Aviation Week & Space Technology

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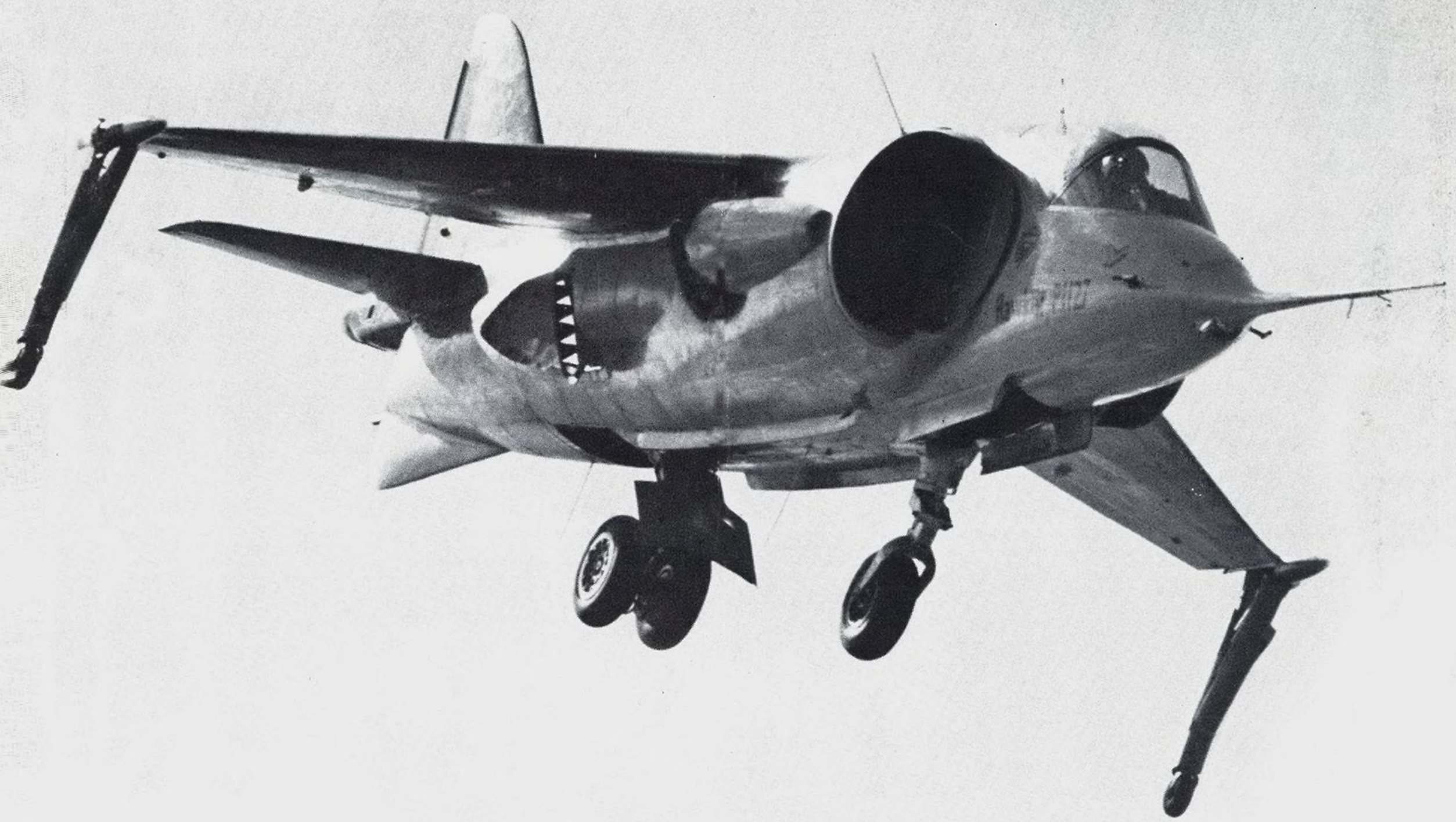
September 17, 1962

SPECIAL PHOTOS:

P.1127 VTOL Takeoff Sequence



Hawker P.1127

AEROSPACE CALENDAR

Sept. 24-28—13th International Astronautical Congress, American Rocket Society, Sofia, Bulgaria.
Sept. 24-Oct. 12—International Air Transport Assn. Traffic Conferences, San Marcos Hotel, Chandler, Ariz.
Sept. 25-26—Conference: Navy Microelectronics Research & Development, Department of Interior Auditorium, Washington, D. C. Sponsor: Office of Naval Research.
Sept. 25-27—Third Annual Symposium on Helicopter Open Sea Rescue, Kaman Aircraft Corp., Bloomfield, Conn. Sponsor: Naval Air Material Center, Air Crew Equipment Laboratory.
Sept. 25-28—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.
Sept. 26-27—Symposium on the Physics of Failure in Electronics, Illinois Institute of Technology, Chicago, Ill. Co-sponsor of the symposium: Rome Air Development Center, United States Air Force Systems Command; Armour Research Foundation.
Sept. 26-Oct. 2—1962 General Conference, Federation Aeronautique Internationale, Athens, Greece.
Sept. 27-28—Symposium on Dynamic Behavior of Materials, University of New Mexico, Albuquerque, N. M. Sponsors of the symposium: University of New Mexico; American Society for Testing and Materials.

(Continued on page 7)

AVIATION WEEK and Space Technology

September 17, 1962
Vol. 77, No. 12

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AEROSPACE CALENDAR

(*Continued from page 5*)

Sept. 27-28—Fifth Annual National Conference & Technical Exhibit, American Production and Inventory Control Society, Statler Hilton Hotel, Boston, Mass.

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

Sept. 30—Third Annual Aerospace Fair, Vandenberg AFB, Calif. Open to the public 10:00 a.m.-4:00 p.m.

Sept. 30-Oct. 5—Fourth Pacific Area National Meeting, American Society for Testing and Materials, Statler Hilton Hotel, Los Angeles, Calif.

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

Oct. 1-3—National Communications Symposium, Institute of Radio Engineers, Hotel Utica, Utica, N.Y.

Oct. 1-5—Northeast Commerce and Industry Exposition, Commonwealth Armory, Boston, Mass.

Oct. 2—15th Annual New York State Aviation Conference, Mark Twain Hotel, Elmira, N.Y.

Oct. 2-4—Symposium on Physics and Nondestructive Testing, Granada Hotel, San Antonio, Tex. Arranged by Southwest Research Institute.

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

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

Oct. 2-4—15th Annual Meeting and Convention, National Business Aircraft Assn., Penn-Sheraton Hotel, Pittsburgh, Pa.

Oct. 6—14th Annual Reunion, U.S. Naval Test Pilot School Alumni, U.S. Naval Air Station, Patuxent River, Md.

Oct. 7-9—International Northwest Aviation Council Meeting, Idaho Falls, Idaho.

Oct. 8-10—18th Annual National Electronics Conference & Exhibition, McCormick Place, Chicago, Ill.

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

Oct. 9-11—National Airports Conference, American Assn. of Airport Executives, University of Oklahoma, Norman, Okla.

Oct. 10-12—Ions in Flames & Rocket Exhausts Conference, American Rocket Society, Palm Springs, Calif.

Oct. 10-12—20th Annual Aerospace Electronics Exposition/Report, Aerospace Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 12-13—Symposium on Photography of Electronic Display, Shoreham Hotel, Washington, D.C. Sponsors: Society of Photographic Scientists & Engineers, National Bureau of Standards.

Oct. 15-17—Fall Meeting, International Scientific Radio Union & Institute of Radio Engineers, Ottawa, Canada.

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

(*Continued on page 9*)

PROBLEMATICAL RECREATIONS 136

If a certain six digit number is split into two parts, one constituting the first three digits and the other the last three digits, and the two parts are added and the resulting sum squared, it is found that the product is the original six digit number. What is the number?

—*Contributed*

ANSWER TO LAST WEEK'S PROBLEM: Among many solutions we offer one: number the square in horizontal rows as follows and start the "Knight's Tour" with the square numbered 1, proceeding in serial order: 1, 40, 13, 26, 3, 50, 15, 28; 24, 37, 2, 39, 14, 27, 4, 49; 41, 12, 25, 58, 51, 62, 29, 16; 36, 23, 38, 61, 54, 57, 48, 5; 11, 42, 59, 56, 63, 52, 17, 30; 22, 35, 64, 53, 60, 55, 6, 47; 43, 10, 33, 20, 45, 8, 31, 18; 34, 21, 44, 9, 32, 19, 46, 7.

AEROSPACE CALENDAR

(Continued from page 7)

Oct. 15-18—International Symposium on Space Phenomena and Measurement, Statler-Hilton, Detroit, Mich. Ninth Annual Meeting: Institute of Radio Engineers, co-sponsored by NASA and AEC.

Oct. 16-17—Symposium on Inertial Guidance Test, Holloman AFB, N. M. Sponsor: Air Force Missile Development Center.

Oct. 18-19—Second National Conference on Planning & Designing Urban Helicopter Facilities. Institute of Aerospace Sciences Bldg., Los Angeles, Calif. Sponsor: Los Angeles Chamber of Commerce.

Oct. 18-19—Sixth Annual Display, Aerospace Electrical Society, San Diego, Calif.

Oct. 22-23—Joint Meeting, Canadian Aeronautical Institute—Institute of the Aerospace Sciences, King Edward Sheraton Hotel, Toronto, Canada.

Oct. 22-24—East Coast Conference on Aerospace and Navigational Electronics, Institute of Radio Engineers, Emerson Hotel, Baltimore, Md.

Oct. 24-26—Annual Meeting & Exposition, Society for Experimental Stress Analysis, Hotel Schroeder, Milwaukee, Wis.

Oct. 25-27—1962 Electron Devices Meeting, Institute of Radio Engineers, Sheraton Park Hotel, Washington, D. C.

Oct. 26-27—17th Midwest Quality Control Conference, American Society for Quality Control, Denver Hilton Hotel, Denver.

Oct. 29-30—Meeting on Large Rockets, Institute of the Aerospace Sciences, El Dorado Inn, Sacramento, Calif.

Oct. 29-31—Symposium on Dynamics of Manned Lifting Planetary Entry, Philadelphia, Pa. Attendance limited; for information: Sinclaire M. Scala, General Chairman, Room M7023A, General Electric Co., MSVD, Valley Forge Space Technology Center, Box 8555, Philadelphia 1, Pa. Co-sponsor: AFOSR.

Oct. 29-Nov. 2—International Symposium, "Basic Environmental Problems of Man in Space." UNESCO House, Paris, France. Sponsors: International Astronautical Federation; International Academy of Astronautics.

Oct. 30—Supersonic Commercial Transport Metals Symposium, Metallurgical Society, Statler-Hilton Hotel, New York, N. Y.

Oct. 30-31—National Conference on Spaceborne Computer Engineering, IRE, Disneyland Hotel, Anaheim, Calif.

Oct. 30-Nov. 1—Eighth Tri-Service Conference, Armour Research Foundation, Chicago, Ill. Sponsors: U. S. Army, Navy and Air Force.

Nov. 5-7—Symposium on Protection Against Radiation Hazards in Space, Gatlinburg, Tenn. Co-sponsors: Oak Ridge National Laboratory; NASA Manned Spacecraft Center; American Nuclear Society.

Nov. 7-8—Symposium on Lasers and Applications, Antenna Laboratory, Department of Electrical Engineering, Ohio State University, Columbus, Ohio.

Nov. 12—Wings Club Annual Dinner, Americana Hotel, New York, N. Y.

Nov. 13-18—17th Annual Meeting and Space Flight Exposition, American Rocket Society, Pan Pacific Auditorium, Los Angeles, Calif.

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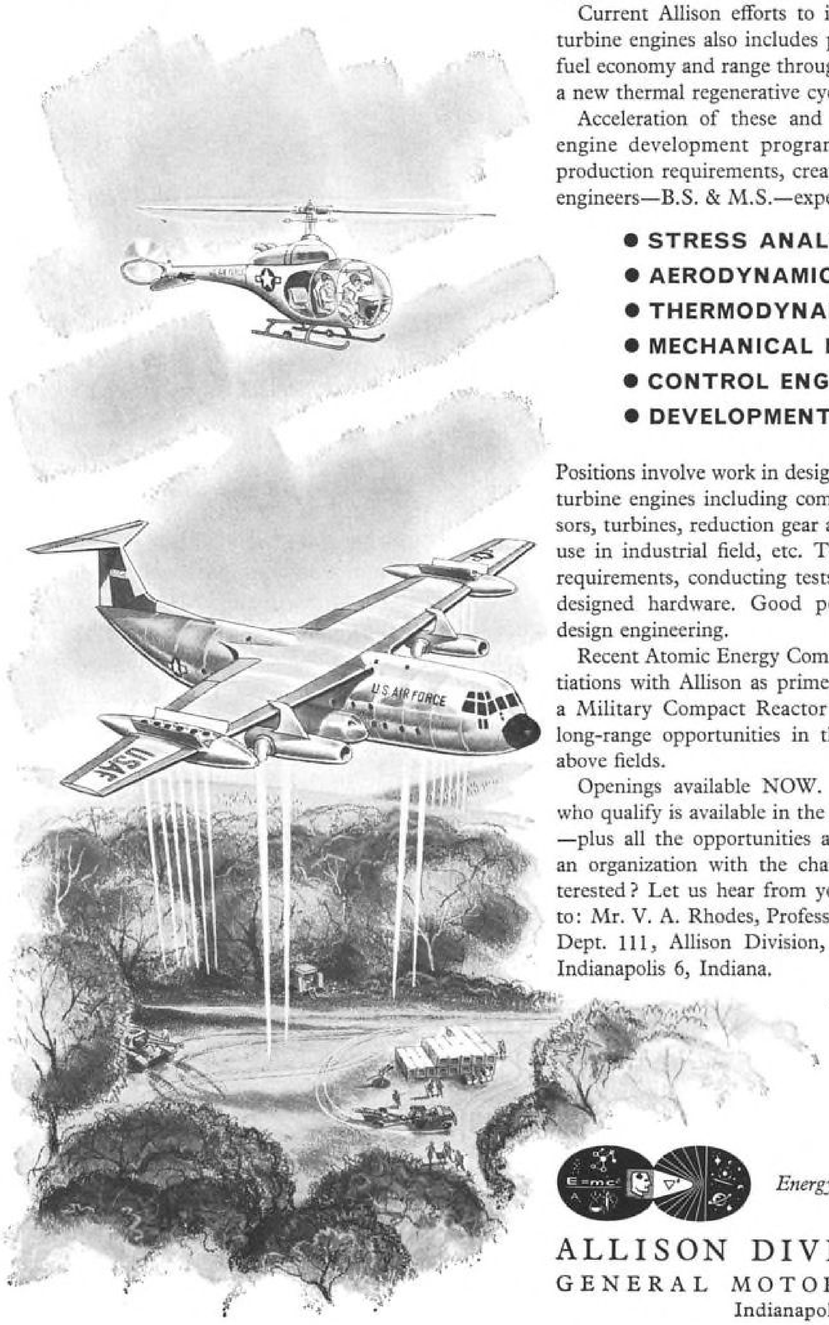

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Recent Atomic Energy Commission announcement of negotiations with Allison as prime contractor for development of a Military Compact Reactor has also created challenging, long-range opportunities in the nuclear field, as well as in above fields.

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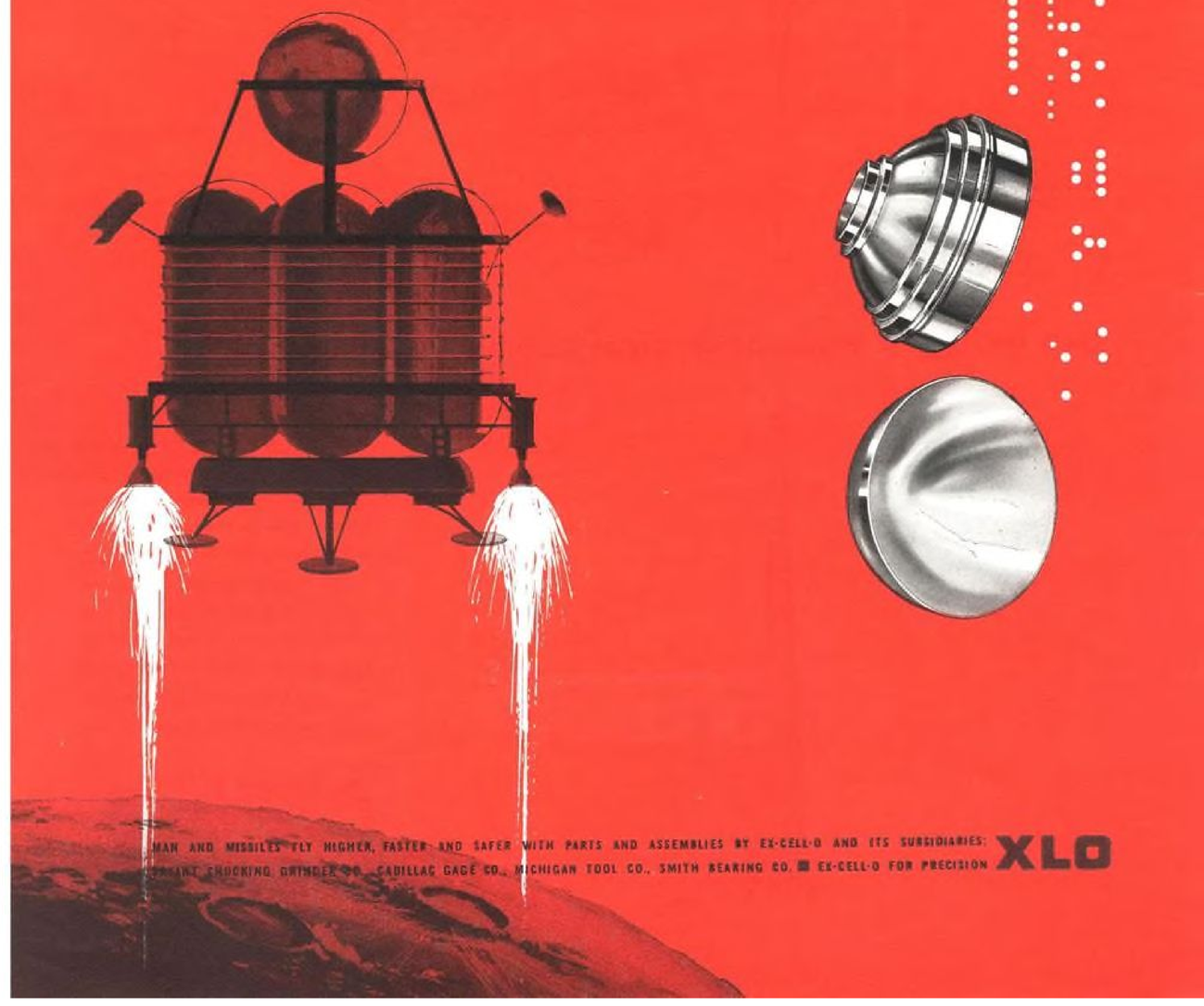

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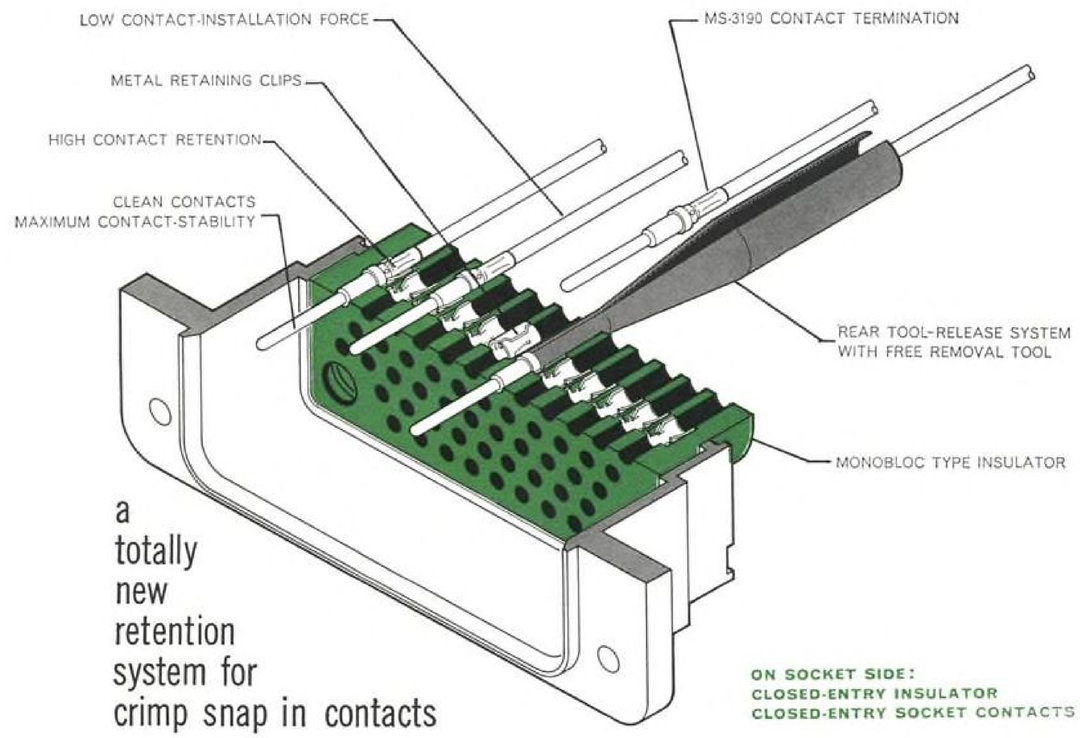

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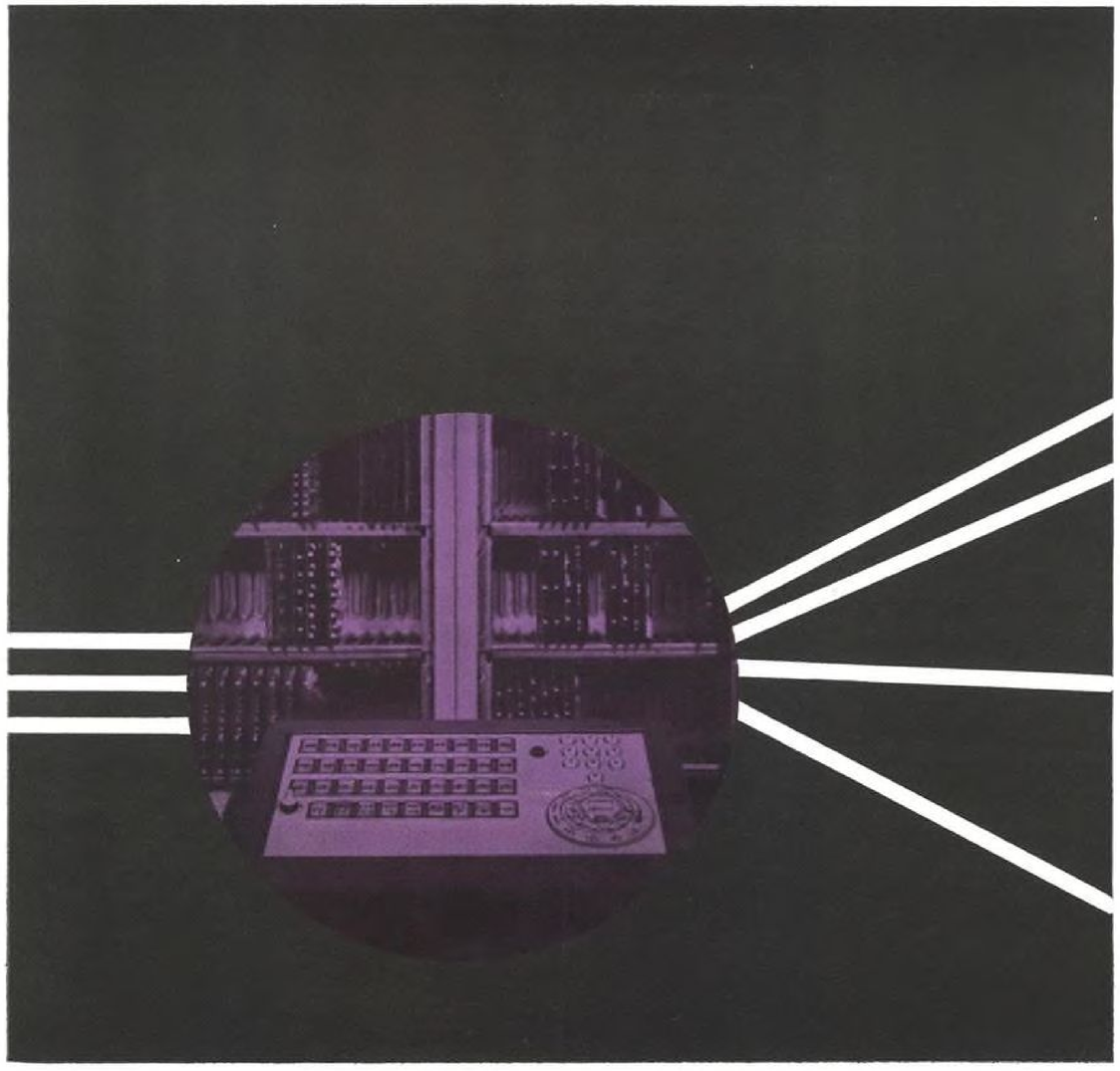

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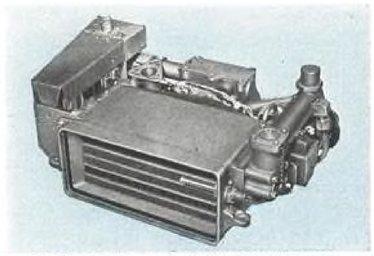
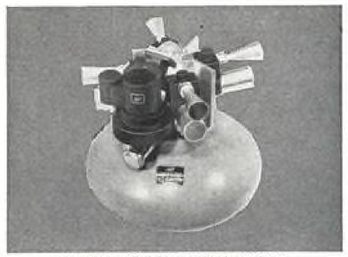
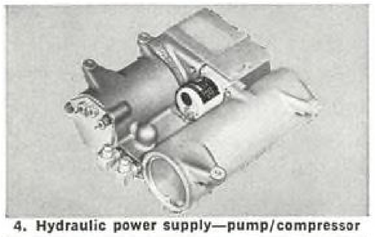


1. Electronic controlled heat exchanger

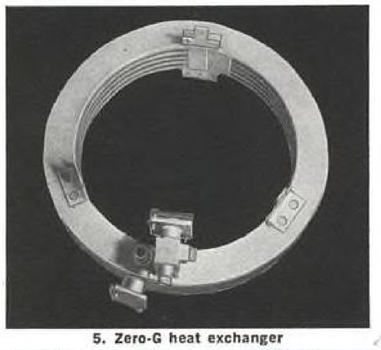


2. All attitude control system

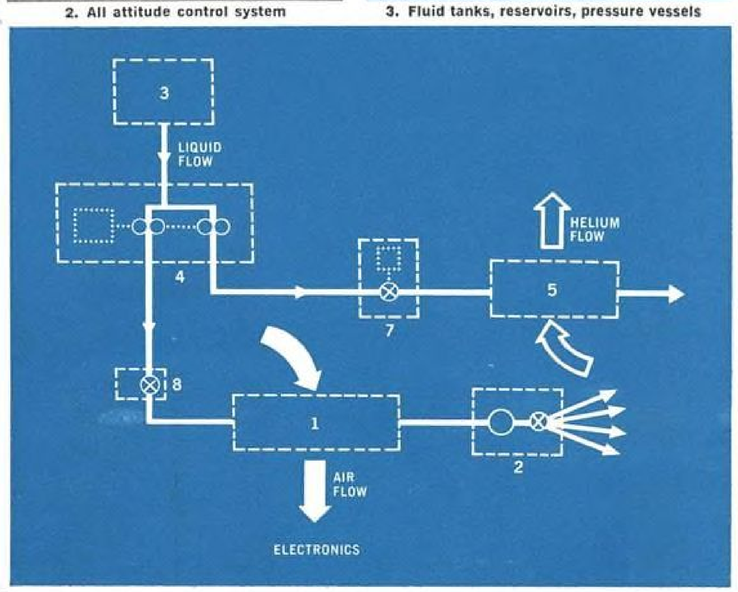
3. Fluid tanks, reservoirs, pressure vessels

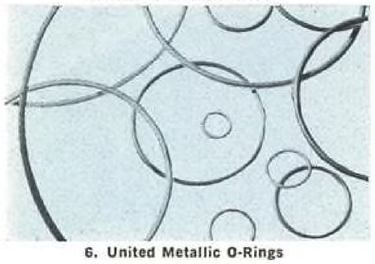


4. Hydraulic power supply—pump/compressor

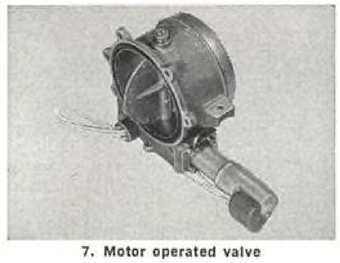


5. Zero-G heat exchanger

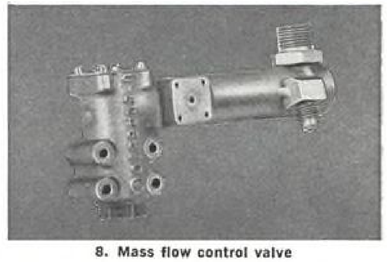




6. United Metallic O-Rings



7. Motor operated valve



8. Mass flow control valve

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Deutsch-developed silicone materials provide better wire and interfacial seals against altitude and moisture...assure temperature performance above 300°F...guarantee better dielectric characteristics and dimensional stability under exposure to oils and fuels.

Contact retention of 25# exceeds the 15# specification by more than 60%.

Fixed coupling rings make sure the connector remains a complete unit throughout assembly... provide grope free engagement...insure proper mating and lock of plug and receptacle.

Positive visual lock indicators afford inspectability for correct connector assembly and engagement.

Millivolt drop, measured by the latest specification techniques, is 50% below the minimums before and after corrosion testing. And insulation resistance is at least four to five times higher at 300°F. than the specification's minimum at room temperature.

Insertable and removable contacts are crimp terminated to military standard geometry, and are held in place by mechanical devices that insure retention, contact alignment and are replaceable if damaged.

MIL-C-0026482 electrical performance ratings, at altitude, are met and exceeded at 110,000 ft. instead of at the specified 80,000 ft.

These and the many additional advantages of DD and BTK connectors may cost a little more, but in terms of value analysis are priced lower due to assembly time savings, repairability and, perhaps most important, favorable MTTF ratios under actual use. If you are faced with criteria calling for a high confidence level rather than just meeting a specification, we suggest you get all the facts on DD and BTK performance from your local Deutschman, or write for Data File R-9.

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ADVANCED SPECIFICATION MINIATURE ELECTRICAL COMPONENTS

September 17, 1962

Aviation Week & Space Technology

Vol. 77, No. 12
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COVER: Hawker P.1127 VTOL strike fighter is shown in hovering flight at the Farnborough Air Show. The aircraft is under development for Britain, the U. S. and West Germany. A total of nine will be built for evaluation. Note engine exhaust slats angled downward to provide lift. The P.1127 is powered by a Bristol Siddeley BS.53 engine. For more photos and details, see p. 54.

PICTURE CREDITS
Cover—Ron Appelbe; 27—Wide World; 30, 34, 35, 36, 54, 55, 56, 57, 58—Ron Appelbe; 33—No. American Aviation; 41—N. Y. Airways; 45—Boeing; 63—Sikorsky; 66, 77—Cornell Aeronautical Lab.; 87—Bell Helicopter; 91 (bot.), 95—General Electric; 98—ITT, Federal Laboratories; 107—Westinghouse.

88,185 copies of this issue printed.

EDITORIAL

'In Dublin's Fair City'

The easy charm of Dublin was a contrasting backdrop to the most serious and thoughtful Annual General Meeting the International Air Transport Assn. has held in at least a decade. This eighteenth such gathering, presided over by Jeremiah F. Dempsey, general manager of Aer Lingus, grappled realistically with such sticky problems as price cutting below IATA fares by member airlines, and for the first time in many years, listened to a critic from the outside give them an unvarnished view of how they look from a customer's seat.

Although many IATA members are obviously not used to barbs as sharp as those tossed at the delegates by Lord Brabazon of Tara, the experience did them an enormous amount of good in contrast to the steady diet of self-adulation that has too often characterized the annual meeting programs. For an industry that is so completely dependent on public confidence and support and which maintains such large public relations organizations, top airline management has remained remarkably indifferent to and isolated from public opinion. Thus, we think Mr. Dempsey had an excellent point in inviting Lord Brabazon to express his views, for he certainly shook many of the delegates out of smug complacency with their handiwork. If some of his barbs were overly sharp to make his points, they needed to be to penetrate this complacency.

The airline business is not in very bright shape the world over, and it is going to take some intelligent and vigorous action to get it back on the black ink trail where both stockholders and passengers are equally happy. We do not share the general gloom over the future prospects of the international air transport industry generated by the $140-million-plus operating loss for 1961. This is certainly not a happy figure, and it is a highly conservative estimate of the full scope of this financial fiasco. But already there are signs of hope on the horizon in rising passenger and cargo revenue and some realistic pooling of ground service equipment and spares.

No industry could hope to manage a basic technical revolution such as the jet age without a period of temporary trouble. Technically, the jet age has made a remarkably smooth transition but airline managements have not adjusted to its realities with uniform perspicacity, and herein lie many of the IATA members' current problems. Full immersion in the jet age has sharpened the contrast between the goals of two basic groups of IATA members—those airlines whose primary mission is to fly their countries' flags around the airports of the world with the smallest possible costs to their nation's taxpayers and those who are in business to make a healthy profit and pay dividends to their stockholders. The brutal economics of the jet age are making the task of the first group difficult, if not impossible. Their type of genteel, overstuffed operations simply don't fit the jet transport, which must be flown constantly with heavy loads to make money. If it is not, it will eat a complacent management out of house and home like a race horse confined to the stable.

Thus we predict the coming IATA conference in Arizona will develop into a battle between one type of management that wants to retreat to a high-fare plateau where it thinks it will find protection, and another type of management that will press for broadening the air transport market with lower promotional fares. This same type of cleavage was evident during the meeting's discussion of the supersonic transport, where the protectionists pleaded for a 50% surcharge on such service, presumably to make it as unattractive as possible.

The tough stand on enforcement of IATA rates taken by the executive committee and not openly opposed in the Annual General Meeting is interesting because the current concern is quite different from the rug merchant haggling in the Middle East that has gone on for years. It represents a deliberate effort by some major airlines to penetrate new markets with cut-rate tickets and in effect buy a foothold in a new market area. It is this policy that has stirred the ire of their competitors who are noticeably feeling the effects of this penetration. While nobody was willing to defend rate cutting on the meeting floor, and even the proved offenders promised to be good boys in the future, it will be interesting to see how this issue is resolved in the upcoming traffic conference, where the sharpest minds in this business wield the sharpest snickersnees.

Another subject not normally discussed in Annual General Meetings is safety, but here again Dublin has proved an exception. We have warned the airlines editorially that this is a subject they cannot continue to sweep under the rug since jet age crashes have a news interest and public impact far greater than ever before. As Sir Hudson Fysh correctly pointed out, the public is not the slightest bit interested in fatalities per hundred million miles if the total fatality rate continues to rise and if front page stories of jet crashes regularly jar their confidence in air travel. There is a lot the industry can do internally and externally to improve the safety situation, and it is high time they accelerated their efforts.

Shadow of the coming supersonic transport cast a pall over the meeting, indicating that some delegates felt the shape of its wings to be more like those of a vulture than a delta. There is a persistent fear among the smaller airlines who perhaps are already too deep into their subsonic jet venture, that one of the large airlines will upset the applecart and force a mad rush into supersonics by placing the first order. This is, of course, always a possibility, but it is highly improbable that such an event is imminent because of the problems still remaining in the technical development of such a beast. Although IATA has been wise in following every turn of the supersonic technical road as it unfolds, its members could invest their current effort more profitably in solving the problems of the subsonic jet age rather than worrying now about supersonics that are realistically a decade away from being a genuine airline problem.

It is a heartening sign of maturity to see the Annual General Meeting devote an increasing portion of its time to stimulating debate on the very real problems of air transport, although their solution lies elsewhere. However, all of this serious talk was alleviated by the small but indefatigably efficient staff of Aer Lingus which skillfully used the natural charm and atmosphere of Dublin and the Irish countryside to provide an effect not surpassed by more lavish efforts of the past. Despite their irritation with some of his criticism, it is obvious that delegates to the 18th Annual General Meeting finally took Lord Brabazon's advice when he told them, "You are for a week in dear, wise old Dublin to confer. Make the most of it. You have much to do."—Robert Hotz

WHO'S WHERE

In the Front Office

Daniel J. Gribbon, president, Lockheed Electronics Co., Plainfield, N. J., succeeding **David F. Sanders,** resigned. Mr. Sanders was one of the founders and president of Stavid Engineering, Inc. which Lockheed acquired in 1959.

C. Rhoades MacBride, chairman of Mack Trucks, Inc., Plainfield, N. J., also elected president and chief executive officer succeeding **Nicholas Dykstra,** resigned.

Dr. Harvard L. Hull, president, Chicago Aerial Industries, Inc., Barrington, Ill., succeeding **Fred T. Sonne,** now board chairman. Mr. Sonne succeeds **Allan M. Loeb,** who has been elected honorary chairman.

Jack Horowitz, president, Telemet Co., Amityville, N. Y., a Giannini firm, and **Donald J. Dudley,** vice president-sales.

Lee Johnson, vice president-federal government marketing, and **Ralph S. La Montagne,** vice president-defense marketing, Univac Division of Sperry Rand Corp., with offices in Washington, D. C.

Richard J. Flynn, vice president and assistant to the president, Ling-Temco-Vought, Inc., Dallas, Tex.

Changes

Dr. Douglas L. Worf, director of scientific requirements, Martin Co., with offices in Washington, D.C. Formerly he was with National Aeronautics and Space Administration as technical assistant to Brig. Gen. Charles H. Roadman, director of Aerospace Medicine; prior to that he was chief of NASA's biology and life support systems.

Kenneth B. Gay, corporate director of material, North American Aviation, Inc., Los Angeles, Calif.

Dr. Domenic Bitondo, director, Advanced Re-entry Systems, Aerospace Corp.'s San Bernardino (Calif.) Operations. Also: **Robert F. Chambers,** associate director of government relations for Aerospace Corp.

Angus Macdonald, manager-Defense Program Development, Chicago (Ill.) Center, Military Electronics Division, Motorola, Inc., and **Dr. William Firestone,** assistant general manager-Research and Development Engineering.

E. D. Hart, assistant manager, Avionics Products, The Bendix Corp., Bendix Radio Division, Baltimore, Md., succeeding George W. Church (AW July 30, p. 87).

Herbert Harris, Jr., director of engineering, Sperry Gyroscope Co., Great Neck, N. Y., division of Sperry Rand Corp. **Frank Conace** succeeds Mr. Harris as manager of Sperry Gyroscope Co.'s Air Armament Div.

Dr. David V. Ragone, chairman, Metallurgy Department, General Atomic Division of General Dynamics Corp., San Diego.

Dr. Alfred E. Barrington, manager, Ion Physics Department, Geophysics Corporation of America, Bedford, Mass.

William P. Bakel, assistant B-52 program manager, The Boeing Co.'s Military Aircraft Systems Division, Wichita, Kan.

Emmett McCabe has opened his offices (Emmett McCabe and Associates) in San Diego, Calif., not in Washington, D.C., as reported in AW Aug. 6, p. 124.

INDUSTRY OBSERVER

► National Aeronautics and Space Administration has invited 31 companies to submit proposals by Sept. 24 for a simple infrared horizon sensor. It must have no moving parts, and operate for at least three years in orbit in unmanned satellites at altitudes between 10,000 and 26,000 mi., NASA's Goddard Space Flight Center is willing to accept reduced stabilization accuracy of about three degrees compared with the current design specification for horizon sensors of one-tenth degree.

► **Intensified Van Allen radiation resulting from July 9 high-altitude nuclear blast poses a dilemma for National Aeronautics and Space Administration and Radio Corp. of America on their Project Relay communication satellite. Although Relay carries dual avionics payload for added reliability, the silicon solar cells it uses are far more susceptible to radiation damage than those used in Telstar satellite and may seriously shorten Relay's operational life. NASA is considering a switch to newer type silicon cells, but this would delay satellite launch which already is several months behind original target date** **(see p. 32).**

► Bell XV-3 convertiplane will undergo further free-flight testing by NASA later this year to compare data with wind tunnel tests at Ames Research Center aimed at improving dynamic stability at upper speed range. Rotorprop modifications produced satisfactory stability characteristics during wind tunnel tests at speeds up to 160 kt., about 24 kt. higher than was possible with the unmodified configuration.

► **Proposals for helicopter weapons platform, presumably for jungle warfare, may be requested from industry later this year by Army Ordnance Missile Command. Armament will include light rockets, napalm bombs and machine guns. Army would like production items by 1965. Parallel effort, to design new helicopter weapons platform with new armament for the early 1970s, probably will be conducted as a study program.**

► Watch for USAF Ballistic Systems Division competition for an advanced re-entry vehicle, including penetration aids, for the Titan 2 ICBM.

► **New solid propellant for modified Hughes GAR-9 air-to-air missile will be developed and demonstrated under contract being negotiated last week between Hughes and Lockheed Propulsion Co. Contract is expected to be valued at approximately $500,000.**

► Air Force Space Systems Division hopes to trim its present list of more than a dozen companies interested in bidding on the satellite tracking and communications subsystem and flight test program (AW Sept. 10, p. 35), which will be opened for industry competition soon.

► **Space Technology Laboratories will perform systems engineering on the stellar inertial guidance system for the mobile medium-range ballistic missile under subcontract to General Precision (AW Aug. 6, p. 33). American Bosch Arma, slated to be STL's subcontractor for the Titan 3 guidance computer before Air Force decided to revamp existing AC Spark Plug Titan 2 guidance for the new space booster, is now performing a similar function for General Precision.**

► NASA is planning to build a second Scout launch pad at Wallops Island, Va., for use by both NASA and the Air Force.

► **Ogival nose heat shield for Polaris A3 test rounds is made of wood, which provides enough heat protection to handle the launch, powered flight and ballistic portions of the trajectory up to re-entry.**

► Extensive investigations of troubles reported with pitch-axis horizon reference in the Mercury MA-7 mission have failed to pinpoint the cause. Mission profile for the MA-8 flight will call for Astronaut Walter Schirra to make performance checks on attitude reference and automatic stabilization and control systems early in the mission. Preparations for retrofire will be initiated sooner to prevent repetition of hectic moments during MA-7 when Astronaut Scott Carpenter discovered error in pitch reference just prior to retrofire.

Washington Roundup

Rising Cuban Tension

Soviet Russia last week linked Cuba, Berlin, U-2 reconnaissance flights and nuclear test ban negotiations in a long statement warning that any assault on Premier Fidel Castro's nation "will be the beginning of unleashing of war." In the midst of demands from U.S. senators and representatives for actions ranging all the way from stern statements to blockade and invasion of Cuba, Moscow indicated it will not send offensive missiles to Cuba. "Our nuclear weapons are so powerful in their explosive force, and the Soviet Union has such powerful rockets to carry these nuclear warheads, that there is no need to search for sites for them beyond the boundaries of the Soviet Union," the statement said.

No one has kept score recently, but late in 1959 the Central Intelligence Agency said Russia had used rocket diplomacy or "ballistic blackmail" to threaten 15 countries on more than 40 occasions since 1956 (AW Jan. 2, 1961, p. 15).

Secretary of State Dean Rusk briefed a secret joint meeting of the House armed services and foreign affairs committees—the first in 16 years—on the Cuban situation last week. The committees apparently took the unusual step of swearing members to secrecy, but Rusk is understood to have said the Cuban buildup still is defensive in nature, and the U.S. is watching closely to ensure that it becomes no more than that.

Space Study Group

Detailed re-examination of the military potential of space is being made by a special study group of civilian scientists and military experts organized by the White House. A report is due before Thanksgiving. The group was formed before the recent flights of Vostoks 3 and 4, as a result of criticism that Defense Department was moving too slowly in space. It is believed to consist of about a dozen people.

Chairman John E. Moss of the House Special Government Information Subcommittee is demanding an explanation from National Aeronautics and Space Administration on why it withheld information on the flights of Vostoks 3 and 4 until Aug. 14, when it published its Satellite Situation Report. Rep. Moss wants to know what grounds are used to justify secrecy on unclassified tracking data. The Moss letter, mailed to NASA Administrator James E. Webb, had not been acknowledged by late last week. By contrast, a joint letter from the House and Senate space committee chairmen to Webb asking for data on Soviet space failures was answered in one day (see p. 31).

ARPA Units Afield

Advanced Research Projects Agency, which answers to the Director of Defense Research and Engineering, is controlling new combat developments. Two Combat Development Training Units are active in South Vietnam and Thailand as part of ARPA's Project Agile. Project Director Robert C. Phelps has the interesting title of assistant ARPA director for remote area conflicts. CDTC programs overlap those of the services, especially Army and Air Force. Two weeks ago, the Joint Chiefs of Staff recommended that the fragmented effort, which has caused some confusion and friction in the field, be put under one director—preferably a military man. The recommendation came back approved, provided Phelps be the man in charge.

Technical presentations on the TFX bi-service tactical fighter were made at USAF's Aeronautical Systems Division last week by General Dynamics and Boeing. Cost presentations are due to be made today. Final presentation in the Office of Secretary of Defense is to be made on Oct. 22.

First North American XB-70 Mach 3 bomber will be rolled out in Palmdale, Calif., late this month or early in October. It is scheduled to fly late in December. Second aircraft is due to fly next September and the fourth in July of 1964.

Mach 3 Interceptor

North American Air Defense Command is pressing for development of a Mach 3 interceptor aircraft. It wants a new design rather than an outgrowth of the North American F-108, which was canceled three years ago. Defense Department is expected to ask NORAD: "Where is the Mach 3 bomber that the new interceptor is supposed to intercept?" Pentagon observers say NORAD's real goal is a long-range Mach 2-plus aircraft, which might result as a compromise.

Green light has been given for full production of the USAF-Douglas Skybolt air-launched ballistic missile. Funding for July and August was released in increments (AW Aug. 27, p. 26), but production money for the remainder of 1962 and research and development money for all of the fiscal year ending next July has now been released. The third flight test of the Skybolt last week produced a third failure.

Watch for announcement that another Polaris submarine tender will be based in the Indian Ocean area, probably at Perth, Australia. Navy said last week that the Polaris tender Proteus will be based at Apra Harbor, Guam. A Navy low-frequency transmitting station will soon be under construction at the western tip of Australia. This type of station, whose long wave radiations can penetrate to submarine depths, already is located on Oahu, Hawaii, in Maine and in the state of Washington.

—Washington Staff

Kennedy Stresses Peaceful Space Theme

U. S. must gain lead to keep space from becoming battleground, President says during tour of centers.

By Edward H. Kolcum

Houston—Continued civilian domination of the U. S. space program seemed certain last week as President Kennedy and key members of his Administration hammered on the theme that U. S. leadership in peaceful space exploration will deny the use of space by Soviet Russia as a battleground.

It became clear during a two-day presidential trip to key Defense Department and National Aeronautics and Space Administration facilities that the President and his top advisers consider space one of the critical fields in the war of ideologies, but that the threat posed by Russia's space program is not one that will alter the fundamental U. S. policy of exploiting space for peaceful purposes.

This means essentially that the Air Force, which sees the recent Soviet Vostok flights as a significant military threat (AW Aug. 20, p. 26), has not sold this position either to Defense Department or to the President.

President Kennedy's official party on his trip included what amounts to the final review board for USAF space projects—Defense Secretary Robert S. McNamara, Dr. Harold Brown, director of Defense Research and Engineering; Air Force Secretary Eugene Zuckert, and Air Force Chief of Staff, Gen. Curtis E. LeMay. None of them is an advocate of a greatly increased military space role, with Brown and McNamara decidedly cold toward any such increase.

Because a considerable portion of the President's trip involved secret briefings at NASA installations, it is believed that NASA will be directed to be responsive to military space requirements particularly in manned space flight. However, a top NASA official told AVIATION WEEK that if this is so, it has not filtered down to the program level. He said NASA has been responsive to the military and will continue to be. The problem, he said, is that the military itself is not putting its full capabilities into the manned space flight program.

Although the President's trip to the Marshall Space Flight Center, Atlantic Missile Range, Manned Spacecraft Center and the McDonnell Aircraft Corp. plant was billed as a business trip to obtain first-hand knowledge of the program, NASA officials here see it as a demonstration of strong support for the manned space program and for a space budget that will approach $6 billion in the coming fiscal year. Fiscal 1964 budget requests are being made final now, and will be submitted to Budget Director David E. Bell by Sept. 30. Bell accompanied the President.

The Administration's philosophy on the use of space for peaceful purposes is subscribed to by the Pentagon civilian leadership, but some deeply-rooted disagreements on methods are becoming apparent (see box).

Rep. Albert Thomas (D.-Tex.), who led the behind-the-scenes effort to have the Manned Spacecraft Center located in Houston, told Wernher von Braun, Marshall director, "If you need more money for Nova, you'll get it." Rep. Thomas, chairman of the House Independent Offices Subcommittee, made this remark when he heard that Nova funding probably will be deferred to finance projects directly related to lunar orbit rendezvous.

The President made brief remarks at each stop. He keynoted the U. S. space policy here in the only formal speech of the trip. "We have vowed that we shall not see it [space] governed by a hostile flag of conquest, but by a banner of freedom and peace," the President said. "We have vowed that we shall not see space filled with weapons of mass destruction, but with instruments of knowledge and understanding.

"Yet the vows of this nation can only be fulfilled if we in this nation are first, and therefore, we intend to be first. In short, our leadership in science and in industry, our hopes for peace and security, our obligations to ourselves as well as others, all require us to make this effort. . . .

"I do not say that we should or will go unprotected against the hostile misuse of space any more than we go unprotected against the hostile use of land or sea, but I do say that space can be explored and mastered without feeding the fires of war, without repeating the mistakes that man has made in extending his writ around this globe of ours," the President said.

This apparently means that the military space program will remain relatively low-keyed in comparison with the rapidly-expanding civilian program.

President Kennedy said he regards his decision of May 25, 1961, "to shift our efforts in space from low to high gear as among the most important decisions that will be made during my incumbency in the office of the Presidency."

Highlights of the presidential trip:

• **Huntsville**—Secret briefing in the guidance and control laboratory; a look at the fifth Saturn flight booster and at a 30-sec. static firing of the fourth Saturn flight booster.

• **Atlantic Missile Range**—Complex 14, where Cdr. Walter M. Schirra's Mercury Atlas-8 capsule was mated to Atlas 130-D booster on Sept. 10 for a flight now scheduled for Sept. 28; Titan 2 Complex 15; Saturn Complex 34, and secret briefing on the Saturn program.

Three-day delay in the Schirra flight was caused by a small leak in the fuel tank, which delayed the test of a new hypergolic igniter, to be used in the Atlas for this flight.

• **Houston**—Speech at Rice University stadium, secret briefing on manned space flight program, emphasizing the lunar orbit rendezvous technique; look at mockups and models of Apollo spacecraft and lunar excursion module vehicles.

At the Manned Spacecraft Center, NASA showed publicly for the first time a full-scale model of the excursion module. The model, 17 ft. high and 22 ft. across the base of the legs, was built by North American Aviation, Inc., prior to NASA's decision to use lunar rendezvous. North American is building the Apollo.

• **St. Louis**—Secret briefings on Gemini and advanced Gemini, look at engineering mockups of Mercury and Gemini spacecraft.

At each stop, the President stressed the requirement of being first in space to maintain peace. At AMR, he noted that Soviet Russia was able to give prestige to its political system and force to its argument that it is an advancing nation and the U. S. is on the decline because of Soviet space feats. He said this nation has made the decision to be first, even though "we started behind. We have a long way to go. . . ."

Both in Houston and St. Louis, he pointed out that the space program, which now costs each U. S. citizen 40 cents a week, will "soon cost 50 cents." This could mean that the President is laying the groundwork for a substantial supplemental request for NASA in January (AW Sept. 3, p. 16) which would eliminate the need for a sizable reprograming in order to go into production on the lunar excursion module and lunar logistics system and to pay for some deficiencies in Centaur funding.

PRESIDENT KENNEDY and party watch Saturn static test at Huntsville, Ala.

Radiation Belt Satellite

Washington—U. S. will launch a 100-lb. radiation satellite as quickly as it can be prepared to study the artificial radiation belt around the earth which was created by the U. S. high altitude nuclear detonation July 9 (see p. 32).

The Delta-launched satellite will bump the Telstar 2 communications satellite from the Atlantic Missile Range schedule. Telstar 2 was scheduled for Oct. 30.

New radiation satellite will contain energetic particles experiments being built by National Aeronautics and Space Administration's Goddard Space Flight Center, Bell Telephone Laboratories, University of California and University of New Hampshire. NASA estimates the project will cost $9 million.

Planned orbit will take the payload between altitudes of 10,350-170 mi. on an inclination of 19 deg. to the equator. Orbital period will be about five hours.

Top Officials Debate Rendezvous Choice

Huntsville, Ala.—Two opponents of the lunar orbit rendezvous technique for landing men on the moon squared off against top National Aeronautics and Space Administration officials in front of President Kennedy during his visit to the Saturn fabrication building here last week (see story).

The lineup pitted Dr. Jerome B. Wiesner, presidential science adviser, and Dr. Harold Brown, director of Defense Research and Engineering, against James E. Webb, NASA Administrator; Brainerd Holmes, manned space flight chief, and Wernher von Braun, Marshall director.

Weisner and Brown apparently feel the chosen technique is too complex, and favor the earth orbit rendezvous method, which had been the leading contender until studies indicated lunar orbit rendezvous could cut two years and save 10-15% in program scheduling and costs (AW July 9, p. 25).

Dr. Robert C. Seamans, Jr., associate NASA administrator, told Aviation Week after the incident that the exchange could not be characterized as a flareup, but was more in the nature of a technical discussion. Brown said he did not feel free to criticize a NASA program, since he is a Defense Department representative. Nevertheless, Wiesner was heard to say "no good" during von Braun's explanation of lunar orbit rendezvous to the President.

Dr. Nicholas E. Golovin, Wiesner's deputy, was a strong earth orbit rendezvous advocate when he headed a panel studying large boosters (AW Nov. 6, p. 26). This method also was favored by von Braun and most high NASA officials until the recent studies, but NASA is now united on the lunar orbit rendezvous technique.

The exchange, which was broken up by the President with a joke, may have prompted von Braun's subsequent vehement declaration to the President: "You promised we would land on the moon in this decade, and by God, we'll do it." . . .

The incident was witnessed by Sir Peter Thorneycroft, British Defense Minister; his deputy, Sir Robert Scott; Wiesner's British equivalent, Sir Solly Zuckerman, and several other members of the President's party.

Later in his tour, the President was given a one-hour briefing on lunar orbit rendezvous at the Manned Spacecraft Center, which has favored this method since its inception.

Olympus Space Station Project Proposed

Washington—Development plan for an 18-man space station called Project Olympus has been submitted to National Aeronautics and Space Administration Headquarters by the Manned Spacecraft Center, with the recommendation that the project be approved and funded now for a 1966 first flight.

Station would consist of a hub and three spokes, which would be erected like an umbrella. Crew would be ferried to and from the station in Apollo-type re-entry vehicles, and the Saturn C-1 launch vehicle would be used to boost both station and ferries. Plan calls first for launch of a station to accommodate six men, then 12, and finally 18. Docking ports would be located on the ends of the spokes, and on the top and bottom of the hub.

Olympus is an effort by Manned Spacecraft Center to get its own design on record before a final NASA decision is made on a space station configuration. NASA's Langley Research Center, following a joint Langley-industry study, has reported on the feasibility of a 38-man station, which could be launched in the mid-1960s with a C-5 vehicle (AW Sept. 10, p. 33). Langley design has an inflatable rim, and the Manned Spacecraft Center configuration has no rim.

Administration Is Testing Space, Defense Funds as Economic Tools

By George C. Wilson

Washington—Kennedy Administration after months of study is trying several new contracting procedures designed to direct more federal defense and space dollars to areas which need them most.

The effort intensifies debate on whether the government should regard defense and space contracts as inviolate or as tools for tinkering with the national economy. How the Kennedy Administration ultimately answers this question will shape the government's contractual relationships with the aerospace industry.

Right now the Administration is trying to get more economic leverage out of defense and space spending by working within the procurement laws passed by Congress. But President Kennedy's campaign to stimulate the economy may well lead to requests for legislation to make it easier to channel this money to small businesses and colleges and to areas of chronic unemployment.

Thomas D. Morris, assistant secretary of defense for installations and logistics, last week told the Senate Select Small Business Committee that the Administration had succeeded in reversing a five-year trend in the percentage of defense dollars awarded to small businesses. Morris said that $4,622,000,000—or 17.7%—of Fiscal 1962 Defense spending went to small businesses. This compares with these amounts and percentages in previous fiscal years: 1961—$3,657,000,000 or 15.9%; 1960—$3,440,000,000 or 16.1%; 1959—$3,783,000,000 or 16.6%; 1958—$3,729,000,000 or 17.1%.

Morris said the upswing was partly due to the Defense Department's "Operation Booster" which gave all the Pentagon procurement organizations quotas and measured performance monthly in channeling contracts to small businesses.

For Fiscal 1963, Morris said the military departments and Defense Supply Agency are developing quotas for small business prime procurement contracts. These quotas for each service and the DSA will become final Oct. 15.

He predicted the amount of Defense contracts going to small business would rise by $200-$300 million in each of the fiscal years through 1965.

Similarly, Morris said Defense would help small firms get more subcontracts from prime contractors. He predicted small business Defense subcontracts would increase by $300 million in each of the three fiscal years through 1965. He estimated the total value of Defense subcontracts going to small firms in Fiscal 1962 would be $3.7 billion, compared with $3.5 billion in Fiscal 1961. Morris said the military services have been directed to keep track of the number of small business subcontractors used by DOD's 264 largest prime contractors. He said quotas would be set for such subcontracts.

Chairman John Sparkman (D.-Ala.) of the Senate Select Small Business Committee told AVIATION WEEK he was "encouraged" by the reversal of the trend in Defense contracts to small business. He said it was unlikely, however, that small business would ever obtain 25% of the Defense dollars because weapons have become so complicated that only a limited number of firms can perform the big contracts.

Besides helping small businesses, the Kennedy Administration is exploring ways to use defense and space dollars to revitalize areas suffering from chronic unemployment. This effort is championed in the Senate most vocally by Sen. Hubert H. Humphrey (D.-Minn.), a party leader who is the second ranking Democrat on the small business committee. He contends it is high time to regard defense and space dollars as tools for stimulating the national economy, and is demanding new approaches.

Sen. Humphrey decried the fact that the federal government is doing so little to direct its spending. He advocated "some kind of an economic coordination advisory group, at least to let the nation know that if this pattern continues you are going to have the following problems in this area of our nation. . . ."

The Minnesotan, whose state has suffered from the shift of Defense business away from the Midwest, also contended that industry is attracted to areas with research resources. "If research and development contracts are not more equitably distributed—which in turn means that you can get some better balance in the scientific and technical personnel and facilities on a geographical and regional basis in this country—you are just never going to get the plants better distributed because plants have a tendency to follow the R&D."

As things are now, Sen. Humphrey said, each lawmaker must fight unrelentingly for government contracts for his state. "I am almost ashamed of myself," he said. "I spend literally six to seven hours a day trying to get business into my area . . . This has become an obsession with us . . . If you do not make more noise than the other fellow, you do not get anything," he said.

Ron M. Linton, director of economic utilization policy within the Defense Department, agreed more could be done to mesh Defense dollars with national economic needs. But he said he merely was an adviser to Defense officials, not a policy maker. He said the mission of his office was to help implement Defense Manpower Policy No. 4 which states, in part: "Success of the Defense program depends upon efficient uses of all our resources, including manpower and facilities, which are preserved through practice of the skills of both management and workers. . . ."

As part of this effort, Linton said Defense is experimenting with a new version of the set-aside program. As it is now, Defense cannot set aside contracts for labor surplus areas unless the items can be made in two or more economic production runs. He said this restriction is usually impractical. The new plan calls for awarding a contract with the understanding the prime will produce a fixed percentage in a labor surplus area or subcontract it to firms there.

Ernest W. Brackett, National Aeronautics and Space Administration director of procurement and supply, told the committee the government's set-aside program for labor surplus areas cannot be used by the space agency because its procurement of standard items is not large enough to be divided into two or more economic production runs. However, he said, NASA is encouraging prime contractors to subcontract in labor surplus areas.

Irving Maness, acting administrator of the Small Business Administration, last week told the committee "it is universally recognized that the growing technological complexities involved in producing military and space items for the government are reducing prime contract opportunities" for small business firms. Because of this trend, Maness said the government must persuade a prime contractor "to explore all possibilities of dividing his orders into quantities and components which can, without sacrifice of time or cost or efficiency, be supplied separately according to the skills of small enterprises and later assembled into the complete product . . ."

Congress last year established the Area Redevelopment Administration to help areas suffering from chronic unemployment. Although the agency is just getting into full swing, Acting Administrator Harold W. Williams told the Senate small business committee that several experiments are being conducted to channel more federal dollars into depressed areas. One such experiment is being conducted in West Virginia, where an agency representative is working full time to help businessmen bid more successfully on procurement contracts.

Chinese U-2s Seek Nuclear, IRBM Data

Washington—Chinese Nationalist Lockheed U-2 reconnaissance aircraft have made about 100 flights over the Communist Chinese mainland, usually on 4,000-mi. round trips that take them to a point in western Kansu province near China's intermediate ballistic missile range. One purpose of the flights has been to monitor the upper atmosphere for signs of an expected Chinese nuclear test in adjacent Sinkiang province (AW Mar. 5, p. 17).

Communist China claimed last Sept. 9 that a unit of the air force of the Chinese Peoples' Liberation Army shot down a U-2 "of the Chiang Kai-shek gang which intruded into the airspace in east China."

U-2 Reward

By late last week it had not said how the aircraft was brought down or whether the pilot was alive. In July and again in August, the Chinese Communists offered $280,000 in gold to any Nationalist pilot who defected to the mainland with a U-2.

U.S.-owned U-2s have been flying in recent months from Alaska, Hawaii, The Philippines, Japan, Okinawa and other locations. They have not penetrated the Chinese mainland, but flights from The Philippines and Okinawa have flown over the water at high altitudes for deep looks inside China, where the Communists have a string of airfields along the coastline.

The Chinese Nationalist government has conceded that it bought two U-2s from Lockheed in July of 1960, two months after a U.S. U-2 flown for the Central Intelligence Agency by Francis Gary Powers was downed near Sverdlovsk, Russia. The U.S. State Department said an export license was issued for the two aircraft.

Both State Department and Defense Secretary Robert S. McNamara declined to comment on whether other countries also have bought U-2s from the U.S.

Australia's Air Minister David Fairbairn announced on Sept. 7 that two U.S. U-2s and four Martin B-57 bombers would arrive soon to be based near Victoria for high-altitude air sampling flights.

Chinese Nationalist U-2s marked with the Chinese Republic's 24-point white star in a blue field encircled by a white band, fly almost daily from a 10,000-ft. dual strip runway at Toayuan, about 15 mi. south southwest of Taipei International Airport. Toayuan is one of five main airports located on the west coast of Taiwan. The middle field, Kum Kuam, has the longest airstrip in the Far East—12,500 ft. long and 300 ft. wide. These fields are almost opposite Chinese Communist military air bases on the mainland.

Many of the Nationalist flights have been at altitudes above 80,000 ft. The flights, most of them at a compass heading of approximately 310 deg., carry the aircraft more than 1,800 mi. into the interior to a turnaround point near Yumen.

Return Route

The return route roughly parallels the inward route, but is separated from it by some 200 mi. It passes over the Chinese Communist IRBM range near Chiuchuan. Long training flights also are made from Taiwan northward along the Ryukuya chain of islands as far as the Kuriles.

The penetration flights include deviations from the straight-line course in order to cover important installations. With these deviations, total miles flown can exceed 4,000. The flights are long, tiring and dangerous. There have been 11 fatal crashes involving U-2s in the U.S.

There has been concern among some U.S. observers for many months that Soviet Russia has had the ability to choose a politically auspicious time and place to attempt to down a U-2. The nature of the Chinese mainland flights has made them a likely target.

There has been private speculation that Soviet or Chinese Communist fighters equipped with rocket boosters might reach 80,000 ft. or close enough to that altitude to launch a missile effectively against a U-2. Fishbeds at Russia's Tushino air show last year were equipped both with single and double boosters.

State Department said some Nationalist Chinese pilots trained in U-2s in the U.S. in 1960 but none had been trained here since. There were other indications, however, that Chinese Nationalist pilots trained in U-2s in Texas as late as last April, probably at Laughlin AFB, Del Rio, Tex., where Strategic Air Command operates some U-2s.

Nationalist Overflights

As late as June of this year, Chinese Nationalists still were making approximately three flights a month over the mainland. The Nationalists maintain that these flights are not trespasses because the mainland belongs to the Republic of China and not to the Communists.

Nationalist military officials last week refused to say whether they would continue flights over the mainland. They also said they had not been able to learn the exact location of the loss of the U-2, how it had been downed nor the fate of its pilot.

Communist China's Minister of Defense Marshal Lin Piao commended the air force unit for "unflagging preparedness" but did not indicate what method was used to down the U-2.

Interference From Cuba

Washington—Sen. Kenneth Keating (R.-N. Y.) said last week that Soviet radar and electronics equipment being installed in Cuba is "designed deliberately to put the Communists in a position where they can interfere with the American space effort at Cape Canaveral."

He said U. S. astronauts might be "sitting ducks for any kind of interference the Soviets might want to stage."

The Atlas boosters for the Mercury program use the radio command guidance system originally developed by General Electric and Burroughs for the Atlas ICBMs. It incorporates signal coding techniques designed to minimize the possibility of enemy interference or jamming.

A GE spokesman told Aviation Week that to jam the system "an enemy would practically have to move its transmitter alongside the launch site."

The Atlantic Missile Range has long monitored all radio signals prior to a mission to locate possible interference.

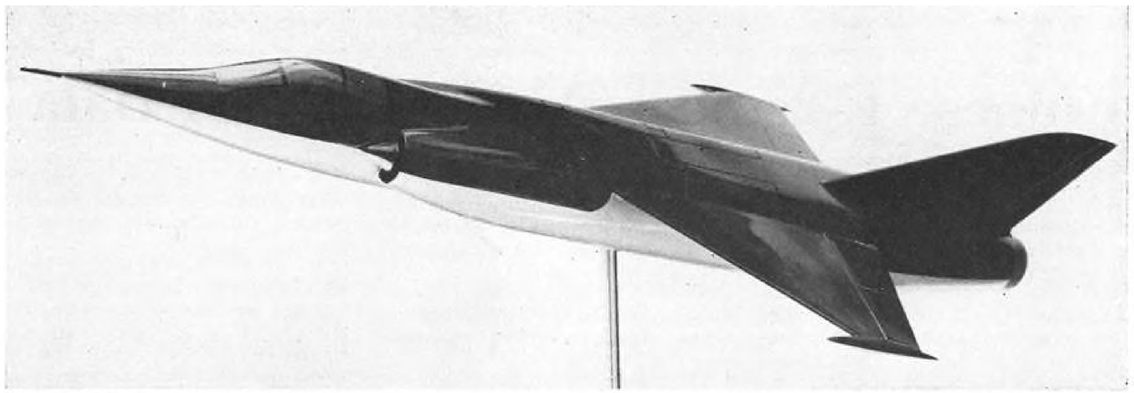
Observers suggest a more attractive opportunity for the Communists would be to monitor the characteristics of the Air Force's newest frequency diversity radars now installed along the Gulf Coast of Florida. Air Force Bomarc and air-to-air missile tests, conducted in the Eglin Gulf Range, offer easier targets for jamming and interference than the large boosters at the Cape.

New SSD Commander

Maj. Gen. Ben Funk, USAF, will formally assume command of Air Force Systems Command's Space Systems Division this week, succeeding Lt. Gen. Howell Estes who has become vice commander of Systems Command at Andrews AFB, Md.

Maj. Gen. Clyde Mitchell will assume Gen. Funk's former duties as area commander for Air Force Logistics Command at Norton AFB, Calif. Gen. Mitchell had been vice commander at AFSC.

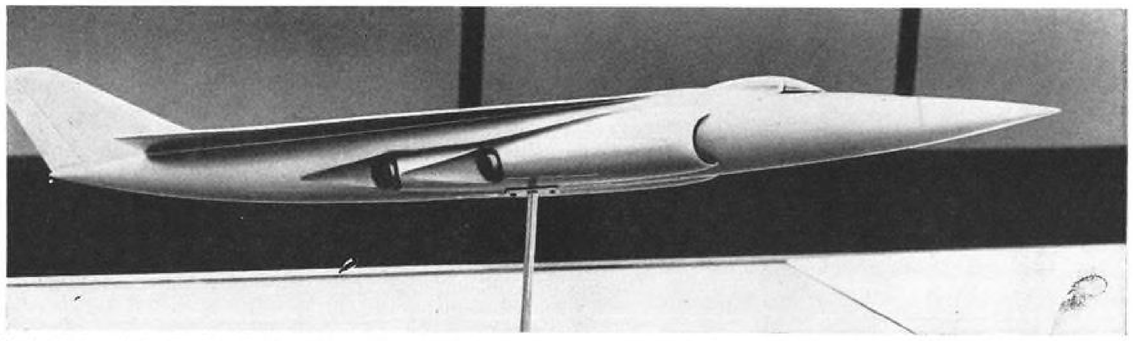
Brig. Gen. Harvard Powell will be vice commander under Gen. Funk at SSD. Assistant vice commander will be Brig. Gen. Harry Evans.



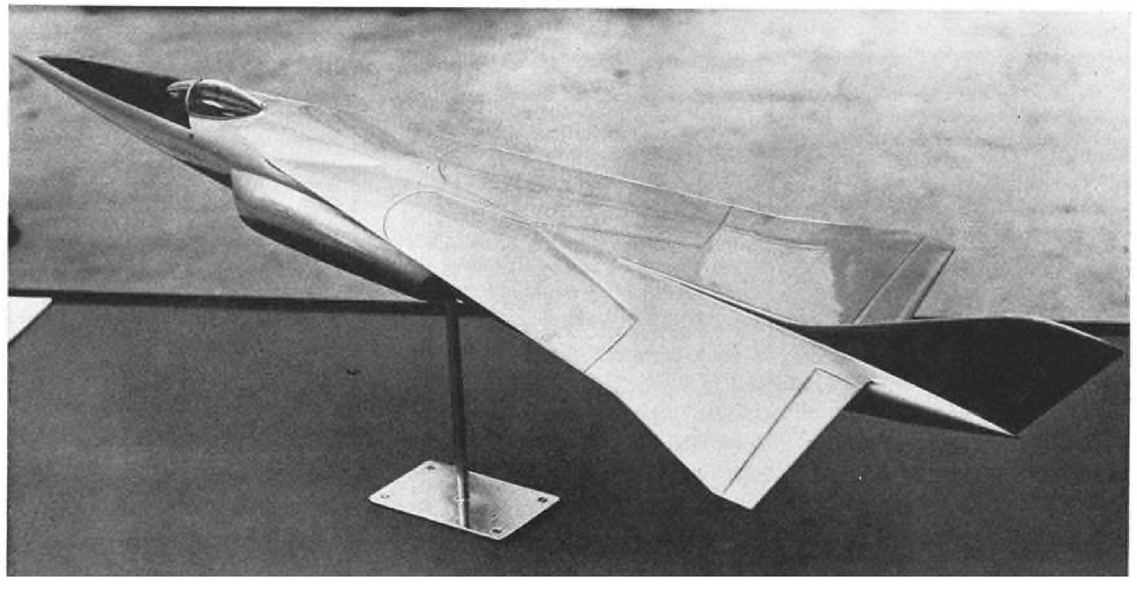
Proposed V/STOL fighter by Short Brothers & Harland incorporates a bank of four 4,400-lb.-thrust Rolls-Royce RB.162 lift engines on either side of the center fuselage section. Elevons are installed along the trailing edge of the delta wing, while conventional power is supplied by a single Rolls-Royce RB.168 located in the fuselage. Design, designated the PD.56, was submitted in the North Atlantic Treaty Organization competition for a V/STOL close-support fighter. PD.56 would have a Mach .9 speed capability at low altitude and could fly supersonic in the medium altitude range.

British Display Models of Future VTOL Fighters

Model with stylized basic configuration of the Hawker P.1154 Mach 2.5 V/STOL fighter designed as a mid-1960s replacement for the Hawker Hunter close-support fighter for the Royal Air Force was on display at Farnborough on the Bristol Siddeley stand (AW Sept. 10, p. 26). Two-place version also may be ordered by the Royal Navy. Model shows proposed configuration for installation of the 32,000-lb.-thrust Bristol Siddeley BS.100/9 vectored-thrust powerplant. Wing on actual aircraft, however, will not be a full delta as shown on the model. Nose also will be more sharply slanted and somewhat shorter. Tail will be larger, and the canopy will have a greater area, resembling that of the first-generation P.1127.



Basic design of the Republic-Fokker D.24 Alliance, below, incorporating a 39,500-lb.-thrust version of the BS.100 also was on display at the Bristol Siddeley stand. Built around the variable-sweep concept, aircraft has a cranked delta wing with elevons on the trailing edge. U. S. Defense Department may order at least two prototypes.



AEC to Manage Spur/Snap 50 Project

Washington—Management of the Spur/Snap 50 auxiliary space power project has been assigned to the Atomic Energy Commission in a reorganization agreed upon last week by that agency, Defense Department and National Aeronautics and Space Administration. The new project office will be headed by an Air Force colonel responsible to the AEC. He will coordinate Defense and NASA work on the project through special deputies in each of those two agencies.

Objective of the Spur/Snap 50 program is to develop an auxiliary space power system of approximately 300 kw. which could operate for 10,000 hr. and have a specific weight of 10 to 20 lb. for each kilowatt produced. Until now, the joint Congressional Atomic Energy Committee has contended management responsibility was so split that it was harming the program. Air Force was managing Spur, and Snap 50 was an AEC project.

Harold Brown, director of Defense Research and Engineering, indicated before the committee last week that the Defense Department would like to have the AEC take over the principal funding for the Spur/Snap 50 project. He said the nuclear space power project "closely parallels" the aircraft nuclear propulsion effort (ANP) that was canceled after about $1 billion had been spent. He predicted the space project could be equally as costly, but if one agency controls the funding, many of the difficulties experienced in the ANP program "could be solved before they become serious."

U.S. Officials Split on Revealing Soviet Space Failure Information

Washington—Debate within the U. S. government over how much it should reveal about failures in Soviet Russia's space program continued last week but the indications were that the long-standing policy of silence would stand.

The U. S. broke this silence last Sept. 5 to announce that Russia has had five failures and one partial success in six attempts to send probes to Venus and Mars (AW Sept. 10, p. 34).

But top government officials still were refusing late last week to let the National Aeronautics and Space Administration publish details of the orbit of the Russian probe launched unsuccessfully on Sept. 1. Earlier, NASA was allowed to publish orbit details on the Russian Venus probe which failed on Aug. 25. Fragments of that vehicle fell from orbit on Aug. 28, Aug. 30, Aug. 31, Sept. 2, Sept. 5 (two pieces), Sept. 6 and Sept. 8.

Information on the Russian failures was released by NASA Administrator James E. Webb in a letter replying to a request from Sen. Robert S. Kerr (D.-Okla.) and Rep. George P. Miller (D.-Calif.), chairmen of the congressional space committees, for "any information" on Soviet planetary probe failures. It is believed that the White House ordered the exchange of letters.

Webb's letter gave these details:

- **Russia used a four-stage** launching vehicle for each planetary shot. Three stages were used to put the payload and a trajectory-injection stage into a parking orbit, and the injection stage was to be fired over Africa after one pass around the earth.
- **In each case, "the probe** would have arrived at Venus or Mars with too high a velocity to have been orbited around either planet" if the launching had been successful—indicating fly-by attempts similar to the U. S. series.
- **Five failures** were caused by "rocket vehicle malfunction."
- **Attempt to launch** a probe on a 230-day trip to Mars on Oct. 10, 1960, failed before a parking orbit was achieved.
- **Second Mars shot** on Oct. 14, 1960, also failed to reach a parking orbit.
- **What the letter called** "the first attempt to send a spacecraft to Venus" on a 105-day flight was made on Feb. 4, 1961. The vehicle reached parking orbit "but could not be ejected into its planned Venus trajectory. The Soviet Union announced the launching as a successful earth satellite, Sputnik 7, and claimed for it a new weight in orbit record of 14,300 lb."
- **Venus probe launched** Feb. 12, 1961, reached the vicinity of the planet in 97 days but the radio transmitter or power supply apparently failed when the probe was about 4.5 million mi. from earth.
- **Venus probe launched** last Aug. 25 "apparently could not be ejected" from its parking orbit. "Had this shot been successful, the probe would have arrived at Venus on about Dec. 7, 1962, ahead of the U. S. Mariner 2," which was launched Aug. 27, Webb's letter said. "It appears that the normal flight time of 112 days for this date was intentionally shortened to 104 days by sacrificing spacecraft weight," the letter said.
- **Shot on Sept. 1** successfully placed a vehicle into parking orbit but the payload could not be ejected.

Labor Talks Snagged On Union Shop Issue

Washington—Dispute over allowing employes to vote on a union shop deadlocked labor-management negotiations at four aerospace firms last week and pushed President Kennedy to the forefront of the controversy.

A special board of mediators failed to break the impasse and recommended to the President that the companies involved should allow a union shop if their employes approve it by a two-thirds vote. The companies are: North American Aviation and Ryan Aeronautical Co., negotiating with the United Auto Workers, General Dynamics and Lockheed Aircraft, negotiating with International Assn. of Machinists.

A union shop requires that an employe cannot be hired unless he agrees to join the union within 30 days. John E. Canaday, Lockheed vice president, opposed any vote on the union shop, declaring: "Our opposition to the union shop is long standing and is a key part of our company's basic business philosophy." IAM replied that this opposition "is based on outmoded and outdated principles that they [Lockheed] themselves have written."

The presidential panel was called into the stalemated bargaining by President Kennedy July 21. The board obtained a no-strike pledge which expires at midnight Sept. 21. President Kennedy is expected to press the aerospace companies to accept the panel's recommendations. He also could postpone the strike 80 days by invoking the Taft-Hartley Act.

The Board's wage recommendations are not at issue, although union spokesmen said they are less than they want. The board recommended wage increases of 5 to 8 cents an hour in 1962; 6 to 8 cents in 1963, and 2.5% of the top rate of each job grade in 1964.

Astronaut Group Picked

Nine astronaut candidates have been selected by National Aeronautics and Space Administration, which expects to announce their names this week. Two are civilians and the other seven are from USAF and Navy.

This is the first of a regular selection process which NASA will conduct every 1-2 years to have a pool of about 30 candidates by the time Apollo missions begin in 1965. New group will form the copilot pool for two-man Gemini missions, in which the Mercury astronauts will be pilots.

The new group of pilots was selected Sept. 10, but NASA delayed announcement of their names because of President Kennedy's tour of the agency's installations (see p. 26).

Scientists Briefed on New Radiation Level

By Philip J. Klass

Washington—Two-day secret briefing on the details and implications of the intensification of the natural Van Allen radiation belt which resulted from the July 9 high-altitude nuclear explosion was given here last week to several hundred industry and government scientists.

The briefing, held at the Goddard Space Flight Center, was sponsored by the Defense Department and the National Aeronautics and Space Administration.

The unexpected long-term intensification of the Van Allen radiation belt (AW Sept. 10, p. 35), which may last for many years, is believed to consist primarily of high-energy electrons with energies of several million electron volts (Mev.) at altitudes above 700 mi.

The increased radiation will require the use of added shielding for satellite solar cells and is expected to spur use of new radiation-resistant types of cells. These include "N-on-P" type silicon cells, in contrast to the widely used "P-on-N" type, and gallium arsenide cells which are even more radiation-resistant.

The principal hazard of the intensified radiation to unmanned spacecraft is to solar cells which are fully exposed. The spacecraft shell provides some protection for transistorized payload which might otherwise be vulnerable to radiation damage. However, electrons with energies of one million electron volts can penetrate about one-third of a centimeter of aluminum and one-half centimeter of water. At higher energy levels, electrons impinging on the spacecraft shell could produce X-ray radiation inside by what is known as the bremsstrahlung effect, i.e. "braking radiation."

The altitude at which the increased radiation has occurred can be deduced from the orbital parameters of the satellites which have been knocked out by the July 9 nuclear test. Transit 4B and TRAAC have apogees of about 690 mi. and perigees of about 590 mi.; Ariel has an apogee of 755 mi. and a perigee of 238 mi. Tiros 5, with apogee of 605 mi. and perigee of 368 mi. has not been silenced. However, one of its television cameras failed shortly after it went into orbit, giving it a surplus of electric power which would allow a significant degradation of solar cells before it would go out.

The Bell System's Telstar communication satellite, placed in orbit with an apogee of 3,500 mi. and perigee of 595 mi. the day after the high altitude blast, has not been seriously affected by the increased radiation. This is attributed to the fact that it is the only satellite to use the new radiation-resistant N-on-P type of silicon solar cells and to the conservative design which provided a surplus of electric power capacity.

The intensified Van Allen radiation is not expected to affect the Samos reconnaissance satellites, which generally operate at low altitudes of several hundred miles. However, the Midas early warning satellite which operates at altitudes of about 2,000 mi. can be expected to feel the impact.

Industry has been slow to adopt the new N-on-P type silicon cells, originally developed by the Army Signal Corps. With little demand, the cost of the newer cells has been higher. But in comparable quantities they should be no more expensive, and perhaps less expensive, than presently used on P-on-N type silicon cells.

Tests conducted by Radio Corp. of America on the newer N-on-P silicon cells indicate that they undergo about one-third the degradation of conventional cells from proton radiation and only one-tenth the damage when exposed to electrons.

Even more promising are solar cells made from gallium arsenide, which appear to be roughly ten times more resistant to radiation than conventional silicon cells and about three times more resistant than N-on-P type silicon cells. These figures are based on limited measurements to date which are continuing.

Gallium arsenide cells potentially have a 20% higher conversion efficiency than silicon cells, although units currently available have somewhat lower efficiencies. An RCA spokesman says the company has produced gallium arsenide cells with efficiencies as high as 11%, compared with a figure of about 14% which is best achieved for silicon cells.

At present the cost of gallium arsenide cells in experimental quantities runs between $175 and $375 per cell, compared with about $8 for equivalent size silicon cells. In quantity production, gallium arsenide cell cost is expected to come down to about $20, still considerably higher than for silicon. The intrinsically higher cost results in part from the fact that it is more costly to produce and purify a compound semiconductor material.

However, a promising difference between gallium arsenide and silicon is that a two-micron thick layer of the former can absorb as much solar energy as 100 micron thick layer of the latter. This suggests that it may be possible to fabricate gallium arsenide cells by means of epitaxial thin-film techniques and thereby slash cost significantly, according to an RCA spokesman.

All types of solar cells can be made less vulnerable to space radiation by protecting them with sapphire or quartz shields. For example, test cells on Telstar, which were protected with 30-mil thick sapphire experienced a drop of only 5% in current output during the first two weeks, while similar test cells protected with 20-mil sapphire experienced a 10% drop.

However, thicker shielding absorbs and reflects more sunlight and therefore reduces the output of solar cells. Also, some types of shielding material become discolored when exposed to radiation, which further reduces solar cell output. Extensive tests to evaluate the effect of radiation on solar cells and shielding material are under way in a number of organizations, including RCA and the Naval Research Laboratory.

Based on theory and the results of the Project Argus experiments of several years ago, the July 9 nuclear detonation was expected to produce a temporary artificial radiation belt below the lower fringe of the Van Allen belt. A panel of scientists convened by the White House last spring, including Dr. James Van Allen, concluded that the artificial radiation would disappear in a matter of weeks or months.

Dr. S. Fred Singer appears to have come closest to predicting the long-term intensification of the natural Van Allen radiation in a paper written in May and submitted to Nature Magazine. Discussing the possible consequences of a high-altitude nuclear explosion, Singer said that "noticeable effects can be produced [in near-space] which can last for many months because of the presence of the earth's magnetic field."

At the time Singer was a member of the University of Maryland's Physics Department, working without access to classified details of the planned high-altitude blast, predicted the creation of a thin shell of electrons with energies of two million electron volts as well as a thick belt of low-energy protons. Currently he is director of the Weather Bureau's national weather satellite center. He pointed out that for a nuclear blast at high altitude near the equator, most of the electrons and protons produced by the explosion would be trapped by the earth's magnetic field, particularly if they hit the lines of the earth's magnetic field with a sufficiently large pitch angle.

If there were no atmosphere and the earth's magnetic field were perfectly quiet, the particles would stay trapped forever. In practice these idealized conditions do not exist so that the particles in time are scattered and released into the lower atmosphere. Particles in the vicinity of the equator, where the earth's magnetic lines of force arch to the highest altitude, will remain the longest.

The length of time which electrons and protons will remain trapped can be calculated, but it is a "complex theoretical problem," Singer said, based on knowledge available to him at that time. Presumably the results of the July 9 test have added new information which will make it easier to predict the results of any future tests.

Glenn Radiation Dose Unexpectedly Low

Washington—Marine Lt. Col. John H. Glenn, Jr., received less than half the heavy primary cosmic radiation dosage expected during his 4.5-hr. space flight in Mercury Atlas-6, according to Dr. Hermann J. Schaefer of the Navy's Biophysics Branch in Pensacola.

Emulsion pack experiment carried on board Glenn's capsule shows a total of 830 heavy primary ray strikes over an area of 600 sq. cm. It had been estimated that at least 2,000 strikes would be recorded on the monitoring plates. Equivalent rate to the astronaut would be 1.4 strikes per sq. cm.

Dr. Schaefer theorized that spacecraft walls and capsule instrumentation absorbed many of the rays and kept the total dosage lower than expected.

MA-6 flight was made at an orbital inclination of 32.5 deg. between the altitudes of 97.6 and 159.5 mi. Recent National Aeronautics and Space Administration balloon flights (AW Aug. 6, p. 30) indicate a strike rate of 78 per sq. cm. for cosmic primaries heavier than iron. Dosage of 357 tracks was recorded for all heavy cosmic primaries.

Balloon experiments were relatively unshielded, and were made at 53 deg. north latitude at an altitude of 130,000 ft. Very few heavy cosmic primaries penetrate below 80,000 ft. Control plates at Cape Canaveral during the flight showed no heavy cosmic ray tracks.

Objective of the cosmic ray experiments is to determine the effect of the rays immediately and genetically.

In the Glenn flight, four emulsion stacks, each containing eight plates, were carried inside the capsule pressure vessel. One was damaged in processing, leaving a total target area of 600 sq. cm. for scanning.

New High-Altitude Tests

Washington—U. S. will conduct several high-altitude nuclear tests from Johnston Island to obtain additional data on the unexpected effects of the July 9 high-altitude burst, which produced a long-term intensification of the high-energy electrons in the natural Van Allen radiation as well as the expected temporary lower-altitude belt of low-energy protons. The restricted area around Johnston Island will be re-established effective Sept. 22.

The new tests, announced by the Atomic Energy Commission and the Defense Department, are expected to have smaller yields and to be conducted at different altitudes, probably under 100 mi. to prevent further intensification of the Van Allen radiation. The July 9 burst, which occurred at about 200 mi. altitude, had a yield of one megaton.

AEC and DOD also announced plans for more tests from Christmas Island, involving air drops of nuclear warheads.

North American T2J-2 Makes First Flight

First of two prototype North American T2J-2 trainers is shown during first flight recently at NAA's Columbus, Ohio, facility. Aircraft is a twin-engined version of the Navy's T2J-1. Change to twin-engined configuration was made under $3.3-million Navy modification contract to evaluate performance, safety and training capability of a twin-engine trainer. New model is powered by two P&W J60s of 3,000 lb. thrust each. T2J-1 had a single Westinghouse J34-WE-36 engine of 3,400 lb. thrust. NAA says two J60s weigh less than a single J34.

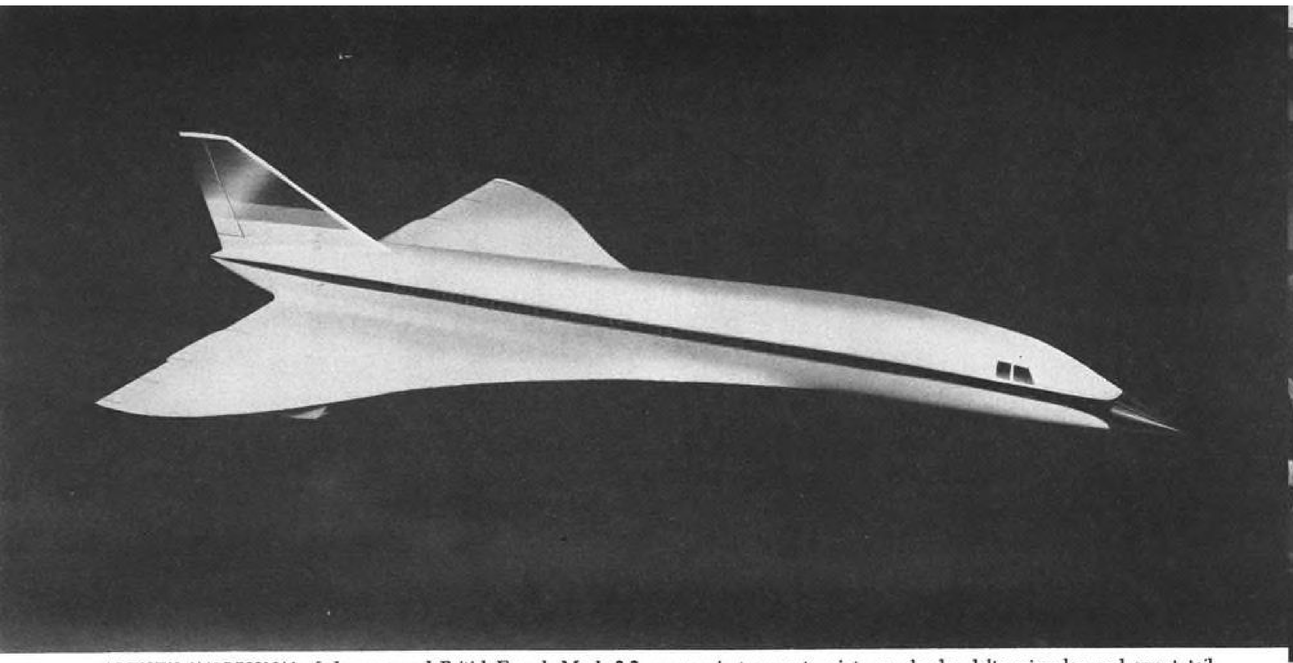
LOH Emphasis

Madison, Conn.—Army enthusiasm for high volume production of a light observation class helicopter may be waning and greater emphasis may be placed on larger classes of rotary-wing aircraft carrying the firepower to protect themselves and complete their combat missions.

Though he qualified it as a personal opinion, Maj. Gen. William B. Bunker, comptroller and director of programs, Army Materiel Command, told an American Helicopter Society group here that he foresaw a decreasing requirement for small helicopters in the Army.

Gen. Bunker estimated the minimum size helicopter as 10-12 place aircraft, the size of the Bell HU-1D Iroquois, and predicted a larger requirement for 12-15 place and 25-30 place assault type helicopters with the necessary firepower. He said the Army would be seeking higher horsepower in powerplants and higher helicopter speeds.

Aviation, now absorbing 12-15% of the Army budget, will grow to 15-20% next year, Gen. Bunker said, and eventually to 25-30%. The Army increasingly will look to company-sponsored developments, he said, where the manufacturer has handled the development cost and the Army can buy the end item.



ARTIST'S IMPRESSION of the proposed British-French Mach 2.2 supersonic transport points up slender delta wingplan and swept tail. Windows are positioned along dark fuselage band. Front windshield is covered by retractable fairing.

MODEL OF BRITISH-FRENCH MACH 2.2 transport was displayed at Farnborough. Aircraft would be built by British Aircraft Corp. and Sud Aviation, with joint government backing. Four Bristol Siddeley Olympus 593 engines are paired in pods below wing.

Key Decision Near on Anglo-French SST

London—British and French governments will make a key decision late this month whether to proceed with joint development of a Mach 2.2 jet transport by a consortium of four firms.

The decision will be made at a meeting between British Minister of Aviation Julian Amery and French Transport Minister M. Dusseaulx in Paris.

Meanwhile, evidence of the extensive technical foundation already laid for this project by British and French firms was shown at the Farnborough air display. Detailed design of the modified delta-wing transport airframe has been completed by a joint Sud Aviation-British Aircraft Corp. team headed by Dr. Arthur Russell of Bristol Aircraft.

Considerable engine development is under way by Bristol Siddeley, working with Snecma in France on the Olympus 593 engine with about 33,000 lb. maximum thrust.

The Anglo-French supersonic transport will be built in two versions—medium range (2,300 mi.) and long range (3,500 mi.). Both versions will use the same basic airframe featuring ogee modification of the delta-wing area rule fuselage and 110-passenger capacity.

The only difference in the two models will be use of the cargo hold in the fuselage to carry additional fuel for the long-range model. Sud will build the medium-range transport in its Toulouse plant, and Bristol will build the long-range version at Filton.

The airframe design team will be headed for two years by Dr. Russell, who will then turn it over to his French counterpart, Pierre Satre. The team is now working on splitting the specific airframe development work between BAC and Sud.

Meanwhile, Bristol Siddeley and Snecma have split the engine development program 60-40, with Bristol Siddeley responsible for the major share in the rotating area of the engine. Snecma will do its work on variable intake and variable nozzle design and construction.

Anglo-French combine also will form a joint task force for sales and production with division heads alternating every two years. Heads of these divisions will not be appointed until after the ministerial meeting clarifies the future of the project.

Farnborough offered considerable evidence regarding the research foundation already laid for this project, with wind tunnel designs used for extensive testing in Royal Aeronautical Establishment and French wind tunnels, plus the Olympus engine already operating on an Avro Vulcan flying testbed. The engine is in its TSR.2 military version.

Low-speed handling characteristics of

Tupolev Gets Farnborough VIP Treatment

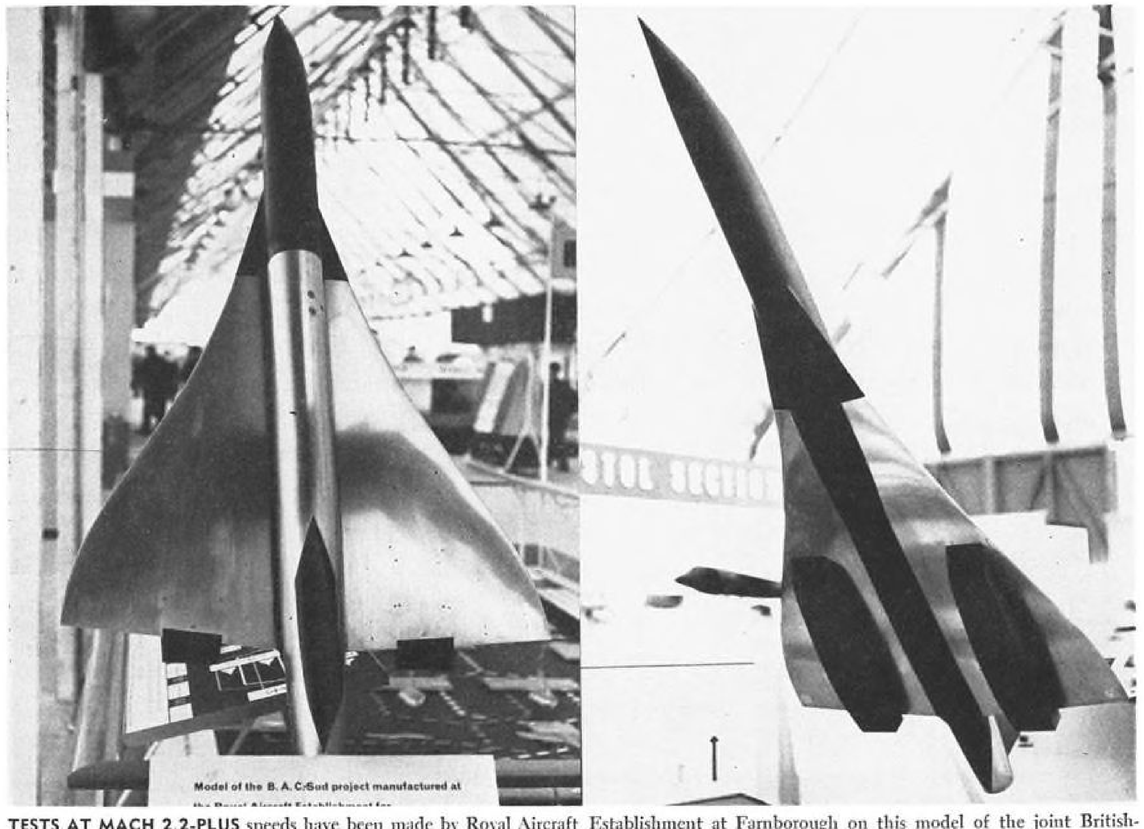
London—Top Russian designer Andrei Tupolev paid his own way into the Farnborough air show, but once inside got VIP treatment from British Aircraft Corp. executives as soon as he was recognized.

Tupolev bought tickets at the gate because of the Ministry of Aviation ban on inviting Russian guests to the private showings, pending similar invitations to visit Russian plants (AW Aug. 27, p. 33).

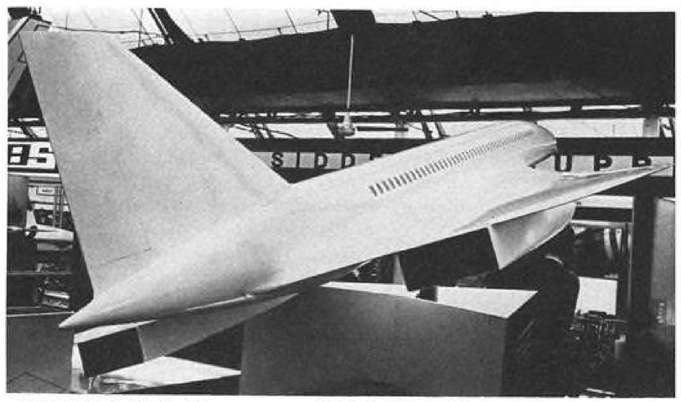
He was accompanied by his daughter, Tatiana, Eugene A. Smirnov, Aeroflot's general manager in London, and A. G. Pavlov, of the Soviet Embassy staff here. He was recognized by a member of the BAC design team who saw the party outside a railing surrounding the Vickers VC.10 four-jet transport.

Sir George Edwards, BAC managing director, who was inside the VC.10 at the time, immediately invited Tupolev and his guests inside for a tour conducted by himself and Jock Bryce, VC.10 chief test pilot.

During the tour, Tupolev mentioned the Russians were building rear-engine jet transports (AW Mar. 29, p. 43), and showed considerable interest in cockpit instrumentation and control placement. The Tupolev party was later entertained at lunch in the BAC enclosure in what Sir George described as a purely social occasion.



TESTS AT MACH 2.2-PLUS speeds have been made by Royal Aircraft Establishment at Farnborough on this model of the joint British-French supersonic transport. Tests were made in the RAF's 8 ft. X 8 ft. supersonic tunnel. Bottom view shows detail of engine intakes, which will employ variable geometry to vary mass flow.



TOP VIEW of Mach 2.2 transport model, left, shows slight waisting aft of wing leading edge. Two versions are proposed, one for medium range and another for long ranges, such as London-Paris to New York. Note extensive tail area and squared exhaust outlets for four Olympus 593 engines, above. Variable geometry ramps are being designed by Snecma, which is responsible for about 40% of engine development, according to Sir Arnold Hall, Bristol Siddeley managing director.

the slim delta design already have been extensively investigated by the Handley Page P.115 research aircraft, now to be followed by the Bristol 221, which will carry the investigation through the full range of transport speeds to above Mach 2.

Bristol T.188 is now a flying materials research program centering on high-temperature materials which will be required for the hot parts of a supersonic transport.

Final airframe design was reached through two separate studies by Bristol and Sud which produced very nearly the same answers to the basic problem posed by Mach 2.2 cruise combined with subsonic performance requirements for takeoff and landing.

Engine development also requires considerable flexibility ranging through takeoff to maximum cruise speed at 60,000 ft. with capability for holding operations at Mach .8 at 30,000 ft., and transonic acceleration to Mach 1.4 at 42,000 ft.

Variable intakes and nozzles are aimed at providing low noise level takeoff power, maximum thrust during transonic acceleration, low external and internal drag during Mach 2 cruise and low thrust and low fuel consumption during the subsonic holding portion of the mission.

Amery Backs Hawker P.1154 for NATO

London—British Minister of Aviation Julian Amery supported the Hawker P.1154 supersonic VTOL fighter as the better solution to NATO's NBMR-3 requirement.

In a speech to the Society of British Aircraft Constructors, he praised Dassault's Mirage 3V, powered by the Rolls-Royce pure lift engine, but said it was the ministry's firm conclusion that the vectored thrust principle, embodied in the P.1154 design, should be the NATO choice.

Amery also said the government is giving full support to the P.1154 program for Royal Air Force and Royal Navy future requirements.

Turning to space, Amery said feasibility study into development of a manned spaceplane has started under the direction of Dr. Barnes Wallis of BAC (AW Sept. 10, p. 30). Powerplants would be ramjets designed by Bristol Siddeley Engines or Rolls-Royce. Both firms are investigating Mach 4 to Mach 11 regimes and work includes studies into combining turbojets and ramjets.

At Farnborough, the Royal Aircraft Establishment is conducting wind tunnel tests on spaceplane models that include, in one case, a piggy-back vehicle which is basically a mother plane to launch the spaceplane. Spaceplane would be carried on the mother plane's top fuselage and, after launch from outer atmosphere, would accelerate to Mach 14 speeds.

The minister also said British Overseas Airways Corp., the state-owned airline, has been given approval to purchase two Canadair CL-44 swingtail cargo transports. Airplanes will be operated by the new BOAC-Cunard, Ltd., joint venture (AW June 18, p. 39).

Russia Claims T-431 Set Altitude Record

Moscow—Vladimir Ilyushin, son of Russian aircraft designer Sergei Ilyushin, set a new world's record for sustained flight at an altitude of 69,885.3 ft. in a T-431 aircraft on Sept. 4, Russia claimed last week.

The T-431 was not otherwise identified, but early last year Russia decorated Ilyushin for setting an altitude record of 94,973 ft., using the same aircraft, in July of 1959 (AW Feb. 13, 1961, p. 102).

In the Sept. 4 flight, Ilyushin developed a speed of 1,304.94 mph., Russia said. Speed is not a factor in the sustained altitude record category, which is formally called "altitude in horizontal flight without payload." U.S. holds the present record of 66,443.8 ft., set Dec. 5, 1961, by Navy Cdr. George W. Ellis in a McDonnell F4H-1 at Edwards AFB, Calif.

When Cosmonaut Yuri Gagarin orbited the earth last May, there were reports that Ilyushin had made a spaceflight earlier but that Russia refused to announce this because he suffered psychological and physical damage (AW May 15, 1961, p. 31). Russia denied the reports and said Ilyushin had been injured in an auto accident and was recuperating in China. Last September, Pilot Ilyushin's father also denied the spaceflight report (AW Sept. 11, 1961, p. 26). In announcing the new record claim, the official Russian news agency Tass repeated the auto accident story and said Ilyushin was confined to bed for six months.

Proposal Requests for 260-in. Solid Motor Expected Next Week

Washington—Requests for proposals covering studies, construction and test firings of a 260-in. solid propellant motor are expected to be sent to propulsion companies next week.

This size motor is being considered for use in the National Aeronautics and Space Administration's Nova super space booster, which will be required to place as much as 500,000 lb. into orbit and boost 200,000 lb. into an earth escape mission.

Whether the initial contract will go as far as construction and firing has not yet been determined. At the least it will cover a detailed design phase. The role of the 260-in. solid propellant motor is still a matter of discussion within NASA. The Air Force and DOD are backing the motor.

NASA plans to demonstrate a 156-in. segmented solid motor. The Air Force would rather eliminate this stage and proceed with demonstration of the 260-in. motor, on the grounds that success in the segmented motor program so far obviates the need for this phase.

Funding for development of the 260-in. motor must be worked out between NASA and the Air Force. NASA is encountering an increasing squeeze in its budget and would like Defense funds for this development work. Air Force claims that it has no need for this motor under its present roles and missions assignment.

Leading contenders in the competition are expected to be Aerojet-General Corp. and Thiokol, both of which have been testing large solid propellant motors. United Technology Corp. will probably not be considered because it was recently chosen to develop the 120-in. segmented motor for use with the Titan 2 workhorse booster, whose initial application will be to place the Dyna-Soar boost-glide vehicle into orbit. Lockheed Propulsion Co. is expected to be in the same category because it does not have a continuous mix facility.

The 260-in. solid propellant motor concept departs from the segmented motor idea which has been applied to the 120-in. and 156-in. motors. It would be monolithic: filled with one grain of propellant. William Cohen, chief of solid propulsion in NASA's Office of Manned Space Flight, says that this motor represents a new class of technology which accepts the fact that weight and dimensions of the motor are so great that new manufacturing and transportation methods will have to be applied.

A motor of 25 ft. 8 in. dia. and 93 ft. high would weigh 3.4 million lb. and would produce a thrust of 6 million lb. Cohen supports the use of this size motor because roughly four times as many 156-in. motors per stage or eight times as many 120-in. motors would be required if the 260-in. motor were not available.

Cohen explained to a special House Science and Astronautics subcommittee that an orderly program has been under way to demonstrate various parts of solid propellant motor technology. These demonstrations have included insulation systems for the interior of the motor, mechanical joint designs and insulation for joint regions, nozzle structures and materials for long burning time, methods of processing very large propellant charges, thrust vector control systems for long burn time motors and handling and transport methods for very large and heavy motors.

The demonstrations so far have included motors of these sizes: Three-segment 86-in. motor, two-segment 65-in., two-segment 100-in., four-segment 100-in., five-segment 100-in., four-segment 96-in., six-segment 100-in. and three-segment 120-in. The last two were fired in May of this year.

These demonstrations, which began in late 1959, have produced thrusts as high as 700,000 lb. and burning times of 120 sec.

Cohen gave three examples of the demonstration program. One was a 96-in., four-segment tapered motor tested by the United Technology Corp. This motor contained 130,000 lb. of propellant and produced a thrust of 380,000 lb. with a burning time of 80 sec. It was fired vertically upward.

Aerojet-General tested a 100-in. five-segment motor. The 220,000 lb. of propellant produced 600,000 lb. of thrust in a burning time of 90 sec., fired horizontally.

The largest diameter motor to be tested was 120 in., by the Lockheed Propulsion Co. last May. The loaded motor weighed 190,000 lb. During a burning time of more than 120 sec., it produced 400,000 lb. of thrust.

Nova Configurations

Four configurations are being considered for the Nova super booster:

- **First stage—12 Rocketdyne F-1 engines, each producing 1.5 million lb. of thrust. Second stage—four Aerojet-General M-1 engines each producing 1.2 million lb. of thrust. Third stage—one Rocketdyne J-2 engine producing 200,000 lb. of thrust. This configuration is favored by NASA.**
- **First stage—Four 260-in. solid propellant motors producing six million lb. of thrust each. Second and third stages are the same as above.**
- **First stage—12 F-1s. Second stage—nuclear—4,000-megawatt rating.**
- **First stage—12 M-1s. Second and third stages the same as in the first two configurations above.**

News Digest

Mariner 2 spacecraft was expected to be 3,505,861 mi. from the earth at 4 p.m. EDT today on its journey toward an anticipated encounter with the planet Venus (AW Sept. 10, p. 34) on Dec. 14.

British European Airways' Vickers Vanguard made an emergency landing Wednesday at Edinburgh after ingesting seagulls into two of its four Rolls-Royce Tyne turboprops on takeoff. Engines were feathered and landing made without incident after airport personnel cleared runway area of gulls by firing flares.

Vladimir Klimov, Russian engine designer died Sept. 9 in the Soviet Union. Klimov designed the VK-3 turbine engine which powers the Tu-104 and the VK-7, a turbojet engine which Russia has offered to allow India to produce under license.

House and Senate last week passed widely different bills to extend the government's guaranteed loan program for air carriers. House extended the current loan program run by the Civil Aeronautics Board for five years but raised the maximum guarantee available to any local service carrier from $5 million to $10 million. Senate transferred the loan program from the CAB to the Commerce Department and extended the program to the cargo carriers. Senate version sets guarantee maximums of $10 million for local service carriers and $15 million for cargo carriers. Conference to compromise differences in the rival bills may be held this week.

North American Aviation's Los Angeles Division will design, build and evaluate a test rig to simulate a supersonic transport fuel system under contract from Coordinating Research Council, Inc. The council is handling supersonic transport fuel research under contract to Air Force's Aeronautical Systems Division (AW Sept. 10, p. 151).

Army-Lockheed VTOL testbed, formerly designated VZ-10 (AW Aug. 20, p. 35) has been redesignated XV-4A.

IATA Plans Czar to Enforce Rate Levels

Plans call for staff of 50 criminal investigators; three-man enforcement group has failed to halt rate cuts.

By Robert Hotz

Dublin—Drastic action to fight cut-rate ticket selling was taken by the International Air Transport Assn. at its 18th Annual General Meeting here last week.

Action to appoint a single enforcement czar backed by a staff of 50 investigators "trained in criminal investigation" was taken after a heated meeting of the IATA executive committee in Killarney during which evidence was presented indicating that the three-man Troika enforcement group now functioning had failed to stop the spread of discount ticket selling below the IATA rate.

The executive committee heard a blistering report from Sir Matthew Slattery, BOAC chairman, on experiences of the five-man investigating team he sent to buy discount tickets from IATA member airlines. Sir Matthew estimated this cut-rate ticket selling had cost BOAC millions in revenue during the last year.

Sir William Hildred, IATA director-general, said price cutting was particularly bad in the Middle East where traditional market-place haggling had unfortunately been adopted in airline ticket sales.

He said there have been seven cases in the last year where maximum $25,000 fines had been levied against IATA members for deliberate underselling of tickets. However, delegates to the meeting here indicated the wave of discount ticket selling was spreading westward and was already prevalent in Rome with several of the most recently proved violations occurring in Frankfurt. Sir William noted that the cargo field in West Germany had also been troublesome on rate enforcement.

Executive committee report to the Annual General Meeting noted "it is sadly evident that some members have less and less scruple about breaching traffic conference resolutions and the effects of this lack of scruple are ugly indeed.

"Discount selling is so prevalent in some parts of the world that no company gains a single dollar by it but only succeeds in robbing itself and fellow members of a large percentage of the fares approved by themselves and their governments."

Sir Hudson Fysh, chairman of Qantas Airlines and retiring IATA president, noted in his farewell address that "our 88 million passengers never had it so good with handsome illegal discounts available world-wide. When some of them climb aboard with broad grins there is plenty of room to stretch out across the empty seats in our lovely new 600-mph. jets.

"The airline passenger, the non-IATA operators, and I regret, some of the agents and IATA members have indeed had their hands in the industry's till during the year at a time when revenue was badly needed there . . . if any member feels that a system of barter is the best method of carrying on our business then I hope he will come forward with the idea at the next traffic conference so that the position can be clarified."

Executive committee of IATA, headed by J. G. Grove, chief executive of South African Airways, said the new IATA enforcement commissioner, who will replace the Troika now functioning, will have full authority to hear cases and assess fines up to the maximum $25,000. His decisions will be subject to appeal to the executive committee only on grounds of new evidence. This commissioner will hear cases immediately after charges are made in contrast to the present Breaches Commission that meets quarterly.

Present IATA enforcement staff of 24 agents will be doubled and the annual enforcement budget of $360,000 will be increased substantially. Sir William said the new commissioner would be required to have a thorough background in airline rate structures, legal experience and a reputation for absolute integrity.

Sir William also noted that if the maximum fine of $25,000 proved ineffective, IATA had the power to expel members for repeated flagrant violations of its regulations. IATA members were also warned by the executive committee that they would be accountable for actions of their non-IATA affiliates.

Trident Appearance Thwarts IATA Ban

Dublin—British European Airways and de Havilland Aircraft combined to thwart a three-year-old International Air Transport Assn. ban on manufacturers' sales activities at the Annual General Meeting here when they displayed the Trident triple-jet transport.

Trident prototypes are still flying experimentally, although they are painted in BEA markings and flown by de Havilland Test Pilots John Cunningham and Peter Bugge.

The Trident first arrived in Dublin Sunday evening, Sept. 9, bringing a load of IATA delegates from London, including the BEA contingent headed by Anthony Milward, general manager. The Trident returned to the de Havilland field at Hatfield but reappeared in Dublin Tuesday during working sessions of the Annual General Meeting for a planned series of demonstration flights for delegates.

Only one IATA delegate appeared for the first scheduled demonstration flight, and bad weather forced cancellation of the rest. This was the first time aircraft manufacturers had attempted any sales promotion activity during an Annual General Meeting since the IATA executive committee ban imposed shortly after the Tokyo meeting in 1959.

At that time, Sir William Hildred, IATA director general, wrote the Society of British Aircraft Constructors, Aerospace Industries Assn. and the French aviation industry's organization, telling them to request that their members stay away from IATA general meetings.

United States manufacturers representatives hovering on the fringes of the Dublin meeting were incensed by what they regarded as "deliberate subterfuge" to evade the IATA ban.

BEA blandly pointed out that there was no IATA ban against an airline demonstrating its own equipment to fellow delegates. The Trident appearance in Dublin may set a precedent for other manufacturer-airline teams to resume active sales promotion at the next IATA Annual General Meeting in Rome.

IATA Meetings

Rome will be the site of the 19th International Air Transport Assn. meeting next fall with Alitalia Italian Airlines acting as host. Bogota, Colombia, appears to be in line for the 1964 meeting of the transport association.

There were mixed reactions among delegates to the new IATA enforcement proposals with some contending it was unrealistic to worry about discount selling from a police viewpoint when the real issue was proper fare level. One airline delegate, after listening to the impassioned pleas of IATA officials to hold the price line, told the meeting "Well, my airline won't be the first to break the line but I guarantee you it won't be the last either."

Basic issues posed by the spread of discount ticket selling during the past year of jet transport overcapacity and airline financial losses will arise at the biennial traffic conference scheduled to open Sept. 24 in Chandler, Ariz.

Other delegates said they failed to note any real distinction between the discount ticket-selling practices and the discounts being offered transatlantic travelers under the so-called spontaneous group charter plan.

Apparently accepting the technical inevitability of the supersonic transport, IATA delegates devoted considerable debate during this meeting to formulating a program to investigate its economics with the same thorough detail that its technical committee was studying design. Delegates agreed that operating costs of the supersonic transport should be equal or lower than present subsonic jets but appeared to be baffled on how adequate economic yardsticks can be found for supersonic transport performance.

Safety, an issue usually ignored in the happy atmosphere of the Annual General Meeting, was discussed repeatedly with the warning that traditional statistics of fatalities per hundred million passenger miles flown no longer had any significance for the traveling public and that the airlines must take a stronger stand in fighting for adequate safety standards.

Sir Hudson Fysh told the meeting "I note that the passenger fatality rate per hundred million passenger kilometers flown on scheduled air services has remained little better than constant over the past 10 years (AW Sept. 10, p. 172). This figure of 0.68 for 1961 was only slightly better than 0.77 registered in 1960. There are no figures available yet for 1962. But on indications I do not think there will be much change.

"However, as volume of flying increased, the number of fatalities increased and the press and public are becoming increasingly sensitive to the position. In this year there have been a number of unfortunate accidents and I wish to make the point that it is not good enough for us to say that our safety factor per passenger carried is as good as ever. I suggest we should set a target of halving our present rate in 1963 and discuss ways and means of how this can be done starting with a careful analysis of causes of all accidents over the past two years."

Erskine Childers, Irish minister of transport, also urged the IATA delegates to "greater devotion to the problem of safety." He said "there is no reason why if cosmonauts can girdle the earth safely there should be even the small number of accidents to civil aircraft".

Lord Brabazon of Tara, pioneer British aviator who was invited to address delegates to present an outsider's view of their activities, asked if public confidence in flight was waning. "If so it is the operator's fault to want to load their craft to the maximum with consequent high takeoff and landing speeds. Modern practice of taking off and landing at 140 kt. is basically unsafe however many times you do it without accident."

Lord Brabazon also assailed the false security of safety statistics, pointing out that if the present fatality rate per hundred million miles flown stays constant, the increase in flying will produce 10,000 passenger fatalities a year by the end of the century with a crash occurring every other day.

Lord Brabazon noted the IATA charter called for promotion of regular and economical air transport and charged bluntly that the air transport industry had failed in this task. "That an industry helped by governments in facilities provided in building of aircraft, with complete control internationally of fares, should be in such a financial mess seems almost to surpass the comprehension of the ordinary man in the street. In ordinary business such results would not be tolerated. I know you are all frightfully clever but the world has always suffered from the intellectual half-wit and aviation has had more than its share."

CAB Divided on Foreign Carriers

Washington—Civil Aeronautics Board's long-standing desire to play a more decisive role in international air transportation matters is creating an open rift between staff-level Board members who advocate the principle of protectionism favored by U. S. carriers, and those who favor an "open skies" policy that might be more adaptable to changing world conditions (AW July 16, p. 42).

A CAB examiner's rejection of a Board proposal to require more extensive traffic and scheduling data from foreign airlines (AW July 2, p. 363) came as a surprise to most of the airline industry and brought a highly critical objection from the Board's Bureau of Economic Regulation (BER). The Bureau has been involved in a running battle that the United States has conducted for a number of years with many foreign carriers over the issues of capacity and route rights.

The basic stand taken by Examiner Edward T. Stodola in the current Foreign Air Carrier Permit Terms Investigation is that need for the regulation change is not grave and if granted, could result in control of foreign airlines which could work against over-all U. S. policy formulation. The case is now nearly two years old and may be decided by the CAB within the next few months, subject to final approval by the President.

Outcome of the case, informed observers say, will depend largely upon a special White House steering committee now engaged in writing a long-range policy for overseas airline operations.

BER's rejection of Stodola's recommendations, as expressed by Bureau Counsel J. P. McKinnon, is being viewed by supporters of the CAB proposal as the last, and most authoritative defense document submitted prior to the final arguments before the five-member CAB.

McKinnon contends that the examiner, rather than rule on whether the regulation change (Part 213) is justified and will accomplish its purpose of providing CAB with more information, instead "substituted his own foreign policy issue" and was "preoccupied" with the thought that the main purpose of the proposal is to control the frequencies and capacities of foreign air carriers. Stodola further reasoned, the attorney claimed, that these actions would violate foreign policy, involved "non-aviation" political considerations and would be a "dangerous instrumentality" in the hands of the Board.

In denying the need for any regulation change, the examiner "belittled the evidence . . . by constructing a bogey man whose components were restrictionism, unilateralism, common market, balance of payments, balance of trade, U. S. foreign policy, etc.," McKinnon said.

He contended that Stodola had "moved away from the case before him" and substituted his own foreign policy issues for the case. It is the Board member's duty to fit CAB responsibilities into foreign policy, he said.

N.Y. Airways Tailors Equipment Plans to Expansion of Heliports

By James R. Ashlock

New York—Eight additional helicopters, several of which might be Sikorsky S-61Ns, will be needed by New York Airways for service envisioned from the rooftops of the Pan Am building and the World's Fair heliport here, officials of the airline say.

Pan Am roof operation will bring an expansion of existing schedules, creating a need for two more aircraft. A high-frequency service planned for the World's Fair, which will be open for two six-month periods in 1964-65, will require six more units.

"We plan to provide 1½ million seats for World's Fair traffic during each of the fair's two periods of operation," said Robert L. Cummings, Jr., president and director of New York Airways. "This is based on a proposed schedule frequency that would provide flights every 2-3 min. during peak periods."

The airline now operates three Vertol 107 turbine helicopters. A fourth is scheduled for delivery in November and a fifth in January, 1963.

Although discussions with manufacturers are still going on, current thinking on the fleet expansion is slanted toward three more Vertols and five S-61Ns. However, Cummings emphasizes that the additional helicopters will not be obtained through standard purchase or lease arrangement.

"We're still a subsidized carrier," he said, "and we can't risk any financial losses that could result from a sizable fleet expansion.

"In our discussions with the manufacturers, which are well advanced, we have had to tell them that in consideration of our subsidy situation, we can undertake this program only if we're relieved of the threat of a loss on it."

On the other hand, Cummings said, New York Airways does want to keep whatever profits may come from the increased traffic expected to result from the fair.

New York Airways feels that helicopters operating to and from the fair can pay for their operation through anticipated high load factors.

"We'd like to obtain the needed aircraft for this operation on a modified lease-purchase arrangement," said John E. Gallagher, vice president.

New York Airways might also obtain one, or possibly two, S-61Ns in advance of the six it feels will be necessary strictly for service to the fair. Gallagher believes at least two additional aircraft will be needed for operation from the Pan Am building, and the S-61N's 28-passenger capacity, three more than the Vertol's, would make it a good unit for this operation.

Sikorsky has plans to build four S-61Ns for which orders have not yet been placed. Two or three of these now appear likely to be ordered by Pakistan International Airlines (AW June 4, p. 44), for which New York Airways has made a prospective operation study. New York Airways could pick up any of the four Pakistan does not order.

In its approach to Vertol and Sikorsky, New York Airways is playing heavily on the promotional aspects of the fair. It feels both manufacturers would like their helicopters prominently demonstrated to fair visitors through scheduled service.

Vertol officials said they received the proposal from New York Airways, but have made no decision yet.

Entire helicopter service plan for the fair hinges on rooftop operation. Cummings and Gallagher both are confident that New York Airways will be operating from the 800-ft. Pan Am building and the 120-ft. World's Fair restaurant-top heliport well in advance of the fair's opening in March, 1964.

The fair site will be approximately 4-min. from the Pan Am roof by helicopter, and 10-12 min. from suburban points such as northern New Jersey. Cummings says the one-way fare from the Pan Am building will be $10 one-way and perhaps $15 for a round trip.

"We also envision service from Trenton, N.J., Paterson, N.J., New Haven, Conn. and other nearby cities of similar size," he said. "And there's no reason why we can't be in the Philadelphia market by the time the fair opens."

The Pan Am roof is expected to become a shuttle pivot, the passing point for helicopters flying a high-frequency schedule pattern between the fair, LaGuardia, Idlewild and points in New Jersey and Connecticut.

The Port of New York Authority is building a $2,500,000 elevated restaurant at the fair, atop which is the heliport with a 150 x 200-ft. landing deck. Port Authority wants the helicopter service at least seven months ahead of the fair's opening for exhibitors.

Port Authority has made New York Airways responsible for helicopter service at the fair, a fact which Cummings says makes acquisition of the additional aircraft all the more important.

Gallagher said the Federal Aviation Agency has now authorized New York Airways to operate from the Pan Am building with a 16,000-lb. gross limitation, which is 3,000 lb. under the Vertol's top gross ability.

INTAKE SCREEN designed by Vertol to prevent ingestion such as that which caused two forced landings of Vertol 107s operated by New York Airways is shown installed. Screen is ¼-in. stainless steel mesh, and effective deicer has yet to be developed. The device reduces engine power by 10-12 shp., shaving approximately 40 fpm. off Vertol's rate of climb at 1,000 ft.

"Tests are now under way to up this to 17,000 lb." Gallagher said, "which is what we'll have to have to make the operation practical. Approval for 17,000 lb. is expected before we begin flying off the roof."

A 16,000-lb. gross limit would restrict New York Airways to carrying only 15-16 passengers on and off the Pan Am building, whereas the Vertol has seats for 25. Figuring 200 lb. per person, the 17,000-lb. gross limit would permit carrying 20-21 persons.

"We'd like to see the limit somewhere around 18,500 lb., but we can go with 17,000," Gallagher said.

Gallagher said the 17,000-lb. gross figure will come through strengthening the Vertol's landing gear, permitting landings at increased rate of descent, and boosting the shaft horsepower rating of the General Electric CT58-110s.

GE officials say they are now modifying the engine to raise its rating from 1,250 shp. to 1,400. The higher-power engine, complete with FAA certification, is expected to be available in the latter part of 1963.

Another problem of rooftop operation, that of turbulent air over the landing area, appears solved through special features around both the Pan Am and World's Fair heliport pads.

Curved "cusps," which round out the otherwise sharp break between the roof and building wall, have been installed on both structures. The cusps break up turbulent vortices and provide a smooth laminar air flow extending 35-40 ft. above the landing pad.

Aircraft Evacuation Measures Formulated

By David H. Hoffman

Washington—Federal Aviation Agency, U.S. aircraft manufacturers and the airline industry are nearing agreement on a long list of modifications aimed at enhancing passenger safety when turbine-powered transports are involved in survivable accidents.

Numerous modifications, each relatively minor in scope, will be implemented voluntarily by the carriers. Others soon will be the subject of formal FAA rulemaking. All are designed to speed the evacuation of passengers from an aircraft crippled on the ground, especially when its cabin fills with smoke and carbon monoxide.

Meeting here last week, a joint industry-government task force ironed out details of the modification program's first phase, which entails making emergency exits more conspicuous with improved paint, placards and lighting. First aircraft to be modified for evaluation purposes are a Convair 880 operated by Delta, a Convair 990 and a Lockheed Electra operated by American, a Douglas-owned DC-8, and a Boeing-owned 707 and 720.

Denver Crash Studied

In the future, U.S. airlines may be asked to widen aisles and install extra emergency exits in the high density seating areas of jet transports as one result of an FAA study of a landing accident at Denver, Colo., on July 11, 1961. In it, 16 of 122 passengers on board a United Air Lines Douglas DC-8 died while trying to evacuate the aircraft after it had come to rest.

According to the study report, which was written by a three-man team of medical experts in FAA's Civil Aeromedical Research Institute, carbon monoxide poisoning accounted for all fatalities. In addition, those who died were passengers in the DC-8's tourist section, where one emergency exit was on hand to serve 81 persons.

In the jet's forward first class cabin, by contrast, there were three exits, and these were used by 36 passengers and five crew members without loss of life.

As part of the broad-based industry-government program to raise the level of passenger safety in survivable accidents, FAA plans to circulate notices of proposed rulemaking on:

• **Class dividers** or movable bulkheads. Nothing stronger than tearaway curtains should be used to subdivide a jet's cabin into tourist and first-class sections. Such curtains should not restrict the minimum width of passageways, which are set forth in Civil Air Regulations. Doors leading to emergency exits, moreover, should be equipped with latches able to withstand high g forces.

• **Marking emergency exits** and installation of escape ropes. A stripe at least 2 in. wide that contrasts with the color of an aircraft is to identify emergency exits on the external skin of its fuselage. In addition, emergency exits of future aircraft are to contain ropes long enough to ease passengers to the ground from either the leading or trailing edge of the wing, whichever is farthest from exit.

• **Interior emergency lighting** and "no smoking" and "fasten seat belt" signs. Throughout the cabin, a light intensity level of about 0.05 of a foot-candle measured at seat arm rest height probably will be required. All passenger-carrying aircraft are to be equipped with both a public address system and an audio signaling system to warn passengers when the seat belt-no smoking signs have been turned on.

Although these subjects will be covered by future rules, this does not mean the carriers now are neglecting them. On most airline transports, for example, a bell system is used to inform cabin attendants when the seat belt sign goes on, and external emergency exits are almost always clearly marked.

FAA, however, feels that such items are so basic to safety that they cannot be left to industry's discretion.

Survivable accidents, as defined by the airlines and the agency, are those in which the forces of deceleration will not necessarily prove fatal to at least some passengers in an aircraft. As the 880, 990, 707 and DC-8 are modified for greater survivability, the government-industry task force plans to evaluate similar improvements for the Fairchild F-27, Canadair CL-44, Vickers Viscount and Sud Caravelle airliners.

Meanwhile, FAA has left it up to the airlines to undertake a number of similar changes in the larger turbojet transports.

Ultimately, the agency believes, all exit signs in airline aircraft should have standard dimensions, colors and light intensities. On the first aircraft to be modified, however, FAA has agreed that the industry-government task force would decide how conspicuous such signs should be.

To make emergency exits stand out, FAA has proposed the airlines use three-quarter inch wide red arrows with arrowheads indicating how the lock is to be opened. If the opening motion is one of rotation, the arrow should describe an arc of at least 70 deg.

During earlier conferences with airline and Air Transport Assn. representatives, FAA had suggested that airlines not allow passengers to carry luggage longer than 24 in. or weighing more than 5 lb. on board their aircraft unless strong tie-down facilities were provided. But it later agreed to study current airline rules governing carry-on luggage before issuing any regulations on this subject.

FAA's study of the United DC-8 accident at Denver, attempting to answer why 67 tourist passengers could not evacuate the aircraft through a single exit, said that several factors should be examined closely. The first was the width of aisle in the tourist section—15.5 in. as opposed to 22 in. in the first-class forward cabin.

This narrower aisle, the study showed, meant that the passengers had to stand in single file while waiting their turn to use the exit at the rear of the cabin.

View Blocked

The study also stressed there were no over-wing or window exits available for tourist passengers and that a floor-to-ceiling partition, which separated the two sections, made it impossible for them to see escape routes in the first-class cabin. No placard on the aft side of this partition directed them toward extra emergency exits available in the forward section, the study said.

Because of aisle width, the study concluded it was "virtually impossible" for cabin attendants in the tourist section to move forward, thus to speed evacuation of the smoke-filled cabin. In addition, the study said, no emergency evacuation briefing was given the passengers prior to the incident, and this despite the fact the pilot had alerted the Denver tower of a known hydraulic malfunction before his landing.

Against this background, the study recommended that:

• **Passengers be given** emergency evacuation instruction prior to any landing which could be complicated by a known malfunction.

• **FAA undertake** a comprehensive research program, weighing evacuation time against the probability of impaired breathing or sight, to determine whether aisles should be widened in high density cabin areas.

• **Placards be posted** in transport cabins to acquaint all passengers with the location of emergency exits in other parts of the aircraft.

• **Research be initiated** on how to furnish passengers with uncontaminated breathing air for periods long enough to evacuate a burning aircraft.

• **Regulations governing** the number and location of exits in transport aircraft be re-evaluated in terms of aisle width, passenger capacity and cabin compartmentation.

Airport Growth Stirs Airline Opposition

By Robert H. Cook

Washington—Scheduled airlines are pitting cost calculations against civic pride in a new campaign designed to avert construction of airports which they fear may require exorbitant airline fees to show a profit.

Focal point of industry concern at this time is the Cincinnati-Dayton area, where municipal officials are considering the practicality of building a third airport to serve the two cities. American Airlines, Delta Air Lines, Eastern Air Lines, Trans World Airlines and Piedmont Airlines are opposing the idea in a critique which promises to establish a pattern for airlines facing the same type of problem in other sections of the United States.

These carriers, through the Air Transport Assn., are basing their opposition primarily on grounds that existing airports serving the cities are and will be adequate; future traffic growth will not support a third installation, and a concern that the general public is under the misconception that the federal government will bear at least half the construction cost of the new airfield.

Industry spokesmen, who wryly refer to mounting airport costs as "leaping inflation," concede that airlines in the past have too often failed to act in time or in unison to head off expansion moves which have proved costly to the industry.

The Cincinnati-Dayton project, they point out, is still in the "thinking stage," so there may be time to convince the municipalities that a third airport is impractical.

An additional drawback to the proposal, they contend, is that the Civil Aeronautics Board's current interest in regional airports to service adjacent localities could conceivably result in only one existing airport being authorized to serve both cities.

Unless this proposal is blocked, spokesmen warn, another imposing "glass shrine" will be added to the burdensome and costly list of such edifices financed primarily at the expense of airlines, rather than local taxpayers, through the flotation of revenue-producing bonds (AW Jan. 8, p. 34).

With the Cincinnati-Dayton proposal as a case in point the airlines contend:

• **Two modern airports** already serve the localities at a combined total investment exceeding $80 million. At the Greater Cincinnati Airport, a $45-million expansion of the passenger terminal is nearing completion. The James M. Cox-Dayton Airport recently completed a passenger terminal expansion project costing more than $6 million. Both airports have been built over a period of 25 years and could not be duplicated today at twice their original cost, the carriers contend. Together they are adequate to handle any expected future traffic growth.

• **A new airport equidistant** from either city would be 26 mi. from a city center as compared with the present average distance of 12.5 mi. Improvement of access roads to both existing airports is being considered, and the location of the third airport would add about 20 min. travel time to either city. This added ground time would increase total travel time from the cities to New York by 17% and Chicago by 32%. Based on the airlines' assumption of the new airport's location, taxi fares would increase from the present rate to Dayton of $5.20 to $13.

• **Consolidating schedules** at a new airport would not result in any appreciable increase of non-stop service. On the basis of present passenger volumes, some new non-stops might be justified, but they would amount to only 12% of the total service provided and would not justify the "inconvenience" to 88% of the travelers.

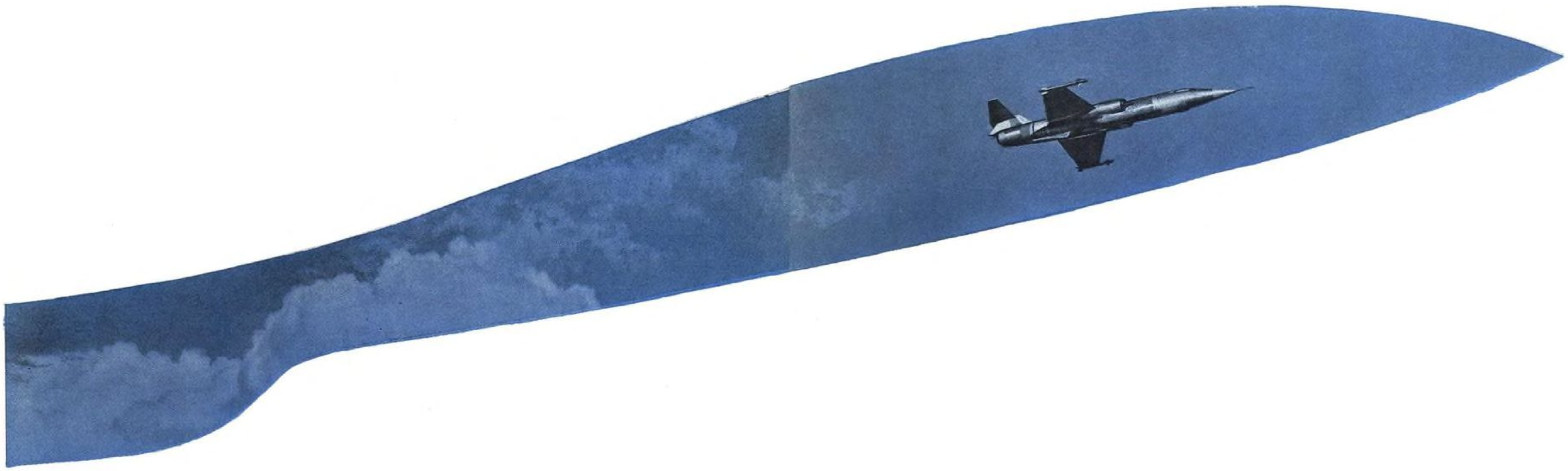
In a similar manner, the airlines noted that it would be unlikely that any more non-stop or through service could be provided for international flights. Last year the total traffic from both cities to Europe and Africa amounted to only 12 passengers a day, including an average of fewer than three passengers a day to London, the largest single destination.

• **Financing of such an airport** could not depend largely upon federal aid and would probably result in high user charges to the carriers, if revenue bond financing were undertaken. A rate of user fees which would pay the airlines' share of the airport operation and maintenance plus retiring the revenue bond issue would be "so fantastically expensive that no airline could, by any stretch of the imagination, afford to use the airport," the carriers stated in their critique. Citing the FAA's regulations on eligibility for airport aid, the carriers noted that federal funds alloted only for eligible items, such as runways and safety items, would cover less than 15% of the total investment needed for the new airport.

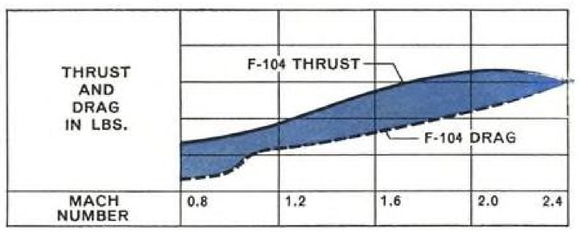
"These are, in the airlines' view, the hard cold **financial facts,"** the carriers stated. "The field cannot become a reality without major public taxpayer contribution. There is simply no other source of funds."

727 Aft Fuselage Mated to Wing

Aft fuselage of the first Boeing 727 short-to-medium range jet transport is lowered by overhead cranes into position for mating with the wing in the final assembly area at Boeing's Transport Division, Seattle, Wash. Later this month, the aft fuselage will be mated with the forward fuselage. Section shown above includes the aft passenger cabin, vertical fin and center engine air intake duct. First 727 is scheduled for rollout in November, with first flight set for January, 1963. Total 727 order is now 127, with deliveries to airlines scheduled to begin late next year.



Have you looked at the F-104's thrust-over-drag curve lately?



As you can see by the chart at left, the F-104's drag doesn't equal thrust until Mach 2.4. The area in blue indicates the available reserve thrust.

This reserve thrust gives the F-104 tremendous extra power for supersonic acceleration, supersonic climb, and supersonic maneuvering. The F-104 can accelerate from Mach 1 to Mach 2 in two minutes. And the F-104 can maintain Mach 2 through a 3.3G steady state turn even when carrying wingtip Sidewinders.

But extra thrust isn't everything. Versatility is important, too: the ability to carry a variety of external stores and internal electronics, including the most advanced all-weather systems. Maintenance is also a big factor. Recently a USAF squadron in Germany flew 836 hours and 5 minutes in one month – with only 12.4 maintenance man hours per flight hour.

The F-104 is rolling off production lines at the greatest rate in its history. F-104s are being produced in 7 nations for 11 air forces, including the United States. Never before have so many nations been brought together to build one weapon for the common defense.

LOCKHEED-CALIFORNIA COMPANY

A division of Lockheed Aircraft Corporation, Burbank, California

LEADERSHIP IN FLIGHT: airplanes, helicopters, aerospace planes, spacecraft

Eastern Is Resuming Flights on All Routes

Washington—Eastern Air Lines last week was scheduled to resume service to all 119 cities along its route pattern using approximately 400 pilots it had trained as flight engineers, plus about 100 engineers who returned to work despite their union's June 23 strike against the company.

On Sept. 13, when Eastern was to resume a full summer flying schedule, it planned to offer about 8,000 daily seats in and out of its Miami home base. Last summer the comparable daily figure was 8,500 to 9,000 seats.

Without operating its fleet of 34 Martin 404s, which are scheduled for retirement, the company still planned to offer service at all scheduled stops by substituting larger Douglas DC-7s and Lockheed Electras for many of the Martins. But frequency of service would be decreased at several smaller cities, according to the company.

In a related development last week the Flight Engineers International Assn. petitioned Civil Aeronautics Board to order Eastern to "cease and desist" alleged violations of the Railway Labor Act during the strike. In a 34-count complaint, FEIA urged the Board to suspend or revoke Eastern's operating authority if it refused to set up a grievance board and take other steps the union said were incumbent under the Railway Labor Act.

Federal Aviation Agency, meanwhile, asked that FEIA turn over all photographs taken by its members of airline pilots allegedly sleeping or reading in the cockpit during scheduled flights. Earlier, the union had submitted 39 such photographs in response to an agency request, while stating that other, "more complete" pictures in the possession of another engineer could not be obtained.

In the interim, FAA was attempting to authenticate the first set of photographs. When this was done, it said, disciplinary action would be started against those pilots that could be identified.

Avro 748s Grounded

Nine Avro 748s were grounded after two in-flight incidents following loss of main entry door. In one case, a stewardess was sucked from the plane at 9,000 ft. on Aug. 30, but there were no fatalities on the second.

Manufacturers' position is that door-locking mechanism was not properly operated and points out there have been no similar incidents in either Avro 748 test program, or in operations by Skyways in Great Britain. Company, however, is considering a modification to pilot panel warning presentation lights to eliminate any possibility of human error.

Since the two incidents, Avro technicians, along with airline personnel, have made a test flight in which the door was deliberately blown free in tests of the lock system.

CAB Probes Chicago Helicopter Traffic Dip

Washington—Civil Aeronautics Board last week ordered an investigation which could eliminate Chicago Helicopter Airways' subsidized operations.

Because of CHA's heavy traffic decline since the end of last year, the Board said it wants to decide soon whether to renew the carrier's authority, which expires Aug. 6, 1963. The Board noted that its action is "consistent with, and indeed is required by, our stated policy of keeping the subsidy requirements of the helicopter experiment at a carefully controlled level consistent with the requirements of the public interest."

CAB spokesmen said that while the carrier legally has until February, 1963 to file for certificate renewal, the time necessary to study its application accepted then would probably extend well beyond Aug. 6, 1963.

The Board expressed concern over CHA's declining traffic, due primarily to a shift of scheduled airline operations from Midway Airport to O'Hare Field, and noted that total CHA passenger originations at Midway were 28,668 during the second quarter of 1961, as compared with 9,569 during the same period of this year. Comparable decreases were noted at O'Hare where passenger originations dropped from 31,949 to 10,688 during these quarterly periods. Mail tons also dropped at Midway from 56.6% to 54.6% in these comparative quarters, but increased at O'Hare from 3% in 1961 to 18.1% for the second quarter of 1962. "Clearly, however, the decrease in passenger traffic may have a significant effect upon CHA's subsidy requirements," the Board stated. "Moreover, it may also indicate a changing pattern of demand for helicopter service in the Chicago area."

CAB Proposes New Supplemental Rules

Washington — Civil Aeronautics Board proposed a new set of regulations to control supplemental airline operations last week as 10 applicants presented their cases for supplemental authority.

The Board's Bureau of Economic Regulation earlier had recommended rejection of renewal for all 10. They are Blatz Airlines, Standard Airways, United States Overseas Airlines, Sourdough Air Transport, Air Cargo Express, Airline Transport Carriers, World Wide Airlines, Quaker City Airways, Paramount Airlines and Associated Air Transport.

CAB's proposals are designed to require more financial stability from the supplementals, continuing operations by the carriers and greater insurance protection for passenger injuries or fatalities. Carriers would be required to perform at least 250 revenue flight hours per calendar quarter.

Minimum limits on liability insurance would be $50,000 per passenger for bodily injury or death or a minimum total amount for each accident in any aircraft equal to the product of multiplying $50,000 by 75% of the number of seats. Non-passenger liability would be set at the same $50,000 rate per passenger, with $500,000 as a minimum for each aircraft accident.

The airlines would also be required to file monthly statements on accounts receivable and payable and quarterly reports on anticipated cash needs for each succeeding three-month period, plus revenue aircraft hours flown during the previous quarter.

FAA to Flight-Check AF Navigation Aids

Washington—By June 1, 1963, Federal Aviation Agency will accept total responsibility for flight-checking the accuracy of Air Force navigation aids in the U. S. and abroad under a joint agreement announced last week.

FAA will flight check all military navigation aids in the U. S. beginning Jan. 1, 1963. On the following Apr. 1, it will assume responsibility for those in Europe and the Middle East. Far Eastern facilities will be flight checked from June 1 on.

Approximately 1,600 Air Force navigation aids are involved. Flight checking Army, Navy and civil navigation aids now is done by the agency.

Group Fare Proposal

New York—Trans World Airlines has requested CAB approval of new "open jaw" group fares between New York or Chicago and the West Coast. Fares would be 25% less than jet coach.

The "open jaw" designation means a person could fly from either New York or Chicago to Los Angeles, then make his return from San Francisco. Available to groups of 10 or more persons, the fares require completion of trips not earlier than 10 days nor later than 30 days after departure.

AIRLINE OBSERVER

► Ghana Airways grounded its single Antonov An-12 turboprop cargo transport permanently due to its low operating economy. Ghana sources said the An-12 payload was only 14,000 lb., about the same as a Douglas DC-4. Its Ivchenko turboprop engines have been removed for use in Ghana's Ilyushin Il-18s, which have the same AI-20 engine. Some Ghana officials suggested that the An-12 be put in a public park as a playground for school children. Ghana Airways already has canceled its order for two Boeing 720 jet transports and will also scrap its plans to operate two Vickers VC.10s.

► **Eastern Air Lines' personnel cutback will touch all major unions in the company. The latest to be affected is the Air Line Dispatchers Assn., which has been notified that 18 of 102 ALDA dispatchers at Eastern will be laid off permanently. About one-third of the carrier's dispatchers have been recalled since the flight engineers strike began.**

► Look for Sen. Warren G. Magnuson (D.-Wash.), chairman of the Senate appropriations subcommittee that passes upon Federal Aviation Agency budgets, to demand that the agency re-write policy it worked out with Civil Aeronautics Board to cover what each should do following major U.S. aircraft accidents. Angering Sen. Magnuson is one policy declaration that provides for joint FAA-CAB statements on possible crash causes. Such statements, he believes, should come from CAB—not FAA, which according to Sen. Magnuson, has been guilty of pre-judging the causes of past accidents.

► **Watch for Air Line Pilots Assn. to attack three features of the new system being employed by FAA to sequence both Visual and Instrument Flight Rule traffic inbound to the Atlanta, Idlewild and Houston airports. Pilots generally feel that radar-based procedure enhances safety. But they also believe that controllers should not cease affording separation to two IFR aircraft merely because one reports the other in sight, nor should they ask for position reports over landmarks on the ground or order pilots to fly certain approach patterns in the absence of conflicting traffic.**

► Single new form will be used by some 5,000 U.S. and Canadian travel agents to ticket airline passengers under a plan worked out by the Air Transport Assn. Revenue collected by the agents then will be deposited in one of nine central banking regions designated by ATA. Under current procedures, each airline supplies each travel agent with ticket forms and collects his receipts twice each month.

► **Nine North Atlantic Ocean stations, maintained by the International Civil Aviation Organization to house navigation aids and furnish pilots with weather information, reported no rescue operations in 1961, ICAO said last week. In emergencies, ships provided by the U.S., Canada, France, The Netherlands, Norway, Sweden and the United Kingdom can vector aircraft, light the sea for night ditching or dispatch launches to pick-up survivors.**

► ALPA may face legal action from disgruntled pilots and flight engineers on United Air Lines over the issue of combined seniority lists arising from the merger with Capital Airlines. Decisions in recent arbitration within the union place an estimated 244 United flight engineers on the bottom of a combined seniority list and former Capital Airlines pilots are prevented from bidding for jet assignments on United until 1968. Meanwhile, United pilots are weighing whether to retain Clarence N. Sayen, former ALPA president, as a consultant on bargaining with management. Even though Sayen would be paid with funds from United's ALPA Master Executive Council, ALPA councils on TWA, American and Pan American are expected to oppose the plan.

► **Announcement of a new Office of General Aviation Affairs within FAA probably will be one of Administrator N. E. Halaby's first acts after his return from a European tour this week. William J. Schulte, now special assistant to the administrator, probably will be first head of the office, which is being formed to give greater emphasis to general aviation.**

SHORTLINES

► **Braniff Airways** is offering groups of South American high school students a 20% reduction in fares to the United States. Groups of 20 or more students will use the fare plan under the airline's "Operation Amigo" project.

► **British Overseas Airways Corp.** has assigned a medical research officer, Dr. G. Bennett, as copilot on a Comet 4 schedule. Dr. Bennett is investigating the effects of time changes on crew fatigue, and effects of humidity and temperature on humans.

► **Delta Air Lines** flew 294.1 million revenue passenger miles during August—a 62% increase over August, 1961. Passenger load factor for August was 69.1% compared with passenger load factor of 56.2% for August, 1961.

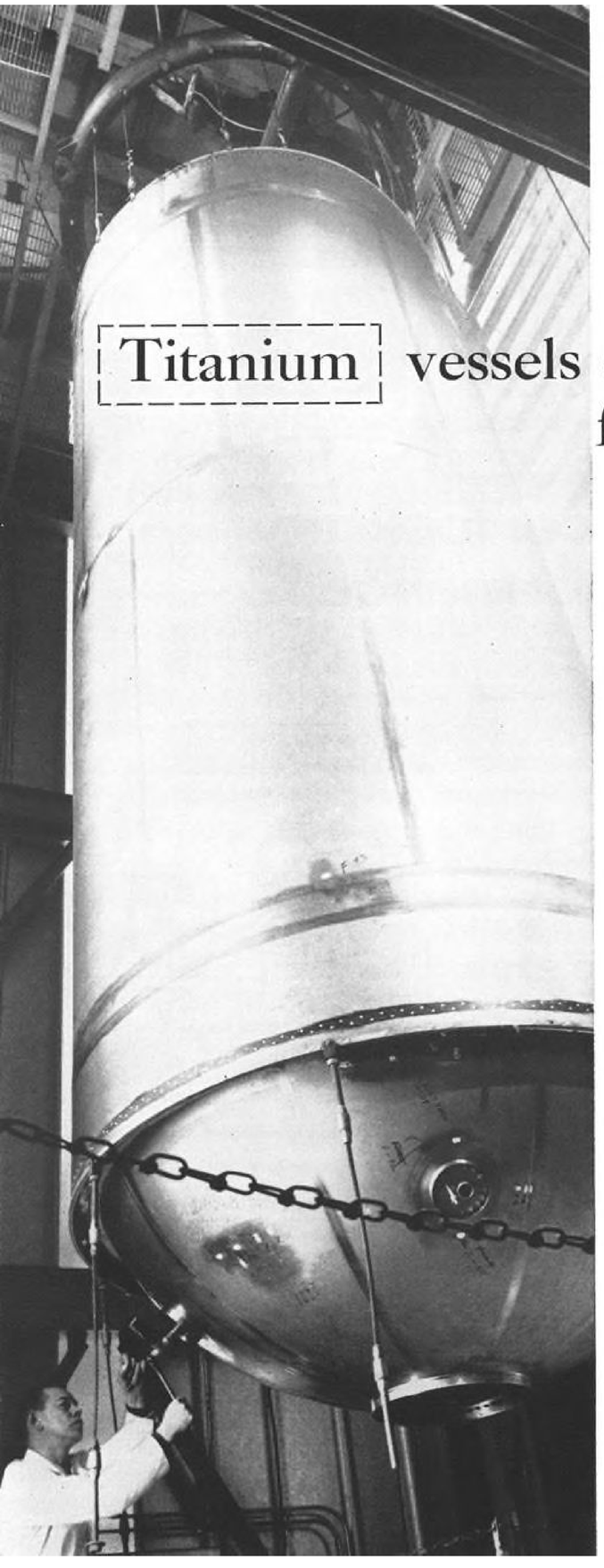
► **International Air Transport Assn.** estimates that the total volume of interline business between its members has increased 11% in the first six months of 1962 over the same period of last year. IATA clearing house figures in the U.S. show a total interline business of $62.5 million as against $59.4 million in interline business for the first half of last year.

► **National Airlines** has engaged fashion designer Oleg Cassini to design a new stewardess uniform. National says the design is expected to be "a complete departure from traditional concepts of stewardess uniforms in both design and color."

► **Pacific Airmotive Corp.**, Burbank, Calif., will distribute airframe spare parts and kits for modifying Caravelle jet transports operating in the United States to meet maintenance requirements of domestic airline operators under a contract with Sud Aviation.

► **United Air Lines** flew 71.2 million revenue ton miles of freight during the first seven months of 1962—a 27% increase over the same period last year. Highest daily revenue ton mileage was flown on Aug. 30 when United flew 561,400 revenue ton miles.

► **Western Air Lines** reports $3.1 million net earnings on revenues of $49.1 million for the first seven months of 1962. Same period last year showed a loss of $430,000 on revenues of $32.1 million. Profits this year were the highest in the company's history for a seven-month period.



TMCA's cryogenic grades...and

Beech's experience with 7,000 gallon tank open way to

Titanium vessels of unlimited size for liquid hydrogen

Titanium can hold more liquid hydrogen at less tank weight than any other metal, and still give you impermeability to hydrogen, generous elongations and notch toughness down to minus 423F.

In brief, titanium thus becomes the easiest way ever devised to buy more payload. And titanium can be used to produce tankage of unlimited size. Here's proof:

1. Beech Aircraft has successfully hydrostated a 7,000 gallon welded titanium tank, produced under an Edwards AFB contract.
2. Titanium Metals Corporation of America has introduced titanium alloy compositions modified especially for liquid hydrogen service. You'll have to know as much as possible about them — as fast as possible — to keep ahead of the LH_2 field. TMCA can help you here.

One-third lighter than stainless. The Beech titanium test vessel measures eight feet in diameter by 24 feet in length. Although its weight is classified, it weighs almost one-third less than a theoretical optimum stainless steel alternate.

The success of the titanium test tank — the largest assembly of its type yet built — makes even larger vessels practical. It was fabricated from sheet supplied by TMCA to less than AISI tolerances, in thicknesses ranging from 0.014 to 0.025 inches. Beech reports that the weight of this titanium test vessel could be reduced by 50%, by using even lighter-gage sheet and designing with titanium's high strength and ductility at liquid hydrogen temperatures.

Titanium grades for liquid hydrogen. Titanium Metals Corporaton of America has introduced two grades of titanium modified specifically for service at liquid hydrogen temperatures. They are the "ELI" (Extra-Low Interstitial) grades, Ti-6A1-4V and Ti-5A1-2.5Sn. The Beech tank was produced of Ti-6A1-4V ELI. Both alloys have strength-to-weight ratios at cryogenic temperatures that are superior to stainless steel and aluminum (see Figure 1). At the same time they retain toughness — a feat that few materials can approach. Control of interstitials also enhances the rolling characteristics of the grades in production of wide, thin sheets needed for LH_2 programs. For example, material is now available in such representative sizes as 0.014 x 36 in. x coil and 0.020 x 40 x 120 in.

Table I — Typical Tensile Properties of Ti-5Al-2.5Sn ELI

	Test Temperature		
	70 F	—320 F	—423 F
Yield Strength, psi	102,000	168,000	206,000
Tensile Strength, psi	117,000	181,000	229,000
Elongation, %	16.5	16.0	15.0
Notched Tensile Strength, psi	155,000	228,000	233,000
Notched/Unnotched Ratio	1.38	1.26	1.03
$K_t = 6.3$			

Table II — Typical Tensile Properties of Ti-6Al-4V ELI

	Test Temperature		
	70 F	—320 F	—423 F
Yield Strength, psi	127,000	202,000	248,000
Tensile Strength, psi	135,000	218,000	263,000
Elongation, %	14.0	13.0	7.0
Notched Tensile Strength, psi	165,000	206,000	211,000
Notched/Unnotched Ratio	1.22	0.94	0.80
$K_t = 6.3$			

TMCA your best bet in titanium. The best bet today for cryogenic vessels in high-energy missiles is titanium. Its successful fabrication in large tankage, such as the Beech unit, underscores the fact that thin-gage titanium sheet is here. And if your best bet *is* titanium, then TMCA is your best bet *in* titanium. TMCA is the nation's only company devoted exclusively to titanium and is the only organization with the experience provided by an unbroken history of full-time technical assistance.

Write for complete data on the "ELI" grades today.

TIMET® titanium

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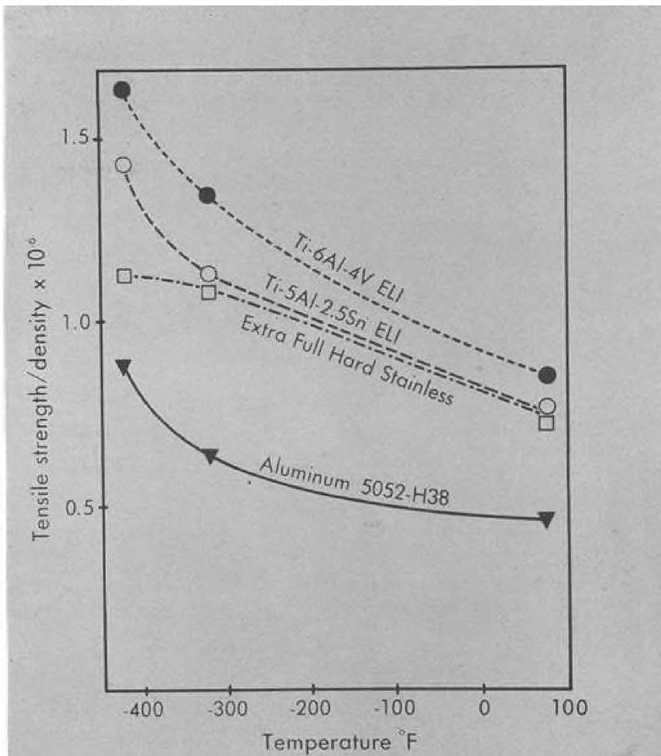
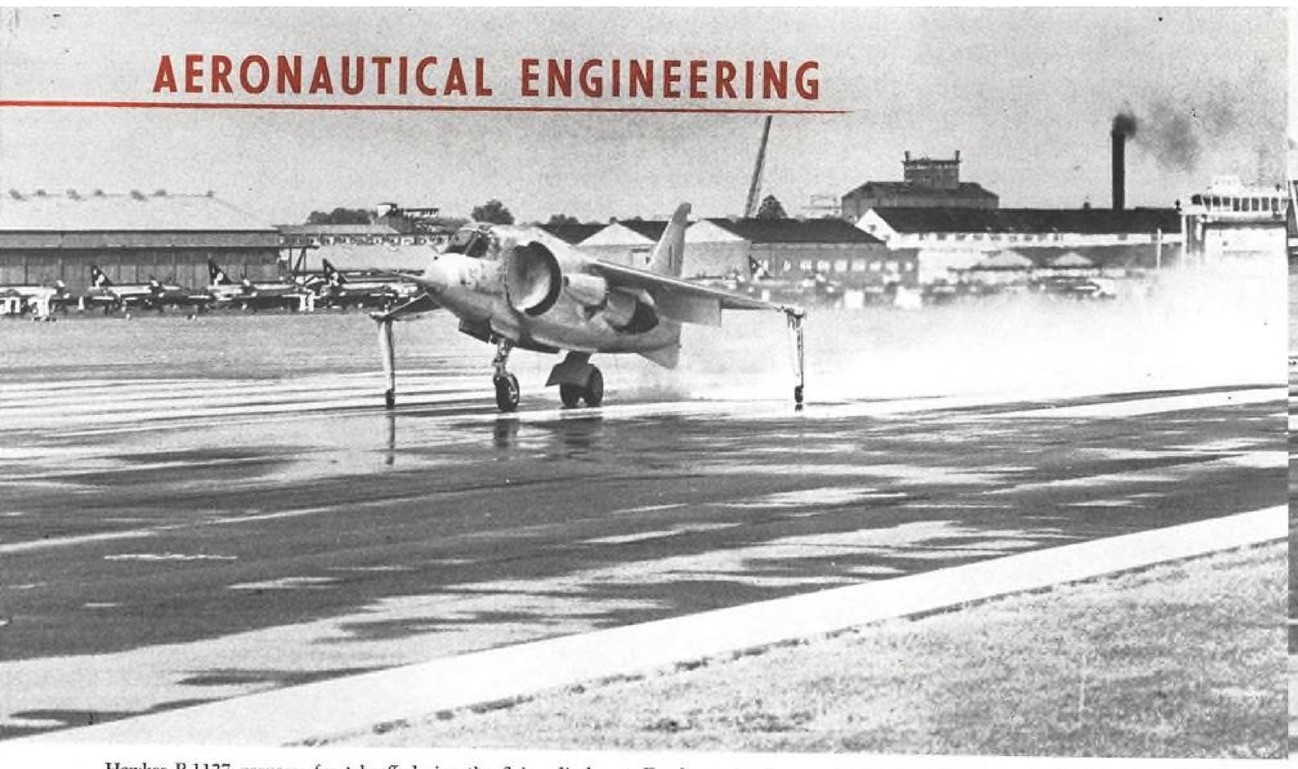


Comparison of strength-to-weight ratios of aluminum, stainless steel and titanium

Figure 1. Curves show superiority of new ELI grades of titanium to stainless steel and aluminum, on a strength-to-weight basis. Called Ti-5A1-2.5Sn ELI and Ti-6A1-4V ELI (for extra-low interstitials) the new cryogenic titanium grades also retain toughness at low temperatures and impermeability to hydrogen.

Largest titanium assembly ever made, the 7,000 gallon test vessel designed and produced by Beech Aircraft, measures 8 feet in diameter by 24 feet in length.

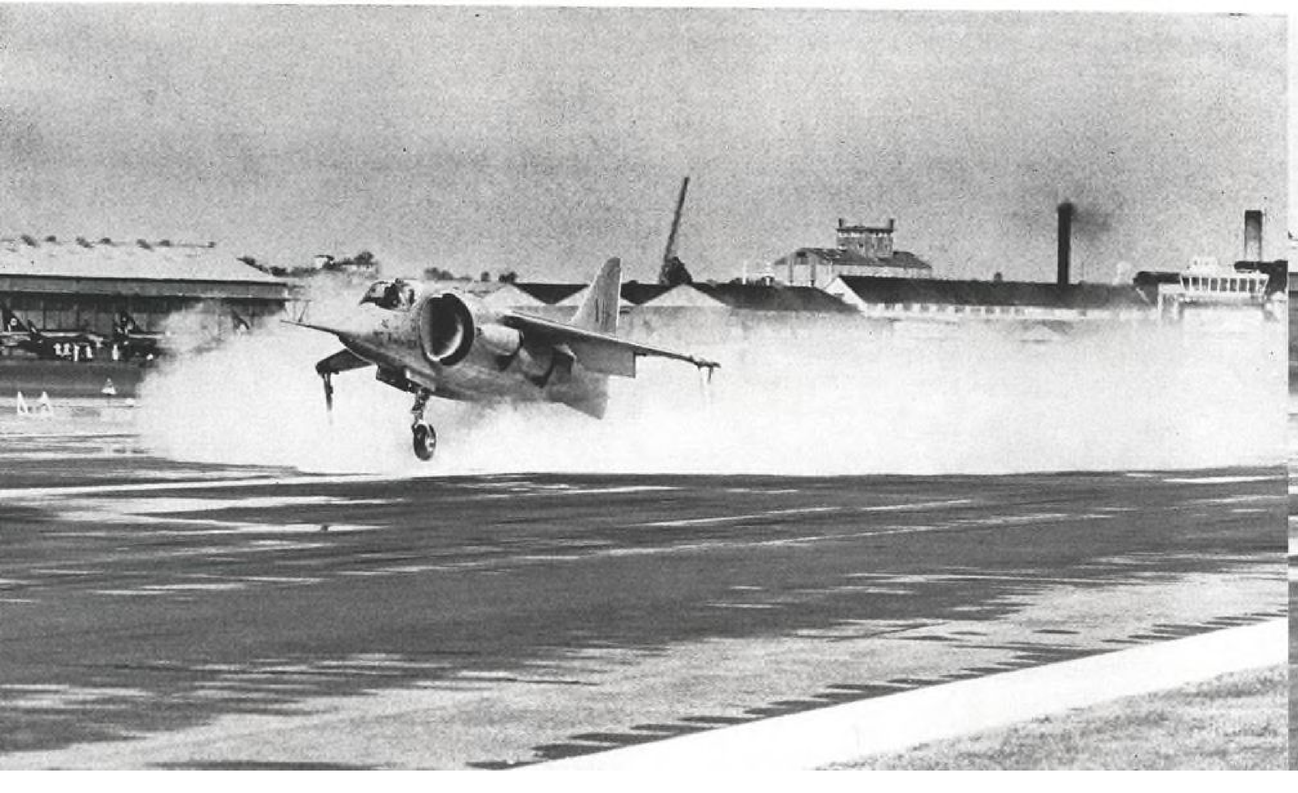


Hawker P.1127 prepares for takeoff during the flying display at Farnborough. Run up of the 12,300-lb.-thrust Bristol Siddeley BS.53 powerplant can be accomplished with the nozzles in the horizontal position, minimizing blast-effect erosion problems.

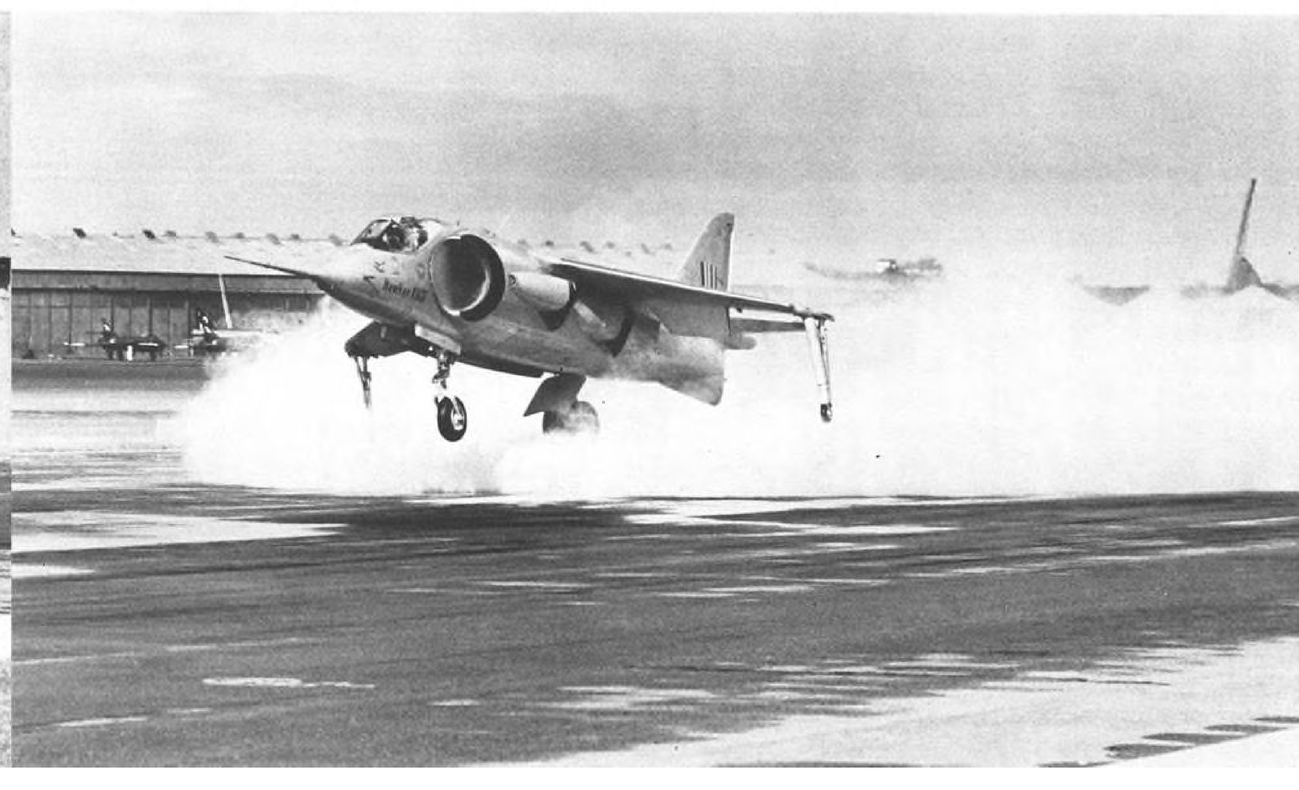
As the four outlet nozzles of the BS.53 are swiveled downward, the P.1127 begins its vertical takeoff. Here, the outrigger gear on the right wingtip has just lifted from the runway. Spray is due to water on the runway.

Hawker P.1127 VTOL Strike Fighter Demonstrates Vertical Takeoff at Farnborough Flying Display

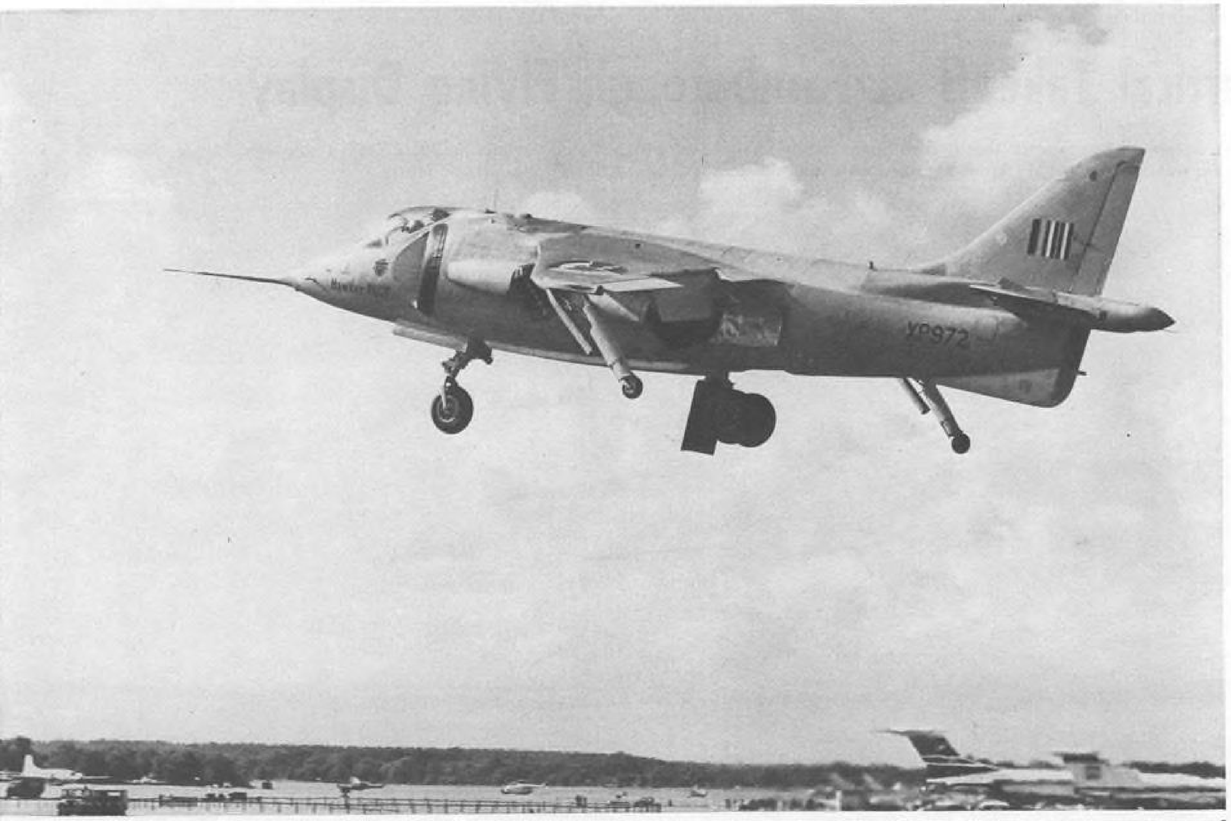
With nozzles in the full down position, the nose wheel leaves the ground. Spray provides an indication of the flow pattern of the deflected thrust. In the background are English Electric Lightnings of Royal Air Force No. 74 Squadron.



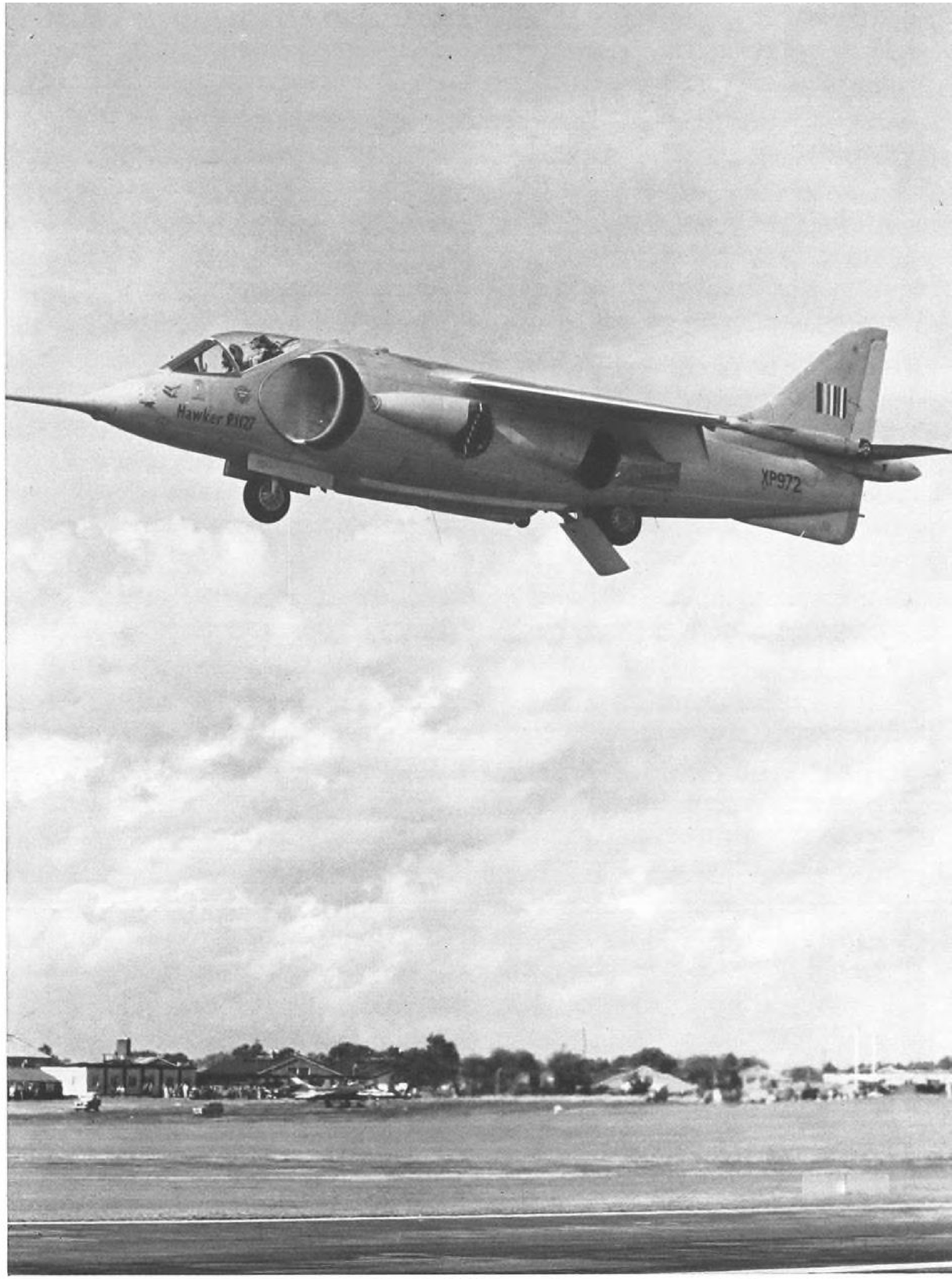
Main landing gear beneath the fuselage begins to lift from the ground as the pilot rotates the P.1127 into a nose-high attitude. Photos are a sequence of a single takeoff, but were taken from different positions with several cameras.



Fully airborne, the P.1127 begins its vertical ascent for transition to horizontal flight. Inflatable engine air intake lips are in fully extended position. Lips change intake contour from a sharp edge to a rounded shape to provide more efficient airflow during hovering.



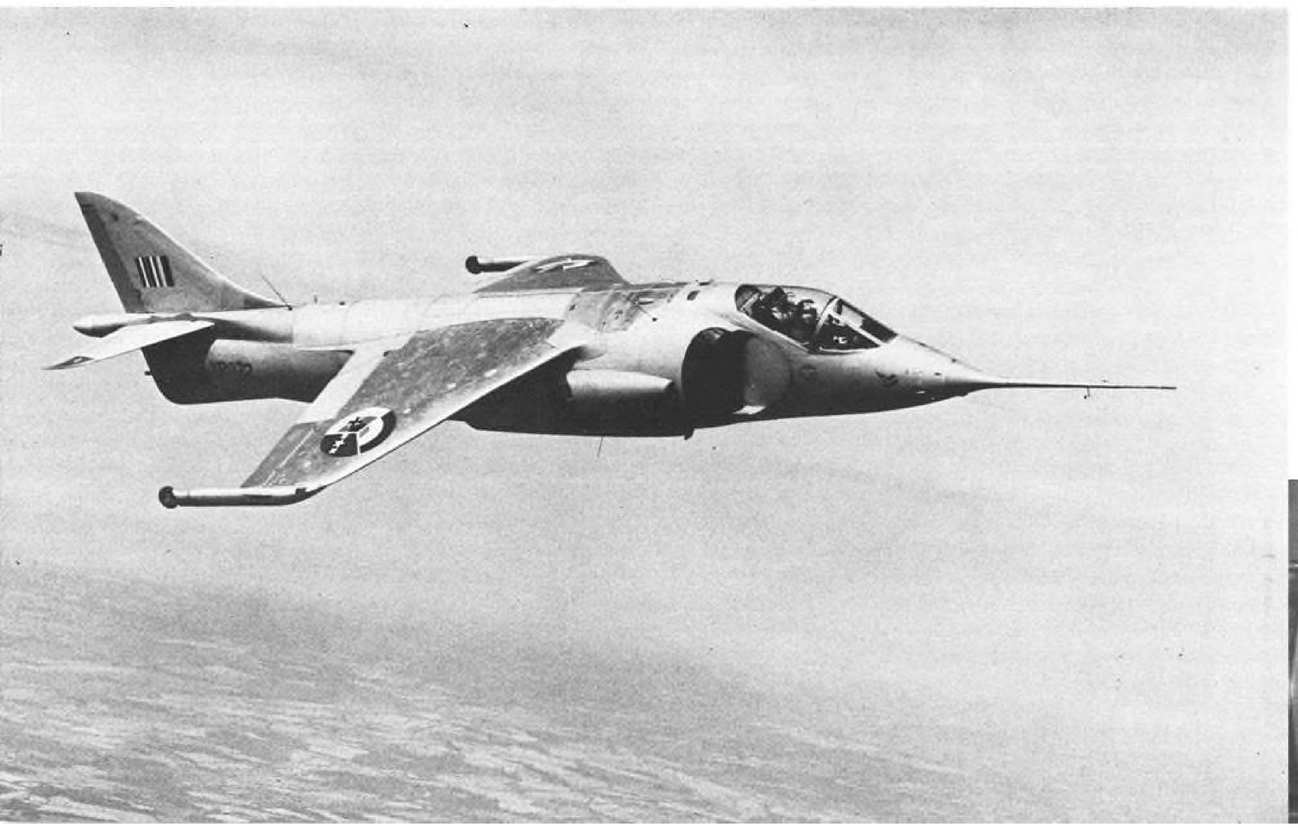
Still in vertical ascent, the pilot begins to retract the outrigger gear on each wingtip of the P.1127. Unique insignia on wings and tail is a combination of the markings of Britain, U. S. and West Germany, all of which have contributed development funds.

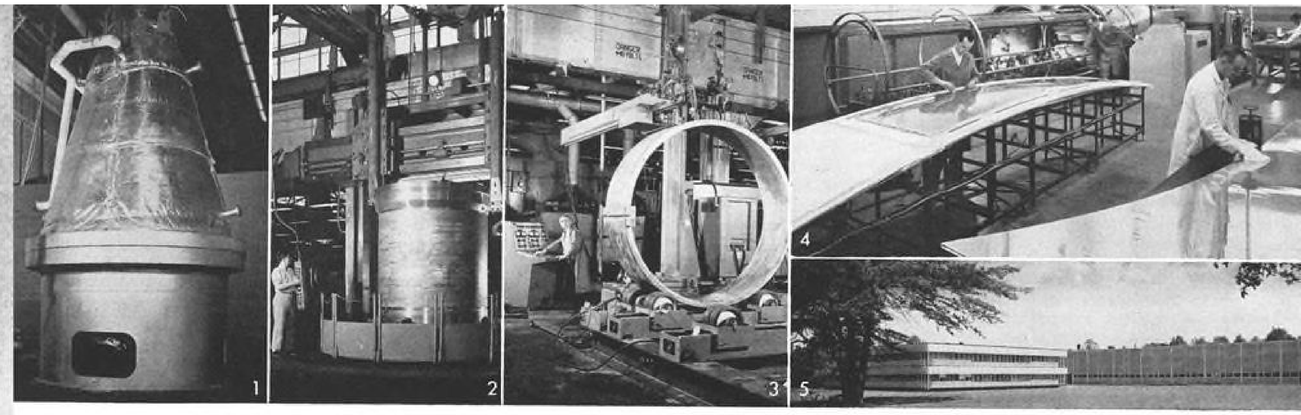


Nose gear and main gear disappear into their respective wells as the P.1127 prepares for transition from vertical to horizontal flight.

Swinging away and around after gear is fully retracted, P.1127 pilot begins swivelling the BS.53 nozzles back to the horizontal position for conventional flight and, moments later, a low-altitude high-subsonic pass over the field.

Air-to-air photograph of the P.1127 shows general inflight configuration as well as wing planform and cockpit arrangement.





EXISTING FACILITIES for initial requirements: (1) Tapco hydroclave forms large rocket nozzles; (2) Machines like this Betts have capacity to machine the 120"; (3) Welding of 120" metal structure done on these units that handle nuclear reactor cores; (4) The same honeycomb techniques developed for Sunflower will be used on big nozzle programs; (5) Adjacent to production, Tapco's Colwell Materials Research and Engineering Center acts as materials evaluator, process and quality control.

TAPCO "scales up" for big-booster nozzles

Now manufacturing the largest nozzle ever built for solid rocket boosters

Tapco is installing facilities to fabricate nozzles for various programs for big solid boosters in sizes ranging from 120″ to 260″. Various nozzles specifically for the 120″ engine programs will be completed this year with in-house facilities.

Thus, a long-time propulsion-component subcontractor moves with the rocket industry into its new era of colossal dimensions.

One of the most diversified supplier backgrounds in industry qualifies Tapco to make the transition . . . to enter production of big nozzles confident of meeting every requirement of the primes. And that background is this:

Materials: Personnel of the Colwell Materials Research and Engineering Center provide the knowledge and control of materials assisting in the design and for quality assurance and reliability of the end product. This has been demonstrated on nozzle programs including Minuteman, Polaris, Scout, Pershing and the Large Solid-Booster program.

Plastics Processing: Understanding of all nozzle-fabrication methods. From nozzle and special-product programs, Tapco has acquired first-hand experience with hydroclave, autoclave, high-pressure die molding, and tape and filament winding.

Machining & Welding: Large-component experience from production of huge nuclear reactor cores whose dimensions and quality requirements parallel big nozzles.

Honeycomb: Development of honeycomb structures as demonstrated by the 32-foot solar collector for the Sunflower system.

Logistics: In-house design and fabrication of special handling equipment from broad GSE experience with ballistic missile transporter-erector-launchers.

Inherent in this diverse activity is the experience of *program control* . . . planning, scheduling, routing, inspecting, liaison . . . for the efficient and economical delivery of reliable components.

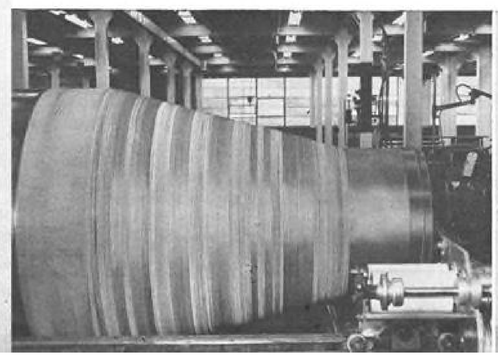
It is this background that enables Tapco to proceed with the production of a full-scale 120″ solid-propellant booster nozzle.

It is this experience that enables Tapco to plan in detail the "mass production" of 120″, 156″ and 260″ solid-propellant booster nozzles.

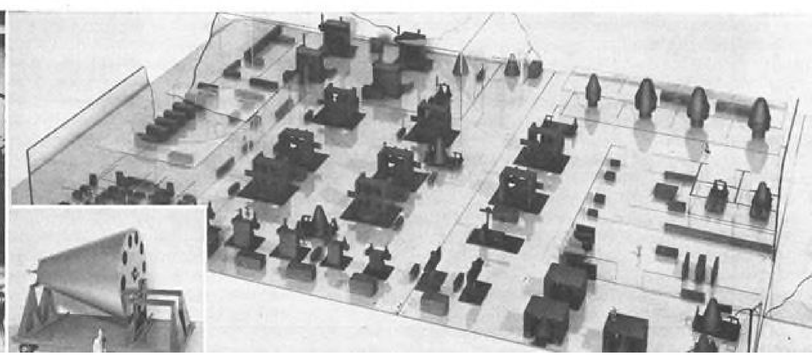
And it is this experience which permits Tapco to suggest that mass production can be reduced to a relatively simple "under one roof" undertaking *. . . at vast savings to the large booster programs.*

TRW **TAPCO** a division of
Thompson Ramo Wooldridge Inc.
23555 EUCLID AVENUE CLEVELAND 17, OHIO

FABRICATION of large solid-propellant rocket nozzles at Tapco.



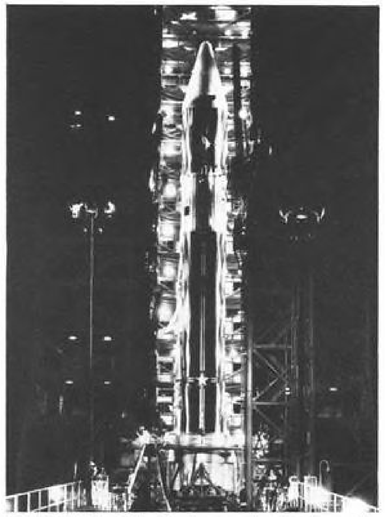
"MASS PRODUCTION" is short step ahead: Three-dimensional detail of large-nozzle production facility. Inset shows vehicle developed by Tapco to route hydroclave mandrels.



POLARIS—called "America's mightiest war deterrent"—relies on Librascope for target data-input units, ship's position-interpolation units, missile-motion units, guidance-correction input panels, alignment units, and erection units. Like the rest of the Polaris weapon system, these units were delivered ahead of original schedule.

ASROC—The computer which directs firing of the Navy's antisubmarine rocket weapon system, a mainstay of U.S. defense. It is one of the latest of 11 major Librascope contributions to ASW dating from 1940. Many of the underwater fire control systems in the Navy's antisubmarine fleet today were designed and/or built by Librascope.

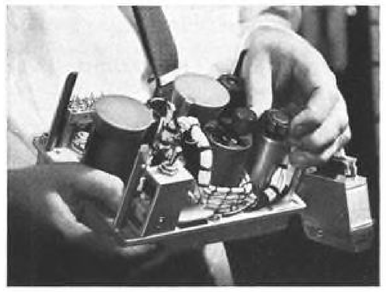
PENTAGON—After 1963, this Librascope multiple-computer system, a key subcomplex of USAF's 473L command-and-control system, will support U.S. global strategy. One of many new, large-scale computing complexes with which Librascope serves the growing needs of business management, science, and the defense establishment.

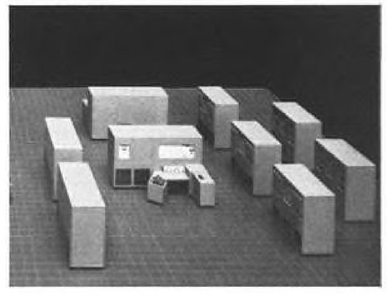


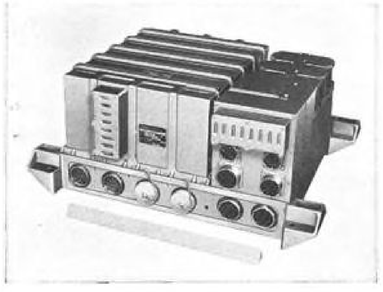
CENTAUR—The first computer designed to guide an exploratory instrument package to a soft landing on the moon will be carried aloft inside NASA's Atlas/Centaur spacecraft. One of the smallest and lightest general-purpose digital computers known, it is typical of many environmentally designed Librascope computers for space vehicles and missiles.

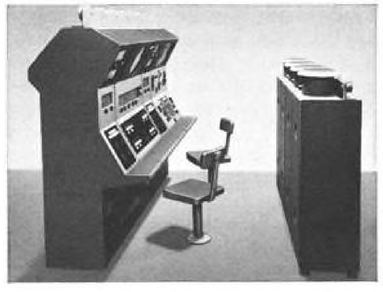
SUBROC—Fire control for the Navy's first four-phase ASW weapon system is furnished by this Librascope digital computer. It directs the complex target approach pattern of a subsurface-to-subsurface weapon with four modes of operation on every shot: underwater launching, atmospheric boost-glide trajectory, water re-entry and target contact.

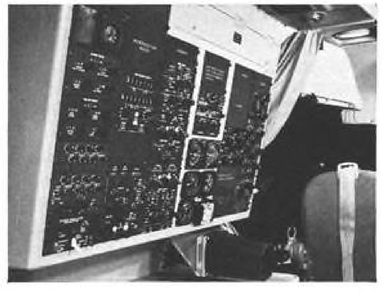
AIRLIFT—This Librascope navigation/data-processing system will participate in global airlift missions aboard the C-141 turbofan transport. Inputs: heading reference, air data, TACAN, LORAN, radar celestial tracker. Outputs: to autopilot, flight-director computer, attitude director/indicator, horizontal-situation indicator, heading/bearing/distance indicator.











HOW LIBRASCOPE COMPUTERS AND DATA-PROCESSING SYSTEMS SERVE ADVANCED PROJECTS

From tactical weapon control to space research to Pentagon strategy, some of the nation's most advanced military and scientific projects depend on Librascope equipment for data interpretation and the control of weapons and operations. Dependability of performance is steeped in the maturity of Librascope experience that dates from the earliest years of computer technology. Above are examples of electronic and electromechanical nerve centers produced by Librascope for systems in today's news. □ The needs of commerce and industry, too, are met by a wide variety of computers developed and produced by Librascope for scientific and engineering studies, operations analysis, product research, industrial process control, and air traffic control. □ Whether your project is industrial, military, or government, consider taking your computer-control, data-processing requirements to the developers of many major operational systems.

LIBRASCOPE DIVISION
GENERAL PRECISION
808 Western Avenue, Glendale 1, California

G2-552

P3V-1 Range Improves Patrol Capability

By Larry Booda

Patuxent River, Md.—Fuel capacity of the production version of the Lockheed P3V-1 Orion turboprop-powered anti-submarine aircraft, accepted by the Navy here recently, will enable it to fly 14- to 18-hr. patrols covering more than 11,000 naut. mi. It will be able to carry a greater load of detection gear and weapons than any aircraft ever developed by the Navy.

First increment of three P3V-1s was delivered to Patrol Squadron Eight (VP-8) here at the Naval Air Test Center. By the end of September, the squadron will have its full complement of 12 aircraft, replacing the Lockheed P2V-7 Neptune, the latest of a model series that has seen service in the fleet since 1948.

Funding for the P3V in Fiscal 1962 was $198 million for 42 aircraft. For Fiscal 1963, this has been increased to $225.1 million for 48 aircraft.

Range capability of the Orion is so great that the Navy is planning to try to break the world straight line unrefueled flight distance record this fall. The record, 12,519 stat. mi., is now held by an Air Force Boeing B-52. Under straight flight optimum conditions, the Navy hopes that the P3V-1 will be able to fly about 15,000 stat. mi. Before the B-52 record was set, the unrefueled distance record had been held for 15 years by the Lockheed P3V-1 Truculent Turtle.

In addition to greatly improved range, speed, detection and kill capabilities, Navy officers said, the P3V-1 provides a measure of crew comfort that will make the operation more efficient during the long patrols. The fuselage is roomy enough to be uncluttered despite a mass of electrical, electronic and other gear. Crew members do not need to wear pressurized flight suits or crash helmets.

A normal crew is 10, rotating at the operating positions. For training purposes until all aircraft have been delivered, the crews will range from 12 to 14. A large crew rest area at the aft end of the fuselage contains two bunks and a galley equipped to heat frozen foil-wrapped meals.

The hunter-killer functions of the Orion will be controlled from a five-place panel along the left side of the fuselage over the wing root area. Normally this will be manned by one officer and four enlisted technicians.

Highly sensitive radar will be used for long range intercept of snorkeling submarines. In the event that the submarine continues to snorkel a homing torpedo would be used for the kill.

If the submarine submerges, a pattern of sonobuoys would be dropped which would transmit the sound of submarine propellers to the aircraft. An automatic computer would coordinate these sounds and give navigation directions to enable the aircraft to approach for a kill.

Sonobuoys are stored in racks on each side of the fuselage aft of the operating positions. Nine sonobuoys in one series can be dropped through a retractable door in the floor of the center of the fuselage between the racks. This would be done in low altitude flight when the cabin is unpressurized. Another opening provides for dropping a single sonobuoy when the cabin is pressurized. This would be used for preliminary detection while the aircraft was descending from a high cruising altitude.

A bomb bay is located under the nose and cockpit section of the aircraft, creating the appearance of a faired bulge ahead of the wing on the underside of the fuselage. It can carry conventional depth charges, the Lulu nuclear depth charge and homing torpedos.

There are four pylons on the under-

S-62A Will Transport Thailand Officials, Dignitaries

Sikorsky S-62A single-turbine, 10-passenger helicopter will be delivered shortly to the Thailand Police Department for use in transporting government leaders and dignitaries. Helicopter is painted maroon, gray, red and white. Second S-62A has been ordered by Thailand police for search and rescue operations and troop transport. Both will be stationed at Gulf of Thailand near Bangkok.

side of each wing, three under the outer wing panel and one between the inboard engine and the fuselage. The outboard pylons can carry a variety of weapon stores, including Zuni rockets, rocket pods and torpedos. Conventional depth charges are no longer carried on pylons. The inboard pylons cannot carry rockets because the propeller arcs block the forward view.

A searchlight hangs under the right wing tip on its own pylon. Electromagnetic countermeasures (ECM) gear is located in each wing tip.

A boom protruding from the tail of the aircraft contains the magnetic anomaly detection (MAD) gear. This is used for low altitude localization when the submarine position has been generally determined. It acts as a back-up system to the sonobuoys.

In some respects the P3V-1 is an outgrowth of the commercial Lockheed Electra. It is powered by four Allison T56-A-10W turboprops rated at 4,050 hp. each dry for takeoff and at 4,500 hp. with water-alcohol injection. Propellers are Hamilton Standard, 13.5 ft. in diameter. The Electra has less powerful Allison 501-D13 engines.

The Navy specified more stringent requirements for the aircraft to enable higher loadings in some areas. This includes stronger wings and other structural strength modifications. The P3V must be able to withstand 3g in turns and pullouts instead of the Electra's 2½g. Engine nacelles are mounted 2 in. higher and the thrust lines of the inboard engines are inclined slightly higher to eliminate shock waves from propellers beating against the fuselage.

Leading edges of the elevator and rudder surfaces are electrically heated for anti-icing purposes. The Electra uses hot air bleed from the engines. Leading edges of the wings of both are heated with hot air.

Generally speaking, the fuselage planform is the same as the Electra, having the same contours, with the exception of the bomb bay. Since the bomb bay area is not pressurized, a pressure deck had to be designed. Nevertheless, the vertical web strength structure remained the same in this area, extending through the pressure deck. Most of the Electra's major fuselage tools are being used in production of the P3V.

Gross weight of the P3V is 127,500 lb., versus 116,000 for the Electra.

In order to accommodate more fuel, the wing sections over the wheel wells were converted into tanks and the wing section under the fuselage was similarly modified, giving the P3V a "wet" wing from tip to tip.

Tanks No. 1 and 2 are in the left wing and No. 3 and 4 in the right wing. The center tank is No. 5, including a bladder cell located forward of the front wing beam and aft of the bomb bay. On the right side between these two sections of Tank Five is a 300-gal. tank for the water-alcohol mixture.

A hydraulic service center is located just forward of the rear section of the fuselage under the floor. It is pressurized and accessible in flight. It contains the main reservoirs and associated plumbing.

The main electrical center is located on the right side of the fuselage opposite the five operating positions. It is designed with three buses, two of which are in operation at any one time. In the event of failure of one, switching is automatic to the standby bus, the change being indicated on the engineer's panel.

Power is furnished by three General Electric 60 KVA alternators on engines two, three and four. This is one less than the Electra. Power demands for interior fuselage heating of the Electra account for the difference.

The cockpit is about the same as the Electra. The flight engineer's position is between the two pilots. In an emergency, the plane can be operated by the pilots alone. The control system is servo boosted. Cables of the control system are tensioned automatically.

An Eclipse-Pioneer PB-20 autopilot offers a disconnect provision when pressure is applied to the ailerons or elevators. It also provides altitude holding from the radar altimeter.

Spirale 3 Support

Paris—French government has abandoned its support of the Dassault Spirale 3 twin-turboprop transport due to lack of credit caused by financial drains imposed by the French air force's nuclear strike force program.

The Dassault aircraft was selected earlier this year in an air force competition for a small transport (AW Feb. 19, p. 41). French air force had earmarked $36 million for the project.

The first prototype was scheduled to fly next year.

Rotary Sales

Rotary wing aircraft commercial sales and deliveries by Bell Helicopter Co. and its Italian and Japanese manufacturing licensees totaled $9.6 million and 111 units in the first six months of 1962 compared with 90 helicopters valued at $6.8 million delivered in the same period last year. Turbine-powered Model 204B (HU-1B) was calculated for the first time in sales reporting. Commercial sales tallies include both those to civil customers and to foreign military forces not handled through Mutual Defense Assistance Pact funding.

NAVY AND FEDERAL AVIATION AGENCY test pilots are flying Cornell Aeronautical Laboratory's variable stability Douglas B-26 under programs funded by the two services. During in-flight demonstrations, pilots learn to recognize and identify stability and control forces that, in combination, make an aircraft behave in its characteristic fashion. The probe extending from the nose of the aircraft is an angle of attack vein that is used for measuring angle of attack and rate of change.

B-26 Will Simulate Supersonic Transport

By David H. Hoffman

Buffalo, N. Y.—Variable stability aircraft, which Cornell Aeronautical Laboratory is using here to teach pilots more about the intricacies of aerodynamics and control forces, may prove valuable in the development of a safe and easy to fly U.S. supersonic transport.

To date, 103 students at the Navy Test Pilot School have taken short courses on variable stability and control in a Douglas B-26 modified by Cornell. Ten Federal Aviation Agency engineering test pilots, whose job it is to certificate new aircraft or major modifications, have just completed more elaborate courses of instruction involving eight flight hours in the aircraft.

To study the problems of re-entry, all seven of the X-15 pilots flew a Lockheed T-33 instrumented for variable stability by Cornell.

This fall, Cornell's variable stability B-26 will be flown to National Aeronautics and Space Administration's Ames Research Center in California and used there to gather data on supersonic transport handling qualities. This contract program will attempt to determine whether NASA's ground-based simulators accurately can predict how various supersonic transport designs will respond for a pilot during approach and landing.

When the typical pilot manipulates the controls of an aircraft and is not satisfied with its response, he often cannot explain why in terms an engineer finds meaningful. Should this breakdown in communications occur after a military or FAA engineering test flight, the consequences could prove to be disastrous.

To dive, the average pilot instinctively pushes the stick forward. He makes a mental note of his plane's performance—rating it good, fair or bad. But rarely does he consciously assess how much force was required to move the stick X distance, how rapidly the aircraft responded, how much stick travel produced this response, whether the nose bobbled or oscillated as it fell through the horizon, or whether his dive angle steepened slightly despite a constant stick pressure.

The value of the variable stability aircraft is that it can train a pilot to evaluate each of these and other motions, all of which usually occur in an instant.

As this AVIATION WEEK pilot learned during a 2-hr. flight in the B-26 here, it does this by simulating singly and then in combination the mixture of motions described by an aircraft when it is disturbed from straight and level flight. Gifford Bull, the Cornell engineer-pilot in the right seat during the demonstration, made the B-26 behave like a dozen different aircraft. They ranged in type from a Century Series fighter at high altitude to a large transport with its center of gravity displaced beyond tolerances.

The variable stability concept is not new, nor does Cornell have a monopoly on such aircraft. Its B-26, which has variable stability only around the pitch axis, was converted in 1951. NASA has engineered similar aircraft.

But Cornell, now working on its seventh variable stability conversion, has sold the idea not only as a means of evaluating aircraft handling qualities in flight, but also as a flying classroom to improve a test pilot's grasp of aerodynamic fundamentals.

To convert an aircraft for variable stability, engineers first disconnect the mechanical linkage between the left or right-side controls in the cockpit and the primary control surfaces. Servos are then installed at each end, with one set driving the control surfaces and another the pilot controls.

When the pilot applies a force—to move the elevator, for example—strain gages generate an electric signal that causes the attached servo to move a proportional distance. This signal is relayed to a control surface servo, which

PRECISION SPECIALS

. . . an integral part of SPS fastener capabilities

Unmatched depth in design and design evaluation, in production facilities and quality control, in important auxiliary capabilities—everything that makes SPS the prime source for standard precision fasteners qualifies it equally well as the most reliable source for specials.

Worlds removed from a "me-too" capability, specials represent a significant portion of SPS design, development and production. And understandably so for a pioneer in an industry that is moving as fast and as far into new fastening environments. In fact many current SPS standards—particularly in exotic metals—were themselves specials only a brief time ago.

SPS urges that where you have a unique requirement in fasteners (or similar hardware), you contact the SPS design group as soon as your thinking clearly indicates the need for it. Our constant research in the fields of high temperatures, cryogenics, high tensile and shear, fatigue, stress rupture, stress relaxation, and corrosion may well save you time and money in arriving at the optimum solution to your need.

Remember also that whether your requirement is for specials or for standards, our entire plant and facility—in all locations—is open for quality surveillance and ratings by our customers. This is so because SPS believes that the only reliability assured the buyer of aerospace fasteners is the methods of manufacture and certification of his supplier.

Titanium fasteners in any configuration—with 2 weeks' delivery if necessary—indicate SPS specials capabilities in exotic metals.

Apex torsion link for aircraft landing gear and a tie rod for turbine wheel suggest range of SPS specials available to you.

Many manufacturers could machine this special. But it is doubtful if anyone but SPS could forge it and fully certify its reliability.

MAXIMUM OPERATING TEMPERATURE (°F)			
to 1600°	SPS high-temperature fastener capabilities by no means stop at 1600°F, though beyond this point the product becomes specialized. For service at higher temperatures, SPS has already produced forged tungsten bolts in quantity and is prepared to develop and supply threaded parts in the full range of refractory metals. If your threaded fastener requirements involve cryogenic environments, here too SPS can offer knowledge gained from much original research. Our complete design, testing and pilot plant facilities—second to none in the industry—are available to help you solve problems peculiar to fastening at extreme low temperatures.		
to 1200°		NAS 501 Series Companion Locknut: SPS 99 F 12	
to 900°	NAS 560 Series (CRES steel) Companion Locknut: SPS FN 1014		NAS 560 Series (A-286) Companion Locknut: SPS FN 1014
ROOM	MS 15992 through MS 16004 (aluminum) MS 24671 and MS 24672 Series (CRES steel) Companion Locknut: SPS 59 FS BHS 12 Series AEC Beryllium Alloy Companion Locknut: SPS 56426 Series BFT 12 Series AEC Beryllium Alloy Companion Locknut: SPS 56426 Series BFH 12 Series AEC Beryllium Alloy Companion Locknut: SPS 56426 Series AN 3DD-AN 20DD Series Companion Locknut: SPS 75 FS AN 173DD-AN 186DD Series Companion Locknut: SPS 75 FS	MS 24673 and MS 24674 Series Companion Locknut: SPS 59 FS MS 35461 Series Companion Locknut: SPS 59FA or FN 1014 NAS 428 Series Companion Locknut: SPS FN 12; 22 FT NAS 1216 Series (CRES steel) NAS 1217 Series (CRES steel) NAS 1218 Series (CRES steel) NAS 1219 Series (CRES steel) NAS 1220 Series (CRES steel) NAS 1221 Series (CRES steel) AN 23 through AN 36 Series Companion Locknut: SPS FN 12 NAS 1297 Series Companion Locknut: SPS FN 12 NAS 1298 Series Companion Locknut: SPS FN 12 NAS 1299 Series Companion Locknut: SPS FN 12	MS 16637 and MS 16638 Series MS 24667 through MS 24670 Series (alloy steel) Companion Locknut: SPS 22 FS NAS 333 through NAS 340 Series Companion Locknut: SPS FN 12 NAS 464 Series Companion Locknut: SPS FN 12 NAS 583 through NAS 590 Series Companion Locknut: SPS FN 12 NAS 653 through NAS 658 Series (titanium) NAS 663 through NAS 668 Series (titanium) NAS 673 through NAS 678 Series (titanium) NAS 1083 through NAS 1088 Series (titanium) NAS 1103 through NAS 1120 Series Companion Locknut: SPS FN 12 NAS 1121 through NAS 1128 Series NAS 1131 through NAS 1138 Series NAS 1141 through NAS 1148 Series NAS 1151 through NAS 1158 Series NAS 1161 through NAS 1168 Series NAS 1171 through NAS 1178 Series NAS 1181 through NAS 1188 Series NAS 1189 Series NAS 1190 Series NAS 1191 Series
MINIMUM TENSILE Room Temperature	50,000-74,000 psi	75,000-84,000 psi	85,000-99,000 psi
MINIMUM SHEAR Room Temperature	50,000-74,000 psi	75,000-84,000 psi	85,000-99,000 psi

SPS

DESIGNERS' GUIDE TO ENVIRONMENTAL FASTENING

with NAS, AN and MS Standards (listed) and SPS Standards (illustrated)

Higher stresses, higher temperatures, plus today's punitive cost for excess weight—all these call for increasingly precise fastener selection by the aerospace designer. To save you time in such selection, SPS here shows virtually the entire range of removable mechanical fasteners, plotted in terms of the two most critical and inseparable environmental factors affecting every aerospace assembly: stress and temperature.

90% of aircraft/missile fastener failures result from fatigue, often because of failure to fully allow for elasticity in certain bolted assemblies (as in fastening aluminum with steel bolting or where gaskets are used). In designing such joints, it is imperative to allow for compression of the jointed material, for this transfers to the bolt a load in addition to its initial preload.

NOTE: Tension fasteners are listed in black type
Shear fasteners are listed in red type

To Insure Proper Preload—SPS Fastening Systems

For joints above 200,000 psi, design must go beyond the bolt—must include a foolproof means of developing proper preload, of maintaining it, of eliminating fatigue. One sure solution is through use of SPS Certified Fastening Systems for 220-, 260-, and 300,000 psi. These comprise matched high-strength bolts and locknuts; special wrenches capable of developing full preload without defacing the fastener drive; and Preload Indicating (PLI) Washer assemblies—the most accurate method of measuring preload and assuring maximum clamping power.

Government Standards and Specifications (abbreviations)

MS—Military Standards
NAS—National Aircraft Standards
AN—Air Force/Navy Aeronautical Standards
AMS—Aeronautics Material Specifications

Threaded Bolt Head Styles

12-Point
Fillister
Flush Head
Brazier
Hexagonal
MS Type
Crown
Pan

Fastener Wrenching Recesses

Phillips
Hex Socket
Torq-Set[1]
Hi-Torque[2]

[1]U.S. Pat. No. 2,847,894 (and other U.S. patents; also foreign)

[2]U.S. Pat. Nos. 2,677,985 and 2,745,120 (and other U.S. patents; also foreign)

MS 20033 through MS 20046 Series
Companion Locknut: SPS 99 F 12

119 FW Series
A-286, Silver Plate
Sizes: #10 through ¾ in.

AN 3C-AN 20C Series (800°F)
Companion Locknut: SPS FN 812

MS 9033 through MS 9039 Series
Companion Locknut:
SPS FN 1216 or 119 FW

MS 9060 through MS 9066 Series
Companion Locknut:
SPS FN 1216, 119 FW

MS 9187 and MS 9188 Series

MS 9224 Series
Companion Locknut:
SPS 1216 or 119 FW

MS 21277 through MS 21294 Series

NAS 1003 through NAS 1020 Series
Companion Locknut: SPS 99 F 12

MS 9177 and MS 9178 Series

EWSB 922 Series
5% Chrome Alloy Steel,
Diffused Nickel-Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 922

SFT 922 Series
5% Chrome Alloy Steel,
Diffused Nickel-Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 922

SFH 922 Series
5% Chrome Alloy Steel,
Diffused Nickel-Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 922

MS 21043 Series
(FN 1014) (1000°F Locknut)

NAS 1291C Series
(FN 1014 and FN 812 Locknuts)

EWB 1615 Series
Udimet-500; M-252; R-235; Waspaloy
Sizes: #6-40 through 1½-12

BE 1615 Series
Udimet-500; M-252; R-235; Waspaloy
Sizes: #6-40 through 1-14

EWSB 926 Series
5% Chrome Alloy Steel,
Diffused Nickel-Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 926

SFT 926 Series
5% Chrome Alloy Steel,
Diffused Nickel-Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 926

SFH 926 Series
5% Chrome Alloy Steel,
Diffused Nickel-Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 926

EWSN 922 Series
Alloy Steel (AMS 6304),
Diffused Nickel-Cadmium Plate
Sizes: #10 through ⅝ in.

FN 1216 Series
A-286, Silver Plate
(Featherweight)
Sizes: #10 through ⅜ in.

NAS 1291C Series
(FN 812) (800°F Locknut)

FN 1418 Series (14
(Featherweight)
Waspaloy, Silver Pl
Sizes: #10 through

EWB 1218 Series
CRES Steel
Sizes: #10-32 thro
Companion Locknu

FN 920 Series (Fea
(200,000 psi)
Alloy Steel, Diffused
or Silver Plate wit
Everlube 810‡
Sizes: #10 through

NAS 1202 through NAS 1210 Series
Companion Locknut: SPS FN 12

NAS 1216 Series (alloy steel)

NAS 1217 Series (alloy steel)

NAS 1218 Series (alloy steel)

NAS 1219 Series (alloy steel)

NAS 1220 Series (alloy steel)

NAS 1221 Series (alloy steel)

NAS 1243 through NAS 1250 Series
Companion Locknut: SPS FN 12

NAS 1253 through NAS 1260 Series
Companion Locknut: SPS FN 12

NAS 1261 through NAS 1265 Series
(titanium)

NAS 1303 through NAS 1320 Series
Companion Locknut: SPS FN 12

NAS 1503 through NAS 1510 Series
Companion Locknut: SPS FN 12

NAS 1603 through NAS 1610 Series
Companion Locknut: SPS FN 12

NAS 1620 through NAS 1628 Series
Companion Locknut: SPS FN 12

NAS 1630 through NAS 1634 Series
Companion Locknut: SPS FN 12

NAS 1703 through NAS 1710 Series
Companion Locknut: SPS FN 12

NAS 2903 through NAS 2920 Series
Companion Locknut: SPS FN 12

NAS 3003 through NAS 3020 Series
Companion Locknut: SPS FN 12

MS 9088 through MS 9094 Series
Companion Locknut: SPS FN 12

MS 9122 and MS 9123 Series
Companion Locknut: SPS FN 12

MS 9146 through MS 9152 Series
Companion Locknut: SPS FN 12

MS 9157 through MS 9163 Series
Companion Locknut: SPS FN 12

MS 9169 through MS 9175 Series
Companion Locknut: SPS FN 12

MS 9183 through MS 9186 Series
Companion Locknut: SPS FN 12

MS 9189 through MS 9192 Series
Companion Locknut: SPS FN 12

MS 15992 through MS 16004 Series
(alloy steel)

MS 20073 and MS 20074 Series
Companion Locknut: SPS FN 12

NAS 1096 Series
Companion Locknut: SPS FN 12

NAS 1292 through NAS 1296 Series
(René 41)

NAS 1322 through NAS 1326 Series
(René 41)

NAS 2803 through NAS 2810 Series
Companion Locknut: SPS FN 12

AN 3 through AN 20 Series
Companion Locknut: SPS FN 12

AN 73 through AN 81 Series
Companion Locknut: SPS FN 12

AN 173 through AN 186 Series
Companion Locknut: SPS FN 12

AN 173C-AN 186C
Companion Locknut: SPS 99 F 12

AN 101001 through
AN 104600 Series
Companion Locknut: SPS FN 12

AN 104601 through
AN 108200 Series
Companion Locknut: SPS FN 812

EWSB 22 Series
5% Chrome Alloy Steel,
Cadmium Fluoborate Plate
Sizes: #10 through ⅝-18
Companion Locknut: SPS EWSN 22

SFT 22 Series
5% Chrome Alloy Steel,
Cadmium Fluoborate Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 22

SFH 22 Series
5% Chrome Alloy Steel,
Cadmium Fluoborate Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 22

MS 9316 and MS 9317 Series
Companion Locknut: SPS FN 920A

NAS 1100 Series (CRES steel)

NAS 1101 Series (CRES steel)

NAS 1102 Series (CRES steel)

NAS 1223 through NAS 1235 Series
(CRES steel)

NAS 1393 Series (CRES steel)

AN 148551 through
AN 149350 Series

EWSB 26 Series
5% Chrome Alloy Steel,
Vacuum Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 26

SFT 26 Series
5% Chrome Alloy Steel,
Vacuum Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 26

SFH 26 Series
5% Chrome Alloy Steel,
Vacuum Cadmium Plate
Sizes: #10-32 through ⅝-18
Companion Locknut: SPS EWSN 26

Hi Ti 55759 Series (NAS 624 Type)
Titanium Alloy—6A1-4V or 4A1-4 Mn
Sizes: ¼-28 through 1 in.-12

Hi Ti 200 through 216 Series
(MS 20004 Type)
Titanium Alloy—6A1-4V or 4A1-4 Mn
Sizes: ¼-28 through 1 in.-12

EWSN 22 Series
Alloy Steel, Cadmium Plate
Sizes: #10 through ⅝ in.

NAS 1292 through NAS 1296 Series
(H-11 alloy steel)

NAS 1322 through NAS 1326 Series
(H-11 alloy steel)

MS 20004 through MS 20024 Series
Companion Locknut:
SPS 42 FW or 42 FLW

MS 21042 Series (FN 12 Locknut)

MS 21262 Series

MS 24675 through MS 24678 Series
Companion Locknut: SPS 42 FW

MS 35455 through MS 35460 Series
Companion Locknut:
SPS 42 FW or 42 FLW

NAS 144 through NAS 158 and
NAS 172, 174 and 176 Series
Companion Locknut:
SPS 42 FW; 42 FLW; FN 22

NAS 563 through NAS 572 Series
Companion Locknut:
SPS FN 22; 42 FW; 42 FLW

NAS 608 and NAS 609 Series

NAS 1100 Series (alloy steel)

NAS 1101 Series (alloy steel)

NAS 1102 Series (alloy steel)

NAS 1223 through NAS 1235 Series
(alloy steel)

NAS 1266 through NAS 1270 Series
(titanium)

NAS 1271 through NAS 1280 Series
(titanium)

NAS 1291 Series (FN 12 Locknut)

NAS 1393 Series (alloy steel)

NAS 1402 through NAS 1406 Series
Companion Locknut: SPS FN 12

EWSB 30 Series
Ultra-High Strengt
Vacuum-Cadmiu
Sizes: #10-32 thro
Companion Locknu

SFT 30 Series
Sizes: #10-32 thro
Vacuum-Cadmiu
Companion Locknu

SFH 30 Series
Sizes: #10-32 thro
Vacuum-Cadmiu
Companion Locknu

UNBRAKO pHd‡ H
Alloy Steel, Plain or
Sizes #0 through 1

42 FW Series
Alloy Steel, Cadmiu
Sizes: ¼ in. throug

42 FLW Series (Lig
Alloy Steel, Cadmiu
without MoS_2
Sizes: ¼ in. throug

MS 21250 Series
Companion Locknu

NAS 624 through N
Companion Locknu
SPS FN 22; 42 F

85,000-99,000 psi	100,000-129,000 psi	130,000-149,000 psi	150,000 psi	160,000 psi, min.	180,000
85,000-99,000 psi	100,000-129,000 psi	132,000 psi, min.	156,000 psi, min.		180,000

00°F) ıte ½ in.			*T.M. Reg. U.S. Pat. Off., The Nylok Corp. †Everlube 810 Coating produced by Everlube Corp., N. Hollywood, Calif. ‡proper Head design (1960 Series) **SPS aircraft bolts can also be supplied as self-locking bolts**
ugh ½-20 t: SPS FN 1418			
therweight) Nickel-Cadmium h or without 3⁄8 in.	EWB TM 9 Series 5% Chrome Alloy Steel, Diffused Nickel-Cadmium Plate Sizes: #10-32 through 1½ in.-12 Companion Locknut: SPS EWN TM 9 LWB 922 Series (lightweight) 5% Chrome Alloy Steel, Diffused Nickel-Cadmium Plate Sizes: #10-32 through 1½ in.-12 Companion Locknut: SPS FN 922 EWN TM 9 Series Alloy Steel (AMS 6304), Diffused Nickel-Cadmium Plate Sizes: ¼ in. through 1½ in. FN 922 Series (Featherweight) Alloy Steel (AMS 6304), Diffused Nickel-Cadmium Plate Sizes: #10 through 1½ in. EWSN 926 Series Alloy Steel (AMS 6304), Diffused Nickel-Cadmium Plate Sizes: #10 through 5⁄8 in.	EWB 926 Series 5% Chrome Alloy Steel, Diffused Nickel-Cadmium Plate Sizes: #10-32 through 7⁄8-14 Companion Locknut: SPS FN 926 FN 926 Series (Featherweight) Alloy Steel (AMS 6304), Diffused Nickel-Cadmium Plate Sizes: #10 through 7⁄8 in.	EWB 930 Series Ultra-High Strength Steel, Diffused Nickel-Cadmium Plate Sizes: #10-32 through 7⁄8-14 Companion Locknut: SPS FN 930 FN 930 Series (Featherweight) AMS 6304 or AMS 6485 Diffused Nickel-Cadmium Plate Sizes: #10-32 through 7⁄8-14
n Steel, m Plate ugh 5⁄8-18 t: SPS EWSN 26 ugh 5⁄8-11, m Plate t: SPS EWSN 26 ugh 5⁄8-11, m Plate t: SPS EWSN 26 -Life Series Cadmium Plate ½ in. m Plate h 1½ in. ntweight) im Plate with or h 1 in. t: SPS 42 FLW AS 644 Series t: N; 42 FLW	EWB 22 Series 5% Chrome Alloy Steel, Cadmium Fluoborate Plate Sizes: #10-32 through 1½ in.-12 Companion Locknut: SPS EWN 22 LWB 22 Series (lightweight) 5% Chrome Alloy Steel, Cadmium Fluoborate Plate Sizes: #10-32 through 1½ in.-12 Companion Locknut: SPS FN 22 EWN 22 Series Alloy Steel, Cadmium Plate Sizes: ¼ in. through 1½ in. FN 22 Series (Featherweight) Alloy Steel, Cadmium Plate with or without MoS_2 Sizes: #10 through 1½ in. EWSN 26 Series Alloy Steel, Cadmium Plate Sizes: #10 through 5⁄8 in.	EWB 26 Series 5% Chrome Alloy Steel, Vacuum Cadmium Plate Sizes: #10-32 through 7⁄8-14 Companion Locknut: SPS FN 26 FN 26 Series (Featherweight) Alloy Steel, Cadmium Plate with or without MoS_2 Sizes: #10 through 7⁄8 in.	EWB 30 Series Ultra-High Strength Steel Vacuum Cadmium Plated Sizes: #10-32 through 7⁄8-14 Companion Locknut: SPS FN 30 FN 30 Series (Featherweight) AMS 6322, AMS 6485, or equivalent Cadmium Plated Sizes: #10-32 through 7⁄8-14
psi, min. psi, min.	220,000 psi, min.	260,000 psi, min.	300,000 psi, min.

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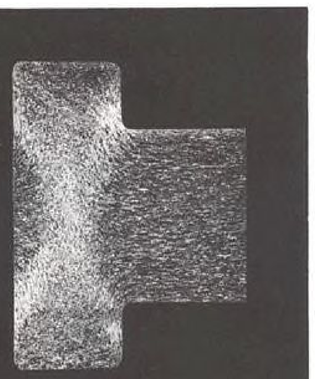

Forged tungsten bolt reflects SPS capabilities in refractory alloys, including molybdenum, columbium and tantalum.

240,000 psi at 900°F. SPS EWB 930 is the only bolt usable at 900°F that can then be reused at room temperature and still guarantee its original 300,000 psi. It is part of SPS' complete fastening system for 300,000 psi.

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This means nothing short of a total facility for hot and cold forming, machining and surface finishing of all metals so as to meet every possible environmental combination of stress, temperature and atmosphere.

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Tomorrow? For tomorrow SPS is already looking at steel bolting beyond 300,000 psi . . . is delving deeper into the refractory alloy spectrum and into the fastening implications of cryogenics . . . is evaluating new head and thread forms to better combat the subtleties of fatigue.

What makes for this all-out capability? It starts with design. Not just interpretive design, but original design that attacks the problem of increasingly severe environments in terms of complete fastening systems. And always the goal is to boost the properties of such systems in direct proportion . . . higher tensile, higher shear, higher fatigue.

Imaginative design must in turn be evaluated for reliability. No one in the industry has more extensive facilities for this than the SPS Aircraft-Missile Division. Metrological instruments sensitive to 0.00001 in.; complete equipment for photoelastic analysis; pilot production laboratories; tensile machines with capacities to 400,000 psi; fatigue machines capable of loads to 250,000 lb. and speeds to 20,000 cpm, each adaptable for test environments to 2000°F . . . the investment here is enormous.

No less vital is manufacturing capability, starting with material procurement so disciplined that every SPS fastener can be traced back to its original lot and analysis. Then, too, SPS machine power is unequaled in the industry. Cutting, forming, forging, thread rolling, heat treat, cleaning, plating—complete facilities each. Indeed, they reflect SPS belief that reliability can be built into its fasteners only by 100% in-process control—to SPS standards. Thus the gages used at threading machines are calibrated daily. And they are indicating type gages, not ordinary ring gages, which are incapable of detecting trends in deviation, let alone lead error or out-of-roundness.

Vital, too, are auxiliary capabilities—tool manufacture, for one. Because SPS specifications usually run tighter than industry or Government specifications, much commercially available tooling cannot produce a precision fastener by SPS standards. Therefore SPS makes all its thread roll dies—for closer tolerance control across the board and because only SPS has evolved certain unique thread forms such as used on its production beryllium bolts.

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also moves a distance proportional to the force exerted by the pilot. The control surface responds accordingly.

By adjusting the sensitivity of the servos, an instructor can make the variable stability aircraft duplicate the control "feel" of almost any aircraft he wishes to simulate.

Independent Sources

At this point, the aircraft has variable control but not variable stability. To give it this quality, signals from other, independent sources are directed to the control surface servos but not to the cockpit control servos. Typical of such inputs—which actually alter the aircraft's behavior—are angle of attack, rate of change in angle of attack, sideslip angle, and rate of roll or yaw.

Of prime concern to a pilot is the short period motion of an aircraft around its pitch axis. With a life of 3 sec. or less, this relatively rapid oscillation, expressed in cycles per second, measures transient response of the aircraft to control pressures.

Natural frequency of the short period motion in very responsive, fighter-type aircraft is high; in larger transports, it is lower.

In most variable stability aircraft, both the duration of the short period motion and the damping that follows it can be changed almost instantaneously.

Cornell's B-26, an aircraft designed for one pilot, must be taxied by the student, because the instructor in the right seat has no brakes. On a clear morning last month, we aligned the aircraft for takeoff at Buffalo's municipal airport. Bull took over when he got rudder control and we climbed to 8,000 ft., paralleling the south shore of Lake Ontario where there was little likelihood of conflicting traffic.

Clutch Mechanism

With the B-26 set up to simulate a B-26, we engaged its variable stability system by throwing a clutch mechanism on the floor at our feet. From that point on, we were flying by wire. But so smooth was servo operation in the system that this fact, somewhat distracting at first, was soon forgotten. No trace of the artificial feel built into early Link trainers was apparent in the B-26 controls.

Our touch moved only servos. But cables linked Bull's control column directly to the plane's elevator, and, as a result, his yoke twitched and jerked throughout the demonstration, copying whatever the elevator did to vary longitudinal stability of the B-26.

Normal damping ratio of the B-26 is about 0.7, the natural frequency of its short period motion is about 0.45 cps., and standard stick forces, expressed in pounds per g, are about 40. This was

our reference framework. The first variable introduced by Bull was to reduce damping first to 0.4 and then to 0.2.

Selecting a farm at about 2 o'clock and roughly 30 deg. below the horizon, we nosed the B-26 over and attempted to acquire it from a turn. In this abrupt tracking maneuver, which might precede launch of an air-to-air missile at high altitude, the B-26's nose bobbled in distinct and annoying fashion. At the 0.2 damping ratio, it oscillated through the point selected at least five times before settling down.

Our attempts to compensate for this bobble made the aircraft even more skittish and exaggerated what we were trying to correct.

With zero damping, tracking was next to impossible, and instrument flight, had it been attempted in such an aircraft, would have required a pilot's total attention.

Next, Bull changed the natural frequency of the B-26's short period from .45 cps. to 0.8 and cut required stick forces by about one half. In this configuration, the aircraft behaved as if it had lost 10,000 lb. Response to control pressures was so sudden and the controls so sensitive it was evident that any aircraft with similar handling qualities could be damaged inadvertently during relatively routine maneuvers performed by its pilot.

Even the most unsafe configurations can be demonstrated in the variable stability aircraft without endangering its crew, for the system can be disconnected instantaneously. By depressing a button on the control yoke, either the student or the instructor can deprive the servos of all power and restore controllability should a maneuver prove hazardous. Although it hasn't yet, this could happen when the B-26 is used to demonstrate effect of extreme centers of gravity or the failure of stability augmentation equipment.

After restoring the B-26's original in-flight personality, we began simulating various transport configurations. At a natural frequency of 0.3 cps.—a short period duration of about 3 sec.—aircraft response typified that of the larger piston-driven transports.

This, Bull explained, makes instrument flying easier. Because the aircraft responds slowly, the pilot can begin a correction during one scan of the panel and note its result on the next. The aircraft's response to sudden gusts would be similarly slow, sparing passengers uncomfortable g loads. Even while taking violent evasive action, the pilot would run little risk of inflicting structural damage on such an airplane.

If, at this point, high stick forces are coupled to the low natural frequency, the aircraft becomes less manageable. According to Bull, veteran fighter pilots almost always grow skeptical when told

RHEOSTAT GAIN CONTROLS on panel forward of the right control column are used to vary the B-26's stability, stick forces and responsiveness.

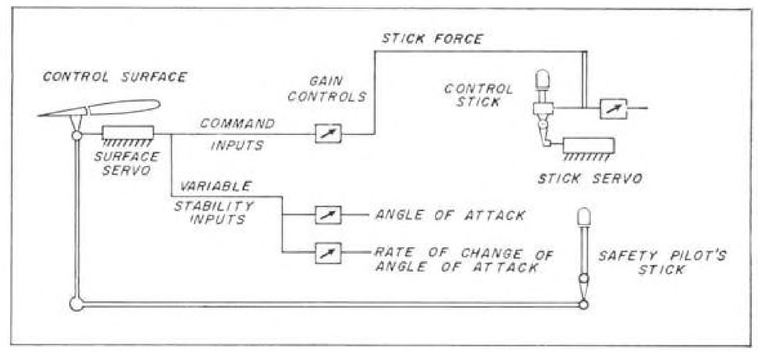

DIAGRAM SHOWS how student pilot and instructor pilot control and maintain safety of the Cornell B-26 variable stability aircraft.

the military uses hundreds of transports that possess similar handling qualities.

Yet Bull maintains that the B-26 with a natural frequency of 0.3 cps., and stick forces of about 150 lb./g flies just like a Douglas DC-4 with its center of gravity a little too far forward. In such a ponderous aircraft, the pilot, merely to rest himself, begins to rely increasingly on trim until the trim wheel actually becomes the primary flight control in turns.

When it appears, the U.S. supersonic transport probably will have a very low natural frequency, especially at subsonic air speeds. This may mean that its pilot, on landing, must begin his flare earlier than is customary, perhaps while not yet over the runway's threshold. Whether a professional pilot can cope with that requirement is a question variable stability aircraft may help answer.

As we experimented with the B-26, it became obvious that high stick forces and low natural frequency can be confused by the average pilot. Both contribute to an aircraft's apparent sluggishness. Variable stability training probably would help an FAA certificating test pilot recognize which is the culprit in, for example, a light plane that had been modified by its owner.

Revision of certain FAA certification criteria also could result from widespread training of engineering test pilots in variable stability aircraft. One such criterion, which many pilots consider unrealistic, is that all aircraft must possess neutral static stability.

Yet the B-26, when rendered statically unstable, is far more pleasant to fly than when it is made to act like one of the larger transports. Although it will not hold trim, maneuvering and tracking are easy, and when the nose is placed on a point, it stays there.

Another question a pilot rarely considers is why controls in the cockpit

must be made to move at all. In the Piper Cub class of aircraft, stick and rudder pedals move cables that position the control surfaces. Hence, stick and pedals must be movable. But in modern fighters, such as the McDonnell F4H, pilot pressures actuate only electro-hydraulic servos, which move the control surfaces. Bungee cords create a customary "feel" for the pilot.

Such a system burdens an aircraft with unproductive weight. In addition, room to move must be afforded the pilot, thereby wasting space in the cockpit.

At the end of our flight, Bull demonstrated the ease with which a pilot can maneuver an aircraft equipped with an immovable control column. Servos linked to the B-26's cockpit controls were adjusted to eliminate all travel. But pilot pressure still generated a signal which excited the servos coupled to the B-26 primary control surfaces.

We found that even with no practice, precise pitch control was available with the aircraft in this configuration. In trying to acquire a target below the horizon, however, we lowered the nose of the aircraft abruptly—much more so than we would have if the stick were free.

Variable stability training offered pilots by Cornell has proved so popular the laboratory is converting a second B-26, this one with variable stability around all three axes. One of the two aircraft probably will be assigned each class graduated from the Navy Test Pilot School at Patuxent River, Md., where, since 1960, each class has received in-flight instruction in variable stability and control from Cornell.

FAA engineering test pilots predict similar training will be of major value when they pass judgment on aircraft handling qualities not dealt with specifically by Civil Air Regulations. Aircraft certificated under Part 3 of the CAR, for example, must be trimmable and controllable with one hand. Longitudinal stability must be "positive." When disturbed from level flight, airspeed can vary as much as 10%.

Between these criteria, FAA certificators point out, there are gray areas in which the check pilot must be subjective. "When we find an aircraft that doesn't quite comply," one FAA pilot told AVIATION WEEK here, "we may be able to pinpoint why and talk knowledgeably to its manufacturer."

Although such advice is not binding on FAA—the agency does not guarantee it will certificate an aircraft after one flaw is corrected—it undoubtedly will aid smaller operators and owners who apply for supplemental type certificates. These must be obtained from FAA whenever a major modification alters the structural integrity, performance or handling qualities of an aircraft.

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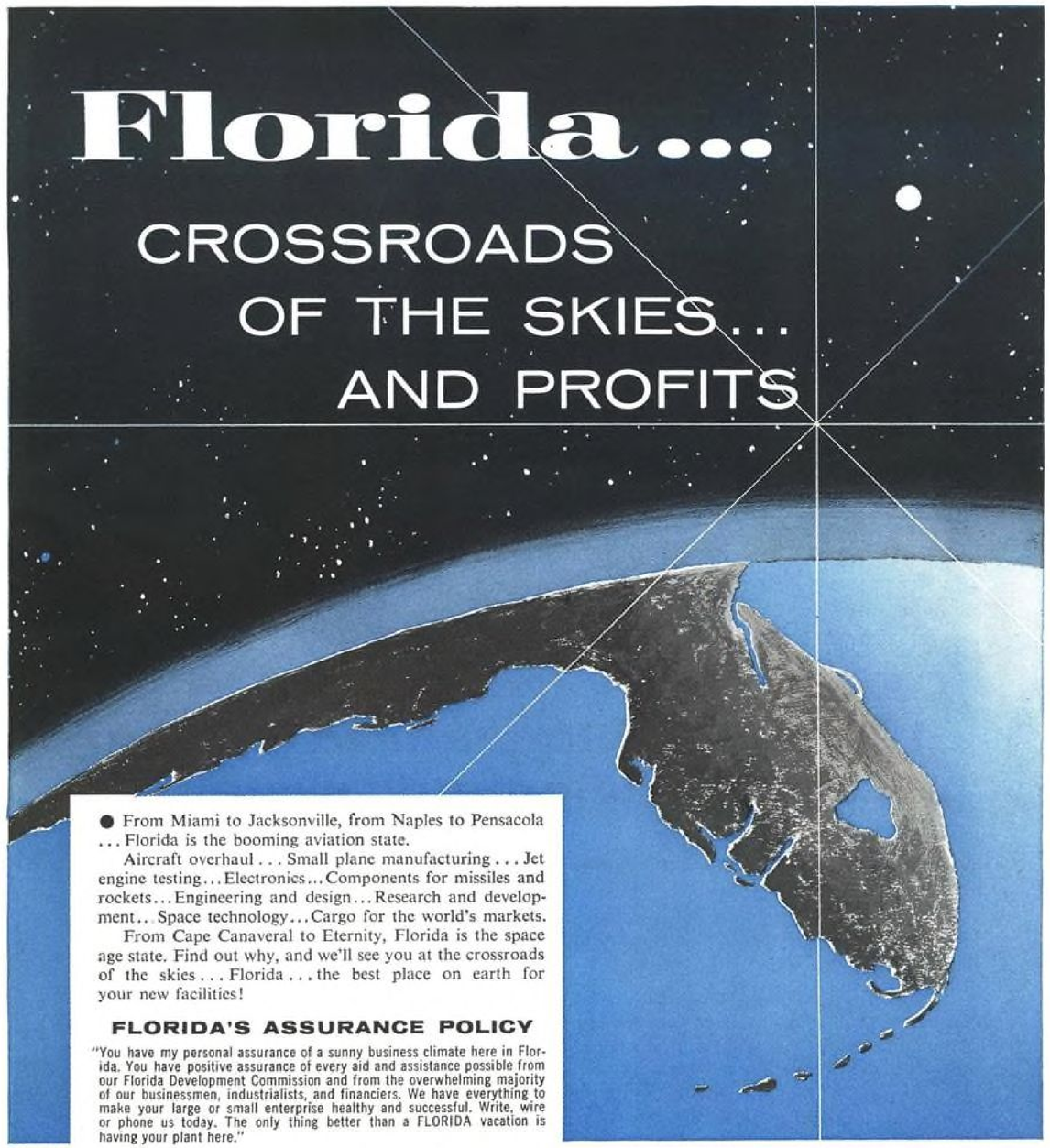

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NASA, AT&T Reach 'Conflict' Agreement

By Katherine Johnsen

Washington—American Telephone & Telegraph Co. is expected to continue as an active competitor for National Aeronautics and Space Administration business, despite the role of its new subsidiary, Bellcomm, Inc., as adviser to NASA on systems requirements for the Apollo manned lunar landing program.

A statement of understanding on conflict-of-interest between AT&T and NASA gives the company a completely free hand to compete for NASA communications business—including communications for the Apollo program. In tracking and guidance, an award to AT&T will be subject to approval by the NASA administrator or deputy administrator. These three areas—communications, tracking and guidance—are the only areas of AT&T interest.

The statement, expressed in a letter from James E. Webb, NASA administrator, and concurred in by E. J. McNeely, AT&T president, as "entirely acceptable," was made public by John A. Hornbeck, president of Bellcomm, in testimony to the House military operations subcommittee. With Hornbeck's testimony, the subcommittee, headed by Rep. Chet Holifield (D.-Calif.), concluded two months of hearings on military and space research and development management. A report will be issued next year.

Industry has been apprehensive that Bellcomm's basic role and close relationship with NASA in the $20-$40 billion Apollo program would give AT&T a competitive advantage for other NASA business.

Hornbeck told the subcommittee that AT&T, as well as NASA, shared this "deep concern" in the beginning. He said it was "resolved" by the statement of understanding.

Holifield made these observations during Hornbeck's testimony:

"What in effect has occurred . . . is that there is a pious statement that there shall be no conflict-of-interest involved, and then . . . there is a complete exoneration of any conflict-of-interest . . . and as a matter of fact, this is a unique situation . . .

"I am not being critical, because, knowing full well the monopoly position of the group that is involved here, and their excellent technical ability . . . I do not know where NASA would go to get better services or even possibly as efficient services, because of your great comprehension of this background . . .

"As a recognition of their industrial position in the field of communications and to some extent tracking and guidance . . . the government needs their product. And the government has made a concession which has not been made in other cases—such as Rand Corp., Mitre Corp., Lincoln Laboratories."

These are three points made in Webb's letter—and concurred in by AT&T:

• **Communications contracts.** In this field, Webb said, "it is apparent that the arrangements between NASA and Bellcomm should not affect the dealings of the Bell System companies with NASA. Such companies would remain free to deal with NASA in the furnishing of communications services generally, and in connection with the communications aspects of projects such as Mercury, Gemini, and Apollo, on the same basis as if the new arrangements had not been made. There is no reason, either, why the dealings of the Bell System companies with NASA in the communications satellite field should be affected . . ."

• **Tracking and guidance.** In this area, Webb stated, "there is no intention on the part of NASA that existing NASA projects for which the Bell System has been selected to perform work . . . would be disturbed."

Webb continued:

"We also recognize that the space program may require on future projects the tracking and guidance capabilities of the Bell System. However, where capabilities in these fields are also possessed by companies outside the Bell System, we would want to examine each future situation on its particular facts to be certain that permitting the Bell System to be eligible to participate in a particular future project would not conflict with the principles . . . regarding the avoidance of a competitive advantage being gained by virtue of information acquired in performing the Bellcomm contract." Webb said that he or the deputy administrator of NASA would make a personal review before a decision is made to select the Bell System over competitors.

Herbert Roback, the subcommittee counsel, said: "In effect . . . there is . . . no contract restraint arising from the Bellcomm contract relationship. If and when on some new project there is the fact that Bellcomm may be privy to a considerable amount of special information which confers a competitive advantage, then the administrator will on a case by case basis decide whether or not it is appropriate."

• **Other manned space flight** contracts. Noting that AT&T has said it would not seek NASA business outside the communications, tracking, and guidance areas, Webb stated:

"Similarly, it would be NASA's intention not to call on the Bell System to perform work in these other areas except where, in the opinion of the administrator or deputy administrator, an exception to this general rule should be made. Such exceptions would be rare and would arise only where the Bell System was in a unique position to perform a valuable service for NASA . . ."

As introduction to these three points on conflict-of-interest, Webb made these comments in his letter to AT&T:

"It is clear that the maximum benefit will be derived from these new arrangements [with Bellcomm] only if there is the closest cooperation and understanding between NASA personnel and the Bell System technical group. In addition, a close relationship must exist between personnel involved in performing major NASA contracts in the manned space flight program and this support group."

Webb then raised the conflict-of-interest problem involved in the three-way close relationship as "a matter, not appropriate for resolution in the Bellcomm contract, which I know we both recognize as an important question to resolve quite explicitly at the outset."

Webb continued:

"It is not at all our desire to deny to the space program the unique resources of the Bell System. Such a course of action would be contrary to the national interest. On the other hand, a necessary result of the close relationship between Bellcomm and NASA is that the new company will become privy to the kind of information regarding current and future plans and programs of NASA that could give the Bell System a competitive advantage in connection with other work."

Webb then made his three points on conflict-of-interest.

Hornbeck gave the subcommittee three examples of work Bellcomm will perform for NASA under its continuing $15 million-a-year contract. They were:

• **Prepare an over-all system** specification for the manned space flight program. The first step—following studies—will be a short document defining and describing the mission mode for Apollo. The studies will be directed at defining the flight missions to be undertaken, delineating the interfaces between the subsystems, and formulating the re-

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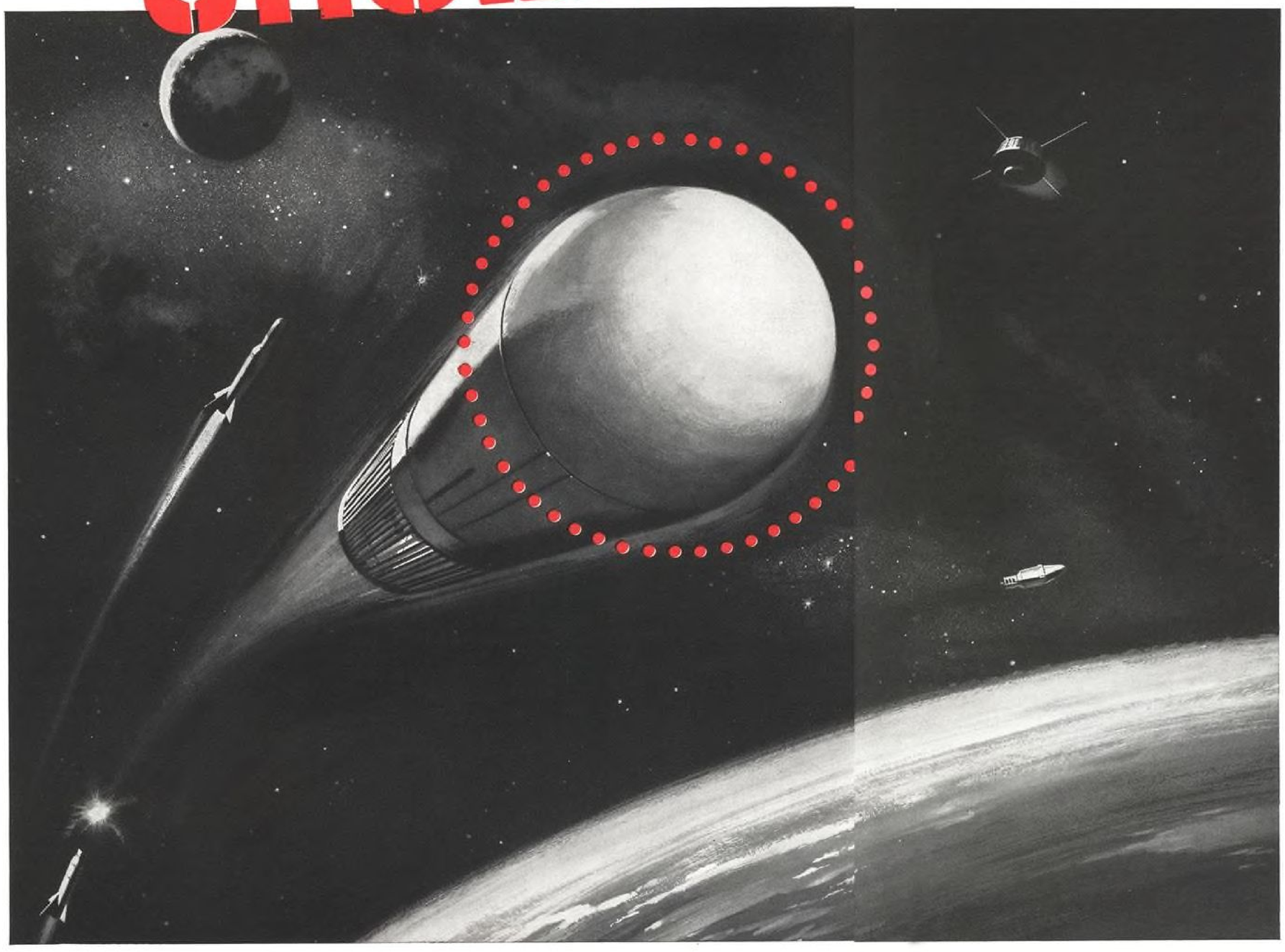

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Australian Air Force to Use Bell HU-1B in Rescue Role

Royal Australian Air Force will take delivery this month of the first of eight Bell HU-1B helicopters scheduled for service with RAAF's Search and Rescue Squadron 9 based at Williamtown, New South Wales. Major difference between RAAF and U. S. Army HU-1B versions is an external hoist on the Australian vehicle which can lift up to 600 lb. and be controlled by the pilot or a cabin attendant.

quirements to be met by subsystems.

The second step will be a more complete application for development and operations through the first manned lunar landing. This document will delineate major subsystems and specify requirements to be met by subsystems.

• **Study check-out and launch** from the lunar surface. The objectives are to search out the critical problems involved in lunar launch and the differences between lunar and earth launch, and consider various primary and back-up launch and check-out procedures.

• **Develop a mission assurance** program for Apollo. This will consist of identifying areas of work relating to mission assurance and developing an implementation for each area.

Participation by AT&T as a systems requirements adviser to NASA in the Apollo program was broached by Webb in a Feb. 21 letter to F. T. Kappell, chairman of AT&T. Webb said:

"It would be a public service of the very first order of importance if the Bell System would undertake to assist NASA . . . by providing an organization of experienced men capable of giving the responsible NASA officials the benefit of the most advanced analytical procedures and the factual basis they need to make the wide range of system engineering decisions required for the successful execution of the manned space flight mission."

A week later, AT&T accepted Webb's proposal.

GE Regroups Defense Electronics

General Electric has formed a new Command Systems Division from some of the departments which formerly made up its Defense Electronics Division and has established a new corporate-level component, Advanced Technology Services.

Dr. George L. Haller, vice president and former general manager of the Defense Electronics Division, will head the new Advanced Technology Services and becomes a member of GE's executive office.

The Command Systems Division, headed by Richard L. Shettler, includes the Defense Systems Department, which Shettler formerly directed, the Lunar Mission Support Program (Apollo), Communication Products Dept., Military Communications Dept., Technical Products Dept. and the Electronics Laboratory.

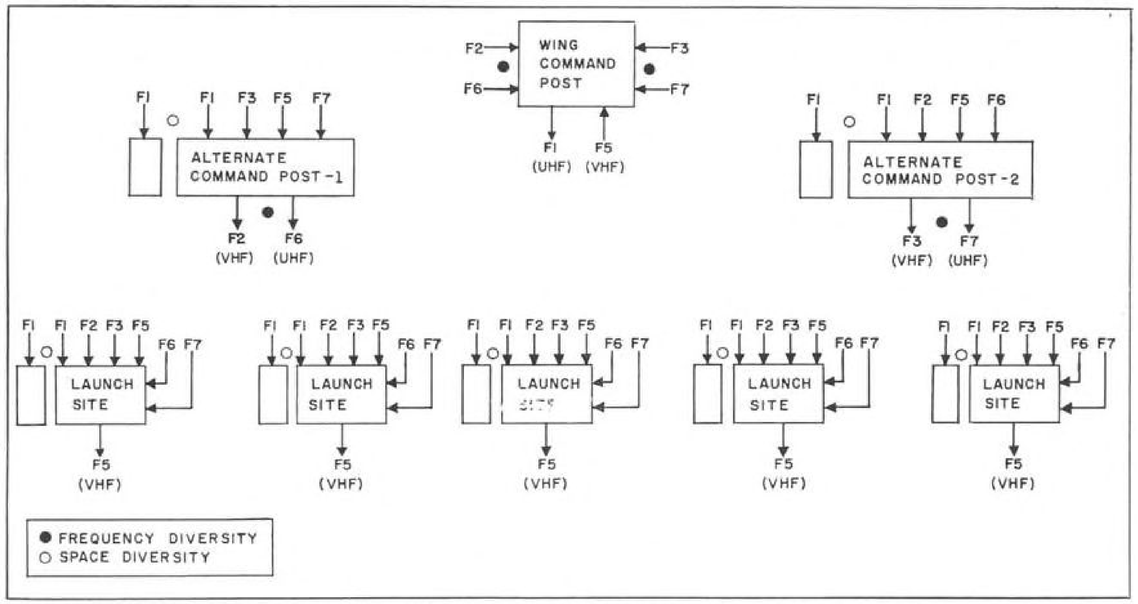
The Defense Electronics Division, which now consists of the Heavy Military Electronics Dept., Light Military Electronics Dept. and Ordnance Dept., will be headed by Gerald A. Hoyd, who was formerly general manager of the Light Military Electronics Dept., and prior to that headed the Ordnance Dept.

During the last several years, the Defense Electronics Division has undergone extensive growth both as a result of internal expansion and through the transfer of additional departments, such as Communication Products, until its size exceeded that which the firm believes is suitable for divisional status under a single general manager. Recently, GE moved its former Missile and Space Vehicle Dept. out of the Defense Electronics Division to give it full divisional status (AW July 9, p. 20).

The new Advanced Technology Services has been formed, GE says, "to strengthen the bridge between technical research and a marketable end product." The company's General Engineering Laboratory in Schenectady, N. Y., has been transferred to the new operation.

The General Engineering Laboratory, originally established to serve as a general development facility for the entire company, has proven to be a problem in recent years. During the early post-war period it became heavily engaged in defense and government-sponsored work, with the result that many departments in the company set up or strengthened their over-all in-house development capability.

About 10 years ago the General Engineering Laboratory was ordered to sharply curtail its defense work and to return to its original role, but individual departments were slow to resume the prewar relationship since they now had their own in-house development capability.



TITAN 2 RADIO NETWORK uses automatic fault detection, standby switch-in, frequency and space diversity to provide reliable communications over difficult terrain. Arrows show channels used for transmission and reception between missile sites.

Flexible Radio Net to Link Titan 2 Sites

By Philip J. Klass

First elements of a flexible, hardened radio network designed to provide reliable communications to 18 Titan 2 ICBM launch sites at each of three Air Force missile bases have been delivered by General Electric's Communication Products Department, Lynchburg, Va.

The equipment is to be installed at Davis-Monthan AFB, near Tucson, Ariz., McConnell AFB, near Wichita, Kan., and Little Rock AFB, Ark.

Variety of techniques have been used to assure reliable communications between the widely dispersed facilities under both pre-attack and post-attack conditions.

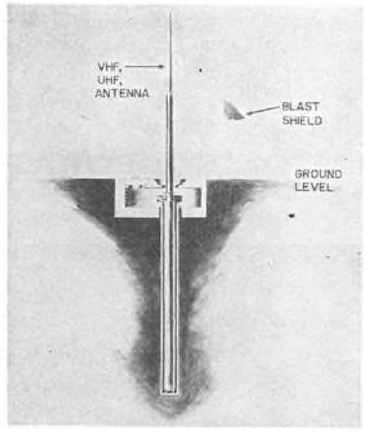
These include:

• **Standby units** are provided for every element of the system, with automatic fault detection to switch the standby into service in the event of a malfunction.

• **Hardened antennas,** buried in an 80-ft.-deep silo, which can be quickly erected by a gas-actuated piston mechanism. Two such antennas are provided at each site, either of which can provide the required communication service. During peacetime, both hardened antennas are retracted, except for periodic exercising, and conventional self-supporting tower antennas are used.

• **Frequency and space diversity** are used to reduce the risk of jamming and to overcome adverse propagation paths. The frequency diversity technique involves the use of a VHF channel (130-160 mc.) and a UHF channel (225-275 mc.). The space diversity technique, used only in adverse locations, employs two physically separated antennas, each with its own receiver. The antennas have combined output.

Protected valleys, which make good locations for securing missile sites against blast effects, are bad locations from the standpoint of radio signal propagation at VHF and UHF line-of-sight frequencies. The situation is aggravated by the separation between launch sites, which can be as much as 80 mi.



HARDENED UHF/VHF antenna, one of two at each site, is buried in 80-ft. deep silo.

General Electric conducted path-loss analyses of all sites using topographic maps, following which it made on-site measurements for the more adverse locations. Out of these studies came the present network configuration, which uses space diversity where necessary and, in the case of Davis-Monthan AFB, special repeater stations at two of the missile launch sites.

The wing command post at each air base is a relatively soft installation, and its primary mission, therefore, is pre-attack. But both of the two nine-missile squadrons at each base have hardened underground command posts, located near a launch site. Each is designated as an alternate command post and is capable of controlling the launch of all 18 missiles, if necessary. One of the two is designated as alternate command post No. 1, and would take over control of the two squadrons if the wing command post were destroyed or otherwise disabled.

The Titan 2 radio network provides four types of communication functions. They are:

• **Primary Alert System:** Command signal received via semi-hardened land cables at the wing command post and

alternate command post No. 1 can be re-transmitted by voice channel to the other alternate command post and to all launch sites. The wing command post broadcasts on a UHF frequency (F1) while alternate command post No. 1 transmits on both VHF and UHF (F2 and F6). Each launch site and the other alternate command post have receivers tuned to each of the three frequencies (F1, F2 and F6) and standby receivers for each channel. Launch sites at adverse propagation locations will have a second soft antenna and receiver to provide space diversity for reception of the wing command post alert.

• **SAC Control System:** Coded binary signals from the Strategic Air Command Control System (465L) are transmitted by land cable to the wing command post and two alternate command posts and instantly re-transmitted to all launch sites. The wing command post transmits on the same UHF frequency (F1). Alternate command post No. 1 transmits on its same VHF and UHF channels (F2 and F6), while alternate command post No. 2 transmits also at VHF and UHF at frequencies F3 and F7.

Since all sites have receivers for all of these channels, the command signal can be expected to get through at least on one of them.

• **Launch Enable System:** The signal which readies the missiles for launch also is transmitted by the wing command post and by both alternate command posts using the same channels.

• **Hard Voice:** All launch sites have the capability of conducting voice communications with any or all other sites and command posts in the complex on a party line basis. This capability is referred to as "hard voice" to distinguish it from the soft telephone lines which are installed for general administrative traffic during peacetime. The launch sites transmit on VHF frequency F5, while the command posts transmit on the previously cited frequencies.

These four functions, plus an "alarm tone" which is transmitted continuously to check on circuit continuity and to actuate automatic switching of standby equipment, are transmitted on a single channel bandwidth of approximately 12 kc., using a combination of frequency modulation and frequency shift keying. The SAC Control System data (see accompanying chart) is transmitted at a rate of 600 bits/sec. by frequency shift keying (FSK) of the carrier by 450 cycles/sec. The primary alert system, (PAS) hard voice (HV), launch enable system (LES) signal and the alarm tones are multiplexed and applied to a phase modulator, according to Igo Meitlis, GE project manager for the Titan communications system.

Primary alert system voice signal is transmitted in the lower sideband of a

single sideband suppressed-carrier, while the hard voice is transmitted in the upper sideband, each occupying about 3.5 kc. of bandwidth. The channel fault sensing alarm tone is transmitted at 3,825 cps., slightly above the voice band frequencies.

The launch enable system uses continuous tones in the baseband at 1,275 cps. for one squadron and 2,800 cps. for the other.

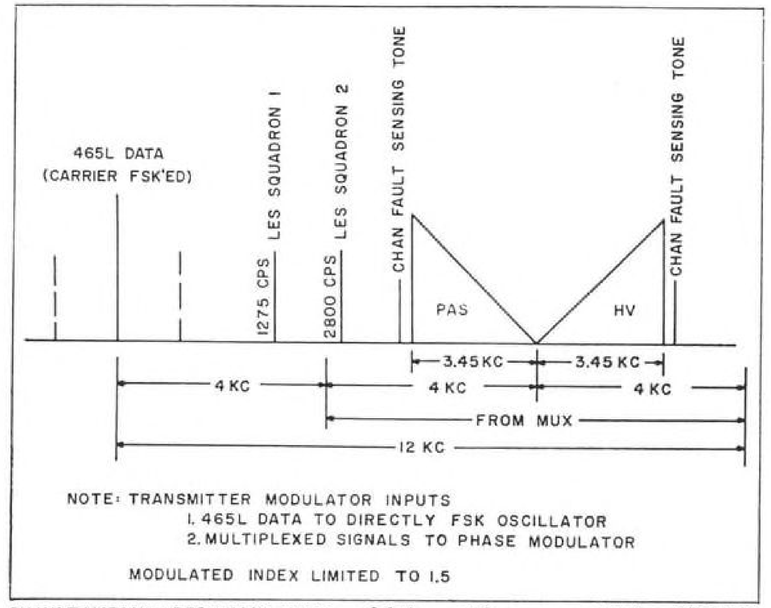
Transmitter Operation

Transmitter, with output of 1 kw., has a frequency swing of ±18 kc. This is done to prevent the modulation index from exceeding 1.5 so that the carrier amplitude never falls to zero. If the carrier amplitude dropped to zero, it would wipe out the SAC Control System data, according to Meitlis.

To recover the individual signals, a receiver with a dual intermediate-frequency amplifier is used. The narrowband IF amplifier recovers the SAC Control System data while the wide-channel IF amplifier is used for the rest of the signals.

Cost Savings

An interesting aspect of the radio communications equipment for the Titan 2 network is that it will use commercial grade components rather than components built to military specifications. This offers considerable cost savings to the Air Force—without any compromise in required reliability, according to GE. Since the equipment will be housed in air-conditioned silos, shock-mounted to withstand external blast effects, high grade commercial components are quite adequate, GE believes.

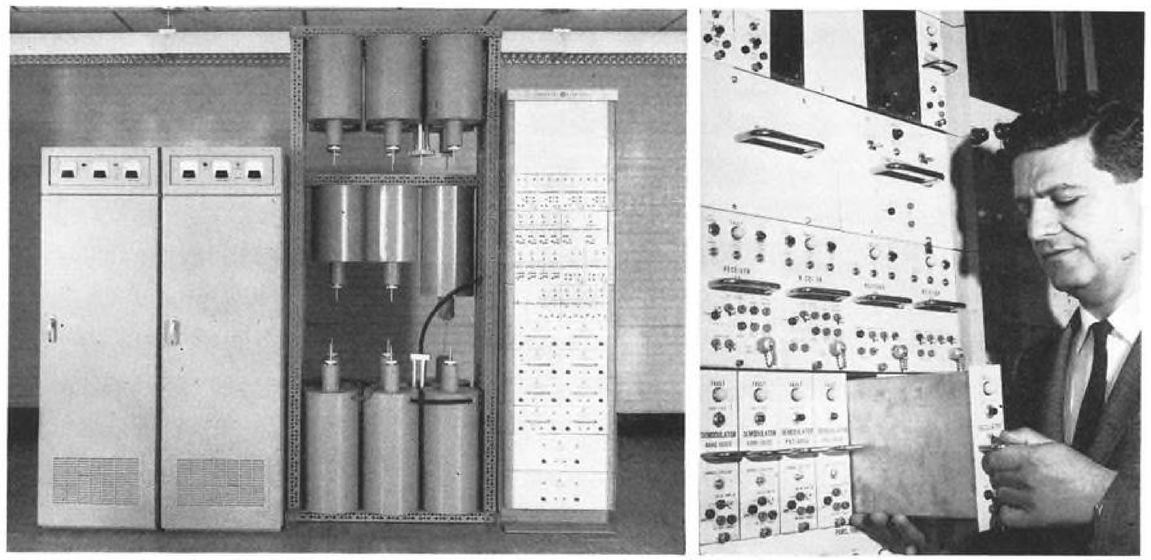


SIMULTANEOUS FREQUENCY SHIFT modulation and frequency modulation (FSK/FM) is used to multiplex data, voice and fault detection on one 12 kc. channel.

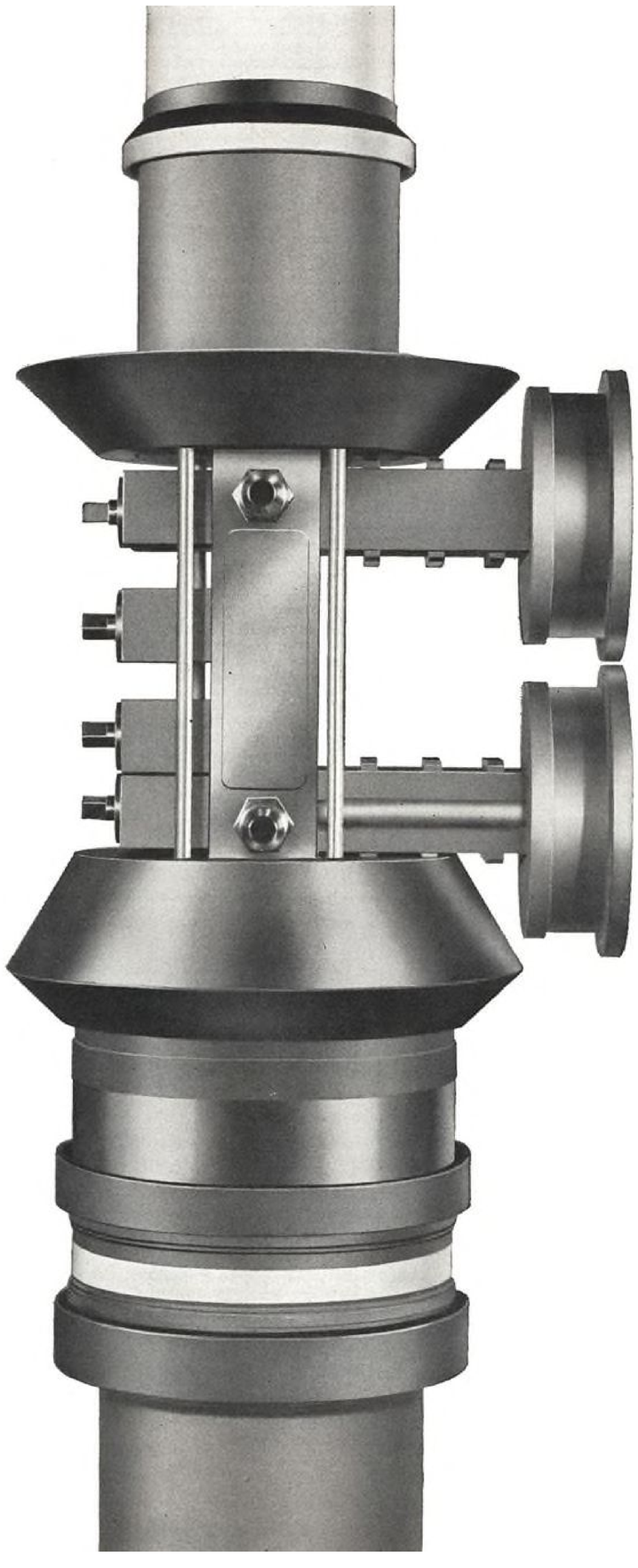
Company spokesman says that the Titan 2 equipment is similar in design to transistorized mobile equipment which GE builds for police use.

As part of the company's reliability program on the Titan 2 system, it has been life-testing 20 of its commercial transistorized mobile receivers. In 6,000 hr. of life tests (120,000 unit-hours) there has not been a single failure, according to GE, except for pilot lights, some of which began to fail after 1,776 hr. To alleviate this problem, GE will operate pilot lights at reduced voltage in the Titan 2 equipment.

Major subcontractors to GE's Communication Products Department include The Andrew Corp., Chicago, which is building the hardened vertically-polarized antennas, and GE's Ordnance Department, Pittsfield, Mass., which is supplying the pop-up antenna erection mechanism. USAF Systems Command's Ballistic Missile Division is system contracting agency.



COMMUNICATIONS PACKAGE, left, is installed at each launch site. Dual 1 kw. transmitters are shown at left, with multiple receivers in rack at right. Modular, plug-in construction, shown at right, is used to facilitate maintenance.



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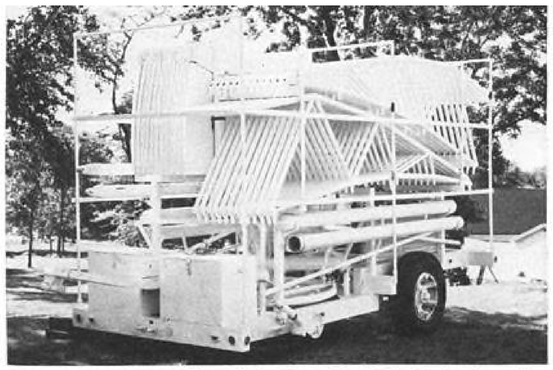
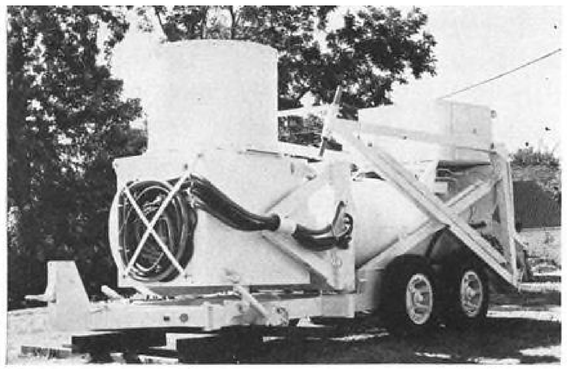




MOBILE STATION, left, will be located at Rio de Janeiro. At right, support tower and antenna mount are retracted for shipment.

Relay, Telstar Ground Stations Displayed

Two ground stations which will be used with Project Relay communication satellite to conduct telephone and teletype service experiments between U. S. and South America and between South America and Europe, were shown recently by International Telephone and Telegraph Corp.

The Project Relay communication satellite, being built by Radio Corp. of America under National Aeronautics and Space Administration contract, is scheduled for launch late this year.

One of the two terminals will be located at Nutley, N. J., site of the ITT Federal Laboratories, which designed and built the stations. The other terminal, a mobile station housed in four trailer vans, will be installed near Rio de Janeiro, Brazil, and operated by Companhia Radio Internacional do Brasil (Radional), an ITT affiliate.

Bell Telephone Laboratories also recently demonstrated a low-cost communication satellite terminal, capable of providing a single two-way voice channel, using Telstar. The station used an 850 watt transmitter and a makeshift 18-ft.-dia. antenna, but BTL says that a 10-ft. dish specially designed for the purpose could provide equivalent performance. The receiver used two low-noise parametric amplifiers operating in tandem, one cooled to 77K.

The ITT station for Brazil will employ a 30-ft. dia. antenna, while the Nutley station will have a 40-ft. dish. The terminals are designed to handle 12 simultaneous two-way telephone conversations, 144 teleprinter circuits or combinations of voice and data. Each voice channel can handle 12 two-way data circuits.

Project Relay will receive at a different frequency than the Bell System Telstar satellite, although both transmit at the same frequency of 4,170 mc. Messages sent via Telstar are transmitted up at 6,390 mc. while those to Relay will go up at 1,725 mc.

Each of the ITT terminals is equipped with a transmitter rated 10 kw. output and with a receiver that uses low-noise (2.5 db.) parametric amplifiers. The Nutley station has a second receiver to monitor its own transmission as relayed by the satellite while the other is used for the incoming signal from remote station.

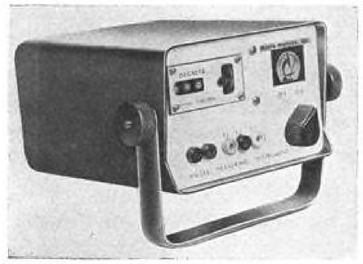
The antennas are designed to provide automatic satellite acquisition-tracking and for signal reception. The stations also contain telemetry receivers to monitor satellite internal conditions.

The Bell System terminal at Andover and the French and British stations now participating in the Telstar experiments are being outfitted with transmitters operating at 1,725 mc. to enable them also to engage in the Relay tests. This should permit signals to be relayed when the satellite position is within simultaneous view of U.S., Brazil and Europe.

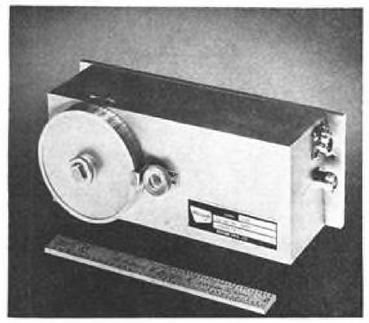
The bulk of the cost of building the two stations has been funded by ITT. NASA provided funds to adapt the Nutley terminal so that it can also serve as the eastern control station for the Relay satellite.

RELAY SATELLITE ground station equipment is displayed by ITT Federal Laboratories.

NEW AVIONIC PRODUCTS



• **Angle measuring instrument,** Model 210, designed for ground support equipment, servo and control system applications, provides accuracy of ± 6 min., repeatability of ± 36 sec., sensitivity of 36 sec., and resolution of 36 sec. Instrument can remotely indicate angular position of an autosyn or synchro shaft, indicate and measure rotary transducers, inertial system outputs, analog computers and servos. Manufacturer: Micro Metrics, Inc., 11 Van Houten St., Paterson, N. J.



• **Phase shifting transducers,** Series V-56, which can continuously shift signal phase angle through 360 deg. without insertion loss, have applications in radar ranging, frequency modulators, rotary position indicators and phase meter instruments. Units contain electrostatic phase shifters with phase splitting networks and transistorized circuits for isolating and amplifying phase shifted signals. Nilsen Mfg. Co., Box 127, Haines City, Fla.

FILTER CENTER

► **Navy Plans Circuit Comparison**—Comparison of three types of identical circuits fabricated by different microcircuit techniques will be conducted by the Naval Electronics Laboratory, San Diego. As part of the evaluation, the laboratory will obtain different versions of the circuits made by Radio Corp. of America (packaged in its micromodules), Lear Siegler (thin film microcircuits), and Fairchild Semiconductor (semiconductor microcircuits). In addition, NEL will build in-house welded electronic module versions of the circuits.

► **Improved Gyro Accuracy a Problem**—New gas-bearing gyro developed by Sperry Gyroscope, as outgrowth of its submarine inertial navigation system (SINS) effort, has drift rates so low that precise measurement is impossible with available instrumentation. Navy Special Projects Office has therefore given company contract to develop new instrumentation for measuring drift rates.

► **Space Components Group Formed**—USAF's Space Systems Division is heading up new Space Parts Working Group, with representation from about 40 major space program contractors. The group will draw up specifications for electronic components suitable for use in avionic systems intended to be carried aboard space vehicles.

► **New Semiconductor Microcircuit Entry**—Watch for Sylvania's Semiconductor Division to announce its entry into the semiconductor microcircuit field within the next several months, based on use of planar epitaxial techniques.

Unexpected Portland Copper Cost Retards Bliss' Six-Month Earnings

By Arnold Sherman

New York—E. W. Bliss Co.'s venture into increased aerospace business through acquisition of Portland Copper and Tank Works last December (AW Jan. 29, p. 102) has run into unexpected and costly snags.

Portland, according to Bliss President Carl E. Anderson, had accepted several fixed-price contracts from the government which resulted in substantial losses. "Costs to complete these contracts were estimated as of Dec. 31, 1961, on the basis of information available in mid-February, 1962, and where losses were apparent, writedowns were included in the 1961 operating results," he said.

"Subsequently, actual costs proved the estimates inadequate and additional writedowns were necessary. These supplemental writedowns were reflected in the operating statement for the first six months of 1962, and they affected adversely the value of the business as it was represented and warranted to be on Dec. 14, 1961, the closing date of the acquisition," Anderson noted.

In the second quarter of 1961 Bliss' net sales were $23,201,467. Its sales, selling and administrative expenses were $21,572,374, and net income was $694,602.

These figures were reflected in common share earnings of 24 cents for that period. In the same 1962 quarter, however, with sales rising to $29.2 million, costs soared to nearly $28 million, net income consequently dropped to $547,918.

Common share earnings declined to 19 cents for the same period.

Anderson, speaking before the New York Society of Security Analysts, stressed that the excessive costs related to honoring the government contracts were not apparent at the time of acquisition due to Portland's accounting methods.

"The Portland Copper and Tank Works, as a private company, used a

Egypt to Produce German-Designed Trainer

German technical concepts are involved in the jet trainer designated the Alkahira, which will be produced by Egypt's first jet aircraft factory. Egyptian President Gamal Nasser (left, looking into cockpit) inspects the aircraft, with its designation written in Arabic on the fuselage, at the new factory at Helwan. The trainer is the Spanish Hispano HA-200 Saeta, designed by Willy Messerschmitt. The Spanish HA-200 is powered by two Turbomeca Marbore 2A turbojets producing 880 lb. thrust each. Engines and airframes will be built at the Egyptian plant. German concepts also were used for designing the Egyptian 300-400 mi. range ballistic missile (AW July 30, p. 20), with Dr. Eugen Sanger of West Germany as a guiding hand. Technicians who worked out the breadboard concept were largely from West Germany, but others were from East Germany, Hungary and other East European nations.

rather simple type of accounting whereby the monthly inventories were computed on an estimated basis that would include built-in profits and losses," Anderson said. "Records to determine results in operation were not prepared at the end of each accounting period and detailed cost records of individual contracts were not available on a current basis."

At the time of the Portland acquisition, terms of purchase included 55,000 shares of Bliss preferred stock and 49,000 common shares.

Additional Safeguard

As an additional safeguard, according to Anderson, an indemnification clause was written into the Portland-Bliss agreement whereby the original owners of Portland agreed to make restitution to Bliss via the return of cash or stock if situations occurred "that turn out contrary to the representations and warranties."

Anderson said that discussions are currently in progress to ascertain the amount of indemnification.

One of Portland's major attractions for Bliss was its position as a defense hardware manufacturer. Bliss, primarily a producer of heavy machinery had variegated its interests by acquisitions of small companies with diversified interests. It was producing timers, potentiometers, catapults and fighter arresting equipment. Under Anderson's leadership, the company decided upon the Portland Copper acquisition to give the company a better competitive perch in terms of increasing defense and space activity.

Portland Projects

Among the projects at Portland were:

- **Thrust vector control nozzles** for the first-stage engine of Minuteman.
- **Launching platforms** for the Hawk missile.
- **Warheads** for the Tartar, Talos and Sparrow missiles.
- **Polaris propellant** casting and loading assemblies.
- **Nike Zeus** radar antenna reflectors.
- **Afterburners** for the J93 engine which will be the powerplant for the RS-70.

In addition, and in conjunction with a facility held in joint partnership with Arde Associates, Portland is engaged in forming spherical and cylindrical metal pressure vessels at cryogenic temperatures.

Anderson pointed out that Portland's backlog of orders had climbed from a little over $9 million as of June 30, 1961, to nearly $11 million a year later. He said that Portland will account for 15% of Bliss' 1962 over-all sales. Net sales for Bliss in 1961 were $102,990,714.

Despite the costs of the government contracts with Portland, six-month figures for Bliss show a healthy increase over the year before. For the six months ending June 30, 1961, Bliss' net sales amounted to $46.3 million, costs were $43.3 million, income was $1.1 million.

In the same period in 1962, sales were $58 million, costs were $54.8 million, and income was $1.4-million.

Anderson said that Bliss' Launch and Recovery Equipment Division is performing work on a ground taxi guidance system in addition to its arresting gear activities (AW July 9, p. 59). He also noted that the company is concluding an agreement with the government whereby Bliss will purchase the Canton, Ohio, plant it now leases from the government for $5.4 million.

Manned Space Center ToDoubleEmployment

Anticipated employment at National Aeronautics and Space Administration's 1,620-acre Manned Spacecraft Center under construction 22 mi. from downtown Houston, Tex., will be 2,760 by the end of Fiscal 1963.

This will approximately double the current enrollment.

Of the total anticipated NASA employes to be based at MSC, 1,004 will have annual salaries of $5,355 and under, 1,200 will receive $5,356-$8,955 and 736 of the employes will receive $8,956 and over.

CAB Accident Investigation Report

Check Pilot's Action Cited in DC-8 Crash

An Aeronaves de Mexico DC-8-21, Mexican Registration XA-XAX, crashed and burned following a balked takeoff from runway 7R, New York International Airport, New York, N.Y., Jan. 19, 1961, about 2017.[1] Four of the nine crew members were killed; all 97 passengers survived but some were injured.

This accident was apparently caused primarily by unnecessary balking of the takeoff by the check pilot who was not in either pilot seat. Contributing factors were marginal weather, snow on the runway, and an anti-icing heater possibly not used.

Aeronaves de Mexico Flight No. 401 of Jan. 19 was scheduled to depart New York International Airport, New York, N.Y., at 1830, nonstop to Mexico City, Mexico. There were 97 passengers and a crew of 9 aboard, including 5 cabin attendants. Capt. Ricardo Gonzales Orduna was in command of the flight in the left seat. Eastern Air Lines' Capt. William B. Poe occupied the jump seat in the capacity of check pilot, directly behind him. Other crew members were First Officer Antonio Ruiz Bravo, Second Officer Xavier Alvarez Bacha, Purser Gloria Sanchez Herrejon, Steward Alberto Reyes Campos, Stewardesses Margarita Badillo, Laura Martin de Jorge, and Maria Autoniata Ponce de Leon.

Departure was delayed about one and one-half hours by the late arrival of the crew and about 40 of the passengers due to weather conditions.

The aircraft had arrived from Mexico City at 1515, that day, and snow had accumulated on it. Glycol was used to remove the snow from the aircraft including the pitot heads, and the process was continued until time to start the engines for taxiing out. The Second Officer and Capt. Poe conducted a walk-around inspection of the aircraft. They had supervised the later portion of the refueling operations, increasing the fuel load by 2,000 lb., because of anticipated headwinds. Capt. Poe walked out on the taxiway to check the snow conditions locally and reported a depth of about one inch. He described the snowfall as "fairly hard," and the snow as "very fine and very dry."

Flight Cleared

The crew boarded the aircraft at 1935. Final clearance and dispatch papers were received from Eastern Air Lines Operations after the de-icing had been finished. The engines were then started and the flight was cleared to runway 7R at 2004. Its gross weight as this time was 272,171 lb., well under the permissible limit, and the location of the center of gravity was also well within permissible limits. While holding short of the taxiway, the flight received its IFR clearance at 2010. Two minutes later it was cleared to taxi to the westerly end of runway 7R, where it stopped and was then cleared for takeoff. The latest airport weather was given to the flight as: precipitation ceiling 300 ft.; sky obscured; visibility one-quarter mile; light snow; fog; wind east-northeast 18; gusts to 24; altimeter 29.64. While the aircraft was being taxied to takeoff position it was given "runway 4R[2] visual range less than 2,000 ft." At 2014:38 the flight reported: "Aeronaves 401 rolling." (The weather minimums for this flight were: ceiling 200 ft.; visibility one-half mile.)

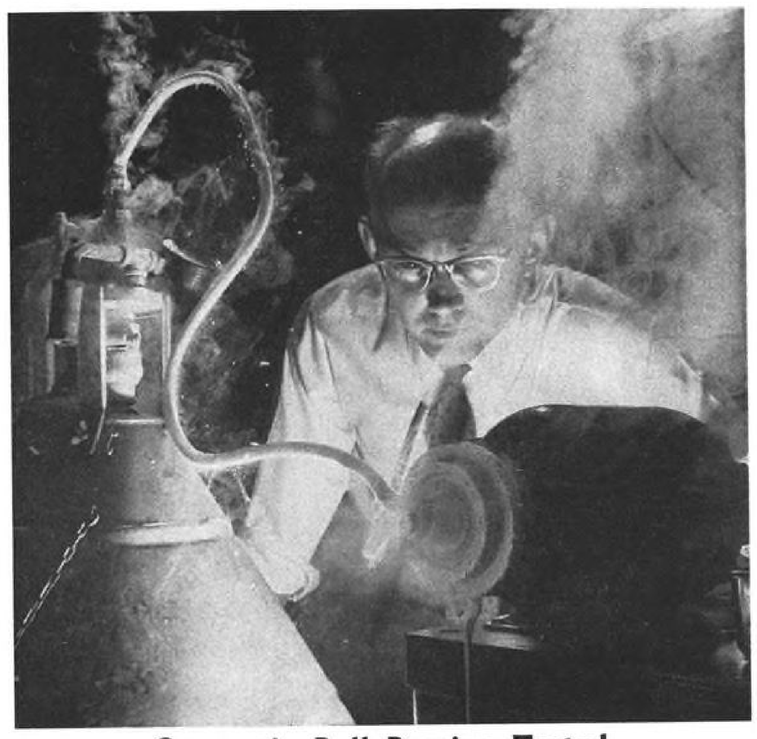
Takeoff Roll

The first approximate 6,200 ft. of takeoff roll was observed by control tower personnel, visually, until the aircraft was lost to view by obscuring snow, approximately 3,800 ft. from the control tower. They stated that at that time the aircraft had not taken off or rotated. Another tower controller observed the aircraft by airport surface-detection ground radar from the start of its roll to the eastern end of runway 7R, where it disappeared from view. A few seconds later he observed a bright orange flash in the sky northeast of the airport. He could not tell if the aircraft left the runway. Emergency procedures were started immediately by the controllers and an unsuccessful attempt was made to contact the flight on the departure radio frequency.

Capt. Poe was the only survivor of the four cockpit occupants. He stated as follows: The checklist was accomplished normally. The runway condition was good and everything apparently occurred in a routine manner through the 100-kt. time check when the first officer called out "cien" (Spanish for 100). Upon reaching approximately 130 kt. (the V_1 speed) the first officer called out V_1 and V_r in rapid succession. The aircraft was then rotated quickly and somewhat excessively. Poe did not see the airspeed go over 130 kt. and as rotation started he saw the airspeed start to drop back quite rapidly to about 110 kt. At this time the Aeronaves captain called or pointed to the airspeed indicator. Poe felt that the aircraft could not become airborne under these conditions and

[1] All times herein are Eastern Standard based on the 24-hour clock.

[2] Runway 4R, not 7R, was referred to because 4R is equipped with a transmissometer.



Cryogenic Ball Bearing Tested

Ball bearing is operated dry—without lubricants—at —320F by Westinghouse Research Laboratories at Pittsburgh, Pa. Bearings, operated in a vacuum, have held up under 10,000 hr. continuous operation at high speed and under load.

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Raymond Atchley and Kellogg Divisions of American Brake Shoe have been consolidated into a single *Aerospace Division* to anticipate the demands for the ever more sophisticated electro-hydraulic gear of the Space Age. □ The new group, with headquarters in Oxnard, California, will continue to manufacture the unequalled Atchley servovalve, Atchley servo-amplifiers and systems, Kellogg airborne pumps, fluid motors and other sophisticated hydraulic equipment for air and spacecraft. □ As a further service to the industry, the Aerospace Division will manufacture the products of Jarry Hydraulics, Ltd., American Brake Shoe's Canadian subsidiary, facilitating immediate, full-scale availability in the United States of time-proved Jarry pumps, valves, landing gear, flight-control systems, autopilot and stabilizer assemblies. □ Most importantly, the new Aerospace Division offers a single responsibility, single source for complete electro-hydraulic systems composed of reliable, compatible components that are both engineered and fabricated to work together under the stringent demands of a single quality control. □ A combined field engineering staff has been organized to serve customers in the United States, Canada and Europe. □ This dynamic group is prepared to work with you on your programs today. □ Address: 3151 West Fifth Street, Oxnard, California.

AEROSPACE DIVISION AMERICAN BRAKE SHOE COMPANY

that the runway remaining was not long enough to put the nose back down to start the takeoff again from that speed. His only choice, so he stated, was to try to get the aircraft stopped on the runway. Poe unfastened his safety belt, stood to gauge progress down the runway, moved forward, shoved the throttles forward briefly, noted a normal and uniform response from the engine instruments (the EPR gauges were reading normally from 2.52 to 2.54), and then pulled the throttles full back. Capt. Gonzales “immediately” pulled the reverse throttles back into reverse thrust and used wheel brakes. Poe extended the spoilers and then sat down on the jump seat without refastening his seat belt. He believes that the aircraft did not take off. Whether it did or not will be discussed later in this report. Poe’s actions would have taken about three seconds, as shown by later test.

The aircraft continued ahead the full length of the 10,000-ft. runway, beyond it, through a blast fence[a], catching on fire, through the airport boundary fence, and across Rockaway Boulevard where it struck an automobile, injuring the driver and sole occupant. After going through the blast fence, many parts were shed before the aircraft came to rest in flames 830 ft. beyond the end of the runway. Emergency vehicles from the airport and of the New York Fire Department were quickly started for the scene. Although impeded somewhat by weather conditions, they reached it within about six minutes and extinguished the fire. Evacuation and rescue of the occupants had already been effected in a total time of about five minutes, although most persons were out of the wreckage and away from the fire site in half this time. Many of the survivors were taken to hospitals in privately-owned vehicles. Destruction of the aircraft was extensive.

Weather

During the period from 1900 to 2100 there was a precipitation ceiling of 500 ft. or less due to snow. Prevailing visibility remained at less than one mile and gradually dropped to one-quarter mile in snow and fog. Runway visual range decreased until it was reported as less than 2,000 ft. at the time of the accident.

The snow consisted of small dry flakes and was blown and drifted by surface winds which averaged 15 to 22 kt. with gusts up to 27 kt.

A check of snow on runway 7R between 1900 and 2000 was reported as follows by a representative of the snow committee.[4]

First quarter (of runway)—Mostly clear with some patches of compacted snow.

Second quarter—Scattered patches of snow one to two inches deep.

Third quarter—Snow patches two to three inches deep.

Last quarter—Scattered snow finger drifts four to six inches deep.

Runway 7R remained open and available for use until closed by the airport management immediately after the accident and because thereof.

As has been stated, the weather information transmitted by the tower to Flight 401 as it taxied onto runway 7R at about 2012 was: precipitation ceiling 300 ft.; sky obscured; visibility one-quarter mile; light snow and fog; wind east-northeast 18; gusts to 24; altimeter 29.64; runway 4R visual range less than 2,000 ft.

About one minute after the accident the Weather Bureau observed and reported: precipitation ceiling 300 ft.; sky obscured; visibility one-quarter mile; snow, fog, blowing snow; temperature 20F, dewpoint 16F; wind east-northeast 19; gusts to 24; altimeter 29.65; runway 4R visual range less than 2,000 ft.

A few minutes after the accident the pilot of another DC-8, which was preparing to take off after Flight 401, was cleared to taxi up runway 7R about 3,300 ft. in order to return to his terminal (runway 7R was then closed). He reported visibility was approximately ½ to ¾ of a mile and that he observed snow patches about one inch deep covering ⅓ of the runway. He did not see Flight 401 take off. Two tower controllers and some eyewitnesses saw Flight 401 during its takeoff roll at distances from ½ to ⅔ of a mile in blowing snow.

The crew of the last flight (also a jet), taking off from runway 7R before the accident, reported that at the time of their takeoff, 1947, visibility was ½ to ¾ of a mile with ceilings of 300-400 ft., with an improving trend, and that snow was not sticking to their aircraft.

Eastern Air Lines Flight Manual prescribes six inches of snow depth as maximum for DC-8 takeoff. There is nothing in the record to indicate a depth of more than six inches anywhere on runway 7R, although it was probably close to that figure at the upwind end of the runway. At LaGuardia Airport, only a few miles away and where weather conditions should not have differed appreciably, the U.S. Weather Bureau measures and reports snow conditions. Official observations there bear out a probable snow depth of up to six inches (discounting drifting and plowing) at New York International at the time of the accident.

Virtually continuous light dry snow had fallen and the temperature had remained at about 20F during the several hours the aircraft was parked on the airport between flights.

The takeoff roll was timed by one passenger, a highly qualified employee of an aircraft manufacturer. His experience caused him to estimate that rotation should start in 35 to 40 sec. When 50 sec. passed and the aircraft was still on the runway he thought the roll was too long, tightened his seat belt, and leaned forward for protection. Not over one or two seconds later, he testified, the aircraft lifted off the runway with a “thump,” stayed airborne no longer than a count of three, and was back on the runway with brakes and reverse thrust being applied. The “thump” was caused, he believes, by the normal rapid extension of the landing gear struts as the aircraft left the runway. He believes the rotation maneuver started

[a] This fence is of 10-foot sections of steel, each 10 feet high, designed to withstand and deflect the blast of jet engines. The sections are bolted sufficiently frangible to fail readily if struck by a landing aircraft, i.e., from the opposite direction.

[4] The snow committee, composed of persons from various airlines using N. Y. International Airport, undertakes the measurement and reporting of snow conditions on runways for all operators.

with a fast pullup just after 52 or 53 sec. of takeoff roll, and, right after rotation and becoming airborne very briefly, the power was retarded and the aircraft touched down smoothly on all three gears and immediately went into reverse thrust. He sensed pronounced braking action from wheel brakes. About this time the aircraft struck something, ran off the runway into rough terrain, during which he heard the rending of metal and felt a "tremendous" series of bounces up and down and sideways. This witness was in seat 2B in the first-class section.

Most of the passengers thought that the aircraft did leave the ground briefly. This opinion, based on the apparent falling away of runway lights, was shared by two Aeronaves DC-8 pilots who were riding as passengers and one stewardess who was seated aft in the cabin. Some persons on the ground who watched the takeoff roll, or parts of it, thought the aircraft did leave the runway rather abruptly. One well-qualified ground-witness saw the aircraft's lights rise for a short time coincident with reduction of engine power at about the 6,400-ft. point on the runway. Others could not see clearly enough, or not at all, to say if the aircraft left the runway. (This runway is nearly two miles long and ground visibility was restricted due to blowing snow.)

Blowing and drifting snow obliterated tire tracks made during the takeoff roll before measurements could be made. This precluded any possibility of learning definitely the precise point at which the aircraft may have left the runway.

Aircraft Systems

Investigation of several systems of the aircraft was greatly hampered by covering snow and cold weather. Fire destroyed most of the structure, including a majority of the systems components. An unknown amount of additional damage was caused by the fire-fighting and rescue operations. There was no evidence of fire in any system prior to the accident. No evidence could be found to indicate any system had been malfunctioning.

As far as can be determined no circuit breakers were opened during the time the aircraft was on the ground at New York. The switch controlling the pitot and stall-warning anti-ice heaters was found in the "off" position. There was no evidence of impact to this switch or to the surrounding structure.

The flight recorder foil survived the crash and severe ground fire, although a heavy accumulation of mud, kerosene, and carbonized residue was found on the exposed portion of the foil which normally would have contained the pertinent intelligence. A mixture of hydrochloric and hydrofluoric acids cleaned the carbonaceous deposits off the foil but caused some etching of the traces.

Examination of the record for a period of at least four trips prior to the accident revealed that the recorder had malfunctioned on two occasions. This malfunction resulted in no lateral foil movement; however, the stylii for the four parameter traces were still tracing. Therefore, only a vertical stylii trace was made when the foil failed to advance. The last failure of the recorder occurred prior to the accident of Jan. 19 and the recorder was inoperative at the time of the accident. Thus, the foil yielded no intelligence whatever relative to this balked takeoff.

All damage resulting from rotational interference is attributable to loads and distortions imposed by impact forces. In general, the rotor blades and vanes of engines Nos. 2 and 3 showed somewhat more severe rotational damage. Oil systems of all engines were normally clean and there were no signs found of inadequate lubrication. All main bearings except No. 6 of No. 1 engine were inspected and found free of any indication of operational distress. Because impact forces had solidly jammed the No. 1 engine in the No. 6 bearing area, and there were no other indications that would cast doubt on the pre-crash condition of this bearing, it was considered impractical to uncover it. The hot sections of all engines yielded no overtemperature indications.

There were no signs of fuel contamination in any of the five samples taken from fuel in use by each engine and from the refueling truck. All were laboratory-analyzed as "satisfactory." The fuel pumps and fuel controls of engines Nos. 2, 3, and 4 were still operable (those of No. 1 were not) and were test-run with satisfactory results. However, there was no reason to suspect any difficulty with the No. 1 fuel pump and fuel control.

In short, the investigation of these four powerplants yielded no indication of any powerplant distress and indicated that they had been producing power as selected.

The general cluster of wreckage came to rest about 100 ft. beyond Rockaway Blvd. in marshy, frozen, and snow-covered terrain on a heading of about 105 deg. magnetic and slightly to the right of the extended centerline of runway 7R.

Tire marks of the normal intermittent anti-skid type were found beginning 7,535 ft. down the 10,000-ft. runway. They extended 2,235 ft. farther down the runway and ended approximately 230 ft. from the runway end.

All four engines separated from the aircraft. Nos. 1, 3, and 4 came to rest east of Rockaway Blvd. close to the main wreckage. The No. 2 engine came to rest on Rockaway Blvd. The left main landing gear also separated from the aircraft and came to rest on Rockaway Blvd. adjacent to the No. 2 engine. Several other airplane component parts and many fuselage and wing fragments were strewn over the accident path from the blast fence to the main wreckage site.

Fire Damage

Fire broke out early during the sequence of events after the airplane struck the blast fence. At approximately 150 ft. east of this fence and extending about 300 ft. in an easterly direction the ground was scorched. A scorched fragment of the wing leading edge was found approximately 400 ft. east of the blast fence. The majority of the destruction of the wings and the fuselage was the result of the intense and prolonged fire which persisted after the accident.

The fuselage was almost completely destroyed by the prolonged fire following the accident. Only portions of the flight deck upper structure, the belly and lower

side panels, and the extreme aft area were unmelted. The fuselage had remained reasonably intact throughout the accident sequence except for a partial separation of the flight deck section. The heat destruction following impact precluded any establishment as to the extent of this damage.

The wing center section and the wings, except for their bottom skins, were substantially consumed by fire but the outline was in its original configuration. The left wing from leading edge wing station 785 and rear spar wing station 693 to the tip, and the right wing from leading edge station 841 and rear spar station 763 to the tip, were unburned.

The wing flaps were destroyed by fire except for the No. 2 engine exhaust gate, which was torn off. The wing spoilers, which were extended, were consumed by fire as was approximately 50% of the tail assembly.

The actuators from the burned wing flaps were in the 15-deg. takeoff flap position. The remaining right outboard wing slot door was open, the remaining right wing spoiler linkage was seized in the 60-deg. extended position, the control gust lock mechanism was in the "off" position and the horizontal stabilizer was set 1.25 deg. aircraft noseup.

The cockpit area, including the instruments, controls, and circuit breaker panels, was almost totally consumed by fire. However, the overhead panel, the glare shield panel, and a number of damaged flight instruments were recovered. The pitot heat selector was found seized in the "off" position, both wing landing light switches were on, and the windshield heat was on warmup, but other switches were freely moveable because of fire damage. Both static selectors and both KIFIS[a] test switches were in the normal position.

Pitot Heater Condition

The pitot heater ammeter was seized at the 1.1 amp. indication, and disassembly revealed that heat expansion of the hairspring had moved the hand from zero to that reading. No impact marks were found on the overhead panel, disassembly of the selector switch revealed no marks of overtravel, and there were no impact marks on the hard rubber pitot selector lever.

An extensive search of the wreckage area failed to locate the copper airspeed pitot heads, the pitot sumps, or any part of the airspeed system other than the indicating instruments, the one static port, and a few short sections of airspeed aluminum tubing.

Only a static port from the air data system was found. It was not contaminated other than with mud similar to that present at the accident scene, and no contamination in the short aluminum airspeed line sections was found.

The airspeed indicators were recovered with the captain's seized at 60 knots (at the stop) and the first officer's at 63 knots. A foam deposit was found within the captain's instrument emanating from an opening in a torn off line. The Nos. 1, 2, 3 and 4 engine pressure ratio instruments (EPRs) indicated 2.25, 2.55, 2.6 and 2.5, respectively. Their setting bugs were found at 2.55, 2.55, 2.5 and 2.2, respectively. The Nos. 1, 2, 3 and 4 exhaust temperature gauges indicated 340°C, 360°C, 300°C, and 300°C, respectively. The Nos. 1, 2, 3 and 4 tachometers indicated 10, 85, 1 and 15% respectively.

The empennage flight control system forward of the leading edge of the horizontal stabilizer was destroyed. The empennage control systems were properly connected and substantially intact. Most of the fuel system, hydraulic system, and electrical system were destroyed.

In summary, there was found no evidence of failure, malfunctioning or fire prior to impact in any of the various parts and components mentioned above.

This aircraft was serial number 45432 and its total airframe time was 529 hr. and 24 min. at the time of the accident. Four hours and 19 min. was accumulated the day of the accident on the trip from Mexico to New York.

The aircraft was delivered to Aeronaves de Mexico at Long Beach, Calif., Oct. 28, 1960, and flown to the Eastern Air Lines maintenance facility at Miami, Fla., the same day. Aeronaves de Mexico and Eastern Air Lines had previously worked out an agreement on the maintenance to be performed on XA-XAX. In general, Aeronaves de Mexico performed all trip checks and call items on the Mexican end of the route, using the same procedures and program as the Federal Aviation Agency-approved Eastern Air Lines system. Eastern performed all routine maintenance and all major and turnaround inspections in the United States and complied with all of the Federal Aviation Agency Airworthiness Directives. Eastern integrated XA-XAX into its own DC-8 maintenance program.

The time since last phase check (No. 2) was 120 hr. and 11 min. and was completed on Jan. 3, 1961, by Eastern Air Lines at Miami, Fla. The time since the last interphase check was 12 hr. and 54 min. and was completed Jan. 17, 1961, in Mexico. The last trip check was completed at Idlewild International Airport, New York, on the day of the accident.

All writeups on the aircraft, except for a hard landing on Nov. 11, 1960, were malfunctions of various pieces of equipment as might normally be expected in routine day-to-day operation. The appropriate hard landing inspection was complied with by Eastern Air Lines personnel.

The maintenance history of this aircraft appeared to be without any item which could be significantly related to this accident.

Medical examinations were made on the bodies of the four deceased crew members. Three had been on the flight deck and one had been in the lounge immediately aft of the flight deck. All four deaths were caused by multiple burns or generalized third and fourth degree burns. Tests for toxicity produced negative results on all four, and there was no significant level of carbon monoxide in any of the four.

As has been mentioned, EAL Capt. Poe was the only flight deck survivor. He was

[a] Kollsman Integrated Flight Instrument System.

thrown several feet clear of the wreckage, as was his seat. No other flight deck seats were found.

Twenty-eight of the cabin occupants, both passengers and attendants, were injured in diverse manners and varying degrees. As far as can be determined, these persons, as well as all other cabin occupants, did have their seat belts fastened, as directed.

Training Agreement

A joint training agreement between Aeronaves de Mexico, Eastern Air Lines, and the Douglas Aircraft Co., provided that Aeronaves flight crews receive DC-8 training, using Eastern Air Lines ground and simulator facilities and Douglas Co. flight instructors for check-out in the DC-8 aircraft. Eastern Air Lines provided DC-8 ground school classes between Oct. 3, 1960, and Nov. 4, 1960, for five Aeronaves DC-8 captains and eight Aeronaves pilots, including the crew of Flight 401/19. Ground school training included the following: general information, dispatch, performance, high-altitude weather, radio and radar, autopilot, anti-icing and de-icing, electrical, powerplant, fire protection, fuel, hydraulics, flight controls, oxygen system, pressurization and air conditioning, instruments, and emergency procedures. All three flight crew members of Flight 401/19 graduated from the DC-8 ground school with high grades.

All three flight crew members received flight simulator training from Eastern Air Lines and completed their courses satisfactorily.

All three flight crew members were flight-trained in the DC-8 at Miami, Fla., by Douglas Aircraft Co. flight instructors. Capt. Gonzales was checked out as "captain" and both First Officers Bravo and Bacha were checked out as both "first and second officers," and qualified at the systems panel.

The cabin attendants received 25 to 30 hr. of DC-8 training at New York, which included: aircraft familiarization, DC-8 systems, jet-age terms, emergency equipment location and use, aviation physiology, emergency first-aid, emergency evacuation, demonstration and individual participation and use of emergency exit doors, windows, evacuation chute or slide, and a review of the training program. This was followed by a written examination which all attendants passed with high grades.

A cooperative service agreement between Aeronaves de Mexico and Eastern Air Lines was arranged so that Eastern would provide certain services for Aeronaves at the New York International Airport Eastern facility, and Aeronaves de Mexico would furnish Eastern certain services at the Aeronaves facility in Mexico City. This agreement provided for ground services at Idlewild (New York International) Airport and included such items as the handling of Aeronaves aircraft at the Eastern Terminal, provision for Aeronaves ticket counter space, turnaround service, including interior and exterior cleaning of the aircraft and aircraft servicing, cargo handling, preparation of weight and balance, flight plans, dispatch releases, flight traffic, and miscellaneous ramp services. Similar services were to be provided by Aeronaves for Eastern aircraft at Aeronaves facility in Mexico City. Eastern provided trip checks and departure checks and included such adjustments, repair, or replacements as necessary to correct unsatisfactory items reported in the airplane powerplant performance report. In connection with Flight 401/19, Eastern provided the required ramp services, including the de-icing, cargo and passenger, baggage handling, flight planning and dispatching, weather briefing and turnaround service and inspection. There were no uncorrected items in the aircraft flight log according to the Mexican captain who commanded the aircraft on its last prior flight and also according to the surviving EAL Capt. Poe.

Eastern loaned Aeronaves qualified check pilots to assist in the early stages of Aeronaves jet operation between Mexico and New York. This assistance was for approximately two months so that EAL check pilots could accompany each Aeronaves DC-8 captain for at least three round trips and each Aeronaves first officer for a maximum of twelve round trips over the New York-Mexico City route. In accordance with agreement to assist Aeronaves in any proper and practical manner, EAL arranged to assign to Aeronaves four of its senior check pilots qualified on the DC-8. These check pilots on this assignment would specifically perform the following functions:

- **Observe and monitor** the performance of Aeronaves flight personnel.
- **Coach and familiarize** Aeronaves flight personnel with standard procedures for the DC-8, and particularly to familiarize Aeronaves flight crews with air traffic control procedures in the New York area.
- **Assist Aeronaves flight crews** in any other possible way which, in the knowledge and experience of our check pilots, would contribute to the safe, efficient conduct of the Aeronaves operation.

EAL Capt. W. B. Poe was aboard Aeronaves Flight 401/19, in accordance with the above. The Eastern Air Lines Flight Manual, utilized by Aeronaves de Mexico, contains the following:

". . . The Check Pilot or Instructor shall take over the controls at any time during the flight when in his opinion the Captain or Pilot will not be able to maintain control or recover within safe limits from any maneuver. This 'taking over' of controls shall include any take-off or landing when it appears the aircraft may be subjected to damage . . ."

Takeoff Performance

The Douglas Aircraft Co., Inc., manufacturer of the subject aircraft, has furnished the Board with certain takeoff data. All of it is predicated on the following conditions, which are those prevailing, or assumed, at the time and place of the accident.

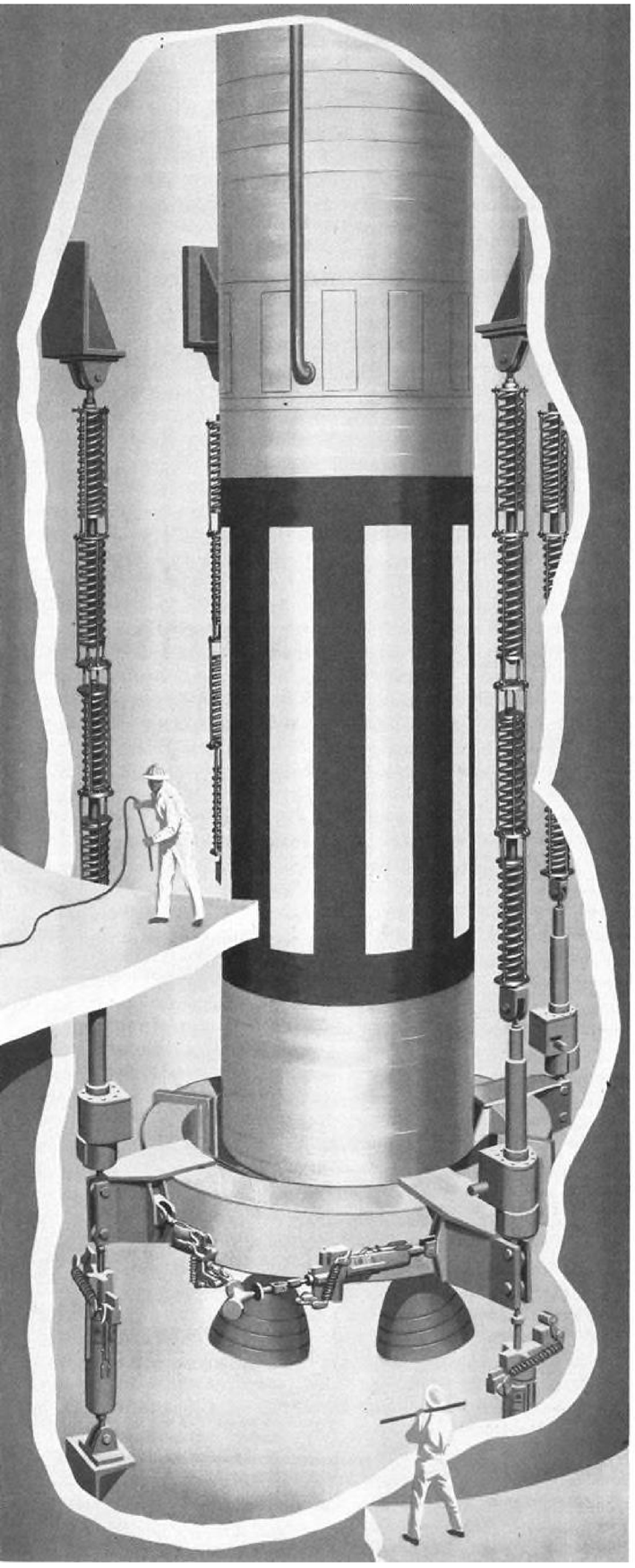
Aircraft nose 300 ft. from southwest end of runway 7R at start of takeoff roll:

Takeoff gross weight	270,671
Flaps set	15 deg.
Engine anti-ice	On
EPR[a]	2.52–96% thrust 4 engines

(Brakes released after takeoff power is set and blowaway jets off five seconds after brake release)

Wind	18 kt. east-northeast
Temperature	20F
Runway	7R Idlewild
MAC	26%

[a] According to testimony of Capt. Poe.



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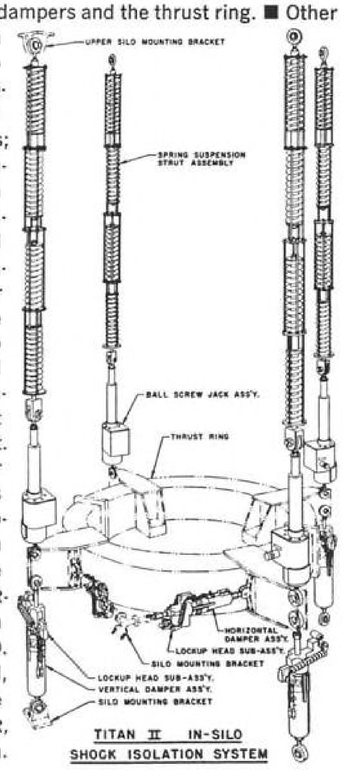


TITAN II IN-SILO
SHOCK ISOLATION SYSTEM

WG PRECISION PRODUCTS DIVISION

Runway gradient ..... Zero

Because there are no known data applicable to snow-covered runways, the box below is based on a dry, concrete runway.

With respect to the runway lighting, investigation has disclosed that the runway lighting had been changed and that there had been one or more notices to airmen (NOTAMS) on the subject. These changes in lighting were on the last half of the runway. At the time Poe pulled the throttles the aircraft was still on that portion of the runway which was lighted, as originally prescribed, and he does not ascribe any irregularity in lighting on the far end as a factor in discontinuing the takeoff of the aircraft.

The methods employed for measuring visibility and snow depth leave much to be desired. As now provided they are not properly representative of pertinent runway conditions. The transmissometer cannot

Normal Takeoff Profile

	Airspeed (Knots)	Distance (Feet)	Time (Sec.)	Thrust (EPR)	Attitude (Degrees)	Altitude (Feet)
100 Kt. Ck.	100.0	2000	21.3	2.52	−1	0
V_1	130.8	3270	29.6	2.52	−1	0
V_r	143.0	3994	33.6	2.52	−1	0
Liftoff	154.6	4801	37.0	2.52	+9 to +11	0
V_2	160.56	5950	42.18	2.52	+9 to +11	35
35 Ft. alt.	160.56	5950	42.18	2.52	+9 to +11	35

(Distance in feet is in relation to western end of runway 7R)

Profile for an Abort (Balk) at V_1

100 Kt. Ck.	100.0	2000	21.3	2.52	−1	0
V_1	130.8	3270	29.6	2.52	−1	0
Brakes	130.8+	3720	33.26	Forward Idle		

1. Accelerate Stop Distance (Brakes Only)

6350	Forward Idle	−1	0

2. Accelerate Stop Distance (Brakes plus #2 and #3 engines in reverse thrust takeoff power and #1 and #4 engines in forward idle thrust)

5965	2.52 #2 and #3	−1	0

3. Accelerate Stop Distance (Brakes plus all four engines in reverse thrust takeoff power)

5660	2.52	−1	0

Abort (Balk) at VR (No rotation started)

100 Kt. Ck.	100.0	2000	21.3	2.52	−1	0
V_1	130.8	3270	29.6	2.52	−1	0
V_r	143.0	3994	33.6	2.52	−1	0
Brakes	143.0+			Forward Idle	−1	0

1. Accelerate Stop Distance (Brakes Only)

8185	Forward Idle	−1	0

2. Accelerate Stop Distance (Brakes plus #2 and #3 engines in reverse thrust takeoff power and #1 and #4 engines in forward idle thrust)

7710	2.52 #2 and #3	−1	0

3. Accelerate Stop Distance (Brakes plus all four engines in reverse thrust takeoff power)

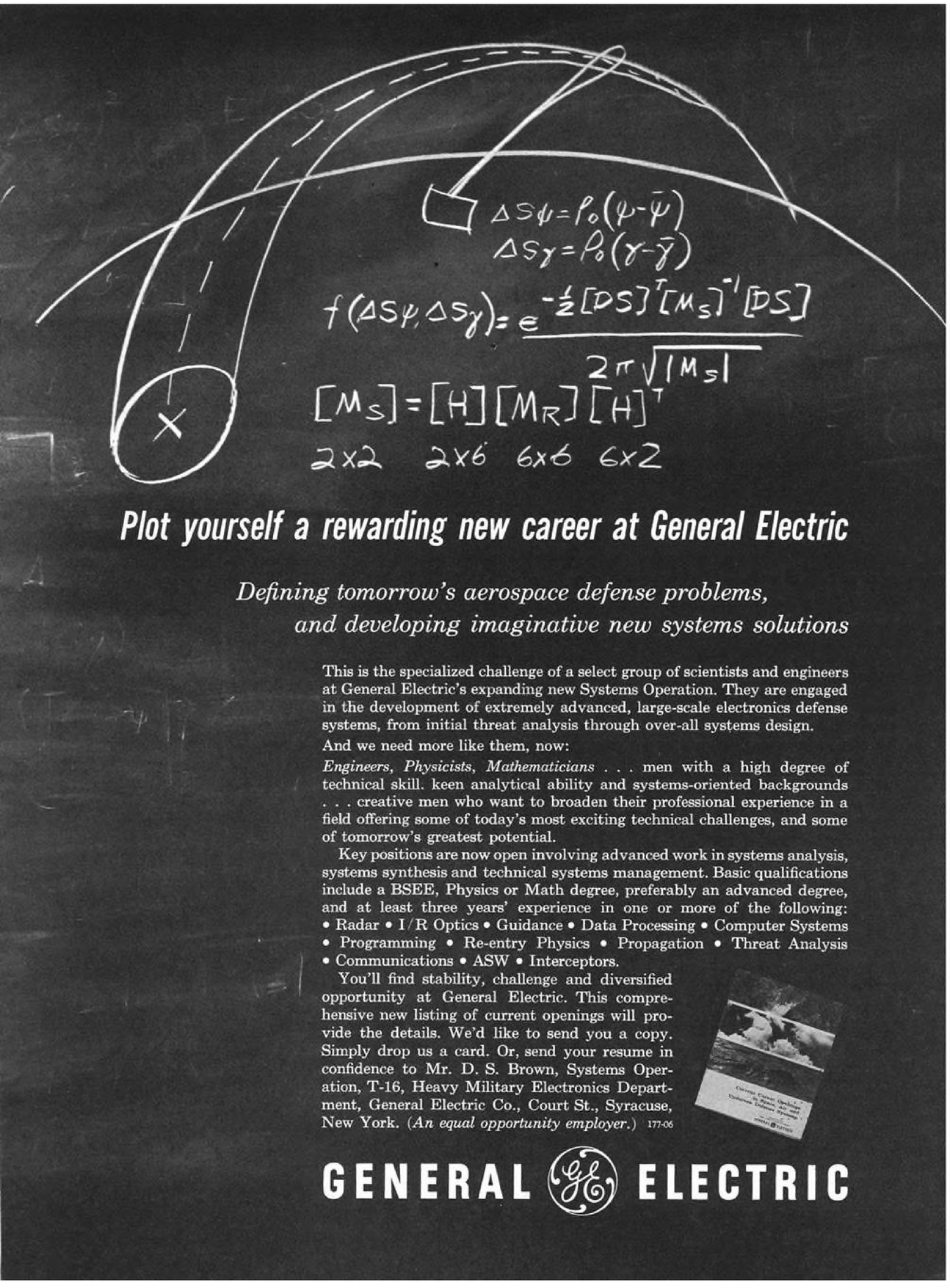
7445	2.25	−1	0

Accelerate to Time of 50 Seconds and 52 Seconds Without Rotation

100 Kt. Ck.	100.0	2000	21.3	2.52	−1	0
V_1	130.8	3270	29.6	2.52	−1	0
V_r	143.0	3994	33.6	2.52	−1	0
50 Sec. Run	200.01	7470	50.0	2.52	−1	0
52 Sec. Run	208	8170	52.0	2.52	−1	0

Note: Estimated distance to stop aircraft after reaching 208 kt. and 8,170 ft. on runway is 5,300 feet additional if brakes are used and all four engines are in reverse thrust at takeoff power.

Vmu (minimum speed at which aircraft could have left the runway) was 137.8 kt.



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POWER TRANSMISSION DRIVES

measure runway visual range values below 2,000 ft. and the prevailing visibility, reported at ¼ mile at the time of the accident was observed at a point well removed horizontally and vertically from runway 7R. The procedures used for measuring snow depth are not precise as to the permissible length of time in advance of a takeoff that runway measurements of snow depth can be made, the points along the runway at which measurements should be made, and the means for establishing density. However, the weather and runway conditions, though marginal, are not considered to have been prohibitive or critical.

Much of the aircraft was destroyed by impact and fire and could not be examined. However, the facts disclosed by those parts which were examinable, plus the circumstances, make extremely unlikely the possibility of failure or mechanical malfunctioning of any part of the aircraft or of fire prior to impact.

Airspeed Indicator

When Capt. Gonzales called or pointed to the airspeed indicator, Capt. Poe felt that the 130 knots which the indicator was then showing was insufficient for takeoff and, after gauging progress, quickly pulled the power. But what remains unknown is Capt. Gonzales' motive in pointing toward or calling attention to the airspeed indicator. He may have been calling to Poe's attention an indication which was too low (as Poe apparently believed), or he may have been conveying the idea that the airspeed indicator was not to be trusted and should be ignored. Whether the latter is the case or not, after Poe pulled the throttles the aircraft was committed to a balked takeoff, irrespective of what was in store at the end of the runway.

There is no way of positively establishing the dependability of this airspeed indicator. The maintenance records indicate that it should have been functioning properly. As has been mentioned, the switch controlling the heat to the pitot tubes was found "off." Whether it was not "on" during takeoff or was knocked to "off" at impact cannot be established, although the latter is unlikely as has been explained. If it was not "on" during takeoff, an erroneous airspeed indication may have resulted. This subject will be discussed later in this analysis.

Engine Examination

Examination of the engines substantiated that they were capable of developing full power and that they had not been damaged prior to impact. As has been pointed out, one of Poe's observations during the brief period when he was weighing a balk was that of the four EPR gauges, and he stated that they were reading normally. These gauges could read erroneously if their probe ends were iced up. These ends are electrically heated and can be turned off only by means of the circuit breakers (which was not done as far as can be ascertained during the period that the aircraft was on the ground between flights at New York International Airport). Thus, there is no reason to suspect that there may have been an erroneous power indication by the EPR gauges.

According to Poe, V_1 and V_r were called in rapid succession by the first officer. However, the aircraft could not have accelerated from the 129 kt. V_1 speed previously calculated by the flight crew to the calculated 143 kt. V_r speed without an appreciable time interval. The captain's airspeed was at the time indicating 130 kt., also according to Poe, and shortly thereafter quickly reduced to 110 kt. during rotation at which time Capt. Gonzales pointed to or mentioned his airspeed. All three of these conditions were obviously abnormal.

Abrupt Rotation

Poe also felt that the aircraft did not become airborne and was not accelerating properly after rotation, although he felt that the rotation was abrupt and excessive. He therefore reduced engine power without cross-checking with the first officer's airspeed. The stewardess in the aft cabin could not have noticed the runway lights becoming farther away unless the aircraft was airborne, as rotation only would have lowered the tail and caused the lights to become closer. Also, the aircraft's lights were seen to rise for a short time coincident with reduction of engine power at about the 6,400-ft. point on the runway. The landing lights are located in the trailing edges of the wings and the navigation lights are at the tips, both of which would lower slightly during rotation since they are somewhat aft of the main landing gear and would not rise except after the aircraft became airborne. The two DC-8 pilots and the well-qualified passenger, all of whom were seated well forward, believed the aircraft to have been airborne, as do two lay ground witnesses. Additionally, the lifting sensation described by passengers in the aft part of the cabin (which should have lowered if rotation only had occurred), the stopping of runway roughness, the smooth feeling of flight, the thump normally coincident with extension of the landing gear oleo struts on becoming airborne quickly, a touchdown bump, and the preponderance of other witnesses' evidence, establish the aircraft being airborne for a few seconds.

According to the Douglas Aircraft Co. performance data, the aircraft, under existing conditions but on a snow-free runway, would normally have been rotated after a 3,994-ft. roll in 33.6 sec. at 143 kt. and become airborne at 4,801 ft. in 37 sec. at 154.6 kt. But the evidence of five persons on the ground indicates that the aircraft was not airborne by the time it had rolled 6,200 ft. down the runway.

Calculated Performance

According to the same performance data the aircraft, in 50 sec., should have traveled 7,040 ft. along the runway and reached a speed of 200 kt. But it did not travel 7,040 ft. in that time. At 50 sec. (by calculation, see box) with uniform acceleration, it should have passed the 6,200-ft. point at an airspeed of 163.8 kt. It became airborne two or three seconds later, touched down, and caused intermittent skid marks beyond the 7,040-ft. point (at 7,535 ft.). Actually the takeoff roll started about 300 ft. from the threshold where a normal turn from the taxiway would place the aircraft. It is, therefore, obvious that the aircraft was not accelerating properly.

The aircraft could not have become airborne at less than 137.8 kt. It must have

been appreciably greater than that figure because an abrupt and excessive rotation, as apparently did occur, is not possible at that minimum takeoff speed due to the relatively slower elevator effect at that speed.

The tested three-second average time required for Poe to unfasten his seat belt, stand up, estimate progress, move the throttles ahead slightly, then close them, when applied to a DC-8 simulator rotated at a 163-kt. airspeed, resulted in a simulated 150-ft. climb.

This altitude could not have been possible as the aircraft could not have touched down again in a maximum 1,335-ft. distance, and indicates that the airspeed at becoming airborne must have been considerably less than 163 kt.

Thus, the takeoff speed could not be less than 137.8 kt. and not as much as 163 kt. A uniform acceleration to 130 kt., then a constant speed to the end of the 50-sec. period, would require 16 sec. at 130 kt. (which no captain is likely to allow). This indicates that acceleration was probably normal to the 100-kt. point, but not normal thereafter. The probability exists that after the 100-kt. point the speed continued to increase, but more slowly, to the 143-kt. airspeed at liftoff, since this was the airspeed that the first officer should and probably did call as V_r. From this it is clear that either the captain's airspeed indication was erroneous or Poe was mistaken in stating that it read 130 kt.

Erroneous Reading

On the basis of the following evidence, it is concluded that the captain's airspeed indicator was giving an erroneous low reading at the time takeoff was aborted. The first officer, observing his airspeed indicator, had called out V_r (143 kt.). Immediately thereafter, Capt. Gonzales had pointed to his airspeed indicator and Capt. Poe in checking the airspeed on the captain's instrument had read 130 kt. and advanced, then closed the throttles.

At the time of the accident, the sustained wind velocity was 19 kt. with gusts to 24 kt. Such gusts might account for a slight change but not a 13-kt. increase (130 to 143) or 20-kt. decrease (130 to 110) in the airspeed indications. It is evident, therefore, that the captain's airspeed must have been indicating erroneously for some other reason.

The possibility of Glycol entering the airspeed systems through the pitot heads during anti-icing and de-icing of the aircraft was explored. However, because both pitot sumps were drained after use of Glycol, the possibility of Glycol having affected the airspeed systems appears to be most unlikely.

It cannot be definitely shown, due to impact and fire damage, that no mechanical malfunction of the captain's airspeed system occurred. However, a review of the aircraft's records revealed no uncorrected airspeed items and indicated a satisfactory leak test of the airspeed systems on Jan. 4, 1961, with no malfunctioning noted thereafter. In addition, the left airspeed indicator was evidently slow by at least 13 kt. up to the rotation point. Similar leaks simultaneously affecting both systems are extremely unlikely.

As has been stated, it cannot be definitely substantiated that the pitot heat selector

was not moved by impact to the "off" position, where it was found. This is so because the copper pitot heads and the transducer heating elements were not found despite extensive effort by investigators and considerable expense for earthmoving equipment.

The pitot heat selector furnishes current for the heating elements in the captain's and first officer's pitot heads and for the stall-warning transducer. Current is supplied to all three when the selector is in any one of the four positions except "off". The ammeter indicates current drawn by whichever one of these three elements is selected. The proper amperage is 1.75 to 2.75 for each airspeed pitot, and 1.25 to 2.75 for the stall-warning transducer. The ammeter indicated 1.1 amp. when found (probably moved to that figure from zero by fire, as has been mentioned). Neither the knob of the pitot heat selector nor the assembly in the immediate vicinity bore any marks of impact, although there was marked fire damage. Moreover, there were no marks of overtravel within the selector switch, and it is unlikely that impact would move the selector knob due to the internal spring followup design of the switch. This strongly indicates that the selector was not moved by impact.

Thus, it appears that the left airspeed indicator was slow to the 130-kt. point and then suddenly changed. Since leaks are unlikely, the cause could only have been of a type that was changeable with increased airspeed. The probable cause for such an erroneous reading could not be determined. However, the possibility exists that failure to apply pitot heat during snow conditions may have played a part in the erroneous indication.

As has been shown, there was no decay in engine power and consequently the slow acceleration must have been due to snow on the runway. The amount of this lessening of acceleration is not subject to precise and specific quantitative analysis. If there had been no impairment of acceleration, the aircraft would normally have been only 3,994 ft. down the runway rather than 6,200 or more feet at time for rotation.

It has been established that the aircraft was capable of continuing the takeoff if power had not been reduced by Poe. Eastern's Operations Manual, utilized by Aeronaves, authorizes the check pilot to take over control at his discretion, as has been mentioned earlier. Whether or not Gonzales would have continued the takeoff if Poe had not reduced power will never be known.

In an effort to determine whether or not continuation of such a takeoff as that involved in the accident (with one or both airspeed indicators malfunctioning) is safer than discontinuing the takeoff, arrangements were made with two air carriers for tests in their DC-8 flight simulators. These tests indicated that (1) such a takeoff by a qualified DC-8 captain could be completed with a reasonable degree of safety, and (2) captains normally do cross-check with the first officer's airspeed under such conditions.

Any small amount of snow which may have remained on the aircraft after desnowing or any small amount which may have accrued while taxiing did not, pal-

pably, have any significant effect on the aircraft's takeoff capability. Therefore, snow on the structure is not considered to be a factor in this abnormal takeoff.

Aeronaves de Mexico utilizes Eastern's checklists and, since the accident, Eastern has changed its cockpit checklist to eliminate turning off the pitot heat selector once it is turned on prior to engine starting. At the time of the accident the procedure was to turn it "off" and "on" again before takeoff.

DC-8 Capabilities

The DC-8-21 aircraft has the capability of being rotated to its physical limits (until the bottom of the empennage almost touches the runway) and continuing to accelerate until becoming airborne. Once it becomes airborne, even though rotation has continued to the maximum physical limits, airspeed continues to increase, assuming there are no malfunctions or failures. It is not possible in a DC-8-21 to "get on the back side of the power curve," i.e., to enter the region of operation wherein the power required is greater than the power available, while the aircraft is on the ground. If the angle of attack is not further increased following liftoff, the aircraft would continue to accelerate. Flight tests have proven that maximum rotation at the minimum speed will result in a positive rate of climb and the shortest runway distance to liftoff. Once airborne the takeoff performance characteristics will be much the same as if rotation had been made at the predetermined flight manual V_r, taking into consideration, of course, the differences in elapsed time, distance, and airspeed.

Speed Decrease

A question has been raised as to the possibility of decreasing the speed of the aircraft from 130 to 110 kt. very quickly—say within five seconds—during or immediately after rotation, as Poe believed. To achieve such a decrease in airspeed the deceleration would have to be 8.44 ft./sec.^{2} (0.26g) which, at the takeoff gross weight of 270,000 lb., would require a drag force of 70,500 lb. Thrust available from the four engines, at between 110 and 130 kt., is approximately 59,000 lb. Assuming conservatively that 59,000 lb. of thrust is in balance with the drag (no acceleration), an additional 11,000 lb. of drag would be needed upon retarding power to idle to produce a 0.26-g deceleration. Actually, with the throttles in "idle," the engines are still producing some forward thrust. To determine the effect of the increased drag on the aircraft, due to the rotated attitude, a series of calculations were made. Assuming that the aircraft's speed was stabilized at about 130 kt. (thrust = drag), and then rotated, the time necessary to decelerate to 110 kt. is:

- 6.9 deg. rotation = 45.7 sec.
- 8 deg. rotation = 34 sec.
- 12 deg. rotation = 18 sec.

These times are obviously too long to be considered in this case. In addition, the assumption that the aircraft was stabilized at 130 kt. is false because the engines were apparently operating properly and producing the proper amount of thrust for continued acceleration. Thus, it can

be seen that it is not possible for the aircraft to have decelerated from 130 kt. to 110 kt. in five seconds.

The Board concludes that the aircraft did become airborne. Investigation of the accident has pointed out that Capt. Poe erroneously believed that if the speed of rotation were appreciably below the calculated V_r speed, a longer takeoff run would result.

The Board concludes that the takeoff was discontinued as a result of the action of the check pilot, who was not seated in a pilot seat, in reaching forward without warning and pulling the throttles back. This action caused power to be decreased on all four engines.

Probable Cause

The Board determines that the probable cause of this accident was the unnecessary discontinuing of the takeoff by the check pilot, who was not in either pilot seat.

The contributing factors in this accident were the marginally poor weather, snow on the runway, and the possibility of the pitot head heat not having been on.

By the Civil Aeronautics Board:
Alan S. Boyd, Chairman
Robert T. Murphy, Vice Chairman
Chan Gurney, Member
G. Joseph Minetti, Member
Whitney Gillilland, Member

The Civil Aeronautics Board was notified of this accident immediately after occurrence, and an investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958.

Aeronaves de Mexico operated under United States Civil Aeronautics Board foreign air carrier permit issued pursuant to Order E-11730, dated Aug. 16, 1957.

A concurrent foreign air carrier operations specification, No. 2032, was issued by the United States Civil Aeronautics Administration, dated Dec. 6, 1957.

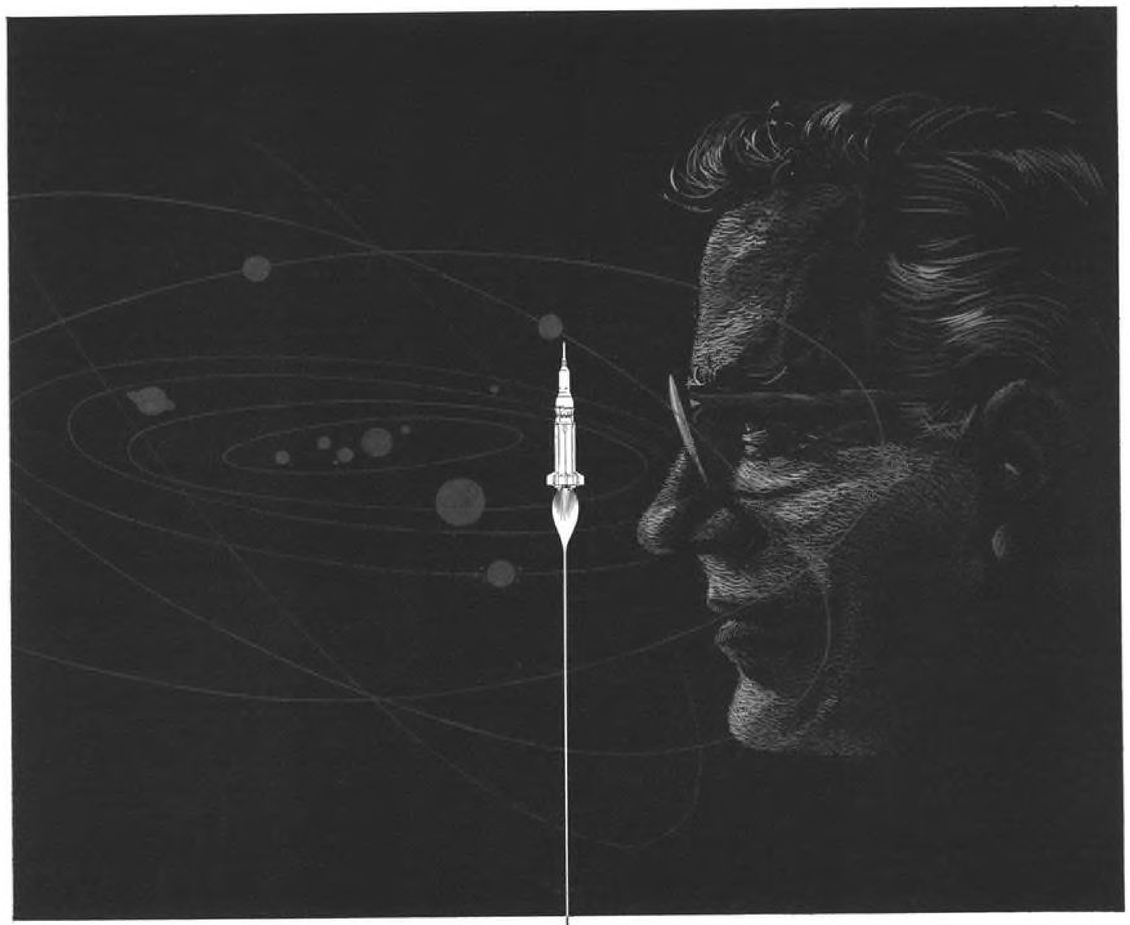
Flight Personnel

Capt. Ricardo Gonzalez Orduna, age 46, a Mexican National, held a currently effective airline transport certificate No. 98 (Mexican). He was checked out as a DC-8 captain by the Douglas Aircraft Co. on Nov. 30, 1960, at Miami, Fla. He was rated in the Boeing 247, C-39, DC-3, DC-4, L-49, Britannia, and the DC-8. His total pilot time was 15,210:34 hr., of which 94 hr. were in DC-8s. His total night time in DC-8 aircraft was 46:47 hr., and his total instrument time in the last three years was 182 hr.

First Officer Antonio Ruiz Bravo, age 32, a Mexican National, held a currently effective airline transport certificate No. 390 (Mexican).

Second Officer Xavier Alvarez Bacha, age 32, a Mexican National, held a currently effective airline transport certificate No. 553 (Mexican).

Capt. William B. Poe, age 53, a United States National, was a designated Eastern Air Lines DC-8 check pilot, and held a valid airline transport pilot certificate with ratings: M-202, 404, Constellation, L-188, DC-3, DC-4, DC-6, DC-7, and DC-8 aircraft. He had a total of 19,495:00 flying hours, of which 285:00 were in the DC-8. His total night time was 4,800:00 hr., with a total instrument time of 2,124:00.



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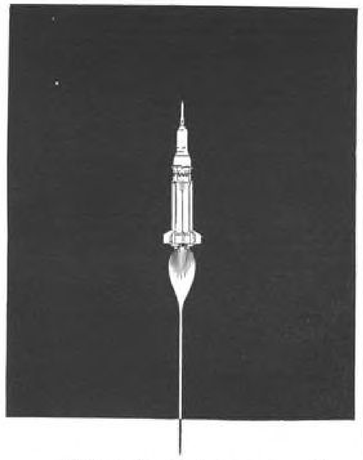

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LETTERS

Flag Carriers

John Brancker's AVIATION WEEK article, Aug. 20 (p. 45), poses valid questions concerning this government's policy for the U.S. flag carriers. It propounds an excellent argument contra protectionism as policy, but says more by omissions than by his inclusions.

He has mustered the foreign airline arguments against recent congressional[1] and Civil Aeronautics Board[2] actions in flag carriage matters. In so doing he has made a persuasive case for unrestricted foreign airline operations to and from the United States, but failed to differentiate in protectionism and exercise of sovereign right.

Argument should be answered, if only to test the validity of points raised. Where the argument concerns a contract, examination of contributory circumstances is of importance to established truth; this being the instigation of the recent actions by this government.

Certain points should be kept in mind in any matter involving the relationship of this government and the American air carrier industry. No other nation possesses the number or complexity of air carriers present here; a situation conducive to ambivalence of policy. This nondetermination, coupled with multiple designation of air carriers over our international routes, has produced the current situation.

A combination of this strong, vocal air carrier industry and foreign governments determined to capitalize on the ambivalence of this government's aviation policy has oftentimes conspired to produce inequitous route exchanges, to the detriment of the U.S. flag carrier. By substituting multiple designation for the chosen instrument, covert advantage was given the chosen instrument foreign government in bilateral negotiation and recent actions by this government merely seek correction of the inconsistencies or inequities.

Through the CAB's attempt to define the character and composition of traffic borne to and from this country by the Part 213 (see footnote 2) proceedings, proper discharge of its regulatory function took place. Its failure to promulgate such regulations as this would appear a toleration of extra-territoriality, which doctrine has certainly passed into oblivion.

Brancker's further attempt to derrogate subsidy does injustice to the unsubsidized flag carriers as well as denying the umbrella's existence that presently shelters most European air carriers from the hard sunlight of reality. Subsidy is a crutch that gives competitive advantage to the subsidized airline and one that shows not the slightest indication of diminishing in European airline operations.

In the nature of subsidy, one should consider the trend of user fees which continue to increase in Europe as well as most other areas outside this country. For example, the following table will illustrate the disproportion that characterizes landing fees; giving a penalty to the U.S. flag carriers while really not penalizing the flag carrier of the particular nation (the transaction being a matter of bookkeeping, at best).

These charges are based on a Boeing 707 with a maximum gross weight of 311,000 lb. at takeoff; are gleaned from ICAO Manual of Airport & Air Navigation Facility Charges, June 1961 (with increases at certain airports either proposed or in effect, but not shown here).

Airport	Landing Fee	Related Fee
Sydney, Australia	$573.59	....
Montreal, Canada	455.52	....
Paris, France	304.16	$3.05/pax Head tax
Paris, France	313.34 (night)	....
Germany: All Airports	269.00	....
Tokyo, Japan	205.09	....
Tokyo, Japan	209.24 (night)	....
Sudan: All Airports	711.76	....
South Africa: All Airports	286.95	....
London, England	677.04	1.00/pax Head tax
Caracas, Venezuela	210.45	28.06
New York Intl., New York	108.05	192.05*
San Francisco Intl., Calif.	71.35	

* New York charges include porter service, incinerator, inspection space and general terminal charges for aircraft.

In his conclusions Brancker suggests the need for universal agreement as a stimulus to development of international air transportation, with special emphasis in matters of rate making agreement. He fails to propose a modus operandi for achievement of international airline amity, as well as failing to demonstrate reasons why this government should not require the same or similar service requirements for all air carriers serving this country.

Considering the enormity of change that has occurred in the field of air transport since the Chicago Convention of 1944, it seems propitious to reconvene IATA-member nations to attempt resolution of the problems currently plaguing the field of international air transportation. Commerce cannot prosper in an atmosphere of acrimony or mistrust, and the surest method of elimination of present disputes is that of consultation.

Certainly we all aim to foster air commerce development as a bulwark to peace and a strong contributor to the economy of participating nations. Agreement with this is universal; cannot come without a meeting of minds.

AVIATION WEEK and Mr. Brancker have done a useful, necessary service to international aviation by publication of his comments. This government's inquiry is also of service—should not be dismissed as "protectionism": for inquiry is necessary when parties to contract disagree with interpretation of the contract terms. From examination comes understanding and cavalier dismissal of complaint cannot produce resolution of amity.

All will benefit from common knowledge of the facts of air carriage.

Men of good intent can resolve their differences through candor and honesty, regardless of the differences. Statements such as this have value in shedding light in matters under dispute, but so does inquiry—either governmental or private examination.

Let us hope that the goad of economic necessity and the desire for resolution of current differences will produce the impetus for an assembly to resolve outstanding problems, possibly to fulfill the predictions of prosperity for this industry so often made.

CURTIS M. OLSEN, Chairman
System Route Committee
Pilots, Pan American Airways**

** A committee financed and directed solely by pilots in the employment of Pan American World Airways, for the purpose of publicizing conditions that have stultified growth of their employer and generally produced stagnancy in U.S. flag carrier operations from this country.

[1] HRs 10655 & 10657, introduced by Mr. Williams, Chmn. House Subcommittee on Aeronautics (Rate & Data Filing).

[2] Investigation of the term, conditions & limitations of foreign air carrier permits: Docket 12063, CAB Order E-16288, dated Jan. 18, 1961.

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.

No Agreement

Let me correct a misconception left by the Aug. 6 AVIATION WEEK article, p. 109, on selection of General Electric's CJ610 as powerplant for the Hamburger HFB.320.

The report gave an impression the West German firm's switch to a General Electric engine was predicated in part on G.E.'s agreeing to share in development financing of the aircraft.

The fact is we have no such agreement with Hamburger, and the European company has not been offered anything that hasn't also been made available to our other commercial customers.

Incidentally, the HFB.320 will be powered by the CJ610-1 developing 2,850 lb. thrust, not the CJ610-2B with 2,400 lb. as reported.

The CJ610-2B has been discontinued and all current applications are using the 2,850 lb. thrust engine.

NORRIS E. KENYON
Manager-Product Information
Small Aircraft Engine Department
General Electric Co.
West Lynn, Mass.

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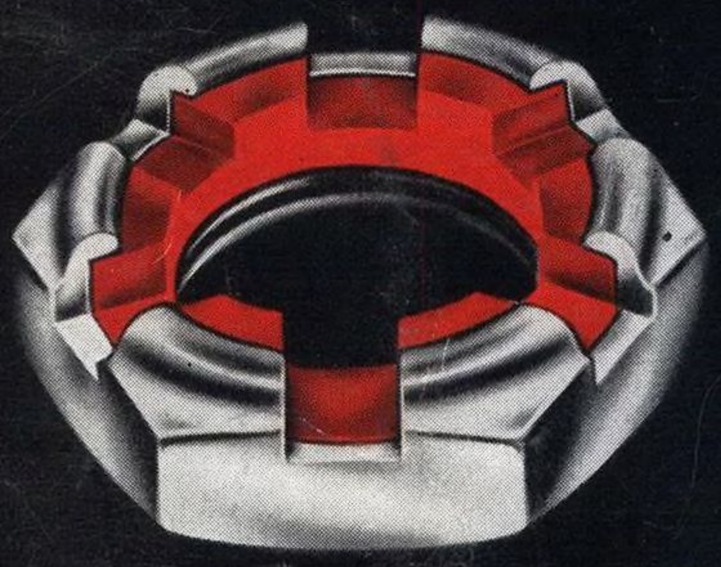

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