAA the right to designate any portion of the airspace as a "positive control route segment" (AW April 28, p. 40).

Specifically, here are the steps the CAA will take to tighten control of airspace as a means of reducing the collision threat:

• **Three airways will be placed** under positive control on all segments where facilities permit such action. Complete control of the airways is not possible until long-range radars are fully implemented on the designated routes.

• **VFR terminal radar advisory services** will be implemented at major airports by Sept. 1. The plan, now undergoing tests by CAA at Indianapolis, will permit controllers to warn aircraft of traffic converging on a collision course by reference to airport surveillance radar.

• **Segregation of high performance jet** aircraft from piston-engine aircraft. CAA will strengthen boundary control of restricted military areas in order to prevent erroneous trespassing of the boundaries in either direction. CAA admitted that restricted areas may be expanded in order to confine military training and tactical operations to specified areas and added that airways will not be laid out in a straight point-to-point pattern but will be required to "go around" the military areas.

• **CAA has sent teams of experts** to visit military bases to determine individual requirements of each installation. In using its authority to establish restricted airspace areas, CAA is not issuing blanket rulings but is attempting to handle each case separately in conjunction with military commanders.

Quesada Testifies

Elwood Quesada, chairman of the Airways Modernization Board, told a House Legal and Monetary Affairs subcommittee that the AMB has no control over airspace. He explained that he was seeking interim relief from the midair collision hazard through the Air Coordinating Committee of which he is also chairman.

He said he acted to persuade the military services represented on the ACC to relinquish some of their prerogatives on a voluntary basis as a means of bypassing drawn-out rule-making procedures to accelerate the introduction of emergency measures. Under questioning from subcommittee members, Quesada said the ACC has no jurisdictional or policy-making authority in the airspace issue.

Later, he explained that, under the arrangement volunteered by the military services, military jet aircraft flying across federal airways or under an altitude of 20,000 ft. would be subject to CAA air traffic control procedures. He said the action, which will be adopted immediately, is the first of a series of steps contemplated as interim measures in segregating military and civilian aircraft.

Overloaded System

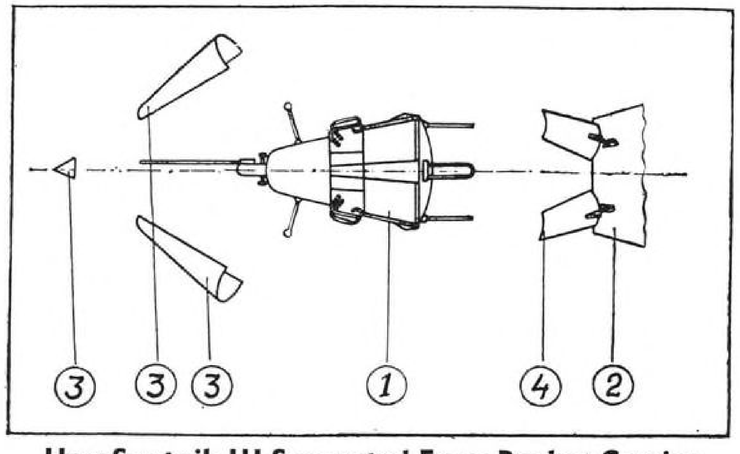
Members of both the CAA and CAB were cautious in estimates as to how much more IFR traffic the present airways system could accept without becoming bogged down. Generally, the consensus was that the airways are now operating at peak capacity and that an increase of additional military traffic would impose a severe strain on the present system.

Air traffic controllers warned that a rapid increase toward positive control of all traffic would either result in a breakdown of the present system or force the grounding of "some 85% of present sky users." Aircraft Owners and Pilots Assn. "demanded" that high-performance military jets, "including the cen-

Establishment of Navigation Facilities

(Scheduled by Civil Aeronautics Administration for Fiscal Years 1959-1963)

FACILITIES	Through Fiscal 1959	In Plan	Through Fiscal 1963
LONG RANGE RADARS:			
Air Route Surveillance Radar	40	60	100
ATC Radar Beacon	—	100	100
Terminal Area Radar:			
Airport Surveillance Radar	62	76	138
Airport Surface Detection Equipment	—	30	30
Precision Approach Radar	23	—	23
ATC Radar Beacon	—	189	189
ATC Tower Service	224	69	293
Air Navigation Facilities (VORTAC):			
VHF Omnirange (VOR)	634	43	677
Backfit VOR With Tacan	299	337	636
VORTAC	47	526	573
VOR Test Signal	31	79	110
INSTRUMENT LANDING SYSTEMS:			
ILS Only	195	40	235
Backfit ILS With Tacan RHO	—	225	225
ILSTAC	—	20	20
Approach Lighting:			
Standard Approach Lighting	89	146	235
Sequence Flashing Lights	36	47	83



How Sputnik III Separated From Rocket Carrier

Method by which Russia's Sputnik III was separated from its rocket carrier and from its own protective casings is illustrated in Soviet sketch. To minimize heat and aerodynamic effects on the pickups for scientific apparatus in satellite's forward section during passage through dense atmospheric layers, front part was enclosed in a three-piece shell consisting of two halves of a cone-shaped shield, and a small cap at the tip. These parts separated from Sputnik III and from each other as the satellite went into orbit. A protective casing for the rear section of the satellite consisted of four shields hinged to the rocket carrier. These four pieces remained attached to the rocket carrier when the satellite separated from it. Sketch shows satellite (1); rocket carrier (2); protective cone-shaped shields and tip for the satellite's nose section (3); and hinged shields (4) which protected satellite's rear section and remained attached to rocket carrier.

tury series of fighters, be banned from airways altitudes and landing facilities used by civil aircraft."

Testifying before the House Legal and Monetary Affairs subcommittee, Oscar Bakke, director of CAB's Bureau of Safety, said every step toward positive control that can be implemented will be helpful but admitted that under present conditions, the total amount of help under procedures proposed as crash program "will be small."

Bakke said latest studies of near-miss reports by the CAB indicate that there is a definite trend toward an increase in near-misses at high altitudes. He added that the collision hazard at lower altitudes has stabilized and shows no signs of an upturn.

Clarence Sayen, president of the Air Line Pilots Assn., termed today's method of air traffic control as a "collective compromise" and endorsed immediate adoption of legislation to create a single federal agency to control air space.

He advised Senate Aviation Subcommittee members to avoid "lengthy quibbling" over fine details of the emergency legislation in order to avert any additional air tragedies.

Sayen charged that present regulations permitting military VFR flights in scheduled airlines' IFR airways allow pilots to "kill each other legally." He said the time honored "see and be seen" theory used by the majority of civilian and military flights is no longer adequate since the necessary time for evasive action is "practically gone." He added:

"Pilots can't sit on the edge of their seats for eight hours of surveillance and maintain a high peak of efficiency."

Tactical Air Command Will Test First Production Line F-105Bs

Farmingdale, N. Y.—Tactical Air Command's 335th Squadron, Fourth Tactical Fighter Wing, took delivery of first production line Republic F-105B Thunderchief supersonic fighter-bomber here last week to start a new program of operational testing aimed at speeding entry of the airplane into service.

First aircraft was accepted by Gen. O. P. Weyland, commander of TAC, who called it the first airplane tailored to the fighter-bomber role embodying considerable information learned during tactical operations in World War II and the Korean conflict.

Operational Next Year

First wing of F-105s is expected to be operational next year. To speed transition of the Thunderchief from test to squadron use, the 335th, commanded by Lt. Col. Robert R. Scott, will carry out operational and functional testing of the airplanes at Eglin AFB, Fla., under a new USAF directive whereby TAC will carry out many functions previously handled by Air Proving Ground Command. The TAC squadron will work with a joint test staff from Weapon Systems Project Office, Air Materiel Command, Air Force Flight Test Center, APGC, Wright Air Development Center and Republic Aviation. Under the program the test squadron will form the nucleus of the wing to receive the aircraft, eliminating test duplication with a central data collection.

Program is expected to shave one to two years from previous time required for the acceptance-to-squadron-use cycle, also will require use of fewer aircraft, providing in addition, a more economical program than previously. Other benefits will include more flexibility in the test program than by previous methods, also, all maintenance and logistical data collected will be simultaneously fed into user squadron procedures during the course of the program.

Production Contracts

Volume production of the Thunderchief will begin this fall; Republic's schedules run through 1960 with contract extensions pending for 1961.

Current contracts total some $347 million.

Gen. Weyland noted that the F-105 will be capable of conventional and atomic weapons delivery from tree-top level up to 50,000 ft. Plane incorporates a General Electric MA-8 fire control/bomb system permitting all altitude and attitude deliveries by varying inputs for particular delivery desired. In addition to nuclear weapons, the airplane can be fitted with rocket clusters, some 4,000 lb. of conventional bombs, napalm, guided and unguided missiles.

Its single GE T-171E3 Vulcan six-barrel cannon is capable of firing rate of 6,000 rounds/minute of explosive 20-mm. shells using a new two-belt feed system especially developed by Republic engineers. Lockheed F-104 Vulcan is believed to have 4,000 round/minute firing rate. System in the F-105 has each of the two belts feed shells alternately with belts timed to 3,000 round/minute rate each. At 1,000 yd., the fire pattern is approximately eight yards.

When the Thunderchief is flying at 1,000 mph., projectiles are traveling some 49 ft. apart.

Among the Korean War lessons incorporated in the F-105 are:

- **Internal weapons stowage** permitting higher speed delivery and also deception.
- **Capability of carrying** varied load of weapons for striking at large variety of targets using most efficient loads. Airplane's area ruling takes into account large variety of external stores that are required.
- **Stable platform** for weapons delivery is provided by minimizing pitchup and yaw through use of low-set tailplane and incorporation of large ventral fin. Petal type dive brakes are also designed to minimize instability during delivery.
- **Use of afterburner** to get the airplane off from normal fields with heavy loads. F-105 is designed to get off in under 5,000 ft. when in clean configuration, i.e., carrying internally stowed weapon. A 335th pilot told AVIATION WEEK that he believed the airplane will have superior takeoff characteristics when loaded than will the squadron's current North American F-100Cs, which it is replacing.

Ejector System

An important factor in the airplane's performance is the company-designed ejector system which expels air taken through the dorsal fin, venting it through the tailpipe for a speed gain of approximately 15%.

Powered by Pratt & Whitney J75 engine of 15,000 lb. thrust plus afterburner power, the F-105B is a "near-Mach 2" airplane. Performance puts it right back on the brink of capability of current Plex-55 cockpit canopy material to take skin temperatures, AVIATION WEEK learned.

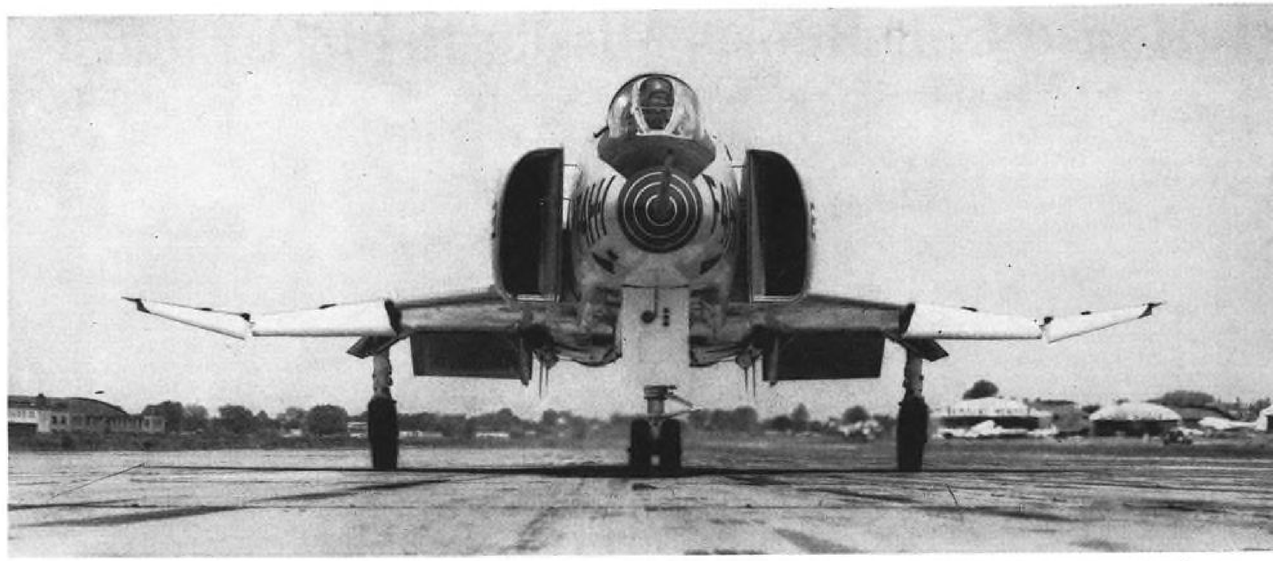
Later, more advanced versions will probably require a tougher material in this area. Plane has Collins communications, navigation and interrogation package.

Republic currently has a buddy refueling system store undergoing testing designed around a standard 450-gal. F-105B external fuel store. Tank will contain refuel gear and some 350 gal. of fuel.

F-105 is designed to carry four 450-gal. capacity tanks internally plus internally stowed fuel for air-to-air refueling.

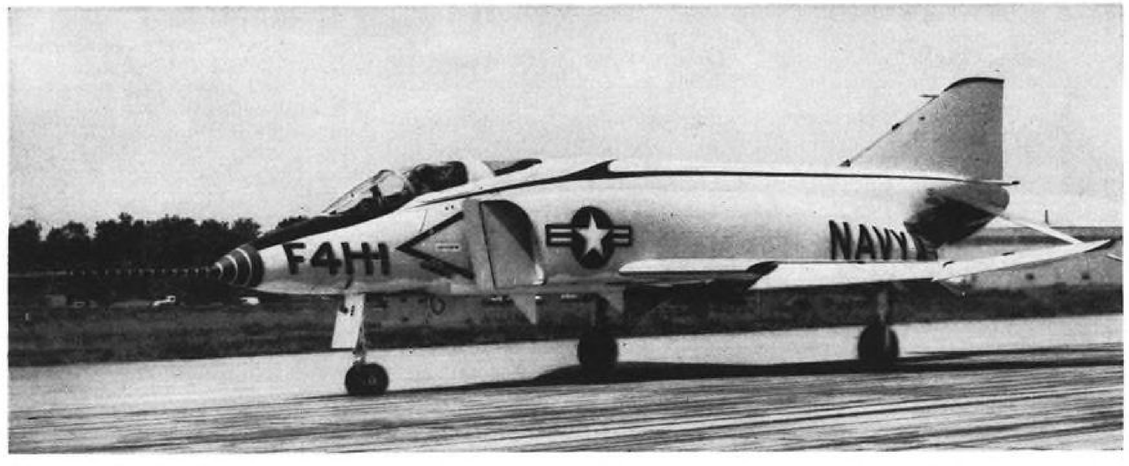
Boeing KB-50J jet-assisted tanker operating at 25,000-30,000 ft., will also be used.

Later versions of the Thunderchief include the single-seat F-105D day fighter incorporating additional avionic equipment and the tandem two-place F-105E mission profile trainer and tactical all-weather fighter-bomber. F-105D is expected to roll out in 1959.



McDonnell F4H-1, designed to fly at more than Mach 2, is said to have greatest range of any Navy turbojet fighter. All-weather aircraft, Navy's first supersonic two-seat twin jet, will carry air-to-air missiles and is capable of long-range delivery of conventional and nuclear bombs. Wing is swept back 45 deg.; horizontal tail slopes downward 25 deg. to improve handling at all speeds. Aircraft is 56 ft. long; wing span is 38 ft. 5 in. Note unusual increase in incidence at wing tips. Also note Sparrow III air-to-air missiles mounted on belly.

McDonnell Unveils F4H Navy Fighter



Soviet Scientist Hits Long Lead Times

Moscow—A leading Russian space scientist has expressed concern over the long lead times required to bring new Soviet electronic equipment from the drawing board to mass production.

Writing in the official government newspaper, Izvestia, Academician A. Blagonravov complains that "the time between conception of a new Russian electronic device and its industrial mastery is inadmissibly great—four to seven years—whereas in the U. S. it is only one to two years.

"The miniaturized M-3 computer, for example, was designed four years ago. The first models were built in 1956 and have been used successfully to date. Yet, the USSR State Planning Committee has already spent about a year trying to decide how to put this machine into quantity production."

Blagonravov also charges that the USSR's radio engineering and electrical industry "still has not achieved efficient mass production of standard, miniature electronic parts, elements and assemblies, especially semiconductor devices." Much of the blame for this situation, he asserts, lies with Soviet planning and coordinating agencies.

British May Produce Short-Haul Jetliner

London—Consortium of de Havilland, Hunting and Fairey is considering production of a twin-jet short-haul transport, the P.107, designed by Hunting Aircraft. Decision is expected this summer.

Consortium—called Aircraft Manufacturing Co.—was formed originally to produce the three-jet de Havilland 121.

P.107 reportedly would have two Bristol Orpheus engines, a 600-800 mi. range and seats for 40. Fully equipped, aircraft would cost $750,000.

House Unit Boosts Missile Project Funds

By Katherine Johnsen

Washington—House Appropriations Committee last week made increases in key Fiscal 1959 defense programs totaling over $1 billion above those asked by the administration. The increases were primarily made to accelerate key missile projects.

These increases were offset somewhat by decreases of $907 million—a substantial part due to "paper changes."

The net increase of $114 million in the President's budget boosted the total to $38.3 billion. This is $3.8 billion more than Defense Department's Fiscal 1958 budget.

Proposed Increases

House Committee increases were for:

• **Polaris fleet ballistic missile** program, $638 million. The President asked for only $336 million for two additional atomic-powered Polaris-equipped submarines. One was previously funded for in January. The $638 million is for an additional six, making a total of eight in the Fiscal 1959 program. In addition, Navy's research and development budget was increased $71 million for work on the Polaris program.

• **Minuteman multi-purpose ballistic** missile program, $90 million—$15 million is for research and development and $75 million for procurement of the solid-propellant ballistic missile.

• **Hound Dog air-to-ground missile,** $48 million to fully equip B-52 forces.

• **Emergency projects,** $65 million—$85 million was asked for the Secretary of Defense to move forward with advanced research and development projects promptly as developments make this possible, plus authority to transfer funds from other military appropriations up to $50 million. The committee provided $150 million and increased the transfer authority to $100 million.

The Secretary of Defense, for the first time, would be authorized to engage directly in test, evaluation, production, and procurement. Up to now the Secretary has been restricted to direct activity in research and development—through use of emergency projects funds and funds for Advanced Research Projects Agency.

ARPA Budget

The committee approved the full $520 million proposed for ARPA for research and development on anti-ballistic missile missiles, space technology and other advanced science programs. Only previous funding of ARPA was $10 million in January.

Defense Department's request for authority to transfer up to $2 billion from one service to another or from one activity to another was rejected.

The House group emphasized that "the sole basic purpose of the defense program is to provide for the military requirements of the nation," but added:

"It is, of course, fortunate that as a by-product of defense spending we can reap added dividends in increased employment and industrial activity." Defense Department was directed "to be ever conscious of the economic impact of defense spending and to conduct its activities in such a way as to make a maximum contribution to economic stability."

The Fiscal 1959 defense program—despite a $3 billion increase in appropriations—calls for only moderate increases in new obligations and expenditures. Obligations estimated at $41.6 billion compare with $41.1 billion for Fiscal 1958; expenditures estimated at $37.4 billion compare with $37.1 billion for Fiscal 1958.

Funds for procurement of executive aircraft were eliminated and requests for aircraft spares and parts were slashed.

Reduce Spares

The committee directed the services to reduce procurement of initial spares and parts to 20% of the flyaway cost of aircraft. It is now running up to 38%. The total reduction of $343 million in spares and parts was divided: USAF, $200 million; Navy, $143 million; Army, $15 million.

A total of $21.8 million was cut from USAF's procurement budget for 10 executive planes with the committee comment that it could see "no valid justification for . . . aircraft for the limited purpose of transporting government officials and documents." The committee said Navy already has a sufficient supply of administrative-type aircraft and eliminated $2 million proposed for additional planes.

Funds approved for the research and development programs of all three services for Fiscal 1959 are substantially over this year's figures.

• **Army: $499 million,** $99 million over Fiscal 1958. The major increases are for the Nike-Zeus system and Pershing and Sergeant missile systems.

• **Navy: $821 million,** $294 million over Fiscal 1958.

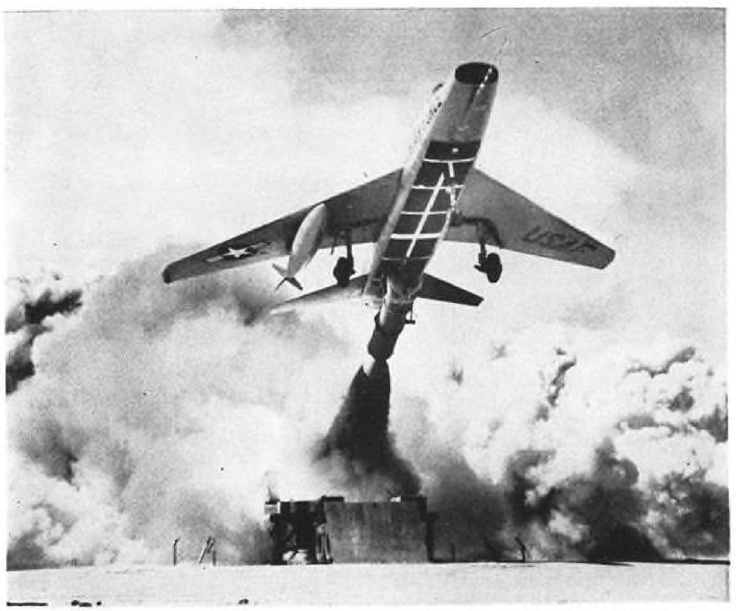
• **USAF: $743 million,** $52 million over Fiscal 1958.

Details on the over-all aircraft and related procurement budgets approved by the committee are:

• **USAF: $6.3 billion,** $422 million over the Fiscal 1958 allocation. This provides for 982 new aircraft, including 39 B-52s and 26 KC-135 tankers. The emphasis is on high performance jet fighters and jet fighter bombers. Further development of the B-70 chemical bomber is provided. Over $2 billion is for guided missiles and components.

• **Navy: $1.9 billion,** $110 million over the Fiscal 1958 allocation. The 697 new aircraft provided for include an advanced carrier based aircraft in the airborne early warning field; carrier based attack planes; troop and cargo transport helicopters for use in the Marine vertical envelopment operation; an improved version of anti-submarine patrol aircraft; turboprop anti-submarine helicopters; Grumman S2F anti-submarine aircraft, and the Martin P6M seaplane. The committee stipulated that procurement funds could be used for only one of two new Navy all-weather fighters—the McDonnell F4H-1 and Chance Vought's F8U-3.

• **Army: $1.6 billion.** This includes $130 million for procurement of initial sets of equipment for the Nike-Zeus anti-missile missile system and $98 million for 420 aircraft. Other missiles in Army's Fiscal 1959 procurement program include the Hawk air defense missile, Nike-Hercules air defense missile, Redstone surface-to-surface missile, Sergeant surface-to-surface, La-Crosse close support missile and Dart anti-tank missile.



F-100D Fighter-Bomber Is Zero-Launched

North American F-100D Super Sabre fighter-bomber is shown being zero-launched "fully combat loaded" at Edwards AFB, Calif. Note fuel tank under left wing, retouched area under right wing. Gen. O. P. Weyland, commander of Tactical Air Command, has said that the F-100D can and does carry a hydrogen warhead weapon for tactical use.

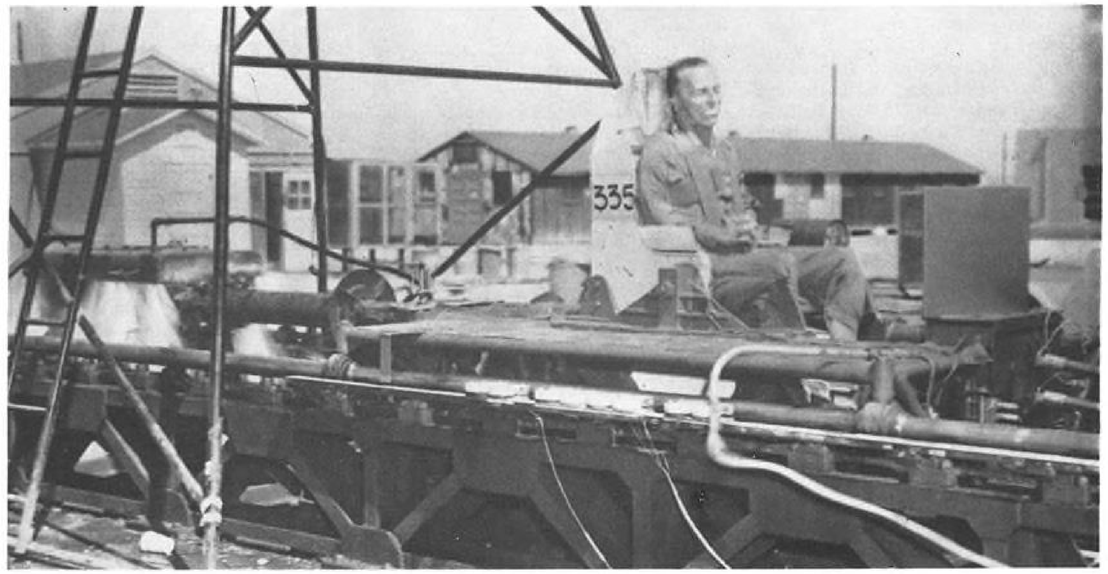
Committee Proposals

Points made by the committee in its report included:

• **Defense Department should utilize** the facilities of commercial research organizations for basic research. The committee said there is now a "reluctance" to do this. It also protested the heavy overhead costs—varying from 30% to 65%—of universities on military research contracts.

• **Special flight pay status** must be restricted to those "who have a real combat proficiency requirement." The committee commented that "it is evident that a great deal of this flying is continued for the sole purpose of qualifying for continued flight pay. . . . Abuses in the field of so-called proficiency flying are reported to members of Congress constantly. . . ." The committee directed the services to make progress reports by next January.

• **Navy should increase emphasis** upon awards to private industry on a competitive basis for aircraft maintenance and overhaul. Cutting Navy's budget by $6 million, the committee said that if Navy did this and there were "a more prudent operation of the overhaul and repair program," the reduction could be offset "without difficulty."



USAF Captain Withstands 83Gs on Holloman Sled

Force of 83Gs was successfully withstood by Air Force Capt. E. L. Beeding seated backwards and in an upright position during a 120-ft. rocket sled run at USAF's Holloman Air Force Missile Development Center, N. M. Highest G number previously successfully encountered was a force of approximately 40Gs. Water cylinder brake stopped rocket sled.

USAF Units Shift Command Jobs

Washington—Number of organizational and personnel changes have taken place or are planned in USAF's office of Deputy Chief of Staff for Development and Air Research and Development Command. They include:

• **Maj. Gen. R. P. Swofford, Jr.,** director of research and development in the deputy chief of staff's office, will become assistant deputy chief of staff for development under Maj. Gen. Roscoe Wilson, who is succeeding Lt. Gen. Donald L. Putt as deputy chief. Maj. Gen. J. S. Mills moves from the assistant deputy's job to command of San Bernardino Air Materiel Area, Norton AFB, Calif.

• **Maj. Gen. Marvin C. Demler,** ARDC's deputy commander for Research and Development, will succeed Gen. Swofford in that post.

• **Maj. Gen. Leighton I. Davis,** commander of Air Force Missile Development Center, Holloman Air Force Base N. M., will succeed Gen. Demler on July 1.

• **Brig. Gen. Daniel E. Hooks,** 109th Special Weapons Squadron, Wash., D. C., will succeed Gen. Davis on June 20.

• **Maj. Gen. Joe W. Kelley,** director of legislative liaison, Secretary of the Air Force, will take command of ARDC's Air Proving Ground Center, Eglin AFB, Fla. Present commander, Maj. Gen. Robert W. Burns, will go to Fifth Air Force in the Pacific.

ARDC has increased its deputy commanderships from three to five, adding a deputy commander for air defense sys-

tems integration over the Air Defense Systems Integration Division, at Cambridge, Mass., and changing Maj. Gen. Bernard A. Schriever's title from assistant to the commander, ARDC, to deputy commander, Air Force Ballistic Missiles. Maj. Gen. K. P. Bergquist heads the new Systems Integration office.

It is possible that Gen. Schriever will be assigned to ARDC headquarters at Andrews AFB and replaced at Ballistic Missile Division, Inglewood, Calif., by Maj. Gen. Don R. Ostrander, presently deputy commander for resources at ARDC headquarters, although ARDC spokesman said there is "nothing official" on this report.

Brig. Gen. Don Flickinger, director of life sciences and command surgeon for ARDC was given title of special assistant for bioastronautics under the deputy commander for ballistic missiles. He will remain at Andrews.

ARDC also has created an office of assistant deputy commander for space systems under the deputy commander, Weapon Systems, to handle new work in this field. It is headed by Lt. Col. Charlton G. Strathy.

Col. Carlo R. Tosti, former information services officer, has been named special assistant to the commander, ARDC. He has been replaced by Lt. Col. William S. Evans, Jr., formerly of Air Proving Ground Center, Eglin AFB, Fla.

GE Turbofan Passes 50 hr. Test

By Craig Lewis

Houston—General Electric Co. has completed a 50 hr. test of its turbofan version of the J79 engine, and the new powerplant has logged over 100 hr. on the test stand. First flight is expected in the fall.

New engine is a modification of the military J79 and civil CJ-805 designed to provide a more efficient powerplant in the Mach .80 to Mach .95 speed range. Details were revealed at the Aviation Writers Assn. convention here last week.

Most immediate application of the turbofan powerplant, called an aft-fan by General Electric, is the Convair 880 transport, and the ability of the engine to provide increased efficiency and economy will be a key factor in airline decisions to fill out their turbine fleets.

Bypass modification is expected to increase takeoff thrust of the basic engine by about 35% and improve cruise fuel economy by 8-12% (AW April 14, p. 40). Engine is rated in the 15,000 lb. class.

Engine uses about 80% of the basic major components of the J79 and the CJ 805 powerplants.

Aft-fan modification is a relatively simple addition to the basic J79 engine. It can be produced as an integral section of a new engine, or it can be added as a modification to current J79 engines.

Since the bypass air enters its single stage compressor fan nearly at the end of the engine case, a number of inlets can be used, including annular or cheek inlets near the rear of the engine. An envelope for bypass air could also be extended the length of the engine, but the extra metal would contribute a weight penalty.

During an AWA convention trip to Corpus Christi Naval Air Station, Sikorsky demonstrated a new version of the S-58 with instrument flight capability. HSS-1N combines new systems and modifications with Sikorsky's automatic stabilization equipment to permit a pilot to operate the machine without ground reference.

Changes include incorporation of new radars for measuring ground speed and altitude, improvement of flight instrument and cockpit layout, addition of automatic engine controls and use of an automatic hover coupler. This coupler uses radar to determine ground motion, permitting the helicopter to move on automatic control from an 80 kt. airspeed at 200 ft. to a ground zero speed hover at 50 ft. over a pre-selected site.

Doppler radar ground velocity system used is built by Ryan Aeronautical Co. AN/APN-97 unit automatically measures heading, drift and vertical components of aircraft velocity. It works without ground stations, wind estimates or true air speed data. The 30 lb. system contains a radar receiver-transmitter and a power supply-signal data converter.

In Corpus Christi, the Navy announced five new climbing speed records set by Maj. Edward N. Lefaivre in a Douglas F4D-1. Flying from Naval Air Missile Test Center at Pt. Mugu, Lefaivre flew to 15,000 meters (49,212.5 ft.) in 2 min. and 36 sec.

Other records, which will be submitted to Federation Aeronatique Internationale as world records, were flights to 3,000 meters (9,842.5 ft.) in 44.39 sec.; to 6,000 meters (19,685 ft.) in 1 min. and 6.13 sec.; to 9,000 meters (29,527.5 ft.) in 1 min. and 29.81 sec.; and to 12,000 meters (39,370 ft.) in 1 min. and 51.23 sec. Records for these four altitudes have been held by the French Gerfaut 88.

Discussing high energy aviation fuels, Robert A. Wells, Gulf Oil Corp. staff engineer, told an AWA session of a new material called tributyl borane which has been synthesized for pyrophoric fuels. Unlike other types, tributyl borane doesn't burn when exposed to air, but it has to be sprayed before it shows it pyrophoric characteristics.

Other developments:

• **New ground control system** will be developed for Bomarc interceptor missile by Westinghouse Electric Corp. under a $10 million contract. Westinghouse will develop a more advanced system for guiding the missile during its flight to target area where terminal guidance system takes over. New system will replace Westinghouse system used in Bomarc.

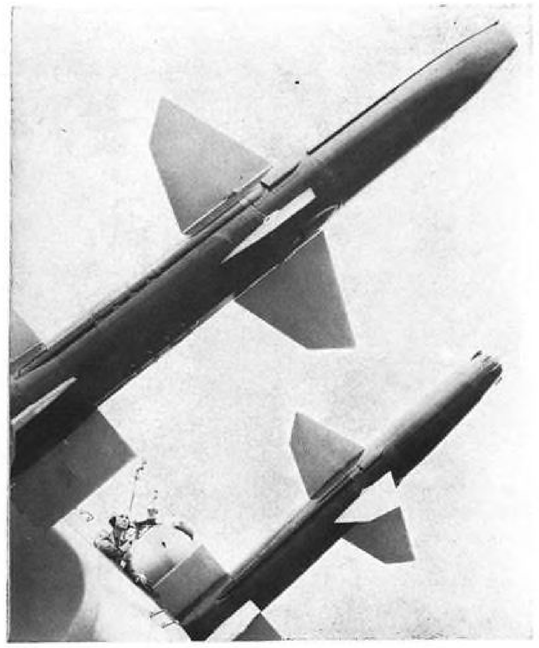
• **Dow Chemical Corp.** has developed a new magnesium alloy with high damping capacity. The K1X1 alloy will be useful in aircraft and missiles where vibration damping is necessary and especially in electronic equipment areas, Dow said.

• **New, small size Mach 3** variable density research wind tunnel for magneto-hydrodynamic boundary layer research has been designed and built by Space Technology Laboratories Division of Ramo-Wooldridge Corp.

• **Goodyear Tire and Rubber Co.** has decided that nuclear radiation is no bar to the use of rubber tires on atomic aircraft. After exposing airplane tires to radiation for two years, Goodyear found that using nitrogen instead of air to inflate the tires helps protect them from damage. As nitrogen diffuses through the tires, it forms a protective cloak around the cords and prevents their degradation.

P&W Moves Into Rocket Field

West Palm Beach—Pratt & Whitney Aircraft completed a major step last week in a program designed to broaden the company's powerplant line as rapidly as possible to include rocket engines and other units for very high speed flight. The step included the opening of an engineering office, a very large shop for building experimental engines and a small open air test area for turbojet engines. During the dedication of this isolated complex situated on a 10 sq. mi. tract on the edge of the Everglades, Lt. Gen. Clarence S. Irvine, USAF, deputy chief of staff, materiel, indicated that Pratt & Whitney's expansion move includes work here with boron and hydrogen fuels. First large design project P&W has moved to Florida is the J58, Mach 3 Navy turbojet which is running on the test stand.



SUPERSONIC Bendix-Talos ramjet-powered guided missile is carried aboard U. S. Navy cruiser Galveston (left), which was commissioned last week at Philadelphia. Missile, built by Bendix Aviation Corp., has range of more than 65 mi. At right, missile in foreground is nuclear armed with "clean" nose except for pitot line visible in photo. Talos in background is conventional version which uses semi-active guidance for homing on target, has four antennas located 90 deg. apart around periphery of nose. Several other ships will be fitted with Talos.

Talos Has Conventional, Nuclear Punch

By Phillip J. Klass

Philadelphia—Two types of Talos missiles—one with a conventional warhead, the other nuclear and employing slightly different guidance techniques—will be used aboard Navy's USS Galveston, first of a series of Talos-equipped cruisers. The Galveston was commissioned here last week.

Both versions of Talos produced by Bendix Aviation Corp. are intended primarily for long-range fleet air defense but can also be employed against enemy ships or surface installations. Range of the supersonic, ramjet-propelled Talos is quoted at "more than 65 min." and its level flight ceiling at "higher than that reached by any bomber." The 3,000 lb., 30 in. dia. missile is 30 ft. long.

Sperry-designed radar is used to guide both types of Talos to target vicinity using beam-rider guidance techniques. Nuclear armed version, for use against large formation targets, is detonated by radio command from shipboard. Conventional warhead Talos, used against single targets, switches over to semi-active guidance in final phase of attack, homes in on shipboard radar energy reflected from target.

Warhead is detonated by proximity fuse. Conventional armed Talos is distinguished by four homing guidance antennas spaced 90 deg. apart, in the nose. Nuclear Talos has only pitot tube.

Galveston is equipped with single aft-located rotable launcher which can fire two missiles individually or practically simultaneously as required. Dual target tracking radars (AN/SPG-49) and two smaller guidance radars (AN/SPW-2), both Sperry designs, permit each missile to be directed at different, widely separated targets.

Launcher, built by Northern Ordnance Co., can be automatically reloaded in seconds. Another pair of Talos missiles can be fired as soon as tracking and guidance radars are freed from previous target assignments.

Galveston, completed shortly after World War II but never commissioned, was taken out of mothballs two years ago for conversion to a light cruiser missile role. Ship, expected to become operational this summer, will serve as guinea pig for other Talos-equipped cruisers, including the first nuclear-powered cruiser, the USS Long Beach.

Galveston will be used to integrate capabilities of Talos with piloted interceptors in fleet air defense. Galveston is equipped with Tacan transmitter which enables interceptor pilots to pinpoint her position and stay outside the range of Talos. Galveston is commanded by Capt. John B. Colwell, former deputy director of Navy's Polaris program.

Bendix is prime contractor for Talos missile, but Vitro Corp. holds responsibility for integrating missiles, guidance radars, computers and other weapon support items. Airframe and ramjet engine are produced by McDonnell Aircraft. Talos is outgrowth of Johns Hopkins University's early post-war Bumblebee program.

Vanguard Try

Navy attempt to place a 20 in. dia. Vanguard satellite into orbit failed last week, possibly due to malfunction of vehicle's pitch-axis programming mechanism. Initial data indicated that all three stages fired successfully, that satellite was ejected and reached an altitude of approximately 2,000 mi. before it plunged into the Atlantic. Radio signals were received from the satellite for approximately 18 minutes. Officials hope to launch another fully instrumented satellite sometime next month.

ALPHA SECTION seen from direction of the Assembly building. Explosion apparently originated between launching position four at far left and launching position three at center. Arrow points to crater about three feet deep where nose and center warheads removed from missile that was being modified are believed to have been placed. Metal framework has all been extensively perforated by pellets from exploding warheads.

Nike Ajax Probe Nears End

Middletown, N. J.—Investigation of the explosion of eight Nike Ajax ground-to-air missiles at the site of Battery B, 526th AAA Missile Battalion here is expected to conclude this week.

Battery launching site consists of three launching sections, each capable of launching four missiles without reloading. Explosion was centered in Alpha section, the closest section to the Assembly building where missiles are assembled prior to fueling and insertion of warheads. Ten persons were killed.

On the basis of physical evidence and accounts of witnesses, this appears to have been the sequence of the accident:

• **Prior to the accident,** battery had been at "red alert" status which was required for raising missiles above ground for operational checks of such active equipment as the missiles' radar beacons. One missile was at each of the 12 launching positions. A few minutes before the accident, the battery changed from "red alert" to "yellow alert"—required as long as equipment is in operation—and prepared to secure.

• **Three additional missiles** had been brought above ground and placed on the Alpha launching section (the metal framework connecting the four launchers with the elevator to the underground storage chamber). These three missiles were positioned horizontally between the four missiles undergoing operational checking so that Ordnance Corps technicians could replace the missile arming device with an improved model. Therefore Alpha section mounted seven operational missiles, Bravo and Charlie Sections each mounted four operational missiles.

• **Explosion apparently originated** with missile undergoing modification between launcher positions three and four, the two positions closest to the Assembly building. To replace the arming mechanism, two of the three warheads in the missile (nose and center warheads weighing 12 and 179 lb. respectively) had to be removed. Crater about 12 ft. in front of position where the missile was suggests these warheads were lying on the ground at the time of explosion. Aft warhead (122 lb.) would remain in the missile with primer cord removed.

• **Warheads are wrapped** with several hundred small pellet cubes about 0.25 in. to a side. Detonation of the aft warhead of the missile being modified would drive these pellets into the warheads and fuel tanks of adjoining missiles. Fuel for Nike-Ajax is red fuming nitric acid and kerosene. Explosion of other missiles could result from pellet impact on warheads, fuel fires, or blast concussion.

• **All seven missiles** in Alpha section exploded. Eighth missile was in launcher position four of Bravo Section, the nearest adjoining missile. This missile apparently did not explode but had its booster ignited by a flying red-hot pellet which blasted the missile into the side of a nearby hill. Failure of this missile to explode may have saved the remaining missiles.

Nike-Ajax warheads use an explosive called Composition B—a relatively inert explosive somewhat similar to RDX. Missile is command guidance type, fired by a "burst command" generated by the ground computer and transmitted by the missile tracking radar as a coded variation in the timing of its double-pulsed transmitter.

Economic Study

President Eisenhower has instructed his special assistant, Elwood Quesada, to conduct an extensive survey of the economic problems facing the aviation industry as a major part of an over-all investigation of the U. S. economy. Paul Cherington, associate professor of the Harvard Business School, has been retained by Quesada to gather factual data pertaining directly to the economics of the entire industry.

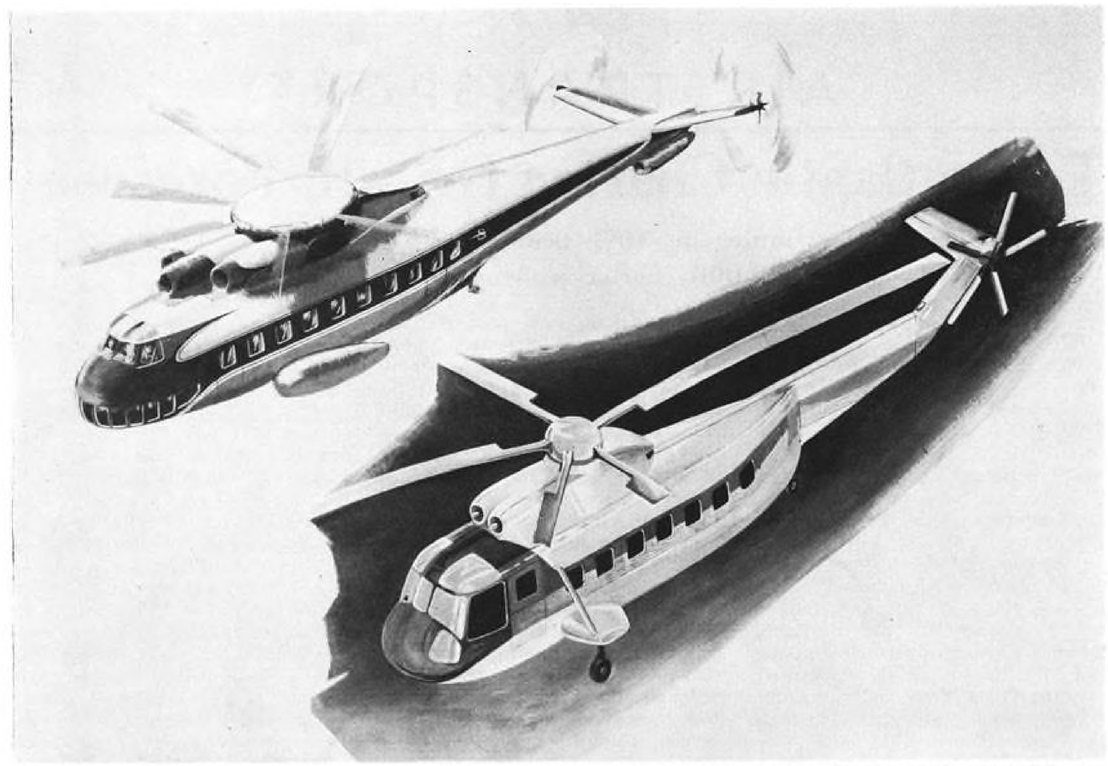
News Digest

General Electric Co. has received USAF contracts leading to development program of more than $100 million for J93 jet engine which will power North American B-70 chemical bomber. Preliminary development work has been under way for several months at General Electric's Aircraft Gas Turbine Division, Evendale, Ohio. Company said details of contracts and design are "highly classified."

Breguet's 940 Intregal, four-engine experimental STOL aircraft, has made its first flight at Villacoublay, near Paris. Aircraft weighs 14,000 lb., is powered by four Turbomeca turboprop engines of 400 hp. each. Later model will weigh 36,000 lb. and will be powered by four turboprop engines of 1,200 hp. each.

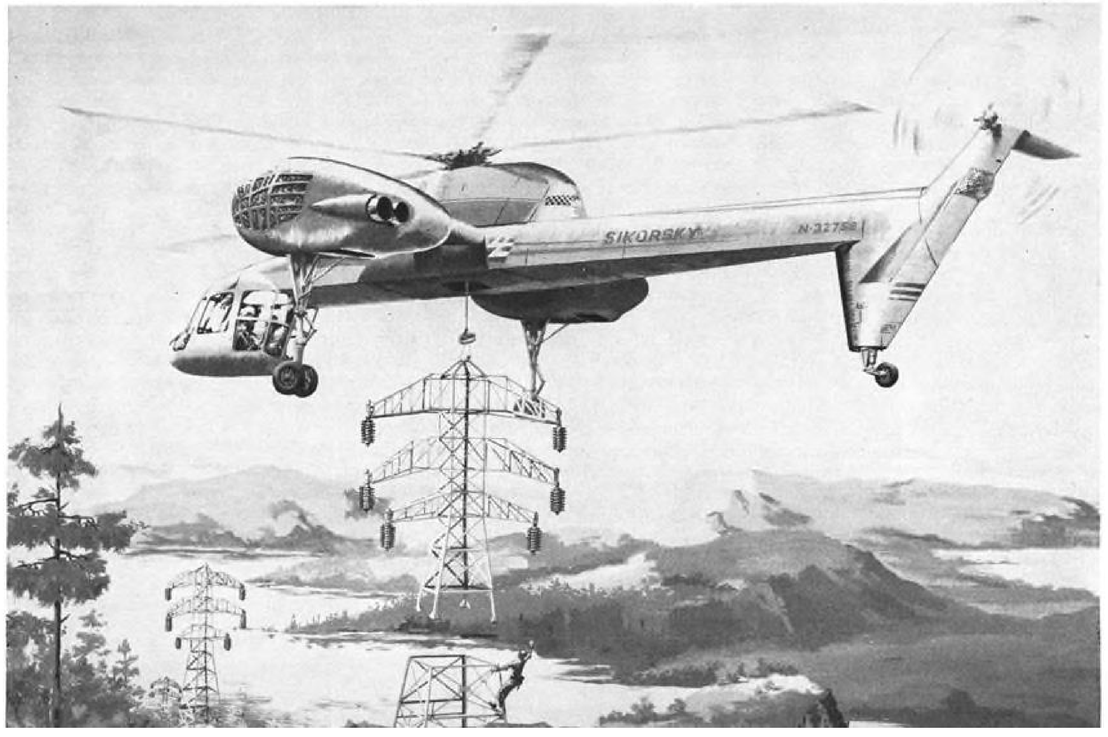
Turbine blade manufacturing process, expected to reduce cost by approximately 50% over any currently used process, has been developed by General Electric's Small Aircraft Engine Department, Lynn, Mass. Special roll and coin method, in pilot plant production by General Electric; overcomes problem of economically making blades for T58 turboshaft, which have a high ratio of airfoil thickness to platform width. Although designed for T58, process is readily adaptable to other engines, company notes.

Second Fairchild F-27 is now flying. Aircraft will continue company flight test program and fly CAA certification flights.



Sikorsky Studying Flying Cargo Crane, Transport Designs

Three advanced helicopter designs on Sikorsky Aircraft's drawing boards include: top left, a 50-passenger triple-turbine type designed to meet International Air Transport Assn.'s scheduled airliner specifications. Project has an auxiliary turbine under tail for boosting forward speed. Twin tail rotor layout is planned to decrease side thrust loads that would be too high using a large single rotor. Smaller type (right) visualizes how new twin-turbine 25-passenger S-61 will look in commercial service. Military model, with amphibious hull, is scheduled for rollout next year. Los Angeles Airways is considering the ship for its future fleet, using the designation Mark III. Adaptation of large twin-engine S-56 to flying crane role, minus conventional cabin to boost payload, is shown below. Deletion of cabin also provides crew-member with optimum view for positioning large items of equipment.



Transatlantic Charter Growth Foreseen

Scheduled carriers anticipate 10% traffic increase above last season's 50,000 charter passengers.

By Glenn Garrison

New York—Economy fares are not affecting the growing commercial charter business, expected to total about 100,000 transatlantic passengers this year.

This estimate counts a roundtrip passenger once in each direction, in the same way that scheduled traffic is computed.

Scheduled carriers, whose summer charter traffic totaled about 50,000 passengers last year, are predicting an increase of about 10% this year in the business. Non-scheduled airlines that will carry the rest of the traffic have expanded their fleets and introduced more late-model, pressurized aircraft on the North Atlantic.

Industrial emplove groups, particularly sales incentive participants, are accounting for an increasing share of the charter business and the potential of this market is considered practically untapped. For those who can qualify, participation in such a group in many cases makes possible a European vacation beyond their means with the economy fare.

Roundtrip economy rate to London is $453.60; charter fares undercut this by $150 and up.

Civil Aeronautics Board this year has modified its charter policy to some extent, spelling out more precisely who is eligible as a charter group and how it is to be handled. This has made things a little easier for the charter operator, particularly the non-scheduled carrier, and for the travel agent and charter applicant.

A fly in the charter ointment this summer is the U.S. business recession, which is having some effect on the industrial group business. Unless withdrawals increase considerably, however, the season is expected to be the best one yet. The nonpressurized DC-4, down to a handful this season on the Atlantic, is becoming an asset instead of a liability in some cases because of the employe withdrawals. Some groups who have chartered larger planes have suffered cancellation by some of their members. As cost per head depends on the number aboard, these groups are looking for smaller planes with less seats to fill—i.e., the DC-4.

Among the major charter operators on the Atlantic are:

• **Pan American,** whose passenger charter business last year totaled 21,309. Some of this was Military Air Transport Service contract traffic, but the MATS share was "considerably under half," according to PanAm. The airline's MATS business has dropped considerably on the Atlantic in the past two years. Basic commercial charter equipment is the DC-6B, with normal tourist configuration of 71 passengers. Seat pitch and service also follows the tourist class pattern, which includes hot meals. Charter price varies with season and direction of travel: eastbound charters are cheaper in the fall, for example, when scheduled traffic movement is predominantly westbound. Passenger charter revenues last year totaled $10,786,000. PanAm attaches considerable importance to the industrial charter market and cites an outstanding example: Fedders-Quigan Corp., booked for mass Riviera vacations this fall for 2,000 employes via PanAm charters. The airline, incidentally, helps such sales incentive programs as this by providing special menus, postcards, banners and the like for the contests of which the vacations are the prize. PanAm says its 1958 charter business will be about 10% greater than last year's.

• **Trans World Airlines,** with $1,326,000 in transatlantic charter revenues last year, earned $874,000 from this source in the first four months of 1958. TWA expects to better the 1957 volume this year, and to get more off-season business.

• **KLM Royal Dutch Airlines,** second to PanAm among the scheduled charter operators on the Atlantic, handled 14,100 passengers last year, 9,800 of them during the peak season—June through September. KLM also is getting considerable company emplove business. Airline expects an increase this year of 10% on-season, 40% in off-season charter work.

• **Flying Tiger Line,** biggest charter operator on the North Atlantic in either the scheduled or non-scheduled class, handled about 15,000 commercial charter passengers last year between the U.S. and Europe. Another 15,000 people in MATS work and 10,000 Intergovernmental Committee for European Migration charter passengers brought the charter total to 40,000. Commercial revenues totaled about $5½ million. This year, MATS business to date is off about 10%, ICEM air charter movements are temporarily at a standstill, but commercial charters are expected to run about 20% ahead of 1957.

ICEM movements into this country amounted to 41,404 passengers in 1956, another 21,966 last year. Flying Tiger has handled about half of all the airborne refugee traffic which began to move in 1954 under the Refugee Relief Act. ICEM expects to move 13,500 people to the U.S. this year, 60% of them by air.

Flying Tiger says it is finding increasing competition from both scheduled and contract carriers for commercial charter business. Industrial groups are a small percent of FTL's charter customers, perhaps 15%, but the potential is considered very big. "Social groups" such as clubs, national origin groups and college groups make up most of Flying Tigers' commercial business. This summer Flying Tiger will use four or five of its Super H Constellations on the Atlantic, in two configurations—114-passenger and 96-passenger. Price per passenger for points such as London, Brussels and Paris is about $300 round trip; service includes free hot meals, drinks for sale and the attendance of three stewardesses.

• **Transocean Air Lines** has put four 749 Constellations on the Atlantic this year, replacing DC-4s which handled 30 commercial charters last year in addition to MATS work. The Constellations are newly acquired from a foreign airline. Transocean expects to handle about 60 commercial charters this season, with aircraft configuration of 80 seats maximum. Hot meals, no drinks, roundtrip fare to London $283.58 or $250.00 a head, depending on whether both legs of the trip are made in the peak directional season or only one leg. Industrial emplove groups constitute approximately 20% of Transocean's commercial business, although the airline is afraid the recession may cut this business back to some extent.

• **Overseas National Airways** has shifted its entire effort to transatlantic commercial charters as far as the on-season is concerned. Airline formerly handled mostly MATS, ICEM and other military contract work. It hopes to fly 100 commercial charters this year in three new DC-6As and in DC-4s. Overseas National moved its headquarters from Oakland to Baltimore to concentrate on the Atlantic, opened a New York sales office last fall. Board chairman L. C. Burwell, Jr. says summer charter tour business to Europe has grown in the past five years to a $25 million volume in transportation alone. Burwell sees industrial groups as the great market for tourists charters. His company will make efforts to sell group organizers on the idea of planning next year's vacation tours early or late in the season instead of bunched in the peak weeks. Overseas National charges $25,559.50 or $29,876 for a 97-passenger DC-6A, depending again on the season-direction combination, and $17,918 or $20,944 for a 68-passenger DC-4. Base price works out to $263.50 per passenger round trip. Hot meals, drinks if desired, 36 in. seat pitch. Industrial groups are making up some 40% of Overseas National's charters this year.

• **U.S. Overseas Airlines** will divide its 11 DC-4, two DC-6 fleet this summer between supplemental common carriage and military work, and transatlantic charters. Carrier says recession has helped its charter business because groups "have shrunk to our size." Full potential of industrial group business has not begun to be tapped, according to U.S. Overseas.

The passenger figures for charter operations actually represent only a part of the total passengers hauled in the work. If 97 persons charter a plane, fly to Europe and return, they count as 97 passengers. But if the same persons flew round trip on scheduled flights they would be considered 194 passengers.

Furthermore, the charter operator is not going to leave his group in Europe and fly back empty if he can help it. The non-scheduled operators must do some involved scrounging to find westbound loads to fill up their backhauls. Besides bid-in MATS or ICEM charters, such groups as ships' crews are much in demand as charter customers to solve this backhaul problem. And these do not show up in the charter totals.

Finding this off-beat business for backhaul traffic is a complicated and competitive affair for the charter carriers. Bidding for seamen groups—which travel as "single entity" charters paid for by the shipping company results in prices much lower than the pro rata charter group pays. But bids, under CAB's watchful eye, never get so low as to be mere token revenue. One operator uses $2.50 per mile as the rule of thumb, rock-bottom point in negotiations.

CAB this year has clarified its policies regarding eligibility for charter groups and has published a questionnaire to be used by the carriers in determining whether groups can qualify, and a standard after-flight report. Non-scheduled operators, who must apply for an exemption 60 days in advance of a pro rata flight, do not, this year, have to offer PanAm and TWA first refusal of each trip as they have in the past. This change, however, applies only to on-season charters.

The Board's new policy definition

Production Boeing 707s Fly in Formation for First Time

Boeing 707 Stratoliners, flying in formation for the first time, pass over Mt. Rainier, Wash. Top jetliner is the first production 707, which made maiden flight Dec. 20, 1957. Bottom aircraft is the third production 707 which flew for the first time May 15, 1958.

also makes more explicit the relationship between the travel agent, who books most of the charter business, and the traveling group. Agent's commissions are limited to the normal International Air Transport Association 5% rate.

CAB also spelled out more clearly its rules tightly restricting advertising and solicitation of groups, and a number of other regulations concerning the organization, payment and handling of such groups.

The growth within the last few years of the industrial employe charter, along with continuing business from other eligible groups such as teachers and national groups, would seem to confirm views that the great mass travel market upon which future transatlantic business may depend, is largely untapped at present fare levels.

What will become of the charter business when the vastly expanded jet-age scheduled capacity is flying the Atlantic—and other routes—is a moot and complicated question.

For example, PanAm's total jet capacity will be about 70% greater than its piston fleet capacity. If the market for used piston aircraft is glutted by then as many observers predict it may be, PanAm could use its Stratocruisers and DC-6Bs—all of which will be written off by that time—as a highly flexible charter fleet.

PASSENGERS board a New York Airways' 15-passenger Vertol 44-B at West 30th St. Heliport in Manhattan. Shuttle serves heliport, LaGuardia, Newark and Idlewild.

Three New York Airways Vertols Begin Scheduled Passenger Flights

New York—Three of New York Airways' new 15-passenger Vertol 44-B helicopters went into scheduled passenger service last week in the airport shuttle between LaGuardia, Newark and New York International Airports. Flights into Manhattan's West 30th St. Heliport were scheduled to begin June 1.

The helicopter airline expects delivery of its fourth and fifth 44-Bs during June, replacing its fleet of Sikorsky S-55s and S-58s and doubling the seat capacity in metropolitan New York area service.

With the Vertol fleet, New York Airways can fly 660 people in 44 daily flights in and out of Manhattan.

Loans Underwritten

CAB member G. Joseph Minetti noted at inaugural ceremonies last week that the helicopters were the first aircraft to be delivered with the assistance of recent legislation permitting CAB to underwrite loans by local service airlines for new equipment purchases.

Minetti said New York Airways' fleet replacement program, by providing greater capacity and a more economical operation, would make feasible effective, speedier passenger service in and out of Manhattan.

He described the airline's nine-year-old operation as a true experiment in determining the best way to provide rapid air transportation in areas of congested ground movement.

CAB's order approving the loan guarantee to the Hanover Bank, Federation Bank and Trust Co. and United States Trust Co. for the $2 million Vertol purchase acknowledged that the new service would require an increase in subsidy over present operations.

But the equipment, CAB noted, will involve much less subsidy than would be required if New York Airways were to serve Manhattan and its present routes fully with the Sikorsky equipment.

The Vertols will, the Board said, therefore "reduce the subsidy needed to provide the total service required by the public convenience and necessity."

CAB said the airline has agreed to accept a final mail rate order establishing rates for each of the five years during which the loan is to be repaid, and that an order placing the carrier on this final mail rate will be issued shortly. Rate is based on data and estimates submitted by New York Airways in connection with the loan guarantee.

44-B Interior

The twin-rotored Vertols in New York Airways service seat 12 passengers two-abreast on the right side of the aisle, with carry-on baggage facilities along the left of the cabin. Two additional rear-facing seats are installed in the front of the cabin, and the 15th seat is located at the extreme rear behind the entrance door. Decor is tan, green, red, cream and gold. Seats are equipped with standard airline overhead reading light and air outlet facilities.

Picture windows give passengers a Viscount-sized view. Noise level is less than the S-58's.

The permanently inflated flotation gear, two outrigger floats aft and a float flush against the forward fuselage, weighs about 340 lb. together with the fuselage seal which makes the Vertol's underside watertight according to the manufacturer.

The gear was developed by Vertol. It is said to cut only about four knots from the aircraft's cruising speed.

New York Airways' 44-Bs will be equipped with the Bendix-Decca navigation system for operational evaluation under a contract with Airways Modernization Board. They will also carry Bendix-developed sonic altimeters.

Continental Starts Viscount II Service

Denver—Continental Airlines last week opened scheduled service with new Vickers Viscount 810-840 turboprop aircraft on its Chicago-Los Angeles route. The 56-passenger planes will be used in daily first class flights.

Continental is buying 15 of the Viscount IIs. Coach traffic on the Chicago-Los Angeles run will continue to be handled with 85-passenger DC-7Bs. Continental has also ordered Boeing 707s and plans jet service in the spring of 1959.

The airline's first class Viscount service will feature new "Gold Cart Service" of food and drink, gold flatware, champagne dinners and suppers. New stewardess uniforms have been designed, including wrap-around smocks to be worn while meals or drinks are being served. The Viscount's decor is gold, with two-abreast seating and a rear lounge.

Subsidy Bill May Spark Industry Battle

By Ford Eastman

Washington — Proposed legislation that would prevent domestic trunk airlines from again receiving subsidy payments is expected to touch off a bitter battle within the airline industry.

The larger trunklines, despite declining profits and heavy commitments for jet equipment, have indicated support of the proposal while the smaller carriers have expressed considerable concern over the impact such legislation might have on their future and, in fact, chances of their survival.

Under proposals, sponsored by Senators Strom Thurmond (D.-S. C.) and Thruston B. Morton (R.-Ky.) and Representatives Peter F. Mack Jr., (D.-Ill.) and John E. Moss (D.-Calif.) eligibility of domestic trunklines for subsidies would be eliminated permanently.

Sponsors in both the House and Senate said the bills will not affect the subsidy policies concerning international, local service and helicopter operations.

A spokesman for the local service industry said, however, that both bills contain a provision that could have a serious affect on local service or feederline operations.

50-Mile Clause

In addition to eliminating trunkline subsidies, the Senate bill also would prohibit subsidy payments for any new route longer than 50 miles and paralleling a route already operated by a non-subsidized carrier. The House version would prohibit subsidy on routes of 100 miles or more in length under similar conditions except for the first two years of local or feeder service.

Sponsors of the proposal said the federal government has spent nearly $200 million in subsidies between 1938 and 1957 to "help develop the finest transport system in the world." They added, however, that the time has arrived for a reappraisal of the entire subsidy program.

What Backers Claim

Backers of the legislation claim elimination of subsidies for trunk airlines would have the following results:

- "**It would require more careful** and efficient management of the larger airlines."
- "**It would eliminate the possibility** of an unnecessary subsidy burden ever again falling on the general taxpayer."
- "**Regulation of the domestic** trunk airlines and future awards of new routes would have to be based on more careful analysis of the needs of the public and the economic conditions of the airlines and less on regional and other pressures or claims."
- "**It would prevent subsidized** competition, such as adding a fourth airline to a route where three operate profitably and the traffic proves insufficient to support four. Consequently, the Civil Aeronautics Board finds itself faced with subsidy requests to offset operating losses of one or more of the carriers."
- "**It would eliminate** a time-consuming area of CAB responsibility and thus increase the efficiency of that federal regulatory agency."

Big Four Support

Airline representatives in Washington predict the Big Four: American, Eastern, Trans World and United Air Lines, will lend enthusiastic support to the subsidy legislation. Airlines of this size have often criticized the CAB for permitting "multiple competition" on high density routes.

They claim that in many cases where certain routes can be operated at a reasonable profit by one or two carriers, the addition of a third or fourth carriers often results in marginal operation for most or all carriers.

There are nine airlines serving between New York and Washington where before World War II there were only two. There are five airlines flying between New York and Boston and five between Washington and Boston. There also are five between New York and Detroit and five between New York and Chicago.

In some instances where the bigger carriers had been able to show a profit and get off subsidy, additional airlines were put in the market that still required subsidy.

Multiple Competition

Although no trunklines are receiving subsidy at present, multiple competition in markets that will not support it may force some carriers back on it, airline spokesmen claim. Not only must the taxpayers stand the expense of the additional and unnecessary competition, but it reduces the economic stability of the airlines already serving the market, where more and better service could be provided with fewer carriers, they add.

The smaller carriers claim they do not intend to go back on subsidy, but that there seems to be no justification for such legislation at a time when airlines are facing their most critical period in history. No one knows what to expect in the future as the industry moves into the jet age, one spokesman said, adding that enactment of such legislation could conceivably wreck the entire industry, including the bigger airlines.

However, the small airlines say such legislation might more likely tend to create a monopolistic situation where competition of the Big Four could be eliminated by law.

Financial Pinch

CAB's policy of strengthening smaller airlines by permitting them access to high density markets has been a major factor in enabling all the trunklines to get off subsidy. However, it is possible that airlines operating on smaller profits may feel a serious financial pinch during the transition to jets where availability of subsidy might mean the difference between continued operation or bankruptcy.

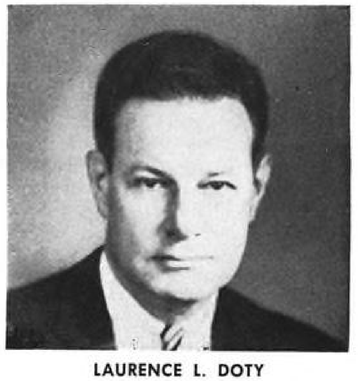
The larger airlines' answer to this is that the CAB is only permitted to grant subsidy to offset operating losses and, if the losses are a result of uneconomical competition, then it should not be allowed.

The small airlines also contend that removal of eligibility for subsidy by law might tend to impair their credit rating with the financial community and reduce their ability to acquire the necessary financing to purchase jet equipment.

Doty Appointed Transport Editor

Laurence L. Doty has been appointed transport editor of AVIATION WEEK effective June 1. Doty's appointment is part of an editorial expansion program aimed at improving the quality and completeness of AVIATION WEEK's coverage of airline activities. He will make his headquarters in Washington, D. C.

Doty has been an associate editor covering air transport for AVIATION WEEK for the past two years. Previously, he was manager of Capital Airline's public relation department for



LAURENCE L. DOTY

Western-ALPA Strike Pact Nears

Los Angeles—Substantial progress was being made last week toward reaching a final agreement on the Western Air Lines-Air Line Pilots Assn. pilot strike which would enable the airline to resume service sometime this month. Airline has been grounded more than three months already.

Although technically still on strike, pilots and company representatives have signed an agreement on terms laid down by National Mediation Board Member Leverett Edwards, under which:

- Both parties were to enter a five-day negotiation period on wages, hours, working conditions, etc.
- Issues still unresolved after five-day negotiation period are to be submitted for arbitration, with both parties bound to comply with arbitration board's findings.

No delays are anticipated by either company or union in negotiation and arbitration procedures and company has already begun recalling employes furloughed by the strike.

Company and union members have signed a separate interim agreement on the crew complement issue. Under this, airline will notify pilots 65 days prior to starting Lockheed Electra operations, and at this time pilots may reopen negotiations on this issue only. If at this time negotiations should fail to settle the third man issue, another strike may be called after complete procedure specified by Railway Labor Act has been carried through. However, it is hoped that in the meantime, a precedent setting agreement for the air transport industry will have been reached which can serve as a pattern for settlement of the controversial issue by all airlines.

Rates of pay, pay for flying international (Mexico) routes, pay for a minimum number of flying hours and improvements to pilot retirement plan are the main issues still pending. In all, 16 items are being discussed.

If all points were settled immediately, there would be a time lag before Western could resume full operations. During the lengthy strike many Western pilots' qualification certificates have expired, making it necessary for them to be re-trained and re-examined. Stewardesses will be given refresher courses. Planes will have to be thoroughly cleaned and checked prior to being put into service.

First employes being recalled are teletype operators to man reservations offices and mechanics and inspectors for servicing aircraft.

six years; worked for United Air Lines in the Midwest and was a reporter on daily newspapers in Wisconsin. During World War II, Doty served as a captain in Air Transport Command's North Atlantic and Pacific divisions.

Assisting Doty in the transport department will be Glenn Garrison in AVIATION WEEK's New York office and Robert H. Cook in Washington. Garrison is a former Virginia newspaperman who came to AVIATION WEEK from the Port of New York Authority aviation publication section. Cook, a Washington newspaperman, was with Capital Airlines for four years before joining this magazine's transport department.

Los Angeles Group Proposes 'Helistops'

Los Angeles—Action to get a new category of landing site recognized and to obtain city code changes required to more fully utilize rotary-wing transportation potential has been accelerated here through moves by the Los Angeles Chamber of Commerce.

The chamber has submitted through proper channels, proposals for changing city codes to:

- **Make the necessary differentiation** between "aircraft" and rotary wing or vertical takeoff and landing machines such as helicopters. Proper wording affects such things as airport and heliport sites, operations from certain zones.
- **Establish new helicopter** operating base to be termed a "helistop," a place for loading and unloading passengers or cargo only, as opposed to a heliport, where passengers and cargo are handled and such operations as refueling, maintenance and the like are carried out. The "helistop" could be a rooftop site, would not need the elaborate facilities required where fueling or similar work is to be accomplished. "Helistops" could be established in many areas where heliports would be impracticable.
- **Have city building structural** standards written so as to clearly define what provisions would have to be made to accommodate a "helistop," according to the category of equipment to be operated into and out of the site.

Request for changes to building code have been initiated into formal channels, and while the Chamber of Commerce recommendations did not incorporate specific numerical values for structures, a categorization of operational helicopters which would use a "helistop" were made. In this, classes were divided according to vehicle weight, Class I being 3,500 lb.; Class II, 7,500 lb.; and Class III, 15,000 lb. and up. Specific structural requirements to match the gross weights of categories will be incorporated by city engineers. However, today's Type I or II fire resistant structures of steel, concrete clad, should be adequate.

Australian Carriers Purchase Electras

Burbank, Calif.—Lockheed Aircraft Corp. last week announced the sale of nine Electra turboprop transports to three airlines in the Australian-New Zealand complex and the confirmation of an earlier order for two Electras by a fourth Australasian carrier.

The purchases cover a total of 11 Electras valued at $27 million. They are:

- **Qantas Empire Airways of Australia** (Qantas)—four Electras.
- **Tasman Empire Airways** of New Zealand (Teal)—three Electras.
- **Trans-Australian Airlines**—two Electras.
- **Ansett Australian National Airways** was granted permission to purchase two Electras following a reversal of an earlier Australian cabinet decision that prevented the carrier from buying any aircraft other than English-made Vickers Viscounts (AW April 14, p. 43).

Sale of the 11 aircraft to the four carriers brings the Electra backlog to 151 airplanes valued at approximately $325 million.

Qantas will operate the Electras in the Far East sector of its around-the-world system. Deliveries will begin in the last quarter of 1959. The airline has seven Boeing 707 turbojets on order for delivery beginning in April, 1959.

Teal will operate the Electras on routes connecting the Fijis with Auckland, Christchurch, Sydney and Melbourne. First of three Electras will be delivered late in 1959.

Delivery of the domestic version of the Electras to TAA and Ansett/ANA will begin in the first quarter of 1959.

In London, news of Australian and New Zealand purchases of the Electra drew angry comments from members of Parliament. One commentator in the House of Commons said "it will be disastrous if we allow these Australian and New Zealand contracts to pass into American hands."

Correction

Douglas DC-8 jet transport prototype is scheduled to make its first test flight in California during early June. Due to a teletype transmission error, the May 26 editorial stated this initial flight would be made in November.

SHORTLINES

► **Air France** has extended its Paris-Bogota route to Quito, Ecuador, and Lima, Peru, using Lockheed Super-G Constellations. The flight departs Bogota on Friday at 9:50 a.m., arrives in Quito at 11:50 and Lima at 4:15 p.m. The return flight leaves Lima Saturday at 8:00 a.m. Both first class and tourist accommodations are available.

► **Emery Air Freight Corp.** reports a first quarter net income of $81,450 as compared with $117,396 for the corresponding period last year. Gross revenues for the period were $2,334,151 compared to $2,216,487 in 1957. The increase in gross revenues, attributed to a 7% increase in shipments handled, was offset by a decline of 16% in the average weight per shipment. Emery has added service from the U.S. to Hawaii to its international freight forwarding operations, using all airlines from the U.S. mainland to Hawaii.

► **International Civil Aviation** Organization has accepted Costa Rica as its 73rd member.

► **KLM Royal Dutch Airlines** will inaugurate a new Polar route linking Amsterdam, Tokyo and Biak, Netherlands New Guinea, on Nov. 1. The new service will be flown in both directions twice a week and will use Douglas DC-7C aircraft. KLM says there will be a regular intermediate landing at Anchorage, Alaska, but says another landing may be made between Amsterdam and Anchorage, depending upon the prevailing wind currents.

► **REAL, Brazilian International Airlines**, pending ratification of modifications on the Brazil-U.S. bilateral agreements, plans to begin operation of a Brazil-Japan service later this year. The new route, using Lockheed Super-H Constellations, is expected to run from Rio de Janeiro to Caracas, Mexico City, Los Angeles, Hawaii, Wake Island and Tokyo. Convair 880 turbojet aircraft will service the route following scheduled delivery to REAL in 1960.

► **United Air Lines** will construct a $1 million training center on the campus of Colorado Women's College in Denver. The facility, a half mile from Denver's airport, will contain classrooms, recreation lounges, cafeteria and banquet hall. The smaller building will be used to house flight crews who remain in Denver for long training period. The center will be used to train stewardesses and flight crews as well as supervisory and management personnel.

AIRLINE OBSERVER

► Airline traffic, which showed an upswing during the first weeks in May, declined slightly in some areas following the mid-air collision April 20, near Brunswick, Md. However, possibility of heavy passenger loads prior to the Memorial Day week-end could round out the month with substantial increases over May of last year.

► **General Electric will have its CJ-805 commercial jet engine certified for both kerosene and JP4 fuel. Company has been testing engines on kerosene for several months. One CJ-805 test engine reportedly has accumulated 800 hr. on kerosene with no significant difference in fuel system or combustion system operation compared with results with JP4. Target date for CAA type certification of the CJ-805 is July.**

► Civil Aeronautics Board is making a detailed survey of the effects of missile firings on civil airways patterns. Major point is to determine whether missiles can be defined legally as aircraft before scope of Board's jurisdiction in airspace allocation can be established.

► **American Airlines proposal to the Civil Aeronautics Board to provide coach service with any type of aircraft on flights that depart originating terminals between 10 p.m. and 3:59 a.m. has been suspended and will be investigated by the Board. Both United and TWA filed complaints against the American tariff filing.**

► Curtis Barkes, United Air Lines senior vice president, predicts that Congress will intervene in the airline industry's economic problems if the Civil Aeronautics Board does not allow a substantial fare increase.

► **Trans World Airlines has been awarded an Air Force contract for $2.1 million to purchase communication equipment for Lockheed aircraft that would be assigned to the military in the event of wartime emergency. TWA will purchase the equipment, take delivery, inspect and hold the devices in reserve at strategic areas for all Lockheed aircraft operated by the scheduled airlines under the Civil Reserve Air Fleet program.**

► British Overseas Airways is studying economy measures that may result in more centralization of engineering and maintenance procedures with a resultant cutback in personnel. BOAC attributes its present financial difficulties in part to delivery delays and teething problems of the Bristol Britannia which it praises as a "very fine aircraft." BOAC admits it lacks funds to finance traffic expansion and new route development although it plans to extend its Comet IIE, familiarization program to include instrument let-downs and approaches at New York International Airport and at Boston's Logan Airport next month. The carrier has been conducting training flights with the Comet between London and Gander.

► **Aer Lingus has ordered three more Vickers Viscount 800s to bring its total fleet to six. They will replace the four Viscount 700s now operated by the Irish airline.**

► Airlines are not expecting any tax relief this year as the result of strong opposition to any tax cuts from key congressional leaders of both parties. However, a number of Senators continued to promise a fight for cuts on the transportation excise tax.

► **Pan American World Airways expects economy fare traffic on the North Atlantic will account for much as 70% of its total traffic this summer.**

► Continental Air Lines has filed a registration statement with the Securities Exchange Commission for a public offering of $12 million convertible subordinate debentures. Proceeds will support expansion costs of routes and services.

► **Trans World Airlines has asked the Civil Aeronautics Board to remove restrictions on its Los Angeles-San Francisco route. The airline charged that "United and Western are not fully meeting the needs" of the market and asked the Board to lift "the oldest surviving restriction in the industry" by granting an immediate hearing and expeditious handling.**

Airline Income & Expenses — February, 1958

(In Dollars)

	Passenger Revenue	Mail Revenue (U. S.)	Express Revenue	Federal Subsidy	Freight Revenue	Charter Revenue	Total Operating Revenue	Total Operating Expenses	Net Income (Before Tax)
DOMESTIC TRUNK									
American	18,139,028	508,893	192,098	.....	1,373,169	.....	20,571,866	21,458,483	−886,617
Braniff	4,023,053	116,945	36,544	.....	116,861	9,191	4,378,498	4,378,375	−15,988
Capital	6,424,224	161,297	72,849	.....	99,207	12,434	6,858,076	7,675,356	−817,280
Continental	1,547,226	38,849	13,200	.....	40,619	3,398	1,676,750	1,889,423	−212,673
Delta	6,063,831	150,745	64,129	.....	232,899	.....	6,654,034	6,869,345	−299,170
Eastern	18,314,937	352,312	.....	.....	740,686***	8,316	19,540,203	19,614,063	−167,746
National	4,624,315	92,263	20,624	.....	143,775	17,647	5,545,320	5,428,151	45,291
Northeast	1,651,469	32,737	15,498	.....	32,878	.....	1,774,416	2,244,776	−512,098
Northwest	3,217,496	128,910	.....	.....	319,339***	8,793	3,713,855	4,740,628	−1,026,773
Trans World	12,416,000	344,000	144,000	.....	400,000	.....	13,889,000	16,524,000	−2,831,000
United	18,707,651	777,087	275,885	.....	960,133	.....	20,991,654	21,430,134	−438,480
Western†	2,270,532	65,181	20,615	.....	56,564	25,422	2,453,686	2,623,345	121,642
INTERNATIONAL									
American	533,460	2,987	78	.....	64,268	.....	625,050	538,641	86,409
Braniff	602,082	8,608	.....	.....	34,298	.....	691,969	656,946	32,805
Caribbean-Atlantic	201,494	2,101	.....	.....	7,203***	1,224	212,292	165,151	50,462
Delta	453,620	4,753	.....	.....	11,690	.....	492,456	432,057	53,994
Eastern	1,618,152	33,307	.....	.....	52,257***	.....	1,707,016	1,473,777	225,037
National	455,731	4,052	1,706	.....	15,370	.....	488,116	324,588	163,987
Northwest	1,116,619	479,819	.....	.....	278,774***	.....	1,950,529	1,978,079	−27,550
Pan American									
Alaska	138,000	13,000	.....	.....	34,000	.....	179,000	383,000	−11,000
Atlantic	5,588,000	392,000	.....	.....	759,000	163,000	7,596,000	9,885,000	−2,273,000
Latin America	5,520,000	165,000	.....	.....	910,000	56,000	7,036,000	7,689,000	−677,000
Pacific	3,167,000	421,000	.....	.....	460,000	386,000	4,644,000	5,014,000	100,000
Panagra	1,199,000	41,000	.....	.....	152,000	13,000	1,632,000	1,592,000	41,000
Trans-World	2,442,000	379,000	.....	.....	242,000	.....	3,562,000	5,471,000	1,980,000
United	861,466	32,656	.....	.....	18,423	.....	928,154	914,250	13,904
Western†	122,787	270	.....	.....	542	.....	125,547	135,677	−13,552
LOCAL SERVICE									
Allegheny	289,526	14,462	3,910	179,993	8,135	.....	504,193	705,048	−200,855
Bonanza	223,077	3,063	1,559	124,561	2,424	64	358,835	350,006	8,263
Central	112,146	3,107	1,071	194,739	3,384	.....	317,775	349,208	−31,433
Frontier	280,069	210,869	3,579	.....	19,954	8,215	528,279	553,998	−27,636
Lake Central	136,591	3,823	.....	137,454	5,132***	2,416	285,542	313,925	−28,383
Mohawk	347,111	4,097	5,025	165,107	8,341	8,405	542,408	659,133	−116,725
North Central	567,427	17,939	8,611	193,612	.....	.....	816,191	966,668	−154,587
Ozark	348,089	213,578	4,851	.....	6,907	6,672	585,007	605,452	−25,053
Pacific	303,461	8,661	2,431	135,937	3,225	15,944	472,417	525,309	−60,036
Peidmont	350,692	7,226	2,664	190,885	4,255	.....	571,650	669,528	−95,549
Southern	179,693	7,277	2,913	150,025	2,844	850	347,533	396,246	−49,528
Trans-Texas	238,016	9,674	2,360	255,927	10,652	4,466	496,499	505,541	−9,876
West Coast	195,861	3,466	1,002	148,367	3,458	3,786	357,706	393,950	−36,244
HAWAIIAN									
Hawaiian	285,018	2,862	.....	.....	45,931***	.....	343,804	432,819	−96,647
Trans-Pacific*	.....	.....	.....	.....	.....	.....	.....	.....	.....
CARGO LINES									
Aerovias Sud Americana	.....	.....	.....	.....	112,482**	21,774	137,296	145,526	−9,729
Flying Tiger	.....	9,526	.....	.....	756,156***	1,459,104	2,210,674	2,468,363	−351,961
Riddle	.....	6,134	.....	.....	655,666***	2,626	652,951	932,321	−279,370
Seaboard & Western	.....	.....	.....	.....	.....	.....	1,145,832	1,689,684	−543,853
Slick	.....	.....	.....	.....	239,965**	230,839	527,596	911,774	−420,845
HELICOPTER LINES									
Chicago Helicopter	31,605	94,749‡	.....	.....	.....	.....	126,392	145,950	−25,073
Los Angeles Airways	9,975	8,609	4,267	73,011	.....	74	96,061	93,976	2,183
New York Airways	35,057	3,148	1,043	123,336	1,754	.....	170,951	190,513	−19,342
ALASKA LINES									
Alaska Airlines	101,028	37,115	600	160,996	28,744	77,660	434,814	417,465	17,349
Alaska Coastal	33,137	7,808	.....	27,994	6,523	442	77,198	105,815	−27,897
Cordova	6,679	39,096	.....	.....	2,631	8,629	58,912	73,700	−14,988
Ellis	.....	.....	.....	.....	.....	.....	54,288	80,431	−26,413
Pacific Northern	260,788	54,384	.....	213,810	51,378	976	593,323	689,044	−110,987

* Not available. ** Listed as "Common Carriage". *** Property figure.
† Western service suspended Feb. 22 because of strike. ‡ Service pay & federal subsidy.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Basic Factors Complicate Plasma Work

Because of the potential importance of the field of magnetohydrodynamics, Aviation Week is offering this article on the fundamentals of the subject. This is a supplement to the two-part series which started in Aviation Week May 12 (p. 48).

By J. S. Butz, Jr.

Washington—Two primary points concerning magnetohydrodynamics are being made today by virtually all the scientists active in this new branch of physics. They are:

- **Research into and applications** of magnetohydrodynamics (MHD) are enormously complicated by the large number of factors that must be considered simultaneously.
- **Extremely wide variety of practical** engineering uses and theoretical explanations for natural phenomena are possible when the kinetic and electromagnetic properties of conducting fluids are influenced by externally applied fields.

Mathematically, the problem with MHD is that it requires the marriage of two theories, hydrodynamics and electromagnetism, each of which must be described in three dimensional space. This has led theorists to describe the situation as dealing in six-dimensional vector space.

Even an abbreviated idea of these difficulties requires a few sentences. An ionized gas or plasma conducting a current creates a magnetic field about itself. This electromagnetic action accelerates the gas, and the gas motion changes the current flow which alters the magnetic field. These electrical and magnetic changes again affect the motion of the gas which further alters the fields and so on with time.

Another indication of the problems of dealing with gas particles which obey the laws of fluid dynamics and electricity and magnetism is given by Walter M. Elsasser of the Scripps Institution of Oceanography, a noted theorist in the field. Elsasser has this to say:

"Now turbulence probably doesn't exist in two dimensions, but it does exist in three dimensions. What happens in six-dimensional vector space is anybody's guess."

This is not the end of the description of the problem, however. Energy losses from radiation and gas diffusion through the restraining magnetic fields are major considerations in any work with magnetohydrodynamics placing further requirements for competence and knowledge on the experimenter.

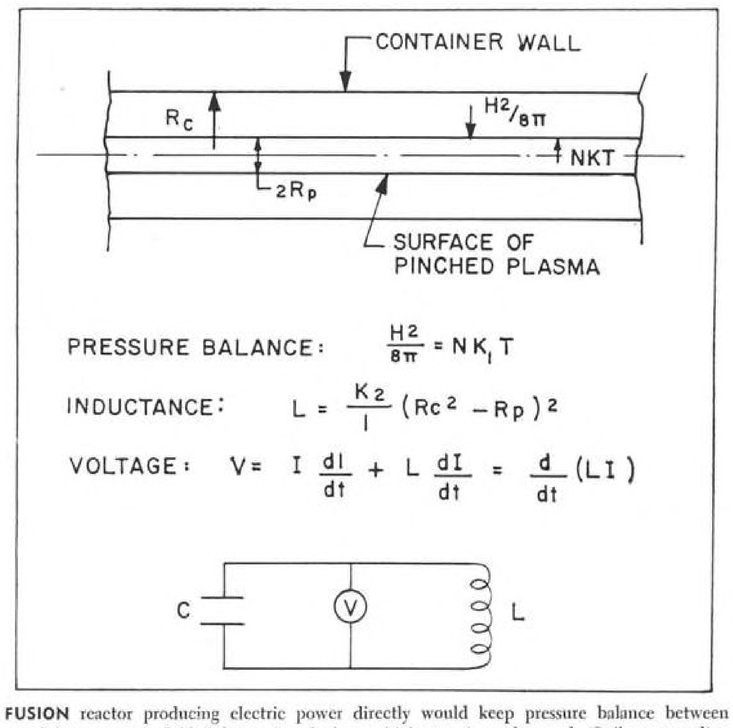
Two principal areas of possible engineering usefulness of MHD are being discussed today. The first has to do with such problems as communications with space vehicles, improving microwave systems, possibility of making nuclear warheads traveling in space inert through a radiation barrage and even the death rays being mentioned to Congress by Administration officials. These ideas all deal with very low density plasmas and the particular area that has probably been discussed most completely concerns the improvement of microwave communication systems.

E. L. Ginzton of the W. W. Hansen Laboratories of Physics at Stanford University explains this type of work:

"Nearly all radio-frequency generating devices employ electrons exclusively; in retrospect, this seems like an artificial restriction upon the potential of electronic devices." He goes on to indicate that he regards the use of fully ionized plasmas and ionic energy as a means of improving the noise level and efficiency of microwave systems which is as promising as the new Maser systems which do not employ electrons at all. The use of plasmas as microwave resonators is believed to have been suggested first by the Russian Feinberg. Experiments along this line are known to be in progress in the U.S.S.R. and Switzerland as well as at several U.S. universities.

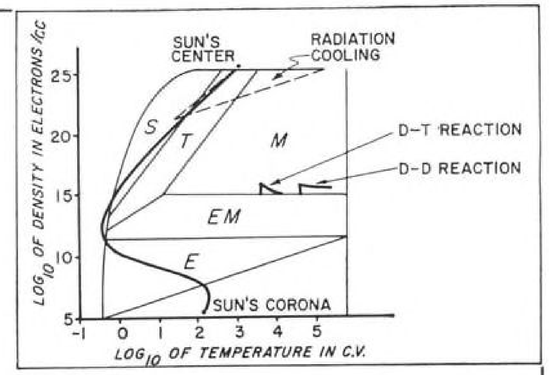
The second general area of possible engineering usefulness of magnetohydrodynamics concerns achieving a controlled thermonuclear reaction and using it to produce electric power and thrust for propulsion. Most ideas in this area involve plasmas of relatively high densities.

A highly simplified model of a thermonuclear electric generator and/or a reaction engine for propulsion is illustrated on this page. Here a cylinder of plasma is confined by a magnetic field created by coils which encircle the container. These coils are the inductance



FUSION reactor producing electric power directly would keep pressure balance between retraining magnetic field (left term) and plasma (right term) nearly equal. Coils surrounding container create the restraining field and their inductance is function of plasma and container radii. When magnetic pressure dominates, plasma is squeezed and fusion reaction occurs. Plasma pressure then pushes field back inducing current in coils and charging condensers (circuit diagram below).

Magnetohydrodynamic Regimes



Complete classification of gaseous magnetohydrodynamic phenomena would be an impossible task at present. However, Arthur Kantrowitz of Avco Research Laboratory has identified the various reaction regions in one of the areas of greatest interest today. In this area, the magnetic pressure of the constraining field is approximately equal to the kinetic pressure of the ionized gas so that a magnetic piston effect is present and a transfer of energy and momentum takes place between the field and the gas.

The curve above and the material below are simplifications of Kantrowitz's work which considers only gases that are in thermodynamic equilibrium (the thermal energy of the electrons and the ions are equal). The low-temperature boundary of the curve is the temperature necessary for 50% ionization of the gas and to the right the boundary is the temperature above which the electrons are relativistic.

To reach the conditions shown above, the gas must pass in some manner through innumerable other planes. They include situations in which the pressure of the magnetic field and the gas pressure are not equal, various degrees of ionization exist, oscillations between gas particles and electric fields occur, and thermodynamic equilibrium does not exist in the gas, to name some of the possibilities. While the phenomena occurring in many of these other planes are of great interest in many fields, the plane represented above is probably of greatest interest to those who want to control the thermonuclear reaction and use it for propulsion and to generate power. The areas on the curve which show the deuterium-deuterium and the deuterium-tritium and reactions comes from computations by R. F. Post.

Kantrowitz based his classification on several lengths which are important in completely describing the motion of an ionized gas.

He used these lengths as a basis rather than several frequency ratios which would have divided this plane into almost precisely the same regions.

These lengths are defined roughly as follows:

- Dimensions of the apparatus—assumed to be one centimeter as he concentrated on laboratory apparatus rather than astronomical observations.
- Mean free path—distance through which a particle moves before an equilibrium velocity distribution is reached.
- Larmor radii—radii of the helical paths followed by the electrons and ions in a magnetic field.
- Debye length—distance by which the positive and negative charges in a gas will be separated if the thermal energy of the gas is used for charge separation.

The Boltzmann equation mentioned here is based on probability theory and is a method of determining the density or number of particles expected to be found in a given volume. It is primarily a function of particle velocity, the magnetic field, the electric field and a collision term.

Regions included in the magnetohydrodynamic regimes plot:

REGION "S"—Collision term is dominant and the particle distribution will be close to the Maxwell distribution as in a neutral gas. The electrons and ions will drift through such a gas in a manner similar to the diffusion of neutral molecules. The drift velocity will be parallel to the average forces applied by the electric and magnetic fields. This region is termed the "S" region because the electrical conductivity is a simple scalar quantity and equal in all directions Larmor radius is large, compared to mean free path.

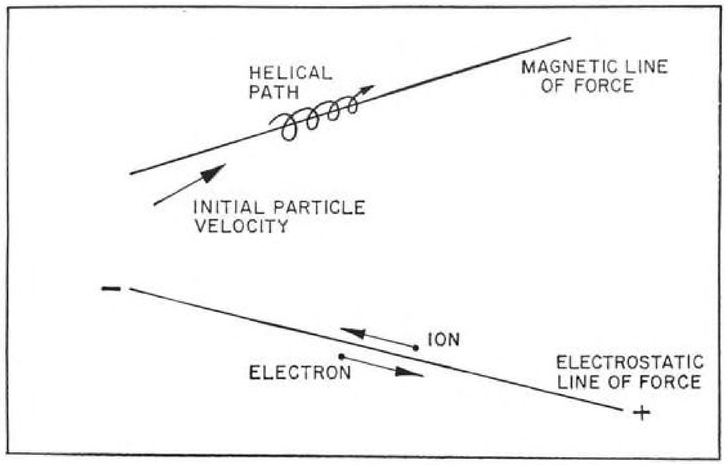
REGION "T"—Boltzmann equation for the ions is still dominated by the collision term as in region "S" and transport properties such as viscosity which are controlled by the ion motions will not be appreciably different. The electron Larmor radius becomes smaller than the mean free path, however, and the magnetic term becomes dominant in the electron Boltzmann equation. Collisions are still important, though, and the distribution function will still approach thermal equilibrium. The drift velocity of a charged particle in a magnetic and electric field has a component perpendicular to the electric field. Thus, the current is in general not parallel to the applied electric field.

REGION "M"—Both the electron and ion Larmor radii are shorter than the mean free path, and both Boltzmann equations are dominated by the magnetic field terms. The magnetic field does not restrict particle movement in the direction of the magnetic field; this must be controlled by some other agent such as a "mirror" arrangement. In the high density, low temperature portion where the mean free path is still smaller than the apparatus, collisions probably will still be important. At higher temperatures, this motion will be inhibited either by the container walls or the restraining magnetic fields. Collisions also will tend to give both the ions and the electrons Maxwellian distribution. In the upper left hand portion of this region, the mean free path is short enough to maintain thermal equilibrium. Below this region the mean free path is too long to produce the required number of collisions. One of the principal reasons for interest in this region is that it includes the gas regions in which it is anticipated that fusion reactors will operate. It also is a region frequently encountered in astronomical phenomena.

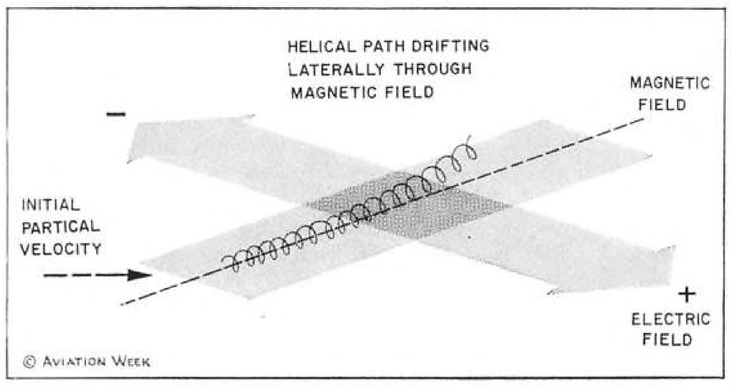
REGION "EM"—The ion Larmor radius is larger than the apparatus, and the magnetic terms will no longer dominate; the ion motion will be essentially free particle orbits subject to the electrical forces maintaining the electrical neutrality of the gas. The electron Boltzmann equation is still dominated by the magnetic term since collisions are infrequent.

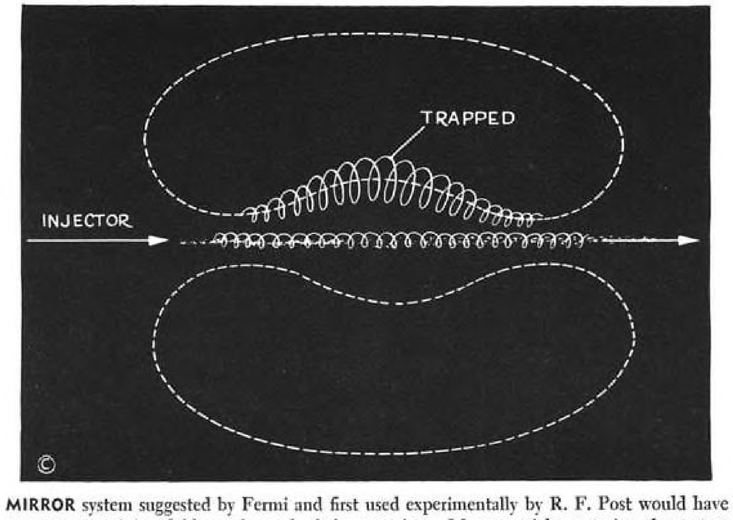
REGION "E"—At still lower densities, the electron Larmor radius also becomes larger than the apparatus and the principal forces are electrical. In this region, the gas is not contained by a magnetic field unless the magnetic pressure is large compared to the gas pressure. This is the region in which many glow discharges operate.

When the Debye length becomes greater than the size of the apparatus, there are no longer any interactions between gas particles. Therefore, it is no longer reasonable to describe the motion of the gas in terms of fluid dynamics. An individual particle description is then far simpler.



MOTIONS of a plasma particle in electric and magnetic fields are shown here in part. Electric field alone produces linear acceleration. Magnetic field causes helical rotation but does not give transverse acceleration. Combination of magnetic and electric fields (below) or non-homogeneous magnetic field will cause drift across magnetic lines of force. Direction of drift and rotation along the helix depend on particle charge.





MIRROR system suggested by Fermi and first used experimentally by R. F. Post would have stronger restraining fields at the end of the container. Many particles entering the system would be reflected into the center increasing the temperature and density of the plasma.

element in an inductance-capacitance circuit. Their inductance is a function of radii of the container and the plasma. The balance between the confining magnetic pressure and the kinetic pressure of the gas is always nearly equal.

The operating cycle begins with a period when the magnetic pressure dominates and reduces the diameter of the plasma cylinder. This increases the thermal energy of the gas and creates a thermonuclear reaction. Energy released by the fusion reaction increases the plasma diameter and pushes back the magnetic field, inducing a current in the coils and charging the capacitor. Theoretically, the electric power produced in this manner could be much larger than the power needed to maintain the magnetic field, ionize the gas, etc.

Preheated Plasma

This cycle is applicable to the case in which the plasma is preheated by a magnetically driven shock wave and accelerated through the longitudinal field created by the coils around the cylinder. This technique would be similar to the methods in use at the Naval Research Laboratory and Avco Research Laboratory described previously.

If the pinch discharge was used and stabilized by an internal longitudinal magnetic field, the situation would be altered. In this case, the squeezing magnetic field would be resisted by the kinetic pressure of the gas plus the magnetic pressure of the internal magnetic field, which existed in the container before the plasma was created.

Regardless of the method used, if a plasma can be controlled to the point that a sustained thermonuclear reaction is possible, then it certainly appears feasible to control and direct the same plasma to provide electric energy and thrust.

Numerous arrangements appear possible with magnetic fields that change with time, squeezing a shocked plasma, controlling its flow through a system, mixing it with heavy elements and exhausting it through a nozzle to provide large amounts of thrust and high specific impulse.

Along with their efforts to control a sustained thermonuclear reaction with the pinch effect that have been widely reported, the Russians have been working with the magnetically accelerated shock for at least two and a half years. The February issue of the Soviet publication, The Journal of Experimental and Theoretical Physics, contains a detailed article by A. I. Morozov entitled, "The Acceleration of a Plasma by a Magnetic Field." This article had been submitted for publication in November, 1955.

Few basic texts are available on magnetohydrodynamics. Lyman Spitzer Jr., of Princeton University; T. G. Cowling of Leeds University, England, and Arthur Kantrowitz of Avco Research Laboratory, among others, have contributed advanced primers. Using these references, it is possible to obtain a broader picture of some of the processes that are leading to the controlled thermonuclear reaction.

Two principal mathematical methods are used to describe the motion and the electrical conductivity of plasmas. One method is to consider each particle separately. The other, which is less laborious, is to consider the plasma as one continuous fluid.

The microscopic or single particle approach is often necessary in complicated situations and where very exact answers are required. The motions of single particles in electric and magnetic fields are partially illustrated on page 38. The electric field alone produces a constant acceleration on a particle which depends on its charge, mass and the strength of the field.

If a plasma particle is accelerated perpendicular to a magnetic field, the particle will rotate in a circle around a magnetic line of force with a radius that depends on its charge, the strength of the magnetic field, its mass and its velocity. If the particle is moving parallel to the field, its direction of motion is unchanged. Therefore, when the particle is moving at some intermediate angle to the magnetic field, its path will be a helix of constant pitch about a magnetic line of force.

Particles also will drift across magnetic lines of force if an electric field exists at some angle to the magnetic field or, if the strength of the magnetic field is not even, perpendicular to the direction of particle motion. Gravitational forces have the same effect as an electric field.

Macroscopic equations for determining the plasma motion and its conductivity have been derived from the Boltzmann equations which are based on probability theory. A large number of simplifying assumptions were required.

Several papers have been written on problems involved in getting the answers given by the microscopic approach to agree with the macroscopic results. This is an involved process, but it still does not explain all of the phenomena which have been observed in plasma reactions.

Unusual motions and current fluctuations, unpredicted increases in diffusion of the gas through the restraining magnetic fields and very large radiation losses appear under many conditions to cool the plasma and prevent the attainment of thermal equilibrium.

Many experimenters believe these effects are due to electron or positive-ion oscillations, and they are presently working to verify any one of a number of theories that have been postulated about the origin and character of these disturbances.

Other experimenters apparently are seeking a more finite goal and are trying to raise a mixture of deuterium and tritium gas to its ignition temperature and create a stable sustained thermonuclear reaction for a few thousandths of a second so that useful power can be extracted.

The ignition temperature of the deuterium-tritium mixture, the point at which the nuclear reactions in the plasma produce as much energy as is emitted in the form of radiation, is around 500,000,000C. This is much lower than the 75,000,000C. or more than is needed for deuterium-deuterium fusion.

The radiation from the thermonuclear reactor probably will require as great a shielding weight as a fission unit of similar power. X-rays will be radiated in large quantity as temperatures rise toward the ignition point. A cloud of neutrons will be released as the deuterium and tritium ions fuse to form helium and a neutron.

One of the primary needs for more advanced controlled thermonuclear research is more powerful test set-ups to compress and accelerate the plasma to the higher temperature. Very large apparatus is available in Russia, the English are building bigger equipment than they showed at Harwell at the first of the year, and large banks of condensers, pinch tubes and other experimental equipment are in use in France and Sweden. Most of this apparatus is at least on a par with the devices the Atomic Energy Commission has revealed to be in use by Project Sherwood, the U.S. controlled thermonuclear reaction program. While Project Sherwood probably has more scientific personnel than any of the other Western nations has working on controlled fusion, the foreign effort is considerable. Many U.S. and foreign scientists are urging that closer cooperation between various national groups be allowed.

Defense Department Space Technology

Defense Department plans to more than double its efforts in the field of space technology. The $601 million earmarked for this by Advanced Research Projects Agency and the services for Fiscal 1959 compares with $261 million for Fiscal 1958. Following are details presented to the House Appropriations Committee.

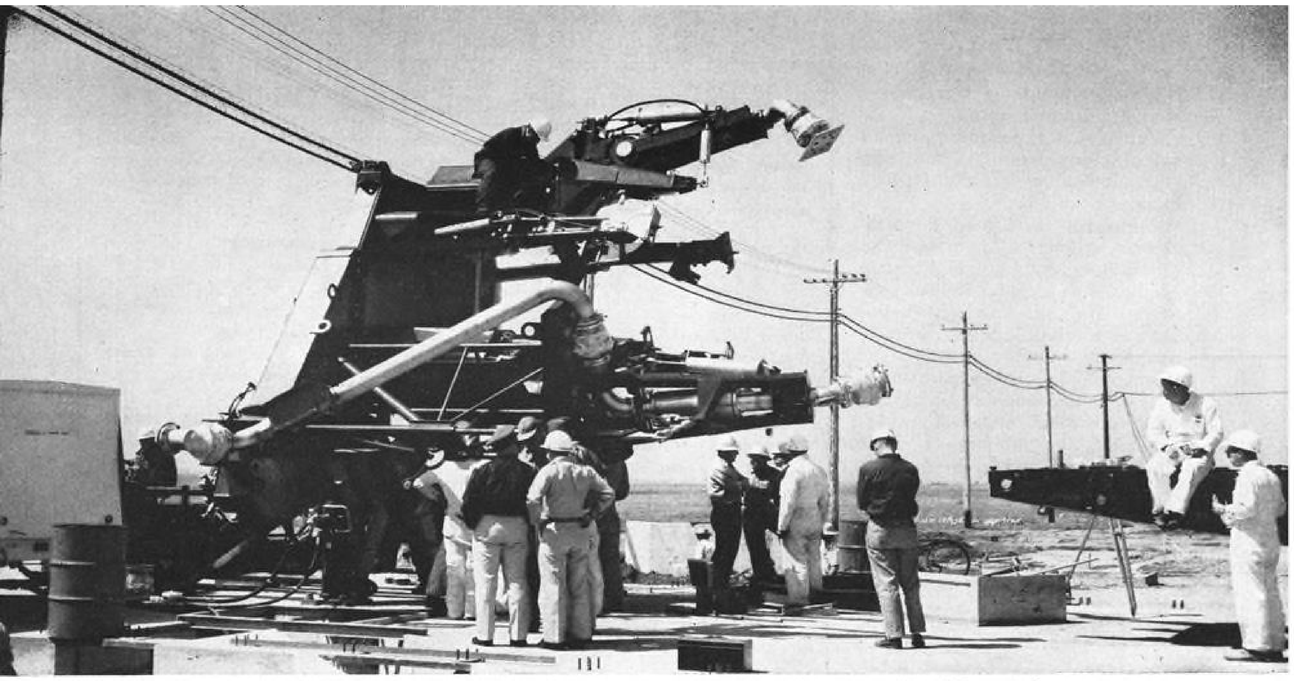
PROGRAMS DIRECTLY RELATING TO SPACE TECHNOLOGY
(Directed by Advanced Research Projects Agency)
(000 omitted)

	FY 1958	FY 1959
Jupiter-C Lunar Probes and Satellites	11,000	
Thor-Vanguard Lunar Probes	10,000	72,000
Lunar Probe Scanner	200	
Space Technology (Including Funds for Million-lb. Thrust Engine and Executive Costs of ARPA)	2,550	138,600
Reconnaissance Satellites	61,336	153,500
Lunar Base Studies	200	400
Vanguard (Including Satellite Tracking)	30,329	9,800
Explorer	3,500	...
Advanced Propulsion Research	3,350	4,400
Space Flight Surveillance	2,672	...
Corps of Engineers Satellite Mapping	1,175	250
Total	113,012	378,950

PROGRAMS (OR PORTIONS OF PROGRAMS) WITH "AN IMMEDIATE POSSIBLE APPLICATION" TO SPACE TECHNOLOGY.*

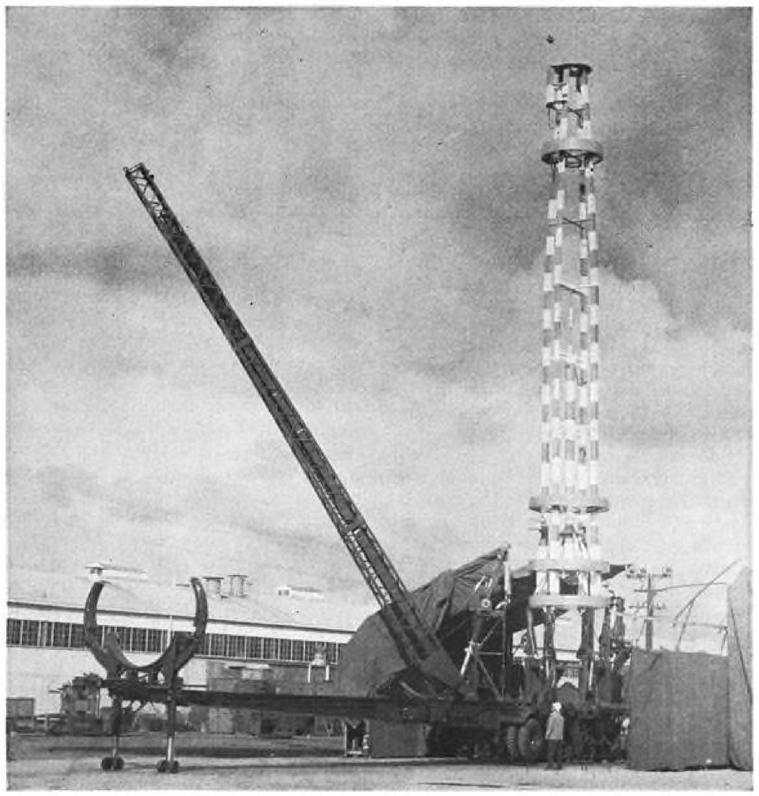
Hypersonic Flight Programs	41,900	52,900
Propulsion, Exotic Fuels, etc.	36,109	69,009
Instrumentation, Guidance, Control, Surveillance	19,825	24,398
Secondary Power	2,625	9,740
Research in Dynamics, Aeronautics, Aeromechanics	7,921	13,155
Communications and Electronics	7,920	9,685
Research in Extra Terrestial Environment, High Acceleration Effects, Habit Ability, Bioscience, Space Suit Development	5,691	8,202
Materials	16,500	20,106
Physics, Upper Atmosphere, High Altitude Geophysics and Magnetic Research, Cosmic Ray Research	10,179	15,836
Total	148,670	223,031
Grand Total	261,682	601,981

*Ballistic Missile and Anti-Ballistic Missile Work Not Included



UPPER launch mount for USAF Douglas Thor IRBM is in horizontal position prior to interconnection of the missile transporter.

Support Items Total 87% of Thor Cost



TRANSPORTER and hydraulically operated umbilical mast are in their pre-launch positions.

By Richard Sweeney

Los Angeles—Thor intermediate range ballistic missile ground support equipment—the facilities and hardware required to ensure a successful mission—was designed to meet these requirements:

- **Reaction time** which has to be less than the time required for an enemy missile to fly to the Thor site from the enemy target area.
- **Capability for strategic** mobility in the fullest sense of the word.
- **Automation so reliable** that man is only a checker in the system.
- **Operational techniques** and procedures which complement these factors, which are on a 24 hr.-a-day alert status year in and year out, yet ensure that personnel constantly keyed for action do not go stale, become overtrained or allow their responsibilities to overawe them.

In the Thor weapon system, more than 200 end items of support equipment are involved in attaining the necessary capabilities. These items represent 87% of the weapon system cost and span from small squib testers to the 30,000 lb. launch mounting and missile transporter-erector.

Ground support equipment ranges from the manually operated voltmeter to the automatic IBM 703 computer.

Thor squadron ground support equipment is located in three areas—munitions, where the warheads are stored and handled; receipt, inspection and maintenance (RIM) building, and launch emplacement.

USAF's Ballistic Missile Division of Air Research and Development Command is Thor weapon system manager. The contractor lineup has these industry participants:

- **Douglas Aircraft Co.**, airframe contractor, also responsible for technical integrity of the entire weapon system, i.e. compatibility of all elements from the smallest light bulb on a test panel to the missile and its transporter-launcher. Douglas also handles development flight testing.
- **AC Sparkplug**, guidance contractor, has contract for airborne system and all equipment and associated items required for ground support and checkout of guidance system.
- **General Electric** Philadelphia is nose cone area contractor, responsible for the marriage of nose cone structure and warhead, specific end items of nose cone handling equipment plus all required material and equipment necessary for service and checkout of complete nose cone.
- **Rocketdyne**, responsible for the propulsion system itself and everything necessary to maintain and check out the propulsion system on the ground.

Douglas plays the predominant part in over-all integration of weapon system's ground support equipment, in addition to the airframe and flying hardware.

Thor was designed as a strategically mobile weapon system. It can be packed up, carried, set up and operated almost anywhere.

It relies on no outside help beyond its own ground service equipment and crew, once delivered to operations.

All elements were designed to be air transportable, everything is on wheels, and the "systems approach" was carried through to such details as tire sizes on the launcher, erector-transporter being standard USAF stock items.

Various elements of Thor ground support equipment are not intended to be operated while on wheels; instead they rest on built-in jacks or specially designed legs. But in all cases, wheels can be reinstalled quickly and equipment returned to transportable status.

Douglas general parameter specifications to contractors associated with ground support equipment were such that all parts were designed for the widest possible latitude of capability, to ensure flexibility, and to keep weapon system operation restrictions due to hardware capabilities to the absolute minimum.

Entire weapon system design is based on a modular concept.

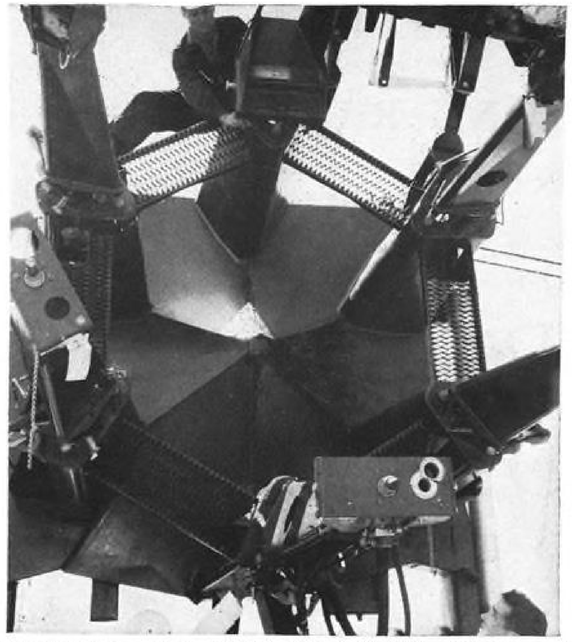
In all areas, Douglas' general specifications to companies designing and fabricating ground equipment stayed with proven techniques, kept goals obtainable within the present state of development to get desired reliability and quick reaction time. Additional Douglas considerations were such factors as weather, with Thor due to operate in Arctic and desert climates, plus salvo ability and long term costs including personnel and training as well as missile purchase and upkeep.

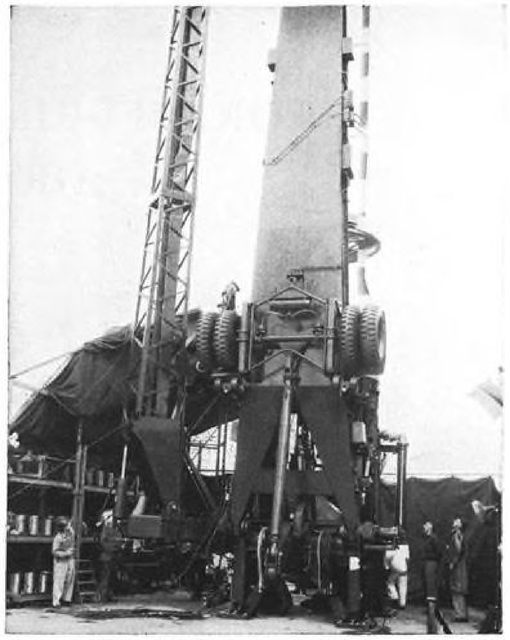
Major ground support equipment suppliers, in addition to Douglas itself, include:

- **General Electric**, power distribution equipment and controls.
- **Cummins Diesel**, power supply generator engines.
- **Fruehauf Trailer**, trailer shell fabrication (Douglas installs equipment).
- **Cambridge Corp.**, liquid oxygen tanks.
- **North Electric**, communications equipment.
- **Food Machinery Corp.**, launcher base, transporter-erector and hydraulic power packs.
- **Packard-Bell and Amelco**, electrical and electronic checkout and firing equipment.

Thor operations envision, according to various published statements made by officials, 15 missiles per squadron. A good look at models being shown publicly of Thor emplacements shows controls for three missiles at a time, per launch emplacement.

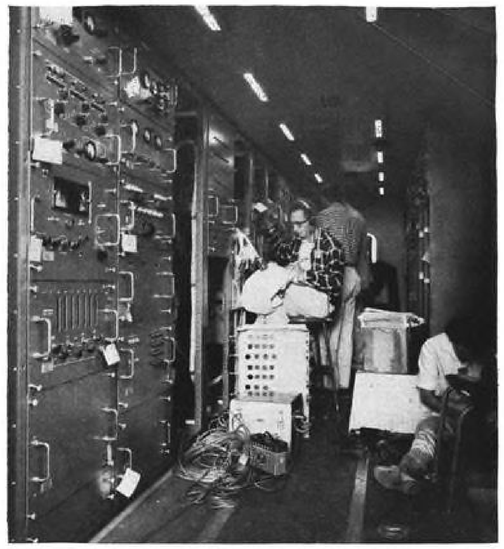
Consideration of the destruction





FLAME deflector plate is visible in photo (left) of Thor IRBM upper launch mount. Photo at right shows the missile transporter which is used as the erector platform. Transporter is cantilevered from the launching mount to erect the ballistic missile to firing position.

LAUNCH control trailer contains command and monitoring consoles.



Electrical equipment trailer is for checkout.

available through one Thor squadron, the normal operating range of the intermediate range ballistic missile, plus the time requirement for reaction in case of start of hostilities, all indicate that there are no "spares" as thought of in connection with airplane squadron spares. A unit goes with what is on the launcher and is operational when the need arises.

Maximum Mobility

In line with strategic mobility operations, a Thor squadron is designed to operate from a minimum of fixed facilities. One usually fixed facility is the receipt, inspection and maintenance building, which is closely related to a present day depot hangar. However, a great deal of Thor maintenance can be done at the launch emplacement and, since any maintenance required for a Thor actually could be done any place, in time a squadron conceivably could operate without the fixed facility and equipment of the RIM building.

A conception of the degree of systems integration accomplished for Thor can be gained from the fact that there are about 1,000,000 lb. of wire, cable and reels involved in one squadron's operations. All this must be assembled quickly once at the destination, without the benefit of engineers for trouble-shooters in assembly and test of the ground support equipment.

Although a Thor squadron would be expected to have a structure for the RIM building available, other elements such as fuel and oxidizer tanks are on transportation wheels and the remainder of the support equipment is on trailers. Two major reasons for this are to reduce amount of facility construction required to operate, and to solve the problem of shipping and assembling various complex components of ground support equipment.

Six major trailers involved in Thor ground support operations are:

- **Launch control trailer.**
- **Power distribution trailer.**
- **Electrical equipment trailer.**
- **Missile checkout trailer.**
- **Hydro-pneumatic trailer.**
- **Supplementary checkout trailer.**

Trailers are standard—the same size Douglas used and became thoroughly familiar with in the Nike program. They measure 8x8x25 ft.

Launch control trailer houses the launch control officer and his master control panel, plus three consoles for monitoring the three missiles handled per launch control trailer.

In the launch control trailer there are more than 700 mi. of wire, more than 200 lights and dials. Plainly marked and one-way-only connector plugs are used throughout Thor ground support equipment.

Launch control officer at his panel can stop a launch up to within one half second before missile is released, this being the least time in which a man can react to stop the flight.

In this trailer is equipment from all four major contractors involved in Thor program.

System Compatibility

Douglas has the responsibility to see that each contractor's contribution to the trailer's equipment is compatible with the whole, that the entire assembly complements and enhances man's ability as a checker, and that nothing is included which would require special effort or detract from the over-all efficiency of the trailer as a unit.

Power distribution trailer handles the 1,000 kw. required for the three missiles operated from each launch control trailer.

Electrical Equipment

Electrical equipment trailer has panels associated with the nose cone, warhead, propulsion system, guidance system, target programming and other elements involved in a mission. For part of a launch cycle the trailer is missile oriented and connected, and functions are linked by remote control to launch control trailer at the proper time.

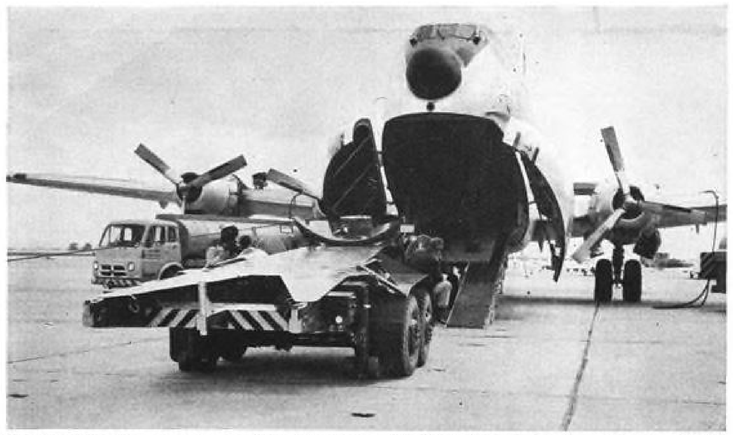
Missile checkout trailer is just what its name implies. It is used for checking subsystems and components functions, and is used normally in maintenance work.

Supplementary checkout trailer, called SCOT, has a computer programmed as a "perfect missile," and acts as a comparator. In use, it is plugged in between the normal missile checkout trailer and the missile itself for comparison as to whether the missile is right or the missile checkout trailer is right.

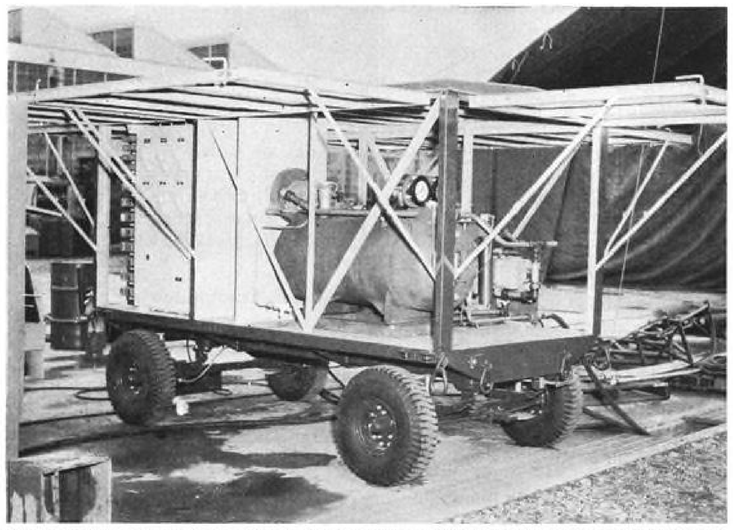
Neither missile checkout trailer nor SCOT is involved in a missile countdown, nor do they come into play in the maintenance cycle ordinarily, although they can be connected with a missile on the launch pad.

If a missile has a malfunction during countdown, (AW May 5, p. 64) its general area is indicated according to the stage of the countdown.

Here the missile checkout trailer can be brought into play, and a maintenance man can go out and work on the missile on the basis of information



FIRST production prototype missile transporter for Thor is loaded into a Douglas C-124.



HYDRAULIC power unit supplies power for erecting Thor and for moving unbilical mast.

gained by hooking the trailer to the missile. Subsystem problems can be isolated and repaired here.

Should such procedure be indicated, the SCOT can be wheeled from its normal RIM building location and plugged in to compare the missile and the missile checkout trailer.

Modular Design

For maintenance on the pad, repairmen have a certain number and type of spare parts on hand, or they can radio for certain other items needed. Under Thor modular design, repairs probably take the form of unplugging a part, component or perhaps even subsystem where trouble is indicated and replacing it with a new part.

In ballistic missiles, a new system of maintenance has come into being. Where formerly there were maintenance levels of operational unit, field and depot, in missiles this has been abbreviated to operational and depot.

USAF personnel handle operational maintenance and contractors perform depot level work.

Ballistic missile weapon system contracts include provisions for the contractor spelling out maintenance on his product, indicating what types maintenance are best accomplished where, how it is best done and at what time intervals. Data also are provided in spare parts type and numerical level, plus where these parts should be stored and handled and, in addition, whether parts warrant bench repair, depot overhaul, remanufacture or scrapping in favor of a new production item.

During the coming summer months, the Thor test program will include testing of operational hardware for reusability. Items such as the launching pad will be checked as to how many missiles can be fired before a part becomes unusable.

Because of the new roles people were to play in the Thor weapon system, a qualitative personnel requirements information program was initiated early. This program ties together people, their training and the hardware so that when the weapon system is delivered to an operational unit, it can be put into immediate operational use.

Qualitative personnel requirements information, (AW July 22, 1957, p. 79), identifies and clarifies, as early as possible, potential personnel and training problem areas which might arise and tend to limit the effectiveness of the weapon system.

Efficiency is Goal

In addition to this work, QPRI seeks to establish the best balance between automation and human effort in various parts of the weapon system so that fullest advantage is taken of the abilities of each. Simultaneously, feasible levels of mechanical and electronic complexity must be maintained, morale factors must be accounted for, and the knowledge acquisition and retention characteristics of personnel must be considered.

These factors must be considered in all functions of the ballistic missile squadron—in missile handling and launching as well as maintenance.

As QPRI studies its areas in connection with a ballistic missile system, it may even come up with alternative plans for weapon system use based on human factors knowledge.

In the first few Thor ballistic missile squadrons, Grade 5 and 7 personnel will be used, but this is not necessarily the final requirement.

Greatest amount of technical effort in squadrons will be required in the RIM building, but presently it is anticipated that operations there will be no more difficult than the present comparable level and type maintenance operations for the B-52. An additional consideration however, will be handling and use of rocket fuels and oxidizers.

Enabling the human parts of a ballistic missile weapon system to contribute the utmost of their capabilities to the proper functioning of the system will require, in addition to having them doing the right kind of jobs, giving them the right tools with which to work. An essential part of these tools is the technical manuals, the training manuals and other written matter which they must use to perform their proper function in the best manner.

Manuals for ballistic missile weapon systems, beginning with Thor, will be based on new requirements rather than traditional format. Information will be complete as necessary, but will be presented in new ways. Clarification and simplicity are stressed, along with the proper illustrations on exactly how to do the job, an almost "by the numbers" procedure outlined in simplest terms.

Work on manuals involved in ballistic missile program began in 1955. It was quickly realized that five major new goals were indicated:

- **Content and format useability.**
- **Timeliness.**
- **Reliability and accuracy.**
- **Production feasibility.**
- **Integrated program.**

Quantity and manner of presentation of information in manuals is tailored to the needs of the operational user.

Missile personnel will be highly specialized and trained, so their manuals should tell them everything they need to know about their job without any references whatever to any other source of information being required. Should a book be used away from a fixed facility (such as a workbench), it should be pocket size.

Timeliness Vital

Timeliness of information on ballistic missiles, especially that in use at the launch site, must be absolutely up to date, and all the administrative support necessary to ensure this status must be applied.

Due to reliability requirements of the ballistic missile system, manuals producers must be sure their material meets the same standards, at all times.

Where deviation from established production procedures for manuals is necessary to obtain the foregoing goals, the production system for the manuals must be such that these goals are attainable. Manuals production must encompass the first three goals or the data are useless.

Ballistic missile manuals program already is integrated with various military commands and also is being coordinated with industry elements which must produce the data. Careful planning is required during the research and development phase to ensure smooth transition to full production phase and full operational capability within Strategic Air Command, the using agency.

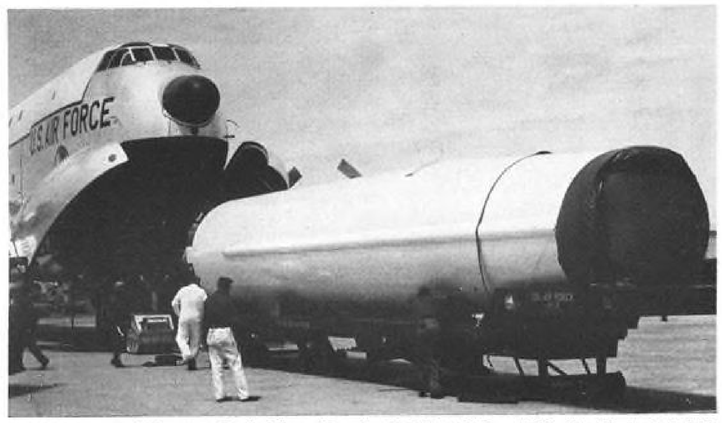
As presently seen, manuals for Thor will be, by types:

- **Depot maintenance, 8½ x 11 in.**
- **Equipment oriented** (bench), for RIM building, 8½ x 11 in.
- **Launch site,** general WS, 8½ x 11 in., job operations, 4 x 8 in., description of function 4 x 8 in. These latter would apply to the various systems and subsystems. The analysts and repairmen would use them in their launch site work and would need no additional reference material.

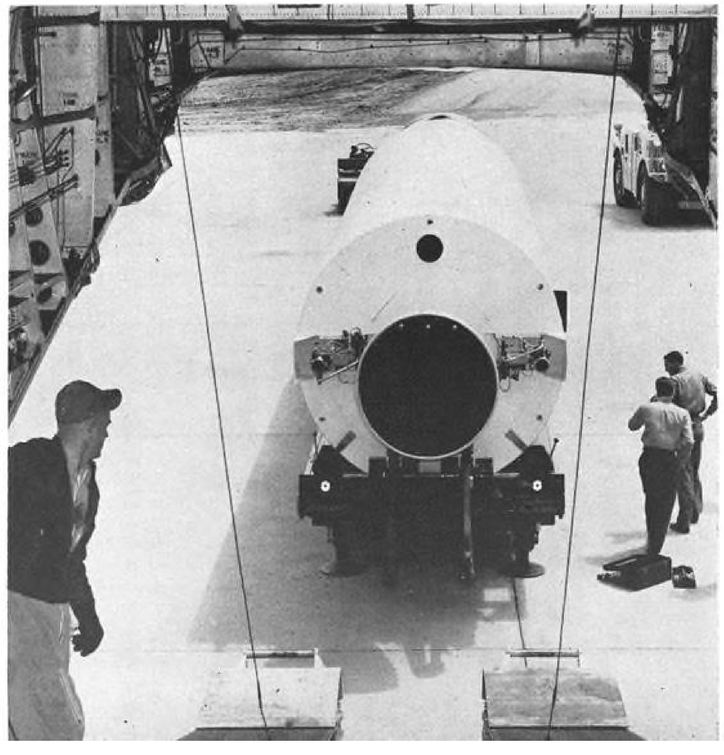
Significant difference between the previous manuals approach, which was equipment-oriented, to the new ballistic missile, job-oriented approach, is the breakout of those documentary elements from the large manual which are needed at the launch site, and presenting them in a manner which will aid in getting the job done, rather than in the traditional manner which emphasizes the equipment.

An example of how far the manuals effort is reaching can be seen in that present manuals are being devised and used on an interim basis. As changes occur they are checked against the actual hardware and equipment. Faster distribution methods were devised, and these have been carried to use of teletype between contractor plant and operating bases, and have even gone to the extent of considering teletypewriting directly on Multilith plates.

To properly integrate information being generated by more than a dozen major contractors in different fields of specialization with their own production and administrative procedures located in widely separated parts of the country, control specifications were adopted based on existing military specifications and adapted to ballistic missile requirements. In the form of a contract exhibit, the specification was clarified and coordinated with the various USAF agencies interested in bettering technical manuals.



MAIN section of Thor is unloaded from Douglas C-124 at Tinker AFB. Small-wheeled dolly has replaced regular road assembly on the trailer to provide ½-in. clearance in loading.



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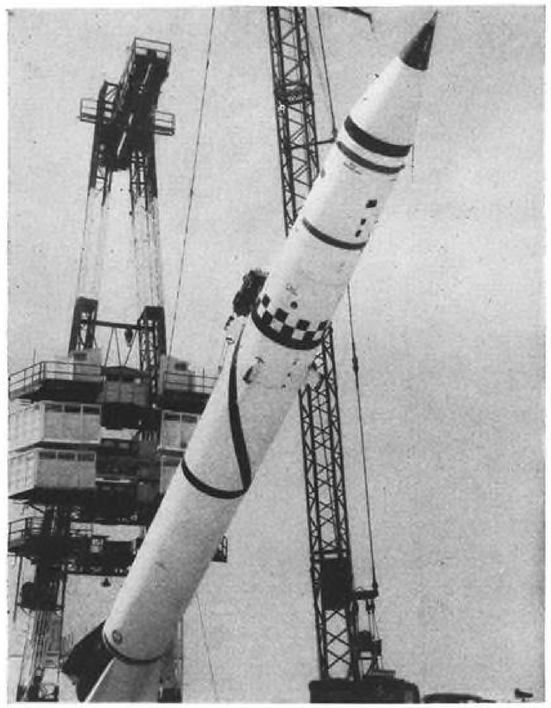
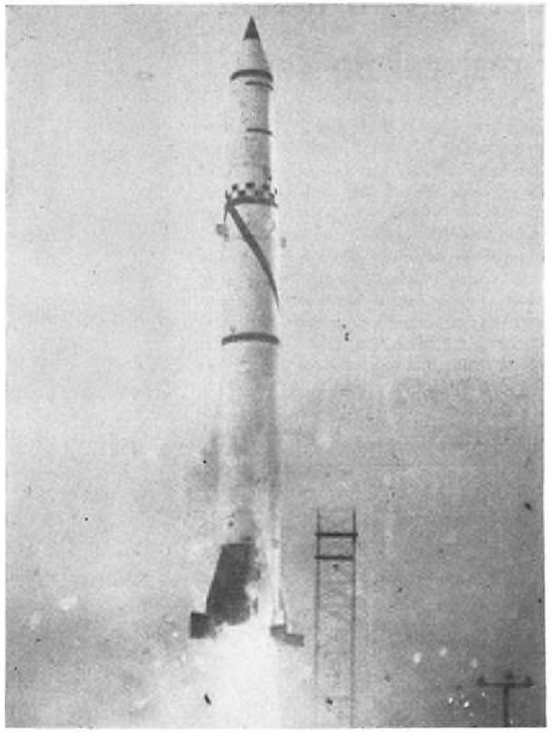
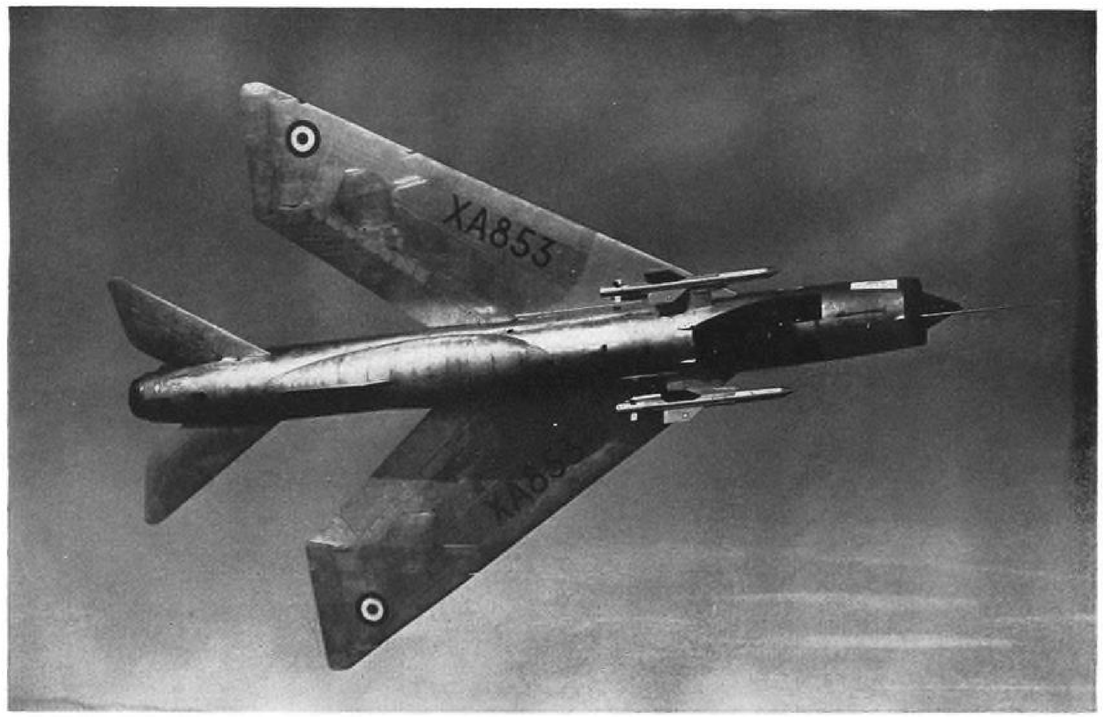
Army Group Fires Redstone At End of Training Program

Army's 40th Field Artillery Missile Group prepares to fire its first Redstone XSSM-A-14 intermediate range ballistic missile at Cape Canaveral, Fla. Troops from Battery A of the 40th Group have been receiving training at the Missile Test Center for about a year. Above, technicians work on the thrust chamber during horizontal checkout. Redstone's rated thrust is 75,000 lb. At right, top, a 62 ft. Redstone is lifted into a vertical position by an erecting crane. The gantry servicing crane is in the background. Below, the missile is guided into position. The weapon will be suspended above the launch pad, then lowered into place. Redstone's range is 200 mi. Missile has an inertial guidance system.



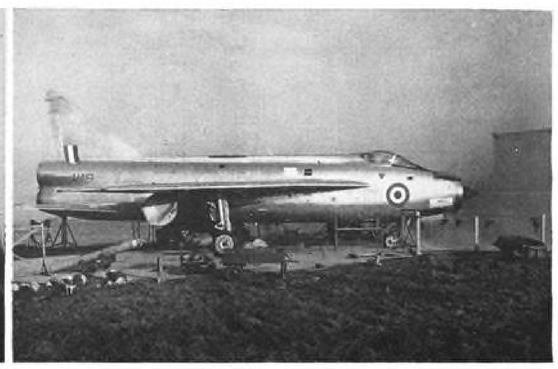


Above, the 6 ft. dia. Redstone rises from the launch site after being fired by the 40th Field Artillery Missile Group. Launching was a graduation test for the Army unit.



Electric P.1B Mounts Firestreak In Tests

More than 1,000 test flights have been completed on English Electric P.1B supersonic fighter. Flight views show bottom and side of large ventral fuel tank and ventral fin. Aircraft is armed with two de Havilland Firestreak infrared homing missiles mounted on launching shoes below sharply swept wings. Ground runup (lower left) utilizes special ramp to tilt two Rolls-Royce Avon jet engine tailpipes upward, deflecting noise and jet blast. At lower right, P.1B fires its four 30 mm. Aden cannons. Aircraft has flown faster than 1,132 mph.



Lockheed Awaits Nuclear Airplane Order

By Robert I. Stanfield

Marietta, Ga.—Lockheed's Georgia Division, which only recently was requested by USAF to submit designs for a low-level nuclear powered bomber, is geared to produce a nuclear airplane in about three years' time, assuming availability of powerplant.

Given the appropriation, the division "can put a schedule on it and a price on it . . . and can get going on very short notice," AVIATION WEEK was told.

Airplane initially—at least six to eight months before nuclear flight—would be chemically-powered.

Performance of first powerplant can be estimated today, though more development is needed in its test and construction.

General Electric Co. is currently developing atomic powerplant. Development has been at a steady pace, with no indications of "breakthroughs" in progress.

General Electric reportedly does not anticipate an increase in 1959 funding over 1958. Lack of additional funds could well negate any chances for development speedup.

Unbalanced Ratio

Unbalanced ratio—lack of development on airframe while powerplant forges steadily ahead—could mean one of two things:

- **Aircraft will not** be ready when powerplant is available.
- **Crash program** will be initiated which increases risk and adds to expense.

Lockheed first entered the nuclear aircraft program in 1950, with award from USAF of a design study contract. But no funds have been forthcoming for hardware because of Administration antipathy to early atomic flight program endorsed by USAF and Joint Congressional Atomic Energy Committee (AW Mar. 17, p. 26).

In mid-October Georgia Division will begin operation of the new $14 million Georgia Nuclear Laboratories. Facility, which Lockheed built and will operate for USAF as Air Force Plant No. 67, is located on a 16-sq.-mi. tract at Dawsonville, Ga.

Here the Lockheed plant will check effects of radiation on complete systems, materials and component parts of aircraft.

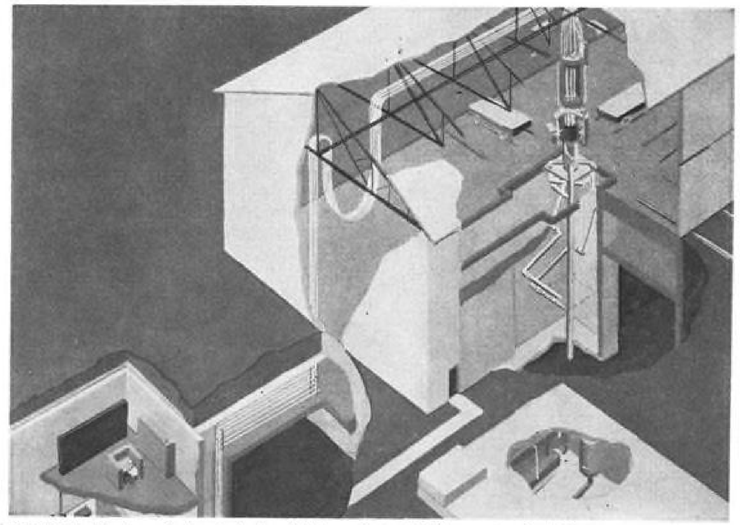
Facility for radiation effects work will center around pressurized water 10 megawatts reactor, designed at the Georgia Division and built by General Electric's San Jose branch.

Date for first full-scale testing is February, 1959.

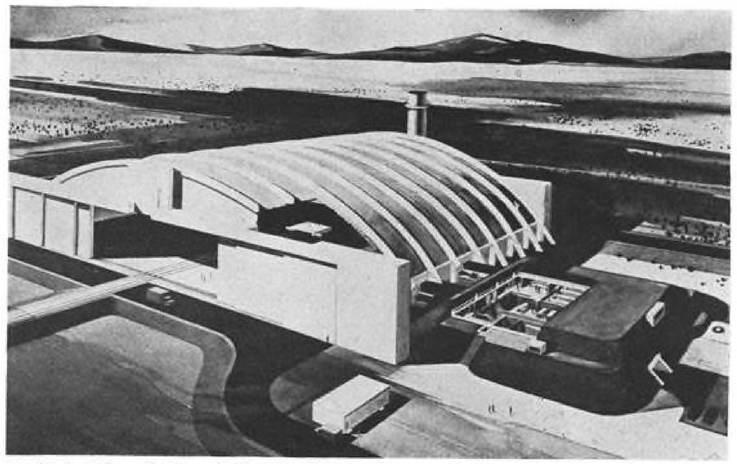
Reactor, which uses flake-type fuel element, is located in center of laboratories' 10,400 acres of land. Normally stored in handling pool, it rests on hydraulic ram (lift) which elevates it to ground level for irradiation testing. Small, light metal shed protects the 21-ft.-high reactor from weather.

Big reactor will radiate into air virtually unshielded. Entire aircraft subsystems and components, placed on up to six flat cars, will be routed along six spur tracks that lead to the reactor. Results are evaluated in the radiation effects laboratory.

Facility will also do test work for in-



GEORGIA Nuclear Laboratories' radiation effects facility reactor building.



MAIN building of General Electric flight engine test facility near Idaho Falls, Idaho, is designed for ground testing a direct air cycle nuclear propulsion plant which Lockheed may use in a nuclear airplane. Building is 320 ft. long, 234 ft. wide and 99 ft. high at crown. Building at right is for control and computing equipment. At far right is two-cell cooling tower for removing propulsion system heat. Site may be finished in two years.

dustry and other branches of the government, including the design, manufacture and servicing of commercial reactors and associated equipment. Manufacturing will be done at the Marietta plant.

Lockheed's nuclear studies have centered on bombardment aircraft, keyed to SAC's approaches to subsonic and supersonic flight, and a logistics and/or defense airplane.

Divided shielding in bomber would be built around powerplant and crew. Nuclear powerplant would tend to be aft of airplane's center of gravity, to balance lighter shielding of crew compartment. By comparison, passenger version would require unit or near-unit shielding. Increased weight over bomber type would necessitate revised powerplant from that of bomber.

Alternative to new airframe would be "fly early" modification route (AW May 12, p. 25). Advantage here is questionable. Chances are that modification airplane would not fly sooner than new because of wait for powerplant. New airplane would also have more future than just being test bed for nuclear powerplant.

Lockheed foresees no radiation problem with nuclear airframe, possibly made of stainless steel, titanium and aluminum. Fluxes generally are not high enough to damage conventional airframe metals.

Components Materials

Components materials which do change properties under radiation include rubber, plastics, sealants, electronic equipment, insulation, transistors, hydraulic fluids, oils and greases.

Shielding will be of major concern because of weight penalty. Lockheed, which is satisfied with its "paper" design, feels that it can produce shielding light enough for configurations with which it has been working.

Need for experimental work is obvious, since it would be impossible to reduce structural balance of prototype airplane, once built, in event shielding weight is further reduced.

Lockheed bought the land for the Georgia Nuclear Laboratories, deeded it to USAF, and built laboratories and buildings for USAF with funds advanced by latter. Director is Robert W. Middlewood, formerly chief engineer of the Lockheed Georgia Division. Manager of operations is W. R. Rhoads. Chief nuclear engineer is Dr. J. C. Flack. Manager of sales is B. A. "Bud" Martin.

Hot Cells

Evaluation and examination of irradiated materials will be conducted within laboratories' four "hot cells," one of which, the "disassembly cell," will be 14 ft. high, 12 ft. wide, and over 17 ft. deep. Flat car will be run right into cell.

Hot material can be observed through four windows in cell. Binoculars and closed-circuit television will also be used. Handling will be via manipulation of remote controlled "hands"—metallic, robot claws. Lockheed will have about 20 experts handling this exacting operation.

There are two types of electrically operated manipulators. One for heavy duty, manufactured by General Mills, has a gripping force of 150 lb.; lifting force of 750 lb. Smaller Model 8 manipulator, designed by Central Research Laboratories, has gripping force of 15 lb., lifting force of about 30 lb. By converting to hydraulic operation, Model 8 gripping force will increase to 1,500 lb.

Four of the Model 8 claw-like hands, which in structure resemble big, telescoping dental drills, are arranged in facing pairs on opposite sides of the hot cell. They can extend across cell. Big General Mills model, facing cell entrance, can cover entire length via travel on overhead mobile platform.

Dexterity of metal grippers is amazing. Claws can wield hacksaw, wrench, screwdriver, impact hammer, etc., to dismantle or cut irradiated components. One can work in conjunction with the other. Varied types of tongs, which operate like fingers, are available and can be quickly interchanged as necessary.

Research program to study selected human factors requirements for manned space and nuclear-powered flight also has been proposed by Georgia Division's Human Engineering Department. Laboratory facility is under sponsorship of USAF Aero Medical Laboratory, Wright Air Development Center. Studies include:

- **Minimum environmental** support for one or more crew members.
- **Necessary and sufficient** survival facilities.
- **Maximum work load** and work schedule to meet minimum efficiency requirements.
- **Maximum isolation time** consistent with efficient performance.
- **Emotional strength** to resist and motivation to withstand long-term confinement and isolation.
- **Group structure** and interpersonal relations.
- **Crew adaptability** to unfamiliar environment and job requirements.
- **Crew selection** techniques and training standards.

Funds Lacking

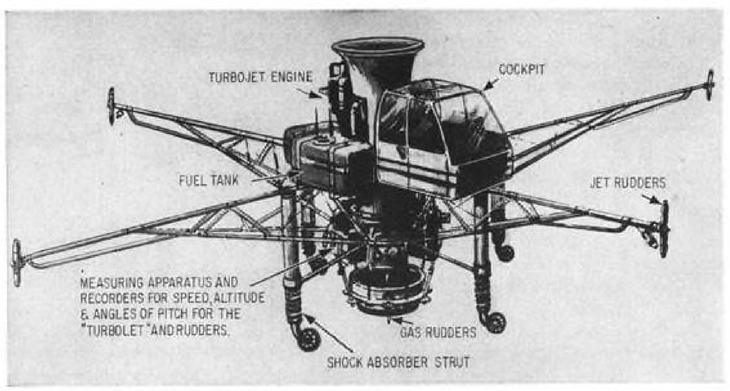
Experimental five-man crew compartment and equipment is available at Lockheed's Marietta plant. Lack of funding is only deterrent to operation.

Compartment was designed to sustain adequately a five-man crew for a period of 120 hr. (five days). Flight station measures 17 ft. long 7 ft. wide, and averages slightly less than 6 ft. head room. Limiting feature is adequate food-storage space. With modifications it could accommodate crew up to 240 hr.; smaller crews for longer periods.

In addition to five days continuous confinement in crew compartment, Lockheed schedule includes five days of observation before and five days of observation following the confinement.

Designation of aircraft commander and copilot would provide atmosphere consonant with authority of men as it actually exists in Air Force. They would hold responsibility for all matters concerning discipline, housekeeping and adherence to duty schedule.

Lockheed built complete mockup crew quarters of nuclear powered airplane. Mockup embraces pilots' seats, designed in capsule for ejection, plus a bunk, writing table, lavatory and complete kitchen.



Drawing Shows Soviet STOL Details

Drawing shows details of the Russian Turbolet (Flying Stand). Flight photo of the VTOL, which may be forerunner of a passenger vehicle, appeared in Aviation Week Oct. 14, p. 26.

FIAT G.91 has been called the only entry in NATO lightweight fighter competition to meet all military requirements.

Test Pilots Report on Fiat G.91 Design

By David A. Anderton

Geneva—First official flight test reports on the Fiat G.91 lightweight strike fighter emphasize that transition to the plane should be easy, even for inexperienced pilots.

Extensive series of flights by contractor and military test and check pilots of Italy, France, Germany, the United States and Turkey, have confirmed the basic aim of Fiat's engineering teams: to produce an unsophisticated, easy-to-fly aircraft designed for a 150-mi. ground attack mission.

Mission and design were the result of a NATO search and competition for a strike fighter able to operate off and on unprepared strips, capable of being flown by pilots with low jet time, cheap to buy and easy to maintain. Much innuendo and criticism surrounded the competition, the competitive flight evaluation on trial missions, the report of the flight-test team, and the final selection of the Fiat G.91 as a first-stage standard for NATO. But one fact stands out: the Fiat design was the only competing airplane to meet every single military requirement.

Here is the first composite report on G.91 flight characteristics including data gathered from test pilot reports.

Characteristics and Performance

		G. 91	G. 91 T (Trainer)
DIMENSIONS			
Wing span	ft.	28.08	28.22
Length	ft.	34.20	36.50
Height	ft.	13.10	13.10
Gross wing area	sq.ft.	176.7	176.7
Wing sweep angle (at ¼ wing chord)		37°	37°
WEIGHTS			
Empty weight	lb.	6,250 (with armor)	6,050
Useful load	lb.	4,750	4,950
Gross weight	lb.	11,000 (approx.)	11,000
ENGINE			
Static thrust	lb.	4,850	4,500
Continuous static thrust	lb.	4,130	3,800
CHARACTERISTIC RATIOS			
Normal wing loading at takeoff	lb./sq.ft.	60	60
Thrust loading at takeoff	lb./lb.	2.27	2.45
PERFORMANCES			
Maximum level speed, class	kt.	600	565
Combat radius at low altitude	n.m.	150	
Endurance			1 hr. 40 min.
Max. design Mach No.		1.17	1.17

G.91 Scramble

Planned military use of the G.91 envisions dispersed squadrons of the planes, operating out of grass-surfaced fields or unprepared surfaces. Planes would be scrambled against a specific target 150 naut. mi. away or less. Time consumed on the ground, buckling in, getting the engine started and taxiing out were to be kept to a minimum.

Pilots agree that the G.91 is easy to get into; buckling-in is simple and quick. Cockpit layout is well-planned; all switches and manually operated items are within easy reach for a pilot of average size.

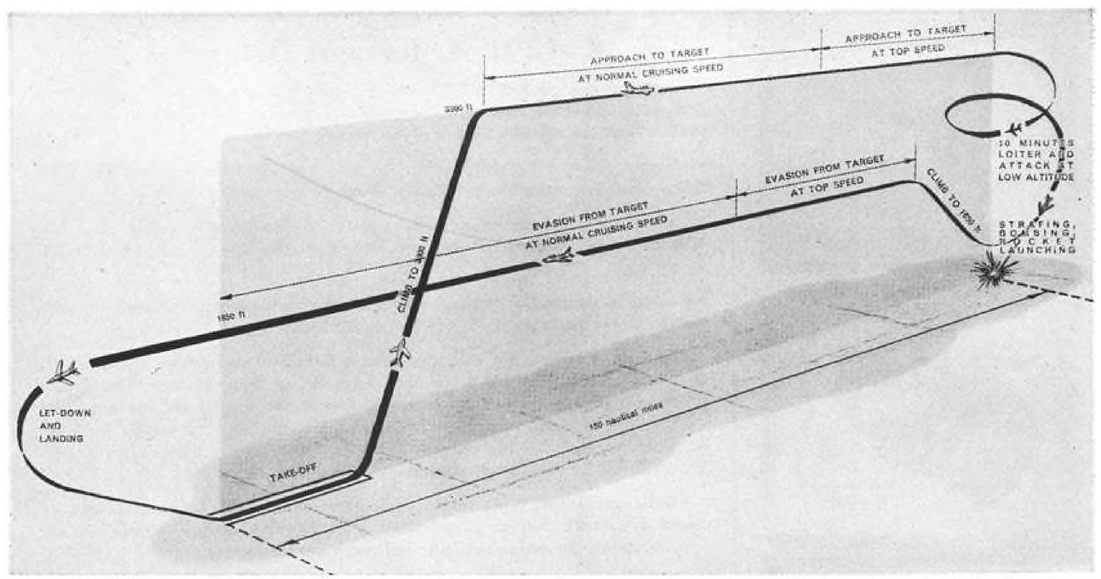
Starting sequence is simple and quick; the cartridge starter gets the engine up to idle rpm. in about 40 sec. after the pilot initiates the start cycle.

Idle power is enough to taxi on hard surfaces; an additional 1,000 rpm. gives enough surplus to make 90-deg. turns easily on the ground. Brakes are effective and brake steering is good for small direction changes; additional power is unnecessary.

Lined up for takeoff, the pilot selects full flap deflection of 40 deg., trims the stabilizer three and one-half degrees nose up, and opens the throttle. Acceleration after brake release is about 0.44G. Rudder and aileron respond at about 50 kt., the nosewheel can be lifted off at about 90 kt., and the plane breaks ground at 110 kt.

At normal gross weight of 11,365 lb., ground run on grass without external stores is 1,970 ft.; with stores, the run is 2,620 ft. Ground run without flaps is about 2,200 ft.

During takeoff and climbout, longitudinal stability is large and positive; slight nose-up changes in trim, which can be easily handled, occur when flaps are retracted and as speed increases. Visibility is good in climbout.

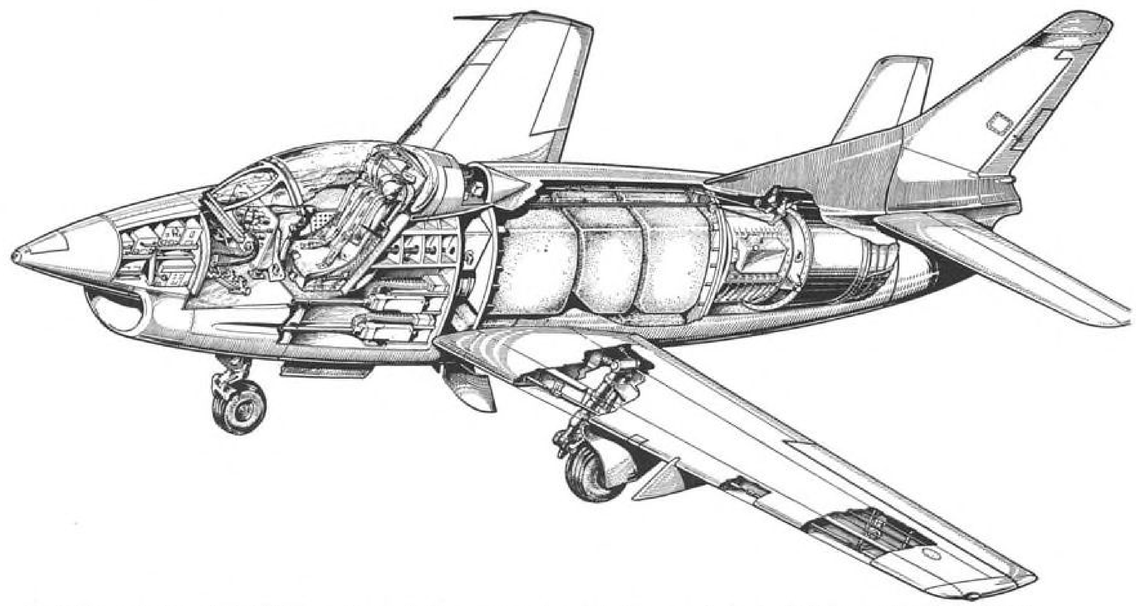


ITALIAN Fiat G.91 would be scrambled against a specific target 150 naut. mi. away or less. Loiter time at target area is 10 min.

About 70 sec. after brake release, the G.91 will have reached its best climb speed of Mach 0.75 at about 1,000-ft. altitude. Pilot holds this only to 3,300 ft., the cruise altitude specified for the mission.

For a high-altitude profile, the G.91 can climb to 26,200 ft. in 3 min., 45 sec.

Most of the approach to target is made at normal cruise speed; for the run-in, the pilot uses full thrust and the G.91 accelerates rapidly to about Mach



COCKPIT controls in Fiat G.91 are easily reached by average size pilot. Guns can be fired with belly speed brakes extended.

G.91 Armament Details

Armament concept for the G.91 evolved a basic gun or rocket pack on removable doors each side of the forward fuselage, plus a wide variety of underwing or wingtip stores. There are basically three kinds of fuselage packages:

- Machine guns for high rate of fire on ground-attack missions, using four 0.50-caliber Browning aircraft m/g with 300 rounds of ammunition per gun.
- Cannon for increased striking power against specific objectives, using either two 30-mm. cannon with 120 rounds per cannon, or two 20-mm. cannon with 200 rounds each.
- Rockets for assigned objectives, using either two packages of 25-two-inch unguided rockets, or two packages of 15 2.75-in. unguided rockets.

Armament alternates for wing storage now include: Two packages each with six three-inch rockets; two 500-lb. bombs; two packs of three five-inch rockets; four 0.50-caliber machine guns in individual pods, one at each wingtip and one under each wing, with 250 rounds each; two 500-lb. napalm bombs; two pylon pods each with 31 two-inch rockets and two tip pods each with 19 two-inch rockets; two pylon pods each with 19 2.75-in. rockets and two wingtip pods each with 12 2.75-in. rockets.

Missile installations being studied include two Nord 5103 air-to-surface missiles, carried one under each wing, and three de Havilland Firestreak infrared air-to-air missiles, carried one under each wing and one under the fuselage.

Maximum rocket firepower is 150 two-inch rounds; maximum machine-gun firepower is eight 0.50-cal. guns with 1,200 rounds total.

0.9, the specified speed for the strike.

Loiter time in the target area is 10 minutes. During this time, the mission would require low-level strikes against ground targets.

Belly speed brakes can be used at all speeds; if they are popped at 460 kt., a typical strafing run speed, the deceleration is 0.65G. At lower speeds—350 kt. might be typical—the deceleration is about 0.4G. There is some light buffeting when the brakes are opening, but this disappears in four seconds when the brakes are completely extended. There is also a slight nose-up trim change which requires between four and seven pounds push on the stick to counter.

Guns can be fired with the brakes out. Maneuverability is rated excellent by the pilots; roll rate is 250 deg. per second at cruise speeds.

Low-Level Runout

Dash away from the target area is made at full throttle and 1,650 ft. altitude, according to the mission requirement. Cruise power is used for the major part of the way home, once the pilot is clear of the target area.

In the pattern, using power approach configuration at 150 kt., controllability of the plane is good. There is a slight yaw when the gear comes down, but this disappears when the wheels are fully extended. There is also a mild trim change easily handled. Gear comes down in four or five seconds, flaps come down in seven seconds.

On final approach, the speed is down to 125 to 130 kt.; the G.91 crosses the fence at a mission landing weight of 8,400 lb. With drag chute and heavy braking, the distance from impact point to dead stop is about 900 ft. Nosewheel can be held off down to about 60 kt.

If the pilot has to abort the landing or has to go around again for any reason, the favorable thrust-weight ratio at the plane's landing weight gives rapid acceleration. In a waveoff at 120 kt., given just before touchdown, full thrust will accelerate the plane at an initial 0.4G to a speed of 140 kt. in about four seconds.

Actual stall speed is about 110 kt. in gliding and power approach configuration, with the airplane light and only minimum fuel on board.

Stability and Control

Throughout the speed range, the static stability about all three axes is positive with a slight gradient. Dynamic-stability tests showed that the airplane would damp out in about one to one-and-one-half cycles at cruise speeds near Mach 0.8.

In all configurations, short-period longitudinal oscillations are satisfactorily damped.

G.91 is controllable, in stalls with ailerons and rudder. Stall warning is ample, with buffeting beginning about 20 kt. above the stall. Aircraft is very stable at high angles of incidence before the stall. Stall characteristics are good and recovery is conventional with no appreciable loss in altitude.

In the power approach configuration, there is a left-wing heaviness that increases as the speed decreases. But the wing can be held up with aileron deflection right down to stall. In G-stalls, there is no appreciable pitchup, and there is adequate warning that the slight pitchup is approaching. Stalls with full aileron deflection left or right show no tendency to aileron reversal.

During the stall in power-approach configuration, prestall longitudinal stability is positive and neutral. If plane is stalled in that configuration, an increase in power keeps the G.91 flying in stalled attitude with no loss in altitude.

Atlantic Council has confirmed an order of G.91s—50 each to Germany and Italy and 48 for France. Price is $240,000 each.

Plastic Rotor Blade Production Started

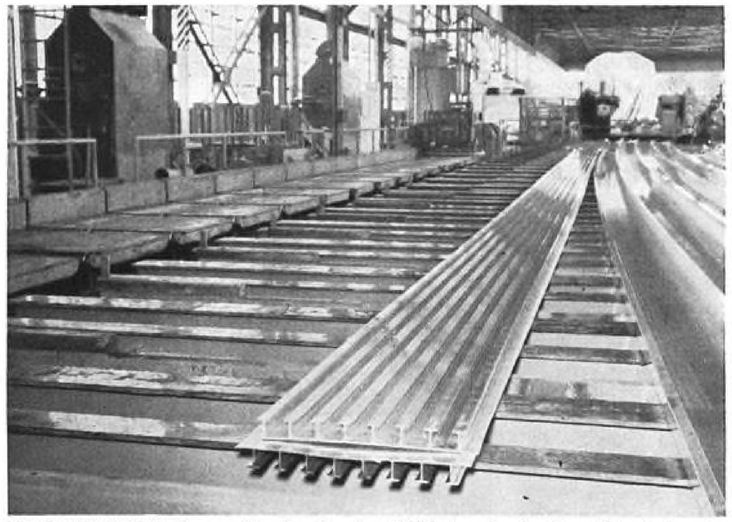
Molded plastic helicopter blades are being produced by the Aircraft Division of Parson Corp., Traverse City, Mich., in two models. The "Monolastic" blade is molded of Fiberglas-reinforced Plaskon polyester resin. "Steelastic" blade is a steel spar version produced under development contract for the Wright Air Development Center.

Severe abrasive effect of blades rotating through dust clouds caused by takeoff from unsurfaced areas is offset by bonding stainless steel sheathing to blade leading edges. Metal is Type 302 chrome-nickel stainless steel, supplied by Republic Steel Corp.

Blade weight is reduced by rolling the metal in .019 in. strips for Monolastic blades and .017 in. for Steelastic models. Metal is cold-worked to the shape of the leading edge and bonded to the plastic body. Parson's designers selected stainless steel sheathing for its corrosion resistance and uniformity of weight to simplify blade balancing.

860 shp. Lycoming T53 Finishes USAF Type Test

Lycoming T53L-1 turboshaft engine passed 150-hr. official USAF type test at rating of 860 shp., with all parts being acceptable and no requirement for penalty runs. Firm recently received $10 million production contract for engine covering installations in Bell HU-1 and Kaman H-43B helicopters, with deliveries scheduled to start next January.



PELLET-EXTRUDED floor section for Douglas C-133 is ready for Dow Chemical's automatic straightener. Section is 17 in. wide and 1.48 in. thick, including integral stiffeners.

Pellet Extrusions Used in C-133

Pellet extrusion method of forming aircraft structural shapes, using magnesium alloy, produces high mechanical properties and weight savings, according to Dow Chemical Co.

System involves pumping spherical magnesium pellets through pipes to extrusion press container where metal is extruded into desired shape. Process was developed by Dow Chemical under sponsorship of Materials Laboratory, Wright Air Development Center, USAF Air Research and Development Command.

Pellet extruded shapes were used in Douglas Aircraft Co. C-133 Hercules cargo transport. Total of 2,163 lb. of pellet extrusions were used in floor substructure, saving 50 lb. Company said application was well-suited to take advantage of increased compressive yield strength, since loading was primarily in compression.

Details of process were outlined in technical paper by George S. Foerster, Metallurgical Laboratory, Dow Chemical Co., Midland, Mich., and Henry A. Johnson, of WADC, Dayton, Ohio. Process resulted from eight years of research and testing.

Pellets are spherical magnesium particles averaging .016 in. dia. and are produced by wheel atomizing in natural gas atmosphere. Process includes:

• **Melt of desired composition** is prepared in conventional manner and then pumped through steel pipes to head pot located above atomizer.

• **Metal flows through orifice** at constant rate and falls upon spinning disk. Centrifugal force disperses molten metal into droplets which solidify in natural gas atmosphere, and fall to bottom of tank.

After screening through coarse mesh to remove irregular particles, pellets are packed in drums for shipment. Actual extrusion process, Foerster and Johnson said, is "equally simple." Advantages are:

• **Pellets are preheated** and blown into extrusion press container and directly extruded into desired shape in short time.

• **Process eliminates** separate steps of precompaction and sintering usually used in powder metallurgy.

• **Pellet extrusion** offers potential process advantage in large scale production by transfer of pellets to presses through pipes.

• **Compressive yield** strength improvement is attributed to very small grain size of pellet extrusions.

Compressive Field

Engineers explained that compressive yield strength of conventional extrusions is substantially lower than the tensile yield strength because of twinning that occurs when metal is compressed. As grain size is decreased, twinning is increasingly inhibited.

Magnesium alloy ZK60XB (Mg+ 6Zn+0.6Zr) was selected for commercial development because of combination of high strength and toughness, Foerster and Johnson explained.

Essentially the same composition—ZK60A (Mg + 5.5ZN + 0.6Zr)—has been used for years in production of high strength magnesium extrusions in conventional process. However, increasing cross-sectional area of the extrusion substantially decreases the compressive yield strength of ZK60A-T5. Similar increase has no effect on extrusions made by pellet process.

For example, the minimum compressive yield strength of a 10 in. I beam with a cross-sectional area of 4 sq. in. is increased 40% from 25,000 psi. to 35,000 psi. Advantage of pellet extrusion of small shapes (cross-sectional area of less than 2 sq. in.) is less but still substantial, Foerster and Johnson said.

Engineers noted that ZK60A ingots must be "heavily worked by extrusion at high reductions in order to produce a uniform fine-grained structure." If the shape is too large to permit adequate reduction, they continued, the cast structure is not completely refined during extrusion and the compressive yield strength is substantially reduced.

Since ZK60XB pellets have smaller grain size than ingots, only a low reduction is required to provide satisfactory welding into an extruded shape.

Dow Chemical now has a 13,200 ton press operating on production basis at its Madison, Ill., plant. Conventional ZK60A-T5 extrusions with a minimum compressive yield strength of 30,000 psi. are expected in sections up to 5 sq. in.

Foerster and Johnson said larger shapes (up to 25 sq. in.) are possible, with 35,000 psi. minimum compressive yield strength.

Mitsubishi Studying Super Tiger in U.S.

A team from Mitsubishi Heavy Industries is visiting Grumman Aircraft Engineering Corp. to outline production plans for the J79-powered F-11F-1F Super Tiger fighter to be built in Japan, pending final approval by the Japanese government of a detailed program and cost estimates.

Final program will also require approval of U.S. government. Grumman reports that Super Tiger production for Japan could start in 1959 and would embrace 300 aircraft to be built by the end of 1964, the majority of them made by Mitsubishi.

Boeing Rolls Out 100th Jet Tanker at Renton

Boeing Airplane Co. has rolled out its 100th KC-135 Air Force jet tanker-transport at Renton, Wash. Total of 345 KC-135s have been ordered. Peak production will reach 15 airplanes per month in July. Company said KC-135s have flown nearly 15,000 flight hours in Strategic Air Command assignments. Aircraft went into production on Oct. 5, 1954; first KC-135 rolled out in July, 1956.

SCIMITAR landing configuration shows droop leading edges, large flap area. Note speed brakes extended engine tailpipe (right).

Scimitar Entering Carrier Service

London—Vickers Supermarine Scimitar, incorporating a number of aerodynamic changes, goes into Royal Navy operational service this month with emphasis on nuclear strike capability.

Swept-wing Scimitar is first Royal Navy aircraft to have:

- **All-hydraulic** 4,000 psi. services.
- **Fully powered** control surfaces and pressure refueling system.
- **Low pressure** air starting unit, using mobile gas turbo-compressor ground equipment.
- **Compressed air** flowing over flaps for reduction in takeoff distance and approach speed.

Scimitar is powered by two Rolls-Royce Avon jet engines, from which air is bled to blow over flaps for supercirculation (AW Sept. 16, p. 19). Armament is four Aden 30 mm. cannons, using radar gunsight ranging.

Wing span is 32 ft. 2 in. and length is 55 ft. 4 in.

Boundary layer control utilizes air bled from compressor stage of each engine and then ejected from a supersonic nozzle over the trailing edge flaps.

Wing tip stall which had led to marked pitchup tendency and poor low-speed characteristics initiated series of aerodynamic changes. Tail plane was inverted to give an anhedral setting, lowering slab tips about six feet into the wing wake.

To further reduce pitchup, saw-tooth leading edge was provided to restrict forward movement of the center of pressure and reduce down-wash on the tail planes. Divided, drooped leading edge was installed to counteract leading edge flow breakaway due to action of flaps. Outer nose flap deflects 30 deg., the inner 20 deg. Boundary fence is 5 in. high, runs for two-thirds of wing chord length.

Flaps use about 15 psi. and reduce final approach speed to 130 kt. Area and angle of dive brakes also has been increased. Hydraulic boost is available for rudder and elevators.

Mobile compressor which supplies low pressure (35 psi., 200C) air to Rotax air turbine starters mounted in engine achieve starting time of about 8 sec. Refueling under pressure has reduced ground time to 15 min.

Noise Incidence

To reduce noise incidence, Scimitar uses jet-pipe extensions leading into Curran mufflers for ground runup. Device also minimizes ground resonance effects on tail section.

Aircraft will be assigned to carrier H.M.S. Victorious. Carrier will have jet-blast deflectors installed behind catapults and island will be soundproofed. Scimitar operational use includes air-to-air refueling. Tankers will be carrier-based and probably will be Scimitars.

Plane has fitting for four external fuel tanks.

PRODUCTION model of Folland Mk.1 Gnat is earmarked for India. Fighter, powered by Bristol Orpheus 701 turbojet (4,850 lb. thrust), has dielectric nose cone containing radar, and two dielectric panels in dorsal spine for radio compass loop (fore) and sense aerials (aft).

Avionic Changes Mark Production Gnat

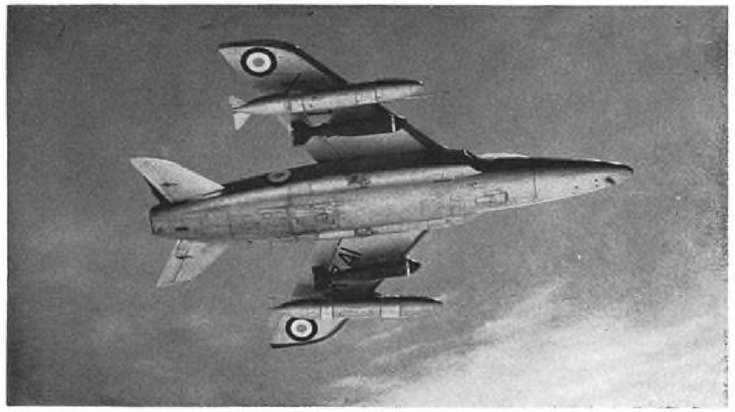
Hamble, Hampshire—Avionic and aerodynamic modifications mark late production models of Folland Aircraft Ltd.'s small Gnat Mk. 1 light fighter. Result: improved navigational capabilities and flight characteristics as compared with basic aircraft assigned to Ministry of Supply flight development program.

Production model, earmarked for India combines these features:

- **Dielectric nose cone,** housing radar ranging equipment, plus two dielectric panels in dorsal spine, which house radio compass loop and sense aerials.
- **Small strakes,** running spanwise on ailerons, designed to prevent aileron "buzz."
- **Deletion of rear-view** windows, plus small ram air intakes at wing root which were on the Ministry of Supply aircraft.

Earlier production aircraft XK-739 and XK-741, shown with British mark-

DROP tank above will be used on all production Folland Gnats. Tank is a conversion of an original Bristol 50 gal. asbestos phenolic tank. The inserted metal sections raise its capacity to 66 gallons.



FOLLAND Gnat XK.741, used by Ministry of Supply for flight development, is carrying two 500 lb. bombs and two 66 gal. drop tanks. Tanks have proved buffet-free to Mach 1.

MOST of Folland Gnat can be reached from ground in final assembly at Hamble, Hampshire. In earlier assembly stages, entire front and center fuselage are rotated in jig for access.

ings, are without radar and radio compass; have two rear-view windows just aft of cockpit.

Basic Gnat is designed to carry two 500-lb. bombs and Folland 66-gal. drop tanks. Latter are modified 50-gal. Bristol asbestos phenolic tanks used to test the aerodynamic qualities of the new shape. They eventually will be of all-metal construction.

Two drop tanks, which give additional hour's endurance, are buffet-free up to the speed of sound. Fuel is transferred to main tanks by compressed air at three pounds per square inch.

Empty weight of the small fighter approximates that of an automobile—3,917 lb. Gross weight is 6,191 lb. Span is 22 ft. 1 in. Length is 29 ft. 8 in. Height is 7 ft. 7 in.

Gnat is powered by Bristol Orpheus 701 turbojet with thrust of 4,850 lb. Speed is specified at Mach .98.

All major subassemblies of aircraft are constructed at Eastleigh Airport, Southampton. Final assembly is at Folland's Hamble plant in Hampshire.

Small size and simplicity of Gnat facilitates production. Subassemblies on trolley can be wheeled from one stage to the other; almost any part of airplane can be reached from ground level. While in rig, front and center fuselage can be rotated by two men through any desired angle to expedite work.

WHAT'S NEW

Publications Received:

First Flights—by Oliver Stewart—pub. Pitman Corp., 2 West 45 St., New York 36, N. Y. $5.50; 225 pp.

Detailed reports on flights which marked application of important technical innovations, and extension in the uses of aircraft, civil and military.

The Millionth Chance—by James Leasor—Pub. Reynal & Co., 221 East 49th Street, New York 17, N. Y. $4.00; 244pp.

This book has set out the strange story of the creation of the great vessel, R-101. It brings out the political reasons, and the bungling in high places, which seems to characterize every new development in national growth.

Landing Gear Design—by H. G. Conway—Pub. the Macmillan Co., 60 Fifth Avenue, New York 11, N. Y. $12.00; 342pp.

This book should meet the requirements of both aeronautical engineers and factories and the aeronautical engineer or student dealing with mechanical and structural engineering.

Strategic Air Command—by Richard G. Hubler—Pub. Duell, Sloan & Pearce, Inc., 124 East 30th Street, New York 16, N. Y. $4.50; 280pp.

This book explains the important function, power and the life-saving promise of America's greatest military command, known as SAC.

Plant Engineering Practice—by editors of Plant Engineering—Pub. F. W. Dodge Corp., in cooperation with the Technical Publishing Co. $18.50; 694pp.

Presents experience of more than 100 experts in different fields all related to daily plant activity.

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

The Stress Corrosion and Pyropyoric Behavior of Titanium and Titanium Alloys—by D. W. Stough, F. W. Fink and R. S. Peoples, Titanium Metallurgical Laboratory, Battelle Memorial Institute, for Office of Assistant Secretary of Defense for Research and Engineering. $1.50; 56pp.; (PB 121635).

Feedback System Testing—by C. F. White, Naval Research Laboratory. $1.00; 31pp.; (PB 131345).

Operational Requirements for ATC Displays—by F. S. McKnight, Technical Development Center, Civil Aeronautics Administration. $.50; 16pp.; (PB 131387).

Volumetric Scanning GCA Antenna Design—W. F. Gabriel, G. D. M. Peeler, H. P. Coleman and D. H. Archer, Naval Research Laboratory. $1.50; 58pp.; (PB 131286).

The Preparation of Highly Effective Rust Inhibitors by Fractionation of Mahogany Sulfonates—by K. R. Frisch, Frankford Arsenal, U. S. Army Ordnance Corps. $.50; 18pp.; (PB 131231).

Jet Age Planning Progress Report No. 3—by Civil Aeronautics Administration, $.30.

Navy Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia, Penna.

Electronic Tube Corp., Philadelphia, oscillographs, (N383-51083A), $29,261.

Holley Carburetor Co., Warren, Mich., maintenance and overhaul parts, N383(MIS) 49482A, (MIPR-41-608-8-2070, amendment 12 and 12A), $417,779.

AC Spark Plug Division, General Motors Corp., Flint, Mich., spark plugs, N383-49478A(383/9081-28327 x 5/2/58 aero), (383/9081-28752 x 5/2/58 aero), $2,246,822.

DISTRICT PUBLIC WORKS OFFICER, Sixth Naval District, Bldg. 13, USNB, Charleston, S. C.

McDonough Construction Co. of Florida, Miami, radar facility, BC-4 camera towers and catchment area for Air Force Missile Test Center offshore facilities at San Salvador, Mayaguana and Grand Turk Islands, B. W. I., NBy-13860, $273,833.

NAVY DEPARTMENT, BuShips, Washington 25, D. C.

Reeves Instrument Corp., Garden City, L. I., N. Y., design, develop and furnish reference azimuth platforms, contract NObs-74287(Inv. No. 565-122Q), two ea., $337,910.

Stewart-Warner Division, Stewart-Warner Corp., Chicago, AN/UPM-70, radar test set, contract NObsr-19035(SHIPS) and amendment No. 1, 66 sets, $262,176.

Premax Products Division, Chisholm-Ryer Co., Inc., Niagara Falls, N. Y., AT-350 antenna, contract NObsr-75122(IFB-600591-58-S), drawing No. RE-66-F-627-H, 101 ea., $121,992.

Stavid Engineering Inc., Plainfield, N. J., AN/BPA-(6), antenna system, contract NObsr-75148(Inv. No. 882D-87513Q) Spec. No. SHIPS-A-2773, 1 ea., $119,000.

NAVY DEPARTMENT, BuAer, Washington D. C.

Kollsman Instrument Corp., Elmhurst, N. Y., pressure altimeters, in accordance with spec. MIL-A-6863A(AS6) and military standard drawing No. MS28044(AS6), NOas-58-389-f(PD-42-1333-57), $77,066.

Emerson Radio Phonograph Corp., Jersey City, N. J., 168 man-months of field engineering services on pilot-operated armament control systems; NOas-58-344-s(AV-05-3520-57), $185,626.

Aeroproducts Operations, Allison Division, General Motors Corp., Dayton 1, Ohio, conduct a ground and flight vibration survey of model ADS6641FN-B3 propellers on the R3Y airplane; NOas-58-457-d(PP-32-1655-58), $31,700.

Massachusetts Institute of Technology Division, Sponsored Research, Cambridge, Mass., conduct an investigation of chromium-base alloys for use at elevated temperatures; NOas-58-253-d(AEO41-2066-58), $36,000.

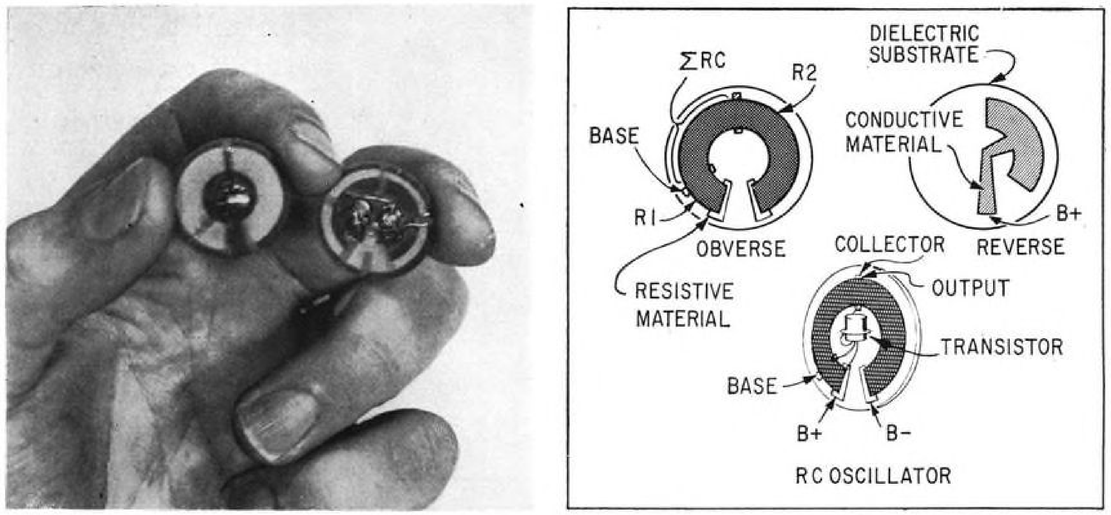
Reaction Motors, Inc., Denville, N. J., provide materials and services necessary to increase the power capacity of the rocket test area under control of the contractor: NOas-58-014-c(IP-31-4412-58), $225,000.

Douglas Aircraft Co., Inc., Santa Monica, Calif., materials and services necessary to construct, modifications, alterations and improvements to maintain plants for production of military aircraft, missiles and components; $370,000.

Norden-Ketay Corp., Milford, Conn., provide fire control system school, instructions, instructors, engineers and 76 man-months of field engineering services in the maintenance, repair, operation of AN/ASB fire control systems; NOas-58-374-s, $126,720.

U. S. NAVY PURCHASING OFFICE, 1206 South Santee St., Los Angeles, Calif.

Mid-Century Instrumatic Corp., New York 10, N. Y., computer consoles, MC-700 diode function generator, MC-650, electronic multiplier, MC-700, N123(60530)16375A, 8 ea., $152,810.



INTEGRAL micro-circuitry, made by evaporative depositing process, may reduce avionic equipment size and weight by a factor of 100 or more, with improved reliability. In photo at left, experimental computer flip-flop circuit is on right; RC oscillator is on left. Oscillator (drawing at right) is made by depositing shaped films of conducting material on both sides of ceramic disk, followed by resistive film on one side. Resultant distributed constants network improves performance. Transistors eventually may be made this way.

Electrochemistry May Cut Circuit Size

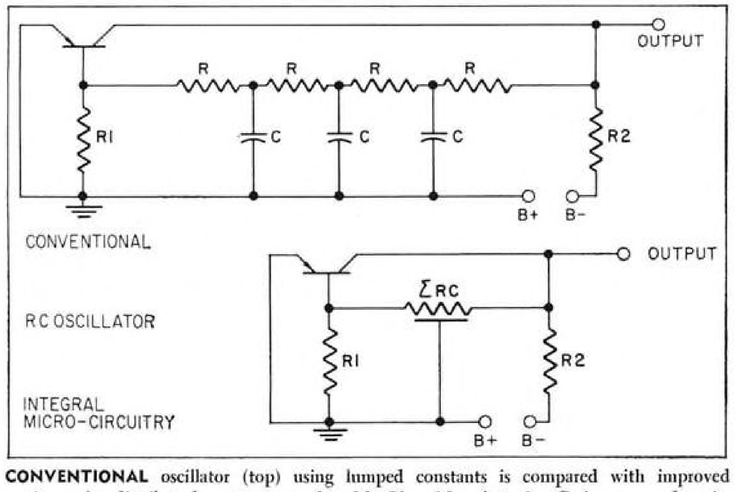
By Philip J. Klass

Washington – Electronic technology may be on the threshold of the most revolutionary change in its history, spurred by needs of space vehicles for microminiature size avionic equipment capable of unfailing operation for extended periods.

Military sponsored programs now under way or about to be launched are expected to result in techniques for manufacturing complete functional circuits as an integral unit using electrochemical processes instead of the present practice of mounting dozens of individual components which must then be interconnected into the desired circuit.

One such technique under development deposits thin films of conducting, semiconducting and insulating material so that circuit elements are interconnected during the fabrication process. There would be few soldered connections.

Many of the materials employed will be new, specifically synthesized to perform a desired function instead of relying largely upon materials found in nature.



CONVENTIONAL oscillator (top) using lumped constants is compared with improved version, using distributed constants, produced by Varo Manufacturing Co.'s vacuum depositing process. Office of Naval Research is sponsoring this phase of Varo's work.

No Pipe Dream

Micro-circuitry, or molecular circuitry as it sometimes is called, already has gone beyond the dream stage in a number of companies and government laboratories, where complete functional circuits of modest complexity are being fabricated on a laboratory or model shop basis. For example:

• **Varo Manufacturing Co.** has produced variety of passive networks, flip-flops, d.c. amplifiers by evaporative depositing process, with only the transistors added as a separate component. Current work is sponsored by Office of Naval Research.

• **Army's Diamond Ordnance Fuze Laboratories** are producing transistors and diodes by a special photo-etch process.

• **Bell Telephone Laboratories** and **Radio Corp. of America** have developed complete decade counters roughly the size of transistors, which perform same shift-register function that now requires 20 transistors, 40 resistors and 20 capacitors (AW Nov. 4, 1957, p. 95; April 14, 1958, p. 71).

• **Britain's Royal Radar Establishment** is working on a four-transistor flip-flop circuit which will employ deposited circuit elements, have equivalent of an emitter follower output with bridges of high resistivity semiconductor to join emitter and collector elements. Entire unit will measure 6 mm. square by 2 mm. thick.

USAF Program

Major speed-up in industry efforts will come soon when Air Force begins awarding contracts for molecular circuitry developments which are expected to total more than $1 million during coming fiscal year. These will be sponsored by Wright Air Development Center's Components Laboratory and by Air Force Cambridge Research Center.

After exploratory visits and discussions with major research laboratories and a number of universities, Air Research and Development Command concludes that molecular circuitry is feasible and that considerable work is already underway, according to Col. C. H. Lewis, chief of Airborne Electronics Division, ARDC Headquarters.

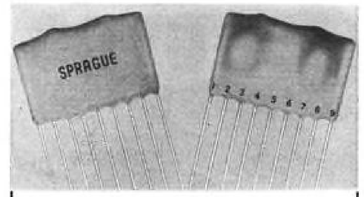
One indication of widespread interest is the fact that ARDC already has received more unsolicited industry proposals for molecular circuitry developments than it can support with available funds, according to Lewis.

Major Advantages

Molecular circuitry should make it possible to achieve equivalent of component packaging densities of between 10,000 and 100,000 per cu. in., 100 to 1,000 times the maximum obtainable today using conventional components and the best miniaturization techniques. Austin Stanton, president of Varo, predicts that one million components per cubic inch may even be possible. There should also be comparable reductions in weight.

Even more important than the size and weight gains is the vastly improved reliability which is expected from molecular circuitry. Today, avionic equipment which can operate for 200 hr. in a military aircraft without maintenance or malfunction is considered a reliable piece of equipment. But for a satellite vehicle, 10,000 hr. of trouble-free operation (approximately 13 months) is an immediate goal.

By eliminating most component interconnections and soldered joints, molecular circuitry is expected to boost reliability. Even more important, the inherent cleanliness of the processes used to fabricate molecular circuitry is expected to greatly reduce impurity contamination. In the evaporative depositing process, used by Varo and Servomechanisms, fabrication takes place under high vacuum at elevated temperature. The "boiling" of the working material, like distillation, makes it possible to separate out unwanted impurities in the material. Techniques similar to those employed in mass spectrometers also can be used to screen out undesirable impurities.



Multiple Logic Unit

Miniature integrated circuit, Type 200C9, consisting of 10 resistors, five capacitors and two transistors, which can be used as a computer flip-flop, pulse generator, for gating, amplifying, clipping, shaping or delaying circuit, has been announced by Sprague Electric Co. Completely encapsulated unit, measuring 1 x 1¼ x ½ in., has nine input/output leads. For application data, write for Engineering Bulletin 6712. Sprague's address: 327 Marshall St., North Adams, Mass.

Developmental Timetable

Initial use of molecular circuitry probably will come in such devices as digital computers, instrumentation, communication receivers where power levels are low and the resulting size, weight reduction and improved reliability are sorely needed for space vehicles and missiles.

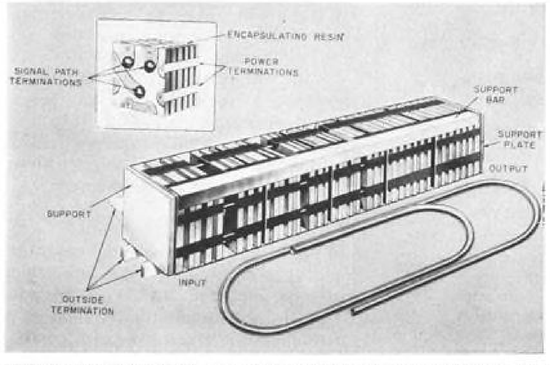
Within five years molecular circuitry will be in limited use in such applications, possibly also in piloted aircraft. Within 10 years, molecular circuitry may be almost as commonplace in military weapons as the transistor is today.

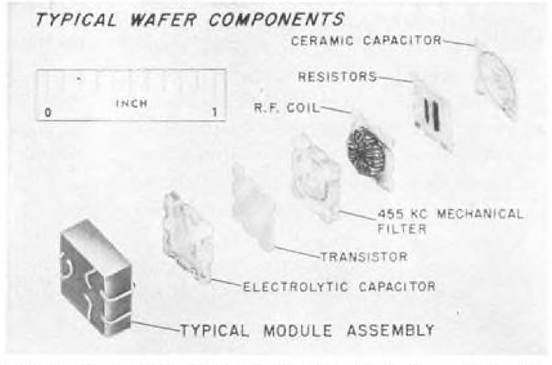
The new techniques' use also seems certain to spill over into industrial and consumer electronic products where microminiature size, weight and high reliability offer advantages. Some molecular circuitry enthusiasts believe that it can greatly reduce costs and that this will assure its widespread use for consumer products.

Lower Costs

Considerable capital investment will be required for the precision machines needed to produce molecular circuitry and to provide automation of the process for good quality control. Even allowing for the higher initial investment, proponents of molecular circuitry say that there should be a net saving because of the considerable reduction in direct labor costs.

An equally important saving, particularly for short military runs, will be the ease of changing circuits produced by a machine, with reduction in setup





MICRO-MODULES (left), manufactured through a new ultraminiature construction technique being developed by Radio Corp. of America, are expected to reduce size and weight of avionic equipment by 90%, permitting volumetric efficiencies of 300 to 400 components per cubic inch. Modules consist of stock of 0.3 in. sq. sub-modules, each of which is built up from tiny ceramic plates (right), each mounting one or more components with flat form-factors which have been fabricated directly on plate wherever possible. This includes such components as transistors, capacitors, resistors and inductors. RCA is developing micro-modules under $5 million Army Signal Corps contract.

and personnel training time from present-day levels. Assuming machines are controlled by magnetic or punched tape, it should be necessary only to change the tape program and substitute new working materials, according to some molecular circuitry supporters.

Industry Impact

Molecular circuitry may upset traditional lines of demarcation between electronic component and equipment manufacturers. Because molecular circuitry poses a direct threat to conventional parts, it is logical to expect component manufacturers to move to protect their position. However, molecular circuitry development will require much more research and know-how than many of the smaller component manufacturers now possess.

Smaller component manufacturers also will be handicapped because molecular circuitry seeks to produce functional circuits rather than merely to reproduce existing combinations of conventional components by a new manufacturing process. Thus the developer of molecular circuitry also requires considerable knowledge of electronic circuitry and its function in the equipment in which it will be used.

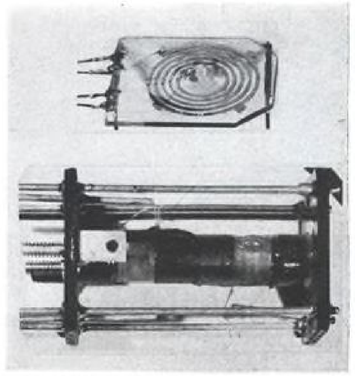
Equipment and circuit designers, long accustomed to working with groups of interconnected components, also will need to take a fresh approach—sometimes with fortuitous results.

For example, in many types of filter networks, better performance could be obtained if the network were constructed of an infinitely large number of components (distributed constants). But this is too costly with conventional components and so the designer compromises performance and settles for a network consisting of far fewer elements (lumped constants).

Varo Manufacturing Co., one of the molecular circuitry pioneers, finds that it is actually easier to produce a network with distributed constants than one with lumped constants, with resulting improvement in network performance, according to Jack G. Smith, vice president-engineering. But to do so requires that Varo employ engineers who are circuit designers to work alongside fabrication process designers.

Varo Microcircuitry

Varo, manufacturer of precision frequency power supplies and other electronic equipment, first began thinking about fundamentally new techniques of manufacturing about five years ago. Objective was to come up with a new approach which would cut the cost and manufacturing problems involved in small-company, short-run production. About two years ago Varo began to investigate evaporative depositing techniques which appeared to be the most promising ideas to come out of their brainstorming efforts.



PRE-TUNED radio and intermediate frequency transformer at top is made by depositing process. Conventional unit is at bottom.

Office of Naval Research took over sponsorship about a year ago as part of its Army-Navy Instrumentation Program (ANIP) which is developing an integrated cockpit instrument display employing TV tubes. Program requires use of an airborne digital computer and the Varo techniques showed promise of major size and weight reductions with hope for greater reliability.

Under the ANIP program, Varo is working closely with scientists of Servomechanisms, Inc., who are conducting research in new materials for possible use in latter's own evaporative depositing process aimed at producing extremely high temperature components (AW Sept. 30, 1957, p. 70).

Molecular Metallurgy

In the evaporative depositing process, the working material is heated (usually by electron bombardment) to its vaporization temperature in a high vacuum chamber. The gaseous vapor then is deposited in a thin film on suitable substrate (base) material. Structure of the thin film can be controlled by choice of substrate material and/or its surface temperature.

Shape of film deposited on substrate can be controlled by placing a mask of the desired shape between vapor source and substrate. Another possibility, currently under investigation by Varo, is to charge vapor particles, then use magnetic fields to deflect on ion beam to trace out the desired pattern on substrate, not unlike deflection technique used in TV tubes.

Varo reports that it has developed techniques which make it possible to simultaneously evaporate several different types of material and mix and deposit them in controlled proportions. This "molecular metallurgy," as Varo calls it, permits the alloying of materials with widely different vaporization temperatures—something that is impossible by conventional metallurgical techniques.

The ability to create new materials by molecular metallurgy opens the way to producing thin films of resistive materials with linear or non-linear characteristics which can vary or be independent of temperature. Films can be produced with a variety of different magnetic characteristics.

Progress at Varo and Servomechanisms in producing semiconductor diodes by evaporative depositing process suggests that it is only a matter of time before field-effect transistors can also be manufactured by this process.

Varo's Progress

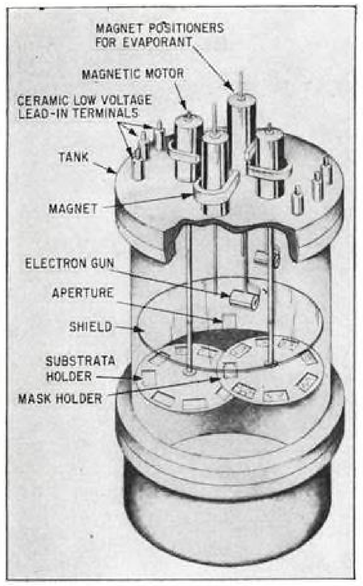
In the course of Varo's ONR-sponsored program, the company has produced a number of interesting examples of what it calls "integrated microcircuitry." Varo emphasizes that it has not attempted to achieve maximum possible size and weight reduction at this stage of the development. Despite this, reductions of better than 20:1 are easily achieved, compared with good subminiature construction.

For example, an Eccles-Jordan flip-flop circuit of conventional design uses two transistors, five capacitors and seven ¼-watt JAN resistors. Volume of two of these resistors is roughly the same as the volume of the complete circuit when produced by Varo's new technique (0.018 cu. in.). Of this total, the two transistors occupy about two-thirds the volume of the integrated microcircuit.

A carrier generator (RC oscillator), which originally consisted of eight resistors, six capacitors and a subminiature tube employed in a lumped-constants circuit was reproduced by Varo using distributed constants. This so improved performance of the circuit that a transistor could be substituted for the original tube. Entire oscillator circuit, including transistor, occupies only 0.015 cu. in. in integral microcircuitry form.

Significant reduction in size and weight, plus improved performance for some types of circuits, results from Varo's ability to combine functions of resistors and capacitors.

For example, to produce a simple network of series resistors with shunt capacitors, Varo deposits a thin conducting film on one side of a ceramic base (substrate) producing equivalent of one capacitor plate. On opposite side of substrate a thin film of resistive (slightly conducting) material is deposited so its position coincides with that of conductor on reverse side. Capacitance between two films is thereby distributed along the length of resistive element, producing the effect of a nearly infinite



VACUUM chamber might be used for tape-controlled fabrication of micro-circuitry by evaporative deposition.

series of resistors with capacitors in shunt.

In the case of the RC oscillator, this network is connected in series with two other resistors (R1, R2) which serve as transistor base resistor and output resistor.

Instead of fabricating R1 and R2 as separate elements and then connecting them to the terminals of the series resistor network, Varo merely extends the deposited resistive film beyond the ends of the capacitance film (on the reverse side). Metal tabs are initially deposited on the substrate to provide terminals for connecting R1 and R2 to oscillator output and transistor base.

To achieve full potentialities of the Varo process, it frequently is necessary to modify a circuit designed for conventional construction techniques. This requires some initial adjustment in circuit designer thinking, and familiarity with the new process, but is not difficult, Varo says. Company currently is writing a handbook which will aid circuit designers in applying new technique.

This type of reorientation, to think of functional circuits instead of a collection of components, is not limited to Varo. Wright Air Development Center's Electronic Components Laboratory soon will award contracts for "fresh looks" at the possible application of radically different approaches to performing basic avionic circuit functions.

One WADC program, for example, will call for study of a variety of phenomena—many of them discovered dec-

Drone Control Station

During first flight tests, Sperry Gyroscope Co. engineers check performance of master ground control station for its Microwave Command Guidance System located inside an air-transportable van. Drone is controlled from position at left of console in front of flight instruments while flight is monitored from right position. Flight path is traced automatically on plotting board.

ades ago—to see if they can be applied to current circuit needs. This includes such things as the Hall Effect, Seebeck Effect, Ettingshausen Effect, Nernst Effect and paramagnetic resonance, to cite only a few.

Another approaching WADC program will seek the development of direct-acting solid-state components that are capable of acting as transducers or performing complex logical operations.

The transistor has radically changed the avionics and electronics art in the 10 years since it was developed. New concepts of producing devices capable of performing complete circuit functions and new techniques for fabricating integral circuits by electro-chemical processes could have an even greater impact in the next decade.

Collins Radio Builds Lightplane Avionics

Cedar Rapids, Iowa—Collins Radio has entered the lightplane avionics field with integrated line of lightweight, moderate-cost "airline quality" communication-navigation equipment which will complement company's new line of lightweight avionic equipment for small twin-engine business aircraft and airliners. Collins says lightplane equipment complies with Civil Aeronautics Administration technical standard orders and meets new Federal Communications Commission requirements.

Typical integrated package for single-engine lightplane use consists of:

• **VHF receiver** 51X-3, designed for panel mounting, provides 90 separate channels in frequency band of 118-126.9 mc., with airline-type digital channel selection. New crystal controlled receiver weighs 3¼ lb., is priced at approximately $650.

• **VHF transmitter** 17L-8, also for panel mounting, provides 90 separate channels in same 118.0-126.9 mc. band, is rated 3 watts output, provides digital channel selection. Unit weighs 2½ lb., is priced at approximately $395.

• **Power supply, modulator,** IF and audio amplifier for VHF receiver, type 427B-2, weighs 5 lb., is priced at $455.

• **Omni/localizer converter-indicator,** 344D-1, provides 3-in. semi-pictorial cockpit display of aircraft bearing relative to omni/localizer beams. Device weighs 2¼ lb., is priced at approximately $1,080.

Where increased instrument approach capability is desired, lightplane operator can add dual equipments plus:

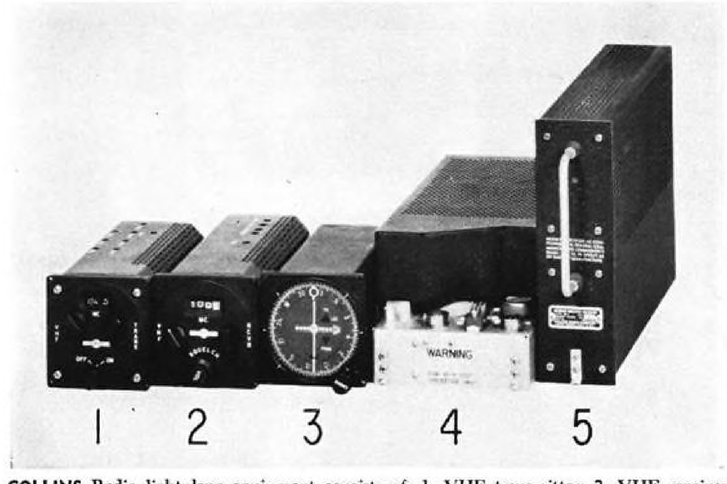
• **Marker beacon receiver,** 51Z-2, weighs 3¾ lb., comes in short ¼ ATR size case, is priced at approximately $705.

Collins says it has tentative plans to furnish complete installation package kits which may include custom-tailored racks for equipment mounting.

FILTER CENTER

▶ **Voluntary Penalty Clauses**—Number of avionic equipment manufacturers have voluntarily offered to accept reliability penalty clauses in new Air Force contracts in anticipation of proposed Defense Department policy to include reliability provisions in future procurement contracts.

▶ **Air Force Swings to SSB**—Air Force flight tests on new Collins AN/ARC-58 airborne single sideband transmitter/receiver and Radio Corporation of America's ARC-65 (modified version of RCA's ARC-21) have proven so successful that Air Force plans speedy switch from present AM to new suppressed-carrier SSB. Collins ARC-58s have been ordered for use in new Boeing



COLLINS Radio lightplane equipment consists of: 1—VHF transmitter; 2—VHF receiver; 3—omni converter-indicator; 4—power supply, modulator IF, audio amplifier; 5—marker beacon receiver. Collins says equipment complies with CAA standards, FCC requirements.

B-52s and KC-135 jet tankers, while older ARC-21s now installed in B-52s and Tactical Air Command aircraft will be converted to ARC-65s by RCA. Military Air Transport Service aircraft, which must carry dual HF sets, may be equipped with lightweight single sideband versions of the Collins 618S commercial sets which MATS is currently using.

► **Voltage Transients**—Trend toward transistorized avionic equipment is focusing attention on voltage transients in aircraft-missile electrical systems which can cause transistor breakdown. Recent tests by Pan American World Airways on one of its Douglas DC-7s revealed that over a 30 day period there were several hundred instances when nominally 28 volt d.c. line voltage reached 40 to 60 v., five times when it reached 60 to 80 v., twice when it exceeded 100 v., according to Pan American's Ben McLeod. Increasing number of avionic engineers is now building transistorized voltage regulator into equipment for protection against voltage transients.

► **New Doppler Navigator**—Newest addition to the ranks of Doppler navigators aimed at the airline, business aircraft market is Radio Corporation of America's AVQ-80. RCA's entry, a modified version of the British Marconi FM/CW system which employs four beams, is expected to weigh under 80 lb., meet Arinc Characteristic 540. Flight tests of breadboard model are slated to start this fall, with airline tests of prototype design early in 1959.

► **DC-8 Avionic Highlights**—Douglas DC-8 will carry up to $140,000 worth of avionic equipment, more than prewar cost of a complete DC-3. Douglas jetliner radio rack contains 26 avionic equipments, weighing about 1,100 lb., with another 1,100 lb. required for installation provisions and 10 mi. of wire. DC-8 uses 20 antennas, 15 of which are flush mounted. Remaining five include two semi-flush ADF antennas, two VHF blade antennas and one marker beacon antenna. Careful weight and drag analysis revealed that specially designed external blade antennas for latter applications were superior to flush types, Robert H. Jerome, Douglas engineer, reported at recent Dayton Conference on Aeronautical Electronics. DC-8 radome uses novel technique for protection against lightning strike damage. Strips of thin adhesive-backed aluminum foil are mounted on radome's external surface and grounded to airplane. Foil strip disintegrates during lightning strike but is easily replaced. Technique was developed by Lightning Transients & Research Institute, Minneapolis, in cooperation with Douglas.

FIRST SIKORSKY S-62 amphibious helicopter is powered by a single General Electric T58 gas turbine engine rated at 1,050 shp.

S-62 Slated for Full Production in 1961

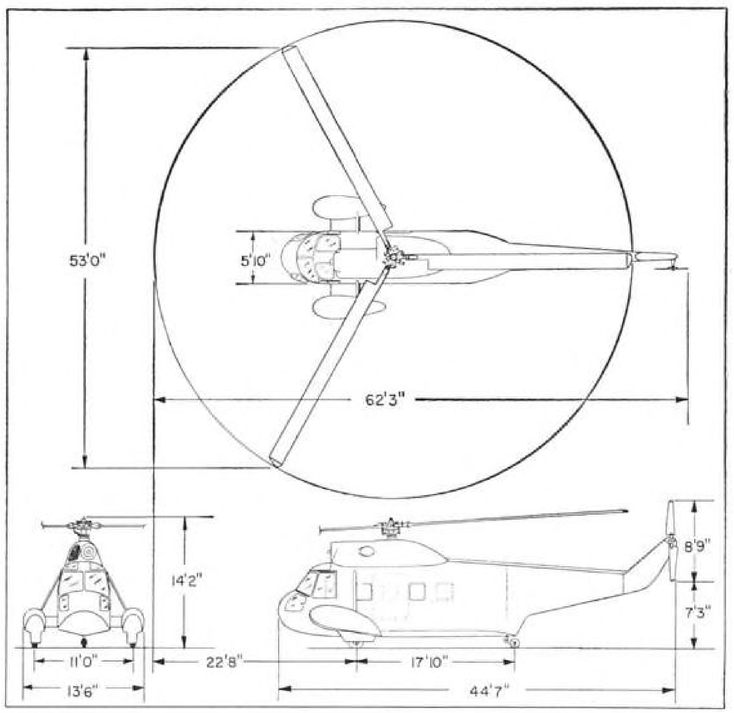
By Erwin J. Bulban

Stratford, Conn.—Sikorsky Aircraft expects to have its new turbine-powered S-62 utility helicopter in large-scale production in 1961 at a price of approximately $215,000-$220,000 depending on whether customers want either a General Electric T58 or slightly lower-powered Lycoming T53 turboshaft engine.

Company states that it could have the S-62 available for delivery next year, adding that early state of turbine production at that time would require higher price.

However, it is unlikely that civilian models would be available at this earlier date, since time required for Civil Aeronautics Administration certification is not expected to make possible 1959 civilian deliveries. First prototype only started its company flight test program in past few weeks.

A wide market is anticipated by Sikorsky for the new S-62 because, in addition to turbine performance and use of time-proven S-55 dynamic components (AW Jan. 20, p. 96), the helicopter's basic design lends itself more readily to a wider range of customer requirements than any of the company's previous models. Sikorsky spokesmen report that the S-62 already has received more world-wide inquiry from potential customers than any previous project. Sikorsky Sales Manager J. S. Beighle says that he anticipates production of at least 1,000 S-62s.



BASIC S-62 design could be changed by adding fourth rotor blade, revising gear arrangement.

Customers will have a choice of two basic models: the amphibious version now flying or a land type minus the flying boat hull and outrigger floats, instead fitted with conventional three-wheel fixed landing gear. Either version will be available with General Electric T58 or Lycoming T53. Later, "low-silhouette" land version, is especially designed for air transportability. Two S-62 land versions could be carried simultaneously in a Douglas C-124, with conversion from flight line to loading taking one hour. Process involves folding main rotor blades, removing the tail pylon and repositioning the landing gear wheels by replacing shock struts with jury struts, providing two-feet minimum overhead clearance on the Globemaster's nose loading ramp.

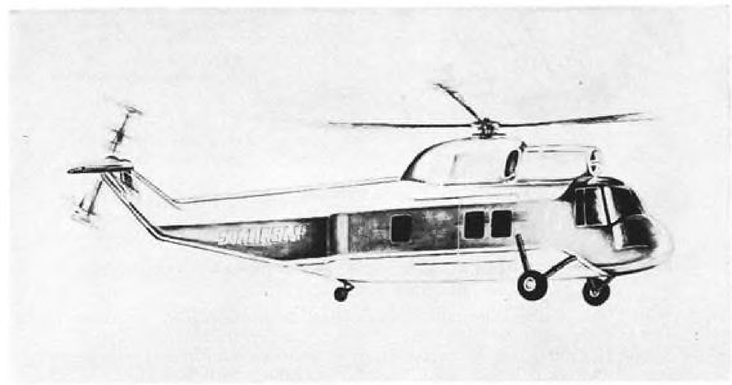
Amphibious Hull

Amphibious model, capable of land, water or snow or ice operations, has hull designed to take eight feet/second contact with surface. Landing gear is hydraulically retractable two-position type.

Sikorsky anticipates major interest in the new design from current S-55 operators since the S-62 is basically a replacement for this model. Company plans to provide S-55 owners with a trade-in program whereby they could turn in their current equipment for the new model with the manufacturer giving them credit of approximately $60,000-$65,000 for the S-55 dynamic components. Sikorsky would scrap the old hulls.

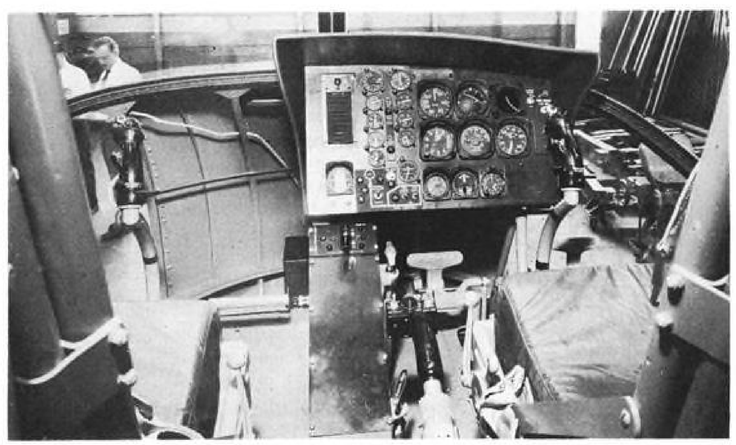
Ability of operators to utilize current supplies of S-55 dynamic com-

V-BOTTOM of S-62 fuselage is designed to cushion impact when settling on water. It also directs spray outward and down. Floats house landing gear and resist pitching and rolling.



THREE fixed-wheel land version of Sikorsky S-62 would be designed for air transportability.

SIKORSKY S-62 interior is designed to accommodate 10-12 passengers.



COCKPIT of Sikorsky S-62 is shown above. Helicopter appears to handle as easily on the water as on land; pilots have made tight turns and can rotate S-62 in its own length.

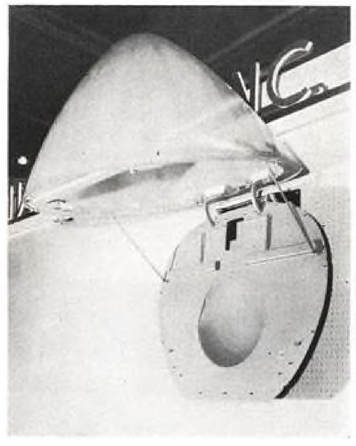
ponents in the S-62 will also provide them with considerable inventory savings. New machine is especially designed to make use of following S-55 parts: main rotor blades, tail rotor blades, main rotor head, tail rotor head, main gear box with a new power input section, intermediate gear box, tail gear box, shafting, major portion of flight controls including servos, major portion of hydraulic system, strengthened tail rotor pylon, rescue hoist and installed equipment.

Transmission System

S-62's transmission system is designed for 670 shp. at the input to the main gear box. This provides derated powerplant operation, enabling the helicopter to maintain the full transmission rating up through at least 104F ambient temperatures. Engine rating will also hold constant from sea level up to 17,000 ft., providing constant power for high altitude operations.

Basic S-62 design also provides stretch for later improvement in performance; by adding a fourth rotor blade (which would require relatively minor changes in the head) and a revised gear arrangement, additional power could be taken from the engines and top speed could be increased to 130 kt.

S-62 prototype, which had only some five hours of flight time prior to recent public demonstration, made a high-speed pass at 100 kt., then pulled up in a 2,500 fpm. climb. Aircraft was being flown within 300 lb. of its gross weight and was carrying 85% of its normal payload. Hull, which was designed using Sikorsky's considerable early flying boat experience, demonstrated clean entry on touchdown into water, minimizing spray even during autorotation landing in nearby Housatonic River. Aircraft appeared to handle as easily on the water as on land, pilots making numerous tight turns and also rotating the S-62 in its own length.



DC-3 Hinged Radome

New radome kit having two sets of hinges, one to the radome and the other on the radome bulkhead, permits easy access to either the antenna or nose interior of DC-3. Kit modification, which can be applied to all Series 1002 radome kits developed by Chamberlain Aviation, Inc., Akron (Ohio) Municipal Airport, is priced at $93.86 and takes 12-16 man-hours to install. Separate, integral rods allow holding open of either the radome or whole assembly during inspections.

Preliminary Specifications Sikorsky S-62

(NACA STANDARD AIR)

	Amphibian	Land Version
Maximum speed, sea level	117 mph.	119 mph.
Cruise speed	98 mph.	98 mph.
Maximum rate of climb, sea level	1,160 fpm.	1,160 fpm.
Hovering ceiling without ground effect	8,000 ft.	8,000 ft.
Service ceiling	15,700 ft.	15,700 ft.
Fuel consumption, cruise speed	63 gph.	63 gph.
Range (182 gal. fuel, 10% reserve, cruise speed)	230 st. mi.	230 st. mi.
Gross weight	7,500 lb.	7,500 lb.
Useful load	2,950 lb.	3,215 lb.
Weight empty, standard equipment	4,550 lb.	4,285 lb.
Crew	2	2
Passengers (miltary)	12	12
Passengers (commercial)	8	8
Fuselage length	44 ft. 7 in.	44 ft. 7 in.
Fuselage width	5 ft. 10 in.	5 ft. 10 in.
Height over-all	14 ft. 2 in.	13 ft.
Main rotor diameter	53 ft.	53 ft.
Tail rotor diameter	8 ft. 9 in.	8 ft. 9 in.
Main landing gear tread	11 ft.	10 ft. 2 in.
Passenger cabin length	14 ft.	14 ft.
Passenger cabin width	5 ft. 4 in.	5 ft. 4 in.
Fuel capacity	182 gal.	182 gal.
Powerplant	1 GE T58-GE-6 (at) 1,050 maximum shp. (at) 19,500 rpm. (at) sea level (30 min.); 900 normal shp. (at) 19,500 RPM. (at) sea level.*	

* Usable engine power is limited to 671 shp. in all conditions.

Airframe Construction

Construction is all aluminum: no magnesium is used anywhere in the airframe. Design utilizes considerable amount of reinforced plastic parts; some 62 components are utilized, primarily fairings and other double curvature parts, also nose and tail of outrigger floats.

Company has built two S-62 prototypes, one as a demonstrator, the other for engineering flight test. Demonstrator is scheduled to make a flight to Washington, D. C., soon for display to military officials; full-scale demonstrations to military and civilian prospects is expected to get underway in August. Plans call for company building additional aircraft to provide it with four demonstrators, two with each type of engine, depending on reaction received during initial sales tour.

Sikorsky spokesmen report that the firm has not yet taken orders for the new craft; experience indicates that selling helicopters depends upon live demonstrations to actual customers, in many cases at the customer's operation. Since the S-62 is aimed primarily at the utility field, it is not expected to be used in quantity in the scheduled passenger airlines. Most current scheduled airline operators, while watching the S-62 because it contains features they approve, such as turbine powerplant and amphibious characteristic, feel that Sikorsky's later, larger S-61, seating about double the S-62, is the machine more closely fitting their needs.

Oakland Airmotive Converts PV-2

Oakland—Prototype executive transport conversion of Lockheed PV-2 Harpoon, renamed the Centaurus, was rolled out here recently by Oakland Airmotive Co., which notes that along with 280 mph. cruise speed and 2,000-mi.-plus range, plane incorporates provision for cabin pressurization.

First Centaurus already has been sold to Lawrence Warehouse Co., San Francisco. Oakland Airmotive has purchased two surplus PV-2s and has options on 10 more. Conversion company reports that basic price of the unpressurized Centaurus is approximately $150,000-$200,000; the pressurized model costs $150,000 more. Final cost, depending upon equipment and interior, would be about $450,000. Company believes that there will be a market for up to 50 Centaurus transports in various configurations.

Major portion of the modification program covered structural changes necessary for pressurization feature; fail-safe testing of a typical fuselage included applying pressures up to 9.1 psi., although the specification calls for maintaining 4.576 psi. Pressurization differential is designed to provide cabin equivalent of 8,000 ft. at actual altitude of 18,000 ft.

Pressurized version of the Centaurus will be ready for flight in six to eight months, according to Edwin H. Gough, Oakland Airmotive president.

The 8-14 passenger Centaurus is powered by Pratt & Whitney R2800

PROTOTYPE Centaurus, World War II patrol bomber modified for executive transport, has extended nose to provide space for radar installation. Formerly PV-2 Harpoon, aircraft can be pressurized if desired, cruises at 280 mph. at 10,000 ft., has 2,000-mi.-plus range.

engines of 2,000 hp. each. Fuel capacity is 1,350 gal. Airplane has gross weight of 32,200 lb.; empty weight is 18,700 lb. Weight breakdown shows that 4,695 lb. are available for passengers, luggage and optional equipment.

Performance data supplied by the conversion company, with Centaurus at 32,200 lb. gross weight, includes: maximum speed at sea level (METO power), 328 mph.; cruise speed at 10,000 ft. (55% power), 280 mph.; stall speed (gear and flaps up), 78 mph.; stall speed (gear and flaps down), 69 mph.; single-engine minimum control speed (propellers feathered), 95 mph.—with propellers windmilling, 106 mph.; two-engine rate of climb (METO power), 2,000 fpm.; single-engine rate of climb (one propeller feathered), 480 fpm.

Conversion has been given Civil Aeronautics Administration Supplemental Type Certificate 4-381.

PRIVATE LINES

A new four-place low-wing all-metal business plane with fixed tricycle landing gear, aimed as a replacement for the high-wing Tri-Pacer, is on the drawing boards at Piper Aircraft Corp., Lock Haven, Pa. New airplane is not expected to be available at least until 1960. Company is hoping to keep price at about $10,000.

Demonstration tour to acquaint businessmen and pilots with new Lockheed JetStar will be made to major U. S. cities in June with the number two prototype (flight evaluation by AVIATION WEEK, May 5, p. 78-99).

De Havilland Canada Otter amphibian has been delivered to N. Y. State Conservation Authority, which will have plane fitted with rapid-load, rapid-dump tanks for use in firefighting in remote forest areas. Plane will also carry firefighters to forest blazes.

Four-place Jodel Mousquetaire D.140 French lightplane, powered by a 160-hp. Lycoming, is being readied for flight tests. With gross weight of 2,400 lb., D.140 is designed for top speed of 160 mph., cruise speed of 140 mph. and six-hour endurance. Production plans call for output of five planes monthly after flight tests are completed.

Army's two civilian-operated primary flight schools in Fourth U.S. Army area soon will have trained more than 2,000 pilots in fixed wing and rotary wing aircraft. Camp Gary, San Marcos, Tex., which has operated nearly two years without a serious accident, operates some 230 Cessna L-17 Bird Dogs, and is flying more than 8,000 student hours monthly; primary helicopter

school, Camp Wolters, Mineral Wells, Tex., has approximately 175 Hiller H-23 Raven copters.

Executive aircraft equipment designed by Chamberlain Aviation, Inc., Akron (Ohio), Municipal Airport includes radome kit in final development stages for Beech Twin Bonanza RCA AVQ-50 installation; new Lodestar radome for use with lightweight equipment, molded Fiberglas one-piece airstair door for Beech 18s.

Western Aircraft Corp., Spokane, Wash., has been licensed by Canadian Air Transport Board to operate charter services with aircraft of less than 1,100 lb. payload to points in British Columbia, Alberta and Saskatchewan. . . . Interstate Airmotive, Inc., St. Louis, Mo., has also been approved by the Board to handle charter services with planes of less than 6,000 lb. payload in Ontario and Saskatchewan.

New distributor for Champion Aircraft and Mooney Aircraft is Blackfield Aero Industries, Oakland, Calif., which formerly handled a Piper dealership. Firm will handle Champion line in California, Oregon, Washington and Hawaii; the Mooney line in Northern California.

STOL Aircraft landing area has been set up at Teterboro (N. J.) Airport by Port of New York Authority covering 200 ft. x 400 ft. area to evaluate effectiveness of the miniature airstrip and possibility of providing similar strips at other airports.

Beech Travel Air production is now 1.1 a day and 100 of the new light twins have been delivered.

Auster Aircraft, Ltd., sold 15 acrobatic elementary trainers to the Iranian government.

Airwork Corp. opened a jet and piston engine overhaul shop at 1740 North West 69th Ave., Miami, Fla. New Southern Division is managed by Jerry Church.

Your Heliport Design Guide gives basic specifications and other data for building heliports for executive, industrial or charter use covering various rotary wing configurations, elevated and ground level platforms. For copies write: Helicopter Council, Aircraft Industries Assn. of America, Inc., 610 Shoreham Building, Washington 5, D. C.

Flying Physicians Assn. now numbers 1,100 members; organization expects to have enrollment of 2,000 by its next annual meeting.

WHO'S WHERE

(*Continued from page 15*)

Changes

Neil Burgess, manager, newly established Commercial Engine Operation, General Electric's Aircraft Gas Turbine Division, Cincinnati, Ohio.

Walton B. St. John, sales manager for airframe accounts-executive aircraft equipment (Wichita, Kans.), Learcal Division, Lear, Inc., Santa Monica, Calif.

Russell S. Atkinson, Western regional manager (Los Angeles, Calif.), Aerol Associates, sales-engineering division of Cleveland Pneumatic Industries, Inc., Cleveland, Ohio.

Jesse H. Zabriskie, assistant manager-systems test department, Pilotless Aircraft Division, Boeing Airplane Co., Seattle, Wash.

Roger E. Robertson, chief engineer, B&H Instrument Co., Inc., Fort Worth, Tex.

Elliott Mehrbach, chief engineer, Communications Division, Topp Manufacturing Co., Los Angeles, Calif.

Walter K. Deacon, chief engineer-Torrance Plant, Aero Hydraulics Division, Vickers, Inc., Detroit, Mich.

Frank Roodman, engineering coordinator-missile projects, the Austin Co., Cleveland, Ohio.

Hubert Bennett, assistant director-applications engineering department and coordinator-field engineering, McCormick Selph Associates, Hollister, Calif. Also: **Carleton Sprague,** staff engineer-preliminary design and engineering; **Edgar Shurtleff,** staff engineer-research and development of explosive ordnance products.

Allen J. Edwards, general manager, Datran Electronics Division, Mid-Continent Manufacturing, Inc., Manhattan Beach, Calif.

Francisco Bonilla, general manager, LACSA Airlines.

Frank Sylvester, foreign sales representative, Lockheed Aircraft Service, Inc., International Airport, N. Y.

John L. Devitt, chief engineer, Frank R. Cook Co., Denver, Colo.

Gordon P. Wiggins, sales manager, Clemco Aero Products, Inc., Compton, Calif.

Dr. S. M. Martin, Jr., general manager, newly-formed Chemical Division, Thiokol Chemical Corp., Trenton, N. J. Also: **D. E. Fish,** sales manager; **F. W. Wilson,** production manager.

Edward P. Loftus, technical sales representative, Marbon Chemical Division of Borg-Warner Corp., Gary, Ind.

Monte L. Marks, chief engineer, Owen Laboratories, Inc., Pasadena, Calif. Also: **Russell E. Quackenbush,** sales manager.

Joseph J. McLoughlin, market research manager, Taylor Fibre Co., Norristown, Pa.

Howard C. Beyer, general manager, Power Equipment Division, Jeta Metal Fabricators, Inc., Yonkers, N. Y.

Thomas F. D'Andrade, national sales manager, Components Division, Fairchild Controls Corp., Hicksville, N. Y.

Col. Robert M. Burnett (USA, ret.), planning coordinator and assistant to the president, Flexonics Corp., Maywood, Ill.

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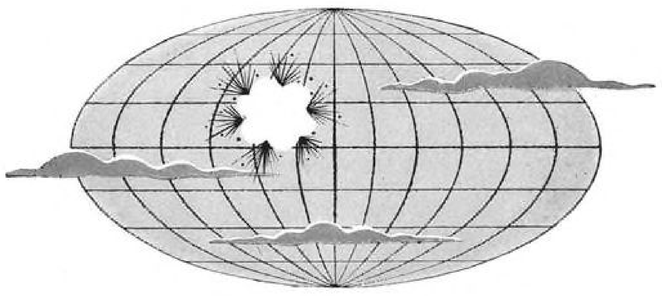

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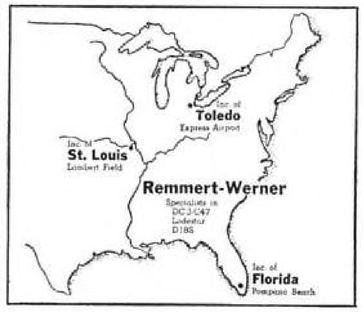

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[Advertisement]

How to meet and beat the hazard of bogus parts

Buyers of aviation equipment know that more and more off-brand, unknown, bootlegged parts made of inferior materials by non-spec processes are finding their way in the regular channels of distribution.

The bogey of bogus parts presents a two-fold problem:

First, bogus parts are a hazard to flight. The crash, burning and death of two pilots in a twin-engine cargo aircraft disaster has been directly traced to nonconformities in the elevator tab control which resulted in pitch down and structural failure.

Second, the C.A.A. already has served notice that the employment of bogus parts in the repair, overhaul or maintenance of an aircraft may result in the suspension or revoking of its airworthiness certificate.

This tends to put the responsibility for protection against bogus parts on the shoulders of the aircraft owner, the parts buyer, and the service-repair-maintenance organization.

Here are a few tips which may better help you discharge that responsibility:

1) *Know your parts.* Aircraft engines and parts handled by California Airmotive Corp., bear plainly visible Wright or P & W marks. A parts bootlegger would never stamp his products with names such as these:

2) In the absence of a company name you can trust, look for inspection marks, or P.M.A. stamp which specifies that this part has won C.A.A. approval.

3) Do not make the mistake of confusing surplus parts with bogus parts. Surplus parts are simply an excess inventory which was *originally* manufactured by America's most reputable concerns to the highest government specifications. But being excess—or surplus—such parts may often be bought at considerable savings.

4) Know the company you're buying from. This may well be the most important precaution. If you have complete faith in the integrity of your parts supplier—and if the supplier deserves that faith—your chances of getting stuck with bogus parts are practically nil.

5) Here, at California Airmotive Corporation, we regularly put a higher premium on the dependability of our parts than even our customers require.

California Airmotive Corporation has its own facility for the certification of engines and parts, i.e., California Airmotive Engineering Corporation, C.A.A. approved Repair Station No. 3890, Powerplant Class II. We have in stock one of the world's largest supplies of new government and airlines excess inventory of Wright and Pratt & Whitney engines and parts. We invite your inspection of our warehouses in North Hollywood (main plant), Mobile, Ala., and Shreveport, La.

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AVIATION WEEK, JUNE 2, 1958

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ADVERTISERS INDEX

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Control panel and 3-inch scope are mounted in cockpit for operation by pilot or co-pilot. Receiver (left) occupies ¾ ATR rack. Installed weight of complete system is only 26 lbs., and compact unit requires only a small fraction of space formerly required. Designed and manufactured by Edo, a major supplier of advanced electronic systems for the U.S. Navy—sonar, radar, ASW equipment.

For the complete data on Edo Model 345 Airborne Loran send for Technical Manual #501, Dept. C-5.

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LETTERS

Submersion Data

This is in reference to your report "Partial Submersion Eases G Force Effect" on p. 33 of the May 12 issue of AVIATION WEEK.

The idea of submerging a human being to moderate the effects of G force was proposed by Hugh De Haven, former Director of Aviation Crash Injury Research, as early as 1945. He also indicated that the supine or semi-supine position in liquid would be advantageous.

This idea was a result of studies conducted on free falls involving decelerations in excess of 100Gs for periods of 1/10 of a second or less; in fact, cases are on record where people have survived—with little injury—forces up to 150Gs in a supine position without the benefit of liquid emersion.

It is quite probable that much of the data in Av-CIR files would be useful in the development of environmental support and restraint for space vehicles—particularly in relation to re-entry and "hard landings."

A. HOWARD HASBROOK
Director
Aviation Crash Injury Research
Sky Harbor Airport
Phoenix, Ariz.

Standard Language

Open letter to AVIATION WEEK.

I am surprised to read in your magazine from March 24, in the article entitled "Soviet Stand May Block Aeroflot Growth" (p. 28), that in a bilateral agreement between Russia and Britain signed late last year the British have conceded to the use of the Russian language in Russian territory and English in the United Kingdom territory. Was this concession necessary? According to the bilateral agreement between Russia and Sweden either English or Swedish is to be spoken on Swedish airways traffic control and either Russian or English in the Soviet zones.

Other agreements will follow. The Soviets will begin talks with the U. S. on a bilateral agreement. Can the U. S. stand firm on ICAO standards as the use of the English language in air traffic functions? Even if the Soviets would agree to the use of the English language, would it be used in such a way that misunderstanding between the airplane crew and the ground crew is impossible? What a hazard can be caused in case of misunderstanding!

On the other hand, if the Soviets would insist upon the use of the Russian language in Russian territory, should the crews of the airlines learn the Russian language? No! Other countries would follow the example of Russia in requesting the use of their own language over their territory. This is not the solution of communication in the international air traffic. There is a neutral and very democratic solution for international communication which provides equal rights and equal opportunities for all parties; it is the international language, Esperanto. This solution is simultaneously the most economical one. It is a matter of fact that Esperanto can be mastered in a small fraction of the time it takes to learn other languages. Esperanto has been proven as the language which requires the smallest effort compared to the achievement after a short study time.

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. 42 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.

President Eisenhower and many other leading Americans have emphasized the importance of people to people contacts to improve international understanding. The international air traffic is now the most important technical means bringing people together; it is the bridge from country to country with a span all over the world. This bridge brings people together, but only physically. The other bridge which brings the people together spiritually is the international language Esperanto.

Now is the time to introduce Esperanto into the international air traffic. Here is a field where an international language is urgently needed. It is a must from the economical point of view. Electronic computers can't do the job. The communication must go from person to person on a neutral basis of a common language.

The U. S., the largest contributor to the international air traffic, should initiate the introduction of Esperanto into the international air traffic as the ambassador of good will demonstrating the willingness to world peace. The first step in this direction made by the U. S. would surprise the whole world more than Sputnik I did. All other countries would appreciate the step and follow willingly.

EDMUND BARTSCH
Burbank, Calif.

Instrument Flight

I've got to take issue with Mr. H. F. Sweitzer (AW May 5, p. 138) who accuses the Air Line Pilots Assn. of attempted white-wash in the Rikers Island tragedy.

First, let it be understood that I have no affiliation with the ALPA, nor does my job (test pilot) achieve benefits from their negotiations. I just dislike baldfaced statements like, "With proper reference to these three instruments . . . this crash could have been averted," when he obviously isn't qualified to pass judgment. Let's leave that to responsible parties like the CAB.

If Mr. Sweitzer's instrument instructor repeated "needle, ball, airspeed, altimeter" so much that it became a chant, he must have been having a little trouble with instrument flying since this is the proper procedure for recovery from unusual or unknown attitudes with partial panel.

I'm not defending Capt. Marsh's technique, but merely want to point out that if everything is working normally: adequate airspeed will prevent a stall, constant heading will prevent a turn, and the rate of climb instrument showing a constant and steady climb will obviously keep the airplane from going down (which it did).

Something went wrong in that airplane, either with the instruments or the pilots. Responsible people have expressed their conclusions and opinions which differ depending on viewpoint.

My opinion is that "needle, ball, airspeed" type flying wouldn't help much except in recovery from unusual positions, where Mr. Sweitzer seems to frequently find himself.

ROBERT C. COLLINS
ATR 484239
Belmont, Calif.

Hydraulic Pressure

Having now read also your second article on the production of the Saab-35 (AW March 24, p. 46 and March 31, p. 64), I have discovered a slight misprint in a caption. Here it is stated that the pressure of our hydraulic rubber press is 8,000 lb. It should, of course, be 8,000 tons. Naturally, most people reading this article will understand that it is just a misprint, but, if it is possible, I would appreciate a correction.

All at Saab, who have read your articles, are extremely impressed with them.

HANS G. ANDERSSON
Svenska Aeroplan Aktiebolaget
Linkoping, Sweden

Union Representation

Re Pilot's Union letter from Mr. Keyes, in the April 28 issue (p. 110). A very minor point but a noticeable omission when we speak loosely of "Captains' Union."

In ALPA Council 36 Pan American, for a captain the additional pilot crew consists of:

APPELLATION	JOB	STATUS
1st Officer	Copilot	Pilot
2nd Officer	Navigator	Pilot
3rd Officer	Pilot (Junior)	Pilot

After one year the junior pilot 3rd officer is an eligible member with full vote.

Of one thing you may be certain throughout—ALPA is able to operate for copilots if they are active, with their majority vote.

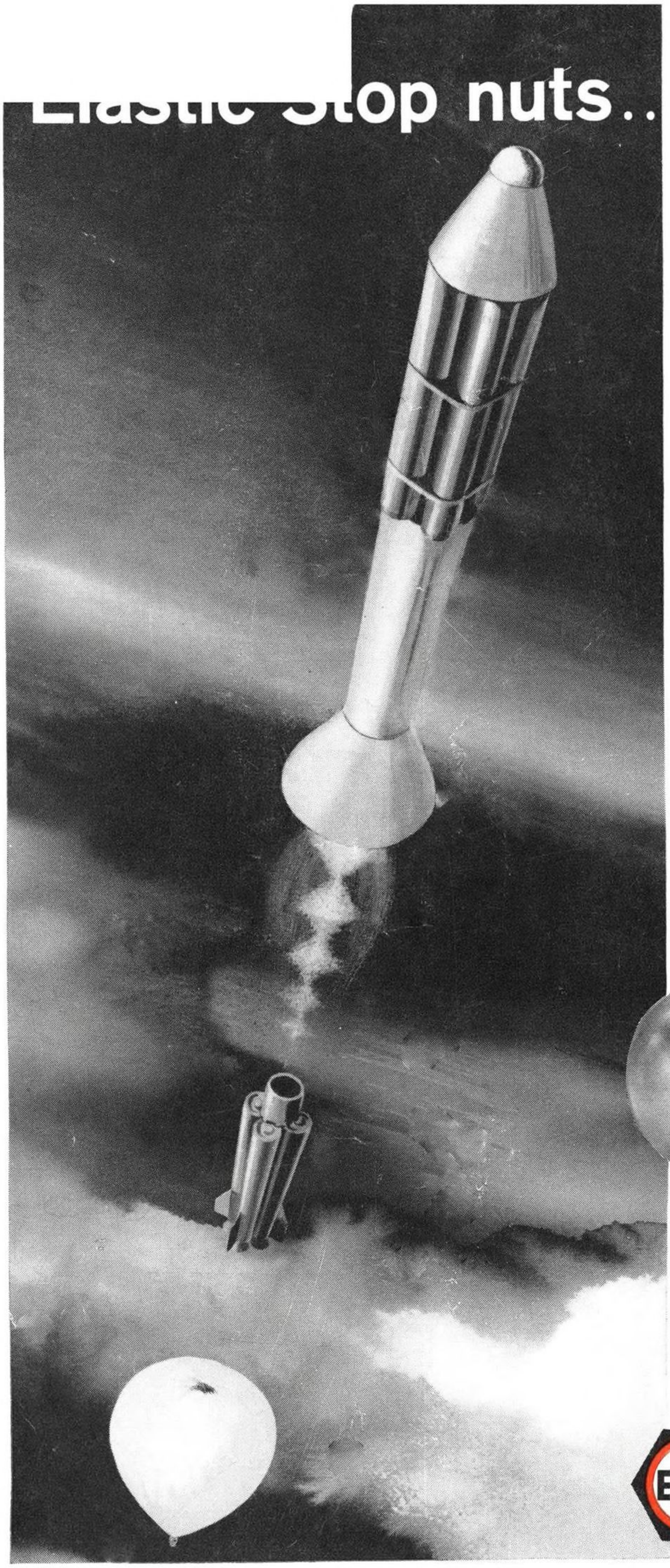
CAPT. JOHN C. O'CONNOR
Norwalk, Conn.

Fuselage Hoops

The March 10 issue of AVIATION WEEK (p. 45) reports the results from crack studies of a Comet I fuselage banded with 10 in. spaced hoops which achieved a 33% uniform reduction in skin stress. For this reduction the hoops weighed at least one half as much as the skin if both were constructed from the same material.

It would be very interesting to see a comparison of the crack behavior of the hooped structure and a Comet I fuselage with a 50% thicker skin. Such a comparison would help to establish the relative merits of hoop and thick skin approaches to the reduction of crack propagation.

ROBERT J. MAYERJAK
Task Scientist
Wright Air Development Center
Dayton, Ohio



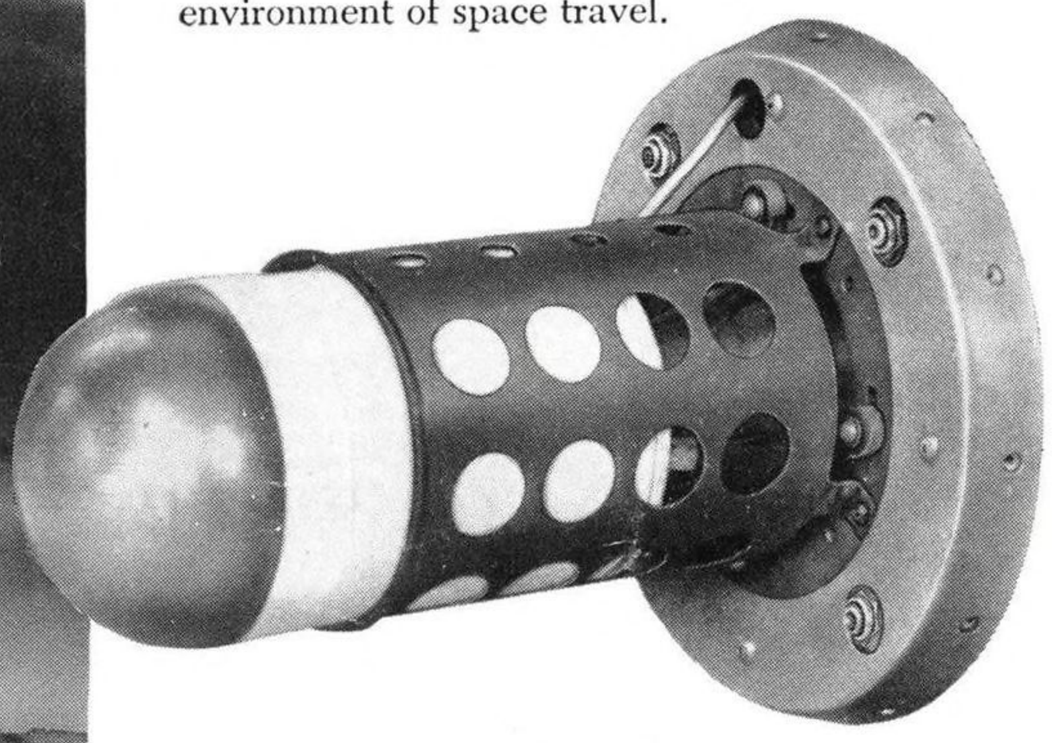
make first trip to the exosphere

What were the requirements for an exploratory trip into the exosphere? The success of project Far Side established these two among others:

1. A launching platform located as far as possible above the effects of atmospheric drag

2. The use of hardware of proved ability

Some of this hardware can be seen in the close-up of Far Side's nose-mounted payload. In the photo showing the payload before the nose cone was placed over it, three of the four Elastic Stop nuts used to secure the third stage rockets to a retaining ring are clearly visible. They are standard ESNA hex nuts—with the familiar red nylon insert. These are the self-locking fasteners that have proved their ability to hold tight under the severest requirements of aircraft operation, through almost three decades of progress in aircraft design and construction. And now they have proved their ability to meet the requirements and unusual environment of space travel.



The complete line offered by ESNA includes self-locking nut designs for every missile, aircraft and power plant application. They cover a range of operating temperature requirements from −80°F. to over 1300°F For specific information, send the details of your application to ESNA. Write to Dept. S17-625, Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey.

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CORPORATION OF AMERICA

An artist's version of the launching of the Far Side rocket. The four-stage vehicle was carried to an altitude of 100,000 feet by a polyethylene balloon made by General Mills. Fired straight up through the balloon, Far Side rocketed to the greatest distance from the earth ever reached by a man-made device. The prime contractor for the Far Side project was Aeronutronic Systems, Inc., a subsidiary of the Ford Motor Company, for the Air Force Office of Scientific Research (ARDC).