Aviation Week and Space Technology

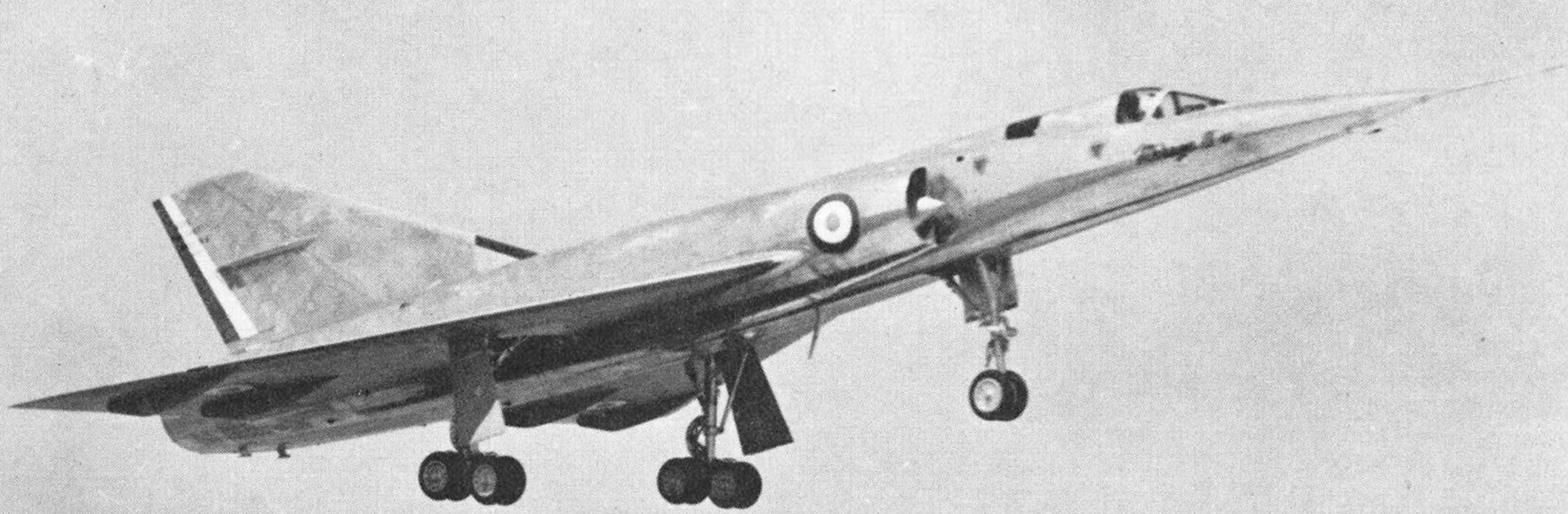
75 Cents

A McGraw-Hill Publication

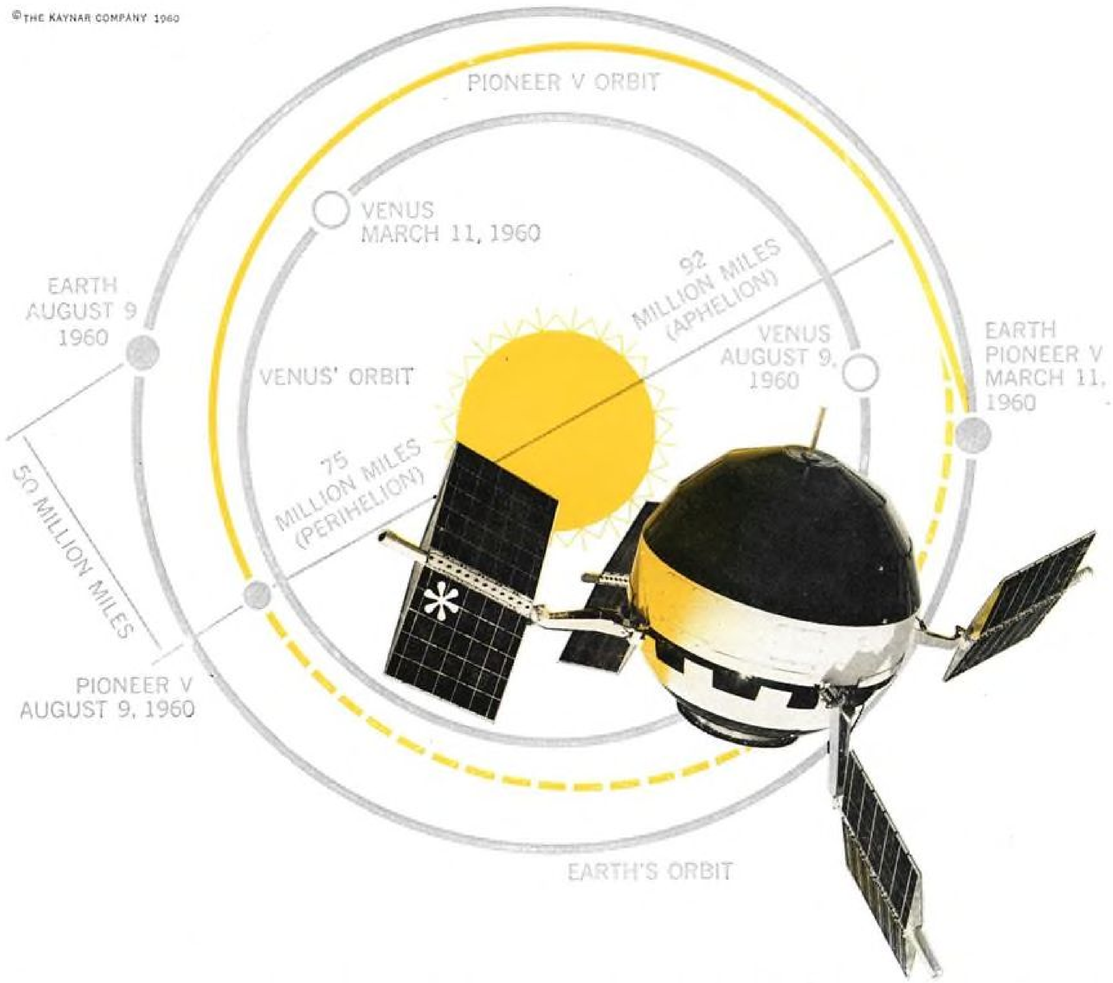
May 23, 1960

Space Medicine Probes Radiation, Weightlessness

Dassault Mirage IV



©THE KAYNAR COMPANY 1960



KAYLOCK® NUTS BOOST PIONEER V PAYLOAD

From one pioneer to another – congratulations! Kaylock,® pioneer in lightweight, self-locking nuts, salutes Space Technology Laboratories for achieving the world's deepest space probe with Pioneer V. Kaylock nuts are used throughout the 95-pound, 26-inch " inter-planetary space laboratory, " which on July 19 will have catapulted more than 50 million miles from earth. On August 9, Pioneer V will penetrate closer to the sun than man has ever come before, and will approach the orbit Venus makes around the sun. This is the maximum range at which communication with earth is now deemed possible.

Selected for their high quality, reliability and space-saving advantages the Kaylock miniature nuts used on Pioneer V help boost the payload-carrying capacity of the compact, highly-instrumented planetoid. Kaylock's engineering and production departments are proud to have supplied vital fastener components for this noteworthy step in space exploration.

Kaylock nuts are plainly visible on the Pioneer V's four solar-cell paddles, which convert solar energy to electricity. Kaylock nuts also are used in many other parts of the space planetoid.

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Ga.; Renton, Wash. Canadian Distributor: Abercorn Aero, Ltd., Montreal, Quebec.

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first in lightweight locknuts

TRANSPARENT PLASTICS: another prime capability of Goodyear Aircraft

Face visor of plastic is optically equal to most prescription glasses.

Canopy of Northrop N-156 "Freedom Fighter" is GAC-built of stretched acrylic.

**Thermo-Shield*—new high-heat-resistant laminate—shrugs off 45-cal. bullet in test.

Look—CLEARLY SUPERIOR acrylics!

When you need a clear plastic *which must have exceptionally high optical qualities, extreme heat resistance, rugged strength or unusual shaping characteristics—Goodyear Aircraft Corporation (GAC) probably has exactly what you want. If not, chances are they can make it to your specific requirements. For GAC has pioneered acrylic development in many fields. Examples: Thermo-Shield, new three-ply laminate for Mach 3 Aircraft and personnel protection—stretched and formed shatter-resistant acrylic canopies and windows. This proven ingenuity can solve a problem for you. For full information, write: Goodyear Aircraft Corporation, Dept. 916AQ, Akron 15, Ohio.*

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*Thermo-Shield—T.M. Goodyear Aircraft Corporation, Akron 15, Ohio

Stretched acrylic windows, made by GAC for newest jet aircraft.

Giant GAC stretching machine can stretch plastic 12 feet square, 2½ inches thick.

Official United States Navy Photograph

Sparrow III Navy air-to-air missile is now operational with both the Sixth and Seventh Fleets. Raytheon is prime contractor for this potent weapon.

RAYTHEON COMPANY, WALTHAM, MASS.

RAYTHEON

EXCELLENCE IN ELECTRONICS

AVIATION CALENDAR

May 28-30—OX5 Annual Convention, Jack Tar Hotel, Galveston, Tex.

June 1-3—Fourth Annual Vacuum Metallurgy Conference, New York University, New York, N. Y.

June 3-4—11th National Maintenance & Operations Meeting, Reading Aviation Service, Reading, Pa.

June 5-9—Semi-Annual Meeting and Aviation Conference, American Society of Mechanical Engineers, Statler Hilton Hotel, Dallas, Tex.

June 14-16—35th Meeting, Aviation Distributors and Manufacturers Assn., Queen Elizabeth Hotel, Montreal, Canada.

June 15-17—1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, Stanford, Calif.

June 22-24—1960 Conference on Standards and Electronic Measurements, NBS Boulder Laboratories, Boulder, Colo. Co-sponsors: Institute of Radio Engineers' Professional Group on Instrumentation; Radio Standards Laboratory, National Bureau of Standards; American Institute of Electrical Engineers' Instrumentation Division.

June 23-25—16th Annual Meeting, Institute of Navigation, U. S. Air Force Academy, Colorado Springs, Colo.

June 26-July 1—63rd Annual Meeting and Apparatus Exhibit, American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 27-29—Fourth National Convention on Military Electronics, Institute of Radio Engineers, Sheraton-Park Hotel, Washington, D. C.

June 28-July 1—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

July 3-4—Fourth Annual Fort Wayne National Championships (civilian, closed-course airplane races), Fort Wayne, Ind.

July 5-15—Special Summer Program in In-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

May 23, 1960

Vol. 72, No. 21

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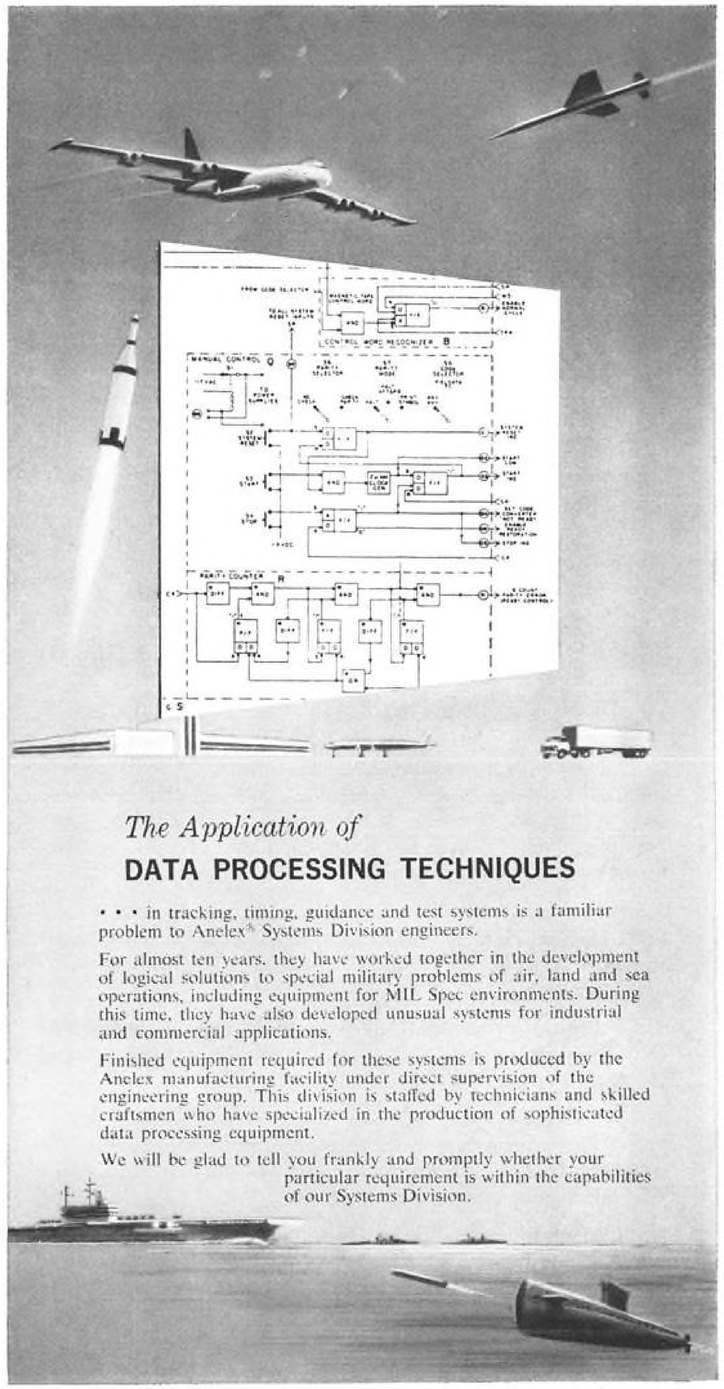

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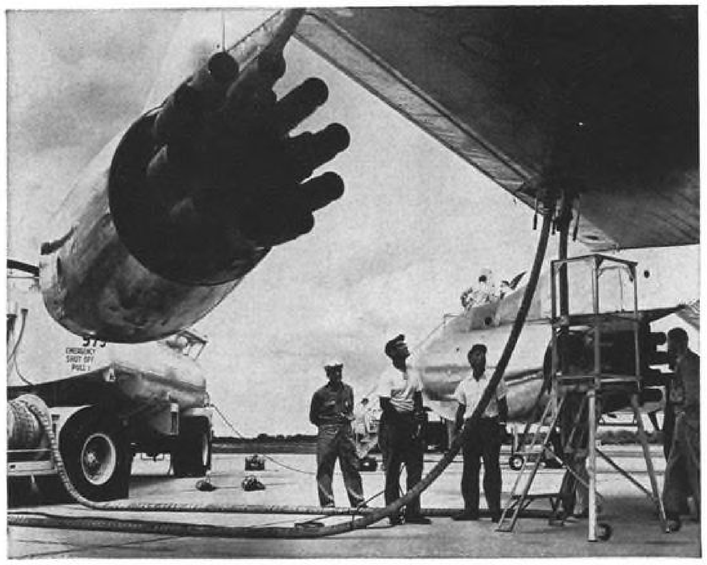

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3. Developed an abrasion- and oil-resistant cover compound that protects the tube and reinforcement from damage when the hose is dragged over concrete aprons.

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AVIATION CALENDAR

(*Continued from page 5*)

ertial Guidance—Terrestrial and Interplanetary, Massachusetts Institute of Technology, Cambridge, Mass.

July 11-12—Conference on Response of Metals to High Velocity Deformation, Stanley Hotel, Estes Park, Colo. Sponsor: Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

July 18-19—Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio.

July 28-29—Seventh Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 2-11—27th Annual U. S. National Soaring Championships, Ector County Airport, Odessa, Tex.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 18-19—Electronic Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado, Boulder, Colo.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland, Ohio.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 27-30—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif. Cosponsors: USAF; U.S. Army; U.S. Navy; National Aeronautics and Space Administration; Atomic Energy Commission.

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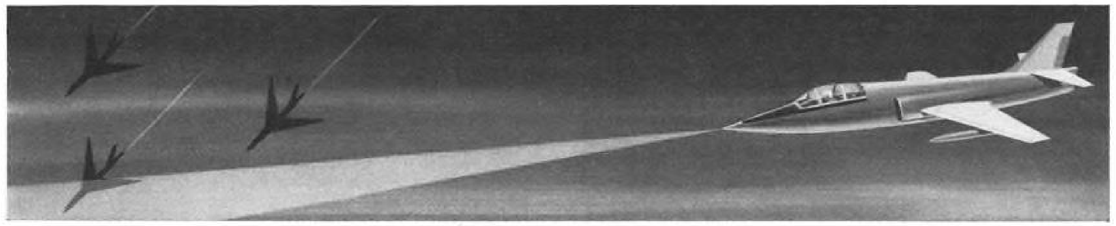
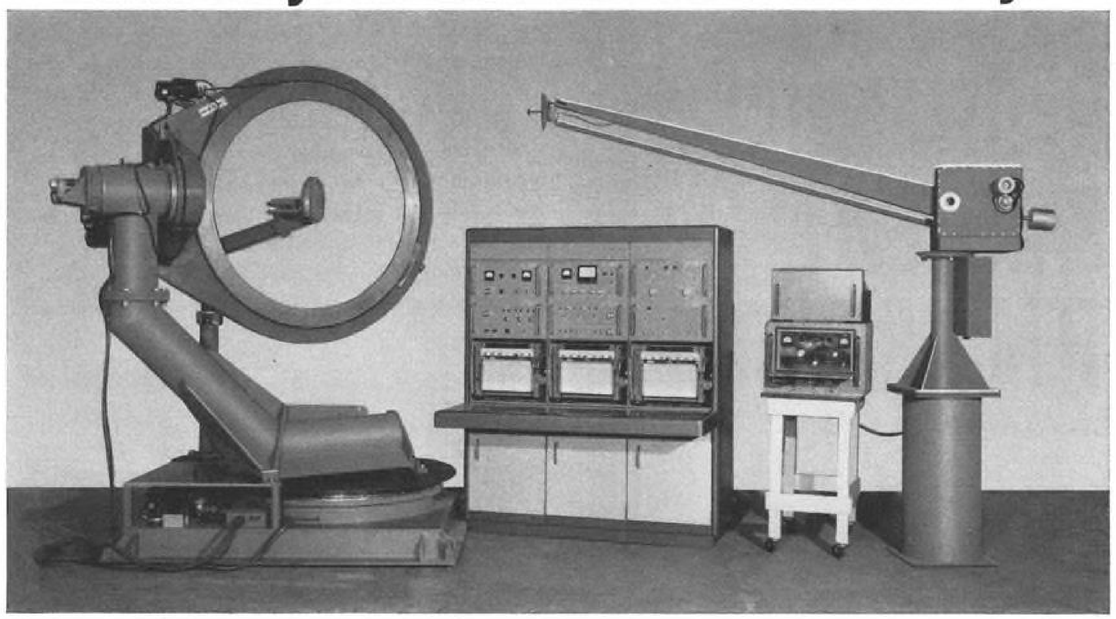
AIRCRAFT, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK



what is your *BORESIGHT* accuracy?



TEST RADOMES TO MIL-R-7705A (ASG)

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In the system shown above, as the motor-driven holding fixture rotates the radome under test, the servo-controlled null-seeking antenna on the boom traces the position of the deflected radar beam. At the control console, which provides single-point control of the entire system, three recorders plot the total magnitude and horizontal and vertical components of the beam deflection angle directly in milliradians. Rate of change of beam deflection, essential to missile applications, is readily obtainable from the recordings.

Additional features include automatic plotting of antenna patterns with or without the radome and radome transmission efficiency measurements. The system is available in frequencies from S through K_a bands and infrared.

For bombing-type and other radar systems using shaped-beam antennas, this beam-seeking unit replaces the null-seeking unit.

Engineers: Career opportunities are currently available at CTI

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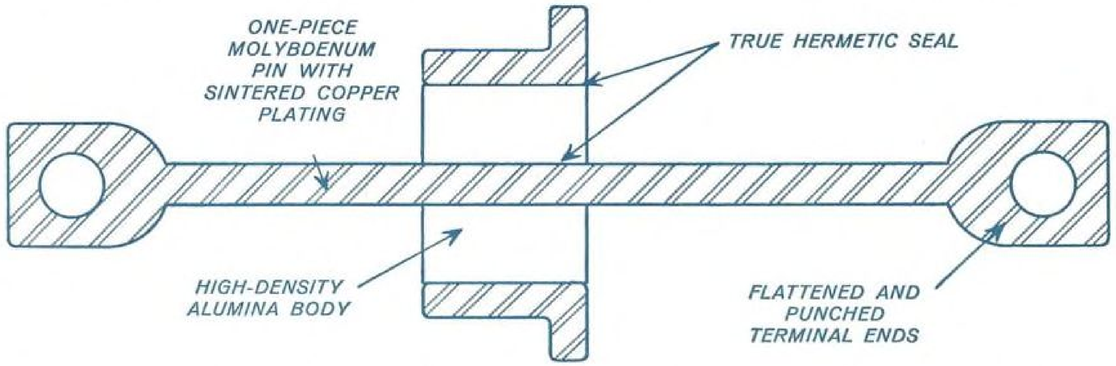

Now in production—this new and better terminal with 8 big advantages: 1 Developed especially for super-reliability on high-performance applications involving shock and high temperatures. 2 Vacuum-tight seal. 3 Will withstand brazing temperatures at 1500°F. 4 Tested to 11,000 psi shear stress without failure. 5 Ideal for encapsulated devices. 6 For both replacement and original equipment use. 7 Extreme resistance to cracking under mechanical or thermal stresses. 8 Variety of configurations. Send for full details.

ELECTRON TUBE PRODUCTS
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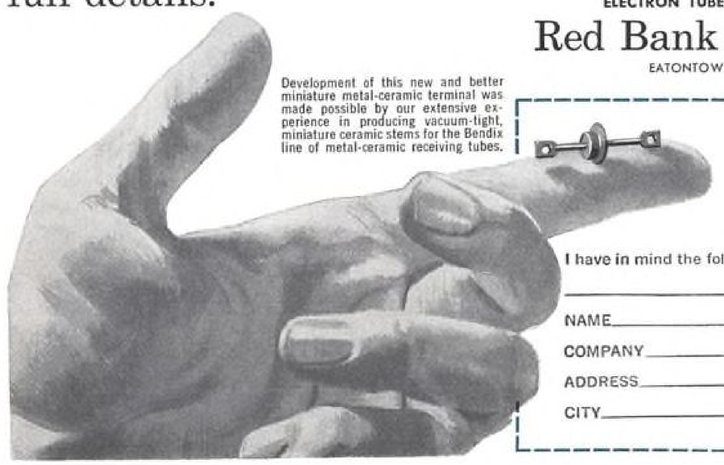

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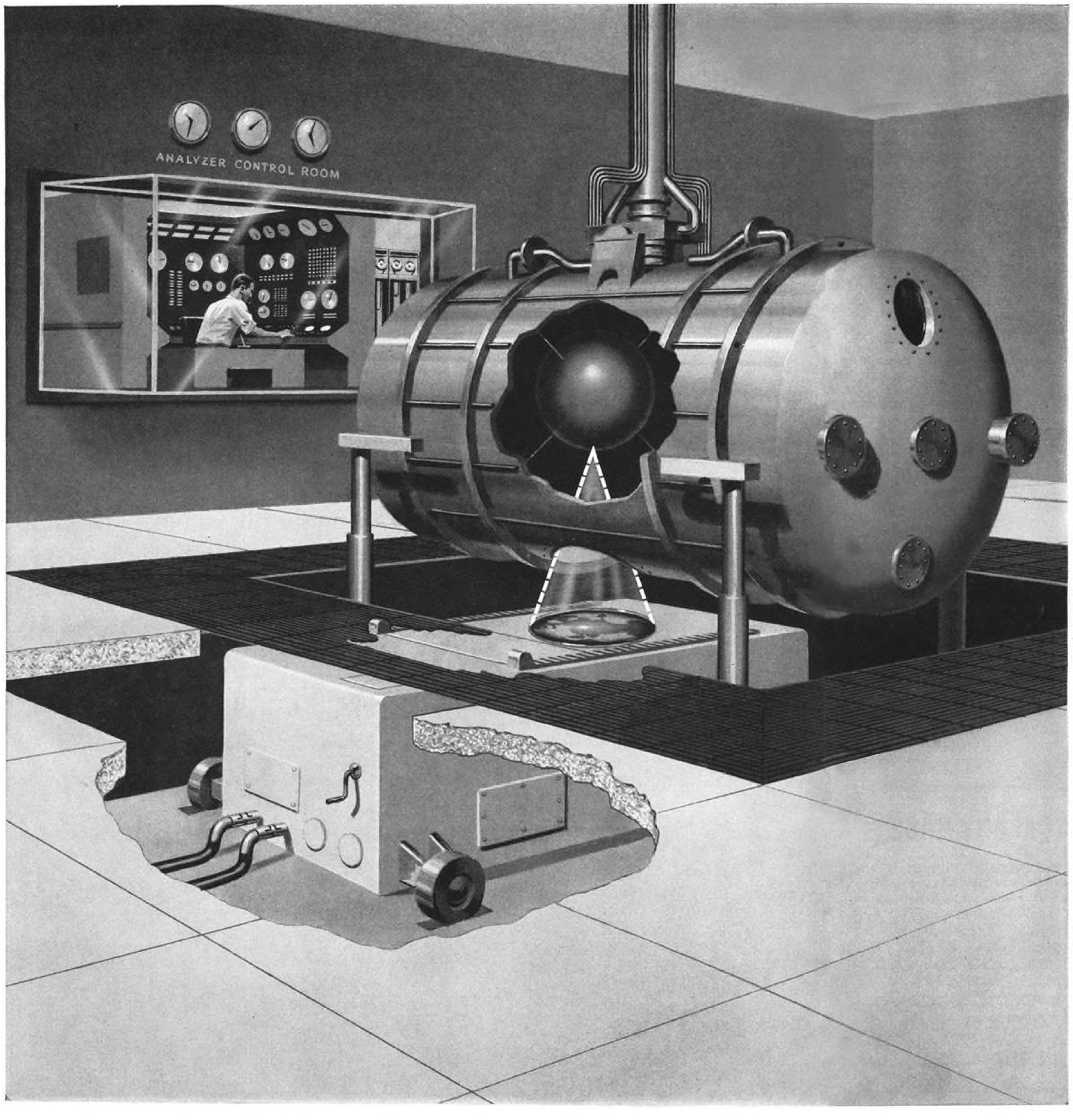

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Honeywell Dynamic Analyzer recreates authentic shoot environment, pinpoints design deficiencies

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It will be independent of the weather, the availability of test vehicles and flight variables. And in many cases, the test data will be more reliable and valid than can be attained in flight testing.

Areas of application include: reconnaissance, guidance, power supply, and communication systems. Tests of complex systems which now might require more than a year to accomplish, will be telescoped down to several weeks. It will be possible to determine which operating systems are detracting from overall performance, and to what degree.

The first Dynamic Analyzer was conceived under the direction of the Aerial Reconnaissance Laboratory of the Wright Air Development Division, USAF. There, the fully instrumented analyzer will be housed in its own building. Capabilities include: high vacuum, high and low temperatures; three-directional vibration; roll, pitch and yaw motion; buffeting; rotation; target variations; controlled ground speed; reflected and transmitted signals.

Honeywell was awarded the prime contract to develop and produce the analyzer on the basis of strong research and development capability. If you have problems in analysis, test or simulation, consider Honeywell's broad experience. Telephone or write: Honeywell, Military Products Group, Minneapolis 8, Minn.

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Normal operating voltage	115v. or 200v. single phase, 400 cycles
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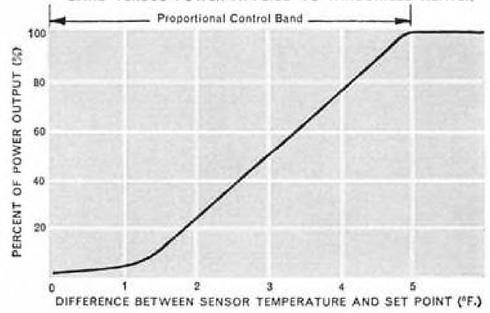

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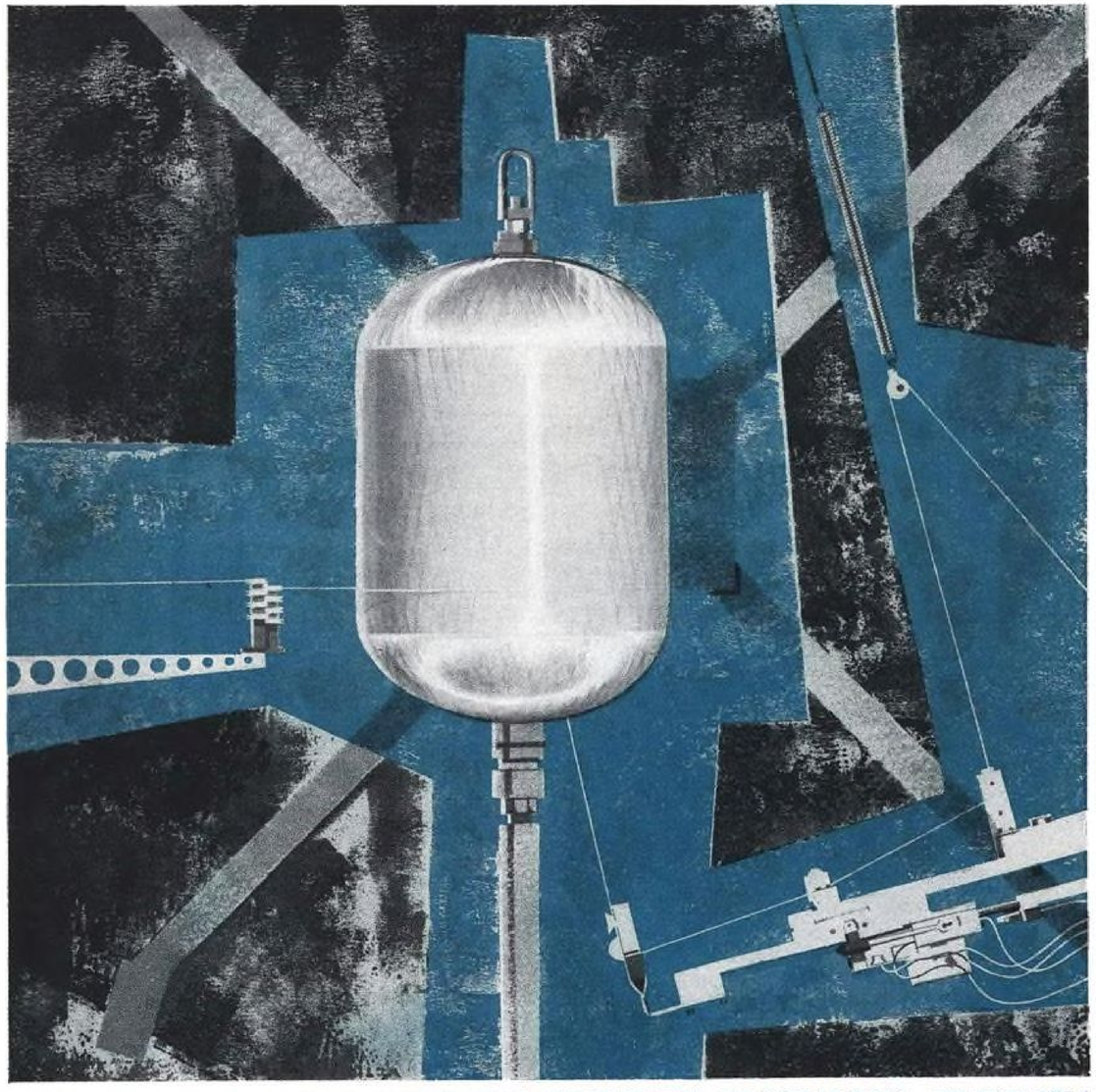

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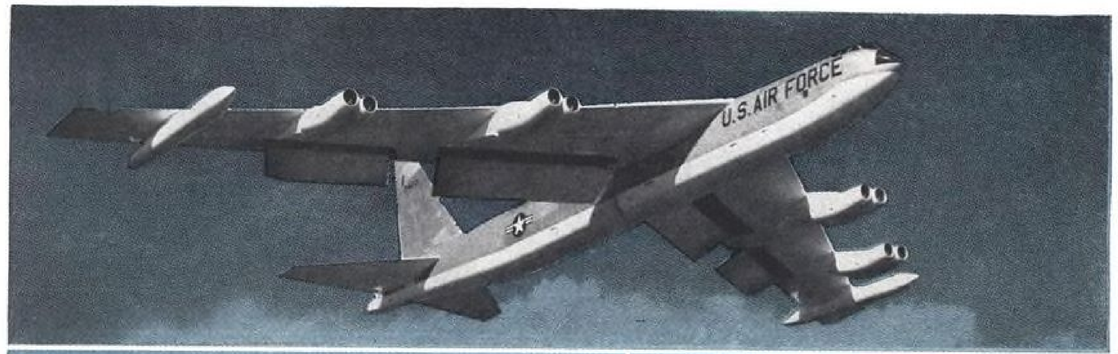

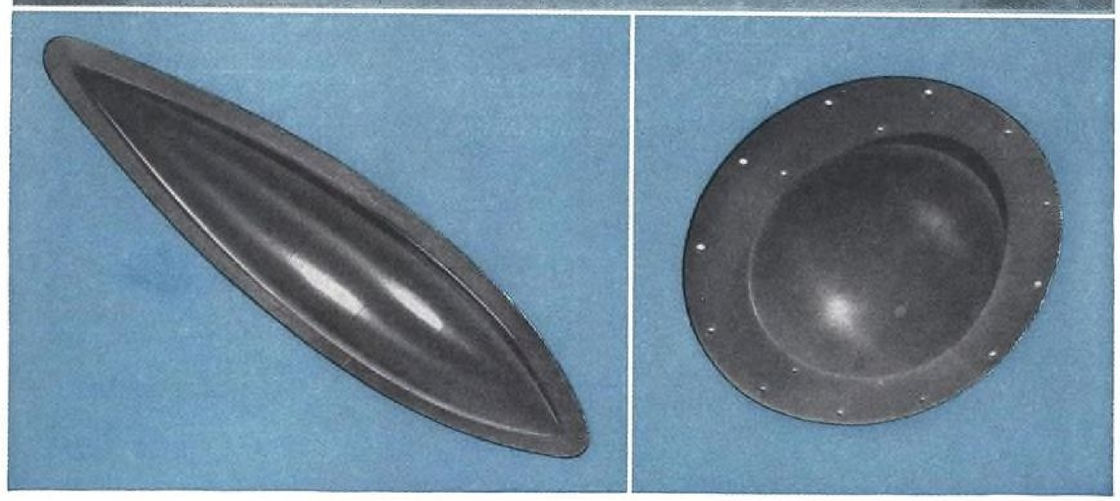

B-52 antenna covers of **VIBRIN**®... to .003 of an inch tolerances!

Workmanship to three-thousandths of an inch is *close* for plastics. And such excellent workability is but one of the requisites for these fiber-glass-reinforced polyester parts made by Boeing.

Thermal stability is a *must*...to withstand the searing temperatures resulting from high speeds, from rocket and jet exhausts. And VIBRIN 136-A is one of only two resins which have met the Military Specifications (R-25042) for such applications. (The other is VIBRIN 135.)

Not only does VIBRIN answer the needs of precision formability and stability at temperatures of well over 500° F, but it is transparent to radio and radar waves as well. It thus offers excellent protection to these vital military "eyes and ears" without in any way interfering with their function.

Now being used for a wide variety of lightweight aircraft and missile parts, ranging from these to the nose cone of the BOMARC missile, VIBRIN, in one of its many task-tailored forms, may be precisely the material *your* product requires ...to make it work, work better, work for less, or sell more.

For more information on the properties and uses of this exceptionally light, strong, and easy-to-mold material... for technical assistance with your own application, see your Naugatuck Representative or write the address below.

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PICTURE CREDITS

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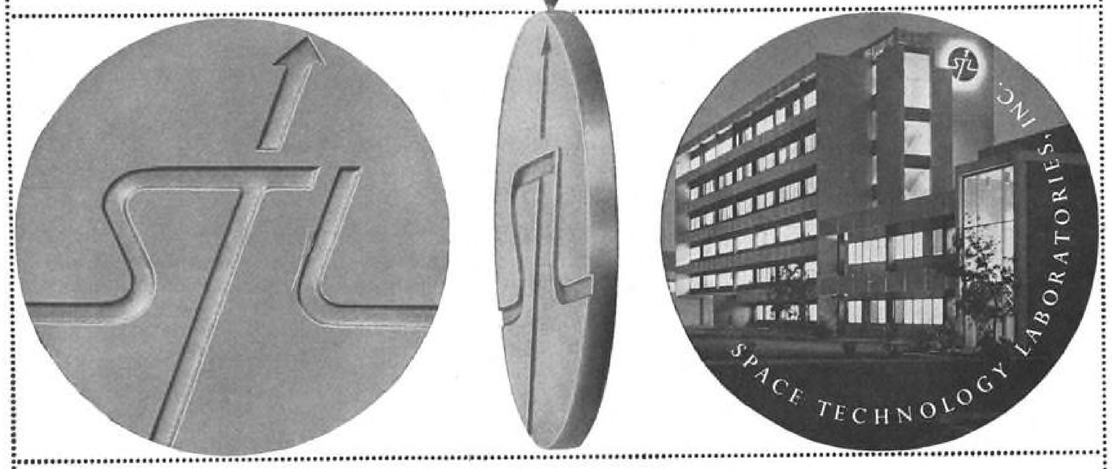

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SPACE TECHNOLOGY LABORATORIES, INC.

EDITORIAL

Fall-Out From the U-2

Last week we warned that the extraordinary statements of Secretary of State Herter and President Eisenhower making aerial espionage and violation of foreign airspace with the Lockheed U-2 an official U.S. policy would produce serious repercussions in the future. The presses printing these words had hardly stopped rolling when the first diplomatic fall-out from these incredible statements began raining down. At this writing it is still continuing with no prospect of early abatement.

One of the extremely harmful effects of these statements has been the embarrassing position in which we have placed our allies on the edge of the Iron Curtain. By those statements this country formally implicated them in an official espionage effort against the Soviet Union and provided the Communists with more potent ammunition against the NATO countries than they themselves have been able to generate in a decade. The gravity of this allied position is indicated in the formal diplomatic protests already lodged with the U.S. by Norway and Pakistan and the cannonade of Soviet threats to rocket-blast these allied bases if any further U-2 operations are conducted from them. Denmark finds it necessary to make an official statement barring its airfields for unauthorized flights over countries not members of NATO. It is hard for people in this country to realize the courage required by our allies on the edge of the Iron Curtain to stand fast behind our cause in the face of the constantly growing Soviet military threat, economic and cultural exploitation and diplomatic pressure. Norway and Denmark by their very presence in the NATO organization provide proof positive of the free world's determination to resist Soviet aggression. Both these countries saw their neutrality shattered by Nazi Germany in World War II, lived under a despot's occupation and resisted it with every means at their disposal. They have learned that there can be no compromise with brutal aggression no matter what political label it bears. Norway has a common frontier with the USSR. Denmark sits on the shores of the Baltic, now practically a Communist lake, and is flanked by Communist Germany to the landward. Both have stood firm in the face of earlier Soviet bluster against their NATO role.

Both of these countries have made vital contributions not only to NATO's strength but to the over-all U.S. military position in the Western world. Norway's underground airfields carved from its rocky northern coast are practically impervious to destruction even by nuclear weapons. The giant radar on the North Cape looks down into the beehive of Soviet air activity on the Kola Peninsula and covers an Arctic flank. The Danish radar on Bornholm Island in the Baltic does a similar job on the Communist periphery from Lithuania to East Germany. The use of key air bases in Greenland along with the BMEWS site is another vital Danish contribution. Both Norway and Denmark maintain small but modern jet and missile forces at considerable expense to their modest national economies to back their determination to remain free and fly their own flags.

Now we have rewarded this loyalty and courage by ineptly pulling the rug from under their exposed position and providing the Soviets with the only valid evidence for diplomatic protest in a decade of searching. Turkey, which has an historic antipathy to the surge of Russian imperialism toward warm water and has never lacked the courage to fight invaders when they threaten, has made similarly important contributions to NATO and is now left in a similarly embarrassing position.

The next chapter in this unnecessary humiliation of ourselves and our allies will be staged in the great world sounding board of the United Nations. It is difficult to see at this time how a successful public defense can be made for our right to unilaterally penetrate other nations' airspace for the purposes of espionage. No matter how anybody feels privately about this matter it will be difficult, if not impossible, for any nation to formally support such a position in an international forum.

But even worse than the position in which some of our firm allies find themselves because of our handling of the U-2 situation is the casual and thoughtless manner in which our top official spokesmen pulled the rug from under their carefully constructed and stoutly defended international position in relation to the Soviet Union. We cannot hope to retain the leadership of the free world unless we exercise it with considerably more intelligence, skill and effectiveness than has been displayed in the U-2 incident.

The belated announcement by President Eisenhower that he had suspended U-2 flights for the duration of his administration came too late to do much good at the summit and if continued will leave this country in a position of losing its sharpest eyes inside the Soviet Union at a time when we need them most. For there is little doubt that the temperature of the cold war is rising. And the knowledge that no prying U-2 cameras will be roaming the Soviet airspace certainly makes the prospect for surprise military action more tempting than ever to Soviet leaders.

As predicted, President Eisenhower's assumption of responsibility for the U-2 flights closed the door on the exit provided for him in Khrushchev's original discussion of the incident and left the Soviet leader no further room for maneuver. It obviously stirred him to magnify the U-2 episode into a far larger issue than originally intended, if only to pacify a rising tide of domestic criticism.

Collapse of the summit was based on unresolved issues far deeper than the U-2 flights although the official U.S. handling of this episode provided Khrushchev with an unusually convenient escape hatch and an unusually fine opportunity to bellow equally well for both international and Russian consumption.

Perhaps the real value to this country of the sorry summit spectacle is that the artificial mask of friendliness slipped from Soviet leadership, revealing its true nature and the fact that its goals have not changed one iota since the days of Stalin's cold war. Mr. Khrushchev's brutal threat to the West of "peaceful coexistence or war" and his post-summit behavior should make it abundantly clear that by "peaceful coexistence" the Soviet leadership means peace on their terms with the naked threat of war to force compliance.

The spectacle of the summit should convince the American people that the basic problem of opposing Soviet imperialism has not changed one whit during the recent "palsy-walsy" era when this country's official policy was to pursue peace without defining the price we were being asked to pay.

It is worthwhile now to recall that there are many American leaders who warned against altering U.S. policy on the basis of this false front of Soviet smiles and who stoutly maintained that our best position for any negotiations would be a position of unchallenged military strength. In the historic light of the summit collapse and the policies that "summitry" stood for, the American people must think seriously on which type of leadership they should look to for future guidance.

—Robert Hotz

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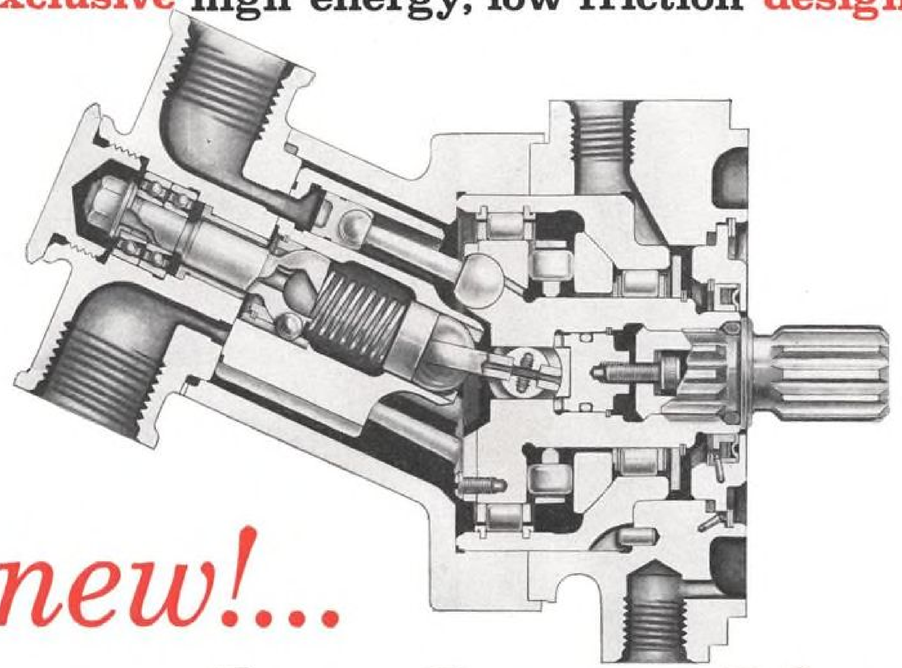

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John F. Hegarty, vice president-marketing, National Semiconductor Corp., Danbury, Conn.

Kenneth C. Moritz, vice president-marketing, General Instrument Corp.'s Semiconductor Division, Newark, N. J.

O. D. Berry, vice president of Iron Fireman Manufacturing Co., Portland, Ore., has been given over-all responsibility for the company's Electronics and Aircraft divisions.

Honors and Elections

Dr. E. S. Moult, chief engineer and technical director of the de Havilland Engine Co., has been elected president of The Royal Aeronautical Society succeeding Peter G. Masefield.

Igor I. Sikorsky, a consultant to the Sikorsky Aircraft Division of United Aircraft Corp., has received the 1959 Grover E. Bell Award for "his foresight and personal contributions to the successful development and demonstration of the helicopter crane concept with the Sikorsky S-60 Skycrane."

Maj. Gen. Robert W. Douglass, Jr. (USAF, ret.), has been elected president of The Wings Club, Inc., New York, N. Y., succeeding Earl D. Johnson, president of General Dynamics Corp.

(Continued on page 119)

INDUSTRY OBSERVER

► Nimbus, 650-lb. meteorological satellite which National Aeronautics and Space Administration will develop as a successor to Tiros, is scheduled for initial launch into a polar orbit within approximately two years. Nimbus will be attitude-stabilized so that the satellite instruments will always be oriented toward the earth rather than being space-stabilized as was Tiros to increase the amount of usable data collected in each pass.

► **Funds for a theoretical and experimental program to determine the nature and threat of satellite reconnaissance to sea forces and the feasibility of active and passive countermeasures to mitigate the threat have been requested by Navy's Bureau of Weapons for Fiscal 1961.**

► Project Dromedary is a Rand Corp. study aimed at a long-endurance aircraft that could be used as an airborne command station. Study concerns state of the art in chemical propulsion, turboprops, turbofans, boundary layer control and other techniques that could give an aircraft extended flight time.

► **Detroit Army Arsenal has set a July 1 deadline on bids for a feasibility study of a mobile field Army ballistic missile defense system against short range ballistic missiles (AW Apr. 25, p. 23). Potential bidders are now teaming up in an effort to win awards for what may be the largest Army missile system in the next five-year period. Chrysler Missile Division and General Electric Defense Systems Department are submitting one joint bid.**

► Courier IB vehicle in ARPA-Army Signal Corps delayed repeater satellite series is presently scheduled for launch on Sept. 1.

► **First full thrust tests of the complete Rocketdyne F-1 1.5-million-lb. thrust rocket engine are scheduled for next spring at the Rocket Engine Test Station, Edwards AFB, Calif.**

► Additional ground stations for the Samos photographic-electronic reconnaissance satellite are planned for New Hampshire, Iowa and Oregon. During research and development phase, Samos will make maximum use of modified Discoverer tracking and acquisition stations.

► **American Bosch Arma Corp. may spin off Arma in an effort to clear the way for a merger. Previous merger efforts have run into difficulty because of requirements stemming from Bosch's German ownership that all stockholders of the company be U. S. citizens. American Bosch Arma negotiated with Northrop over a merger two years ago and recently had been talking quietly with Bell Aircraft Corp., whose defense interests have since been acquired by Textron (AW Apr. 25, p. 31).**

► Engineering design of the Convair Centaur upper stage vehicle is near completion, and the Pratt & Whitney XLR 115-P-1 liquid hydrogen rocket engine has been fired at its rated thrust for full duration a number of times. Stage uses two XLR 115s rated at 15,000 lb. thrust each in early versions and will eventually use two rated at 20,000 lb. thrust each.

► **Cost of each Centaur stage, exclusive of development costs, ground support equipment, transportation, launching, etc., is estimated by National Aeronautics and Space Administration at $7.5 million. Similar figure for an Atlas booster is $4.81 million; for Thor-Agena, $3.41 million; for Thor-Delta, $2.6 million. Scout, which originally was expected to cost less than $500,000 per vehicle, is now estimated at $750,000 each. Figures do not include costs of payloads to be boosted by these vehicles.**

► Four Northrop T-38 Talon supersonic jet trainers now being tested have made approximately 250 flights, and the initial N-156F "Freedom Fighter" has made more than 70 flights. A second N-156F was recently delivered to Edwards AFB, Calif. Latest two T-38s, which have afterburners fitted to the twin General Electric YJ85-GE-5 turbojets, have attained Mach 1.25 in shallow dives. J85-GE-5 engines for production versions will deliver 3,850 lb. thrust. General Electric has received a T-38 for its flight test programs.

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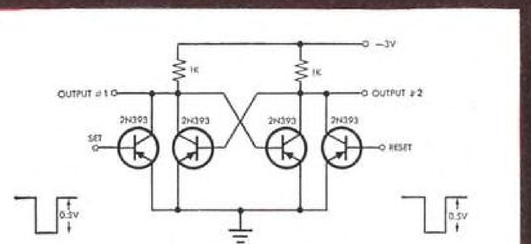

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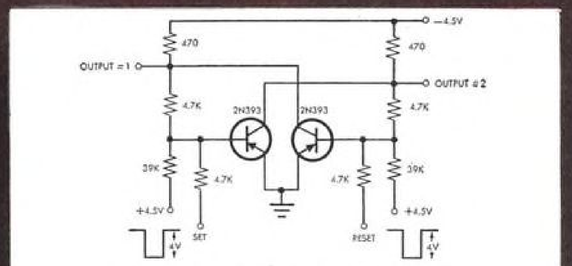

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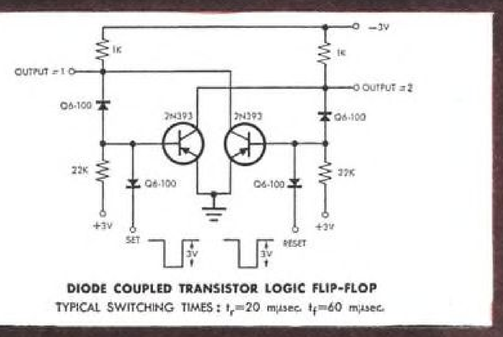

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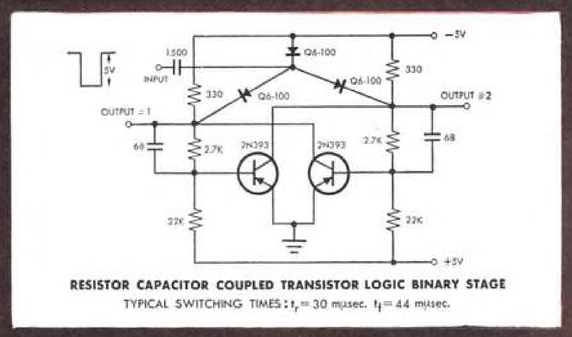

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Washington Roundup

ARDC-AMC Debate

USAF Air Staff is split about evenly on deciding whether to shift some AMC procurement functions to ARDC. After a split vote, Air Staff decided to call for additional study of the proposal.

Proposal was made by ARDC Commander Lt. Gen. Bernard A. Schriever. Schriever argues that the development phase of present and future weapon systems extends far into their operational life. And there are relatively few systems procured in large numbers now. Schriever feels it would be more efficient to assign their procurement to ARDC under these conditions.

The move is strongly opposed by AMC Commander Gen. Samuel E. Anderson. AMC fears it would be relegated to a routine nuts-and-bolts type supply function.

Bigger defense budget for Fiscal 1961 seems an inevitable result of the collapse of the Paris summit conference. Joint Chiefs of Staff are reviewing U.S. defense policy. Administration will be reluctant to admit its policy can be unbalanced by a bad turn in international relations, but fresh cold war tensions will make it difficult to turn down any JCS recommendations.

Summit failure will aid efforts of congressional supporters of more defense spending. A modest increase in the budget was in prospect before the summit incident.

There was Senate support for budget changes even before the Paris crisis. Senate leaders generally accept the alterations made by the House in the Administration's budget, but they also want to make some changes of their own.

There were indications last week that the Senate Appropriations Committee would provide money for development of the B-70 as a complete weapons system. This would expand the House-approved Administration request for prototype aircraft development funds.

Additional spare parts and personnel funds for an expanded airborne alert capability are expected from the Senate group. More development and procurement money for Air Force Atlas, Titan and Minuteman programs also is a good prospect.

Restoration of the $400.5 million House cut in general procurement funds is expected. So is restoration of a specific House cut of $128 million in Army procurement funds, and there is a chance these funds will be increased. Restoration of House cuts amounting to $85.8 million for operation and maintenance, $84.3 million for communication facilities, $33.6 million for administrative personnel and $73.1 million for travel also is expected.

Little Senate support is expected for Administration request that funds be restored for a conventional aircraft carrier and for the Bomarc-B missile.

FAA Wartime Status

Administration is asking for authority to make the Federal Aviation Agency an adjunct of the Defense Department in wartime. Sen. Warren Magnuson has introduced an Administration bill that would make the FAA administrator directly responsible to the Defense Secretary in a war.

USAF Maj. Gen. Harold W. Grant is a leading contender for the job of running the new Defense Communications Agency. This group will take over general communications facilities and functions now the province of the individual services, excluding specialized weapon control systems. Gen. Grant is now director of Air Force Communications-Electronics.

Choice of an Air Force officer for the job would pacify USAF objections that the joint organization represents an expansion move by Army Signal Corps. There is a counter opinion that the job should go to an Army man because an Air Force officer, Maj. Gen. Donald N. Yates, was named to head the last joint organization formed—Defense Department's missile and space range coordination office.

NASA Bio-Med Plans

NASA expects to have plans for its Life Sciences Research Center ready to present to Congress next spring. Dr. Clark Randt, director of NASA's Office of Life Sciences, is currently looking for an assistant director to plan the center and justify it to Congress. Facility will cover about 90,000 sq. ft., have a maximum professional staff of 60.

Dr. Freeman H. Quimby has been named assistant director for grants and contracts, an area where 75% of the life sciences budget will be spent. Dr. Quimby is a former Office of Naval Research scientist who has run the life sciences effort in Army's Research and Development Command for the past year. Other assistant directors are Dr. C. A. Tobias for bioscience and Alfred M. Mayo for bioengineering.

Advisory committees are being formed to correspond with the three divisions in the research center. Dr. Randolph Lovelace will head the flight medicine and biology committee, a new version of the current Mercury advisory committee. Dr. Melvin Calvin, of the University of California, will head the space biology committee. No chairman has been chosen for the space medicine and behavioral science committee.

—Washington Staff

Joint Chiefs Evaluating Defense Program

Paris summit crisis sparks military policy review; Douglas asks restoration of carrier, Bomarc funds.

By Katherine Johnsen

Washington—Joint Chiefs of Staff are re-evaluating the U.S. defense program as a result of the Paris summit crisis.

Deputy Secretary of Defense James H. Douglas told the Senate Appropriations Armed Services Subcommittee last week that the Fiscal 1961 program "will have to be seriously reviewed and evaluated." Douglas' statement followed a protest by Sen. Richard Russell (D.-Ga.), chairman of the Armed Services Committee and a member of the Appropriations committee, that the U.S. "does not have a position of strength and the President did not have it in Paris." Douglas, however, insisted that "the President went to Paris with a strong defense position." Russell replied that "the strength was not sufficient to cause Mr. [Soviet Premier Nikita] Khrushchev to exercise the usual courtesy of diplomacy. The President, a symbol of the United States, was publicly insulted."

Meanwhile, aerospace industry stocks, whose prices have been depressed for almost a year, reacted sharply to the summit breakup. Quick gains of two to eight points were recorded by major companies, including Boeing Aircraft Co., Douglas Aircraft Co., General Dynamics Corp., North American Aviation, the Martin Co., McDonnell Aircraft Corp. and United Aircraft Corp.

Generally, Douglas opposed House changes in the Administration's Fiscal 1961 budget (AW May 9, p. 30), which was submitted in January and revised in April, at least until completion of the Joint Chiefs' re-evaluation. However, he did support House additions of some funds for modernization of USAF's Military Air Transport Service —$150 million of the $250 million added by the House for procurement of Lockheed C-130Bs, Boeing KC-135s, or similar aircraft, for MATS.

The two major reductions made by the House which Douglas protested were:

• **Bomarc B** air defense missile for Air Force. The House's action in canceling the operational program for the Bomarc B, Douglas declared, was "most serious" and "would leave a serious gap" in the air defense program "which could not be filled either quantitatively or qualitatively in the same time period" with interceptors.

The House eliminated $40.4 million in Fiscal 1961 funds and $253.6 million in funds from former years which USAF wants to complete 10 Bomarc B squadrons, including two squadrons for Canada. In April, Air Force voluntarily reduced the program from 16 squadrons to 10, reducing its original budget request by $381 million. The House approved $50 million for continued testing of Bomarc B.

"The continued testing of the Bomarc B with the expectation of resuming production in Fiscal year 1962 or 1963 would delay the program by several years and would add almost one-half billion dollars to the present program cost," Douglas said.

Failures in the early flight tests of Bomarc B, he said, are "typical of research and development experience rather than indicative of deficiencies in design or technical engineering" and "should in no way be used to prejudge the ultimate effectiveness of the program." Since the House's action, Douglas pointed out to the Senate subcommittee, there have been two "completely successful" Bomarc B flight tests (see box below).

Douglas urged elimination of a $215 million increase made by the House for purchase of 50 F-106s in lieu of Bomarc Bs, pointing out that the initial F-106 delivery could not be effected until more than a year after the planned initial deployment of the Bomarc B.

• **Conventionally-powered aircraft** carrier for Navy. Douglas urged the subcommittee to restore $293 million eliminated by the House for the attack carrier, emphasizing its role in limited war situations. He said the Forrestal-class carrier will be needed by 1966 to replace four Essex-class carriers, which will then be over 20 years of age and no longer capable of performing an attack carrier role.

Navy's 14 attack carrier force is now composed of four Forrestal, three Midway and seven Essex-class ships. Three Forrestal-class carriers now being built—including the nuclear-powered Enterprise—will replace three of the Essex-class ships by the end of 1962.

Bomarc Tests

Washington—Air Force last week reported six successful Bomarc missile firings out of a total of seven launched during the week of May 12-18.

The firings included the second successful Bomarc B test flight 270 mi. over Eglin AFB, Fla., Gulf test range in a simulated intercept. First successful firing was on Apr. 13. Of the eight previous Bomarc B firings, USAF said that seven achieved 75% of their test objectives. One burned on the pad.

During the week of May 12-18, two Bomarc As scored hits on their targets —a Regulus II supersonic target and a QF80 target drone. Three Bomarc As intercepted their targets with near misses. One Bomarc A launch was unsuccessful during the week.

Other Highlights

Here are other highlights of Douglas' presentation:

• **Space satellites.** Douglas said a $54 million increase voted by the House for the Midas missile warning satellite, Samos reconnaissance system and the Discoverer experimental satellite is not necessary because, if additional funds are needed during the year, they can be drawn from Defense Department's emergency fund.

• **Minuteman solid propellant** intercontinental ballistic missile. Douglas said the Defense Department does not anticipate that the $20.7 million added by the House to push this program would be needed and recommended that it be eliminated.

• **Fleet ballistic missile.** Douglas asked the subcommittee to rescind $241 million added by the House—including $38 million for Navy's Polaris fleet ballistic missiles—for this program. The House program provides for full funding of five Polaris submarines and their missiles plus the purchase of long-lead items for seven submarines in Fiscal 1961. The Administration's request is for full funding of three submarines and procurement of long-lead items for nine.

• **Anti-submarine warfare.** Douglas agreed to $41.9 million of a $100 million House increase in funds for anti-submarine warfare research and development. This would bring the total Fiscal 1961 allocation to $220 million —$20 million over the Fiscal 1960 allocation.

• **Airborne alert for Strategic** Air Command. Douglas stood pat on Defense Department's program for an airborne alert capability for one-fourth of SAC's heavy bomber force and asked the subcommittee to delete a $115 million addition by the House for a compromise capability between the Department plan and that advocated by SAC commander, Gen. Thomas S. Power, for an airborne alert capability for one-third the heavy bomber fleet.

Douglas noted that the defense budget passed by the House gives the President authority to incur all expenses essential for an emergency airborne alert. Including the $85 million in the Fiscal 1961 budget, Douglas said USAF has programed a grand total of $250 million for the airborne alert, including $40 million in operations and maintenance funds and stocks on-hand transferred to the program.

• **Army modernization.** Douglas agreed to a $37.5 million increase in procurement funds for Army modernization but objected to the method for financing the remainder of a $207 million increase provided by the House—from reimbursements from sales under the mutual security program and from savings derived on contract costs.

• **Contract management.** Douglas strongly protested an across-the-board 3% cut applied by the House to all procurement categories in a move to force Defense Department to drive better contract bargains. The reduction would total over $400 million.

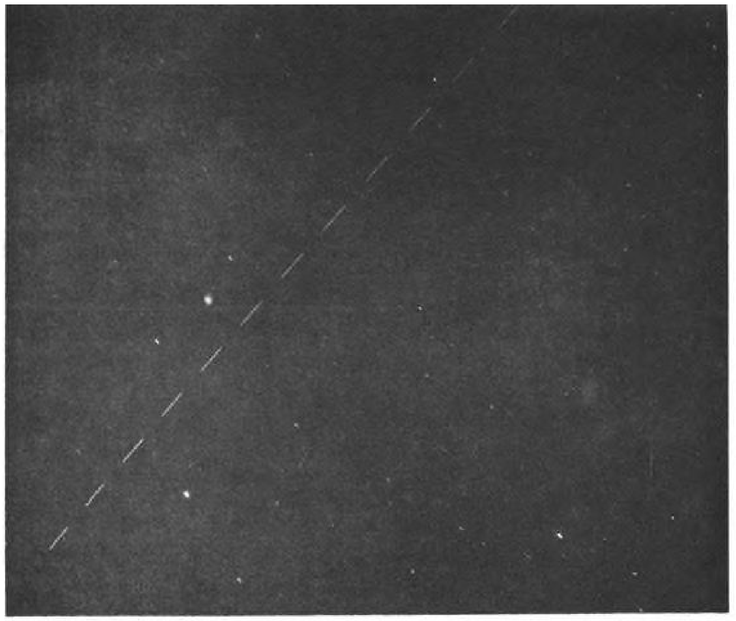
• **Administrative overhead.** As an alternative to the $33 million 10% reduction made by the House in departmental administration costs, Douglas proposed a $10 million 5% reduction in the originally planned June 30, 1961, civilian and military personnel strengths for all administrative-type headquarters and commands except for the Air Force. Douglas said that the budget presented in January already reflected an average reduction of 10% in military and civilian administrative personnel for USAF.

Nike Zeus Funds

Washington—Army hopes to transfer $18 million in unused Fiscal 1960 funds to accelerate production techniques for its Nike Zeus anti-missile missile system.

Richard S. Morse, Army director of research and development, said that under present plans the funds will be used for development of new automatic processes for production of mesa type transistors, precision resistors and other Zeus components "which require an extreme degree of reliability and ultimately will be required in large quantities."

The funds are now being transferred from the Army to the Defense Department Emergency Fund. Defense Department, in turn, will request Bureau of Budget approval to transfer the funds to Army's research, development test and evaluation appropriation.



SEVERE TUMBLING of the new Soviet satellite can be discerned in this photo taken by Grumman's control station over a 90 sec. period. Viewed under a magnifying glass, the individual streaks all show a strong corkscrew pattern and the second streak at bottom left shows an asymmetrical indication in addition. Track is from southwest (bottom left) to northeast (top right).

Space Technology

Life Support Systems for Space Tested in New Soviet Satellite

By Evert Clark

Washington—First trial flight of the five-ton spacecraft launched by the Soviet Union on May 15 was aimed primarily at testing life support systems that will allow a man or men to conduct research on "long" flights into outer space, according to Russian scientists.

Soviet broadcasts in Russian said the craft carried "a load equivalent to the weight of a human being," while Soviet English language broadcasts said it carried a "dummy astronaut."

Some Western scientists speculated that this first craft carried a man whose existence would be admitted only if he were returned safely to earth.

But comments by Soviet scientists indicated that this is merely the first of a series of unmanned tests; that the problem of safe re-entry has not yet been solved and would not be attempted on this first flight, and that the launching of the first manned craft still is months away—although one Russian scientist said it "perhaps" will occur this year.

By late last week, Russia said the end of the satellite's flight was imminent. U.S. tracking indicated the apogee had been increased to 418.5 mi. and perigee to 198 mi., which would have required firing of a rocket while in orbit and would have put the satellite into the lower Van Allen radiation belt.

The two-part spacecraft weighed 10,008 lb. and consisted of a pressurized, heat-regulated cabin section weighing about 5,512 lb. and an instrument compartment containing some 3,250 lb. of instrumentation plus chemical and solar batteries. The cabin was to detach from the instrument compartment on radio signal from the earth and both were to burn on re-entry, Soviet scientists said.

The spacecraft was launched at approximately 1 a.m. Moscow time on May 15, the second anniversary of the launching of Sputnik III, at an inclination of 65 deg. to the equator.

The orbit was the most nearly circular of any Soviet satellite launched thus far—with an apogee of 229 mi. and a perigee of 194 mi. Orbital period is 91.2 min. Several Russian scientists referred to the "more powerful" Soviet rocket tested last January (AW Jan. 18, p. 29) in discussing this launching, although none specifically said that the newer rocket was used.

The spacecraft carried a "signal" radio transmitter operating on 19.995

megacycles in both the telegraph and telephone regimes, the Russians said. It also carried "special radio equipment to play back data on the operation of its instrumentation and for the exact measuring of the orbit elements. The power supply for the scientific and measuring instruments is provided by chemical and solar batteries," Russia's Tass news service said.

Voice signals received in the U. S. from the spacecraft led Melvin Y. Landon of Nasson College, Springvale, Me., to the conclusion that the craft carried a man and not just a recording of a man's voice to test communications. Landon, assistant professor of mathematics and physics, said he and his students recorded on tape both beep and voice signals from the satellite and said he is convinced the "scrambled voice . . . like Donald Duck with a sore throat" was that of a live human being.

Special Compartment

Prof. Vladimir V. Dobronravov said the weight of the vehicle "has made it possible to equip the spaceship with a special compartment, a cabinet adapted for man's flight into outer space. The cabinet has been equipped with various instruments and installations for preserving the conditions necessary to insure the pilot's life and to carry out research."

"Thanks to reliable radio-telegraphic and radio-telephonic communications," Dobronravov said, "a radio transmitter will send information to scientists on how the instruments recording the physical conditions required to support human life are working.

"The main purpose of the spaceship, the cabin in which future scientists will fly into interplanetary space, is to check and investigate the cabin design," Dobronravov said.

The spacecraft "will be guided to some extent," Dobronravov said. On Moscow home service broadcast, he said the cabin would "automatically separate itself from the ship" after necessary information on its functioning had been obtained. But a Tass interview quoted him as saying the length of time that the spaceship would remain in orbit "will depend on the time its instruments will require to transmit all the findings, after which the spaceship will receive a signal to descend."

Clarification Needed

Questions needing clarification include "the dependability of the equipment generating the conditions for life and work inside the cabin—atmosphere, temperature, pressure, humidity and so on," Dobronravov said. The day is not far off, he added, "when the problem of satellite recovery can be solved. Then Soviet researchers will be sent on a space trip."

Junior Birdmen?

Washington—U. S. statements that weight of satellites is not so important because U. S. equipment is lighter have nettled at least one Moscow broadcaster.

"Of course, such arguments can only be regarded as an attempt to belittle the success of Soviet science," commentator Merkulov told listeners on the day the five-ton spacecraft was placed in orbit.

"Reduction in the weight of an instrument by even a few grams deserves attention," Merkulov said. "But it will not solve the problems we are facing in mastering the cosmos and achieving manned flights into the cosmos.

"For, while we can reduce the weight of an instrument, for instance replace its heavy frame by a lighter one, it is not likely that we shall be able to cut off the heavy body of a man and join his head to the body of a sparrow or a humming bird.

"Clearly, to make flights into the cosmos, we need powerful rockets which can carry into space heavy ships. At present our motherland is the only country to possess such rockets."

Both the ship and the cabin were to burn on re-entry, Dobronravov said, "but there can be no doubt that in the near future the problem of the return of satellites to earth will be solved."

Leonid I. Sedov, member of Russia's Academy of Sciences and president of the International Astronautical Federation, also said "the problem of a safe return to earth has not yet been solved in practice."

Extended Flight Problem

Safe flight for long periods presents problems that require considerable research, Sedov said. "It is possible that biologists and medical men will now have the last word," he said.

A candidate of medical sciences, identified only as Godenko, said on the home service broadcast that "the problem of the accuracy of landing of a cosmic apparatus back on earth is of most importance" and is getting the "concentrated attention" of designers and scientists.

"The cosmonaut and the equipment in his ship must be conditioned to provide for the safety of his life and health when touching down either on land or water at any geographical point on earth," Godenko said.

V. N. Chernigovskiy, director of the Institute of Physiology and corresponding member of the Soviet academy, said physiologists are studying in their laboratories "the conditions of man's stay in the pressurized cabin and are working out the methods for protecting the future space flyer from the possible harmful effects of cosmic rays and are studying the conditions of feeding the man and other physiological functions."

Tass, in its official announcement of the launching, said Soviet work over the past few years, including testing of "powerful rocket carriers," had paved the way "to the building and testing of a spaceship for long manned flights into outer space." This and other references to "long" or "interplanetary" flights indicate that the spacecraft may be a general purpose vehicle that would allow manned flight around the moon or farther, rather than earth orbits alone.

Although re-entry was generally disavowed as a test purpose, the Tass announcement said the launching was undertaken "to perfect and check the satellite ship's system, ensuring its safe flight and controls, its return to the earth and the necessary conditions for the space crew." There also were a number of references by Soviet scientists that indicated the cabin might be capable of holding more than one man.

"This [launching] lays the beginning for difficult endeavors to build reliable spaceships, guaranteeing safe manned flights into outer space," Tass said.

Telemetry

Later announcements said telemetric information indicated that the satellite's equipment was working "normally," that temperature and pressure were being maintained within established limits in the instrument compartment and in the cabin and that the radio transmitter signal was working "stably both in the telegraph and telephone transmissions."

"The reliable sealing and the thermoregulating apparatus ensure normal conditions of living in the separate cabin," one broadcast said. Comparison of the actual orbit with the planned orbit in electronic computing machines confirmed agreement between the two, a broadcast said.

Yevgeni K. Fedorov, corresponding member of the Academy, said "many factors and much equipment have to be investigated and tested before a human being could be launched into space—careful testing of individual assemblies and trial flights of the cosmic ship as a whole have to be carried out."

Space Preparation

Charles Villmann, head of the Estonian Branch of the All-Union Astronomy and Geodesy Society, said the present rate of Soviet scientific and technical development indicates that "in all probability, not years but months will be sufficient to prepare for the flight of a human being into outer space."

He said that this "great moment" might "even occur this year."

Re-Entry Study May Be Satellite Goal

Washington—Orbiting of a five-ton Soviet spacecraft may have been an attempt to determine the behavior of an inhabitable capsule under the most extreme conditions of heating and dynamic forces that re-entry into the earth's atmosphere can produce, Brig. Gen. Don Flickinger, assistant to the commander of the Air Research and Development Command for bioastronautics, said last week.

Although Soviet scientists have indicated that the main goal is a checkout of life support systems (see p. 27), Flickinger believes that this may, in fact, be a secondary goal. He also believed re-entry over Russia and recovery of the capsule will be attempted, in spite of Soviet statements indicating otherwise.

When he toured the Soviet Union as a delegate to the Federation Aeronautique Internationale meeting there last summer, Soviet space scientists were most interested in exchanging information on these two aspects of manned space flights, Flickinger said:

• **How far along the U. S.** was with investigation of stabilization, heat pulse and dynamic forces of re-entry, and impact forces on landing.

• **What had been done on** monitoring of the biological aspects of space ambient radiation.

From 1955 through 1959, Russian scientists explored these and other problems extensively, using the A-1, A-2, A-3 and A-4 geophysical rockets both with and without animal payloads (AW July 13, p. 69); with the Laika dog-carrying satellite and with other Sputniks and space probes.

They concluded that the dynamic forces of launching, weightlessness in orbit, etc., had no irreversible effects on the animals. But, in all summaries of their work, Flickinger said they made quite a point of the fact that the actual mechanics of the recovery phase were very difficult and said that they lost both test subjects and records on a number of flights.

Last July 2 and July 7, Russia fired two separate series of rockets, each carrying "quite a menagerie aboard," Flickinger said. It became apparent with these shots that they were working on manned components totaling around 5,000 lb., he said. This is approximately the weight of the pressurized cabin that is supposed to separate from the orbiting spacecraft.

Russia announced that two dogs and a rabbit were recovered in good condition from a single-stage ballistic medium-range rocket launched last July 2 (AW July 13, p. 35). The payload exceeded two tons. Instruments yielded data on composition of light gases in the atmosphere "for the first time" and produced new data on the conduct of animals under zero gravity, Russia said.

Flickinger said results of the July shots made it appear that Russia "may have really wrung out the re-entry sequence by having the total package come back in at re-entry forces" that would be encountered if the re-entry trajectory were an undesirable one. National Aeronautics and Space Administration plans similar tests with the Mercury capsule, launched by Atlas boosters, to see what heat pulses and dynamic forces are produced from undesirable trajectories.

The Russian shots last July in effect were "proof testing" of a manned capsule at extreme limits that could be produced if, for example, the capsule initially went into an eccentric orbit that carried it into the lower Van Allen belt and immediate re-entry was necessary to save the crew regardless of whether the vehicle was positioned for optimum re-entry trajectory, Flickinger said. Electrons in the lower belt have produced X-rays inside Explorer satellites by striking the outer shell.

Flickinger said the July shots also made some attempts to monitor ambient radiation and made preliminary investigations on shielding problems. He predicted last January that Russia would orbit a manned spacecraft by late spring or early summer (AW Jan. 25, p. 35).

The spacecraft put into orbit "fits the general pattern of events and brings the Russians to a point in time where they are ready for a manned shot—maybe more than one man," Flickinger said.

With the capability to put some 10,000 lb. into a 300 mi. orbit, Russia can add accessory lift devices, an extra man, redundancy of life support systems, etc., he said.

Flickinger believed that the pressurized cabin mentioned by the Soviets is essentially inserted in a shell, or outer container, and that it would be ejected during the re-entry sequence, possibly between 60,000 and 40,000 ft. altitude, and stabilized by a drogue parachute much as Mercury will be.

Heat pulses on USAF man-in-space capsule studies and in NASA's Mercury program have shown that, although peak heating for ballistic re-entry is short and steep, temperature remains high in the capsule for a relatively long period of time, even after landing.

In an emergency situation, where oscillation or tumbling would increase heating over that of a perfect trajectory, the outer shell would absorb most of the heat, lessening danger to the crew inside the cabin. This increases safety, not only during re-entry but particularly after landing if crewmen should be injured and unable to leave the capsule and if recovery should take longer than planned.

Secondary goal of the current test probably is reliability of life support and other components by time, Flickinger believes. Although life of the capsule has been predicted as some three or four weeks, systems might be tested to destruction if the life is longer.

Yevgeni K. Fedorov, corresponding member of the Soviet Academy of Sciences, said in Moscow that a "very important question" in the flight is "testing the apparatus designed to separate the cabins." Other purposes, he said, are to test such things as "oxygen regeneration equipment . . . apparatus to enable spacemen to take food under weightless conditions . . . protection against excess strain in takeoff and ejection of the pressurized cabin from the mother ship and many other things."

Flickinger said he does not believe the spacecraft carries life because Russia has gone to extremes to dispel the Western notion that it is careless with life. But, he believes it may carry tape-recordings of a human voice, since at the current state of development of biological monitoring instrumentation, "the human voice is still about the best indication doctors have of the state of the spaceman's health."

Jupiter Radiation

Washington—Existence of a Van Allen type radiation belt around the planet Jupiter, believed to be 100 trillion times stronger than the one surrounding the earth, has been almost conclusively established, according to scientists at the California Institute of Technology working under Office of Naval Research sponsorship.

The radiation belt, believed to be about 200,000 mi. above the planet's surface, would almost preclude manned vehicle approach any closer than to one of Jupiter's moons, some of which are more than a million miles from the planet.

Recent Cal Tech measurements, made with twin 90-ft.-dia. radio telescopes mounted on mobile platforms on a railroad track, have confirmed that the emission is polarized and also have established that the source of radio emission is approximately 400,000 to 500,000 mi. wide in a direction roughly parallel to the planet's equator.

Policy Weakness Laid to Lack of Debate

Washington—National Security Council's major weakness is its failure to fully debate new and controversial matters in order to create policy lines designed to meet changing world conditions, Dr. James A. Perkins, vice president of the Carnegie Corp., charged during closed hearings of the Senate Subcommittee on National Policy Machinery.

Perkins, a member of the Gaither Committee which was appointed in 1957 to survey national security problems, told the subcommittee the National Security Council system is "not likely to permit new or substantially new ideas to filter their way up uncompromised and vividly expressed" to aid the President in deciding on new policy lines. He added:

"I would say that it has been at its best when it has to do with matters that come within fairly well established guidelines, both in terms of budget and in terms of established orientation, and it has been at its weakest when matters are extremely controversial and break into new ground or that require major revisions of policy."

Dr. Perkins told the subcommittee that the President has not received from the normal National Security Council routine "the kind of sharp debate, the clear differences of opinion, the new ideas that would require major modifications of program."

Dr. Perkins did not testify as to the nature of the Gaither Report on national security needs, which is still classified by the Administration, but said that when the committee began its review "it seemed to us that the nature of the threat was not fully determined or fully considered . . . as a matter of fact, I said then and I say again that whatever words of wisdom we may have put into that document would have largely been wasted if the Russians had not so fully cooperated by sending up a missile one week before we submitted our report, or a satellite, and another one some weeks afterward. We were well bracketed."

In another set of hearings before the same group, witnesses told Sen. Henry M. Jackson (D.-Wash.), subcommittee chairman, that revision and clarification of the "conflict of interest" statutes are required.

Roswell B. Perkins, chairman of the New York City Bar Assn.'s special committee on the federal conflict of interest laws, called for "a careful regulatory scheme that effectively restrains official conflicts of interest without generating pernicious side effects on recruitment."

The association's report served as the basis for a bill introduced by Sens. Kenneth Keating and Jacob K. Javits, both New York Republicans and William Proxmire (D.-Wis.) that would revise the conflict of interest statutes.

Recommendations made by the association include:

- "**The present scattered** and uncoordinated statutes relating to conflicts of interest should be consolidated into a single unified act. . . .
- "**The statutes should permit** the retention by government employes of certain security-oriented economic interests, such as continued participation in private pension plans.
- "**The restraints contained** in the present statutes should be greatly expanded in their scope by making them applicable to essentially all matters in which the public deals with the modern federal government."

Marion B. Folsom, director of Eastman Kodak Co. and the former Secretary of Health, Education and Welfare, made the following suggestions:

- "**A central agency** in the White House should maintain lists of positions and the necessary qualifications, recruit people, place them properly and instruct them in the unique features of government administration.
- "**The maximum salaries** of the three top grades of Civil Service should be increased.
- "**A more extensive management** development program should be adopted throughout government to identify and develop the most promising younger people."

Polaris, Minuteman Glass Fiber Casings

Navy will use a glass fiber-reinforced plastic casing on the second stage of the Polaris solid propellant IRBM in an effort to extend range of the missile.

Glass fiber material also will be used in the Minuteman ICBM third stage casing, if production contract goes to Hercules Powder Co. (AW Apr. 18, p. 54). However, titanium also is now receiving serious consideration for application in the weight-critical Minuteman third stage.

Fabricating equipment is being completed and Aerojet-General is scheduled to deliver the first Polaris glass fiber cases in September. Navy has been investigating glass fiber materials for rocket casing applications for a number of years and apparently feels the material is ready for major missile applications.

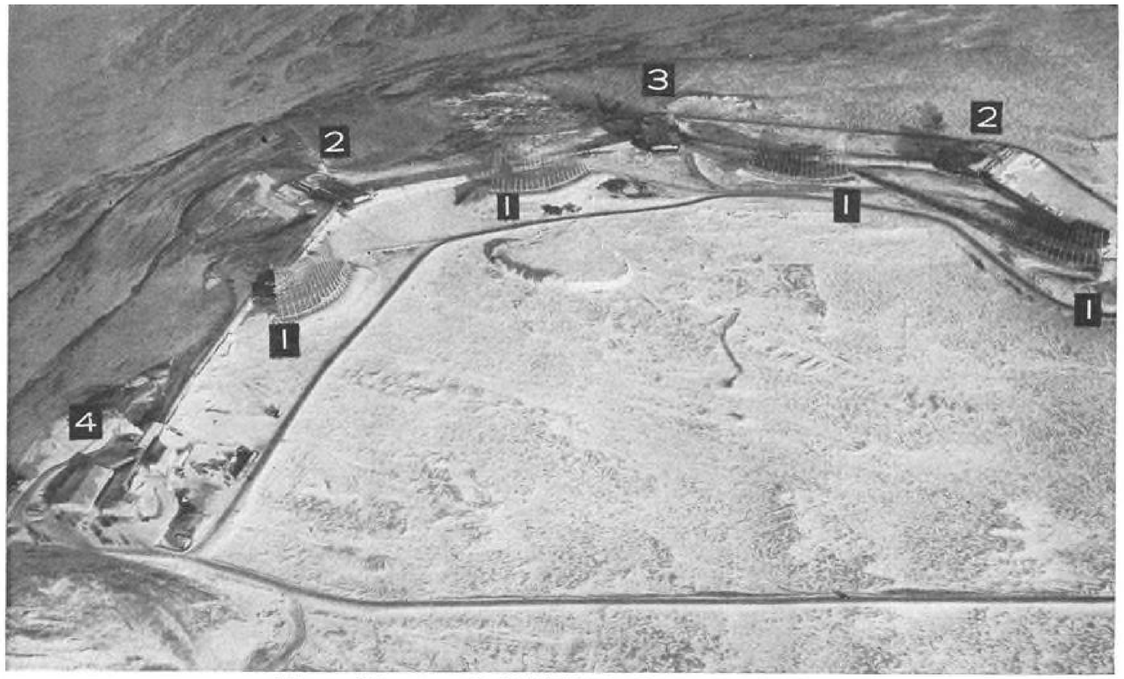
In the competition for the production contract on the Minuteman third stage engine, codevelopers Hercules and Aerojet are putting their primary efforts, respectively, into the development of resin-bonded glass fiber and into steel casings. Starting with Pioneer I in October, 1958, Hercules glass fiber-encased engines have been successfully fired 13 times in space shots. Three of the casings are still in orbit. The company feels that the capability of the glass casings has been established and has predicated its Minuteman third stage engine proposal on the use of this type case.

Aerojet, on the other hand, reportedly has been working primarily on the development of steel casings for the Minuteman third stage engine. But recently, in conjunction with Space Technology Laboratories, the company initiated a secondary development effort on titanium casings. The results so far appear promising. In this project, 6Al-4V is reported to be the titanium alloy of primary interest.

Work to date in the development of glass fiber and titanium case structures for the Minuteman program has uncovered no serious drawbacks in either system, according to a STL researcher. But there is still much to be learned about both materials, he adds; it is the unknowns in both systems—such as titanium's performance under high stress and the resistance of glass to various environments—that could prove to be the important deciding factors.

Principal complaint against glass, its loss of strength in the presence of moisture, doesn't apply to resin-bonded glass fiber structures. The resins protect the glass fibers adequately, a researcher says. Even more protection can be built into the system should it prove necessary.

Meanwhile, titanium casing development work is being revived in another quarter. As part of its new solid propellant rocket motor materials development program, the Defense Department's Research and Engineering Group has given Pratt & Whitney the go-ahead to resume its development work on titanium casings for the Pershing missile (AW Oct. 19, p. 32). Originally underwritten by Army funds, this program was considered to be the most sophisticated titanium development program to date. Army reportedly canceled the program due to tightness of available money. Revived program will be handled for Defense by Army's Ordnance Materials Research Office, headquartered at Watertown Arsenal.



First Photo of BMEWS Greenland Site

First Ballistic Missile Early Warning System, (BMEWS) site at Thule, Greenland, slated to go into operation this fall, employs four giant detection radar antennas (1) which jointly cover 150 deg. sector. Pipe-organ type scanners are housed in buildings immediately behind each antenna. Also shown are two radar transmitter-receiver buildings (2), a central data processing and tactical display building (3) and service buildings (4), all interconnected by a 6,000-ft.-long enclosed passageway.

Navy HSS-2 and H-43B Resume Flight Tests

New York—Flight program of Sikorsky's Navy HSS-2 and plant flight operations of Kaman's USAF H-43B have resumed, following temporary grounding of the two turbine-powered helicopters.

HSS-2 crashed during a high-speed run at Sikorsky's Stratford, Conn., plant Apr. 23 and was immediately grounded by the company. Three crewmen died in the accident (AW May 2, p. 37). The Navy rotorcraft reportedly was traveling faster than the world's helicopter speed record (162 mph.) when the fixed horizontal stabilizer partially separated from the airframe and was carried into the tail rotor, which was damaged along with the tail cone and main rotor system.

Air Force grounded the H-43B Huskie, a crash-rescue helicopter, on May 9 because of limited clearance between rotors and tail fins, which had been hit by the blades (AW May 16, p. 37). "Incidents" in every instance resulted from pilots flying "outside the handbook" during backward flight and in hovering tail-to-the-wind, AVIATION WEEK was told.

Sikorsky said that loss of the HSS-2's horizontal stabilizer during the high-speed run, the first such separation in the company's 20-year history, would not—at normal flight speed—cause the aircraft to go out of control. The company explained there was no failure or malfunction of the control system, dynamic components, blades or powerplant. Control tower personnel said the flight path and maneuvers of the HSS-2 were normal up to the moment of the accident.

The HSS-2 flight program, resumed with Navy concurrence, has been authorized under conditions which prevent high loads on the stabilizer, pending a complete re-test and re-analysis of the forces involved. Test work is being conducted at the Stratford, Conn., plant, at the Naval Air Test Center, Patuxent River, Md., and at the Naval Air Station at Key West, Fla.

Kaman's H-43B has been cleared for experimental flight testing at the company's Bloomfield, Conn., plant. Flights are being made to establish temporary operational limitations which might be imposed to unground aircraft at Air Force bases, and to test tail modifications. USAF is expected to lift restrictions at its bases within the next few days. Major restriction is in backward flight, which has been limited to 15 kt.

Tail modification of the Huskie probably will be made within three months, AVIATION WEEK was told. This could involve a change in arrangement of the fins, possibly including frangible sections in the dorsal areas, plus other structural modifications being considered. In its present configuration, the H-43B might be limited in maximum rpm., center of gravity and gross weights, in addition to rearward speed. Kaman has delivered 20 of the turbine-powered rotorcraft to USAF, with about 100 more on contract.

Vela Spending

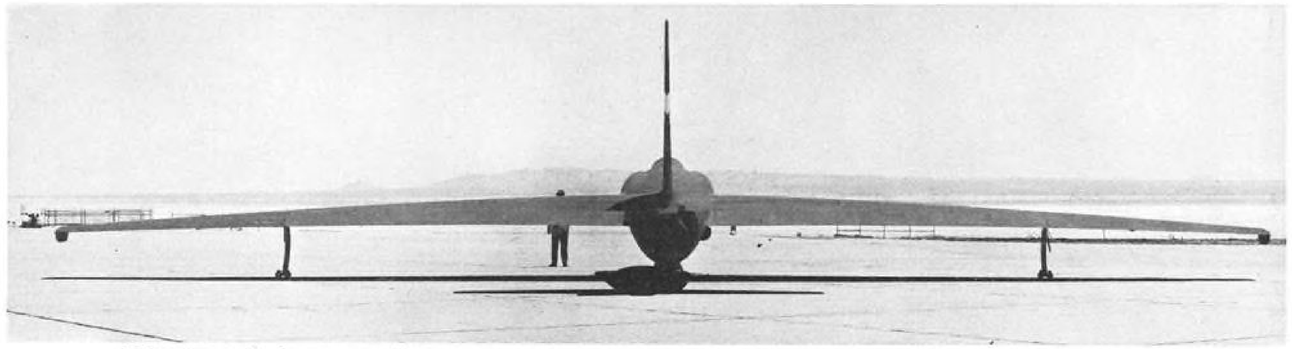
Washington—Advanced Research Projects Agency is spending $9,885,000 during the current fiscal year on Project Vela research and development program dealing with the problems of detecting nuclear explosions.

Joint program with Atomic Energy Commission, National Aeronautics and Space Administration, departments of Commerce and Interior and the Air Force includes three categories:

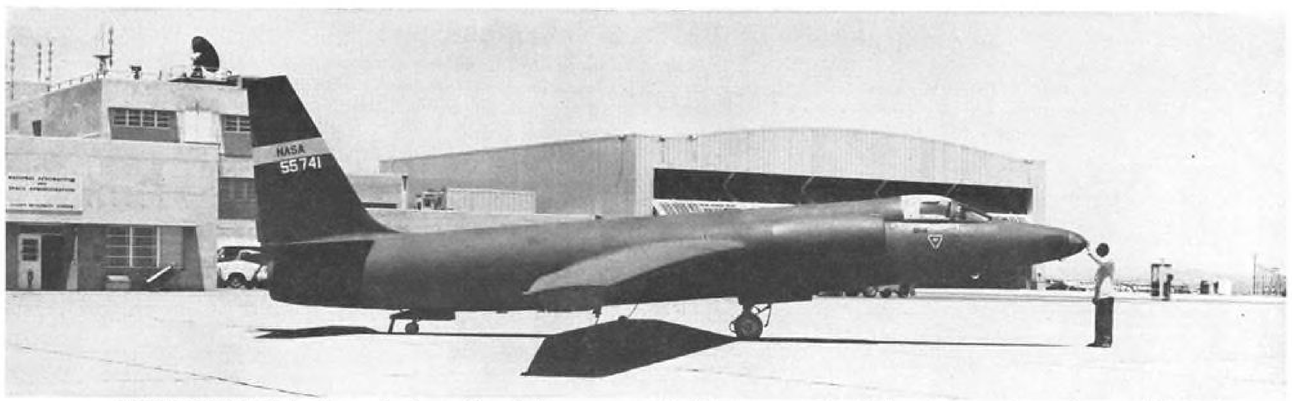
- **Vela Uniform, $8,535,000, research and development concerned with detection of underground nuclear explosions.**
- **Vela Sierra, $1,050,000, research and development involving ground-based detection of nuclear explosions in space.**
- **Vela Hotel, $300,000, research and development concerned with satellite detection of nuclear explosions in space.**

Contractors under Project Vela include: Geotechnical Corp., Bell Telephone Laboratories, Sandia Corp., United Electro-Dynamics, Inc., Air Force Technical Applications Center and Rand Corp.

Low Volatility Fuel Used in U-2 Lightweight



LOCKHEED U-2's drooping, flexible, high aspect ratio wing is an indication that the aircraft's structure is stressed for a maximum speed of about 200 mph. or less at sea level. At cruise altitude of about 90,000 ft. where the air density is low the aircraft can fly in the neighborhood of 500 mph. without exceeding the design loads. Mach number at this cruise speed is around 0.7. Maximum altitude is reached when the aircraft flies into its "coffin corner" and begins to stall because of low air density at the same time that it has reached its critical Mach number (about Mach 0.75) and its drag is beginning to increase rapidly. While the U-2 was designed primarily to cruise at the highest possible altitude, this single performance objective also pays off in the high groundspeed of about 500 mph. and long range because of low drag in the thin air near 90,000-ft. altitude.



WHITE SUNSHADE has been placed over the pilot's canopy on this U-2 to protect him during the hours he spends near 100,000 ft. when most of the earth's atmosphere is below him. Long fuselage of the U-2 has a high fineness ratio of nearly 10.0, but its fuselage diameter of about 5 ft. in its powerplant section is sufficient to allow the use of a wide variety of large airflow turbojets. Small belly dome beneath cockpit houses lens for Perkin-Elmer Model 501 panoramic camera (AW Sept. 16, 1957, p. 76). Camera designation 73B and focal length reported by Russians does not fit the Perkin-Elmer equipment, however.

ALTITUDE PERFORMANCE of the U-2, which is essentially a powered sailplane, is achieved primarily through a light structure and a very low wing loading. Wing loading of the original U-2, which was designed using 1954 state of the art, was approximately 25 psf. Several versions of the U-2 have been built and a number of improvements have been incorporated into the aircraft in the past few years. One of these was the replacement of the original Pratt & Whitney J57 with the Pratt & Whitney J75-P-13.

J75 Engine

By J. S. Butz, Jr.

Washington—Specially refined kerosene with a high boiling point apparently was used as fuel in the Lockheed U-2 reconnaissance plane lost near Sverdlovsk, Russia (AW May 16, p. 26) to keep evaporation losses low during high altitude cruise.

Instructions stenciled on the U-2 wreckage exhibited in Moscow's Gorki Park say the aircraft should be filled only with MIL-F-25524A fuel which is purchased in small lots under Air Force contract specifically for use in the U-2. Specification for this fuel calls for a boiling point of 300F at sea level which is about double that of normal jet fuels. Otherwise, the U-2 fuel closely resembles current turbojet fuels.

The high boiling point and low volatility of the U-2 fuel is essential for good range performance and low fuel vaporization during high altitude flights lasting several hours. Evaporation losses of JP-4 is very high at the low atmospheric pressures above 70,000 ft.

Main performance penalty accepted with the low volatility fuel is a poor altitude restart capability unless the aircraft is fitted with a specially-designed restart system. U-2 lost over Russia was forced to descend from its operational altitude of approximately 90,000 ft. after an engine flameout.

Specifications for the U-2 fuel were developed at the Wright Air Development Division of the Air Research and Development Command several years ago. Present suppliers of the fuel, which has a narrow distillation range and can only be made from a few grades of atmospherically-distilled petroleum cuts, are the Ashland Oil and Refining Co., Ashland, Ky., and the Howell Refining Co., San Antonio, Tex.

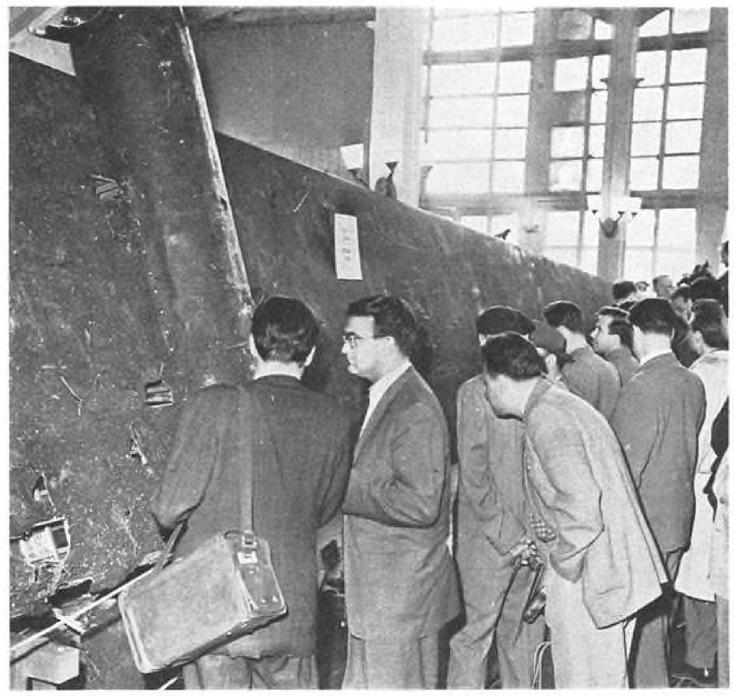
Original Pratt & Whitney J57 engine in the U-2 was replaced by a more powerful J75-P-13 in the aircraft lost over Russia. This number of the J75 was specifically intended for the U-2.

According to Soviet sources, it weighs about 4,850 lb., which is about the same weight as the JT4A-10, a civil version of the J75 which delivers 16,800 lb. thrust at sea level. Military versions of the J75 weigh about 1,000 lb. more than this engine and deliver about 25,000 lb. thrust with afterburner.

Special features of the J75-P-13 in the U-2 include a modified fuel control system to allow for the special fuel, which is denser than that ordinarily used in the J75, and a more powerful ignition system for starting because of low volatility of special U-2 fuel.

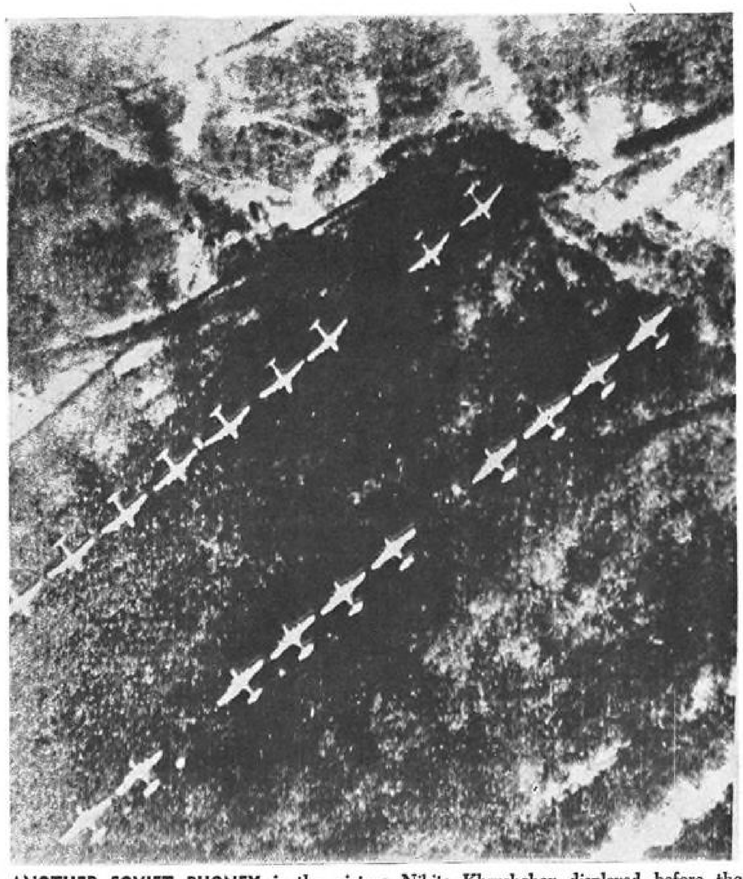
Reconnaissance gear and communications equipment aboard the U-2

BADLY DAMAGED and twisted pilot's ejection seat from the Lockheed U-2 is shown in the foreground above. The cockpit canopy just behind the ejection seat still has a large section of Plexiglas intact and its frame is only slightly twisted.



RIGHT WING of the U-2 has several large holes in its upper surface, and its trailing edge has been broken off. Slipper fuel tank on wing is at left in photo. Both wings apparently were sheared off the fuselage when the U-2 struck the ground.

U-2 PILOT's high-altitude partial pressure suit, helmet, bailout oxygen regulator and parachute were exhibited in Moscow after the U. S. aircraft was downed at Sverdlovsk.



ANOTHER SOVIET PHONEY is the picture Nikita Khrushchev displayed before the Praesidium of the Supreme Soviet in Moscow claiming it came from the U-2 camera on Francis Powers' flight. This picture is actually of a training field near Baku some 900 mi. from the nearest point of Powers' flight route as tracked by the Russian radars. Aircraft on the field are four engine Tu-4 bombers, a copy of the Boeing B-29. This type bomber has not been in first line service with the Red Air Force for many years.

displayed in Moscow was mostly standard military issue and not of special manufacture. Much of the equipment and the U-2 structure displayed in Gorki Park was in relatively good condition, indicating that the aircraft did not disintegrate in the air during its descent over Sverdlovsk and that its impact with the ground was relatively easy.

The communications and reconnaissance equipment included:

- **Sensitive "ferret" receiver** for electromagnetic reconnaissance to record radio/radar transmissions striking the aircraft. This receiver was manufactured by Huggins Laboratories, of Menlo Park, Calif., and it was equipped with two antennas. One of these was type MP 11719, the other MP 12570. The installation taped a record of the frequency and strength of all signals reaching the aircraft so that the information could be examined in detail after the flight.
- **Seven camera windows,** each six to eight inches in diameter, in a section of the fuselage. Camera model 73B was installed in the aircraft with enough film to photograph all of the Russian territory it passed over during its flight of more than 3,000 mi., according to the Soviets. Format size of the photographs made by the camera was 9.5 x 18 in.
- **Astrotracker,** believed to have been made by Kollsman Instrument Corp., was installed in the U-2 to provide a reference to aid in orientating the photographs and other reconnaissance data.
- **Automatic radio direction** finder AN/ARN-6 made by Bendix Aviation.
- **UHF command radio AN/ARC-34** produced by Magnavox, which has 20 preset channels and one guard channel for emergency. Using this radio, the pilot could communicate with another aircraft many hundreds of miles away if they were both at very high altitude. It would be difficult for him to reach a ground station over a thousand miles away with this standard set.
- **Lear autopilot A-10,** which is similar to the lightweight L-5 model the company supplied for the North American F-86.
- **Lear compass system** Type MA-1.
- **Pneumatic starter** for the J75-P-13.
- **Hydraulically-powered,** flap control gearbox.
- **Alternating current** and direct current power sources.

Equipment in the U-2 which the Soviets said was intended for its destruction in the event of an emergency carried a name plate of Beckman and Whitley, Inc. Its assembly number was MDL 175-10A.

Damage to the cockpit section of the U-2 in Gorki Park included the failure of the wheel on the control column and one broken rudder pedal. Six green oxygen bottles were intact

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U-2's International Repercussions

Washington—Soviet Union carried the U-2 incident into the United Nations last week as the aerial espionage issue (AW May 16, p. 26) continued to trigger a series of international repercussions.

Soviet Foreign Minister Andrei A. Gromyko submitted the U-2 affair to the UN and demanded a meeting of the Security Council to stop "the unheard of provocative action of the United States" in sending reconnaissance flights over Russian territory. Request for UN action was the latest in a series of incidents in which:

- Paris summit conference collapsed when Soviet Premier Nikita Khrushchev demanded that the U. S. admit its U-2 intelligence flights are "to be condemned," apologize for them, cancel them and punish those responsible for operating them. President Eisenhower refused to meet the demands.
- Khrushchev insulted President Eisenhower, accusing him of making "treachery the basis of his policy with regard to the Soviet Union" and withdrew the invitation to the President to visit Russia next month in exchange for the Soviet premier's tour of the U. S. last year. Khrushchev also suggested postponing the summit meeting six to eight months—obviously until after the President has left the White House.
- U-2 flight operations were canceled before the summit meeting, although the President decided not to reveal it until the conference met. Making it clear that U-2 operations had been halted as of May 12, President Eisenhower also said he had planned to propose a UN aerial surveillance system similar to the "open skies" proposal made at the last summit meeting in 1955. Russians rejected the proposal then and continue to oppose it.
- Protests were filed by U. S. allies implicated in the U-2 incident. Soviet Union sent notes of protest to Norway, Pakistan and Turkey over their roles in the U-2 flight. Norway sent a protest to the U. S. against the planned use of a Norwegian landing field for the U-2 which came down in Russia and forbade any repetition. Pakistan sent the U. S. a memorandum saying it would "have cause for bitter complaint" if Russian claims that the U-2 took off from Peshawar, Pakistan, are true. In addition, Denmark, which was not implicated in the Soviet U-2 incident, has banned the use of its air field for any unauthorized flights over countries not members of North Atlantic Treaty Organization. Incident also hampered Japanese government efforts to gain Diet approval of the Japan-U. S. Security Pact. U. S. assured Japan that U-2s stationed there (AW May 2, p. 158) had been used strictly for weather research flights.
- Khrushchev admitted the Soviet Union has known of U. S. intelligence flights over its territory for some time when he said he almost brought the subject up during his conversations with President Eisenhower at Camp David during his U. S. visit last fall.
- Soviet Chief Air Marshal K. A. Vershinin postponed a trip to the U. S. planned for him and nine aides because of "unfavorable circumstances."

but somewhat blackened. Pilot's ejection seat was deformed, but the canopy was only slightly bent, with some glass intact.

Pilot Francis G. Powers' helmet had black scuff marks on its top but that was the only visible damage. The pilot's boots were in perfect shape in Gorki Park. His parachute harness had no stains on it, and the chute's orange and white canopy was unsoiled.

Damage to the aircraft structure was heaviest in the center fuselage section where the Soviets claim its air-defense rocket hit. Western observers at Gorki Park say that the rocket, if one actually struck the plane, must have been unarmed or equipped with a light warhead. The wings were sheared off at the roots and trailing edges on both of them were badly torn. Left wing was almost scratchless forward of the trailing edge damage, with the bottom of the slipper tank for fuel on its leading edge flattened. Right wing had jagged holes 8 to 10 in. in dia. on top.

Kiwi Reactor Facility Construction Starts

Jackass Flats, Nev.—Advanced Kiwi reactor for Project Rover nuclear rocket program is scheduled to begin static tests next year. As in the eventual flight propulsion system, the new reactor will use liquid hydrogen as the working fluid.

Air Products, Inc., under a prime engineering contract from the Atomic Energy Commission, has begun construction of the reactor test facility.

This summer, AEC expects to test two reactors in the Kiwi-A Prime series. Like the Kiwi-A reactor that was tested last summer (AW June 29, p. 18), the Prime series reactors are designed to use a gaseous hydrogen working fluid.

Test facility for the more advanced reactor, which may be given the designation Kiwi-B, will have storage units for liquid hydrogen but no production capability. It is expected that the liquid hydrogen will be trucked to the Nevada test site from plants in California, and possibly Florida. Air Force, which has a large liquid hydrogen plant in West Palm Beach, Fla. (AW July 27, p. 28), recently purchased four 7,000-gal. insulated tank trailers that reportedly can carry liquid hydrogen across the country without venting any gas to the atmosphere.

Contractor team for the advanced Kiwi project is expected to follow closely the lineup selected for the Kiwi-A Prime work (AW Feb. 8, p. 64). In addition to Air Products, it will include Edgerton, Germeshausen and Grier, Inc., for control and monitoring instrumentation for test cell and reactor. It is also assumed that ACF Industries, Inc., will be a member of the team.

News Digest

Radio Corp. of America has received a $116,000 Defense Department contract in connection with Advanced Research Projects Agency program to develop positive means for identifying missile warheads from their electromagnetic radiation early in their trajectories. Contract covers automatic data processing of radar data.

Russians proposed a helicopter to India—understood by U. S. sources to be the Mi-4—and the Indian government said it is delaying a decision to hear further details. India, however, is examining a Sikorsky proposal on building the S-62 in India, with the S-62 still the leading contender to fill an Indian requirement for a high-altitude aircraft for troop transport to its northern border area.

Lockheed Electra operators have been ordered by the Federal Aviation Agency to check the elevator controls of the turboprop transport to avert the possibility of in-flight buffeting which caused minor damage to an Eastern Air Lines Electra in a recent flight from St. Louis. FAA spokesmen disclaimed any connection between this incident and Electra midair disintegrations near Buffalo, Tex., and Tell City, Ind.

Maj. Gen. Stanley T. Wray, commander of Air Research and Development Command's Wright Air Development Division, will move to the Pentagon in July as director of the Personnel Council in the Office of the Secretary. He will be replaced by Maj. Gen. Joseph R. Holzapple, now director of Systems Management at WADD. Holzapple will be replaced in August by Brig. Gen. Allman T. Culbertson, now vice commander at the Missile Development Center, Holloman AFB, N. M.

TWA-Northeast Merger Sparks Debate

First in expected series of airline requests draws varied reaction; opposition to the plan expected.

By L. L. Doty

Washington—First of a series of mergers which top airline managements are convinced will be touched off by mounting competition in major air travel markets was proposed last week by Northeast Airlines and Trans World Airlines.

Industry reaction to the merger proposal, which has been rumored in industry circles for at least a year but which was actually resolved within the past few weeks, ranged from violent opposition to passive acceptance of the inevitable. Both National Airlines and Eastern Air Lines can be expected to put up a vigorous fight against the strengthening of a competitor on the already hotly competitive New York-Miami route (AW Jan. 18, p. 36).

Other carriers view the proposal as an inescapable result of rising costs, multiple competition on major routes and an expanding volume of available seat miles. Airline heads have been warning with increasing intensity that, because of these factors, survival of some carriers beyond 1961 is highly questionable (AW Dec. 28, p. 26).

Here are typical examples of how the industry now stands on mergers:

• **C. R. Smith,** president of American Airlines, is not talking mergers with any company. Smith, however, feels that some mergers are essential to the fiscal health of the industry and has called upon business and government to encourage route/service rearrangements.

• **David H. Baker,** president of Capital Airlines, will seek a merger—probably with an eastern regional-type carrier—once the pressing problems brought about by Vickers-Armstrongs foreclosure proceedings against it are resolved (AW Mar. 9, p. 39). Baker said objective of merger would be to lengthen traffic hauls, reduce operating expenses and improve financial structure.

• **Robert F. Six,** president of Continental Air Lines, admits the need of mergers within the industry but emphasizes that his company has laid out its long-term financial planning in such a way that, when the time comes for Continental to consider a merger, it will be in a position to dictate terms rather than be forced to accept acquisition.

• **Charles E. Beard,** Braniff Airways president, says bluntly that "we are not seeking a merger, have not been approached by another airline for merger."

• **C. E. Woolman,** president of Delta Air Lines, sees no need for a merger so far as his carrier is concerned. Woolman, who directs his airline with a highly conservative management policy, feels his company is equipped to weather any unusual competitive pressures and increased seat capacity without resorting to mergers for relief.

• **E. V. Rickenbacker,** Eastern Air Lines board chairman, has said he is interested in a merger if it would bring increased earning power and leadership. He said, "if we can get both, we're interested and we might be willing to let the other fellow take the lead" (AW May 16, p. 45).

• **George T. Baker,** National Airlines president, has no specific merger plans. Baker is strongly opposed to the proposed Northeast-TWA merger and told AVIATION WEEK that the "CAB gave Northeast a Florida route so that it could get off subsidy, not so it could go on sale."

• **Donald W. Nyrop,** Northwest Airlines president, is interested in acquiring a company when it will "benefit" Northwest. He is not interested in merging with Capital, squashing a rumor that has been perisistently circulated within the industry during the past three months.

• **Terrell C. Drinkwater,** Western Air Lines president, feels that traffic growth potential in the far west traffic areas, where the carrier's operation is heavily concentrated, will remain sufficiently strong during the next few years to obviate any need for merger talks with other carriers. Drinkwater's conservative management programs coupled with a strong financial condition apparently eliminate Western as a merger candidate at this time.

The proposed Northeast-TWA merger will require approval of stockholders of both companies, senior creditors, Securities and Exchange Commission and the Civil Aeronautics Board. It is quite possible that the Justice Department will review the proposal.

Each company is owned by a single majority stockholder: Atlas Corp. controls 56% of Northeast's outstanding common stock and Hughes Tool Co., which is solely owned by Howard Hughes, controls 79% of TWA's common stock. Hughes also has an approximate 10% interest in Atlas.

Under a Civil Aeronautics Board order issued in August, 1958, Hughes' Atlas stock is held in trust under which Hughes has relinquished his voting rights to a trustee. The order also requires that Hughes may not "hold an officership or directorship in Atlas Corp. as long as Mr. Hughes has control of Trans World Airlines and Atlas controls Northeast Airlines."

Floyd B. Odlum, founder of the Atlas Corp., an investment company with $93 million in assets, retired last week as chairman and chief executive of the organization. He will be succeeded by David A. Stretch who is also chairman of the board of Northeast.

Since the Northeast-TWA proposed merger calls for an exchange of three shares of Northeast common stock for one share of TWA stock, Atlas will lose its position as a majority stockholder in any airline if the merger is approved. Although Odlum's retirement apparently had no connection with the merger, he did note that "I now feel free to retire" since arrangements for re-equipping Northeast with jet transports and additional financing for the airline have been "completed."

James W. Austin, president of Northeast, told AVIATION WEEK that the carrier's board of directors approved the merger proposal last week "in principle" and added that the "thinking" of the Northeast board on the proposal has been submitted to the TWA board for consideration. The TWA directors are expected to act on the merger plan at the next regular board meeting late in June.

If approved, the plan then goes to the stockholders for their consideration. A majority of the non-Hughes common stockholders, about 22% of the TWA stock outstanding, must vote in favor of the merger if it is to be approved.

Austin expects strong opposition to the merger plan from many quarters and forecast a "real Donnybrook" before the case is finished. He said that no decision in this stage of planning has been reached as to what slots he and his officers will fill in the merged organization.

National Airlines has already petitioned the CAB to cancel or suspend Northeast's temporary New York-Florida certificate which comes up for renewal in November, 1961. Immediately following the announcement of the proposed merger, National's president, George T. Baker, said that approval of the merger "would serve only to compound the critical weakness of the New York-Florida route structure and thereby invite heavy subsidies or financial collapse for carriers in this market." Other trunklines serving the Florida market—seven in all—undoubtedly will join in protesting the Northeast-TWA plan.

Major factor in the case will be the CAB, which must bear the responsibility of making a decision that will undoubtedly be accepted by industry as precedent. Recent statements by Board members have suggested that proposed mergers will get a cordial reception, and a large number of industry observers feel that the Board will act favorably in the TWA-Northeast case as one means of helping to cure the financial illness of the industry.

The fact remains, however, that competition in the East Coast-Florida market is so strong that the three competing companies—Eastern, National and Northeast—have been either operating in the red or at marginal profit levels during the past year. In addition, the Florida vacation market has recently shown signs of losing some of its former strength, and a number of observers feel that it has held up this year only because political unrest in Cuba has discouraged Caribbean tourist travel (see p. 47) which would have diverted a number of vacationists from Florida resort areas.

Since 1943, CAB has reviewed 20 merger proposals and approved 10. Northeast has been involved in two of these: a proposed merger with Capital in 1945 and one with Wiggins in 1948, both of which were denied by the Board. TWA has not been involved in any merger negotiations that reached the CAB approval stage since 1943. TWA acquired Marquette Airlines in 1940.

Northeast 1959 Loss

Northeast last year showed a net loss totaling approximately $7 million, although passenger revenues increased 30% over 1958 and revenue passenger miles climbed 27% over the previous year.

TWA's total 1959 revenues were 22% above those of 1958, and the net profit for the year was $9.4 million, second highest in the company's history. The company will report a net loss of $6.8 million in the first quarter of the year (AW May 2, p. 26).

Northeast has concluded arrangements for the lease of six Convair 880 jet transports from General Dynamics Corp. and General Electric Co., which manufactures the transport's CJ-805-3 powerplants. The aircraft are a part of the 30 880 transports ordered by Hughes Tool Co. for use by TWA.

In addition, Hughes Tool Co. will lend Northeast up to $9.5 million for integration of the turbojets into its fleet, spare parts and working capital. Austin said the six Convairs will be in service on the Florida route before the winter season begins. The airline will continue to operate the one Boeing 707-331 it leases from TWA.

Twenty Convair 880s will go into service on TWA routes this summer. At present, TWA is operating 15 Boeing 707-120s and nine 707-331s on domestic and international routes in addition to the 166 piston-engine transports in the carrier's fleet.

Howard Hughes recently undertook a $340 million financing program for TWA to cover purchases of jet equipment. Of this, $190 million will be provided by insurance companies and bank groups with the balance coming from $100 million in subordinated debentures to be offered stockholders and $50 million from Hughes, if required.

As of Dec. 31, TWA had 6.7 million shares of common stock outstanding. Under the new financing program, the company is increasing the number of authorized shares from 10 million to 15 million. Northeast had 1.9 million shares of an authorized 3 million outstanding as of Dec. 31. In addition to the 996,226 shares it holds, Atlas also owns $12.2 million of Northeast subordinated demand notes.

The merger would result in a very slight duplication of routes in the new system so that little or no present competition would be eliminated, a fact that the CAB would look upon with favor. Charles Thomas, TWA president, said that, under present plans, all routes would be absorbed, including Northeast's local service-type routes in northern New England.

Capital Board Shifts

Washington—Capital Airlines last week voted major changes in its board of directors as a first step toward making revisions in its top-level management structure which it hopes will ease the pressure from Vickers-Armstrongs for immediate payment of some $33 million in outstanding indebtedness (AW May 9, p. 39).

Under the changes, Charles H. Murchison, whose 80,000 shares of stock represent the largest single holdings in the company and who recently made an unsuccessful bid for the board chairmanship, was dropped as chairman of the board's executive committee. He will be replaced by Arthur F. Kroeger, a board member for several years. Murchison will remain as a board member.

In addition, Capital's contract with Murchison's law firm—Adair, Ulmer Murchison, Kent and Ashby—as general counsel for the company has been terminated. Thomas D. Neelands, Jr., former Capital board member and New York investment banker, was named chairman of the board.

The revamped board breaks a deadlock that has blocked the carrier from making various changes in management which Vickers has felt are necessary to get the company back on its feet.

Delta Convair 880 Service

Delta Air Lines last week became the first airline to place the Convair 880 turbojet transport into scheduled service, with the inauguration of regular flights between New York-New Orleans, Atlanta and Houston. Service will be extended between Dallas and Atlanta on May 29 and between Chicago and Houston on June 1. By fall, the airline will have all 10 of the 880s it has ordered in scheduled operation. The aircraft is powered by four General Electric 11,200-lb.-thrust CJ-805-3 turbojet engines, the first GE powerplant to operate in commercial scheduled service.

Support Urged for Supersonic Transport

By Ford Eastman

Washington—Top government civilian and military officials last week urged federal financial support to the development of a supersonic commercial transport and said continual development of the Air Force-North American B-70 Mach 3 bomber is "vital" to the program.

The officials, testifying before the House Committee on Science and Astronautics investigating the problems connected with the development of a supersonic transport, included Elwood Quesada, administrator of the Federal Aviation Agency; Maj. Gen. V. R. Haugen, Air Force director of development and planning; Ira H. Abbott, director of advanced research programs for National Aeronautics and Space Administration, and John Adams, associate director of the Civil Aeronautics Board's Bureau of Air Operations.

Quesada told the committee it would require approximately $500 million to build a prototype Mach 3 transport suitable for commercial operations even after drawing heavily from the knowledge gained from the development of the B-70. Other witnesses estimated that the cost would range from $250 million to $1 billion, a burden too heavy for one manufacturer, or a group of manufacturers, to bear alone.

B-70 Need

Key factor in development of a supersonic transport is continued progress in the development of the B-70, Quesada said. "Without it," he added, "development of a commercial supersonic transport is hopeless."

While the B-70 could not be converted into a suitable commercial transport, Quesada said development and testing of the bomber will supply the answer to "many questions needed before a commercial transport can be built."

FAA and NASA are conducting a joint program to identify and solve the basic problems of developing a money-making supersonic transport (AW May 2, p. 60).

In the past, Quesada pointed out, commercial transport aircraft have largely had their basis in a military counterpart already in being, or at least from prior military development of powerplants or major components.

"In the supersonic field," he said, "there is no advanced military airplane configuration easily adaptable to conversion for civil transport use. Hence, there is a very real prospect that, unless some new approach is taken toward development of a supersonic transport, further progress toward such a civil aircraft may not take place."

Quesada suggested that the best approach to the problem is that the responsibility for the development should be assumed by industry, with the government furnishing coordination, financial support and specifications for the aircraft, which also would have military value.

He said the development should be undertaken by an industry team rather than by a single company, although manufacture of the aircraft probably would be carried out by one firm since less than 200 aircraft would fulfill airline requirements throughout the world.

Competition, he said, should be confined to design competition between manufacturers and, once the design has been selected, only that version of the prototype should be produced in hardware form.

Recovering Costs

Quesada also said he felt the government should be able to recover a portion of its financial support by placing a royalty on each aircraft sold commercially (see box), much in the same manner as the British government recovered the cost of developing the Vickers Viscount turboprop transport. This also was suggested by Robert F. Six, Continental Air Lines president, in a letter to Committee Chairman Overton Brooks (D.-La.).

Gen. Haugen said the Air Force considers development of a supersonic transport to be technically feasible and a "desirable national objective" and that it should be undertaken as a national effort, combining the resources and talents of many government agencies and industry.

The best approach to building a commercial transport, he said, is by the way of an off-shoot of the B-70 prototype development. To design and build a supersonic transport from the ground up, he said, would result in an operational aircraft by 1968 or 1970, but it would be difficult to support the expense involved.

"We have already expended almost three years of development effort and some $350 million on the B-70 program," Gen. Haugen said. "By reason of this effort, we are already far along the path that must be followed to develop a transport capability."

Additional Prototype

Gen. Haugen suggested that, while the B-70 is "admittedly not optimized for a transport," an additional prototype vehicle could be configured to carry approximately 100 passengers and used to obtain the data necessary for the final design and operation of an efficient transport. When the B-70 developments confirm the utility of a transport configuration, he added, a prototype vehicle could be brought in service within a short time and with relative modest funding when compared with the system approach.

John Adams, speaking for the CAB, said it is certain that a supersonic transport will be developed and will appear on commercial routes, probably within the next decade. He added that there is an "overriding necessity" that such an aircraft be of U. S. design and manufacture. He told the committee:

"If our country were to stand by and permit another country to step into the American position of prominence in the field of aircraft manufacture, it would be a tremendous blow both to the prestige and the economic stability of the American aircraft manufacturing industry."

With estimates of the cost of developing such a plane ranging from $250 million to $1 billion, he said it is obvious that full financing is beyond the capability of one or a group of companies, and that some form of government assistance will be necessary. Adams also told the committee:

• **"The tremendous speed** of the aircraft, if accompanied by proper navigational aids and ground handling equipment, would be such that airlines with long distance routes could operate those routes with about one-third of the equipment needed to operate current jet equipment.

• **"The high cost** of the aircraft (estimated at $12 to $25 million), together with its tremendous capabilities, could very well mean that many carriers would have to utilize interchange agreements in order to get sufficient utilization to warrant the investment itself.

• **"Manufacturers** to whom board representatives have talked speculate that no manufacturer could build the aircraft without initial orders for between 40 and 80 aircraft, and most of them assume that, in order to be profitable, whichever manufacturer gets the initial order probably will have to manufacture all the aircraft which are built, although some concede that perhaps two manufacturers, each capturing about half the business, might build the aircraft profitably.

• **"The economic cruising altitude** would require the aircraft to fly so high (55,000 to 75,000 ft.) that economic utilization would be improbable at distances of less than 1,200 to 1,800 mi. Consequently, carriers serving essentially medium haul routes probably would not be able economically to use the aircraft."

Ira Abbott, in urging government financial support in the development program, said that, while NASA is proceeding with research, "the time has now arrived when research by itself is not enough if progress is to be made at the rate that is technically possible. A concerted effort by the government and industry design teams is needed to bring the problems into focus and perspective, and to enlist the talents and resources essential to such a difficult task."

Design Criteria

In designing the supersonic transport, Abbott said the following requirements must be met:

• **"Fuselage volume** must be larger than that of the supersonic bomber to accommodate the passengers.

• **"Each airplane** should have a long operating life of many thousands of hours of flight to be economical.

• **"The airplane must be compatible** with the airports from which it is expected to operate and with the traffic control system that can be brought into existence at the time the airplane goes into service.

• **"The airplane must be socially** acceptable in the sense that it must not cause undue noise at or in the vicinity of the airport or over the routes it will be flown.

• **"Safety requirements** are even more stringent than for the bomber and more difficult to realize.

• **"The airplane should have** substantial growth potential to avoid large later developmental costs to achieve increased performance and to avoid the difficulties of bringing another completely new airplane into operation."

Stuart G. Tipton, president of the Air Transport Assn., also urged government financial support of the supersonic transport development program. "It is clear that neither the manufacturers nor the airlines are able to finance such an undertaking," he said.

In urging that the U. S. take prompt action, Tipton told the committee that "whoever does build a good supersonic transport will be in a position to dominate the air routes of the world, and its factories will have an unchallenged project for export."

New Engine

J. B. Montgomery, general manager of General Electric Co.'s Flight Propulsion Division, told the committee that a "new type jet engine, capable of powering military and commercial transport aircraft efficiently and reliably at speeds of up to 2,000 mph., can be produced whenever it is needed."

The new type powerplant, he said, would be equipped to burn fuel in the exhaust of a fan mounted directly behind the basic jet engine. It is possible to add this aft-fan component to an engine such as GE's J93 engine which has been selected to power the B-70, Montgomery said.

FAA Royalty Plan

Washington—Provisions that would require manufacturers to pay the government a royalty on articles sold commercially and originally developed for government use with federal funds are now being negotiated in research and development contracts let by the Federal Aviation Agency.

FAA Administrator Elwood Quesada said the royalties amount to about 6 or 7% of the selling price. "When the government furnishes the funds to develop a product," he said, "it seems only fair for the government to receive a reasonable percentage of the cost in return when the product goes into commerce."

Military F-27 Proposed

Washington—Fairchild Engine and Airplane Corp., has proposed a military version of its F-27 turboprop transport to the Defense Department for immediate production. Price range is quoted at between $800,000 and $1 million.

Its design would be based primarily on a M-258G model now in use by Northern Consolidated Airlines. It can be offered with rear loading and STOL performance, Fairchild says.

Maximum gross weight quoted for the military designs was 38,500 lb., permitting payloads of up to six tons. STOL versions could take off with a ground roll of 560 ft. at a gross takeoff weight of 34,000 lb. and carry a payload of 6,000 lb. over a 250 naut. mi. range, according to Fairchild.

Aircraft would be powered by two Rolls-Royce 2,500 eshp. Dart 8 turboprops.

FAA to Review Engineer Rules

Washington — Initial action that could lead to a settlement of the current crew complement issue between the Air Line Pilots Assn. and the Flight Engineers International Assn. was taken by the Federal Aviation Agency last week.

Noting that it has been approximately 12 years since public hearings that resulted in regulations requiring the addition of flight engineers to many classes of airline aircraft, FAA issued a notice of conference calling for a review of flight engineer requirements. Comments from the industry on the notice are due by May 29, and the conference is planned for June 6, 7 and 8.

Primary reason for the conference is to determine whether the current flight engineer regulations are adequate for flight safety for turbine aircraft operations, FAA said.

Scope of the planned talks will cover a variety of questions involving details such as which aircraft, including current and planned models, should carry flight engineers; the proper placement of engineer control panels and the duties, and training and certification of flight engineers.

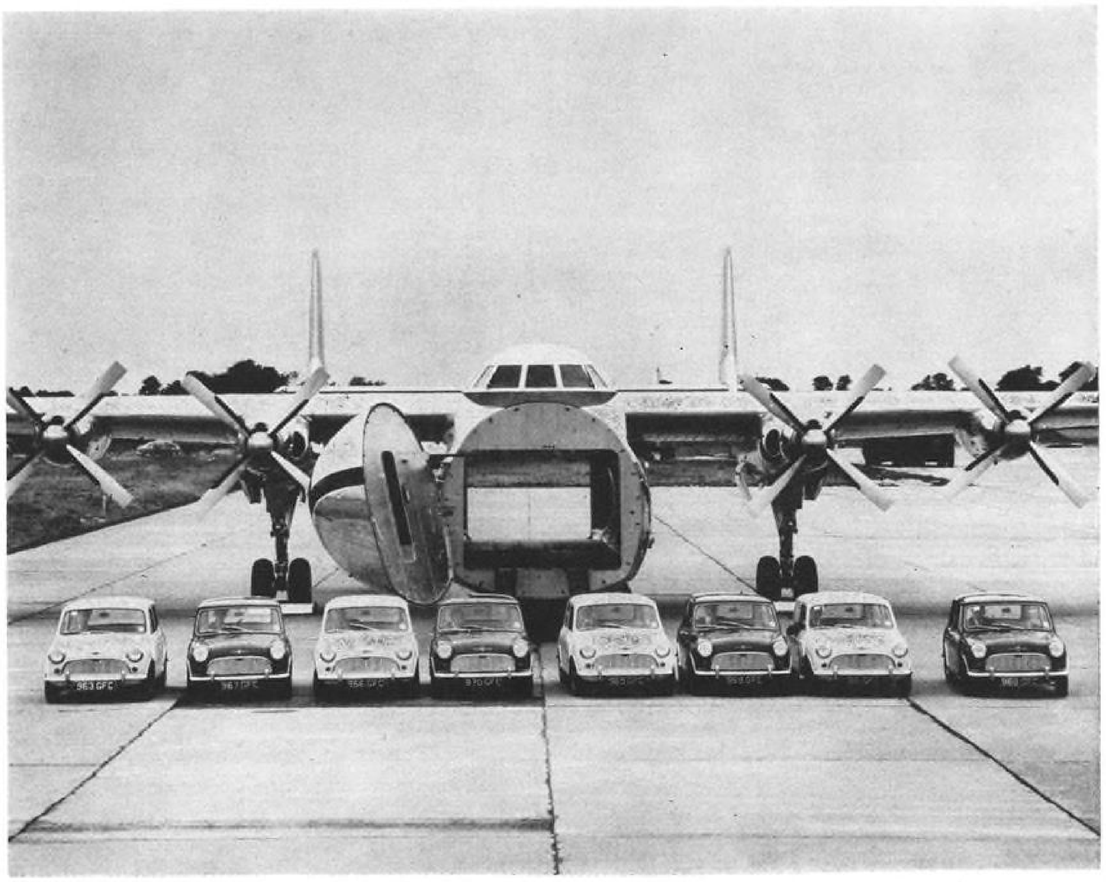
Proposed overhaul of the present regulations requiring flight engineers, based upon aircraft weight, is aimed at clarifying much of the conflict between regulations governing domestic and international operations and airworthiness regulations governing type certifications.

Essentially, present FAA regulations require a flight engineer on all four-engine aircraft certificated for more than 80,000 lb. and others certificated for 30,000 lb., or over, when found necessary by the administrator. Other sections of the Civil Air Regulations contain the same requirements but stipulate that the 30,000 lb. rule applies to all four-engine aircraft, while airworthiness regulations require the minimum crew to be selected according to crew workload rather than aircraft weight.

Present Regulations

Industry observers point out that these regulations fail to cover the crew complement question on such aircraft as the twin-jet Sud Caravelle, which has been certificated for a maximum takeoff weight of 110,000 lb. FAA says its problem will be to determine whether it should make its requirements identical for all aviation segments and also clarify the rule to include "practical and realistic" provisions from two-engine aircraft. At the same time, the agency said it will consider incorporating the weight requirements into the airworthiness regulations.

In connection with this requirement, FAA wants to undertake a detailed study of flight engineer duties tailored to the question of what cockpit instruments should be accessible to this crew member in order to comply with airworthiness regulations calling for such controls to be positioned for convenient operation and avoidance of confusion.



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Airlines Ask Airports to Balance Costs

By Glenn Garrison

New York—Airport executives were asked last week not to "kill the goose that lays the golden egg" by expecting airlines to pay more than they should of the costs of airport construction and operation.

Robert E. Peach, president of Mohawk Airlines, asked members attending the annual conference here of the American Assn. of Airport Executives to exercise a degree of caution in not killing the "goose." "I'm just suggesting that there is an increasing tendency to expect more and more of the goose," Peach said during a lively question-and-answer sequel to addresses by a panel of four airline presidents.

Malcom A. MacIntyre, president of Eastern Air Lines, was the panel's trunkline representative. In addition to Peach, local service presidents who participated were Gwin F. Hicks of Lake Central Airlines and R. Earl McKaughan of Trans-Texas Airways.

MacIntyre described airlines and airport operators as "joint venturers," but said airlines could hardly be expected to pay on a "cost-plus" basis for airport operation. Carriers, he said, have no way of ensuring efficient low-cost operation by the airport officials.

The Eastern official called for volume discounts in charges to airlines with high-frequency service.

Expansion Risks

Both airports and airlines should share the risks of expansion, according to MacIntyre. Airports don't provide guaranteed payloads to the carriers, and perhaps both should be prepared to face deficits in the first few years of a cycle of fleet and airport expansion.

MacIntyre was asked how trunklines regarded the future of non-hub airports where the trunks have been eliminating some schedules. Eastern, MacIntyre said, is somewhat different than most trunks in that it is to some degree also a local service carrier, with a policy geared to connections within its system. It will continue to offer service to non-hub cities except possibly a few "peripheral places."

Eastern's equipment program — "which we're bringing to a head"—will consider such service, MacIntyre said, "but we're not in any expansion mood as far as service to local points is concerned."

Regarding future use of smaller jets not only at small airports but with increased frequencies at larger airports, the Eastern official said the frequency question has to some extent been overlooked. There will be a shift, he predicted, and more aircraft of the Caravelle size will be built in the future.

Among the airline complaints was alleged failure on the part of airport officials to consult the carriers about plans for costly expansion projects. When a city undertakes its planning, McKaughan said, the airlines are the last to be consulted, "usually after plans have been firmed up." Many cities, the Trans-Texas official said, use the advice of an airport consultant and not the carriers to determine expansion requirements.

However, the airlines have not always met their responsibility in this area by assigning enough personnel to assist in airport planning or by offering substitute plans, McKaughan said.

Outgoing AAAE president Edward L. Colby of Lubbock, Tex., told AVIATION WEEK that the airport operators would welcome more carrier participation in planning, giving the airlines a voice in what they will occupy and use "before it's a fait accompli."

But it has been a problem in the past, Colby said, to get the airlines to participate or to enter the discussions early enough. One recent problem the airlines have encountered in this regard, he said, is that of several airport programs spreading carrier technical personnel somewhat thin and making it more difficult for them to participate in individual programs.

Agreeing with the desirability of greater airline participation in airport planning, incoming AAAE President G. Edwin Petro of Indianapolis added a reservation. Many carriers, he said, hesitate to specify as much as they really will need because of the money involved. Their planning advice, therefore, may err on the side of too little in terminal space and the like.

Also, where several airlines are involved, it can be difficult to achieve unanimity in what they believe will be required, according to Petro.

Colby noted the complex of organizations involved in airport planning, including local, state, and federal agencies. However, he said, it is the basic responsibility of the airport operator to make the final decision within his fiscal limits.

Some airlines, Colby said, contend that their airport user costs have increased more heavily than other expenses, and complain that they pay more than their fair share of the airport costs. This may be explained, Colby suggested, by the fact that many cities in their early stages of airport operation offered very low rates to attract airlines. These rates carried through long-term leases and in many cases only recently have been adjusted to more realistic levels, in Colby's view.

Regarding this point, MacIntyre told AVIATION WEEK that in many cases there might not have been airports unless the airlines originally had put up the money for such items as hangars, which were built with prepaid rentals.

As to participation in planning, MacIntyre said, airlines had not always been responsive enough. Planning is a two-way street, too, he pointed out, and the carriers could provide the airport planners with more information about future schedules and the like to work out mutual requirements.

Fare Increase Debated

In the panel discussion, the local service carriers split on whether a fare increase would price them out of the market. McKaughan felt that if fares went much higher, Trans-Texas would lose business to a major competitor—the automobile. But Peach held that over Mohawk's routes—which differ from those of the Texas carrier in that they serve high density markets where highway connections are congested—it would benefit strongly by an increase, which might cut subsidy needs in half. Peach said he has never heard a passenger complain about the fare. Hicks concurred with Peach, and said a 17% increase on an $11 average Lake Central fare would not discourage business.

The AAAE members at another session heard Ira H. Abbott, director, Office of Advanced Research Programs, National Aeronautics and Space Administration, say that the U.S. could have supersonic jet transports within about 10 years. NASA, he said, is deeply involved in research on a Mach 2 commercial transport.

Runway requirements for the supersonic transport are difficult to pin down now, Abbott said, but one study of a four-turbofan, 100-passenger design indicated that it could take off in less than 10,000 ft. But runways and taxi strips will require considerable reinforcement and smoothing out.

Construction of a supersonic transport will be more difficult than building the B-70, the NASA official predicted. One reason is the additional space, and hence width of fuselage, needed for passengers and baggage. Choosing the right size will be critical.

How much of NASA's work is directed toward aeronautics and how much toward space flight, Abbott said, is impossible to determine, because there is no clear dividing line. For example, research in heat resistant metals might result in applications in both areas.

Boyd Foresees Stiffer Route Policies

New York—Civil Aeronautics Board is likely to adopt more stringent standards for approval of new route awards to airlines, CAB Member Alan S. Boyd told the National Federation of Financial Analysts Societies here last week.

Boyd explained that he meant stringent in the sense of legal proof. In some civil cases, he said, a preponderance of proof is sufficient to win; in others it must be clear and convincing, and in criminal cases evidence must be beyond a reasonable doubt. Thus the Board, he said, is likely to insist on a greater degree of proof—clear and convincing evidence rather than a preponderance with which past policy might be compared (AW May 2, p. 38).

"By more stringency," Boyd added, "I don't mean more senators coming in to testify or more Chambers of Commerce coming in with useless statistics and fouling up the record beyond repair.

"The pole star of government policy should be vigorous but sane competition. Mergers can be of some assistance. If legally and practically feasible, a realignment of routes through suspensions and/or redistribution can be helpful. Technical progress would have made this necessary in any event."

Competition itself is not the root of airline troubles, Boyd said. The statute requires competition, and if there is not vigorous competition, the Department of Justice can enter the picture. But, he added, there can be vigorous competition without having nine carriers operating between two cities.

Boyd took part in a discussion of airlines with Albert H. Gordon, senior partner, Kidder, Peabody & Co., representing the financial community viewpoint, and Stuart G. Tipton, president of the Air Transport Assn., as an airline spokesman.

Both Gordon and Boyd agreed, though not in degree, that airline management bore some share of the responsibility for what airline managements complain of as excessive route authorizations. Both made the point that all the routes in service today had been aggressively sought by the operators themselves. But Gordon added this criticism of airline management:

". . . When I testified before the CAB in the General Passenger Fare Investigation matter, I was shocked by the evident indifference which appeared to exist on the part of top management in this important proceeding. Only one airline had a senior officer continuously in attendance supervising the preparation and presentation of his company's case.

"Now surely we would think that an issue as vital as the rate structure of the industry could command concentrated attention of top management. Certainly that has been my observation in the public utility field."

The closest any of the three came to becoming openly nettled was over a comment made by Boyd on luxury services aboard airlines.

"Of what benefit is 'free' champagne when the flight is late and the passenger must wait 30 min. for his baggage?" Boyd asked. "Most airline passengers realize that champagne, fresh flowers and meals catered by restaurants recommended by Duncan Hines are not gifts of the airline.

"It strikes me that industry has jumped on a merry-go-round in trying to provide extras which add to the cost of passage, do nothing to the speed and add little to the passengers' comfort. A more utilitarian system of passenger handling with such savings as might result could be one way to fill more of the available capacity and increase profitability."

Gordon—who had noted that in the face of a 243% increase in operating revenues over the last decade airline net earnings had risen only 94% at the same time—said in reply: "In spite of what Mr. Boyd said, I doubt if that money has gone into champagne and flowers."

Boyd emphasized the Board's own concern with the financial health of the airlines—if there is any collapse, he said, Washington would feel the blast of complaint first. He placed the burden on airline management to find imaginative solutions to financial problems, and singled out approaches such as in-flight ticketing and no-reservation flights at reduced prices as good examples of this.

On the other hand, Gordon stressed the flight of capital from the airlines and asserted that a good deal of the responsibility for this rests with the CAB.

Airlines ought to have appeal to the institutional and individual investors, since they epitomize technological progress and expansion. But a compilation of 67 investment management groups he cited shows instead substantial liquidation of airline holdings by trusts which held such shares. Eight funds sold a total of 131,300 shares of American Airlines, for example, five selling out their positions completely. There were heavy sales in Braniff, Pan American and Eastern, and in the latter only was there a large purchase to approximately match the sales.

"It is an astounding fact," he said, "that with the exception of Northeast —selling at $5 a share—the common stocks of every trunk airline at a very recent compilation were selling at discounts to their book values. Discount disparities have, at one time or another, appeared among individual airline issues but there was always a handful of air transport equities which commanded premiums over book values."

By contrast, not one of 115 electric utility common stocks available in the market sells below book value. As a practical financing matter it is virtually essential that the market price of the equity of any company sell at a premium over the book value for a sustained period of time.

In 1956 and 1957 when serious analysts saw no solid basis on which to recommend airline equities (AW Oct. 6, 1958, p. 49), Gordon said, some astute speculators surmised that conditions in the industry were so bad they couldn't get worse and made commitments in the group that produced profits when airline stocks rose in 1958 and 1959. Since then, airlines have lost even those limited gains and returned to their former low levels.

"This performance may be enough," he said, "to discourage even the breed of astute, hardy speculators who bought at the lows of a few years ago. Certainly if the airlines rely on attracting equity capital primarily on the basis that conditions in the industry are so bad that they can't become any worse, they are leaning on a weak reed."

Multiplicity of competition in many markets over the same routes has been a failure, Gordon asserted, and a complete overhaul of the U. S. airline system is necessary. Route realignments, mergers, suspensions and consolidations will be essential, he felt, if airlines are to reach their fullest potentials.

In connection with suspensions, Boyd replied to a question that the Board's legal department felt that the Board could suspend any carrier on any route, but that revocation legally would be extremely difficult if not impossible. Thus far, he said, he did not believe the Board had ever exercised its powers of suspension except on request of the carrier.

Changes in Fund Airline Holdings

The following table, compiled by E. F. Hutton & Co. and based on the portfolios of 42 leading investment trusts, shows first quarter changes in airline holdings:

Purchases				Sales		
Fund	Bought	Now Held	Airline	Fund	Sold	Now Held
Financial Industrial Fund	13,000	56,000	American Airlines	Bullock Fund	1,100*	—
				Dividend Shares	15,200*	—
				Dreyfus Fund	9,000*	—
				Eaton & Howard Stock	15,000*	—
				Investment Trust of Boston	7,000*	—
				Madison Fund	10,000	40,000
			Braniff Airways	Dreyfus Fund	1,500	8,500
			Delta Air Lines	Dreyfus Fund	6,900	11,100
Delaware Fund	10,000	40,000	Eastern Air Lines	Eaton & Howard Stock	13,460	4,900
Institutional Growth Fund	2,000	22,000				
			KLM Royal Dutch Airlines	Madison Fund	6,400*	—
			Northwest Airlines	Bullock Fund	400*	—
			Pan American World Airways	Investment Trust of Boston	10,000*	—
				Lehman Corporation	30,000*	—
			United Air Lines	Madison Fund	2,800	28,200

* Complete Elimination

Western Air Lines' 707 Shows Modified Tail

Western Air Lines' Boeing 707-120 shows addition of ventral fin and extension of vertical tail by 3 ft. The Western aircraft is the first domestic 707 to be delivered with the new tail configuration. First WAL 707 is scheduled to begin operations in June.

Boyd's Merger Views

No speedy action can be expected as a rule on airline mergers or consolidations because of the lengthy process required to deal with interveners, CAB Member Alan Boyd believes.

Where no interveners have appeared, the Board has had a respectable record, he said, but it will be difficult to find many cases where at least one carrier will not feel its interests are affected.

"Due process requires that the issues be fully aired and each intervener have his day before the Board," Boyd said. "Certain critics might like to eliminate the Board, but they cannot eliminate due process."

As to the encouragement of mergers, Boyd said the Board's authority in this area is negative, that is, it cannot issue an order without making certain findings dealing with public interest, restraint of trade, etc.

"This does not provide the Board with a very big stick," he said. "It should certainly convince anyone that the Board cannot force a merger or consolidation . . . It is entirely possible that a series of mergers or consolidations might be beneficial to the trunkline industry and in the public interest. There is nothing in the Federal Aviation Act provided for the sanctity of existing corporate enterprises."

British May Restrict Caravelle Night Flights

London—Swissair and Scandinavian Airlines System have been warned by the British government that permission for their proposed night flights from London Airport with Caravelles depends on the result of noise tests.

Minister of Aviation Duncan Sandys said the two airlines had "taken a chance" in announcing specific dates for commencement of these services (Swissair May 24, SAS June 2). "They have been warned," continued Sandys, "it is quite likely that no decision will have been reached by the time these services are due to begin."

Sandys acknowledged as "a very relevant consideration" the possibility that if Caravelles were banned at night from London, Zurich might similarly restrict the Comet, but a Swissair spokesman said that reciprocal action was "most unlikely."

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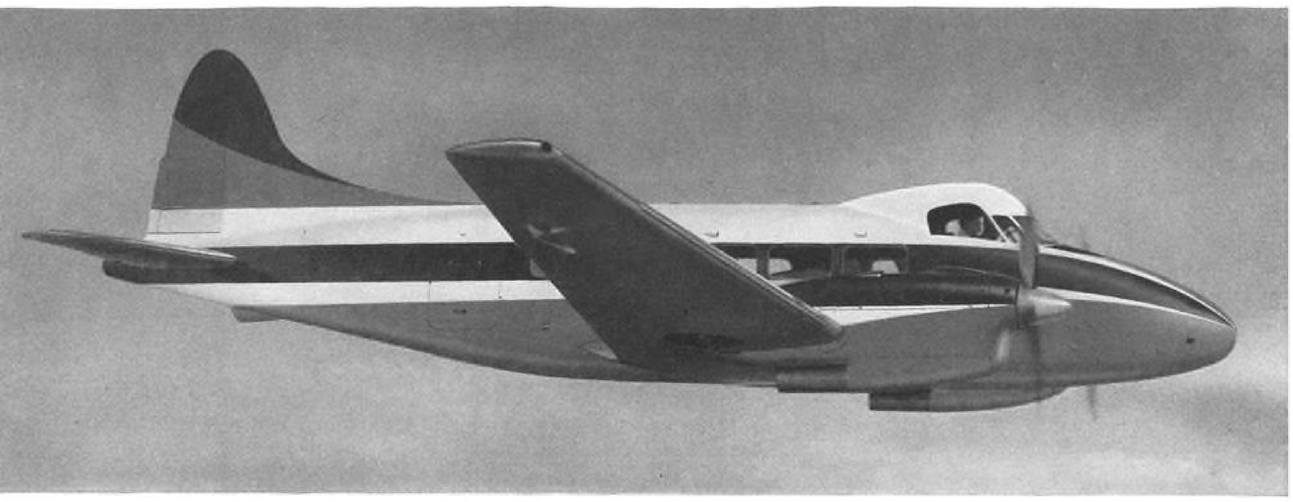

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Schedules Cut as Traffic to Cuba Drops

By David H. Hoffman

Faced with rapid fall-offs in tourist traffic, U.S. airlines operating into Havana, Cuba, have slashed their schedules, thus diverting an increased proportion of a dwindling passenger flow to Cuban flag carriers.

Despite this diversion and a series of promotions last winter in which the Cuban government indirectly subsidized airline travel to Havana, the largest of the Cuban carriers—Compania Cubana de Aviacion, S. A.—was hard hit by falling load factors.

Last May, Cubana, along with six other airlines and airport companies, was seized by the Cuban government. Operational control of the carrier was given to the ministry established to recover property obtained by officials of former President Batista's administration through the use of Cuban treasury funds. Since then, actual management of the airline has been entrusted to a government-appointed intervenor.

Still nominally a private company, Cubana has postponed its commitment to purchase two Boeing 707-120s. These aircraft, in Cubana configurations, were leased to Western Air Lines by the manufacturer and will enter service next month.

Earlier, one of four Vickers Viscount 818 turboprops on order by Cubana was sold off the line to Tennessee Gas Transmission Corp. Last March, during the peak Cuban tourist season, the carrier leased one of its four Bristol Britannia 318s to Eagle Airways, Ltd.

Adding to Cubana's scheduling and equipment problems have been a series of recent incidents in which Viscounts flying Cuban routes were commandeered by men seeking political refuge from the Havana government. Twice in 1959 Cubana crews were forced at gunpoint to fly escapees to Miami, Fla.

BRITANNIA 318 turboprop transport on ramp at London Airport was overhauled and repainted by Bristol Aircraft after Eagle Airways, Ltd., leased it from Cubana.

Last month, the pilot and copilot of another Viscount radioed the control tower of Havana's Jose Marti International Airport that they would ask asylum in Miami.

A third crewman and one passenger filed similar requests.

After landing, the pilot contrived the freezing of the plane's four turboprops, giving Miami Airport authorities the reason that he wanted to deny Cuban Communists use of the aircraft. Damage was estimated at $300,000.

New engines, flown in by Cubana, were installed by American Airmotive, Inc., and the plane was retrieved by the carrier two weeks ago.

The air movement of U.S. tourists to Havana—which remained relatively constant during the revolution that brought Premier Fidel Castro to power in January, 1959—began to plummet last winter. Based upon data filed with the Civil Aeronautics Board:

• **National Airlines** flew 11,063 passengers to Havana from New York, Miami and Tampa during December, 1958, and January and February, 1959. The carrier's comparable figure for the same three months of 1959-60 was 5,666—representing a decline of about 49%.

• **Pan American World Airways** flew 58,248 passengers between Havana and Miami during December, 1958, and January, February and March of 1959. In the same four months of 1959-60, by contrast, the airline carried 26,644 point-to-point passengers—representing a decline of about 54%.

• **Delta Air Lines** flew 2,786 passengers between New Orleans and Havana during December, 1958, and January and February, 1959. The carrier's comparable figure for the 1959-60 season was 1,526—representing a decline of about 45%.

Delta's share of U.S. to Cuba traffic, though small, assumes significance because the carrier enjoys a route monopoly between Havana and New Orleans, whereas Pan American and National compete directly with Cubana. On Jan. 1, 1960, Delta dropped one weekly round trip from its schedules, continuing a total of eight flights per week into Havana. C. E. Woolman, president, told AVIATION WEEK that Delta also had subscribed to "seizure insurance" to protect its aircraft making Havana turn-arounds from possible confiscation by the Cuban government.

National, during 1958 and 1959, flew three daily round trips to Havana from Miami plus one daily flight from New York and from Tampa. On Jan. 11, however, the carrier cut its service from all three points to three round trips per week.

Pan American, during the 1958-59 tourist season, operated an average of 46 weekly flights between Havana and Miami. During the 1959-60 season, Pan American operated the 50

Cuba-U.S. Passenger Flow

Period	Total Passengers Between U. S.-Cuba	Per Cent Decline	U. S. Flag Passengers	Per Cent Total	Cuban Flag Passengers	Per Cent Total
Year Ending June 30, 1957	622,585	..	366,781	58%	253,109	41%
Year Ending June 30, 1958	585,754	6%	354,266	60.5%	227,342	38.8%
Year Ending June 30, 1959	540,556	7%	334,639	61.9%	203,230	37.6%
Six Mos. Ending Dec. 31, 1959	252,516	..	134,671	53.4%	118,632*	45%

*Estimated

min. flight an average of 32 times each week.

As traffic volume to Havana declined, the number of aliens traveling to the Cuban capital from all points in the United States surpassed the number of American tourists. A majority of these aliens were Cuban nationals and presumably favored Cuban flag airlines in choosing a carrier.

Alien Traffic

In the year ending June 30, 1957—the last of the so-called normal years before the outbreak of fighting in Cuba's Oriente Province—aliens accounted for 32.4% of the 622,585 passengers that traveled to and from Cuba by air.

But during the six months ending Dec. 31, 1959, aliens accounted for 50.7% of total passenger traffic.

This factor coupled with the schedule cutbacks on the part of U. S. airlines garnered a larger share of over-all U.S. to Havana passenger traffic for Cuban carriers. The trend established in the three years preceding June 30, 1959, in which the Cuban carriers steadily lost ground to U.S. competition, was reversed during the last half of 1959. For at some point within that six month period, U. S. airlines were deprived of about 10% of their previous year's share of air traffic between the U.S. and Cuba. In January, the last month for which data was available, Cuban carriers were flying about 57% of inbound and outbound passengers.

More than offsetting the percentage gains of Cuban flag operators, however, has been the over-all decline in air travel to Havana, the full impact of which probably won't be felt until this summer. Even now, however, load factors on Cubana's daily Britannia flight from New York to Havana are falling off. According to airline sources, they averaged 76% in January, 59% in February and 50% in March on the 96-seat turboprop aircraft.

Figures on file with the Port Authority of New York and made available to AVIATION WEEK by Cubana indicate that in the 1958 calendar year, the carrier's total traffic between Havana and New York equaled 35,695 passengers. In 1959, this number rose to 41,355.

Comparing Seasons

Comparing tourist seasons, Cubana flew 10,844 passengers between New York and Havana during the December through March period of 1958-59. During the same four months of 1959-60, the airline carried 14,762—an increase of about 25%.

Partially explaining Cubana's high January load factor on the route is the "Friendship Airlift" promotion staged by the Cuban Tourist Commission (CTC), an agency of the Cuban government. This lasted from Jan. 8 through Jan. 31 in New York and from Dec. 23 through Jan. 31 in Miami.

The promotion offered tourists traveling by air a 50% discount at a hotel of their choice in Cuba. CTC reports that 13,000 tourists accepted the vouchers distributed by the airlines and applied for the rebate.

From Feb. 8 through Mar. 7, the CTC subsidized a second promotion in which tourists were offered a free night at a hotel with dinner plus visits to a night club, race track, golf course, etc. Statistics detailing its success or failure were not available.

But spokesmen for Delta Air Lines told AVIATION WEEK that about 40% fewer passengers took advantage of CTC promotions linked to Cuban hotels in 1959 than in 1958.

A top official within the tourist commission itself confirmed that CTC did not contemplate additional promotions to boost tourist travel to Cuba. Rather, he said, CTC would concentrate its efforts on American travel agents by increasing their commission on airline tickets sold and by rebating more of their expenses incurred in preparing brochures publicizing package tours in Cuba.

Tourism's Importance

According to CTC, tourism—Cuba's third ranking industry—should earn the country about $350 million annually. In 1957, a "normal" year, the CTC reports that tourists contributed about $70 million to the Cuban economy, of which about 90% was furnished by the roughly 315,000 Americans who visited the island.

"Less than 30% of this number visited Cuba in 1959," a CTC spokesman admitted. Of these, about 78% traveled by air, making Havana, which enplaned 139,441 passengers in 1959 (AW Mar. 28, p. 51), the busiest terminal in Latin America.

Cuban Plans

To counteract American hesitancy to visit Cuba in view of recent friction between Washington and Havana, and also to conserve Cuba's dwindling supply of U. S. dollars, the Cuban government and the CTC have:

- **Launched a "See Cuba First"** campaign aimed at encouraging internal vacations.
- **Opened new CTC offices** in South American capital cities to promote Cuban vacations on the part of other Spanish-speaking nationals.
- **Clamped currency restrictions** on Cubans who would take U.S. dollars out of the country on business or pleasure trips. Today, all Cubans earning U.S. dollars must exchange them for pesos, and the use of U.S. currency in Cuba, formerly a common place is now a penal offense.

Forecasting the future of airline operations into Cuba is complicated by abrupt changes in traffic flow and aircraft movement that seem to follow the policy speeches of Premier Castro and the propaganda activities of his opposition.

Last October, to illustrate, the Cuban government spent $1.5 million as convention host for 2,000 delegates representing the American Society of Travel Agents (ASTA). It was generally conceded that Premier Castro, with his welcoming address, favorably impressed most of those in attendance.

Before the convention had adjourned, however, a Miami-based Douglas DC-3 piloted by Diaz Lanz, former head of the Cuban air force, sprinkled Havana with anti-Castro leaflets. This prompted Premier Castro to denounce the United States over television for "harboring" the exiled officer.

Traffic Slumps

In the month following Castro's speech, November, the number of passengers departing the U.S. for Cuba plunged 46% to 11,796. The average figure for July, August, September and October of 1959 had been 21,972.

During January, February and March of 1959—immediately after Castro seized power—Cubana's plane movements in and out of Miami International Airport averaged 239 per month. In 1960, the airline's plane movements at the same terminal fell from January's peak of 536 to 410 in February and 420 in March.

These figures would seem to indicate that although Cubana is a privately owned airline, it is far more responsive to political developments within Cuba than are its U. S. competitors.

BEA Reschedules Helicopter Service

London—British European Airways has delayed plans for scheduled helicopter services by one year. New scheduled date for introduction is the summer, 1962.

Reason is that the airline has not yet decided which type of helicopter to order.

BEA spokesman confirmed that two U. S. helicopters—Vertol 105 and Sikorsky S-61—were being considered along with two British types, the Bristol 192 and the Westland Wiltshire. The boat-hulled Wiltshire is a development of the Sikorsky S-61, and it is the first time BEA has mentioned its interest in this helicopter.

SHORTLINES

► **Allegheny Airlines** has been issued a cease and desist order by Civil Aeronautics Board demanding that the airline stop allowing persons other than the original purchasers to use flight coupons from its "Book-Ticket Plan." Plan involves purchase of a book of 10 tickets between two points at a 15% discount. Trans World Airlines, which has parallel routes with Allegheny, filed a complaint with the Board charging that the latter carrier was permitting the transfer of coupons to persons other than the original buyer in violation of the Federal Aviation Act. Allegheny agreed to accept the order.

► **American Airlines** plans to begin nonstop Boeing 707-123 service from Philadelphia to Los Angeles on a daily basis beginning June 8. The turbojet transport will be operated with 44 first-class seats and 74 "Royal Coachman" coach seats. Flight will leave Philadelphia at 6:15 p.m., arrive in Los Angeles at 8:40 p.m. Return flights will leave Los Angeles at 8:30 a.m. and arrive Philadelphia at 4:30 p.m. All times are local.

► **Civil Air Transport** is opening a Western U.S. sales office in Burbank, Calif., on June 1. CAT says purpose of new office is to develop new interline sales in North American markets.

► **Flying Tiger Line** reports a net loss of $623,688 for the nine-month period ending Mar. 31 as compared with a net income of $1,275,614 for the same period of last year. The all-freight carrier attributes the drop to a 49% decline in contract business, which fell from $15,845,972 last year to $8,143,951. Air freight revenues increased 14%—from $9,778,141 to $11,154,702.

► **New York Airways** reports that it carried 41,796 passengers during the first four months of 1960, a 45% increase over 1959 and a 110% increase over the same period of 1958.

► **Thai International,** the airline of Thailand, is offering several new Orient services, using Douglas DC-6B aircraft piloted by Scandinavian Airlines System crews. SAS has helped develop the Thai airline and will lend technical assistance and act as its world-wide general sales agent. Initially, the Asian carrier will operate three weekly services from Tokyo to Hong Kong, two via Taipei connecting with five weekly flights over the carrier's route from Hong Kong to Bangkok. The airline also will operate three weekly flights from Bangkok to Rangoon and Calcutta.

AIRLINE OBSERVER

► Soviet Union had made no response by late last week to a U.S. proposal that negotiations on a bilateral air transport agreement begin June 18 (AW May 2, p. 25), and State Department officials now feel there will be no immediate action in this area in view of the current Summit crisis. Originally, the Russians wanted to meet with the U.S. to begin talks in April or May, but the U.S. was forced to set the later June date as a starting time for the talks because of previous commitments with other countries. Meanwhile, talks with Mexico were recessed indefinitely last week after the U.S. refused to concede to Mexican demands that capacity of U. S. carriers serving Mexico be restricted to permit a more equal allocation of traffic between the airlines of the two countries.

► **Domestic trunkline traffic showed a sharp upswing in April, giving strong indications that business has returned to the normal healthy trend established in 1958 after experiencing a sharp dip in March. Revenue passenger miles in April were up 10.8% as compared with a 1% decline in March. Available seat miles rose 9.7%—slightly higher than previous monthly increases. April's load factor was 61.23% as compared with 55.75% in March and was the first increase recorded in the past seven months.**

► American Airlines is studying short-range jet transports such as the Boeing 727 and the Convair Model 60 but is showing little interest in them, at least for the present. American feels they offer no notable advantages in capacity or performance over its Convair 600s and the prices quoted—probably $3.5 million to $4 million—are almost as high.

► **Capital Airlines agreement with Convair to purchase a fleet of seven 880 jet transports is still in effect although the carrier has no aircraft on the manufacturer's production line. If and when the airline finds a way out of its current financial plight (AW Mar. 9, p. 39), Convair will build the planes and Capital will buy them. Agreement with Lockheed for the purchase of five Electra turboprop transports, also dependent on financial arrangements, has not been dropped. Lockheed has offered to lease the planes, which are now ready for immediate delivery with Capital markings, to the airline pending its ability to buy the planes but the carrier prefers to refrain from any lease commitments until Vickers-Armstrongs foreclosure proceedings against it are resolved.**

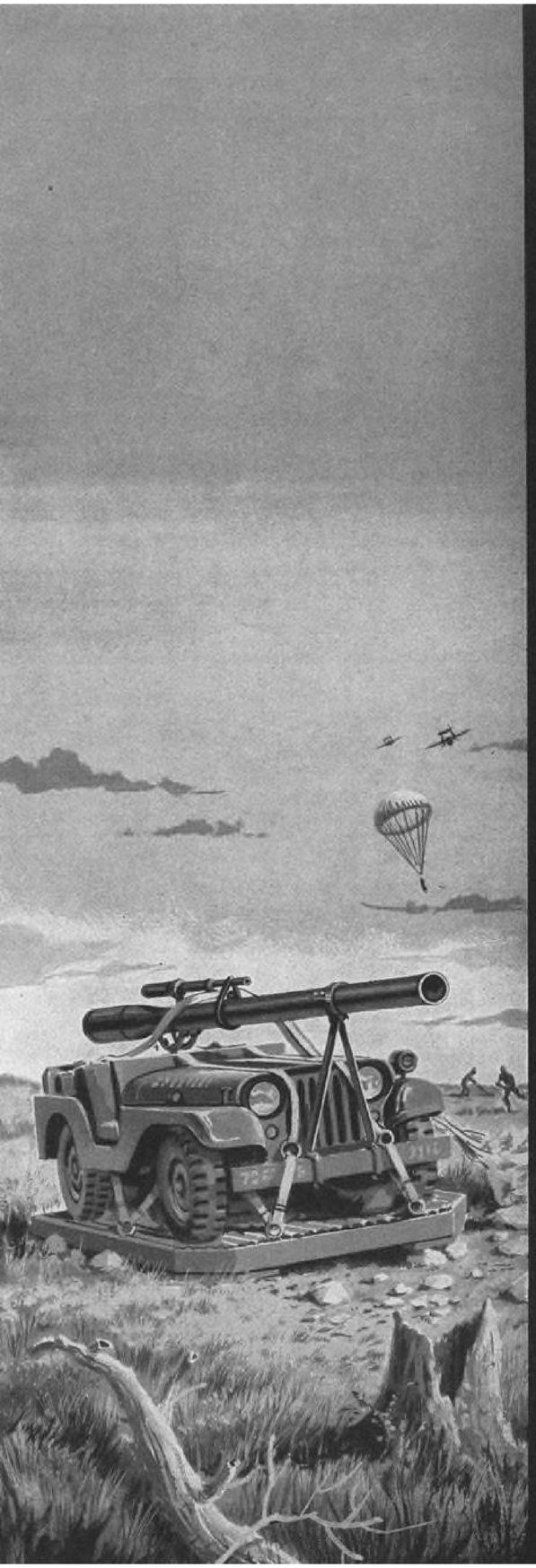
► International Civil Aviation Organization decision to reject the British Decca navigational system again has again become the subject of hostile criticism in the House of Commons (AW Apr. 25, p. 41). Answering charges that the decision in favor of VOR/DME was "political in defiance of the technical merits of the two systems," Duncan Sandys, Minister of Aviation, expressed sympathy for this interpretation but maintained that Britain has decided to abide by the decision to prevent a breakup of ICAO.

► **United Air Lines will operate its Sud Caravelle in first-class service when scheduled flights begin in August 1961. Although the Caravelle will be used for medium-range stage lengths, United does not plan to operate it into either New York's La Guardia Field or Chicago's Midway Airport.**

► Domestic trunkline stocks generally pulled away sharply from 1960 lows following the Civil Aeronautics Board press release announcement that the trunkline industry is entitled to an average rate of return on investment of approximately 10.5%. As of late last week, most carriers had filed, or were planning to file, for varying rate increases that would provide this return.

► **Lake Central Airlines has purchased five Convair 340 airframes from United Air Lines for conversion to Allison 501-D13 turboprop engines which have already been contracted for with Allison Division of General Motors. Allison will handle the conversion which will begin in late 1960.**

► Civil Aeronautics Board will begin oral arguments this week on the award of a St. Louis-Florida route to Trans World Airlines which earlier had been vacated by a Court of Appeals. Board decided to hold oral arguments because of the "many controversial matters" involved and because only two of the five members of the Board who participated in the original decision are still with the Board.



NEW BATTLEFIELD MOBILITY FOR CREW-SERVED WEAPONS

WITH THE VERTOL 107

The twin-turbine Vertol 107, prototype of the army YHC-1A light tactical helicopter, is giving new meaning to an old word — mobility.

In "shoot and scoot" tactics for crew served weapons, the YHC-1A can swiftly transport three 106mm battalion anti-tank rifles each with 4-man crew and ammunition. Terrain is no obstacle. Each crew and weapon can be dropped off at pin-pointed firing positions to ambush advancing armor with convergent fire. Within minutes they can be scooped up and redeployed to engage another target miles away.

With its rear loading ramp and unobstructed payload compartment, this helicopter has the ability to airlift a complete Little John system and crew, laying fire on a target 60 miles away 35 minutes after receipt of orders.

Vertol's advanced YHC-1A and the forthcoming YHC-1B (Chinook), provide battlefield transportation which equals the advanced firepower of MoMAR — Mobile Modern Army.

VERTOL DIVISION BOEING
MORTON PENNSYLVANIA

Wherever Navigation News is Made

Edwards AFB, California, May 6 — The public got its first glance today of the operational readiness and navigation-bombing capability of America's supersonic B-58 as the Hustler bomber simulated an inertial bomb run here before members of the Aviation/Space Writers Association.

CREW — U.S. AIR FORCE

BOMBER — CONVAIR

NAVIGATION — SPERRY

Washington, May 10 — The USS TRITON, world's largest nuclear submarine, today completed history's first underwater circumnavigation of the globe in 84 days, covering 41,500 miles.

CREW — U.S. NAVY

SUBMARINE — ELECTRIC BOAT

NAVIGATION — SPERRY

Airline Traffic—February, 1960

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNK								
American	594,590	437,336	61.8	1,736,737	938,851	9,244,653	53,927,789	54.9
Braniff	172,874	76,854	51.2	366,453	163,455	525,692	8,420,286	41.0
Capital	254,617	104,386	47.4	463,260	259,304	398,673	11,415,170	43.4
Continental	91,991	58,579	48.3	141,442	110,072	314,859	6,186,838	38.4
Delta	245,738	139,683	57.1	390,011	267,618	1,192,916	15,298,813	47.9
Eastern	644,597	357,142	52.52	1,138,392	468,672	1,568,489	37,611,111	42.46
National	140,562	101,112	56.0	327,348	67,679	581,623	10,800,227	45.1
Northeast	102,672	51,527	55.95	135,204	36,658	212,966	5,322,234	48.74
Northwest	142,311	107,466	53.3	591,458	253,338	1,487,854	12,677,559	48.4
Trans World	356,593	295,968	57.8	1,674,666	736,206	3,317,718	34,077,075	51.2
United	489,804	319,091	57.9	2,313,305	841,220	6,137,306	39,974,014	54.3
Western	141,051	77,744	60.0	315,587	95,084	326,052	8,197,712	53.0
INTERNATIONAL								
American	10,917	12,018	80.1	8,355	233	189,026	1,437,758	79.4
Braniff	4,496	8,268	48.8	24,946	.....	128,308	1,044,417	44.0
Caribbean Atlantic	34,546	2,465	62.9	1,842	.....	7,145	270,159	69.5
Delta	2,214	2,899	33.9	6,688	.....	30,283	354,018	32.6
Eastern	32,466	48,225	53.22	88,199	.....	150,982	5,220,588	52.99
Mackey	13,658	2,536	42.8	.....	241	5,693	279,551	40.8
National	2,107	1,661	45.1	3,150	953	8,216	186,907	38.4
Northwest	14,458	24,382	44.6	1,105,492	19,743	850,585	4,614,583	49.2
Pan American								
Alaska	2,969	2,849	32.0	31,954	.....	110,821	450,631	35.2
Atlantic	69,122	101,292	55.9	1,218,015	.....	3,498,637	15,427,458	52.2
Latin America	103,184	119,219	69.4	393,606	.....	4,031,808	16,494,196	68.7
Pacific	29,808	101,836	70.9	1,599,908	.....	1,942,491	14,237,736	60.6
Panagra	11,399	17,200	67.5	70,815	.....	523,039	2,445,148	66.8
Resort	.....	.....	.....	.....	.....	2,824,629	2,824,629	74.7
Trans Caribbean*	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	14,552	42,551	44.8	913,825	.....	1,116,914	6,533,409	46.1
United	6,075	15,127	72.5	110,703	6,566	62,420	1,713,395	70.9
Western	4,921	7,654	76.4	7,423	.....	13,480	825,055	78.6
LOCAL SERVICE								
Allegheny	36,230	6,534	40.2	11,473	21,388	27,495	683,839	39.0
Bonanza	21,744	5,448	44.5	9,378	2,633	8,896	543,133	45.8
Central	11,299	2,244	34.3	6,312	2,898	7,732	232,011	30.8
Frontier	23,795	6,157	34.4	24,517	8,196	56,731	683,259	38.6
Lake Central	16,889	2,591	36.5	4,276	18,510	.....	270,699	40.3
Mohawk	42,096	8,261	44.3	15,964	17,450	18,859	839,732	41.6
North Central	66,568	11,738	38.95	36,621	39,458	29,281	1,243,222	40.07
Ozark	38,349	6,753	38.1	13,666	21,120	24,170	705,640	40.4
Pacific	35,840	8,313	44.8	16,559	3,853	8,781	822,182	41.9
Piedmont	28,796	6,076	38.4	10,619	11,865	14,291	618,646	39.6
Southern	19,968	3,611	31.4	15,379	10,941	12,793	385,584	33.5
Trans-Texas	20,857	4,895	33.1	17,899	10,509	33,545	530,610	34.4
West Coast	28,818	6,864	41.55	13,180	3,493	13,906	686,162	41.29
HAWAIIAN LINES								
Aloha	24,952	3,699	60.8	2,323	.....	6,185	304,974	57.2
Hawaiian	37,590	6,770	61.1	10,534	....	154,467	736,653	57.4
CARGO LINES								
AAXICO	.....	.....	.....	.....	.....	4,680,956	4,680,956	56.41
Aerovias Sud Americana	.....	.....	.....	.....	.....	512,436	512,436	88.1
Flying Tiger	2,609	14,133	100.0	75,534	48,524	6,392,567	7,929,967	82.1
Riddle								
Domestic	.....	.....	.....	7,226	28,632	1,539,333	1,575,191	76.4
Overseas	.....	.....	.....	6,528	.....	463,412	469,940	69.4
Seaboard & Western	3,391	13,232	100.0	441,163	.....	3,882,888	5,657,572	77.0
Slick	2,789	11,407	100.0	.....	.....	6,256,204	7,395,227	100.0
HELICOPTER LINES								
Chicago Helicopter	20,216	348	53.7	1,007	.....	.....	34,265	44.4
Los Angeles Airways	2,607	91.3	55.0	4,515	2,170	.....	15,446	60.8
New York Airways	9,755	204	47.9	1,438	1,348	615	22,905	49.7
ALASKA LINES								
Alaska Airlines	9,936	168	58.6	58,542	3,766	359,682	1,282,293	59.3
Alaska Coastal	2,828	306	48.9	4,046	.....	3,354	38,667	55.0
Cordova	793	137	34.8	3,281	.....	28,377	45,654	40.6
Ellis	3,371	230	49.3	2,466	.....	2,411	28,534	61.2
Northern Consolidated	1,596	491	37.4	35,585	.....	40,886	130,516	59.3
Pacific Northern	5,745	4,966	28.8	101,411	5,082	194,693	838,963	39.6
Reeve Aleutian	926	855	28.8	48,360	.....	56,899	199,846	54.3
Wien Alaska	1,552	429	26.5	38,449	.....	87,253	170,479	49.5

*Not available.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

New Methods Probe Space Flight Hazards

By Evert Clark

Miami Beach, Fla.—New techniques developed in recent months promise to increase the basic understanding of radiation damage and the effects of weightlessness, the two greatest unknowns in manned spaceflight, the Aerospace Medical Assn. was told at its 31st annual meeting here.

Radiation from interstellar space and from relatively rare but intense solar flares now appears to pose the greatest threat for manned flight to the planets.

Specific Damage

But, for the first time, specific biologic damage done by a specific particle of radiation has been defined. This promises a detailed understanding of radiation damage to living tissue that has many implications in the study of aging, radiation effects on cancerous and non-cancerous cells and other areas of general medicine as well as a direct contribution to space medical problems, Lt. Col. David G. Simons told AVIATION WEEK.

Simons, as head of the bioastronautics branch of the Department of Space Medicine at the Air Force School of Aviation Medicine, reported on studies done for USAF by Dr. A. Gib DeBusk, of Florida State University.

DeBusk sent paper saturated with bread mold and attached to emulsion plates to high altitudes by balloon. By obtaining the rifle-bullet-like track of a particular very heavy particle and correlating it with damage done to the bread mold (neurospora crassa), DeBusk was able to determine what damage a particular particle did.

Two groups of amino acids are involved, and Simons said it is believed that researchers can tell exactly which atoms of which molecules are involved in the damage.

Further experiments with bread molds, nuclear emulsions and mice are to be made in a series of balloon flights scheduled to begin soon from Prince Albert, Canada. Flights are sponsored by USAF's Air Research and Development Command, the School of Aviation Medicine and the National Aeronautics and Space Administration. They also will carry experiments of a number of researchers.

Shielding studies, including one done by J. W. Keller and N. M. Schaeffer of Convair Ft. Worth for NASA, still indicate the need for very heavy shielding to protect a manned space vehicle against heavy solar and galactic radiation.

Both Simons and the Convair researchers made it clear that information on radiation is still considered fragmentary, and Simons said data reduction on radiation from satellites and probes already flown is lagging behind.

Right now, the inner Van Allen Belt about the earth appears to be useless for manned orbiting missions. Intensity of radiation in the outer Van Allen Belt varies by a factor of at least 10 in intensity and by as much as 50,000 km. in extent. Here, a vehicle can be shielded to prevent production of X-rays caused by the stopping of electrons, and solar protons then become the major problem, Keller and Schaeffer said.

Solar protons persist up to about 12 days following a flare, but maximum intensity lasts only about one day. These flares are occurring at the rate of about 10 a year now, but their dependence on other solar cycles is not known. In addition to these, outbursts of protons with energies of billions of electron volts have been observed some five times in the past 20 years.

Even if the giant flares could be avoided by timing of flights and shielding could protect against those of lesser intensity, there still will be "an area in between where it gets to be a very sporting proposition as to how big a chance you want to take," Simons said.

Weightlessness Effects

Understanding of the effects of weightlessness may be advanced considerably by a null-gravity simulator now nearing completion at Lockheed Aircraft Corp's Marietta, Ga., plant. While it does not produce weightlessness, it is expected to deprive man of the three cues which tell his body it is weightless—visual cues, proprioceptive or "seat of the pants" cues from the muscles and cues from the vestibule of the ear, which responds to both movement and position.

Dr. Raphael B. Levine of Lockheed Aircraft Co. Operations Research Division said the simulator is based on ideas put forth independently two years ago by geneticist H. J. Muller of Indiana University, engineer Otto Schueller of ARDC's Wright Air Development Division and Ralph W. Stone of NASA's space task group.

Simulator Principle

Basic idea is to suspend a man in a rotating tank of fluid of specific gravity equal to his own, depriving him of most of his proprioceptive cues and any visual indication of vertical or horizontal. Rotation at the proper rate is expected to rob the otolith organs of the inner ear of the ability to tell the man what his motion or position is by exceeding the ability of these organs to respond. Experiments with fish were encouraging enough for Lockheed to proceed to build a full-scale device.

The company expects to use the simulator to study native tolerance to weightlessness or ability to develop tolerance, ability of man to orient by visual cues alone, effects of small lineal and angular accelerations on the vestibular mechanism, performance under stress and fatigue, work and rest cycles and sleep requirements, effects of drugs on these reactions, and effects of weightlessness on physiological processes.

Dr. R. L. Cramer of the USAF School of Aviation Medicine's vestibular laboratory reported that experiments with cats indicated the vestibular mechanism has the ability to sense a change in position but will not continue to provide this information if the position remains the same over a period of some few minutes. While Dr. Cramer is interested primarily in the sensor organ and the circuitry through which it sends information to the brain and intends to explore this further, he told AVIATION WEEK that initial experiments indicate that man may well be able to adapt to weightlessness without the need for artificial gravity in space stations. Man apparently can sleep in the weightless state if the vestibular mechanism is not repeatedly sending information to the brain that indicates movement, Cramer said. A few years ago, researchers felt that weightlessness might give man a sense of being in a continual fall, with resulting fear.

Col. Ralph N. Kraus, from the school's Department of Clinical Medicine, reported that studies there indicate that it may be possible to train space pilots so they will have no undesirable responses to vestibular stimuli. Professional ice skaters apparently have no undesirable response, and tests at the school indicate that the duration of the response of a group of pilots to these stimuli was shorter than that of non-pilots.

Dr. Carl C. Clark, head of the Biophysics and Bioastronautics Division of the Aviation Medical Acceleration Laboratory at the Naval Air Development Center, reported that he lived, ate, drank, slept, read, talked and wrote in a 24-hr. ride in the Johnsville centrifuge at a constant acceleration force of 2g.

Rotational illusions generated by rapid motions of the head were nauseating, a point which Clark said had not been considered in most designs for rotating manned space stations.

Two hours after starting the test, Clark walked a few steps in the centrifuge, but, when he tried the same thing 12 and 24 hr. after starting, he had a dimming of peripheral vision and some nausea. He said that exercises must be developed to facilitate circulatory and other mobilization factors before changing acceleration level or attitude.

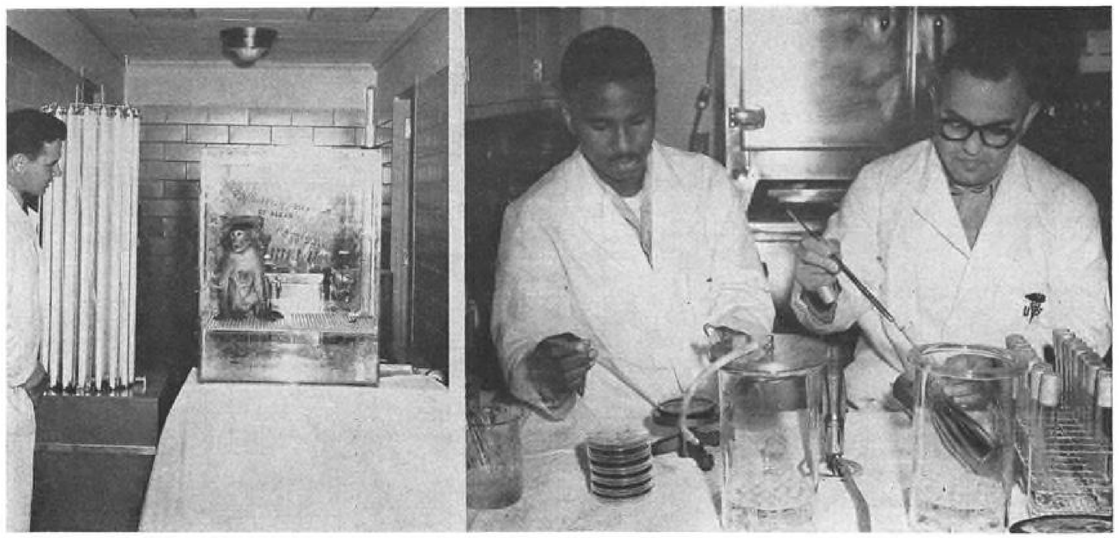
In the first two hours, Clark had abdominal discomfort and a mild frontal headache. Aspirin relieved both symptoms. Sixteen hours after the start of the test, an anesthesia sensation developed in the ring and little fingers of his left hand. Some tingling sensation remained for about two months after the experiment.

White blood count increased from 11,300 to 22,000 per cubic millimeter, a feeling of lightness lasted for approximately one half hour after the centrifuge stopped. An abrupt head motion 30 min. after the test run produced vomiting.

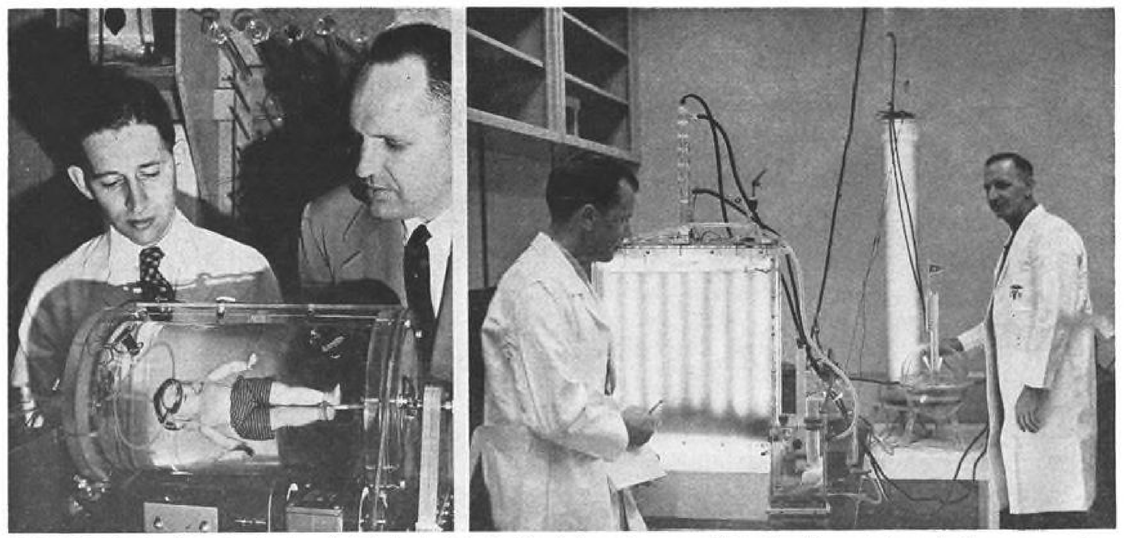
Clark concluded that tolerance to the 10 revolutions per minute of the centrifuge for 24 hr. was achieved only by minimizing head motions and that tolerance to 2g was achieved only at the price of reduced motivation, finger anesthesia, water retention and increased white blood count.

Appraising Risk

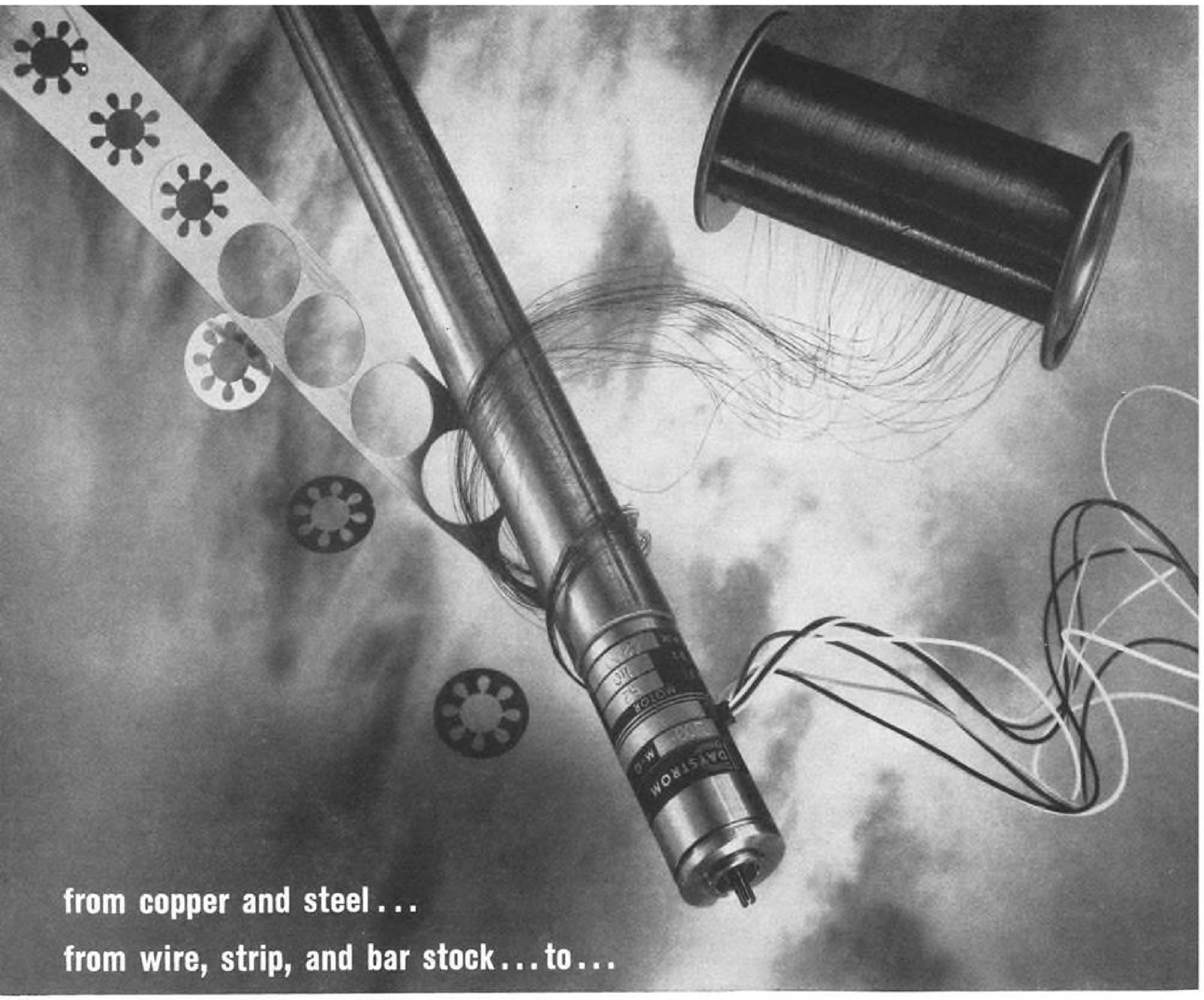
USAF Lt. Col. John A. O'Connor, Jr., chairman of the Atomic Energy Commission's Aerospace Nuclear Safety Board, said an "honest, unemotional appraisal" of the risks involved in the nuclear aircraft, ramjet, rocket and auxiliary power programs is "no more than, and usually less than, those risks encountered in the progressive development of steam and electric power,



MONKEY in plastic box (left) breathes oxygen produced synthetically by closed ecological system at USAF School of Aviation Medicine. Preparations are made (right) at the school for an experiment in which bacteria are exposed to simulated Martian environment.



SCALE MODEL of null gravity simulator (left) being built by Lockheed shows how man will be placed in revolving tank of water so reactions to weightlessness can be observed. Two closed ecological systems developed by USAF School of Aviation Medicine are at right.



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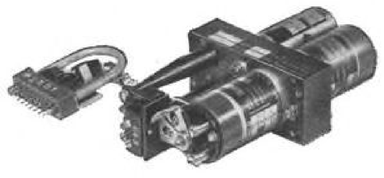

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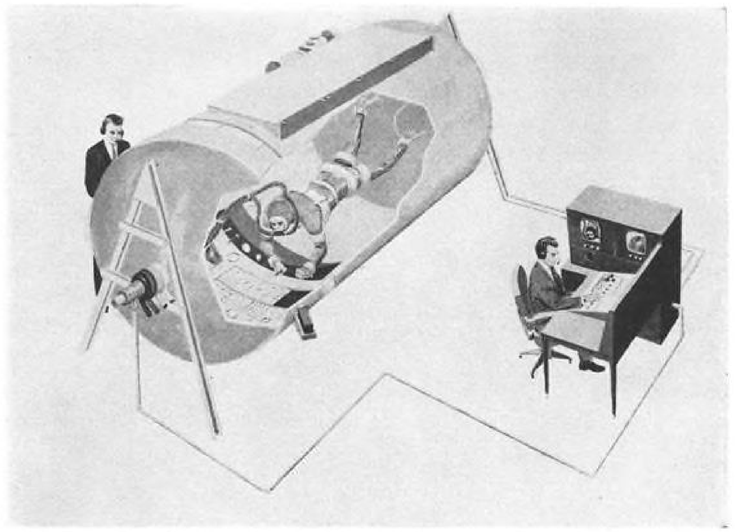


SPINNING TANK of water would simulate weightlessness, as shown in drawing of space simulator Lockheed Aircraft Corp.'s Human Factors Research Laboratory, Marietta, Ga., expects to have in operation soon. Subject suspended in the tankful of water would be observed to determine his responses to operating tests and the artificial environment.

the airplane, the automobile or even something as basic as fire."

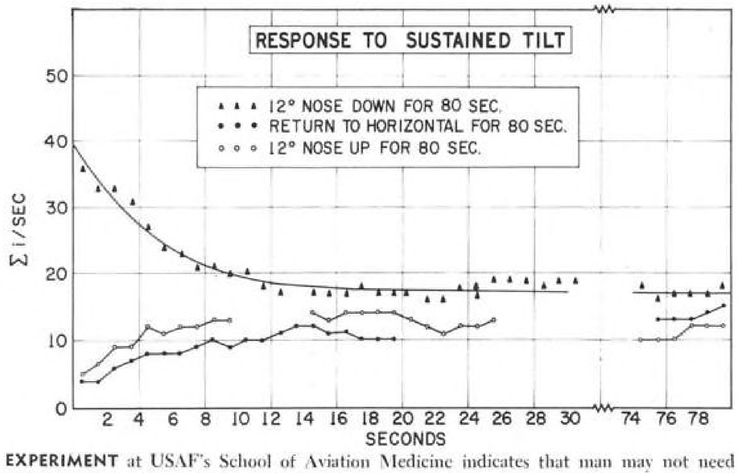
To allow for these risks, however, requires unusual safety measures. Testing of the Pluto reactor for the Slam missile will require an exclusion area of 1.4 mi. from the launch site for a cold launch and 5.1 mi. for a hot launch.

Exclusion Area

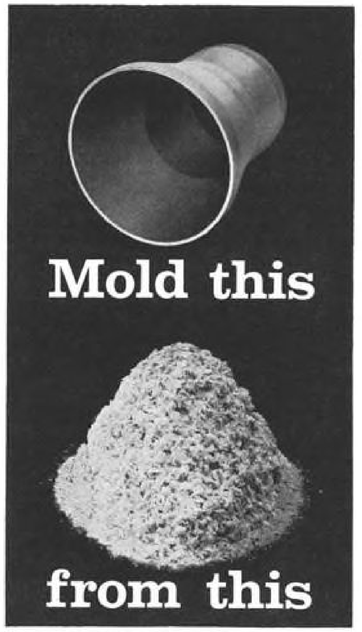
Ten miles outside the exclusion area there should be no towns of over 500 population and the rural population should be less than 5 per square mile. Ten to 20 miles outside the exclusion area, there should be no towns of over 5,000 population and a rural population of less than 10 per square mile.

Slam's reactor will be essentially unshielded so that direct radiation to a person directly beneath the flying missile might exceed the maximum allowable once-in-a-lifetime dose, which indicates low level tests over the ocean. From altitudes above 25,000 ft., direct dose to a person on the ground is negligible.

Fission released during flight at any



EXPERIMENT at USAF's School of Aviation Medicine indicates that man may not need artificially induced gravity to function in a space station. Vestibule of the ear, which senses changes in gravity, apparently adapts itself quickly and does not continue to feed "alarm" information to the brain if the new condition remains steady. Experiment, done by tilting an anesthetized cat and measuring the response in a single cell of its brain, also indicated that parabolic aircraft flights should be more than 30 sec. duration if they are to tell anything more than the initial response to weightlessness.



. . . for missile parts of high-temperature asbestos-phenolics

R/M Style 150RPD molding compound

Virtually every U.S. missile carries plastic parts made of R/M raw materials. Starting point for many of these parts exposed to burning propellants and other high-temperature environments is R/M Style 150RPD molding compound.

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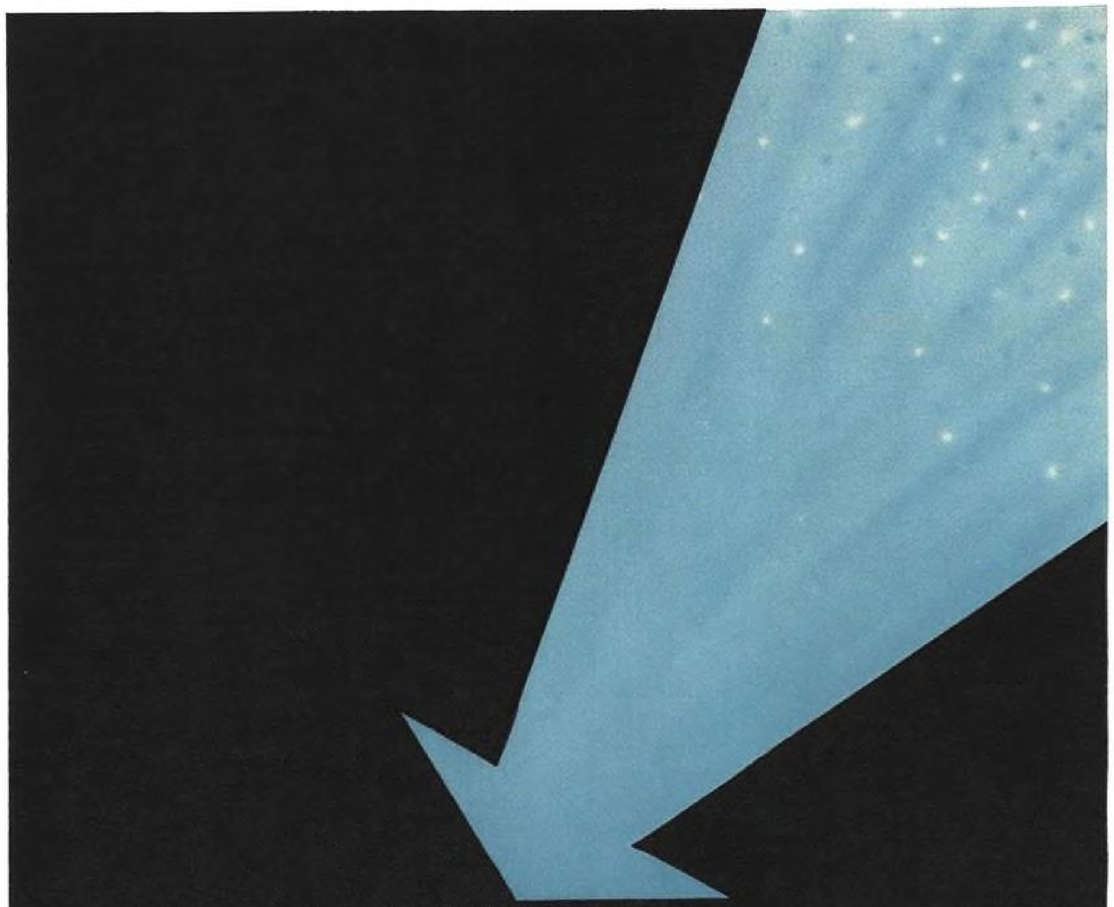

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altitude above 500 ft. will be within allowable limits for the general population. But, in the event of impact on land, an exclusion radius of 53 mi. will be required for off-site personnel. O'Connor said this makes the need for a cleared ocean test range obvious.

Most of the fission products from a Rover heat transfer nuclear rocket would remain in the shielded reactor and the few gases that diffuse through walls of the reactor's fuel cells will readily diffuse with the atmosphere, O'Connor said.

Rover-type rocket could be launched from coastal regions if four conditions are met, O'Connor said. They include starting the reactor only after it is in a stable orbit and only if it can be burned up with wide dispersion and fission has decayed to an acceptably low level.

Not enough is now known about re-entry to control it properly or to be certain the reactor would be destroyed, he said. The same problem applies to nuclear auxiliary power systems if they are used in earth-orbiting satellites.

Capt. M. H. Goodwin of Navy's Bureau of Medicine and Surgery said preliminary data from noise tests with the McDonnell F4H fighter during recent carrier suitability trials indicates that the aircraft subjects the steam catapult crew to twice the noise that the Chance Vought F8U Crusader did when it was introduced in 1958. This is a continuing trend with new aircraft and is of "tremendous significance," Goodwin said. It means that crewmen with deck-edge operations such as catapult operators eventually will need sound-treated rooms, and others may seek shelter as soon as momentary jobs such as attaching a catapult bridle are completed.

Noise level on the flight deck has become so high that at times even the crash warning alarms could not be heard, Goodwin said. One-way radio receivers installed in ear muffs did not solve the problems but two-way radio helmets have, he said.

J. J. Konikoff, of the Space Sciences Laboratory at General Electric's Missile and Space Vehicle Department, reported on an experimental oxygen regeneration system that would produce more than a man's daily requirement of oxygen by recapturing oxygen from carbon dioxide and water vapor exhaled, from fluid and solid body wastes and perspiration. Konikoff, an aerodynamicist who became interested in life support systems, believes that such a system, using a variation of the Fischer-Tropsch synthesis, could be kept to a weight of 120 lb.

This system appears to be the most desirable for any period exceeding one man-month, he said.

These are men you should know

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Their names are Robert Freed and John Esbensen. They're Delavan Fuel Injector Sales Engineers. Both are fully qualified to discuss the technical aspects of fuel injector application. Bob Freed holds an E.E. from Kansas State U. and has had six years of jet engine experience. John Esbensen has a B.S. in General Engineering from Iowa State University and over eight years experience as a sales engineer. These men are ready to come to you. They and the staff of project engineers and production specialists at Delavan are the main reasons leading turbo-jet, rocket and APU manufacturers rely on Delavan for fuel injection problem solving.

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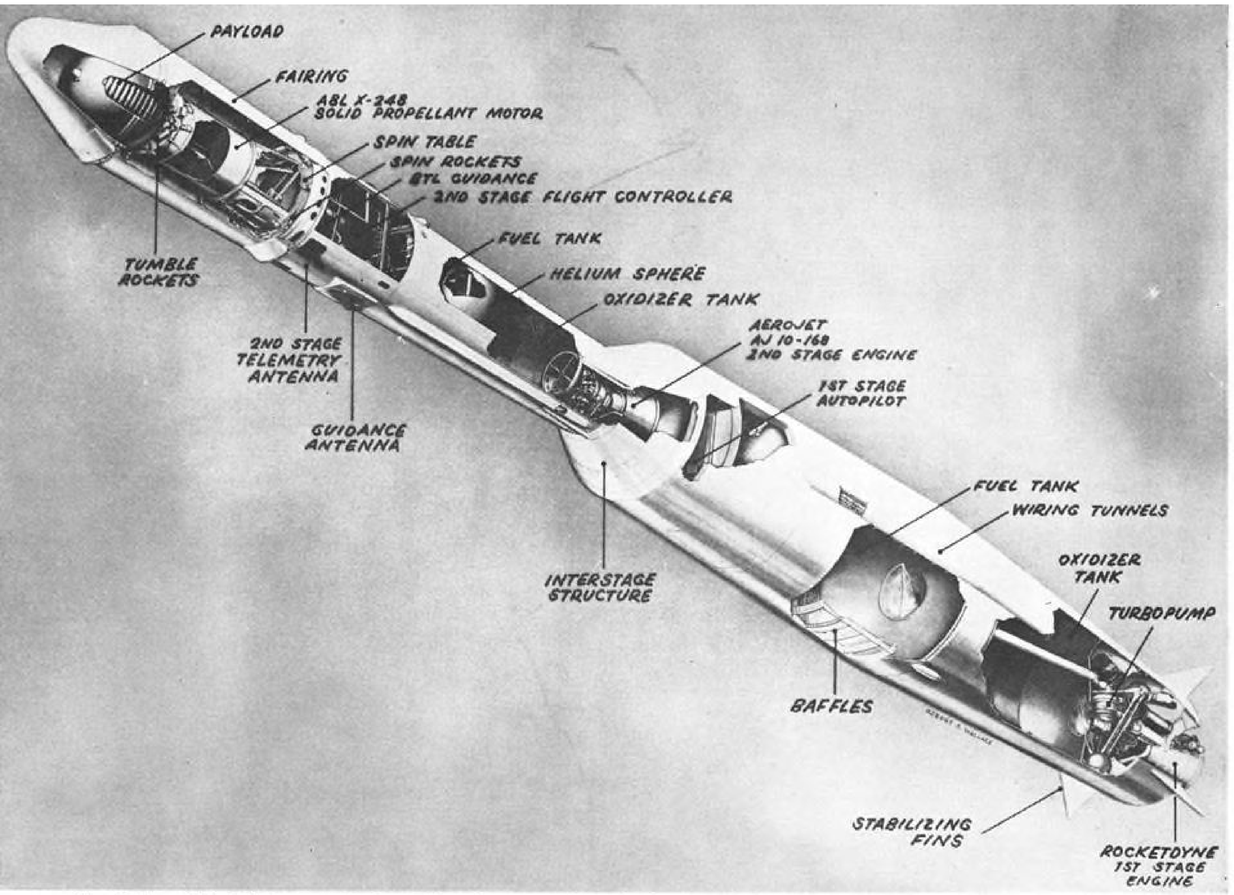
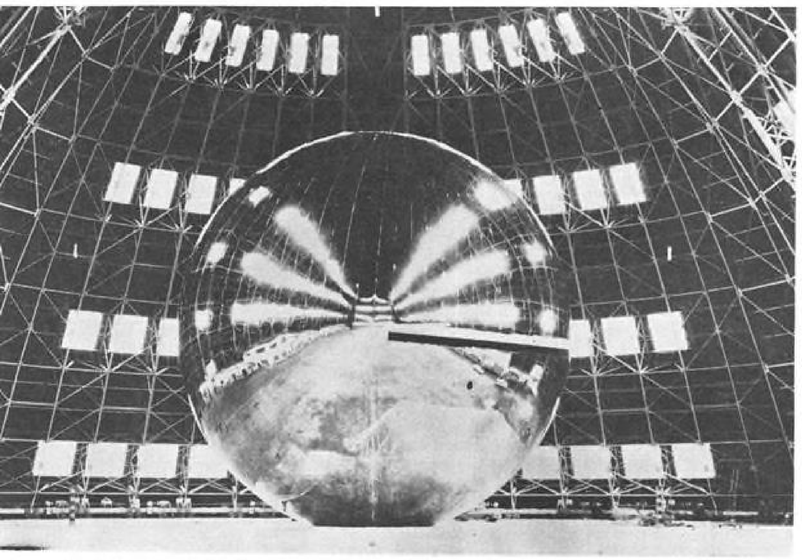
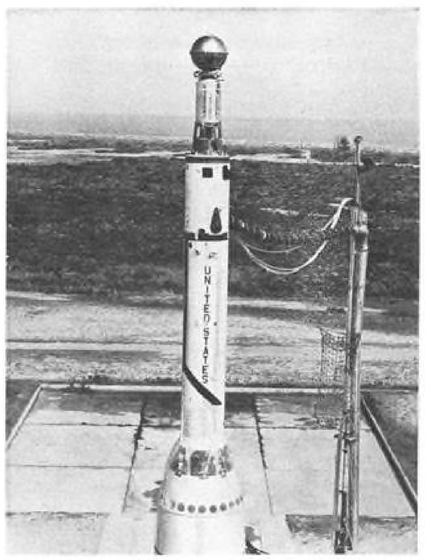


Thor-Delta vehicle failed to put a Project Echo sphere into orbit in its first launch. Second attempt will be made this summer.

Echo Sphere Fails to Go Into Orbit



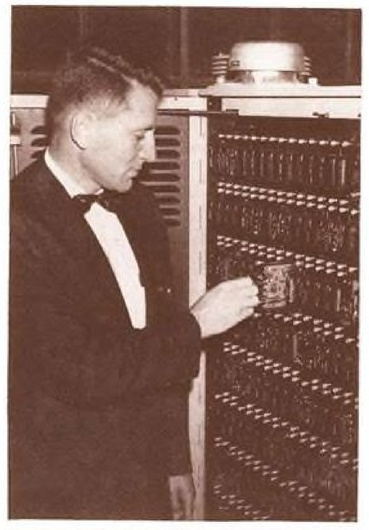


Project Echo inflatable sphere, planned for use as a passive communications satellite, is 100 ft. in diameter when inflated (left) and is folded into a 28 in. cannister for launch on a Thor-Delta vehicle (right). First Delta launch of an Echo sphere was unsuccessful May 13 when attitude control jets in the second stage failed to operate during the coast period after second stage burnout. Vehicle apparently deviated too far from its planned attitude to reach orbital velocity.

FORD INSTRUMENT CO.
data bulletin

Developments at Ford Instrument Co., Division of Sperry Rand Corporation, that are of particular interest to users of special-purpose computers and controls.

NO. 1 OF A SERIES OF ADVERTISEMENTS LONG ISLAND CITY 1, N. Y.



M. Moscarello, Chief Engineer of Ford Instrument, demonstrates ultra-compact plug-in modular construction of launching and control order computer for TARTAR missiles.

Radically New Inertial System Subject of $1-Million AF Contract

Digital computer provides mathematical platform in new approach

Under a $1-million U. S. Air Force contract, Ford Instrument Co. is building and will test an experimental model of a radically new airborne inertial navigation system for the Weapons Guidance Laboratory of Wright Air Development Division.

Designated the AN/AJN-7, the new system does away with the conventional "stable platform" of inertial navigation systems. The gyroscopic components are body-mounted, and the functions of the platform are performed by a special digital computer employing novel computing techniques. The computer itself, known as "Fordac," is an all-solid-state unit.

The AN/AJN-7 "strapped-down" system (sometimes also called a "no-gimbal" or "platformless" system) was the subject of an earlier Ford Instrument study contract.

The use of a digital computer to replace the stable platform greatly simplifies construction problems. In conventional systems, the gimbal structure requires a great deal of unobstructed space for motion, and parts must be built to very close tolerances. And, usually, the more accurate the navigating system, the bulkier the supporting gimbal system. The compact, lightweight digital computer avoids these problems entirely.

Of additional interest is the fact that, in the AN/AJN-7, the Air Force will be evaluating unique air-bearing components built by Ford Instrument. Ford Instrument was the first company in the country to set up production lines for extremely accurate air-bearing components (gyroscopes and accelerometers) for missile guidance.

TARTAR TAKE-OFF

. . . Calculated by Ford Instrument

U. S. Navy TARTAR missiles receive their launching and control orders from a computer developed and manufactured by Ford Instrument Company. The TARTAR missile is built by Convair (Pomona) Division of General Dynamics Corporation.

The computer makes use of both electromechanical modules and all-transistorized electronic plug-in modules—providing a design which offers the utmost in serviceability and extreme compactness.

Ford Instrument also builds the launching and control order computers for the Navy's TERRIER missile. The TARTAR and TERRIER are designed to intercept enemy aircraft at ranges and altitudes beyond the capabilities of conventional anti-aircraft guns.

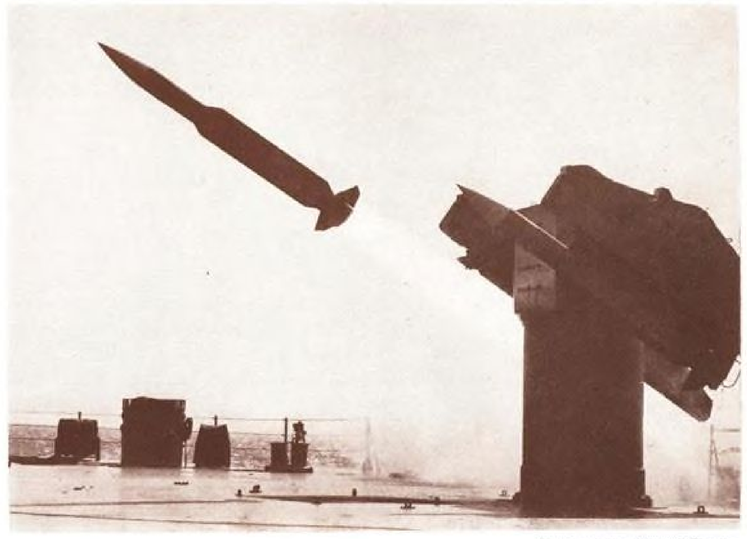


Photo courtesy Convair/Pomona

Engineers, Scientists Needed New programs at Ford Instrument have created outstanding employment opportunities for experienced systems engineers and scientists for work in digital computer engineering and programming, advanced mathematics, thermionics, experimental solid-state physics, and microwave devices. Address inquiries to A. L. Buckwalter. They will be held in strict confidence.

Ford Instrument "Firsts" in Inertial Guidance

...have made Free World headlines

Ford Instrument guidance and control have been used in many important firsts:

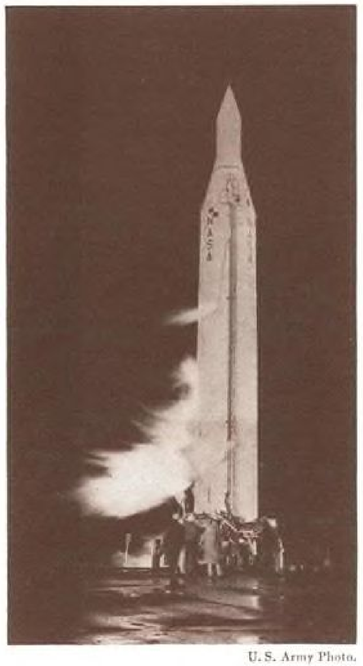
FIRST operational ballistic missile (REDSTONE)

FIRST successful launching of a Free World satellite

FIRST successfully recovered nose cone

FIRST recovered simian passengers (Able and Baker)

FIRST successful Free World space probe.



U.S. Army Photo.

New Project to Study Combined Airborne Display of Radar, Infrared and Photo Data

Ford Instrument engineers here compare map with aerial photos. Sensor interpretation study includes psychology, statistical analysis, cartography, and photography, as well as radar and infrared detection techniques.

Methods for airborne interpretation of information received from the most commonly used types of reconnaissance sensors—photographic, radar and infrared—are being developed by Ford Instrument Company under Air Force contract from Wright Air Development Division.

The new study contract, one of the largest ever received by Ford Instrument in this field, extends the pioneering work previously done by the company on the subject of integrated Sensor Interpretation Techniques. This work encompassed psychological studies, actual field tests at Ft. Holabird, Md., and Sheppard Air Force Base, Texas, and statistical analyses. The results of the studies are classified. Their paramount importance to national defense is indicated, however, by the fact that during World War II aerial reconnaissance accounted for more than 85% of all intelligence collected.

Each of the three types of sensing devices—camera, infrared, and radar—has advantages and limitations.

For instance, cameras provide very clear pictures in good weather. However, the identification of a particular target frequently can be facilitated by use of infrared and radar information in addition to the aerial photograph.

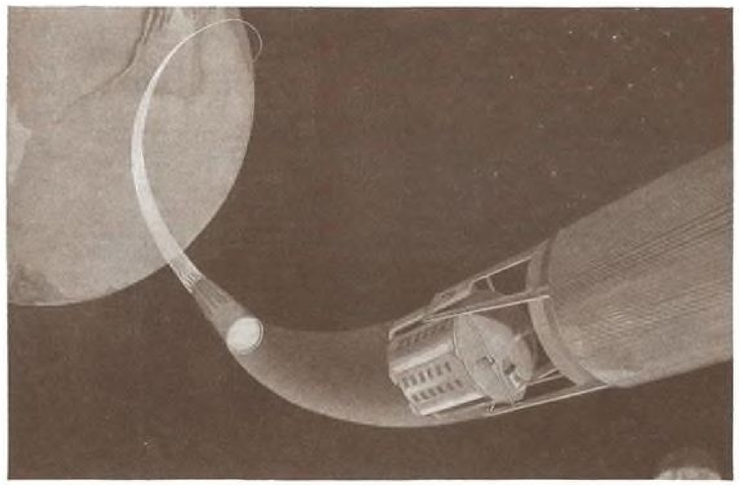
Infrared sensors are especially good for obtaining data on an object whose temperature is different from that of its surroundings, and, unlike light sensitive photographic equipment, infrared systems can be used at night without special illumination. For these reasons, an operating plant shows up much better than the same plant idle, but the quality of the pictures does not compare in detail with an aerial photo.

Radar, like infrared, misses much detail, but has the advantage of working at any time of day and in all but the worst weather. It is particularly excellent for detecting metallic objects and structures.

Ford Instrument engineers are devising methods for combining data from two, and possibly all three, of the sensors to provide a display which contains more information than any sensor alone provides and which can be interpreted rapidly and accurately.

Above: Ford Instrument engineer checks temperature of experimental thermionic cell.

Right: Using nuclear or solar energy for heat, thermionic converters are an ideal low-mass electrical supply for satellites and space vehicles.



Study Shows Thermionic Power Close at Hand

Thermionic studies, now under way in Ford Instrument laboratories, indicate that a vast new field for power generation is being opened up. First-generation model thermionic cells (for direct conversion of heat into electricity) have been built, including units which provide surprisingly high current densities at moderate temperatures.

Ford Instrument thermionic studies include the feasibility of building thermionic converters into the fuel elements of nuclear reactors, the use of fossil fuels and solar energy for thermionic conversion, and the construction, study and evaluation of numerous thermionic cell types—particularly for operation at moderate temperatures.

Investigations indicate a wide variety of practical applications, including small gas-fired units to serve as generating systems for land-based military uses, naval applications such as powering sonobuoys and survival equipment plus a large number of industrial applications.

In addition, the thermionic converter, because of its simplicity, compactness, and low mass, is believed to form a nearly ideal electrical power source for satellites and other space vehicles, using as a source of heat either solar or nuclear energy.

New Data Transmission System to Aid Air Traffic Control

Airborne equipment Coder-Decoder Group AN/APA-117, electronics unit at left and three transducer units at right. This prototype equipment has just completed air traffic evaluation tests at Mitchel Air Force Base.

Utilizing existing interrogator-responder-type beacon equipment, a system designed to augment present air traffic control facilities, both civilian and military, has just completed evaluation tests at Mitchel Air Force Base, Long Island.

The equipment, designed and built by Ford Instrument under Air Force contract from Rome Air Development Center, uses high-bit-rate digital transmissions on a time-shared basis to obtain flight data from discretely addressed aircraft. The present equipment handles information on aircraft altitude, air speed, and magnetic heading. The system is completely flexible, however, and future developments can include other data or allow data transmission from ground to aircraft.

In addition to offering speed and accuracy for air traffic control, the system is readily adaptable to military IFF needs.

Mitchel Air Force Base was chosen for prototype evaluation tests because of its location within the congested New York area. Nearby LaGuardia Airport alone handled 155,000 planes in the first eight months of 1959.

Airborne portions of the new equipment are extremely compact and lightweight, considering their function and also considering that they are prototypes. Each data converter occupies approximately 40 cubic inches and weighs just over 2 pounds. The electronics unit has a volume of less than ⅓ cubic feet (5¼ x 7½ x 12¾ inches) and weighs just under 20 pounds, including shock mounts.

R. M. Schwartz, Chief Engineering Scientist for Special Weapons of Picatinny Arsenal, and J. Kallenberg, project supervisor of Ford Instrument, examine JUPITER fuzing device after flight into outer space and recovery from ocean.

New Fuzing Contract for Ford Instrument

The Ford Instrument Company has received a $2.3-million contract from Bulova Research & Development Laboratories, Inc., to develop and produce a fuzing device for the Army's newest missile, the PERSHING.

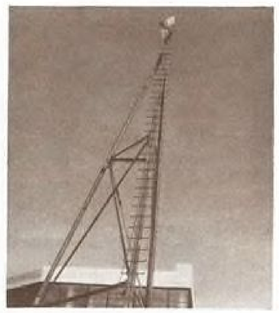
Ford Instrument has had wide experience in warhead control work. Notable completed activities include safety, fuzing and arming devices for atomic weapons and the fuzing device for the JUPITER missile (see photo). The PERSHING fuze program is under the technical direction of Picatinny Arsenal.

Additional Aero Navigation Contracts Awarded

U.S. Air Force Photo.

In the past six months, Ford Instrument has been awarded approximately $5,000,000 in additional U. S. Air Force contracts for AN/ASN-7 systems, components and test equipment. The ASN-7 is a dead-reckoning course and distance computer system being used in KC135's, F101-F's and other aircraft to provide extremely accurate navigation.

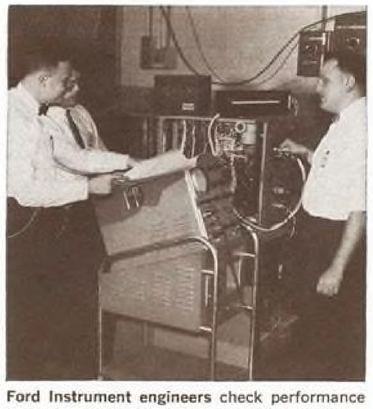
Flight Control System is Tested At Ford Instrument Facility



Ford Instrument engineer adjusts control on panel of the AN/UPW-1 Flight Control System, during test at company facility. At right, is target tower on which radar is focused. The AN/UPW-1, developed under the direction of the U. S. Army Signal Research and Development Laboratory, is designed to control combat surveillance drones on flights deep over enemy territory, to actuate and control their sensors (such as cameras, TV, infrared and other devices for locating the position and movements of troops and materiel), and to telemeter data from the drone to the ground.

The AN/UPW-1 system includes the control trailer shown, as well as other ground-based and airborne equipment.

New Multi-Channel Data Converter



Ford Instrument engineers check performance of first transistorized data converter model.

Built by Ford Instrument Company, an all-solid-state data converter which can convert two-speed synchro voltages into digital output has successfully completed evaluation tests at Naval Electronics Laboratory, San Diego, Calif. The basic equipment can be packaged into less than one-half cubic foot, making it ideal for aero and missile applications.

Styled the "universal sensor data converter," this design can also be adapted to handle inputs in the form of a-c and d-c voltages and resolver voltages.

Several separate converters have previously been necessary to perform the conversions capable of being handled by the new device. This is the first time that a *single, solid-state* converter has been able to convert inputs of widely diverse nature. In addition, the new device can be made to translate digital output information back into analog terms for actuation of analog-type servo and control systems for such applications as aircraft flight control, missile launching and guidance, and industrial control systems.

Ford Instrument engineers, who have been working on the problems of data conversion for the past six years, started work on the new converter in 1957.

We invite you to learn more . . .

Responsible agencies or industries, possessing the requisite security clearance and need to know, are invited to learn more about Ford Instrument capabilities. Ford Instrument Liaison Engineers are always ready to discuss your new or special requirements, and will be glad to provide you with detailed information on specific project capabilities.

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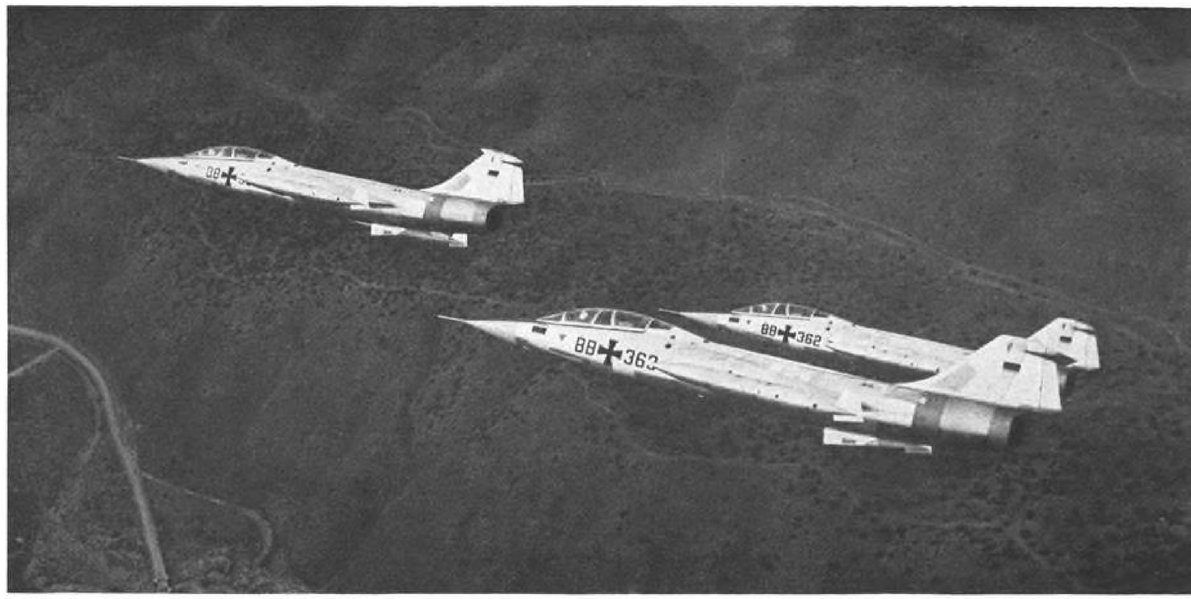

LOCKHEED is manufacturing 66 F-104Gs for West Germany, which will build hundreds under license. Canada will build the CF-104, and Japan the F-104CJ, under licensing agreements. Netherlands and Belgium also are working out F-104 licensing arrangements.

Lockheed Diversifies for New Markets

By Russell Hawkes

Burbank, Calif.—Sales of aircraft accounted for less than half of Lockheed Aircraft Corp.'s total sales in 1959 for the first time in the company's history and the trend is being paralleled in other companies within the industry.

"Concentric diversification is the way Lockheed officials describe their version of the drive for new capabilities and markets. The term refers to the expansion of existing product lines and capabilities, not the establishment of radically different ones.

Realignment of corporation capabilities to fit a rapidly changing competitive picture has demanded a furious pace of Lockheed's concentric diversification. In the past 15 months, three subsidiaries have been acquired, two more have been created out of existing divisions and affiliations have been made with two foreign firms and one domestic firm. Reasons for this and estimates of the future course of the program were outlined to AVIATION WEEK by Dudley E. Browne, Lockheed vice president-finnance and Dr. Igor Ansoff, head of the corporation's Diversification Task Force.

They predict that the pace of Lockheed diversification must slow down. Speedy diversification was needed at first to catch up with the pace of technology and related changes in defense contracting patterns. The predicted slowdown will not result from lack of interest in further diversification, but because Lockheed experts are convinced that time is needed to assimilate the acquisitions already made and allow management to adapt itself to new responsibilities.

Thorough Planning

Thorough planning and anticipation of trends are expected to prevent rapid-fire bursts of diversification such as the company has just experienced. Even technological breakthroughs can be forecast to some extent and included in corporate plans.

Though repetitive cycles of intense diversification may be avoided, some Lockheed officials are beginning to feel that the high rate of technological obsolescence may demand never-ending diversification. However, they have noted a trend in the corporation toward acquisition of progressively smaller

Lockheed, Kaiser to Build Azcarate

Aviones Lockheed-Kaiser Argentina has been established as an equal partnership between Industrias Kaiser Argentina and Lockheed Aircraft International, a subsidiary of Lockheed Aircraft Corp. The new plane manufacturing company in Argentina is in accord with a decree signed recently by Argentina President Frondizi to encourage Argentine industrial development.

Initial product will be the light, single-engine Azcarate utility airplane specifically developed by Lockheed-Azcarate, another Lockheed affiliate, and in Italy by the newly-formed Aeronautica Macchi-Lockheed partnership (AW Apr. 25, p. 95).

Aviones Lockheed-Kaiser will start with a working capital of $2 million, contributed equally by Industrias-Kaiser and Lockheed International in cash, equipment and facilities. A new factory will be built adjacent to Industrias-Kaiser automobile plant in Cordoba, a city of 300,000 population about 400 mi. northwest of Buenos Aires. Production of the airplane is scheduled to start this year. Several hundred persons will be employed when production gets under way.

The new airplane, whose prototype was test-flown at Lockheed's Georgia Division last September and certificated by Federal Aviation Agency last month, is an all-metal, high-wing transport carrying six persons or about 1,000 lb. cargo (see p. 67).

Industrias-Kaiser is 33% owned by Willys Motors, Inc., a Kaiser subsidiary. About 18% is owned by the Argentine government, and the remainder by private investors, largely Argentine.

Much that was new and informative was discussed and demonstrated at Eclipse-Pioneer's recent cost conference held with representatives of the Air Force, Republic Aviation, and over 50 of E-P's subcontractors and suppliers.

Bendix cost conference reports

IMPORTANT PASS-ALONG SAVINGS

on F-105D Air Data and Instrumentation Systems

Spelled out to E-P vendors were advanced techniques that shaved significant dollars from the manufacturing costs of Air Data Computer Systems and Vertical-Scale Instruments for the USAF's Republic-built F-105D Thunderchief.

Objective was to stimulate E-P's vendor organization into similar types of cost reduction effort.

One successful E-P cost-saving technique presented was the use of "electronic instructors" on the assembly floor. These novel audio-visual aids —individually controlled by each assembly worker to his own learning rate—reduced lead man requirements by 80%, cut learning time in half. Another technique discussed was the replacement of point-to-point wiring with prefabricated harnesses to improve quality, reduce assembly time. Other savings noted came from the use of close-range slow-motion pictures to seek out "lost motion" in assembly operations, from the use of tool standardization and material handling innovations, and from the use of standardized data. All added up to an effective demonstration of how E-P KNOWMANSHIP has saved—and is continuing to save—money for Republic, the Air Force, and the taxpayers.

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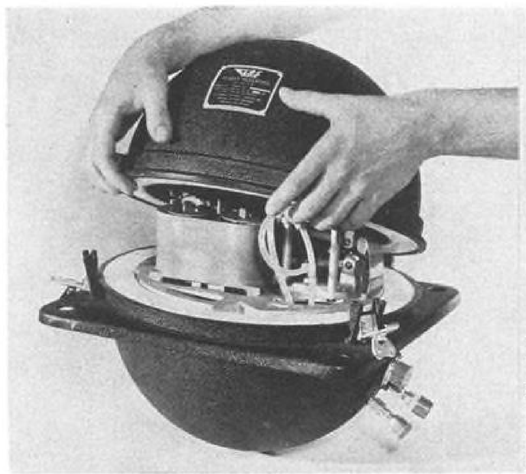


FLIGHT RECORDER (above) is built by Lockheed's Special Devices Division and automatically produces permanent, continuous oscillographic record; unit is used in Boeing 707 jet transports. At right is the Lockheed Azcarate Model 60 utility plane.

companies to fill corresponding needs in its capabilities.

One of the motivating factors behind Lockheed diversification was the imbalance of defense contracting patterns caused by the weapon system concept, progress in missiles and the relatively small ratio of airframe investments to total missile system costs. Prime contracts usually go to the company responsible for the most critical element in the system.

The first big guided missiles were air-breathing cruise missiles such as Northrop Snark, Chance Vought Regulus and Martin Matador. This business naturally fell to old-line aircraft companies because the missiles were essentially airframes. This could not be said of smaller missiles and the first big ballistic missiles. For the first time, Lockheed and the other old-line airplane makers found themselves facing outside competition, notably from electronics firms.

Avionics Importance

Most of the first long-range ballistic missile prime contracts came to the aircraft companies because the military did not immediately appreciate the increased importance of avionics and the lesser demands for the metal-bending skills of the aircraft companies.

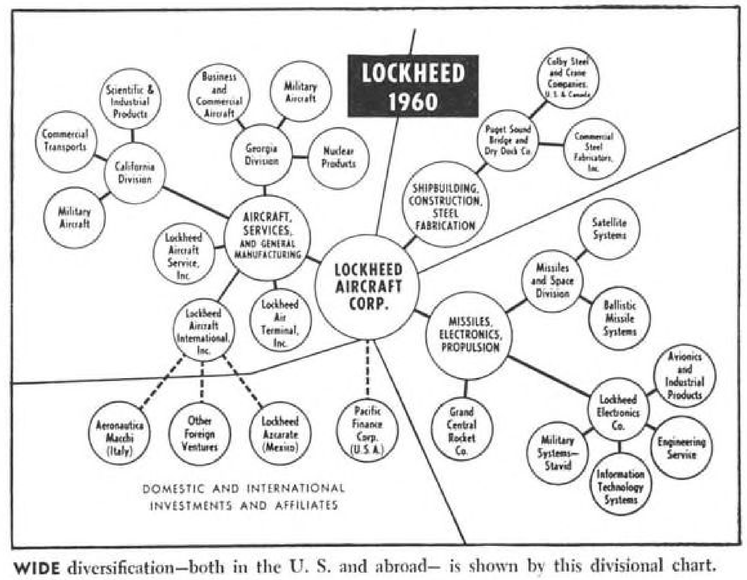
The situation called for quick adjustment of the corporation's capabilities. In March, 1959, Lockheed Electronics and Avionics Division (LEAD) was spun off as a separate entity, but certain critical skills were still found lacking. In May, 1959, Lockheed agreed to acquire Stavid Engineering Co. which became a wholly owned subsidiary in September. Though a small company, Stavid had built a respectable reputation for its work with advanced radar. In December, Stavid and LEAD were joined to form Lockheed Electronics Co.

Lockheed officials foresee the day when propulsion will replace checkout equipment and guidance and control electronics as the critical field in missilry and space technology. This was behind the announcement that Lockheed would purchase a 50% interest in Grand Central Rocket Co. The share of missile money assigned to electronics is expected to remain high, but as electronic engineers perfect their art, company officials anticipate a trend back toward off-the-shelf purchase of electronic components and subsystems.

The decision to buy Puget Sound Bridge & Dry Dock Co. of Seattle, a shipbuilding firm, was due partly to the observation that a large part of the missile budget is being assigned to launch complex construction, especially if the bases are hardened. The Seattle firm has considerable experience in heavy construction work.

The Lockheed announcement of plans to acquire Colby Steel and Crane Co. is related to the purchase of Puget Sound Bridge. Colby plants in Seattle and Vancouver fabricate steel structural components under subcontract for assembly in the Puget Sound Bridge shipyard. In the future, Lockheed plans to move Colby under the same roof with Puget Sound Bridge so that fabrication and assembly will form a single integrated operation.

Lockheed officials say the Puget Sound acquisition now appears even wiser than it did at the time it was made. They anticipate that ocean cargo-hauling with nuclear-powered vessels



WIDE diversification—both in the U. S. and abroad— is shown by this divisional chart.

THEY RELY ON RADIATION

for missile range instrumentation

In 1956, the Air Force called for a major advance in antenna design to instrument the Atlantic Missile Range. The requirements: long-range automatic tracking of missiles in flight.

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Two of the antennas were delivered to the Pacific Missile Range to meet an accelerated launching schedule.

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Radiation's plants are at Melbourne and Orlando, Florida; Mountain View and Palo Alto, California.

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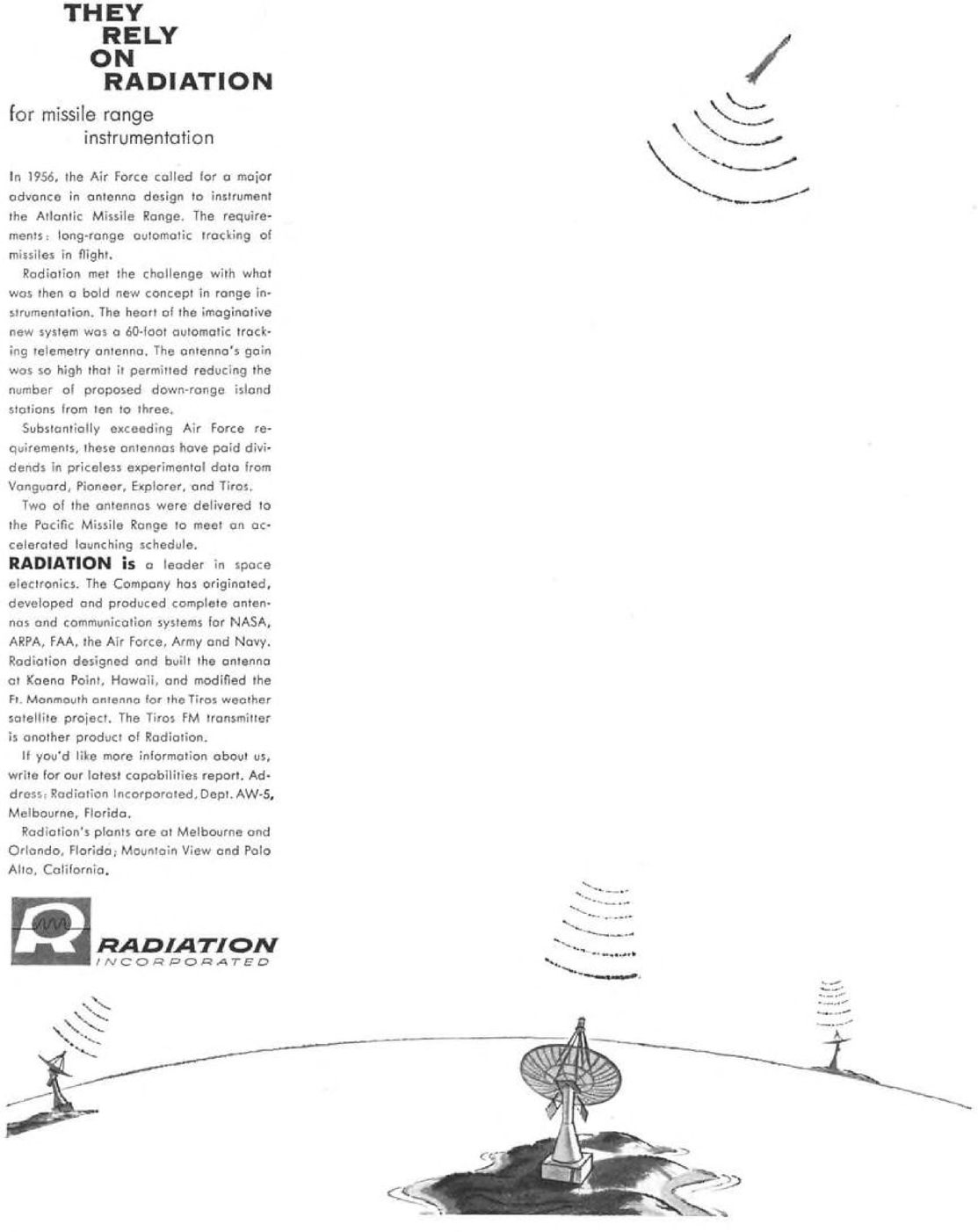

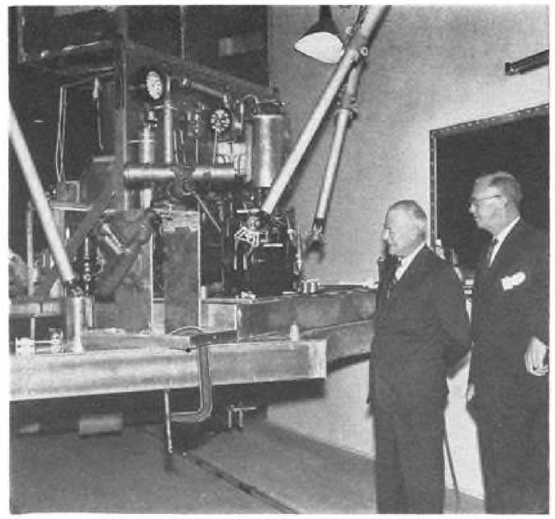

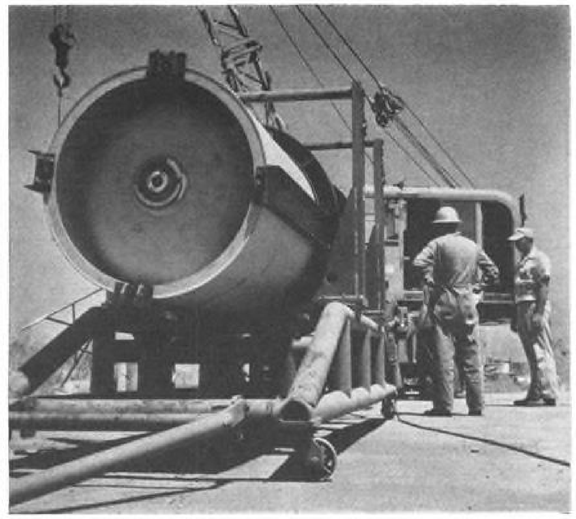

LOCKHEED'S board chairman, Robert E. Gross (left) and W. A. Pulver, Georgia Division vice president and general manager, inspect hot cells in Nuclear Research Laboratory at Dawsonville, Ga., as remote-controlled manipulator checks radiation effects. At right workmen hoist Nike Zeus sustainer motor, built by Grand Central Rocket Co., prior to lowering it into an underground curing oven where propellant will be poured into its fuel chamber.

will become a big and highly profitable business. Lockheed's Nuclear Products Division has built reactors.

Lockheed's California and Georgia divisions are both interested in the vertical lift field. California Division is working on the CL-379 tilt-wing turboprop Army liaison plane and a helicopter. A prototype of the helicopter crashed recently in flight test (AW Mar. 21, p. 37). The twin-engine CL-379 is being designed especially for forward area work with ground troops. No civilian market is foreseen, though the same principles could be used in civil aircraft.

Georgia Division has offered Army a proposal for a two-place VTOL aircraft using jets deflected through the fuselage bottom from a pair of turbojets located at the wing roots. Thrust is augmented by entraining ambient air through louvers in the fuselage top. Propulsion system is switched over to forward thrust by re-positioning the deflector valve to direct exhaust gases through the engine tailpipes.

Lightplane Field

The corporation is exploring the light aircraft field through Lockheed-Azcarate, a Mexican affiliate, and Aeronautica Macchi, an Italian firm in which Lockheed is buying a substantial minority interest. LASA-60, light utility aircraft to be built by Lockheed-Azcarate, was designed by the California Division.

Georgia Division is trying to sell the Super Hercules, stretched version of USAF C-130 cargo transport to civilian airlines (AW May 16, p. 39) but corporate officials believe the air cargo market will not achieve its potential until ground handling delays and costs are reduced. California Division is seeking a solution.

An anomaly among Lockheed subsidiaries and affiliates is Pacific Finance Co., which was acquired in 1946 with an eye to financing a boom for small aircraft, then foreseen. When the boom failed to materialize, Pacific Finance devoted its resources largely to automobile and home loans, making it the single example of non-concentric diversification in the Lockheed stable. It is expected to serve as financier for the Lockheed-Azcarate LASA-60 program, coming into its planned role 15 years later.

The term, "concentric diversification," means setting up new organizations to improve competence in fields at the edge of the company's existing capabilities. For instance, an aircraft manufacturer naturally develops some

TRACKING antenna was designed and built by Lockheed Electronic Co.'s Military Systems-Stavid Division, at Plainfield, N. J. Antenna is an advanced technological contribution in the area of long-range missile detection and high-powered radars.

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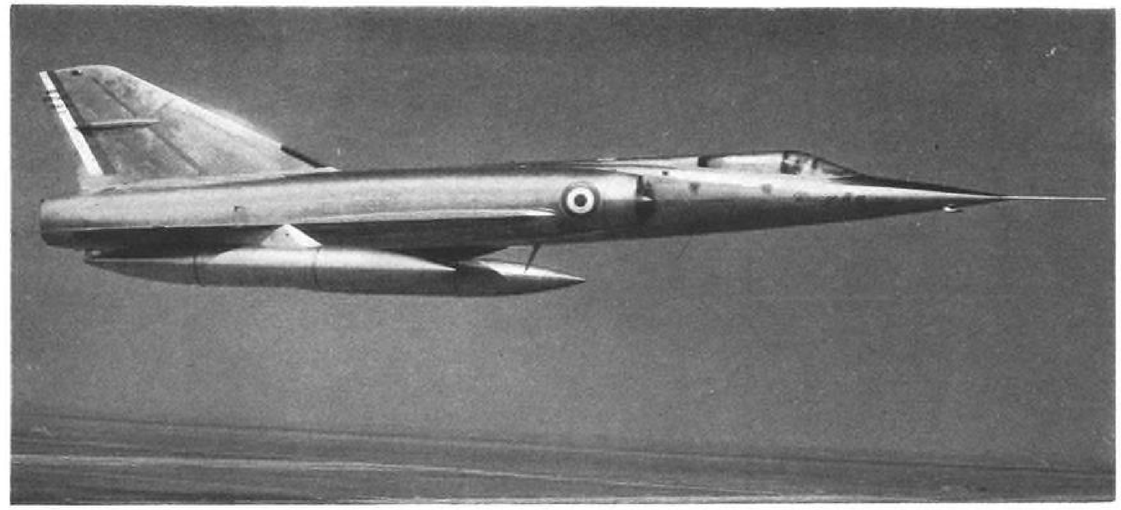

Dassault Mirage IV Strike Bomber Prototype

Three preproduction Dassault Mirage IV tactical strike bombers have been ordered by the French government; all will be powered by Snecma Atar-9 turbojets. Deliveries are scheduled for 1963 (AW May 2, p. 147). Government eventually plans to order 50.

competence in avionics and a missile airframe builder naturally learns something about propulsion. Concentric diversification is to form separate organizations based on these peripheral capabilities and market them outside the company. By so doing, a new, wider periphery of capabilities and markets is built, setting the scene for a new round of expansion.

Lockheed is strongly identified with its products, as are the other old-line airplane builders. Because of this, its diversification program is a process of broadening product lines. It will not become a holding company.

Lockheed officials back the concentric diversification system because the parties in a merger can get cost-free technical, productive or administrative power from each other if their operations are closely related. They apply the term "conglomerate" to other patterns of diversification. The word refers to a process of acquiring or creating new companies for their profit or financial stability without regard to operational tie-ins. The result is a stable, profitable "conglomeration" of unrelated products and capabilities.

Lockheed executives list three variations on the concentric diversification theme and have used all of them. They are:

• **"Build-up" of a new or peripheral** capability by adding to the existing staff and constructing new facilities.

• **"Spin-off" of intramural departments** or groups to form new divisions or subsidiaries when their strength, size and the extramural market for their capabilities justify the action. There are advantages in allocating specialized overhead costs to specialized product groups while sharing general overhead costs at the corporate level. There are also advantages in segregating fixed-price from cost-plus-fixed-fee operations and separating technical arts which serve different markets.

• **Acquisition by merger** of outside companies with related operations.

Acquisition of outside companies is the quickest and probably the most rewarding of the three, but it also is the most complicated. To find and analyze potential mergers, Lockheed created the Diversification Task Force. The task force reports directly to a policy committee headed by Robert E. Gross, chairman of the board.

Critical Skills

Decision to consider possible mergers is made if critical skills for entry in a desirable new field are found to be lacking in existing divisions. Task force procedure is to examine the needs of the corporation, search industry for merger opportunities, evaluate alternatives and establish a strategy composed of broad rules for selecting the right alternative. If the task force recommends acquisition of a company, the policy committee will appoint a negotiator from the top echelon of the corporation.

Dr. Ansoff reports there is no simple, objective yardstick by which to measure the wisdom of acquiring a particular company. A minimum of 20 financial indices and ratios are used in the analysis but the final decision rests heavily on the business insight of corporate officers.

One criteria which can squelch any possibility of acquiring a large company is its price-to-earnings ratio. If the ratio of price on the open market to earnings per share is much higher than Lockheed's, an exchange of stock results in a dilution of earnings on Lockheed stock. The Lockheed price-earnings ratio is typically around 7.5. Electronic companies are usually around 20 and rocket manufacturers may be as high as 100. Lockheed executives call the stock of high ratio companies "Chinese money," because of its low value in an exchange of stock. High ratios discount earnings far into the future. The low price-earnings ratio of aircraft companies such as Lockheed is obviously a stumbling block in a diversification program.

The two other most important factors are profit outlooks and the degree to which the new company's operations would fit in with those of the corporation. If the fit is not mutually profitable in respects other than financial, Lockheed probably would not be interested. The Policy Board and the Diversification Task Force have turned down clearly profitable mergers for failing to fit into the concentric diversification pattern, according to Dr. Ansoff.

Browne says Lockheed must grow to give the company's best employes opportunities for advancement, or the firm can expect to lose them. It also must grow to make its stock attractive to the public and to attract lenders. Browne quotes a study which shows that the 48 leading corporations in the country record a steady 9% per year growth in volume.

Diversification is necessary for growth because Lockheed's traditional aircraft market is limited. The military services, predominant airplane buyers for 20 years, no longer provide a market which will support the desired growth rate. Under the present constant-level-of-ap-

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propriations philosophy, the entire defense market is shrinking relative to the Gross National Product and the proportion of the market assigned to aircraft is being compressed by missiles.

Lockheed's historic share of the defense market has been about 7%. Browne said Lockheed cannot increase its share at the expense of competitors because the Department of Defense is under continuous pressure to spread its purchases geographically and keep companies with important productive capacity from going out of existence.

Commercial transport aircraft buyers have long been a fruitful source of income for Lockheed but the market is nearing saturation, for the moment, and production rate of the turboprop Electra is being tapered off to bring it closer to the expected rate of new orders.

In response to all these pressures, Lockheed has:

• **Diversified its military products** to keep its 7% of the defense market, or expand it.

• **Sought overseas markets** for its military products as a partial remedy for the shortcomings of the U. S. defense market.

• **Broadened its line** of products and ventured into new markets.

Lockheed hopes to increase its operations in civilian markets to obtain the stability so obviously lacking in the defense business. A highly tentative goal is one-third of corporate earnings from non-defense markets. Earnings are a larger percentage of sales in non-defense business, so the fraction of corporate sales assigned to non-defense markets would be, perhaps, one-fifth or one-fourth.

Lockheed has no interest in the consumer market. Browne points out that consumer sales are almost completely dependent on short term popularity obtained by aggressive and costly promotion rather than intensive, expert engineering, which is the forte of aircraft, missile, electronics and heavy construction companies.

The concentric diversification philosophy is based on maintaining a high percentage of common problems and techniques among corporate divisions and subsidiaries. Therefore, all Lockheed products are likely to remain heavily engineered.

Since an important aim is to balance the cyclic instability of Defense Department contracting, Lockheed officials looked for markets which are countercyclic to the defense business. They found one in road-building and heavy construction, for the government puts more money into highways, dams, schools, etc., when defense spending is pared. Puget Sound Bridge gives the corporation an entry in this field. The Diversification Task Force has been looking for a suitable company to acquire which could produce heavy construction equipment. So far, the search has been unsuccessful.

Lockheed civilian products probably will be limited to durable goods for producers. The corporation's capabilities in electronics and computer technology will be marketed in the form of industrial or commercial automation. Lockheed proposes to tailor its new computer products to specific design requirements.

Reduced size and productive capability probably is in the future for California Division, historically, the core of the company. However, its technical capability will increase, according to division vice president and general manager Burt C. Monesmith. In five or 10 years, employment and net worth of the division is expected to fall 10 or 15% and it will operate fewer facilities, but the diversity and strength of the scientific and engineering departments should rise sharply.

As much as 50% of the division's business may be non-aircraft operations. The division has already been doing a surprisingly wide variety of business ranging from the conducting of important solar research as part of the U. S. effort in the International Geophysical Year, to structural subcontracting for other airframe builders and high stress plastic manufacturing.

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Arinc Unveils New Avionic Reliability Data

By Philip J. Klass

Dayton—New data for advance prediction of avionic equipment reliability, which reveals that reliability falls off more sharply than previously thought as equipment complexity increases, was disclosed here during the recent National Aeronautical Electronics Conference (Naecon).

Analysis of data for a variety of airborne, shipboard and ground-based equipment shows that the relationship between reliability and complexity is not a linear one, George T. Bird, Arinc Research Corp., reported. Arinc Research Corp. specializes in reliability problems.

This means that while a one-tube airborne analog type system will operate an average 21,700 hr. before failure, a 1,000-tube system can be expected to operate for only 2.2 hr. before failure, not 21.7 hr. as previous theory suggested. The foregoing figures are based on a design without redundant circuits.

Prediction Formula

Analysis of data on reliability of a number of different airborne, shipboard and ground-based systems in field use, collected by Arinc, Bell Telephone Laboratories, Vitro, Radio Corporation of America and others, indicates that the following "complexity de-rating" should be employed in predicting the mean-time-between-failure (MTBF) of electronic systems:

- **Airborne:** $\text{MTBF} = 21{,}700\ (N)^{-1.05}$
- **Ground/Ship:** $\text{MTBF} = 187{,}000\ (N)^{-1.39}$

The factor "N" is the number of non-redundant "active element groups," called "AEGs" for short. An active element group consists of a tube or transistor and its related circuit components.

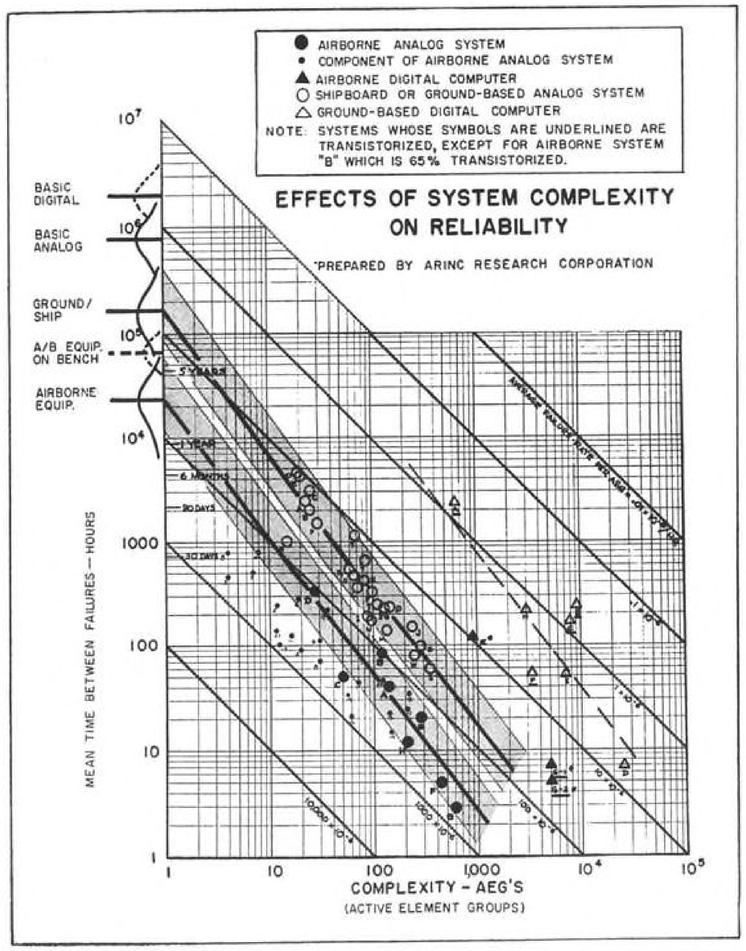
For example, an AEG for a transistorized equipment consists of one transistor, plus one diode, three resistors and two capacitors. In addition, the AEG includes the following, figured (for convenience) per 1,000 transistors: 50 inductors, 10 power transformers and chokes, 10 IF and pulse transformers, 10 motors, 25 relays, 100 variable resistors, 100 switch contacts, 20 jacks and plugs, 10 receiving-type vacuum tubes and two special purpose tubes.

The reliability prediction chart, called a "scattergram," which Arinc has developed shows the actual reliability experienced in the field for a number of military equipments, whose design age ranges from two to 10 years, Bird said. These encompass a variety of types, ranging from airborne bomb-navigation systems to ground-based communications receivers.

The Arinc scattergram shows the inherent, or "true random" failure rate per basic AEG when used in analog circuits. This ranges between one and three failures per million operating hours, with an estimated mean of 1.2 failures per million hours. This figure assumes that parts whose deterioration patterns are Gaussian are replaced by preventive maintenance before actual failure. Also, that initial design debugging has eliminated the "maverick" tolerance problems and that parts testing has eliminated the initial defectives, Bird said.

Preliminary data on digital-type circuits indicates that they will have a somewhat higher basic reliability (lower failure rate) than the basic analog type circuit, Bird said. However, the data at present is not sufficient to establish a basic digital data rate, although the preliminary estimate is shown dotted on the Arinc scattergram.

Ground-shipboard equipment experiences a mean failure rate of 5.3 malfunc-



NEW DATA for predicting reliability of avionic equipment, based on actual field performance of a variety of airborne, ground and shipboard equipment, shows that reliability falls off more sharply with increasing complexity than previous theories indicated. Reliability of satellite avionics equipment is expected to be comparable to that of ground/shipboard equipment. Scattergram was prepared by Arinc Research Corp.

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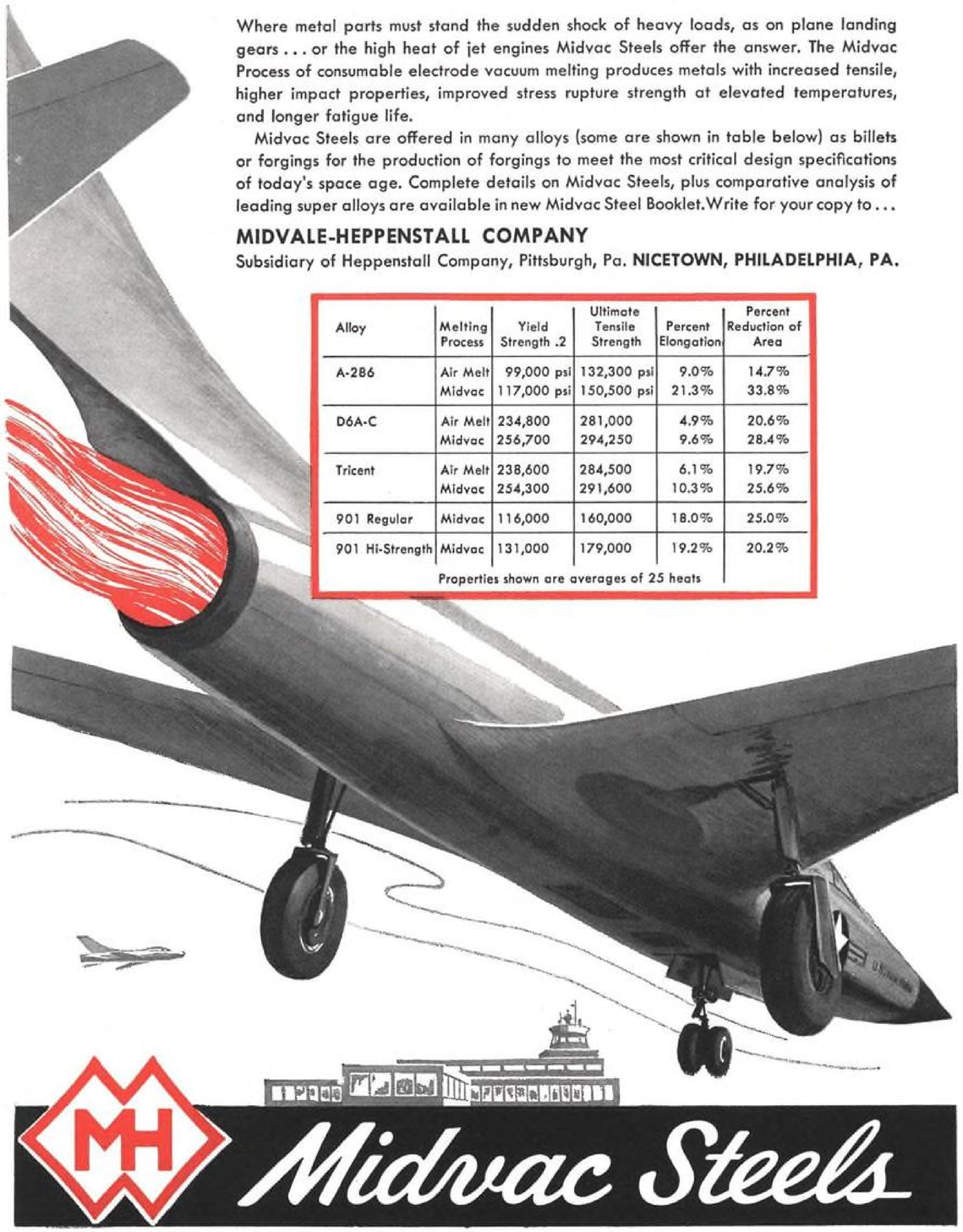
	Midvac	117,000 psi	150,500 psi	21.3%	33.8%
D6A-C	Air Melt	234,800	281,000	4.9%	20.6%
	Midvac	256,700	294,250	9.6%	28.4%
Tricent	Air Melt	238,600	284,500	6.1%	19.7%
	Midvac	254,300	291,600	10.3%	25.6%
901 Regular	Midvac	116,000	160,000	18.0%	25.0%
901 Hi-Strength	Midvac	131,000	179,000	19.2%	20.2%

Properties shown are averages of 25 heats



MH Midvac Steels

tions per million hours of operation, considerably lower than the 46 failures per million hours, both for a single (one) AEG. The failure rate of airborne equipment when operated under bench-test conditions is roughly midway between ground/shipboard and normal airborne failure rates.

The Arinc chart shows the "complexity de-rating" which must be applied as the number of AEGs increases in the form of cross-hatched bands. These drop off more sharply than the theoretical values (at a 43 deg. angle) previously used in predicting equipment reliability.

Adjustment Factor

One reason for the fall-off in reliability with increased complexity, Bird speculates, is that increased complexity usually results in an increased number of knobs and other adjustments by which the operator can compensate for deterioration in performance or degradation of individual subsystems. As the number of such adjustments increases, the burden on the human operator increases and he is less able to take effective and timely action to correct the deterioration.

Although only limited data is available on the reliability that can be expected in satellites and space vehicles, it indicates that the failure rate will approximate that of ground/shipboard equipment, Bird said. This is substantiated by intuition on the basis that the environment in space should be relatively favorable, with no sudden or large changes of temperature, no shock or vibration, except for the initial launch conditions.

Future Satellites

Because of payload limitations imposed by rocket booster power, most satellite equipments have necessarily been limited in their complexity. With the advent of larger boosters, and the more sophisticated payloads they make possible, designers of satellite avionics equipments are going to run headlong into the "complexity derating" factor.

If satellite payload reliability proves comparable to ground/shipboard equipment reliability, a system of 100 AEGs complexity approximately 733 total components), can be expected to operate for only about a month. This, in terms of complexity, is roughly the equivalent of a Tacan navigation set.

Assuming that a communications satellite can be built with a complexity of around 100 AEGs, a 10:1 or greater improvement in reliability would be needed to give it a useful life of one year.

One partial solution, Bird pointed out, is the use of redundancy in payload design. That is, providing one or more backup circuits or subsystems

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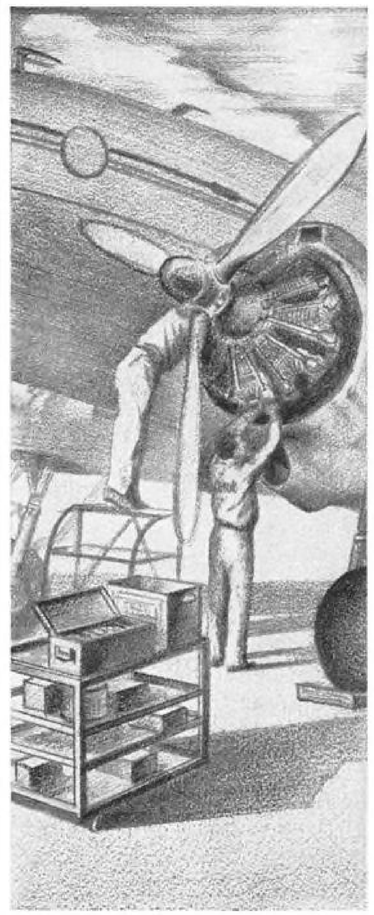

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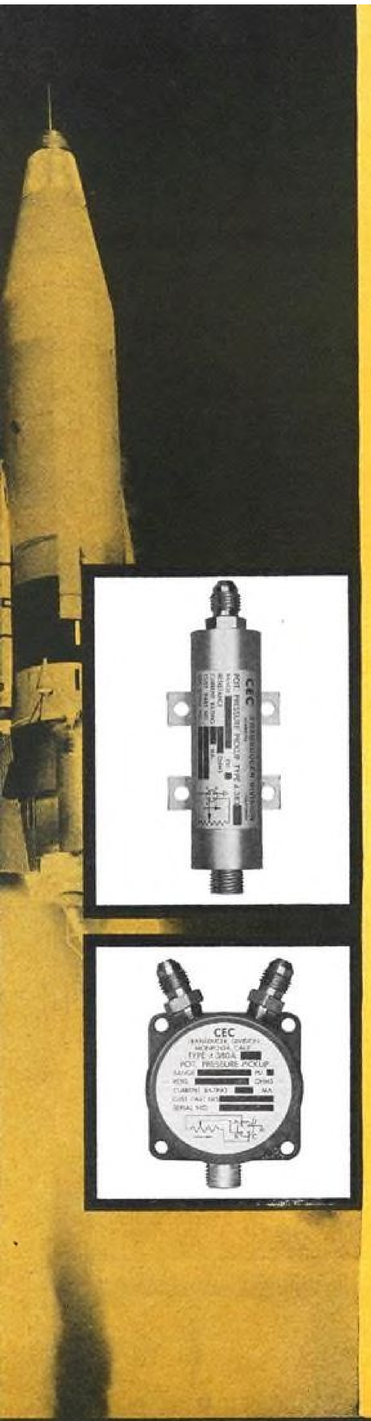

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with provisions for switching in the backup for a defective circuit or subsystem.

However, this adds to payload size and weight, and adds to the complexity of switching circuitry which in itself tends to reduce some of the gain from redundancy.

Reliability Effort Needed

"There is always the tendency to want to shoot first and ask questions later," Bird said in discussing space programs. "The space business is too costly to permit us to shoot without first verifying that interim reliability goals have been met. While reliability assurance, like quality control, is often regarded as a lackluster function, it is a function which in the space program will be vital . . . ," Bird said.

He cautioned that the following is required to prevent space from becoming "a multi-billion dollar orbiting junk heap":

- **Functional simplification** of space systems through a sacrifice of sophistication or a reduction in precision to avoid unnecessary complexity.
- **Multiple-redundancy** at component and subsystem levels.
- **Reliability assurance** program which will guide, specify, test and demonstate reliability progress from the parts level upward.

RADC Is Operating Language Translator

Washington—Automatic language translator with ultimate capability of translating Russian scientific and technical literature into English at the rate of 35 words a second is being operated at the Rome Air Development Center, it was disclosed here.

The translator, developed over the last several years by Air Force engineers and several contractors, has been in experimental operation since June, according to Rep. Overton Brooks (D.-La.), chairman of the House Committee on Science and Astronautics, which is looking into machine translation devices.

Present translations are performed on a crude word-for-word basis but give the sense of the original. This will be improved later this year when a word analyzer, which will correct grammar, goes into operation. The analyzer is being developed by International Business Machines Corp.

The language translator is limited by the inability to feed the machine Russian at speeds comparable to its translating ability. A typist, for example, working on a Russian keyboard can only prepare 40 words a minute on tape. This fall, however, Baird-Atomic, Inc., is expected to deliver to RADC a high-speed print reader, which will boost the input capability to 2,400 words a minute. An earlier electronic print reader made by Intelligent Machines Research Co. is now in use with the translator.

Key portion of the translator is an IBM-developed memory unit that can store 550,000 Russian-English words. As the Russian words are fed into the translator on punched tape, they are converted into electrical signals matched with coded equivalents on the memory unit, and the English translations are read out on an electric typewriter. Any word can be located in the memory unit in less than one 300th of a second, according to a House committee report.

The Air Force is only one of a number of government agencies, including the Central Intelligence Agency, the Army and the National Bureau of Standards, which are understood to be interested in machine translation of the Russian language. The U. S. government is presently spending about $1.5 million on manual translation of Russian into English.

Other organizations known to be working on different aspects of machine translation include the Rand Corp., Thompson Ramo Wooldridge, Harvard University, Lincoln Laboratories of Massachusetts Institute of Technology, Syracuse University, Georgetown University and Air Force's Cambridge Research Center.

Under Rome Air Development Center contract, Syracuse University is exploring means of transmitting graphic as well as written material. Design for construction of such a machine will get under way this month, according to the committee.

A dictionary as well as the word analyzer are undergoing development at IBM. A lexical buffer which can store words coming from the dictionary in complete sentences was recently added to the translator.

Space Data Capacity

Dayton—Data capacity (bandwidth) of space vehicle telemetry systems is increasing so rapidly that by next year it will be possible to transmit more data, faster, from the moon to the tracking station at Woomera, Australia, than it can be transmitted from Woomera to Los Angeles, Calif., according to Dr. Henry L. Richter, Jr., of Jet Propulsion Laboratory. Speaking at the recent National Aeronautical Electronics Conference here, Richter predicted that space vehicle telemetry bandwidth would reach a megacycle for lunar distances by the mid-sixties, adequate for slow-scan, high-definition television.

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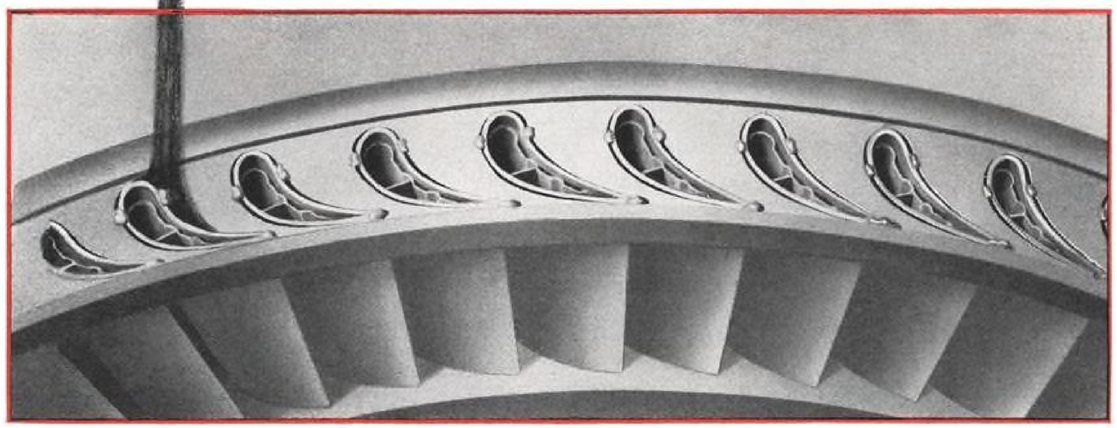
Metallurgical Memo from General Electric

G-E Vacuum-Melted Alloys Now Conquer Wide-Gap Brazing Barriers



Wide-gap brazing alloy is applied to turbine nozzle assembly. Vanes are tack-welded in position prior to brazing.

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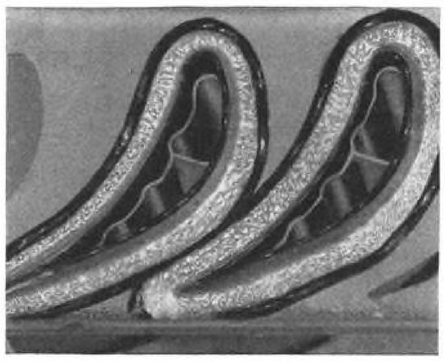

Insert shows vanes completely brazed in spite of gaps. Stains around perimeter of brazes are from stopoffs.

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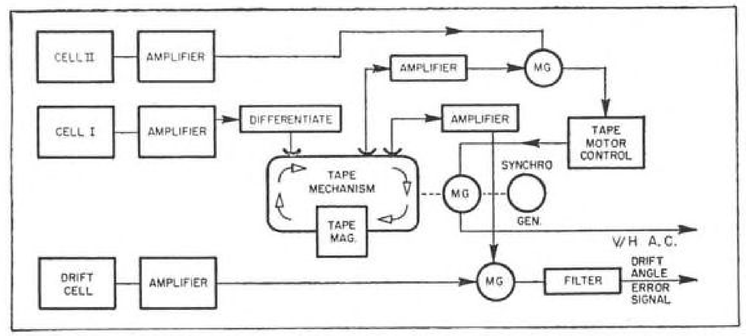
IR Velocity/Height Computer Studied

By Barry Miller

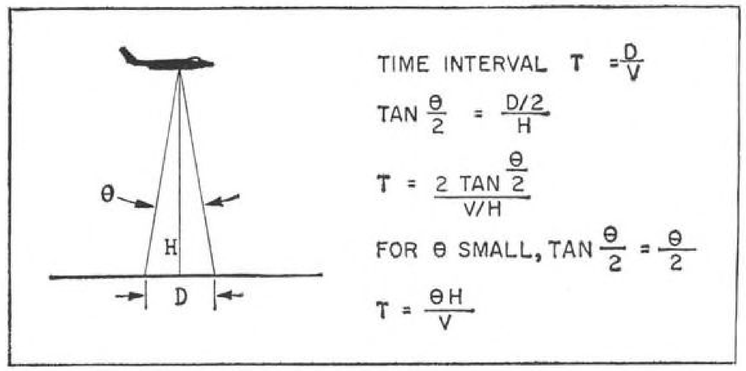
Paramus, N. J.—Airborne computer which will employ detection of infrared radiation emitted by the earth to determine the velocity/height ratio of a photo reconnaissance aircraft to accuracies approaching 1% or better is entering the final stages of development here.

Known as a velocity/height (V/H) computer, it is being built in the laboratories of the ACF Electronics Division of ACF Industries, Inc., for Air Force under a $100,000 study contract from the Wright Air Development Division (AW Aug. 24, p. 116). Pursuing a different approach, another company, Chicago Aerial Industries, Inc., working under a parallel WADD contract, also is developing an infrared responding V/H computer which is scheduled for comparison with the ACF Industries device. Both computers are to be completed early this summer.

V/H computers help solve the problem of blurred films which arise when film speed through a camera is not kept constant in relation to aircraft speed/altitude. The computer determines the velocity/height ratio and then provides signals which can be used to maintain film at proper speed. Normal accuracy of V/H computers, industry sources say, is slightly better than 3%. Laboratory accuracy of the ACF computer is better than 1%, according to Ken Ward, a senior physicist on the project.



VELOCITY/HEIGHT COMPUTER in development at ACF Industries is shown in block diagram form.



VELOCITY/HEIGHT RATIO is shown to be inversely proportional to the time between detection of ground emissions by two airborne infrared sensors.

Altitude Capability

The device is expected to be able to operate at altitudes of 500 to 100,000 ft. with a V/H range of 0.01 radians/sec. to 10 radians/sec.

According to ACF, the computer will sense infrared radiation emitted from the earth during day or evening hours and also distinguish cloud cover. The radiation is detected by two thermistor bolometer detector cells, which are pointed at different angles toward the ground. When one cell senses a variation in radiation, a signal is generated, followed an instant later by another signal generated as the second detector senses the same object.

This time interval between the detection of any ground object by both bolometers is then measured by an autocorrelation technique. The time interval is inversely related to the velocity/height ratio and the processed information from the system controls a servo which adjusts film speed.

The time interval is extracted from the signals generated by the two cells, ACF explains, by delaying the first signal with a variable-speed magnetic tape mechanism. Then, the signal is recorded and played back, the company says, with a delay directly proportional to the distance between record and playback heads and inversely with tape velocity. About 100 ft. of tape in a single continuous loop is employed. The tape not passing through the record and playback heads is stored in a special magazine. Used tape can be cleared by an erase head.

Error Signal

An autocorrelation technique which involves the average of the integral of the product of the derivative of one signal and the second signal itself gives an error signal which is proportional in sign and magnitude to the error in tape speed.

An induction motor functions as the correlation detector—the output of a tachometer coupled to the induction motor controls the speed of the tape through the motor. Because the speed of the tape drive motor is inversely proportional to the time interval between detection by the two cells, it is directly proportional to the velocity/height ratio.

Drift angles up to 15 deg. can be corrected with another infrared cell, ACF says. The time delay between the two cells will vary with drift angle. An additional pickup head on the tape mechanism processes the drift signal provided by the drift cell.

To keep the sensor pointed in the same direction as the camera, ACF engineers will mount the cells, collecting mirror and chopper on the inner camera gimbal of a two-gimbal stabilized platform. This arrangement, they say, will also minimize the effects of structural bending, pitch and roll of the aircraft.

Increased Range

For increased V/H range, two sets of cells are used with separate pickup heads on the tape mechanism. Each set is positioned so that it shares the total dynamic range. Switching cells and heads require that the tape mechanism operate over a 30:1 range whereas the dynamic range of V/H is 1,000:1. Two cells are also included for drift

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correction over two ranges. The cells are small—the six of them with temperature compensating elements are mounted on a $\frac{5}{8}$ in. diameter disk.

Cell assembly accounts for the bulk of the cost of the V/H computer, ACF says, but this cost may be reduced in quantity production.

Only moving part in the optical head is a chopper which modulates the bolometer signals. The chopper contributes about 1% of the optical assembly weight.

The tape drive motor, as indicated, rotates at a speed which is proportional to V/H. A synchro generator geared to the motor provides an output which can control the film through the camera.

In operation, ACF explains, an approximate V/H indication is obtained by breaking the feedback loop to the drive motor and varying tape speed for maximum correlation. At this instant, tape speed is locked into a memory circuit and the loop is closed. V/H changes, the company says, are then automatically measured by the correlation equipment and transmitted to the tape drive.

The drift pickoff head on the tape mechanism, the firm explains, is so located that when the drift angle is completely compensated by rotating the camera or other mounting platform in the proper direction, drift signal delay results in maximum autocorrelation.

Cloud Patterns

Cloud discrimination is possible with this system, ACF says, because of a difference in the signal frequency spectra of the clouds and the ground. Ground signals are of higher frequencies because successively viewed ground objects produce more frequent and abrupt changes in radiated energy than are produced by slowly varying pattern of the surface of typical clouds.

Differentiation is performed in one signal channel and it produces different effects for ground and cloud types of signal. Although ground and cloud signals have the same total rms values, the rms value of the differentiated ground signal is much larger than the corresponding cloud signal, the company points out. This makes cloud discrimination possible.

For the detectors, thermistor bolometers were selected despite their lower signal-to-noise ratios, by a factor of four, than those of lead selenide cells. The latter, however, require cooling and have a larger response to reflections from the atmosphere.

Chicago Aerial Industries has been examining lead sulphide, photo duo diodes and silicon sensors as possible detectors for its IR tracker head platform. Probable final choice, according to the firm, will be the photo duo diode.

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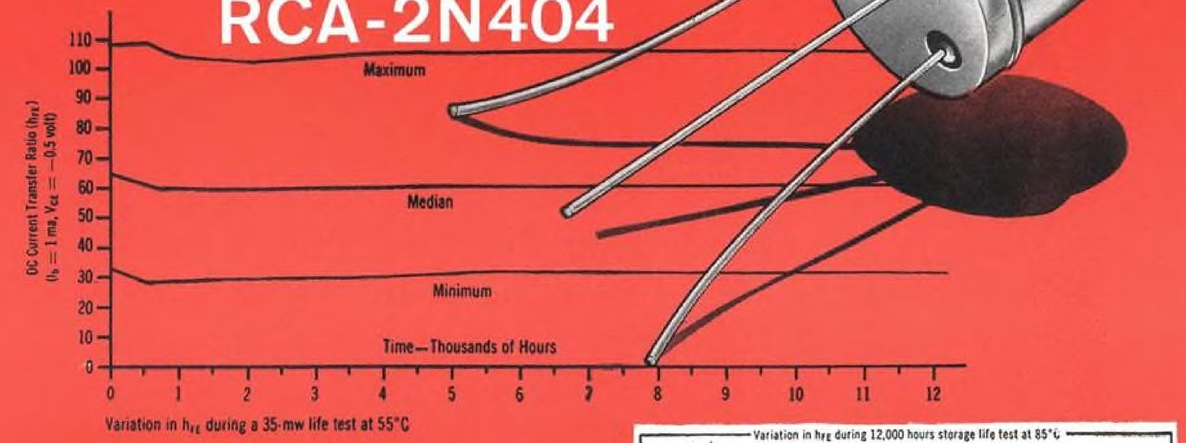
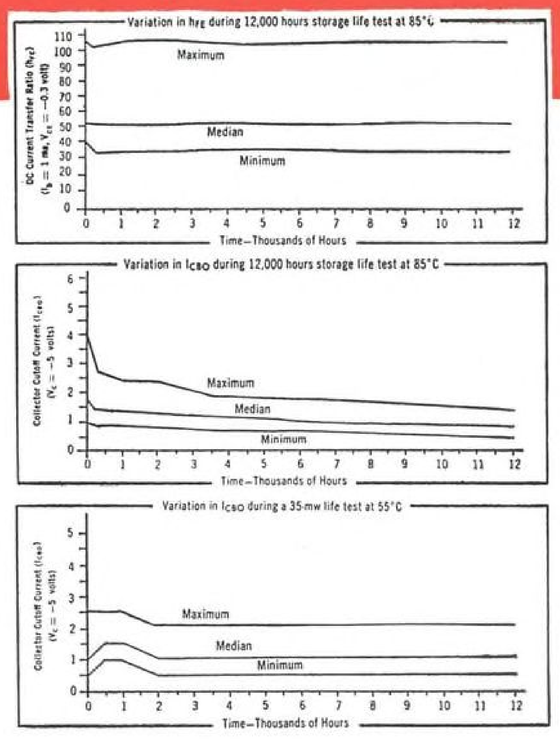


Variation in h_{FE} during a 35-mw life test at 55°C



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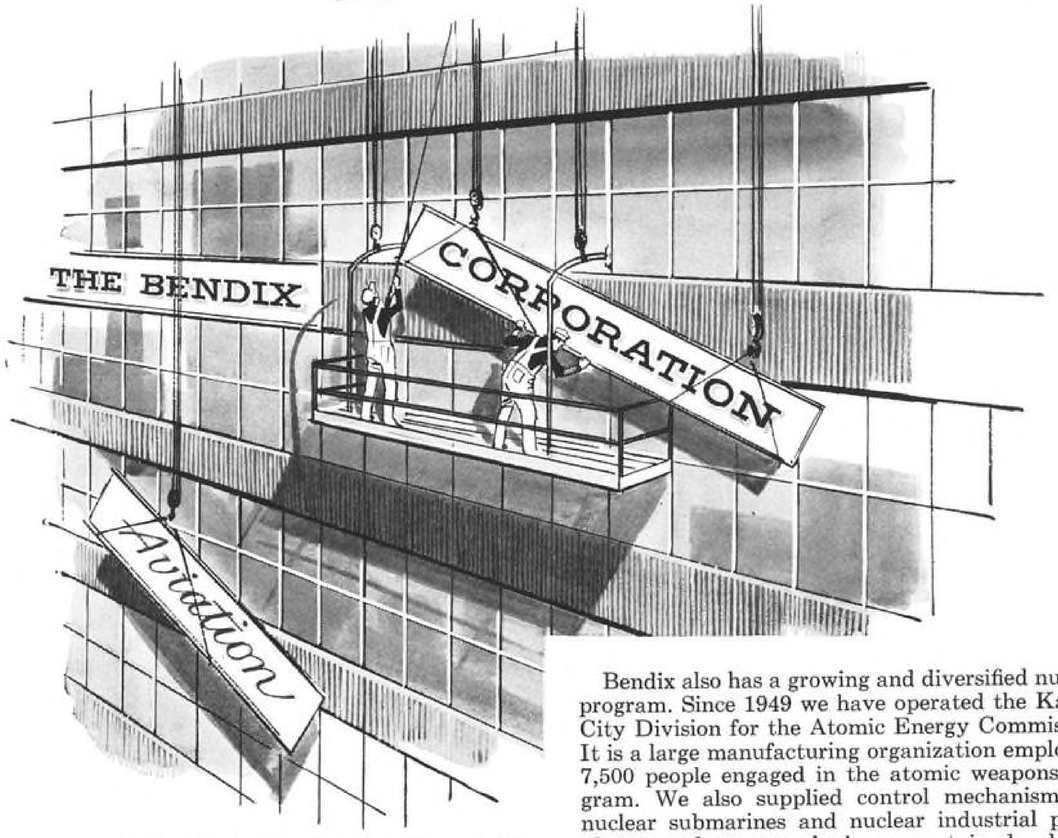

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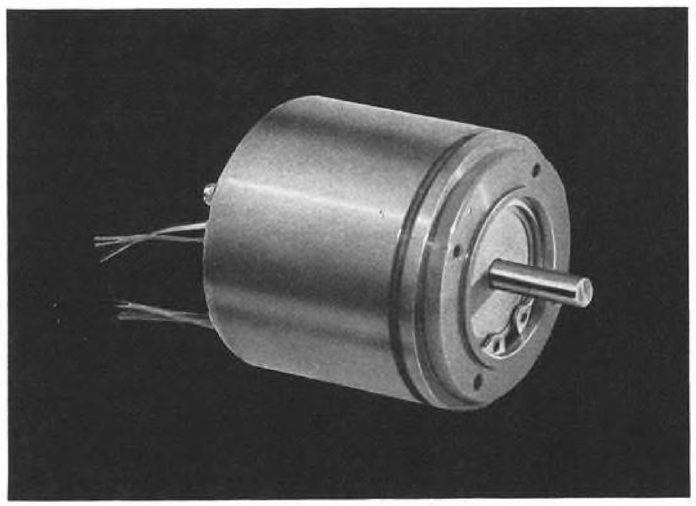

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▶ **Stubbornness Blocks Merger**—Proposed merger of the IRE's Professional Group on Aeronautical and Navigational Electronics (PGANE) and the Professional Group on Space Electronics and Telemetry (PGSET) is being blocked by a few members of the PGSET administrative committee, despite the fact that chairman Conrad Hoeppner favors the merger. The PGANE administrative committee approved the merger several months ago. Despite PGSET's effort to keep PGANE "out of space," the recent National Aeronautical Electronics Conference in Dayton, sponsored by PGANE, was dominated by reports on the subject, including technical sessions on space reconnaissance systems, managing space systems, radio astronomy, interplanetary environment, electric propulsion and a forum on space electronics. Naecon even had one session on telemetry.

▶ **USAF Molectronics Meeting**—Air Force plans to hold a symposium on the subject of molectronics and microcircuitry this fall, tentatively scheduled for mid-September. Location and firm date have not yet been announced.

▶ **WADD Consolidates Avionics**—Under recent reorganization, Wright Air Development Division will consolidate its newly formed Avionics Division's four laboratories in a single building at Wright-Patterson AFB in Dayton. The new location will be Building No. 22, formerly the Weapons Guidance Laboratory, located on the flight line. The Avionics Division, one of four divisions in the new Directorate of Advanced Systems Technology, will consist of four laboratories: Navigation and Guidance Communications; Reconnaissance and Electronic Technology (formerly Electronic Components Laboratory.)

▶ **Improved Passive Communications Satellite**—Several techniques for improving the gain of spheres used as passive communications satellites to reduce the required power of ground transmitters and/or permit use of smaller, more rigid satellite structures were suggested by Y. E. Stahler of Wright Air Development Division at Naecon. Most effective would be a combination of lens and reflector which could be fabricated using two concentric balloons. The outer surface of the inner balloon would be dimpled and coated with a reflecting material while the space between the two balloons would be injected with styrofoam and a special refractive dielectric foam which would serve as a lens.

MINIATURE time-temperature recorder for jet engines, developed by Avien, records total time engine operates at excessive temperatures and number of such instances. Complete system weighs only 5½ lb., can be used with a variety of jet engines, company says.

Device Records Number, Time Of Turbojet Over-Temperature

Woodside, N. Y.—Miniaturized time-temperature recorder for jet engines, which not only totals the accumulated time during which an engine has been operated at excessive temperatures, but also records the number of instances that over-temperature has occurred, has been developed here by Avien, Inc.

The new recorder is a smaller, lighter and more versatile version of the time-temperature recorder developed several years ago by Avien for use on the North American F-86D with General Electric J47-GE-17 and -33 engines (AW Mar. 25, 1957, p. 93). Developed under Wright Air Development Division sponsorship, new recorder will be used on Northrop T-38 jet trainers.

Experience indicates that the number of instances that a jet engine is operated at excessive temperatures as well as the total time at excessive temperatures are both important criteria in determining when an engine should be removed for maintenance or overhaul.

The new Avien system tabulates the number of such events and total time an engine is operated at or above three different temperature levels; for example, 580C, 660C and 700C. However, temperature levels can be tailored to the application.

By substituting transistors for vacuum tubes used in the earlier model, Avien has been able to cut system weight by 70%, to only 5½ lb. Volume has been slashed by 80%. The new model consists of only two elements, the indicator and the recorder, instead of the original three. Power consumption has been cut from 140 va. to only 25 va. Shock mounts, required on the earlier model, have been eliminated.

Company also has increased the upper ambient operating temperature limit from 71C to 125C, it says.

The cockpit panel indicator size has been reduced from a 3-in. diameter case to a 2-in. diameter. The indicator has a compressed, but linear, scale for the lower and extremely high temperature ranges, with an expanded linear scale for the critical 500C to 800C temperature region.

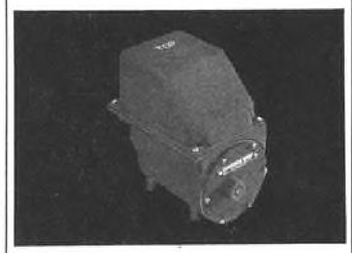
Instrument includes a red "Hot" warning flag which drops into view when engine exceeds normal temperatures, and a "Power-Off" flag to warn of power failure. The "Hot" warning flag can be designed to drop instantly when an over-temperature occurs, or a time delay can be introduced if desired. Instrument incorporates integral lighting.

Unlike the earlier Avien time-temperature recorder, which was tailored to the J47 engine, the new model is adaptable to any engine, company says. Avien's address is 58-15 Northern Blvd., Woodside 77, N. Y.

ENGINEERING
REPORT
ON OTHER BENDIX COMPONENT PACKAGES

BAROMETRIC ALTITUDE CONTROL

Maintains aircraft altitude in automatic flight systems.



This Eclipse-Pioneer pressure-sensing instrument helps maintain aircraft at a selected altitude in automatic flight. Sensing barometric altitude, it generates electrical control signals whenever the aircraft is displaced from the reference. These signals, proportional to the deviation, are power amplified and provide a control signal to restore correct altitude. Write for details.

VERTICAL SENSOR

Indicates true vertical positioning within ±3 minutes of arc.

Eclipse-Pioneer's Vertical Sensor is a small (4⅞" high), lightweight instrument for highly accurate determination of vertical positioning. An iron pendulum is suspended in a tube of damping fluid. Two magnetic pickups, 90° apart at the bottom of the tube, detect deviation from vertical by sensing movement of the pendulum from center. Output increases linearly as the unit tilts from vertical, and cross coupling is minimal. Ask for further information.

Manufacturers of
GYROS • ROTATING COMPONENTS
RADAR DEVICES • INSTRUMENTATION
PACKAGED COMPONENTS

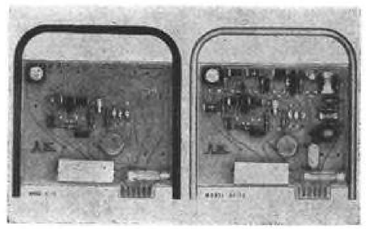
Eclipse-Pioneer Division

Bendix
AVIATION CORPORATION
Teterboro, N. J.

NEW AVIONIC PRODUCTS

Components & Devices

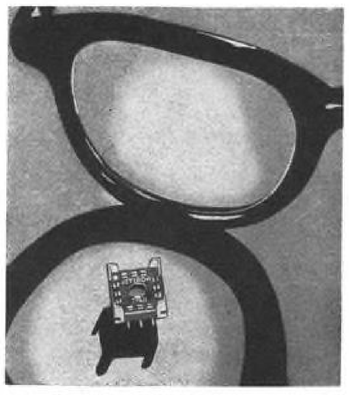
• **Oscillator clock,** Model OC-10, and slave clock, Model SC-10, are two additions to firm's 1 mc. digital modules. Oscillator clock has crystal oscillator providing 1 mc. pulses and requires −16



v.d.c. ±10%, 25 milliamps. Slave clock requires−16v.d.c., ±10% 6 mils current. Computer Control Co., Inc., 983 Concord St., Framingham, Mass.

• **Small storage tube,** Type K1938, is a 2¾ in. diameter tube with maximum length of 9¼ in. from tube face to end of 14-pin conventional low-leakage base. View gun is high current, low velocity type; writing speed up to 100,000 ips. and resolution of 50 lines/in. are possible. Storage time is two minutes, erase time 50 milliseconds and brightness level is 3,000 ft.-lamberts at 8 kilovolts. Allen B. DuMont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.

• **Socket,** designed to use with and make possible removal of RCA micromodule with same ease as replacing a tube, can be mounted on printed cir-



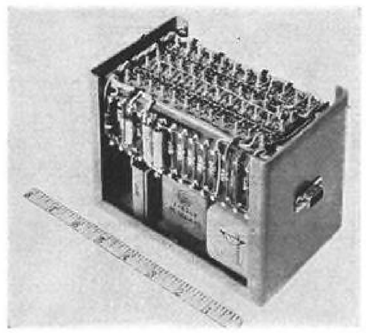
cuit board and is only 94 mils high. Socket assures low contact resistance and will mate the 13 mil diameter lead wires of the micromodule, according to firm, Jettron Products, Inc., 56 Route 10, Hanover, N. J.

• **D.C./D.C. Converter,** Model PC 1129, provides 0.1% regulation for 10% line change and 100% load change. Nominal input to transistorized converter is 28 v.d.c. and output is 150 v.d.c., zero to 250 milliamps. Dimensions are: 3.75 x 4.5 x 3.75 in. Weight is 3.2 lb. Power Instruments Corp., 235 Oregon St., El Segundo, Calif.

• **Silicon rectifiers,** line of JAN series made by double diffusion process, are available in hermetically sealed axial lead top hat design (1N538, 1N540 and 1N547) and in ⅜ in. stud design (1N253, 1N254, 1N255, 1N256). All units meet MIL-E-1 specs. Columbus Electronics Corp., 1010 Saw Mill River Rd., Yonkers, N. Y.

Test Equipment

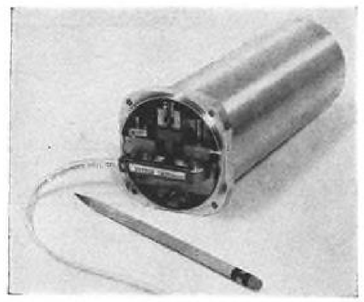
• **Digital Timer,** Model DET-420, may be used in computer systems needing precise elapsed timing intervals. This electronic timer has a maximum error of 100 microseconds over the time base error. Several intervals can be preset in



the timer and any interval can be selected on special order. Unit requires 115 v. 400 cps. single phase and 28 v.d.c. Output is 26 v. at ½ amp. maximum current when not timing and during timing interval current drops to 5 mils. Over-all dimensions are 3 x 3½ x 6½ in. Bulova Research & Development Laboratories, Inc., 62-10 Woodside Ave., Woodside 77, N. Y.

Instruments

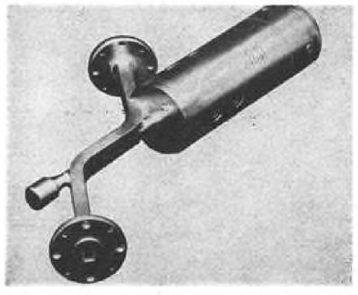
• **Digital tape recorders,** Models DT 01 through 03, are designed for airborne, shipboard and mobile applications. DT 01 is write only, DT 02 is read only and DT 03 is read/write model. The last named is capable of seven or eight tracks of read/write on ½ in. tape and is contained in a single 80-lb. package. Adding an auxiliary printed card package allows expansion to 16 read/write tracks on ½ in. tape or 14 to 32 read/write tracks on 1 in. tape. Different heads are available in various formats, including IBM 705 and 704. Operating speeds are adjustable from ½ to 45 ips. with less than 5 millisec. start-stop times. Speed control is maintained even during variations in aircraft power supply. Shepherd Industries, Inc., 103 Park Ave., Nutley, N. J.



• **Cockpit printer** is designed for burst communication to conserve the bandwidth of any radio transmission link or wire line and is capable of printing more than 30 characters/second on ⅜ in. paper tape. The printer is 9¼ in. long with a self-contained paper supply and it fits into a standard 3 in. aircraft instrument case. The printer is designed to sell for less than $500, according to the company, Potter Instrument Co., Sunnyside Blvd., Plainview, N. J.

Microwave Components

• **Tunable oscillator cavity,** Type 9127, is end tuned in 2.65 to 3.65 kmc. range (S band) and supplies 100 watts peak minimum over band (0.001 duty cycle, one microsecond pulse, 1,500 volt pulse). Output rise time is less than ⅒ microsecond. Using GE type 7486 tube, the oscillator weighs 7 oz., measures 1 in. in diameter by 4½ in. in length, not including brackets and output connector, has an output impedance of 50 ohms. Trak Electronics Co., 48 Danbury Rd., Wilton, Conn.



• **Gas tube noise source,** T44Q1B, operates in the 26.5 to 40 kmc. range and can produce 18 db. above KTB. Source is suitable for CW or pulse operation under typical adverse military environments, has 45 mils operating current, 6.3 v. a.c. or d.c. filament voltage and is triggered by 2,000 volts. Tucor, Inc., 18 Marshall St., South Norwalk, Conn.

AC Seeks and Solves the Significant—AC has earned an enviable reputation for scientific accomplishment with national defense projects such as AChiever inertial guidance systems. But AC is not limiting its goal to leadership in the international technological race. Utilizing scientific "fallout," AC is also increasing its development of significant new commercial products. / This, too, is AC QUESTMANSHIP: the scientific quest for new ideas, methods, components and systems . . . to promote AC's many projects in guidance, navigation, control, detection and communication. / In the commercial field, AC is already producing communications systems, automotive controls and fuel controls for gas turbine engines. Some day they may even add such advanced projects as systems controls for "ground effect vehicles." According to Mr. B. H. Schwarze, AC Director of Commercial Engineering, "the proper application of scientific 'fallout' to commercial products leads to diversified career opportunities." / You may qualify for our specially selected staff . . . if you have a B.S., M.S. or Ph.D. in the electronics, scientific, electrical or mechanical fields, plus related experience. If you are a "seeker and solver," write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, 7929 So. Howell Ave., Milwaukee, Wisc.

GUIDANCE / NAVIGATION / CONTROL / DETECTION / COMMUNICATIONS / AC SPARK PLUG The Electronics Division of General Motors

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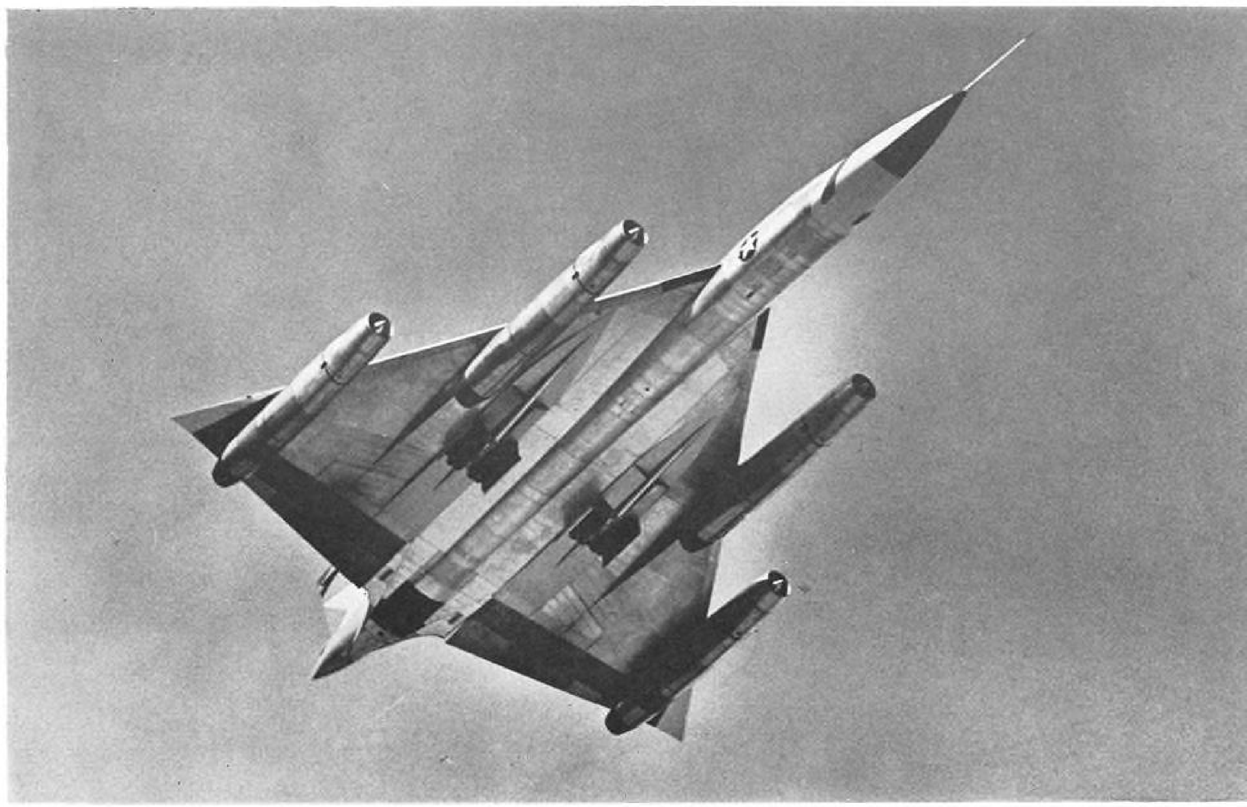


CONVAIR TB-58 jet bomber trainer makes first flight without carrying external stores pod. View above is just after takeoff.

TB-58 Trainer Makes Initial Test Flight

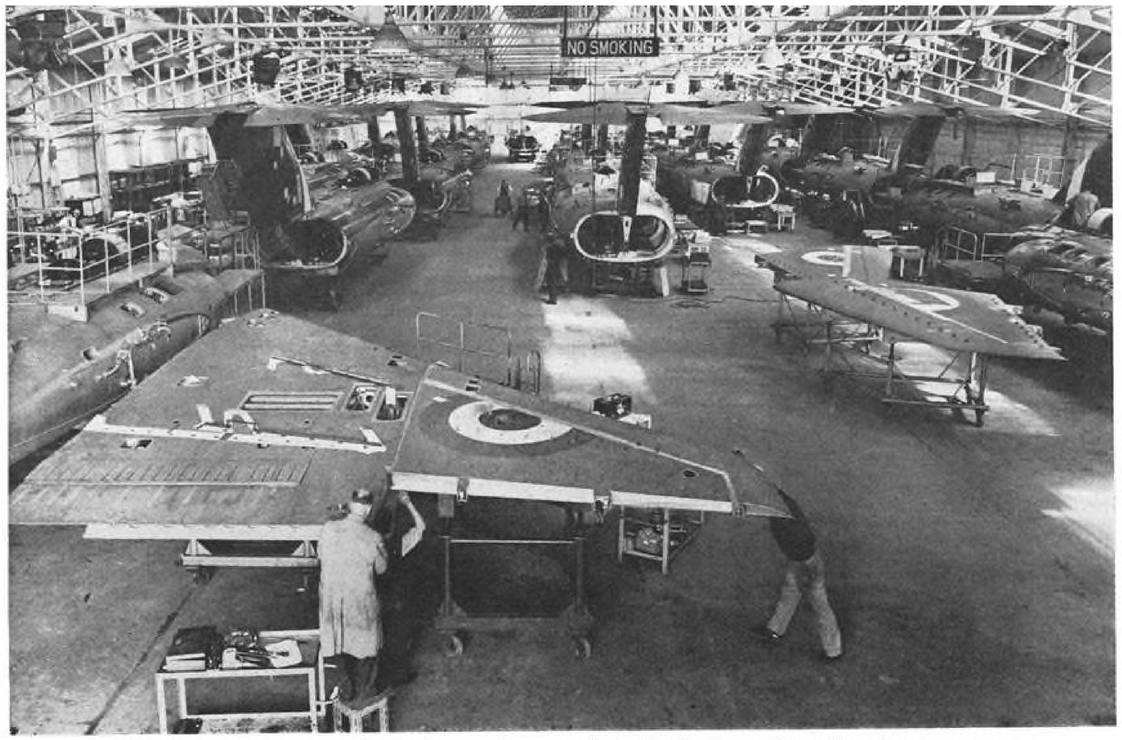
Ft. Worth, Tex.—First of four Mach 2 Convair TB-58A trainer versions of the Hustler bomber has made its first flight here, achieving programed Mach 1.52 speed at 44,000 ft. Flight crew was Val Prahl, pilot, Earl Guthrie and Grover C. Tate.

The TB-58A program utilizes airplanes initially built here for the B-58 test program. The TB-58A will provide transition training and enable tactical Hustler squadron pilots to maintain their proficiency for virtually any operational bomber mission, including air refueling techniques and procedures for dropping the external pod store. Delivery of initial TB-58A to USAF is scheduled for early July.

Major external difference is additional window area providing improved lateral visibility. Second station also has a 15-in. x 24-in. overhead canopy.

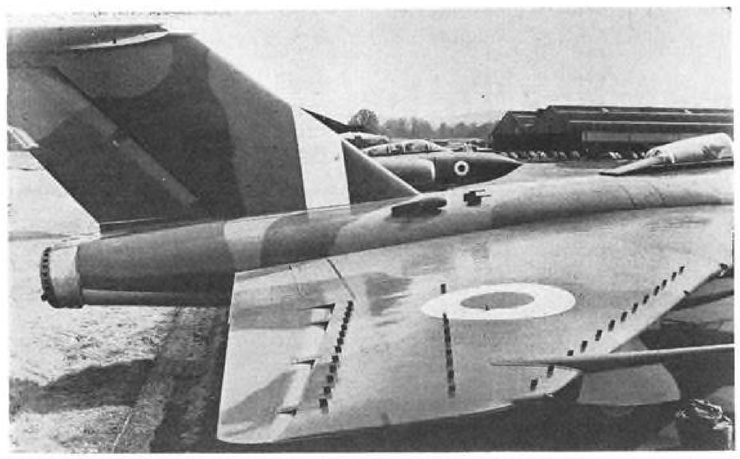
Instructor or check pilot is located in the second station, seated tandem behind the TB-58A pilot and has a duplicate set of flight controls and instruments. Instructors' seat is 8 in. higher than the pilot's and is offset 10 in. to the right. The TB-58A's third station has provision for carrying another pilot, who may change seats with the instructor to take the controls during proficiency checks.

INCREASED window area is pointed up in this ground view. Overhead canopy has been provided for the second station.

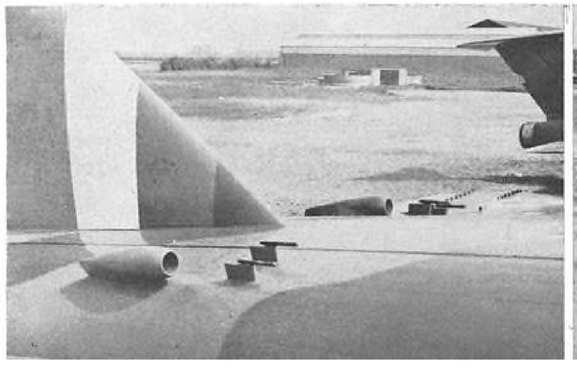


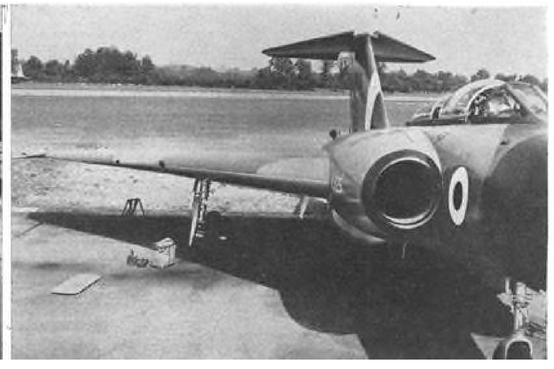
ELEVON SYSTEM is superseding conventional aileron system on Gloster Javelin to provide quicker damping response.

Javelins Receive Major Modifications



MODIFIED JAVELIN has three banks of vortex generators (above). Drooped outer wing leading edge increases camber (below, right). Note air scoops on fuselage (below, left).





London—Pitch autostabilization is part of a major modification program being conducted at the Moreton Valence Works of Gloster Aircraft, Ltd., to improve combat ceiling and high altitude handling characteristics of all Mk. VII Javelins now in service.

Current program includes afterburning, fitting, switching from a cranked leading edge to a drooped outer wing leading edge to increase camber, and vortex generators in three banks, with one bank close to the leading edge to combat high altitude flow separation at maximum speed.

AVIATION WEEK learned that the thrust at altitude has been increased by over 12% and the turning radius halved.

Pitch autostabilization system in the Javelin converts the conventional aileron system—the aircraft is a delta with a slab tail—to an elevon system. Using the ailerons as elevators provides a quicker damping response than is possible from the slab tail, AVIATION WEEK was told. The aircraft already has yaw stabilization.

New item on the fuselage is an air scoop to cool the rear fuselage structure, which bordered on 300C following incorporation of afterburning. Engines are Armstrong Siddeley Sapphire Mk. VII-Rs which develop 11,000 lb. static thrust without afterburner. Afterburner is not employed at heights below 20,000 ft. Two-position nozzle is actuated by 12 pneumatic rams working on 36 petals. The additional thrust does not increase maximum cruising speed, because of increased drag, but is used to maintain speed at higher altitudes.

About 140 modifications are involved on each aircraft and are being incorporated on a production line basis. All Mk. VII aircraft now in service will be returned to the Gloster production line for modification to the new Mk. IX standard. The conversion at Gloster will provide work for about 700 persons during the next 12 months.

Backing up the conversion, which involves modification of some relatively old airframes, an extensive structural fatigue test program has recently been completed which, Gloster maintains, shows that the fatigue life of the structure exceeds the design expectations.

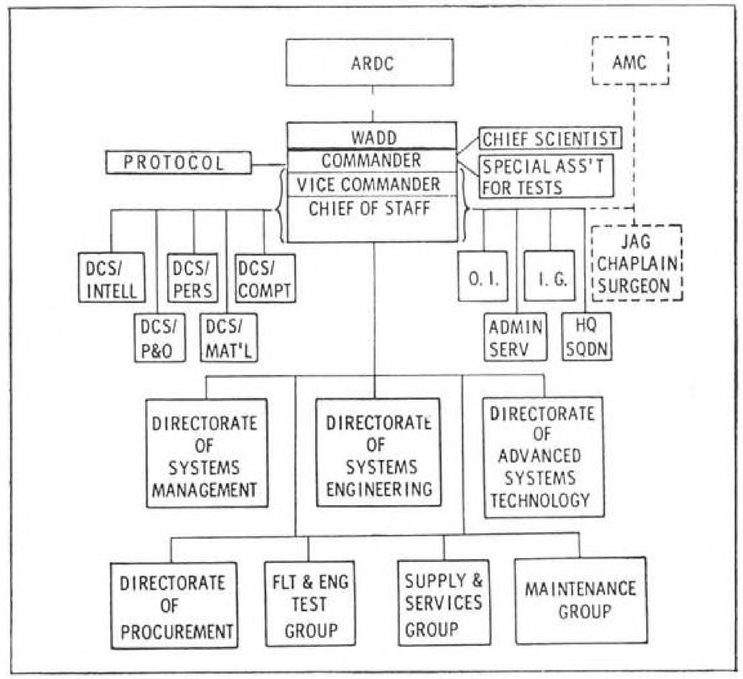
After joining the line, engines are removed and the airframes stripped to their smallest subassemblies. After modification of parts the aircraft are reassembled and the systems, including the armament, are tested.

The Mk. IX aircraft is fitted with Mk. A117 radar, the sole feature distinguishing it from the Mk. VIII variant which carries a U. S. radar system.

Navy Orders Carrier Auto-Landing Systems

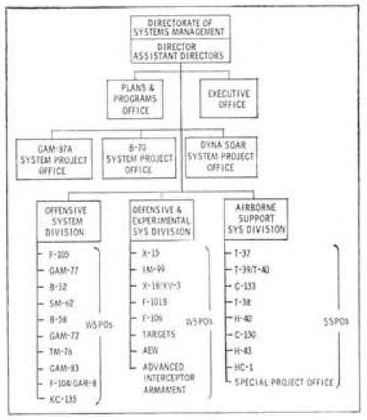
U. S. Navy will install four Bell Aircraft Corp. AN/SPN-10 automatic landing systems under a $4.3 million Bureau of Ships contract. Three of the systems will be installed on carriers within 18 months and the fourth will be located at a land base for pilot familiarization.

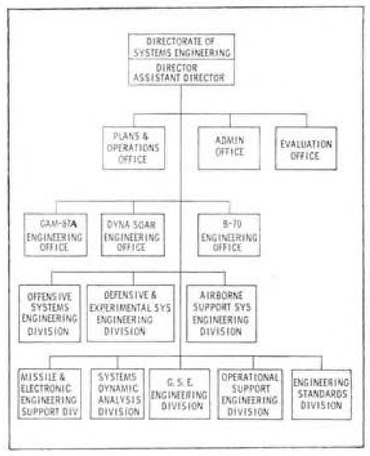
The automatic landing system, using glide slope information, ship motion prediction and precision radar, can fly an aircraft to touchdown on the carrier deck without the pilot touching his controls. The initial shipboard installations of the automatic landing system will be evaluated in good weather prior to its utilization in an all weather landing system. Original evaluation of the Bell landing system was made aboard the USS Antietam.

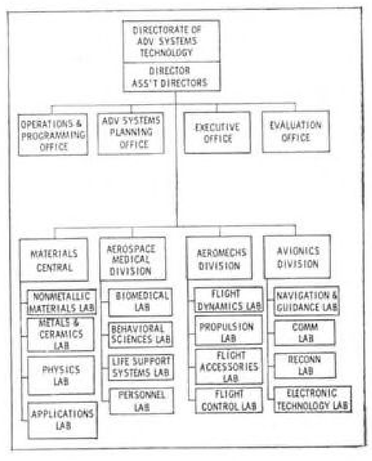


WADD Reorganizes For Increased Capabilities

New organization structure for Wright Air Development Division at Dayton, Ohio, shown in charts, is expected to increase its capability for system engineering and integration of complex weapon systems (AW May 9, p. 27). WADD now is divided into three major directorates: Systems Management, Systems Engineering, and Advanced Systems Technology. Personnel from former WADD laboratories have been split up into the latter two directorates. Those in Systems Engineering will provide technical support for Systems Management Directorate; Advanced Systems Technology will devote efforts to advancing the state of the art.







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Cherrylock
Aircraft Rivets
Give you ALL
these advantages...

★ *Positive Mechanically Locked Stem*
★ *Flush Fracture (No Stem Trimming)*
★ *Strong Clinch*
★ *Wide Grip Range*
★ *Positive Hole Fill*

The Cherrylock* "2000" Series Locked Stem Rivet offers every feature desired in an aircraft blind rivet . . . proven high sheet clamp-up with no stem trimming (fractures flush on installation), uniform head seating, complete hole-fill, wide grip range, and positive mechanically locked stem.

Fast, economical, easy installation (with no stem trimming) is available with Cherrylock rivets, using existing Cherry installation guns. You get better fastening at lower installed cost.

One rivet can be used for several material thicknesses, reducing stock requirements and lowering costs. Positive hole-fill, even in oversized holes, simplifies preparation problems to further reduce installation costs. Available in:

A-286 Stainless Steel—Monel—Aluminum

For technical data on the new Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

**Patent Pending*

CHERRY RIVET DIVISION
SANTA ANA, CALIFORNIA
Townsend Company
ESTABLISHED 1816 • NEW BRIGHTON, PA.
In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario

X-15 Tests Center On Stability Augmentation

Edwards AFB, Calif.—Successful flight to study characteristics of stability and control and also of the rocket engine propellant system at burnout at less than 1g was accomplished by Maj. Robert M. White, USAF, during the fifth powered flight test of the North American X-15 No. 1 aircraft here.

Maj. White, making his second flight in the X-15, was launched from the Boeing B-52A Stratofortress at 45,000 ft. and climbed to 60,000 ft., where he pushed over to attain "something less than 1g."

After propellant burnout Maj. White turned toward Edwards AFB, climbed and turned off the aircraft's stability augmentation system to study the X-15's handling characteristics.

Characteristics of the airplane's normal and sidestick controls were studied with stability augmentation active and inactive. Maj. White reported some minor difficulty with the roll damper system which made the airplane laterally more sensitive than normal.

At the conclusion of the flight, Maj. White glided into Edwards AFB and at 600-900 ft. unsuccessfully attempted to jettison the airplane's ventral fin in preparation for landing. The fin failed to jettison properly on actuation of landing gear down controls, during the flareout but landing was accomplished.

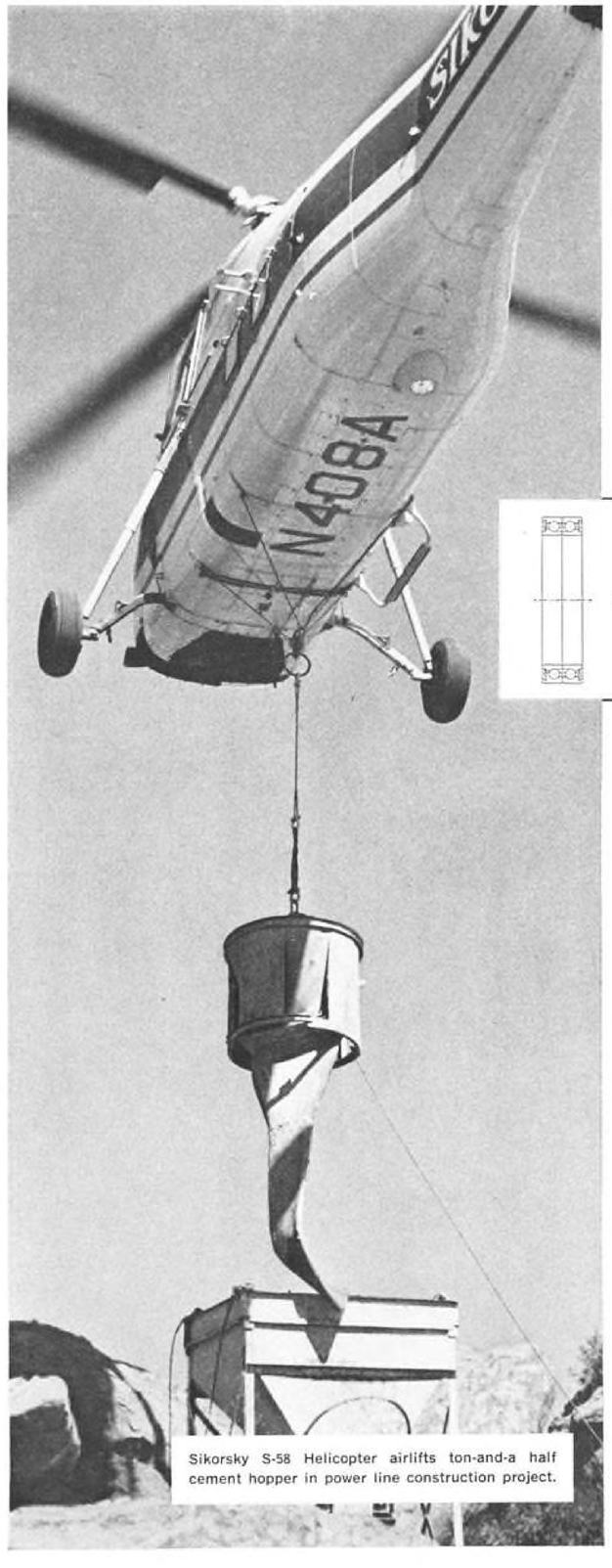
The X-15 will now move into another phase of its flight test program to study longer-range operation in the launch-to-landing program. Attempts will be made to convert some of the energy that has been used up in turns during flight to extend the airplane's distance-covering capabilities and duration.

It is expected that new flight profiles will provide several minutes more powered flight than the present duration of approximately 10 min. which has been available on the basis of turning the airplane to maintain desired flight profiles.

The No. 1 X-15 has been accepted by USAF and turned over to the National Aeronautics and Space Administration. The No. 2 airplane should complete North American Aviation's flight program this month, prior to being turned over to USAF. The No. 3 airplane is being readied for installation of the 57,000-lb.-thrust Reaction Motors XLR-99 rocket motor next month. The XLR-99 has now completed flight rating tests necessary prior to installation in the X-1.

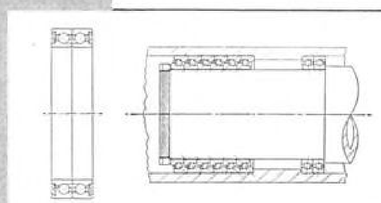
First two X-15s have each been flying with a Reaction Motors XLR-11 16,000-lb.-thrust engine.

Scott Crossfield, North American test pilot, is scheduled to make the first



Sikorsky S-58 Helicopter airlifts ton-and-a half cement hopper in power line construction project.

Fafnir Ball Bearing "Six Packs" Anchor Sikorsky S-58 Rotor Blades!


A tandem set of six Fafnir WI Type counterbored ball bearings plus a duplex pair absorb unusual thrust loads in S-58 main rotor blade retention section. At left: Fafnir Y-PWI Series Duplex Helicopter Bearings.

During development of the S-58, Fafnir engineers worked closely with Sikorsky on bearing requirements. The blade retention sections presented especially interesting problems.

The entire load encountered in pitch control of the rotating blades (the "wings" of the helicopter) falls on the ball bearings used in the blade retention section. Smooth instantaneous response is a must — since blade pitch is what steers the aircraft. The answer: A tandem set of six Fafnir counterbored bearings, plus a duplex pair, in the main rotor section and a tandem set of five Fafnir bearings in the tail rotor.

Fafnir ball bearings are also used in the tail drive shaft, main shaft, and other critical locations. Job-right applications such as these have helped establish Fafnir as a leading supplier of ball bearings for aircraft, jet engines, and accessories. For help with problems *you* may have, write The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR
BALL BEARINGS

SOMETHING NEW IN A SUITCASE...

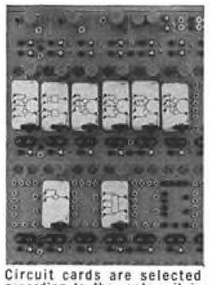
...Complete transistorized EECO Digital System Breadboard

Designers who want to go places fast systemswise can be sure of getting there on time with an EECO suitcase. It's packed with a complete and integrated breadboarding system designed around mutually compatible EECO T-Series Germanium circuit modules, N-Series transistorized decades, and R-Series Minisig® sensitive indicators.

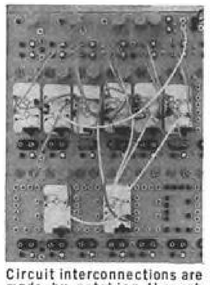
Standard 19" amateur-notched panels have the necessary permanent wiring to accommodate any standard EECO Germanium circuit module, and all other circuit interconnections are made by patch cords or plugs, **with unique, prepunched circuit cards to guide you.** No soldering is required, and experimental arrangements of T-Series circuits can be quickly patched up, changed, or taken down without waste of time or materials.

Bottom half of breadboard suitcase is compactly laid out to store all necessary T-Series circuit modules, circuit cards, patch cords, and compatible power supplies.

EECO T-Series breadboard equipment is available in both suitcase and rack-mounted types. Breadboard Kits of any degree of complexity can be built up in stages, according to the specific panels and number of circuits incorporated. Compatible interconnections between racks or suitcases further enable the designer to expand the equipment into a complete systems development console. Compatible solid-state, convection-cooled power supplies are also available in two different models: ZA-720 is a dual 12-volt, 5-amp supply; ZA-721 is a 12-volt, 1-amp plug-in power supply.



Circuit cards are selected according to the system it is desired to breadboard and placed on the panel in alignment with the jack pattern. Corresponding T-Series circuit modules are plugged in above each card.



Circuit interconnections are made by patching through holes in the circuit cards. Resulting pattern of symbol cards and patch cords shows a schematic and bill of materials for the system, once it is checked out

FEATURES

- **Permits rapid formulation of digital electrical systems.**
- **System may be operated slowly to permit inspection of its mode of operation, or over-speed to indicate system derating.**
- **Operation may be analyzed with a minimum of test equipment.**
- **Provides a means for rapidly building and testing alternate ways of formulating a system.**
- **Minimizes wiring errors and the inclusion of defective parts.**
- **Circuit cards provide a means for rapidly visualizing the system, and facilitate drawing a circuit diagram.**
- **Circuit cards enable the designer to determine the elements involved, as well as the cost of the system.**

A request, on your company letterhead, will bring detailed information on the flexibility of the EECO T-Series Breadboarding equipment, and a demonstration if desired.

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TAC Design Slowdown

Washington—Air Force project for development of a new tactical low-level attack aircraft has been slowed at Pentagon levels, largely because of Air Staff insistence that additional operational data be gathered on such an aircraft. Apparently no decision will be made on the project before the end of the fiscal year.

Tactical Air Command also is reportedly not completely happy with the two designs proposed by Wright Air Development Division in its development plan for the aircraft, which is to have sea-level supersonic attack capability and be designed to take off within 3,000 ft. (AW Mar. 14, p. 29).

Final decision to develop the new aircraft will not be made until it has been approved by the Air Force Weapons Board. Review by this group is being delayed until TAC headquarters approves a design and Air Staff planning groups have prepared a more detailed outline of operational capabilities to complement the mass of technical data available on the proposed aircraft.

flight with the XLR-99-powered No. 3 aircraft in about a month if the engine checks out correctly. After demonstrations the airplane will be turned over to USAF. Then both No. 2 and No. 3 X-15s will be equipped with the larger engine and it is expected that all three airplanes will be active with the high-thrust engines sometime this fall.

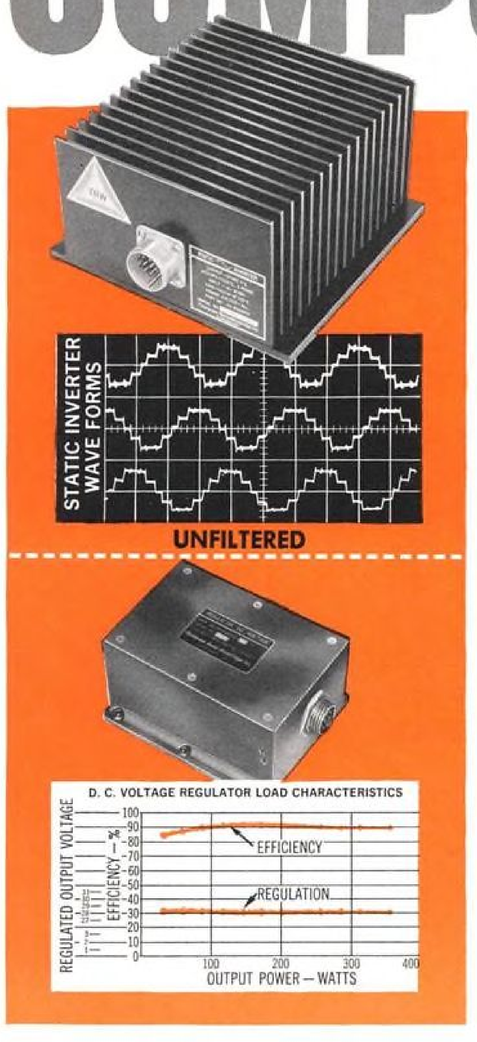
First step in the X-15 research program calls for developing data with speeds up to 2,000 mph. and altitudes of 130,000 ft. using the X-15s powered with the interim engine. NASA project pilot Joseph A. Walker and Maj. White will develop the X-15's flight envelope expansion during this program to establish speed and altitude parameters, according to D. E. Beeler, assistant director, NASA Flight Research Center.

Other members of the pilot pool used in this joint X-15 research program will be Lt. Cdr. Forrest S. Petersen, USN, John B. McKay and Neil A. Armstrong of NASA and Capt. Robert A. Rushworth, USAF.

When the XLR-99 engine becomes operational, Walker and White will continue a buildup from the previous program in the speed-altitude envelope. With the performance capability of the new engine, regions of high temperatures and extreme altitude will be possible and ballistic type flights with reentry maneuvers will be explored in correlated steps, Beeler pointed out.

Before attempting to reach a new altitude on a ballistic-type flight, the X-15 will be flown at fairly level paths at speeds expected to be encountered on returning from the altitude mission. Beeler said this will provide informa-

TAPCO ELECTRONIC COMPONENTS



STATIC INVERTER—The TAPCO inverter employs special logic and power circuitry which generates the three-phase output shown in the photograph at left. This technique of "synchronous switching"* provides an output which is essentially devoid of 3rd and 5th harmonics and their multiples as well as all even harmonics. Although the resultant wave form can be used unfiltered in many applications, a total harmonic distortion of less than 5% can be obtained with a filter that is appreciably smaller and lighter than would be required to filter a square wave. Special controlled rectifier output circuitry provides both efficient voltage regulation and short circuit protection. Switched mode operation throughout insures maximum efficiency as well as minimum size and weight. *Patent applied for

PERFORMANCE DATA – Input Voltage d.c.: 18-31 vdc. **Output Voltage 3-phase:** 115 vac ±1%, WYE or DELTA connected. **Output Power:** 500 VA. **Power Factor:** Unrestricted. **Output Frequency:** 400 cps ±0.02% standard ±0.0001% where required. **Distortion:** Less than 5%. **Maximum ambient at full load:** 125°C. **Wave Form:** Sine wave. **Short Circuit Protection:** Limits to 300% rated current. **Efficiency Full Load:** 85%. **ENVIRONMENTAL DATA Vibration:** 10g through 3000 cps. **Shock:** 40g. **Acceleration:** 12g for 5 minutes. **Temperature:** −55°C to +125°C. **PHYSICAL DATA—Envelope Dimensions Including Fins:** 4.5" x 9" x 10". **Weight:** 25 lb.

VOLTAGE REGULATOR—This regulator utilizes a pair of silicon controlled rectifiers in a full-wave, buck-boost configuration. By means of a fast response magnetic amplifier, this circuit simultaneously provides efficient voltage regulation, transient elimination, and short circuit protection. A stable internal d.c. reference in conjunction with the magnetic amplifier provides the necessary control to maintain an output voltage constant to within ±0.7%. Efficiency of over 90% is obtained with d.c. input voltage variations as high as 22 to 30 vdc.

PERFORMANCE DATA—Voltage Regulation (Under worst combination of load, environment, input power): ±0.7%. **Input Voltage d.c.:** 22-30 vdc. **Output Voltage d.c.:** 28.3 ±0.7%. **Input Voltage a.c.:** 115v ±5%, 2000 cps ±1%. **Output Power:** 350 watts. **Output Ripple:** 15 mv peak to peak. **Efficiency Full Load:** 90%. **Transient Protection:** Will absorb up to 46 volts peak at the d.c. input terminals. **Short Circuit Protection:** Current limited to 300% rated current. **Output Impendance:** .02 ohms d.c., 2 ohms 10 cps to 40 kc. **ENVIRONMENTAL DATA—Vibration:** 10g through 3000 cps. **Shock:** 40g. **Acceleration:** 12g for 5 minutes. **Temperature:** −65°F to +165°F. **PHYSICAL DATA – Size:** 3" x 4" x 6". **Weight:** 5.3 lbs.

TRW

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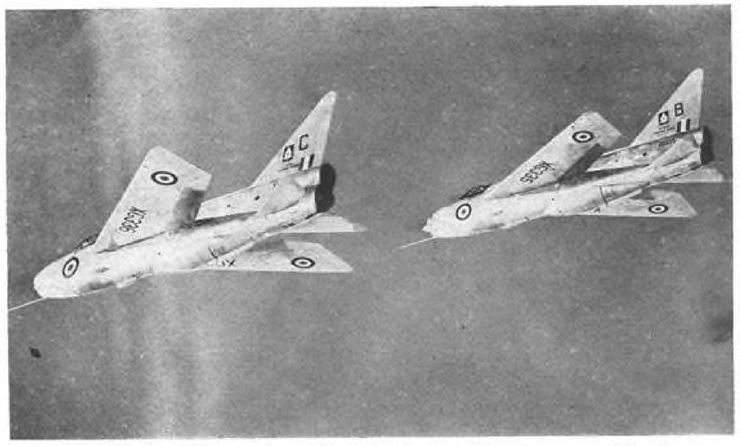
Please send me a Product Data Folder on:
☐ Static Inverter ☐ Voltage Regulator

Name _____

Title _____

Company _____

Address _____



English Electric Lightnings Undergo Tests

Two English Electric P.1B Lightning jet fighters, part of a group of 20 preproduction aircraft, undergo assessment flights by Air Fighting Development Squadron of the Royal Air Force's Central Fighter Establishment. All-weather fighter has exceeded Mach 2 speeds, powered by two Rolls-Royce Avon turbojets. Missile armament is two Firestreaks.

tion on critical temperature, stability and control at speed before attempting the more difficult re-entry maneuver from a ballistic trajectory.

Initial flight tests will be made in the neighborhood of 90,000 ft., with successive flights progressing in half Mach number increments until significant or critical levels of aerodynamic heating occur. This is expected to show up near Mach 4.5 or 5, Beeler noted. If it can be shown that heating and thermostructural properties can be safely and reliably predicted, the program will proceed in increasing speed, to obtain stability and control data through the lift coefficient range for non-critical conditions of aerodynamic flight.

The program will then be directed to obtaining design altitude test flights.

Should thermal analysis turn out to be very difficult or time-consuming, low-speed altitude buildups will be initiated or alternated with speed flights. If thermal limits are attained before reaching maximum speed capabilities, altitude profiles will be designed within these limits.

The X-15 design speed with the XLR-99 engine is about 4,000 mph. and altitude approximately 50 mi., Beeler said, with temperature capability of withstanding up to 1,200F, which is what NASA expects to encounter on a re-entry maneuver from 50-mi. altitudes.

Beeler emphasized that although the X-15 has been unofficially credited with a 100-mi. altitude capability, NASA now has no program for any specific heights above 50 mi.—one of the purposes of X-15 flight studies will be to see how much higher it can be safely operated.

Fokker Probes F-27 License in Britain

London—Fokker is interested in having the F-27 Friendship turboprop transport built under license in Britain.

A series of demonstration flights for British aircraft manufacturers has been held, and the idea has been put to Minister of Aviation Duncan Sandys, although no firm discussions have yet been held.

Fokker's interest in U. K. production stems from the difficulty of breaking into a British market already covered by the Handley Page Dart Herald and the Avro 748. The Dutch company feels that local manufacture would help its chances of sales to British independent airlines which has requirements for an estimated minimum of 50 aircraft for inter-city and cross-channel services.

PRODUCTION BRIEFING

University of California, with the cooperation of Space Technology Laboratories, has produced a series of 21 film-lectures entitled "Ballistic and Space Vehicle Systems." The film series, including such topics as propulsion, flight dynamics, guidance and re-entry, may be rented over a 21 week period from the Department of Visual Communication, University Extension, University of California, Los Angeles, 24. The series is rented only in its entirety for $2,500.

Hexcel Products, Inc., Berkeley, Calif. will conduct research and development on high energy propellant under Advanced Research Projects Agency contract. The Stanford Research Institute of Menlo Park, Calif. will support Hexcel as subcontractor.

Lear, Inc., has been working with Boeing Airplane Co. in adaptation of Lear's remote fuel trimmer to turbofans; one of these has been fitted to Pratt & Whitney JT3D-1 mockup at Renton, Wash.

AiResearch Mfg. Division of The Garrett Corp., Phoenix, Ariz., will produce 14 turbine starting units for ground support of West German Lockheed F-104 fighters. The trailer mounted units will be delivered to Lockheed, Burbank.

WC — **WHITTAKER CONTROLS:** Designs and produces fluid control systems, subsystems and components for military and commercial aircraft and missiles.

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WG — **WHITTAKER GYRO:** Leading designer and manufacturer of precision gyroscopes, accelerometers, guidance and control systems.

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TSI — **TELECOMPUTING SERVICES, INC.:** Specialists in data processing and data systems engineering.

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CB — **COOK BATTERIES:** Designers and manufacturers of automatically and manually activated silver zinc batteries for missile applications.

EC — **ELECTRONIC COMPONENTS:** Designers and producers of microminiature relays, sub-miniature ceramic capacitors, magnetic amplifiers, transformers and delay lines.

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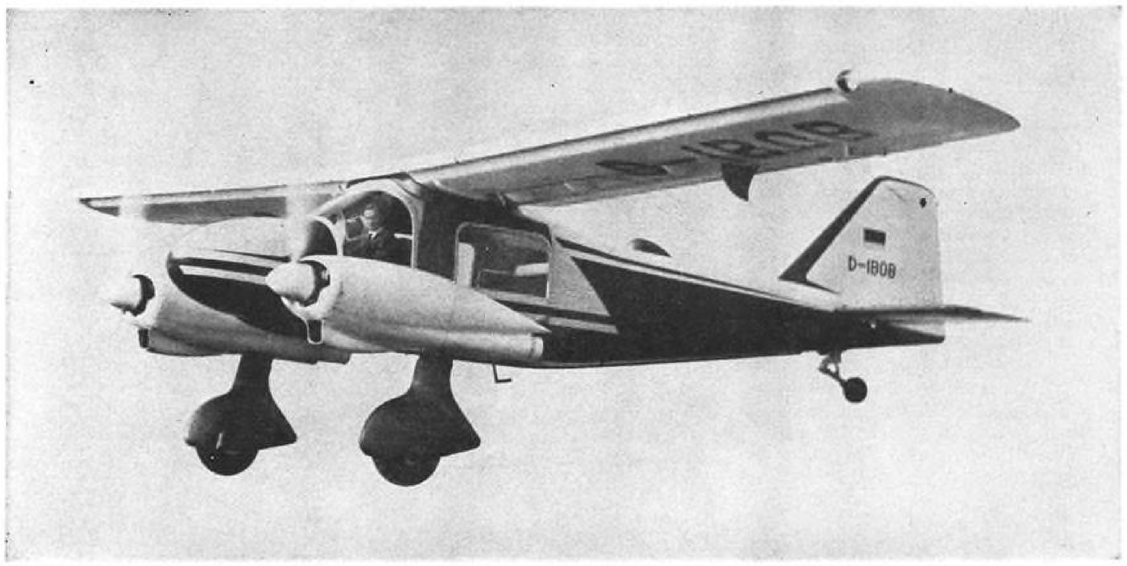


DORNIER'S second prototype Do-28 is powered by two Lycoming O-540-A1A engines rated at 255 hp. each at 2,575 rpm.

Dornier Raises Do-28 STOL Performance

By Edith Walford

Hanover, Germany—Increased power and wing area are features of Dornier's second prototype Do-28, shown for the first time at the air show here last month.

The six-seat, twin-engine STOL plane made its first flight on Mar. 20 and was flight-tested at Dornier's Munich-Neuauling airfield before being introduced at Hanover, Germany.

First prototype Do-28, powered with two 180-hp. Lycoming engines, was announced during last year's Hanover show (AW June 1, 1959, p. 83) and subsequently demonstrated at the 1959 Paris air show. Since then, Dornier has improved the plane's STOL characteristics by power and wing area increases. Second prototype has two Lycoming O-540-AIA engines rated at 255 hp. each at 2,575 rpm. They are mounted on short stub wings attached to the fuselage, one on either side of the cockpit, and are driven by two-blade, all-metal Hartzell HC/82XC constant-speed propellers.

The aircraft is a continuation of the single-engine Do-27 series and basically the same plane except for its twin-engine powerplant. In addition, by inserting a middle section in each of the wings, total span has now been increased by 5 ft. 14 in. to 46.4 ft.

Price of the standard model is approximately $48,750 (DM 195,000); the standard Do-27 is priced at about $28,750.

Taxi Plane

The Do-28 is aimed at the business flying market both at home and abroad, but particularly at the growing number of companies running charter, tie-in or air taxi services of one kind or another. One German company of this kind, Deutsche Taxiflug GmbH., Mannheim, established last year, has done good business so far with a fleet of Do-27s, but is now planning to extend its services with Do-28-type aircraft that have a higher ceiling and longer range. Taxiflug has ordered several Do-28s for delivery this summer, following delivery of the first five production models to Protea Airways, a South African carrier.

Particular design attention has been given to making the Do-28 suitable for a wide range of uses as well as to increasing the safety margin to the maximum possible.

Standard Do-28 configuration accommodates six passengers including the pilot: two side-by-side in the cockpit and the remaining four in the cabin behind. In addition, the aircraft is available with several different interior layouts according to its intended purpose.

Cargo Space

For example, for the transport of small freight the cabin seats can be removed to provide space for about 106 cu. ft. of cargo. An 1,100-lb. load can thus be carried over a distance of some 323 mi.

If the load weighs less, fuel intake and therefore range can be increased accordingly.

Due to the Do-28's good takeoff and landing characteristics, it is also suitable as an ambulance or rescue plane and no major adjustments are required for either of these two duties. The seats in the cabin are simply removed and replaced by two stretchers and the medical attendant sits next to the pilot in the cockpit.

Useful load of most of the Do-28 configurations varies between 1,598 and 1,653 lb. Service ceiling is 20,500 ft. which makes it well suited for duty in

Do-28 Performance

Cruising speed (average gross weight at 75% power at 6,000 ft. INA)	162 mph.
at 60% power at 6,000 ft. INA	152 mph.
Maximum speed at sea level	171 mph.
Stalling speed at rated power, flaps 45 deg	34 mph.
at idling power, flaps 45 deg	44 mph.
Rate of climb with 5,130 lb. gross weight 0-3,000 ft	2.4 min.
0-6,000 ft	5 min.
0-9,000 ft	9 min.
Service ceiling with 4,970 lb. gross weight	20,500 ft.
Absolute ceiling with 4,970 lb. gross weight	22,000 ft.
Range without reserves at zero wind, at 60% power, at 6,000 ft.	660 stat.mi.
at 75% power at 6,000 ft.	745 stat.mi.
Endurance at 45% power	5.45 hr.
Takeoff distance with 5,130 gross weight, wind 8 kt.; running distance	440 ft.
Distance to clear 50 ft	790 ft.
Landing distance at 4,700 lb. gross weight, zero wind	355 ft.
Distance from 50 ft.	420 ft.

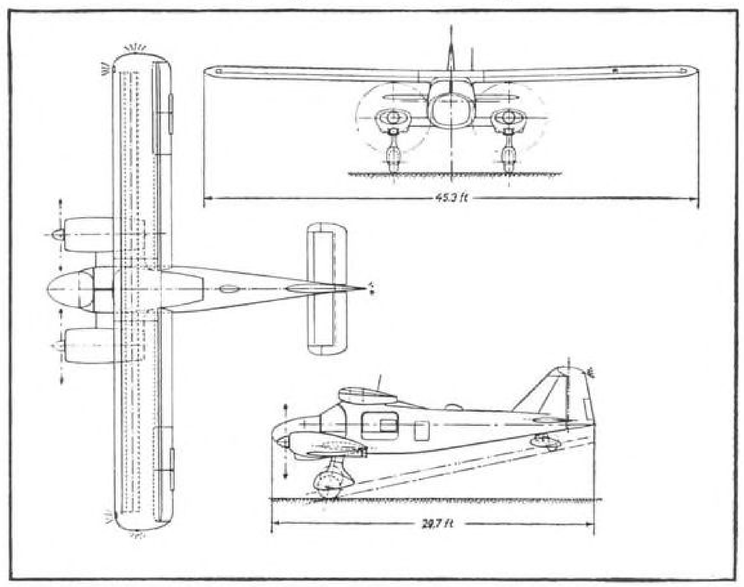
Note: The above performance figures are the results of flight tests conducted by Dornier-Werke with the Do-28 in certain conditions. Figures will vary, the manufacturers stress, with individual aircraft and various factors affecting flight performance.

Do-28 Specifications

Dimensions	
Wing span	46.4 ft.
Length	29.6 ft.
Height without propeller	10.4 ft.
Wheel track	10.5 ft.
Wing area	262.3 sq.ft.
Cabin length including cockpit and baggage compartment	11.5 ft.
Cabin length without baggage compartment	10.1 ft.
Space for freight	6.55 x 3.4 ft.
Cabin width	4.3 ft.
Cabin height	4.6 ft.
Size of cabin door	41.3 x 31.5 in.
Size of cockpit door	29.5 x 35.4 in.
Size of baggage compartment door	15.2 x 20.6 in.
Size of baggage compartment	16.5 x 39.4 x 22.4 in.
Baggage compartment capacity	8.8 cu.ft.
Wing loading at 5,130 lb. gross weight	19.5 psf.
Power loading at 5,130 lb. gross weight	10.3 lb./hp.
Weights	
Empty weight including instruments, lights, heating system and full cabin equipment	3,610 lb.
Useful load	1,520 lb.
Maximum gross weight	5,130 lb.

Do-28's engines have two-blade, all-metal Hartzell HC/82XC constant speed propellers.

SIX-PLACE Do-28 seats two passengers on each of two facing benches.



THREE-VIEW of Do-28 shows rectangular all-metal wing with constant airfoil section.

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mountainous regions. Range is 745 mi. when cruising at a speed of 152 mph. and at an altitude of 6,500 ft. Maximum takeoff weight is 5,137 lb.

Rear fuselage is designed as a monocoque structure, the fuselage center section as a four-stringer open frame and stringer structure giving the fuselage sides very large cutouts. Fuselage nose is a plastic shell. The stub wings forming the engine and landing gear support are bolted to frames of the lower fuselage shell and can be dismounted.

There is a large upward-opening and jettisonable crew door on either side of the fuselage and the cabin has a wide, transparent door, also opening upward. Windshield and large dorsal Plexiglas window allow both crew and passengers good, all-round visibility. Useful cabin area is approximately 88 cu. ft.

Dimensions of the loading door opening are 41.3 x 31.5 in.

The baggage compartment behind the cabin can accommodate a load of 17.6 cu. ft. It is accessible from outside and can be locked. For small hand baggage, space is provided immediately behind the rear cabin seats.

Wing Design

The rectangular main wing is an all-metal design with a constant airfoil section over the entire span. The center section of the three-piece wing is bolted to the fuselage, the outer sections to the center section.

Leading edge with a fixed slat is attached to the front spar of the sheet metal torsion box; the trailing edge structure is attached to the aft spar. The leading edge slat extends uninterruptedly across the full span and is constructed in several sections to facilitate maintenance and repairs. For the same reason the wing tips are attached to the wings by detachable bolt connections.

Wing flaps and ailerons are designed as double-slotted, fabric-covered surfaces. They are hinged onto a fixed axis within the airfoil contour and therefore easily actuated. Ailerons are statically and dynamically balanced.

Vertical fin and horizontal stabilizer are sheet-planked, all-metal structures. The fabric-covered rudder and elevator are aerodynamically balanced and detachable. The horizontal stabilizer, adjustable in flight, can be mounted or dismounted without removing the horizontal fin.

Flight Controls

All controls are operated by a conventional cable and pushrod system. If required, the aircraft can easily and quickly be fitted with dual controls. Trim wheel for setting the horizontal stabilizer is located between the two forward seats. A rudder trim control is also provided and can be operated from the pilot's seat in the case of single-engine flight. The wing flaps are operated by a gated level located centrally in front of the two forward seats. They can be deflected by various intermediate settings up to 45 deg.

Tempo II, On Mark Marksmen B-26 Conversions

Pressurized Tempo II B-26 conversion to a 10-passenger executive transport (above) is currently undergoing Federal Aviation Agency certification tests at Miami, Fla. The aircraft (AW Mar. 14, p. 107) is manufactured by L. B. Smith Aircraft Corp. Below is the pressurized Marksman conversion, built by On Mark Engineering Co., Van Nuys, Calif. Marksman carries 7-8 passengers, plus pilot and copilot, and will make its first flight in June. Basic price is $257,430; range is 1,200 mi. with reserves. Remanufactured fuselage has side entrance air-stair door with aft ring spar installed, DC-7 type cabin windows and walk-in toilet facilities. Firm also builds unpressurized Marketeer conversion.

Landing Gear

The fixed landing gear mounted on the stub wings consists of two cantilevered oleo legs provided with streamlined fairing. The wheels are mounted in a fork and are faired. Wheel brakes are controlled by foot pedals from the cockpit.

The tail assembly wheel consists of an airwheel swiveling 360 deg. with spring strut and automatic centering. For towing or tying down, the towing bar of the tail wheel axle is fitted with two different attachments.

Two twin main tanks contain 51 gal. of fuel each; two auxiliary tanks contain 13.2 gal. of fuel each, so that total the fuel carried amounts to 128.4 gal.

The twin powerplants are elastically mounted on tubular engine bearers attached to the firewall at four points. The engine cowling consists of four panels; the two side panels are fitted with quick-release fasteners. The upper and lower panels are detachable by unbolting.

Air from the carburetor is ducted to the engine through a filter which can easily be replaced. Air can be heated by bypassing along the exhaust tubes.

Heating and Ventilation

The plane is fitted with a cabin air-conditioning system. Air is heated in heat exchangers by both engines and warm or cold air can also be blown by a nozzle in the cockpit against the windshield to prevent misting.

Most of the flight and engine instruments are pneumatic, but electrical instruments can be fitted as optional extras.

Eastern Stainless meets deadline on rework job at Douglas Aircraft

Planes were flown to the Douglas plant where passenger floors and lightweight floor beams were entirely replaced with new rugged structure to withstand heavy cargo loads. On each plane, both passenger door openings were enlarged to form cargo doors. Part of this assembly-line operation involved Type 347 stainless steel which Douglas needed in a hurry. Eastern was asked to supply the required stainless on a rush basis.

Given top priority at Eastern Stainless, the order arrived at Douglas within the allotted time enabling the project to proceed on schedule.

This is another example of the importance of stainless steel to West Coast companies—and the service Eastern Stainless offers the aircraft, missiles and rocket industry in that area. If your problem is one of tonnages, time or technical advice, talk to Eastern Stainless (or one of their good West Coast Distributors).

EASTERN STAINLESS STEEL
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PRIVATE LINES

Twente Flying Syndicate has been formed by a number of large and medium-size Netherlands companies, mostly textile mills, as a cooperative which will own and operate small business aircraft for joint use of personnel of these concerns. A six-passenger de Havilland Dove has been purchased to start the operation and plans are to expand the fleet in the future.

Export sales of more than $1 million for March are reported by Cessna Aircraft Co., Wichita, Kan., the largest sales volume to foreign markets in any single month in its history. Total export volume in March totaled 89 aircraft and spare parts valued at $1,185,000 to exceed the previous record month of February, 1958, when sales totaled $863,000. Latin American countries took 39 aircraft, Canada 18, Australia 17, Puerto Rico 5 and South Africa 5. Argentina took 15 units. Commercial Export Sales Manager M. F. Mellinger believes that Cessna's 1960 foreign sales volume should well exceed last year's 506 airplanes valued at $6,665,000.

Delivery of first Bell 47G-3 turbosupercharged utility helicopter has been made to General American Helicopters, Inc., Los Angeles, Calif., which will operate the aircraft on a charter basis. Bell Helicopter reports that it had a backlog for 17 of this new model before ship one came off its Hurst, Tex., production lines.

Hertz Corp. has discontinued its Rent-a-Plane System, Inc., operation which started in May, 1957, by licensing plane rental operators. Hertz said it was terminating the service "in view of the apparent inevitability of federal controls" on Rent-a-Plane's activities. CAB has previously indicated that Hertz was operating as an indirect air carrier.

Aviation Power Supply, Inc., Burbank, Calif., has Federal Aviation Agency approval to install modified Pratt & Whitney R985 engines, which it has in production, in all twin-engine Beech aircraft which have prior approval for installation of standard R985s. APS says its modification increases altitude and single-engine performance by raising impeller blower ratio to 12 to 1.

Canadian Aero Service, Ltd., will conduct an 18-month survey of 100,000 sq. mi. of Turkey under an $850,000 contract from the Turkish government. Survey aircraft will carry Gulf type magnetometers and scintillation counters of special design. Possible mineralized areas are being sought.

Civil Aircraft, Engine Shipments

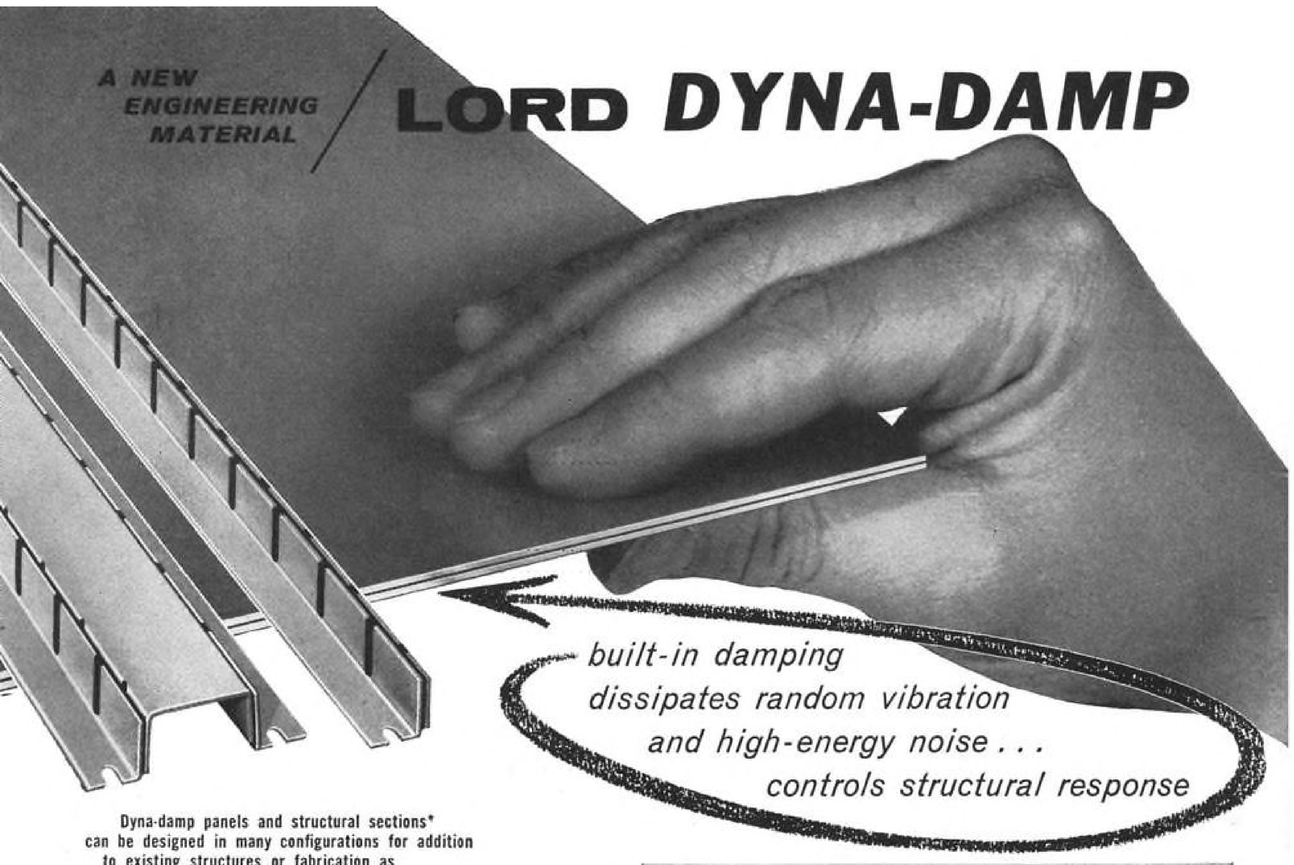
Shipments by Plants Manufacturing Complete Civilian Aircraft and Engines for Civilian Aircraft

Item		February 1960	Jan.-Feb. 1960
Complete aircraft, total airframe weight	(Pounds)	2,647,600	4,910,000
By weight of plane:			
Under 3,000 lb. airframe weight	(Pounds)	845,700	1,590,800
3,000 lb. airframe weight and over	(Pounds)	1,801,900	3,319,200
By number of places:			
1- and 2-place	(Pounds)	798,500	1,465,700
3- and 5-place	(Pounds)		
Over 5-place	(Pounds)	1,849,100	3,444,300
By total rated horsepower, all engines:			
Under 100 hp	(Pounds)	683,300	1,287,900
100-399 hp	(Pounds)		
400 hp. and over	(Pounds)	1,964,300	3,622,100
Aircraft engines:			
Reciprocating	(Number)	1,039	2,064
Gas turbine	(Number)	(D)	(D)
Aircraft engines:			
Reciprocating	(Total horsepower)	227,300	444,600
Gas turbine	(Total horsepower)	(D)	(D)
Complete aircraft	(Number)	855	1,602
By weight of plane:			
Under 3,000 lb. airframe weight	(Number)	812	1,523
3,000 lb. airframe weight and over	(Number)	43	79
By number of places:			
1- and 2-place	(Number)	795	1,478
3- and 5-place	(Number)		
Over 5-place	(Number)	60	124
By total rated horsepower, all engines:			
Under 100 hp	(Number)	726	1,376
100-399 hp.	(Number)		
400 hp. and over	(Number)	129	226
Value of shipments of complete aircraft and parts, total	(Dollars)	124,417,000	230,339,000
Aircraft, total	(Dollars)	112,721,000	209,041,000
Under 3,000 lb. airframe weight	(Dollars)	14,709,000	27,064,000
3,000 lb. airframe weight and over	(Dollars)	98,012,000	181,977,000
Aircraft parts	(Dollars)	11,696,000	21,298,000
Value of shipments of aircraft engines and parts, total	(Dollars)	16,160,000	31,299,000
Aircraft engines:			
Reciprocating	(Dollars)	2,639,000	5,125,000
Gas turbine	(Dollars)	(D)	(D)
Engine parts	(Dollars)	13,521,000	26,174,000
Unfilled orders (planes 3,000 lb. airframe weight and over)	(Number)	461	.....

D = Withheld to avoid disclosing figures for individual companies. Data prepared by Bureau of the Census, Industry Division, Machinery & Equipment, received from 22 companies operating 22 plants producing complete aircraft and seven engine companies operating seven plants.

A NEW ENGINEERING MATERIAL

LORD DYNA-DAMP



Dyna-damp panels and structural sections* can be designed in many configurations for addition to existing structures or fabrication as complete damped assemblies.

Lord announces Dyna-damp—a new engineering material that counteracts broad-band "white" noise and vibration. It offers a new, better way to solve acoustic fatigue and structural response problems.

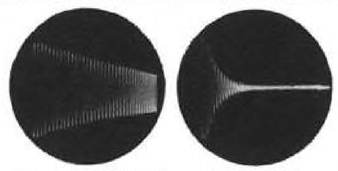
Dyna-damp's laminated design converts vibratory energy into shear strains which are dissipated in a highly damped viscoelastic layer. The damping medium is a special form of BTR® elastomer, bonded between metal elements to give structural integrity and load-carrying strength.

In jets, missiles, ships, vehicles, electronic units—wherever control of resonant response is required—Dyna-damp can introduce dramatically improved performance, higher reliability. It is available to industry in sheet and structural sections or in engineered, finished products for use as primary or secondary structures, electronic chassis, complete mounting systems.

Design engineers can obtain further information and able application assistance on Dyna-damp from the nearest Lord Field Engineering Office or the Home Office, Erie, Pennsylvania.

*patent applied for

Radically improved damping is illustrated by typical decay rate traces.



Undamped: 2024 T-3 aluminum panel

Damped: 3-ply Dyna-damp panel

DYNA-DAMP FEATURES

High strength: bonded construction provides structural integrity across complete part. Ultimate strength: 60% of solid aluminum. Shear strength of BTR layer: over 500 psi. Climbing drum peel strength: over 60 lbs.

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SAFETY

British Accident Investigation Report:

Britannia Crash Cause Undetermined

(Following is a report to Minister of Aviation Duncan Sandys into circumstances involving the crash of Ministry of Supply's Bristol Britannia G-ANCA Nov. 6, 1957 (AW May 16, p. 45) at Downend, Bristol. The report was submitted by P. G. Tweedie, chief inspector of accidents.)

Notification was by telephone from Bristol police at 1245 hr. on Nov. 6. An investigating team from the Accidents Investigation Branch arrived at the scene of the accident the same evening.

The aircraft was making a development flight from Filton Aerodrome, Bristol. After a flight of approximately 1 hr. 40 min. the aircraft approached Filton from the west, then made a complete left hand circuit of the aerodrome followed by the downwind leg of a second circuit. When it was at about 1,500 ft. and after having commenced a left turn onto the base leg the aircraft banked steeply to the right and turned some 270 deg., losing height in the turn until it struck the ground. All the occupants of the aircraft were killed (four crew members and 11 technicians).

The aircraft was built by Bristol Aircraft, Ltd., for the development of the 300-series Britannia. It first flew on July 31, 1956, and was granted a Certificate of Airworthiness on Nov. 19, 1956, in the "Special" category for research or experimental and demonstration purposes. It was equipped with the Smiths Integrated Flight System. The airframe was maintained in accordance with a Bristol Aircraft, Ltd., maintenance schedule and was subject to constant modification and development.

One such modification included the installation of a solid forged duralumin bladed propeller on No. 2 engine in place of the normal hollow steel bladed propeller. Excluding the subject flight, the aircraft had completed 267 flights representing 719 hr. of flying. At 0730 hr. on the day of the accident, a Flight Clearance Certificate was issued which stated that the aircraft was airworthy.

The weight and load distribution were within the prescribed limits.

Engine Data

No. 1 engine was a Proteus 765 and was fitted with a de Havilland hollow steel bladed propeller. No. 2 engine was a Proteus 755 and was fitted with a de Havilland solid forged duralumin bladed propeller upon which strain gage measurements could be made. No. 3 engine was a Proteus 765 and was fitted with a de Havilland hollow steel bladed propeller. No. 4 engine was a Proteus 755 and was fitted with a de Havilland hollow steel bladed propeller.

The captain, E. H. Statham, aged 46, was the Assistant Chief Test Pilot of Bristol Aircraft, Ltd., and held a Commercial Pilot's License endorsed for Britannia aircraft in Group I. He also held a Private Pilot's License which included a current instrument rating. Mr. Statham's total flying experience amounted to 6,647 hr., of which 697 were acquired in Britannia aircraft. He had been engaged in Britannia development and production flying since January, 1954, in the course of which he had carried out many stalling tests in various configurations.

The copilot, Squadron Leader D. M. Hunter, aged 35, was a qualified Royal Air Force pilot with a total flying experience of over 3,400 hr. He had flown 16 hr. as copilot in Britannia aircraft and had completed a course on the airframe and engines. He held no valid civil flying license but his RAF Master Green Instrument Rating was valid at the time of the accident.

The flight engineer, D. C. Cameron, held no license as a flight engineer but he had completed a full Britannia airframe and engine course and had flown 94 hr. in Britannia aircraft. His total flying experience amounted to 406 hr. The subject flight was the first occasion on which Mr. Cameron had acted as flight engineer-in-charge in this type of aircraft.

The radio officer, W. J. Todd, aged 32, held a valid First Class Flight Radio Telegraphy Operator's License. His total flying experience amounted to 3,229 hr., of which 1,329 hr. were in Britannia aircraft.

Weather Report

The weather report issued by the Filton Meteorological Office at 1156 hr. on Nov. 6, 1957, reads as follows:

Wind	310 deg., 2 kt.
Visibility	5 naut. mi.
Present weather	Nil
Cloud	1/8 at 4,500 ft.
	6/8 at 23,000 ft.
QNH	1003.9 mb.
QFE	995.2 mb.

The aircraft took off from Filton at 1007 hr. with an operating crew of four and 11 technicians on board. The purpose of the flight was to carry out a test program which included strain-gage measurements on a non-standard propeller of No. 2 engine, high speed upset maneuver recovery tests in connection with the American certification and the making of both a cine film and still photographic record of flight compartment instruments for use in the building of a Britannia flight simulator.

On its return the aircraft was first seen to the west of Filton at between 8,000 and 10,000 ft. descending on a southeasterly heading. An R/T call from it was received to the effect that it was 5 mi. from the airfield and approaching from the northwest. When the aircraft entered the aerodrome circuit the main undercarriage units were partly extended with the bogies almost vertical and the rearward pairs of wheels half inside the wheel-bay. The nose undercarriage unit was retracted and the doors shut. The aircraft made a complete circuit of the aerodrome during which time the undercarriage was retracted and lowered again to approximately the same position as previously described. When the aircraft flew downwind of Runway 28, the undercarriage was again retracted and the aircraft was seen flying in a slightly nose-up attitude and at a speed considered to be slower than was normal.*

Steep Turn

When at an altitude of approximately 1,500 ft. a turn to the left onto base leg was commenced but before the aircraft had made any substantial change of direction the right wing dipped and the aircraft went into a right hand turn in a very steeply banked attitude. There was a substantial recovery from this steep bank and at about this stage the call "Mayday-Mayday-Mayday-Manoc 10" was made on the R/T. A few seconds later the aircraft again banked steeply to the right and lost considerable height.

When the aircraft was about 200 ft. above the ground, the angle of bank decreased momentarily but when the aircraft struck the ground it was again steeply banked to the right. From the time it first entered the right hand turn maneuver up to the time of impact, the aircraft had turned through approximately 270 deg. The impact with ground resulted in the disintegration of the aircraft and wreckage was scattered over a wide area. All the occupants were killed instantly. Small isolated fires broke out.

Inspection at the scene of the accident showed that the aircraft had struck the ground in a wood near a residential area. The main force of impact was taken by a rising bank within the wood and complete disintegration of the aircraft resulted. Wreckage was flung forward some 200 yards and several houses in a residential estate were considerably damaged although none were made uninhabitable. Nobody on the ground was killed although some persons received varying degrees of injury and shock.

The task of salvaging the wreckage of so large an aircraft is one of great magnitude necessitating the use of much manpower and transport over a considerable period. Facilities for the transportation of about 50 tons of wreckage were made available by Bristol Aircraft, Ltd., and subsequently this wreckage was sorted and laid out within a hangar at Filton.

An extensive technical inspection was then carried out by the Accidents Investi-

*Note: It is not known why the partial extensions of the undercarriage occurred. It may be that attempts were being made to complete undercarriage free fall tests which had failed the previous day but such tests were not included in the authorized program to be carried out during this flight.

TF-33 Turbofans Mounted on B-52H

Cowling configuration of new Pratt & Whitney TF-33 17,000-lb. thrust-plus turbofan engines on Boeing B-52H missile platform-bomber is detailed in this view of installation on the latest model Stratofortress at the company's Wichita, Kan., Division. The new TF-33s will provide a substantial range increase in the B-52H over previous models, in addition to 30% increase in takeoff power. Initial flights of turbofan-powered B-52H are scheduled for mid-summer with production models delivered to SAC in 1961.

gation Branch. This failed to reveal any pre-crash failure or defect in the structure or the flying control circuits. It was established that the flaps were retracted on impact and that no asymmetric operation had taken place prior to their last retraction.

The undercarriage was locked up. There were indications that all the engines were running under some degree of power when the aircraft struck the ground. Subsequent strip examination of the four engines revealed nothing of an unsatisfactory nature with respect to either their mechanical or operational state.

Propeller Assembly

Examination of the propellers by the manufacturers failed to reveal any evidence to indicate that each assembly was other than at a positive pitch within the constant speed range. A broad assessment of the blade pitch angles on impact is as follows:

No. 1 propeller between 24 deg. and 30 deg. positive pitch; No. 2 propeller between 26 deg. and 36 deg. positive pitch; No. 3 propeller 36 deg. positive pitch; No. 4 propeller 36 deg. positive pitch.

A torn piece of paper which was identified as part of the Flight Test Observer's handwritten log was recovered from the accident site after most of the wreckage had been removed to Filton. With the aid of infrared photography it was possible to decipher the log (see box).

The heading of the log confirms that the notes are concerned with the 'accident flight' and it indicates that there existed another sheet of the log covering the earlier part of the flight. This was not recovered. An interpretation of the first line of the log is that at 1135 hr. the cabin differential pressure was 7.9 psi. and the indicated altitude was 27,600 ft. Calculations show that the resulting cabin altitude from these figures would be 3,800 ft.

The second line probably refers to a single exposure (SE) of the Automatic Observer Panel camera, the counter number of which was 0070. The third line indicates that very severe buffeting was experienced and a Mach number greater than .75 was registered. This line may be a continuation of the second line, and the buffeting and Mach reading may have been registered at the same time as the speed of 300 kt. If, however, it is a separate item, there is the possibility that a speed higher than 300 kt. registered when the Mach reading was greater than 0.75.

The fourth line of the log probably refers to the emergency switch in the cockpit which operated the Automatic Observer Panel camera continuously and that the counter numbers of the resulting exposures were from 0071 to 0077 after which the emergency switch was put to "OFF."

The next line indicates that at 1150 hr., course was set for Filton and that it was the intention to record on the Automatic Observer Panel the operation of all four propellers in reverse pitch during the landing. The Flight Test Observer had noted that the counter number of the exposure recording the propeller reversal would be 0078 (last line of the log).

Pertinent to the speeds recorded in this log, the following are limitations for this aircraft: normal operating limit speed—250 kt. IAS and 0.60 Mach; demonstrated flight diving speed—304 kt. equivalent air speed and 0.70 Mach.

Farnborough Examination

It was decided, after consultation, that the wreckage should be moved to the Structures Department, Royal Aircraft Establishment-Farnborough, where a partial reconstruction and a detailed examination could best take place. This examination was concerned in the first instance with the aircraft structure and primary control systems. The fact that the aircraft had exceeded its speed limitations on the subject flight was particularly borne in mind.

The extensive disintegration of the aircraft necessitated partial reconstruction of the wings, their respective ailerons and flaps, and the tailplanes. No attempt was made to reconstruct the fuselage. The conclusions drawn from the subsequent examination were that the starboard wing had been disrupted progressively from tip to root by forces upward and backward. The port wing had been crushed by spanwise forces from tip to root and the port and starboard tailplanes had been damaged in a manner similar to their respective wings.

The main control surfaces, their tabs and trimming circuits, were near to the neutral position at the time of impact and there was no evidence that any hydraulic control lock had inadvertently operated in flight. The nature of the damage to the aircraft indicated that it had struck the ground in a starboard wing-low attitude and had cartwheeled about that wing, finally sliding sideways over the ground, port wing tip leading and breaking up in the process. No evidence was found of any pre-crash defect or failure in the aircraft or its main controls.

The examination was then extended to include the electrical and autopilot systems. Signals from gyro units of the autopilot cause elevator, aileron and rudder servomotors to be energized. A system of shafts, levers and push-pull rods connect the servomotors to their respective main control circuits. Each push-pull rod incorporates a preloaded spring, the deflection of which operates an electrical cutout switch connected to the electro-magnetic clutch of its associated servomotor. The push-pull rods are called force limiting links. A shear neck is machined into each of the servomotor shafts so that if its associated reduction gear seizes, the neck can fail in order to free the control circuit.*

Link Inspection

Inspection of the force limiting link of the aileron control circuit showed that the ball which operates the cutout switch had made a pattern of indentations over a distance equivalent to the mechanical limits of travel of the shaft within the force limiting link. From an examination of the aileron channel servomotor shaft it was concluded that the shear neck had failed in torsion before it sustained damage from ground impact. An identical test specimen which was deliberately subjected to a torsion failure showed the same type of fracture. It was established that the autopilot power switch was in the "OFF" position at the moment of impact but closer examination of individual components indicated that the gyro rotors and another associated motor were rotating, though not under electrical power at that moment.

This suggests that they were 'running down' after having been switched off a short time before the accident occurred. No direct evidence was found to indicate that the aileron servomotor clutch had remained engaged after the autopilot had been switched off.

The conclusions of the Structures Department on their examination of the wreckage are as follows:

- "From the examination of the wreckage of Britannia G-ANCA, evidence has been discovered which shows that the autopilot aileron channel had been damaged before the crash in a manner consistent with failure of the channel clutch to disengage, although the appropriate switches had been operated.
- "It is considered that the lack of disen-

*Note: Although during static tests the neck has been made to fail by human loads equivalent to a pilot effort of about 180 lb. applied to the control column, there is no known case of this having occurred in the air.

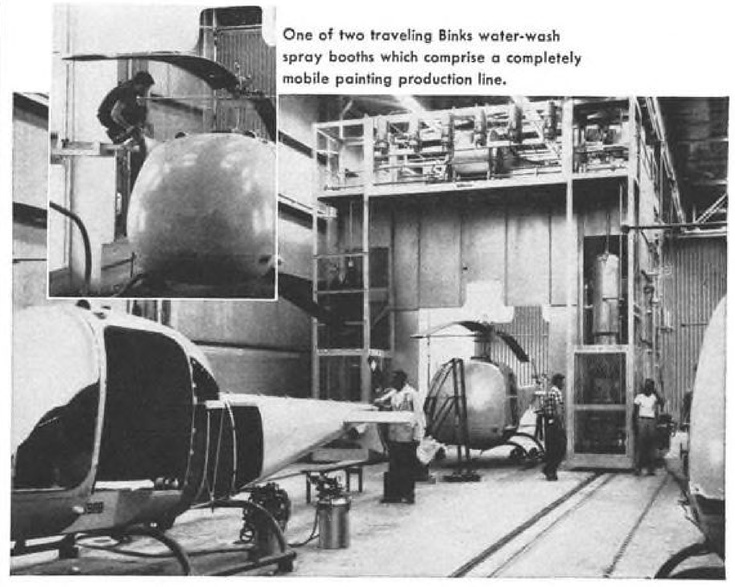
Aircraft G-ANCA

Flight No. 268 Sheet 2

Fuel A.U.W. lb. c.

Time	Counter	Frame Speed	AOP	Event	
1135				$\Delta p = 7.9$	27600'
	0070-			SE at 300 Kts.	
				very severe buffeting	M >.75
	0071-77			Em Sw	
1150				Going home will record landing on all 4 reverse	
	0078-				

INVESTIGATORS reproduced a portion of the test observer's log by infrared photography.



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traveling spray booths help cut painting time 80%

"Helicopters are difficult to move down an assembly line so we decided to move the assembly line past the helicopters," states the paint shop foreman at Bell Helicopter, Fort Worth, Texas.

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Semi-conductor	0.6
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Filter	3.1
All other electronic	0.2
Operating Components	**14.0**
Case & base plate	1.7
Mounting hardware	2.7
Total	**18.4**
Dimensions	
Length	10"
Width, including base plate	7"
Height	4"

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gagement of the aileron channel could have seriously hampered the pilot's actions and led ultimately to a loss of control of the aircraft.

• "**There was no direct evidence** as to the cause of the clutch failing to disengage but it was most likely due to some undiscovered fault acting in conjunction with a known design fault in the electrical circuits of the autopilot/flight system."

Similar Incident

Referring to an incident involving Britannia G-AOVG; this aircraft was equipped with the Smiths Integrated Flight System similar to that of the subject accident aircraft.

During its first flight which took place on Jan. 10, 1958, and while descending from 6,000 ft. in instrument meteorological conditions with heavy rain and turbulence, dangerous aileron control difficulties were encountered shortly after disengagement of the autopilot by means of the cutout button on the pilot's control column. The emergency lasted several minutes and at times the combined efforts of the pilot and the engineer were required to maintain lateral control.

Although the autopilot cutout buttons on both control columns had been operated, it was not until the power supply to the autopilot was cut off by switching off the appropriate inverter that the emergency was resolved.

Investigations into this incident revealed that a design fault was incorporated in the electrical circuitry of the autopilot/flight system. This resulted in single pole instead of the intended double pole operation of the aileron servomotor clutch. The fault was such that in conjunction with a stray positive feed, malfunctioning of the autopilot could occur to a degree consistent with the conditions experienced during the emergency. A stray positive feed due to defective soldering, was, in fact, ultimately located. Component inspection showed that the shaft of the force limiting link in the aileron circuit was not marked by ball indentations; neither was the aileron servomotor shaft shear neck fractured despite the combined force of two men having been applied to the aileron controls.

The design fault in the electrical circuitry of the autopilot/flight system which was detected in G-AOVG was also present in the subject aircraft G-ANCA.

Observations

It is not considered relevant to this report to list all the hypotheses which were considered before finally being rejected. Two examples are, however, worth noting. The first was the theory that a photographic flash bulb might have burst in the cockpit and incapacitated the crew. A photograph shows such a bulb bursting and illustrates the consequential high velocity dispersal of glass particles and burning magnesium. Glass particles extracted from flying helmets belonging to crew members and from the cockpit area were the subject of a very careful analysis. This was carried out by the research department of Messrs. Pilkington Bros., Ltd., whose excellent and detailed report concluded that none of the glass extracted could have originated from the type of flash bulb used.

The experiments do demonstrate, however, the potential dangers inherent in the bursting of a flash bulb in the cockpit of an aircraft. The second concerns the possibility that the maneuverability of the aircraft may have been influenced by radio coupling to the Greenham Common VOR. However, radio flight tests were conducted in the area flown by G-ANCA and it was found that at an altitude of 2,200 ft. the VOR signals commenced to fade and they were lost completely at 2,000 ft. and below.

The final maneuvers of the aircraft indicate that the pilot was unable to prevent it from making a steeply banked descending turn to the right.

Shaft Investigation

It is the view of the Structures Department, RAE-Farnborough, that the evidence of the pattern of ball indentations on the aileron force limiting link and the time at which the torsion failure of the shaft of the aileron servomotor occurred suggest that the aileron channel clutch remained in engagement after the appropriate disengagement switches had been operated in flight. In support of this it was held that only slight movement of the shaft of the force limiting link should be necessary to cause the ball to enter the housing and break the electrical circuit to the clutch. During this process the ball was not intended to leave the confines of the shaft ramp and bouncing, which is necessary to make the indentations, could not occur.

The manufacturers of the autopilot argued that the servomotor shaft can be sheared and ball indentations on the force

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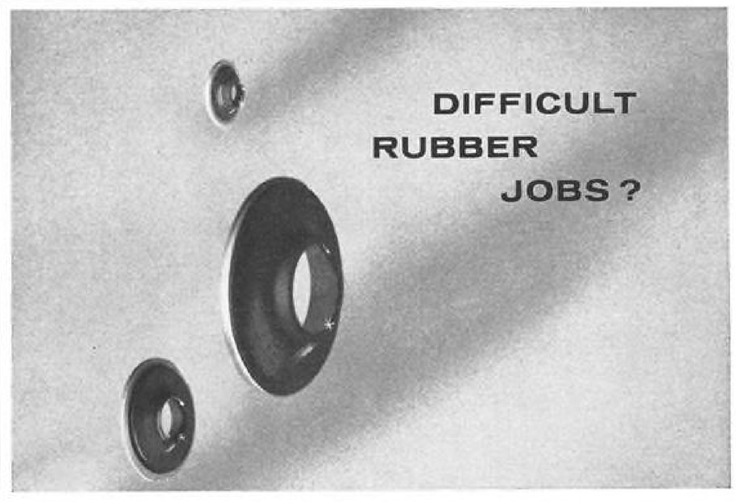

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Aerospace Age

The changing role of the Strategic Air Command in the national defense picture will be featured on June 20th in a special 36-page report prepared by AVIATION WEEK editors with on-the-spot coverage of the SAC Command—The nation's shield against aggression.

This exclusive report will be published in answer to the growing requirement for an improved national understanding of SAC's changing role as the primary deterrent force guarding national security. The annual R&D issue will be devoted to this message which is today's most challenging subject.

The Strategic Air Command's deterrent position has undergone complex and fundamental changes in its transition to a Strategic Aero-Space Command—with its formidable bomber fleet soon to be reinforced by intercontinental ballistic missiles operationally deployed to instantly counter any aggressive action.

The transition of SAC is one of the most rapid and exciting events in the history of our nation and its defense. What SAC needs, what lies ahead and the weapon systems to be employed in the immediate future will be key subjects included in this first-time technical evaluation. The impact of new technologies and weapon systems has changed the entire defense concept and the response of SAC to these new requirements has been effective and positive.

AVIATION WEEK editorial teams are now engaged in the compilation of the new SAC story—one that will generate world-wide readership. This issue, "SAC In Transition," offers manufacturers and suppliers of the aerospace industry an unusual opportunity to advertise and identify their role in the national defense effort.

Aviation Week *and Space Technology*

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NASA's

2nd, 3rd, 4th generation space rockets

To go vastly greater distances . . . to send heavier payloads . . . NASA scientists and engineers are working on the Centaur, Saturn and the Nova type vehicle. As the curve of scientific progress approaches the vertical, these advanced rocket boosters may bring significant breakthroughs in space exploration.

CENTAUR—the first rocket booster to be fueled with liquid hydrogen—will enable NASA scientists and engineers to put four-ton payloads into 300-mile orbits around the earth.

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NOVA TYPE—a cluster of single chamber 1.5 million pound thrust engines now being developed to launch multi-ton space stations or to send manned expeditions to the moon.

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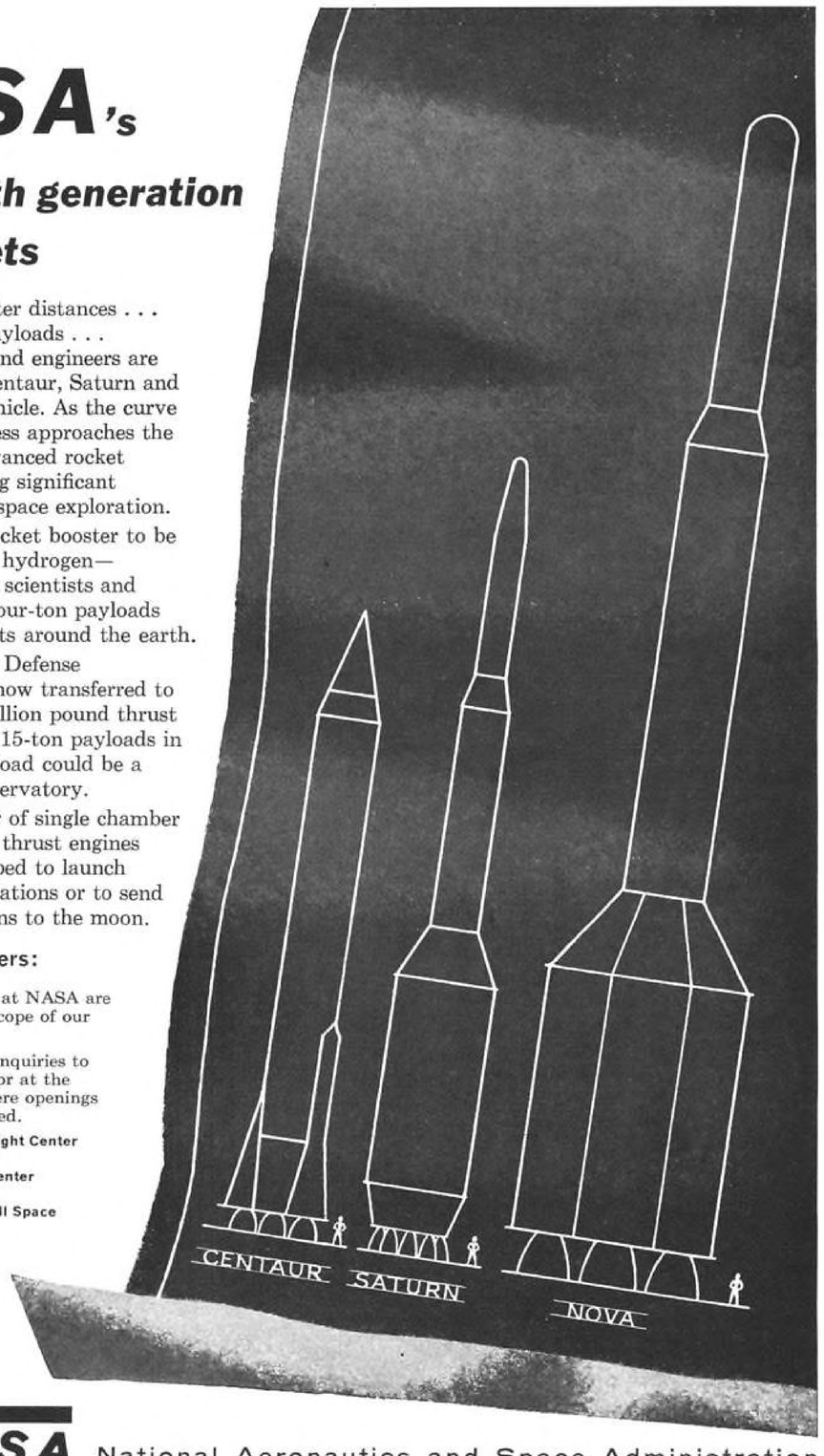

NASA National Aeronautics and Space Administration

limiting link shaft can result from crash impact damage with the clutch disengaged. To support this they carried out tests which sheared the servomotor shaft in a manner similar to that of the accident aircraft and which produced representative ball indentations.

Their report on the tests carried out concludes as follows:

"The tests as carried out, have shown that the servomotor mounting output shaft can be sheared and ball indentations can be produced on the force limiting link shaft, due to impact damage in either compression or extension with the servomotor electrical clutch disengaged."

The accident has involved a prolonged consideration of matters of considerable technical complexity and the carrying out of numerous tests and painstaking examinations by a large number of specialists.

Although as a result a considerable number of possible causal factors can be eliminated, the cause of the accident must still remain a matter of speculation. Considering the accident as a whole, the balance of evidence is not inconsistent with malfunctioning of the autopilot although there is no conclusive proof of this.

On the subject flight, the aircraft carried a quantity of flight recording equipment but this was destroyed by the force of impact and no useful information could be obtained from any of the recordings made.

The equipment is not intended to withstand the type of shock loading to which it was subjected but a suitably designed crash recorder might well have remained intact. The aircraft was not fitted with one.

Conclusions

(1) The documentation of the aircraft was in order.

(2) The captain and the radio operator were properly licensed. The copilot was a qualified RAF pilot but held no valid civil pilot's license. The flight engineer held no license to fly in that capacity but was adequately trained to carry out a flight engineer's duties.

(3) A detailed examination of the airframe and its main control circuits revealed no evidence of pre-crash failure.

(4) An examination of the four engines and their respective propellers indicated that these were functioning normally.

(5) A design fault in the electrical circuit of the autopilot flight system had the effect of changing the switching arrangement of the aileron servomotor clutch to a single pole operation when double pole was intended.

(6) There is no positive proof that the autopilot aileron clutch failed to disengage when the appropriate switches were operated.

Opinion

The accident was the result of the aircraft developing a very steep descending turn to the right which the pilot was unable to control. The reason for this could not be determined but the possibility that it occurred as the result of malfunctioning of the autopilot cannot be dismissed.

P. G. Tweedie
Chief Inspector of Accidents

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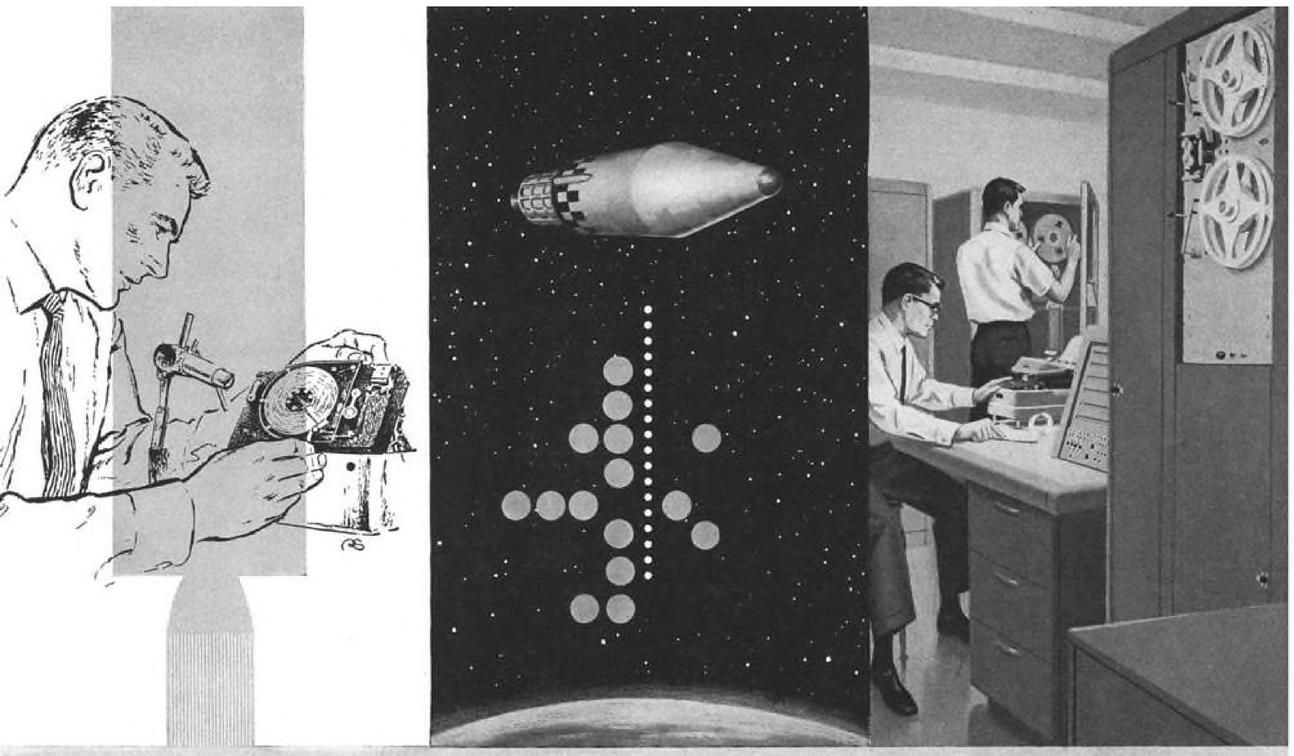

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Special emphasis is being attached to the research, design and development of improved military electronics systems for communications, including new methods of data transmission, reception and storage. Pioneering work is also being conducted in space vehicle borne computers, DC-AC inverters, non-gyro guidance systems. Studies in oceanography include underwater communication and navigation, and natural phenomena and military aspects of the deep sea.

Lockheed's programs reach far into the future and deal with unknown environments. It is a rewarding future and one that outstanding scientists and engineers are invited to share. If you are experienced in any of the above areas, or in related work, we invite your inquiry. Please write: Research and Development Staff, Dept. E-17-B, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

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WHO'S WHERE

(*Continued from page 23*)

Changes

Dr. Charles F. Gell, chief of life sciences, Astronautics Division of Chance Vought Aircraft, Inc., Dallas, Tex.

Thracy Petrides, director of government programs, U.S. Industries, Inc., New York, N. Y.

Fred Morrison, head of the advanced Sidewinder project, Motorola's Western Military Electronics Center, Phoenix, Ariz.

John C. Howe, assistant district manager of Thompson Ramo Wooldridge's Dayton (Ohio) office.

Joseph Rae Conway, Jr., director of marketing, Whittaker Gyro Division of Telecomputing Corp., Los Angeles, Calif.

Austin F. Stuart, chief engineer, Airborne Equipment Department, Huyck Systems Co., a division of Huyck Corp., Huntington Station, N. Y.

Military Products Division of Hoffman Electronics Corp., Los Angeles, Calif., has announced the following appointments: **Dr. John J. Myers,** director of engineering; **Philip J. Koen,** director of controls and procedures; **Frederick J. Seufert,** director, Systems Department; **Lawrence Mendelsohn,** director, Instrument Department; **Dr. A. L. Floyd,** technical adviser to the general manager and he continues as director of reliability.

Kenneth Young Knight, manager of the newly formed manufacturing services and controls department at Hughes Aircraft Co.'s Ground Systems, Group, Fullerton, Calif. Other Ground Systems Group appointments: **Lester V. S. Sanson,** manager, Manufacturing and Parts Service Division; **Robert M. Snyder,** manager, Radar Systems Department of the radar laboratory.

Bastian Hello, program manager for the rocket booster portion of the Air Force Dyna-Soar project for The Martin Co., Baltimore, Md. **William A. Bortner** succeeds Mr. Hello as P5M and miscellaneous programs manager at the Baltimore Division.

Stanley G. Fisher, general sales manager, The Fafnir Bearing Co., New Britain, Conn.

A. Clyde Flackbert, manager of administration, Tactical Weapon Systems Operations at Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Defense Systems Department of General Electric Co. has opened a district office in Huntsville, Ala., and **William S. Henry** has been appointed district manager.

Lawrence J. Gale, director of commercial sales, and **Edward C. Greuling,** director of military sales, Burton-Rodgers, Inc., Cincinnati, Ohio.

Robert F. Wigmore, senior air transport analyst, Bonanza Air Lines.

The British Ministry of Aviation has announced the following appointments: **Eric Bairdstow Carter,** director of engine production; **John Dickens Clare,** director of guided weapons research and development (air).

Harold P. Field, director of plans and programs, System Development Corp., Santa Monica, Calif.

L. J. Lekus, manager of business programing-market section, General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa.

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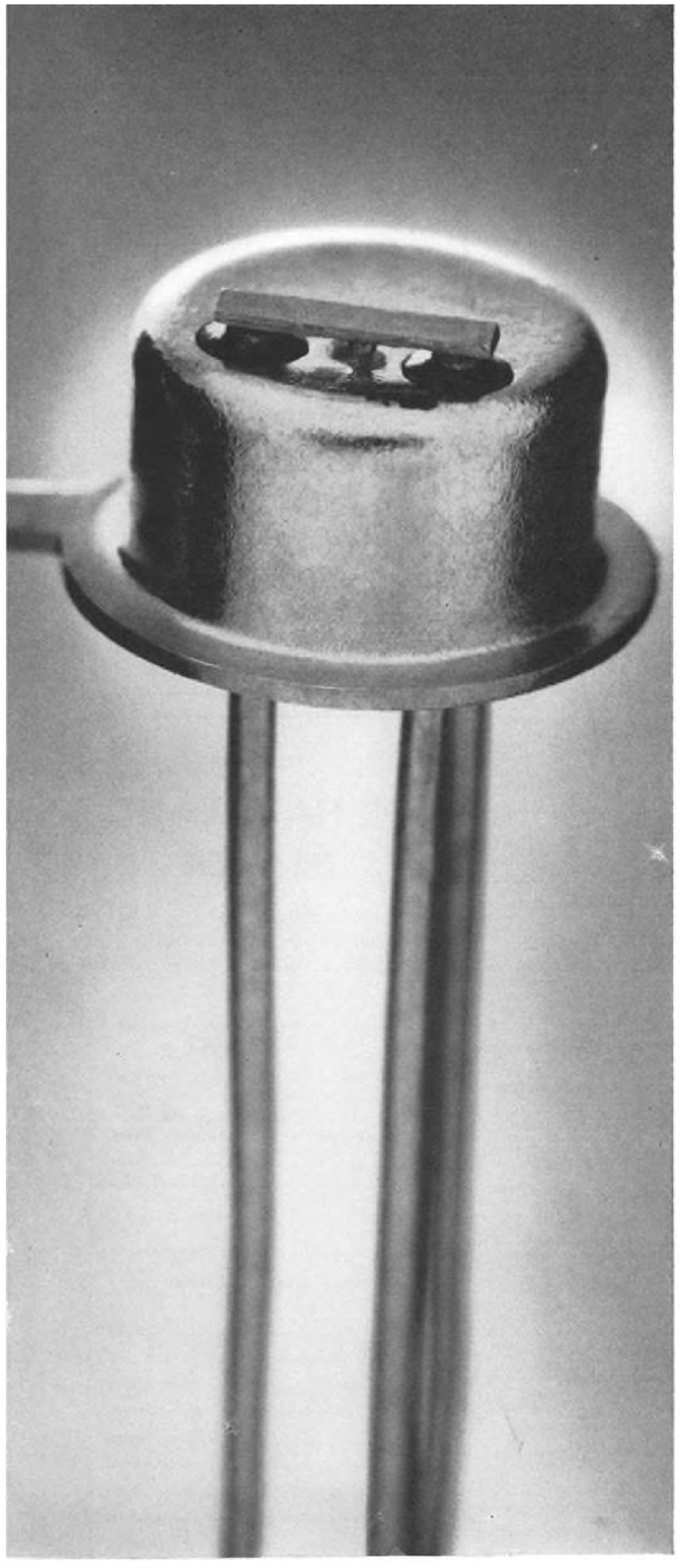

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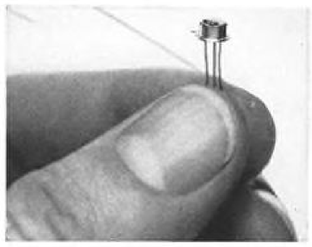

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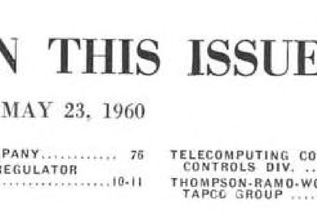

An Aerodynamicist out for a stroll walks eastward at a rate of 3 mph. He notices that the wind appears to blow directly from the north. He doubles his speed and the wind appears to blow from the northeast. What was the wind velocity? —*Mathematics Magazine*

When you are out for a stroll sometime, consider the fact that we have made our stable platform gyros, accelerometers, and gimbal systems more compact, yet more accurate than previously thought possible. If you can make unusual contributions in this field, write to our Mr. Don Krause.

ANSWER TO LAST WEEK'S PROBLEM: If X = the least number of marchers, then X + 1 is congruent to 0 modulo 3, modulo 5, modulo 7, and modulo 11. That is X + 1 must be divisible by 3, 5, 7 and 11. The least number which is so divisible is the product 3x5x7x11 since these four numbers are prime factors. Hence the least number of marchers is 1154.

LITTON INDUSTRIES
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Beverly Hills, California

LETTERS

CAB Appointments

I read with great interest your editorial "Airlines at the Crossroads" appearing in the May 2 issue. I am enclosing for your information two letters that I recently wrote to the Honorable Sen. Mike Monroney on this very same subject.

It is my firm belief that unless the aviation industry, our leaders in Washington, and the people responsible for appointments to the Civil Aeronautics Board come to grapple with this problem, commercial aviation will suffer one of the largest setbacks in its history.

Your editorial was a most welcome sight, and I only hope that the issue isn't allowed to die. The aviation industry must now roll up its sleeves and go to work in order to preserve the great strides of progress the industry has made in recent years.

HAROLD D. COPE
Vice President
All American Airways, Inc.
Miami, Fla.

Academy Classmates

In regard to your reference to Thomas G. Lamphier, Jr., as a "son of a West Point classmate of President Eisenhower" (AW Apr. 11, p. 127), I must join Col. E. De Treville Ellis, U.S. Army (Ret.), assistant secretary, Class of 1915, U.S.M.A. (AW May 2, p. 198), in his protest at your loose interpretation of just what constitutes a classmate at the Point.

Your temerity in lumping the two classes together is alarming; mere association for three of the four years of a cadet's tour at the Point does not imply social, military, business or human equality.

I trust you will be more circumspect in your reference to military academy class year groups in the future.

I am writing to you since my wife is out of town.

(Name withheld by request.)

COMMANDER, U.S. NAVY
Missouri '41.

Sensible Strategy

I feel rather reckless intruding into the verbal slugfest between those two unhappy giants of recent letters, "Bitter" Atlas (AW Feb. 15, p. 166), and "Sour" Titan (AW Apr. 4, p. 146).

However, recall the wisdom of Descartes: "Man should doubt everything he observes. If a man doubts, he thinks, and to think is to exist."

As this puzzled pygmy sees the situation, we're obscuring the need to make our military capability fit a sensible national strategy by indulging in an extravagant contest of numbers and dubious requirements.

Why, for example, build hardened missile bases unless we expect to ride out an enemy missile attack? But in that event our ultra-sophisticated counterforce missiles (20-40 million dollars per shot) are no longer required for the soft enemy targets remaining. A true deterrent strategy requires a sufficient number of relatively cheap, invulnerable, low-accuracy missiles aimed at their cities.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

On the other hand, if we accept the option of deliberately initiating this mutual suicide pact, then we do indeed require the high-yield, high-accuracy missiles presently being procured. Besides not being a deterrent strategy this option leads to some interesting speculation. Assuming that the presently authorized 243 shots (AW Apr. 4, pp. 34, 65) have the capability desired by "Sour Engineer" we then will have a 90% probability of destroying, at most, 40 hard targets, presumably enemy ICBMs. This, I believe, assumes 100% reliability per shot. How does this goal compare with the enemy missile force allegedly in excess of ours, some of which must be aimed at our soft cities? Using the above figures, simple arithmetic shows that we would need at least $30 billion (1,500 ICBMs) just to neutralize an enemy force equivalent to our present procurement. This, of course, assumes a simple static situation which is not typical of a classical arms race in which each party attempts to at least neutralize the opposing force.

Although I'm normally a proponent of manned aircraft, I don't see how the B-70 would help even if it could be operational before 1965. It's dependent on high-confidence early warning for launching; will be very vulnerable at high altitude; cannot fly at Mach 3 at low altitude where manned penetration is feasible; will also be very expensive and, therefore, few in number on target.

Examining our present procurement policies it seems as if we can't decide between the strategies of deterrence and pre-emptive war, and are trying to hedge both ways. I'm only confused, but imagine what the enemy's response might be. If it's pre-emptive we've lost both bets, and if it isn't we've wasted a lot of effort on overly extravagant weapons.

While we're spending astronomical sums to ensure annihilation of the enemy society, hoping that this will prevent nuclear catastrophy, the enemy is matching our effort. Yet we provide almost nothing to ensure the survival of our society in the event that the "deterrent" fails. Is this a sensible national policy?

And if all-out nuclear war is deterred, how well are we prepared to cope with other options left to an aggressor such as limited war situations or the use of "inhumane (!)" (therefore, hush-hush) weapons, such as bacteriological and chemical agents?

There are those who believe that more money is needed. I'd like to be convinced that we've been wise in our procurement to date. A revealing example is the recently reversed decision to harden our defensive (NORAD) installations. On examination, this was an exercise in futility. It was apparently based on the self-deluding assumption that the enemy rated our defense-only installations (e.g., SAGE) as high-priority targets. Yet the very decision was a tacit admission that our defenses weren't very effective and, therefore, did not rate top priority for enemy weapons that must be reserved for assignment to SAC bases. I suppose we should be thankful that no more money will be spent on that particular nonsense.

This and other cancellations of "marginal" yet expensive programs make me wonder about the judgment used in allocating past billions. We gave our present leadership an undeniable mandate on two distinct occasions to "clean up the mess in Washington." After eight years and perhaps 250 billion defense dollars, where do we stand? It seems that we're bleeding our economy without achieving a high confidence of preserving our society. If we do not soon untangle our politico-generals and our politicians who try to out-general the generals, history may label this era "Wait, Waste, Wish and Wham" rather than "Peace and Prosperity." Will we ever have a better chance to reorganize than right now?

J. L. ROTH
Huntington, N. Y.

Editorial Emphasis

I don't want to tell you how to run your magazine, but the main points of your fine editorial "Pentagon White Paper" (AW Apr. 18, p. 21) should have been printed in boldface type. (Actually, I do want to tell you how to run your magazine, including changing from limited circulation to mass circulation and changing the name of the magazine to Aviation and Space Technology.)

Why not print the main points in boldface type right on this page:

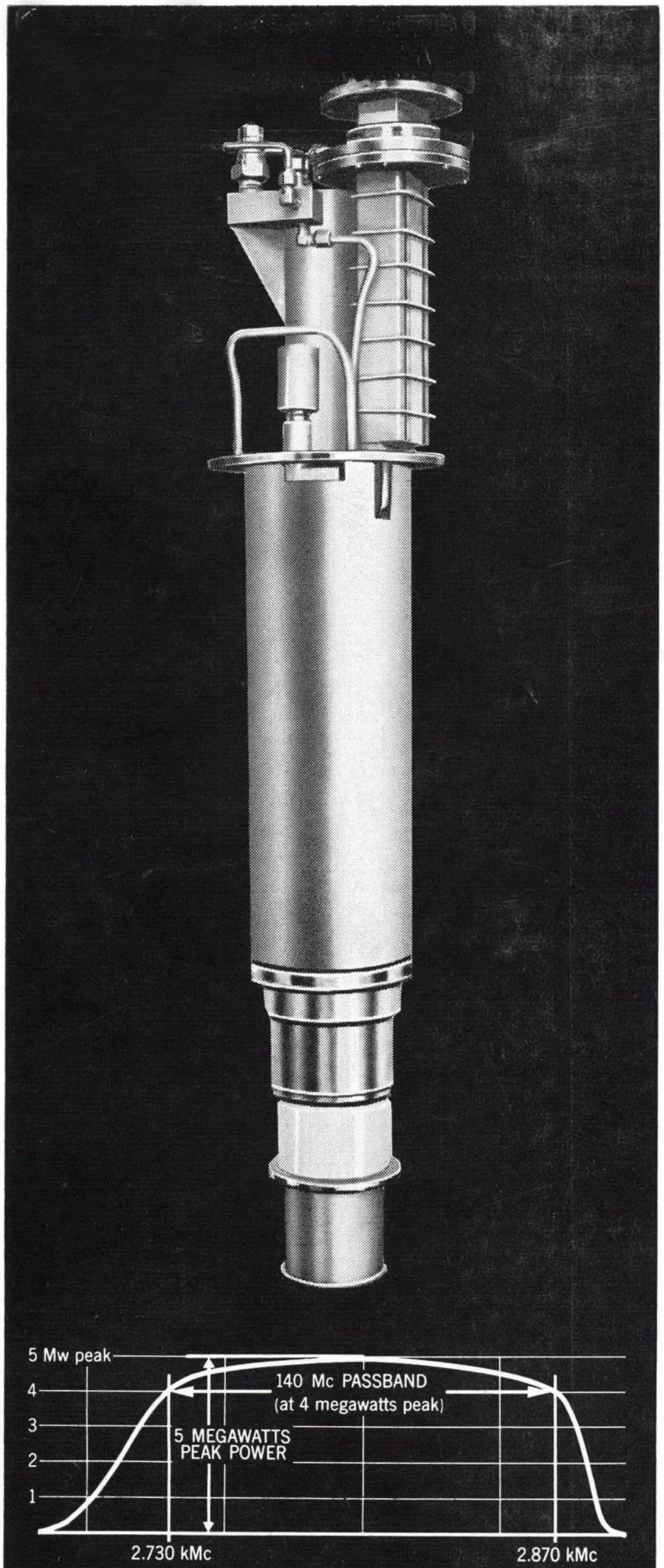
"The White Paper ignores completely the most frequent charge that the defense program is artificially tailored to a budget ceiling rather than realistically molded to meet the changing military threat and then costed accordingly.

"It says we are cutting back the B-58 program because there is supposedly not much requirement for a Mach 2 bomber, and then we are all but eliminating the Mach 3 bomber on the grounds that it won't be much better than the Mach 2 bomber that we aren't getting in any significant quantity either.

". . . If this White Paper really represents top-level Defense Department thinking, we are in worse shape than previously imagined."

By utilizing boldface type, almost everyone who sees that forbidding word "Editorial" will at least read the boldface items. Reading of the boldface items will stimulate many to read the entire editorial; in fact, most persons who read this letter will dig back into the Apr. 18 issue to peruse p. 21 thereof.

CARL HEYL
Bethpage, N. Y.



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