# Aviation Week & Space Technology

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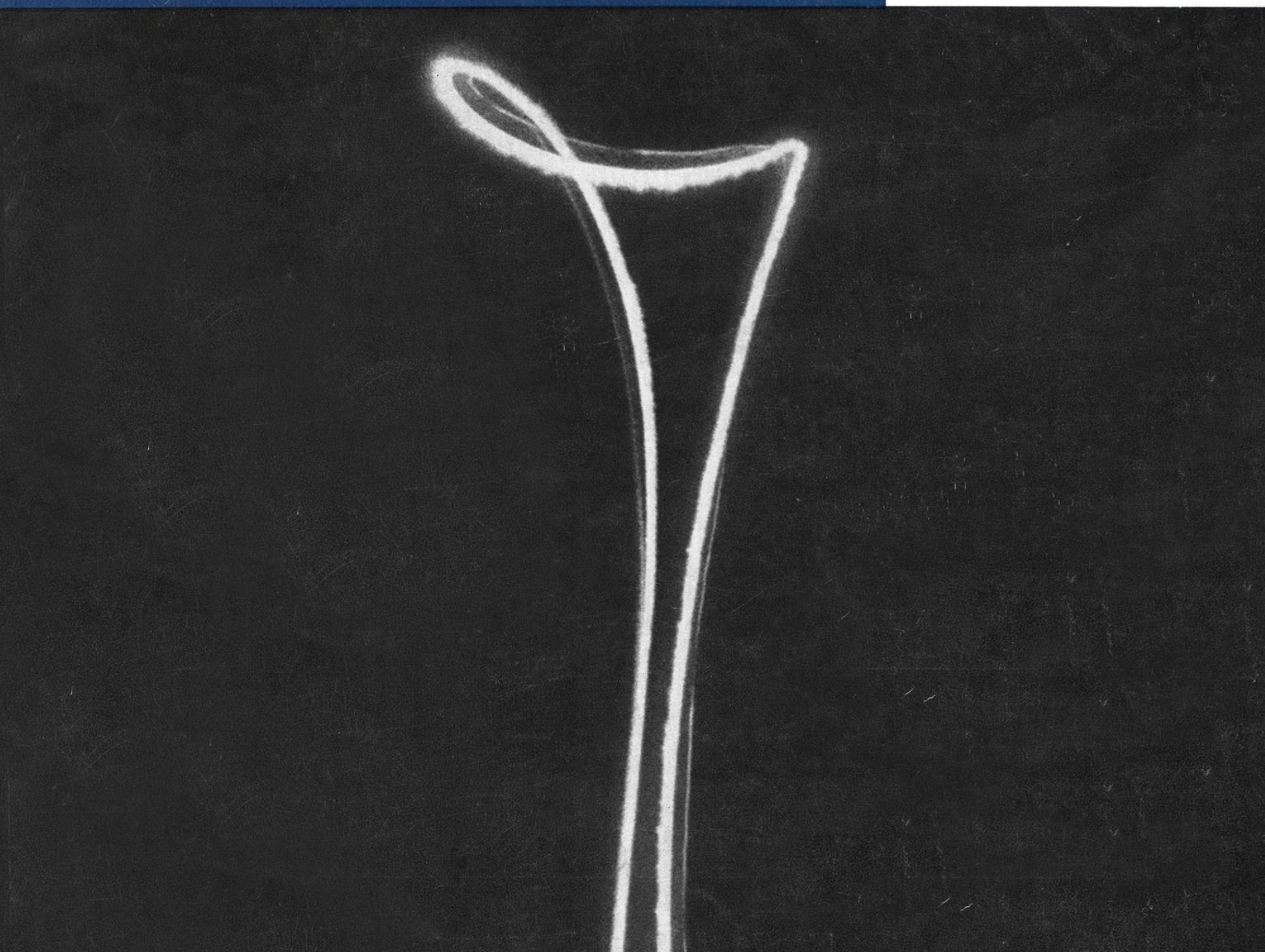
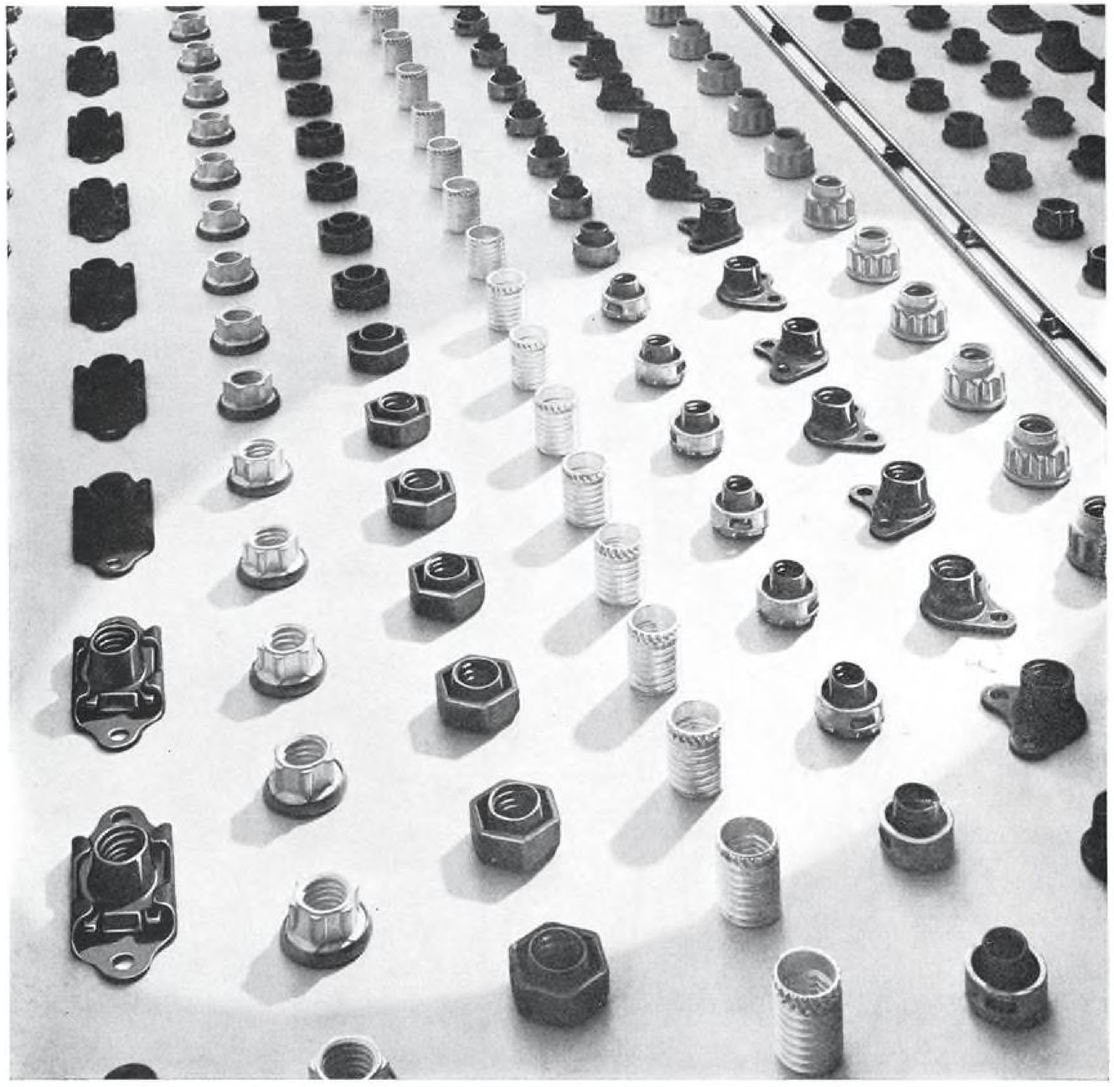
December 30, 1963


## Argentina Expands Transport Project

Scout Failure at Wallops





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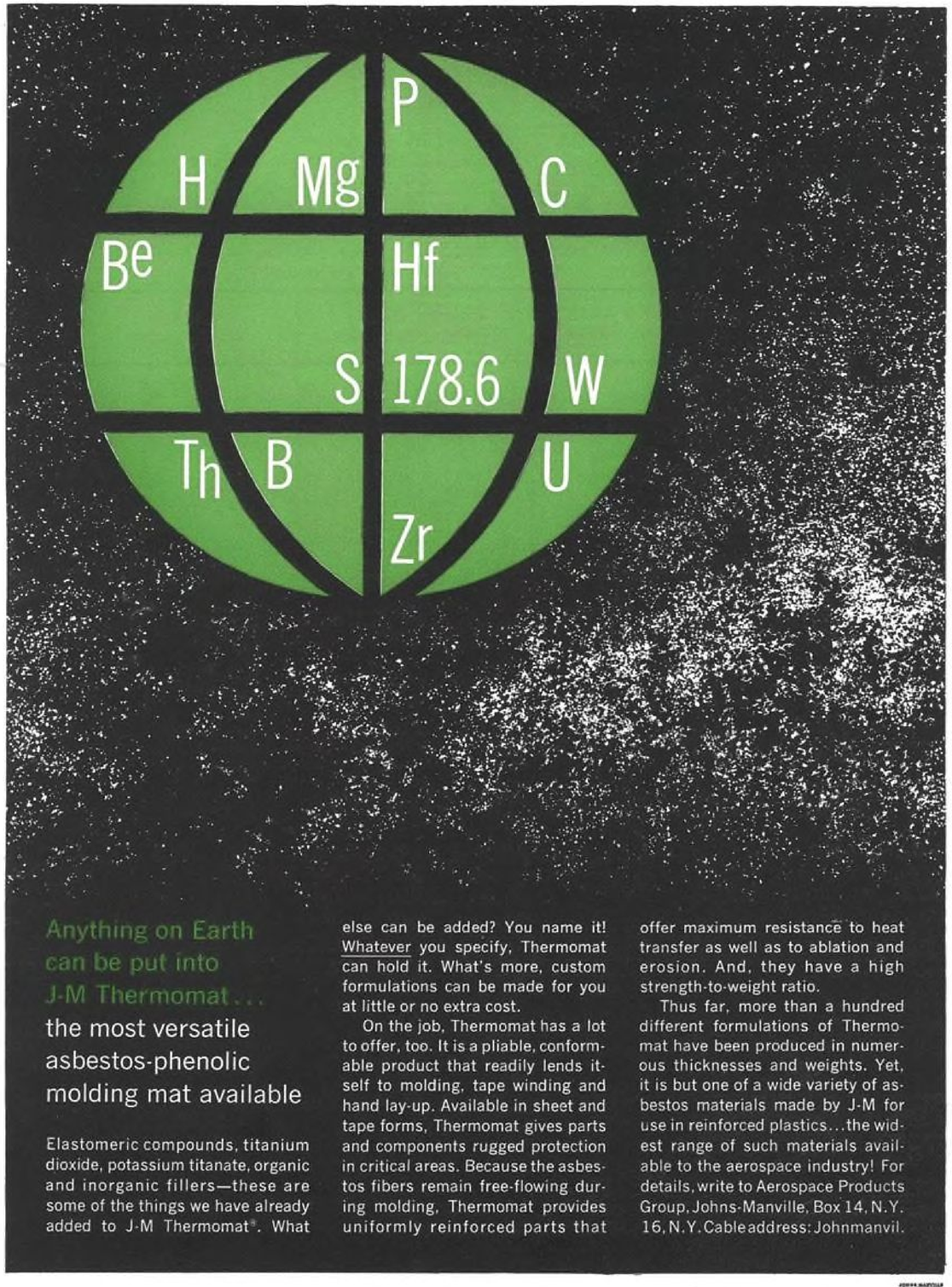


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## AEROSPACE CALENDAR

Jan. 7-9—Tenth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D.C.

Jan. 9-10—Workshop Conference on "Long Range Goals of Biology in Space," University of Rochester, Rochester, N. Y.

Jan. 13-17—Society of Automotive Engineers Automotive Engineering Congress & Exposition, Cobo Hall, Detroit, Mich.

Jan. 19-23—16th Annual Convention, Helicopter Assn. of America, San Marcos Inn, Chandler, Ariz.

Jan. 20-22—Aerospace Sciences Meeting, American Institute of Aeronautics and Astronautics, Hotel Astor, New York.

Jan. 21-24—Second International Arms Control and Disarmament Symposium, Ann Arbor, Mich. Sponsors: University of Michigan; The Bendix Corp.

Jan. 25—Seventh Annual Inland Empire Quality Control Conference, American Society for Quality Control, California State Polytechnic College, Pomona, Calif.

Jan. 27-28—Second Annual Symposium on Fundamental Phenomena in the Material Sciences, Sheraton Plaza Hotel, Boston, Mass. Sponsor: Ilikon Corp.

Jan. 27-29—Conference on Control and System Optimization, Monterey, Calif. Sponsors: Society for Industry & Applied Mathematics; American Institute of Aeronautics and Astronautics; Institute for Mathematical Statistics; U. S. Naval Post Graduate School.

Jan. 27-30—20th Annual Technical Confer-

(Continued on page 7)


AVIATION WEEK & Space Technology

December 30, 1963

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## AEROSPACE CALENDAR

(Continued from page 5)

ence, Society of Plastics Engineers, Chalfonte-Haddon Hall Hotels, Atlantic City.

**Jan. 27-30**—Applications Forum on Antenna Research, University of Illinois' Midwest Electronics Research Center, Urbana, Ill.

**Jan. 29-31**—44th Annual Meeting, American Meteorological Society, University of California, Los Angeles, Calif.

**Jan. 29-31**—Solid Propellant Rocket Conference, American Institute of Aeronautics and Astronautics, Palo Alto, Calif.

**Feb. 3-7**—Fifth Annual Lectures in Aerospace Medicine, USAF School of Aerospace Medicine, Brooks AFB, Tex.

**Feb. 3-7**—International Conference on Materials "The Impact of Modern Physics on Materials," Sheraton Hotel, Philadelphia, Pa. Sponsor: American Society for Testing and Materials.

**Feb. 5-7**—Fifth Winter Convention on Military Electronics, Institute of Electrical and Electronics Engineers, Ambassador Hotel, Los Angeles, Calif.

**Feb. 13-15**—Golden Gate Metals Conference, American Society for Metals, Fairmont Hotel, San Francisco, Calif.

**Feb. 19-21**—International Solid-State Circuits Conference, Institute of Electrical and Electronics Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

**Mar. 2-6**—Fifth Conference on Applied Meteorology (Atmospheric Problems of Aerospace Vehicles), Atlantic City, N. J. Sponsors: American Meteorological Society; Federal Aviation Agency.

**Mar. 4-6**—Symposium on Thermal Radiation of Solids, San Francisco, Calif. Sponsors: National Bureau of Standards; National Aeronautics and Space Administration; USAF Aeronautical Systems Div.; University of California at Berkeley.

**Mar. 9-10**—Aerodynamic Testing Conference, Marriott Twin Bridges Motor Hotel, Washington, D.C. Sponsors: American Institute of Aeronautics and Astronautics; U. S. Navy.

**Mar. 23-26**—International Convention, Institute of Electrical and Electronics Engineers, Coliseum and New York Hilton, New York, N. Y.

**Mar. 25-27**—Aerospace Bearing Conference (unclassified), Granada Hotel, San Antonio, Tex. Sponsors: USAF; Southwest Research Institute.

**Apr. 1-2**—Fifth Symposium on Engineering Aspects of Magnetohydrodynamics, Institute of Electrical and Electronics Engineers, Massachusetts Institute of Technology, Cambridge, Mass.

**Apr. 1-3**—Fifth Annual Structures and Materials Conference, American Institute of Aeronautics and Astronautics, Riviera Hotel, Palm Springs, Calif.

**Apr. 6-8**—International Conference on Nonlinear Magnetics (Intermag), Institute of Electrical and Electronics Engineers, Shoreham Hotel, Washington, D.C.

**Apr. 7-9**—Symposium on Parachute Technology and Evaluation, U. S. Naval Air Facility, El Centro, Calif.

**Sept. 7-13**—1964 Flying Display and Exhibition. Society of British Aircraft Constructors, Farnborough, England.

**Sept. 7-13**—15th International Astronautical Congress, Warsaw, Poland.



## PROBLEMATICAL RECREATIONS 203


On what days of the week can the first day of a century fall? (The first day of the twentieth century was Jan. 1, 1901)

*—Contributed*

A new, S-band electrostatically focused klystron has been developed by our Electron Tube division weighing just 25 pounds complete, measuring only 17 inches long. The L3668H is rated at 50 kilowatts peak and 5 kilowatts average in the 2700 to 2900 Mcs frequency range. You may use one for mobile, airborne, space tracking and communications systems. Contact the Marketing Department, 960 Industrial Road, San Carlos, California.

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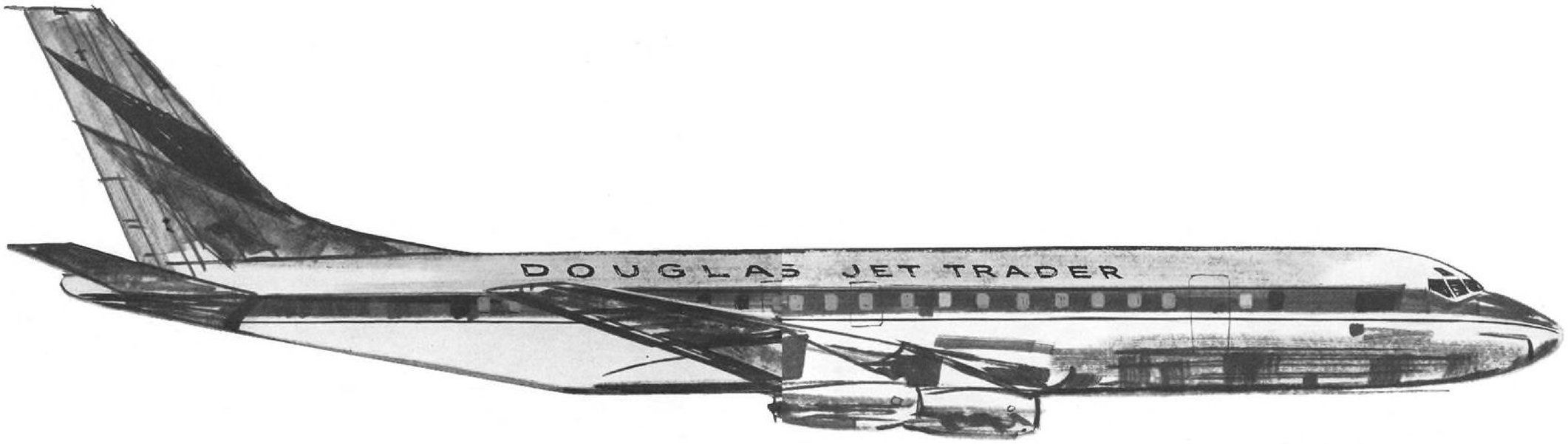


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**DC-7Fs** play a major role in airline freight operations.

**C-118s and C-54s** were the Air Force's workhorses during the Berlin Airlift...showed the dependability built into Douglas transports.

**DC-6As** were the first to break-through the high cost barrier to the expansion of air freight.

**C-47s** were the mainstays of our World War II military supply effort, flew "the hump" regularly to keep our life-lines to the Far East open.

**DC-3s** are characteristic of what can be expected of all Douglas transports...more than 2500 commercial and military versions are still flying after *25 years* of rugged service.

It all adds up to this conclusion: for transports that perform better, last longer, maintain easier, and stay in there when the going is roughest, you can depend on Douglas.

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DOUGLAS AIRCRAFT DIVISION

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CONTENTS



COVER: Night time exposure made by ground camera at Wallops Island, Va., traces the spectacular flight path of a Scout rocket, destroyed 11 sec. after liftoff as it veered off course on July 20 (AW July 29, p. 27). Wide light trail is the first stage burning. Moment of destruct is indicated by flare in first stage track just above the beginning of the track. Light lines on either side of the wide track are the upper stages burning. Specific cause of the malfunction was not determined, but a successful Scout launch Dec. 19 (see p. 24) indicated that modifications solved the technical difficulties.

PICTURE CREDITS
Cover—David Corson, National Aeronautics and Space Administration; 20, 21—General Electric; 24—U. S. Navy; 28—Lockheed-Georgia Co.; 27—Boeing; 31—British Aircraft Corp.; 32, 33—Lufthansa German Airlines; 42, 43, 45, 51—DINFIA; 53—General Dynamics/Astronautics; 56—Douglas Aircraft; 59—Beech Aircraft Corp.; 64—Sikorsky; 66—United Air Lines.


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# EDITORIAL

## Laurels for 1963

This year in aerospace has been marked by few spectacular public achievements.

It has been a year of intense, grinding work in laboratories, factories and program managers' offices to build the technical foundations for the next generation of aerospace vehicles and missions. This theme will continue during 1964, with the first fruits of these labors leaving the launch pads in the 1965-66 period.

In a year of quiet, solid achievement these are the people and organizations we think made major contributions to U. S. aerospace progress:

• **Harry Goett, Jack Townsend and Bob Gray** of NASA's Goddard Space Flight Center for its excellent record (100% on eight launches in 1963) of successful satellite launchings and operations. This is the second consecutive year that all of Goddard's satellites were successful.

• **Juan Terry Trippe,** president of Pan American World Airways, for his relentless fight to lower international airline fares, particularly on the North Atlantic.

• **Bill Lear,** for having the zest to abandon one fabulously successful career to launch another that developed the fastest executive jet aircraft and got it flying this year.

• **Allen Donovan** of Aerospace Corp. and **Maj. Gen. Charles Terhune, Jr.,** of USAF Systems Command for their organization and direction of USAF's Project Forecast, which charted the shape and character of aerospace power for the 1970s.

• **Dr. A. L. Jones** and his associates at the Sohio Research Laboratory in Cleveland for achievements in operating a private satellite tracking station which provides so much valid data on Soviet space flights.

• **Maj. Gen. Osmond J. Ritland,** USAF, for his long and persistent fight to develop a military manned space flight program that saw fruition this year in the Manned Orbiting Laboratory program, and for his many prior years of contributions as commander of the atomic bomb flight test group and as sparkplug of the reconnaissance satellite program.

• **Abraham Schnapf,** Tiros program manager for the Astro-Electronics Div. of Radio Corp. of America, for his direction of this highly successful weather satellite program culminating in the launch and operation of Tiros 8.

• **Alan S. Boyd,** chairman of the Civil Aeronautics Board, for the judicious and impartial manner in which he has operated his agency, and for his courage and effectiveness in battling for lower fares on international routes, and protecting the interests of the American air traveler.

• **Grant Hansen** of Convair/Astronautics; **Bill Gorton** of Pratt & Whitney Aircraft; **Edmund Jonash** of NASA's Lewis Laboratory and the others on the Centaur project (AW Dec. 9, p. 21) who successfully flew the first liquid hydrogen-powered space vehicle.

• **Brig. Gen. Joseph S. Bleymaier,** USAF, for his tight and efficient management of the Titan 3 space booster program, which has the excellent co-operation of his two major contractors, Martin Co. Denver Div. and United Technology Corp.

• **Dr. Harold Rosen** of Hughes Aircraft Co., inventor of Syncom, for his unusual and bold approach to space communications satellites that resulted in the successful operation of the world's first 24-hr. communication satellite, Syncom 2; and to his associates at Hughes, **Donald D. Williams,** orbital control system designer, and **Thomas Hudspeth,** electronics designer, for Syncom.

• **Robert F. Six,** president of Continental Air Lines, for providing superb service to air travelers in the regions his airline serves, and for continuing to do it at a profit in the face of the fierce competition from larger lines on his segment of the transcontinental route.

• **Charles J. Hitch,** Pentagon comptroller, for his reforms in the military budgeting process that have forced the services into more realistic costing of their weapon systems.

• **Carl Vinson** and **C. E. Woolman,** two fine Georgian gentlemen, who are closing their careers. Rep. Vinson will retire after 50 years in Congress, 15 years of which were spent in outstanding leadership of the former Naval Affairs Committee and 14 years as chairman of the Armed Services Committee. Mr. Woolman, retiring president of Delta Air Lines, built it from a crop dusting operation to one of the nation's finest and most profitable airlines.

• **Mrs. Betty Miller,** the first woman to solo across the Pacific, completing a 7,400 mi. flight ferrying a Piper Apache from California to Australia.

• **Col. Lonnie Q. Westmoreland,** USAF, system program director for the Vela Hotel project that put two nuclear radiation detection satellites into 50,000-mi. circular orbits, 140 deg. apart, with a single launch as the first step in developing a warning capability to detect nuclear weapon testing in space.

• **Rep. George Mahon** (D.-Tex), chairman of the House Defense Appropriations subcommittee, for his tough-minded insistence on getting sound, detailed explanations of U. S. military policy and programs from the parade of star-studded witnesses and glib civilians who appear before his group annually.

• **Brig. Gen. Samuel Phillips,** USAF, who, as program director of the Minuteman, was responsible for getting 300 of these solid-fueled ICBMs operational and into the hands of Strategic Air Command.

• **Sen. John L. McClellan** (D.-Ark.), chairman of the Senate Permanent Investigating subcommittee for his dogged courage in calling the top Pentagon civilians' bluff on how they awarded the TFX contract. Sen. McClellan's persistence in pursuing this tack uncovered a conflict of interest by former Secretary of Navy Fred Korth; forced Defense Secretary Robert McNamara to admit he had not practiced what he preaches in decision making but relied instead on rough judgments, and forced admission from Deputy Defense Secretary Roswell L. Gilpatric of far more involvement with General Dynamics both prior to and during his Pentagon service than he had revealed during initial questioning.

—Robert Hotz

# WHO'S WHERE

## In the Front Office

**Clarence J. Woodard,** president, The Rucker Co., Oakland, Calif., succeeding **Clark E. Rucker,** now board chairman and chief executive officer. **W. Gordon Jarvis** succeeds Mr. Woodard as vice president-general manager.

**Milton Farber,** a vice president of Rocket Power, Inc., Mesa, Ariz., a subsidiary of Maremont Corp., has been named president of Maremont's newly established Pasadena (Calif.) Research Div.

**Edward W. Virgin,** a vice president of Bell Aerosystems Co., in charge of all Washington (D. C.) operations.

**E. Douglas Kenna,** a vice president, Avco Corp.; the general manager of the company's Research and Advanced Development Div., Wilmington, Mass.

**Douglass F. Johnson,** elected a director of Atlas Corp. (AW Nov. 25, p. 23).

**Donald M. Wilder,** vice president for Navy programs, Lockheed-California Co., Burbank, Calif.

**Lester R. Grohe,** a vice president, Nortronics Div. of Northrop Corp., and manager of the Precision Products Dept., Norwood, Mass., succeeding **William A. Jones,** resigned.

**Chester A. Dotter,** vice president-manufacturing, Weston Hydraulics, Ltd., Van Nuys, Calif., a subsidiary of Borg-Warner Corp., and **Thomas F. Fitzgibbon,** vice president-sales and marketing. **Kilbourne H. Knox,** vice president-engineering at Weston Hydraulics, also named a director.

**Thomas J. Rowe,** corporate controller, Trans World Airlines, Inc., succeeding **James F. O'Crowley, Jr.,** resigned.

**Dr. D. W. Randolph Lovelace, II,** president of the Lovelace Foundation for Medical Education and Research, has been appointed a consultant to **Dr. George E. Mueller,** associate administrator for manned space flight, NASA.

## Honors and Elections

**Charles F. Horne,** president of General Dynamics/Pomona, has been selected by the Electronic Industries Assn. to receive the EIA Medal of Honor for "outstanding contribution to the electronics industry."

**A. Paul Vance,** St. Louis, Mo., has been elected president of the National Pilots Assn. for 1964. Also: **Dr. Mark DeGraff,** Tulsa, Okla., 1st vice president, and **Marilyn Link,** New York, 2nd vice president.

**J. T. Dyment,** chief engineer for Trans-Canada Air Lines, has been elected president of the Society of Automotive Engineers for 1964.

**Dr. Arnold O. Beckman,** president of Beckman Instruments, Inc., has been elected chairman of the board of trustees of the California Institute of Technology, succeeding the late **Robert L. Minckler.**

## Changes

**Robert E. Rutherford, Jr.,** chief engineer, CBS Laboratories Electron Tube Dept., Stamford, Conn., and **Saul Decker,** section head, CBS Laboratories Military and Industrial Systems Dept.

# INDUSTRY OBSERVER

► Pentagon proposes to continue funding of Nike X anti-ICBM missile development in Fiscal 1965. Present stage of development forestalls the need for a decision on whether to commit the missile to production until at least Fiscal 1966.

► **National Aeronautics and Space Administration's Marshall Space Flight Center is conducting payload and trajectory analyses for a vehicle configuration incorporating a liquid hydrogen-oxygen Douglas S-4B stage atop a half-length, 260-in.-dia., solid-propellant motor, now in feasibility demonstration phase for USAF's Space Systems Div.**

► Interest in counter-insurgency aircraft has spurred design work within the Argentine government's autonomous DINFIA (Direccion Nacional de Fabricaciones e Investigaciones Aeronauticas) in Cordoba. Two single-engine COIN aircraft designs are being prepared by separate departments of DINFIA. One design, the I. A. 55, would be powered by a Turbomeca Astazou 10 engine, giving it a cruise speed of about 236 mph. with a 1,150-lb. weapons payload and 158 gal. of kerosene.

► **New propulsion contractor for Advanced Research Projects Agency's high-impulse booster experiment (HIBEX), may be selected by Boeing, the prime contractor, for development of the vehicle's high-acceleration solid motors. Cost negotiations between Boeing and Hercules Powder Co., previously selected as propulsion contractor, have not been resolved.**

► Third General Dynamics/Astronautics Centaur upper stage is expected to be launched from Cape Canaveral between late March and mid-April. The hydrogen-fueled stage will be delivered to NASA next February.

► **Modified version of the Sparrow air-to-air missile recently demonstrated its capability as an air-launched anti-radar weapon during tests conducted by Navy and Raytheon. The missile homed so accurately on a ground radar set up as a target that it went through the van on which the antenna was mounted. Raytheon also has developed a pod-mounted guidance system which enables the Sparrow to be used against moving ground targets. In air-launch tests, missiles scored hits against two small barges.**

► NASA's Flight Research Center at Edwards AFB will issue requests for proposals in January for a powered version of the M-2 manned lifting re-entry vehicle to investigate transonic flight up to about Mach 1.3. Program will call for dropping the vehicle from a Boeing B-52 at about 40,000 ft. The M-2 will then climb to about 70,000 ft. before re-entry. Lockheed may propose an F-104 fuselage as the powered core unit for the M-2 configuration.

► **McDonnell Aircraft Corp. may seek another industry source for ablative thrusters in the 25- and 100-lb.-thrust categories for the Gemini spacecraft attitude control system. Problems have been experienced with thrusters of these types built by Rocketdyne, developer of the control system for McDonnell (AW July 22, p. 184).**

► Proposals relating to a submarine-launched ballistic missile considerably larger than Polaris were submitted recently to Navy BuWeps Special Projects Office as part of a series of advanced sea-based deterrent studies. Contract award may be made next month. Proposals previously submitted (AW Nov. 4, p. 23) were for a configuration smaller than Polaris. Both missiles will be designed to be launched from great depths.

► **Naval Ordnance Test Station (NOTS) will have systems management responsibility for the Condor air-to-ground missile. Industry will support NOTS in development of certain subsystems (AW Dec. 9, p. 23). Predevelopment phase of the program is expected to be initiated early next year.**

► Choice of a contractor for the Minuteman ICBM launch enabling system (AW Nov. 4, p. 23), a secure backup circuit to ensure foolproof launch, is expected to be announced early in January. Two finalists in the Ballistic Systems Div. competition apparently are Hughes and ITT.

# Washington Roundup

## Disarmament Probing

**Mutual reductions in defense spending will be one of the items discussed when U. S. and Russian disarmament negotiators sit down at the conference table** in Geneva Jan. 21 for another meeting of the Eighteen-Nation Disarmament Conference.

**But high State Dept. officials see little chance of accomplishing anything beyond talk because of the Soviets' reluctance to accede to U. S. inspection demands.** As one high official put it recently: "We have no easy and simple way of knowing what their budget is and what it means in military terms without an enormous amount of inspection."

**Even though all sides want to put "some ceiling on this arms race," the official said, progress will be made through reduction of tensions** rather than through complicated agreements. It has been the Russians who in the past have suggested bilateral cuts in military budgets, according to the State Dept.

**The same inspection hurdle stands in front of a proposal for a U. S.-Russian bonfire of USAF-Boeing B-47s and Tu-16 Badger bombers to prevent more of these aircraft** from going to smaller nations. Already, Australia is receiving B-47s, and Egypt and Indonesia have Tu-16s. Anything less than a well-inspected destruction of these bombers would be assailed by U. S. lawmakers in election year 1964.

**Another discussion topic at the coming meeting is ways to detect arms buildups by stationing inspection teams at such critical points as rail centers.** U. S. has experimented with such techniques under Project Cloud Gap, a joint Defense Dept. and disarmament agency effort.

**More significant than the results of these specific discussions will be the general climate prevailing at Geneva. Forecasters see favorable signs** in U. S. and Russian reductions in military spending, the Yuletide lowering of the Berlin wall and the goodwill usually extended a new President.

## Presidential Action

**President Johnson's appointment of a Committee on the Economic Impact of Defense and Disarmament underscores the Administration's concern about** the immediate effects of base closings and other economy actions as well as the long-range problems posed by disarmament.

**The new committee's job is to review and coordinate Executive Dept. attempts to determine the consequences of changes in military spending.** With this knowledge in hand, President Johnson said, the government will be in a better position "to minimize potential disturbances which may arise from changes in the level and pattern of defense outlays."

**Heads of several executive departments were requested in the President's memorandum to name senior officials to serve on the committee.** The Council of Economic Advisers representative will serve as chairman. Other departments and agencies to be represented are: Defense, National Aeronautics and Space Administration, Commerce, Labor, Disarmament Agency, Atomic Energy Commission, Office of Emergency Planning and Budget Bureau.

**Chairman Walter W. Heller of the Council of Economic Advisers formed such an "early warning" group July 10 (AW Sept. 30, p. 28). Defense Dept. already has asked** the Institute for Defense Analyses to find a way to provide five years advance warning to companies and communities faced with readjusting to changes in defense spending. President Johnson said he wanted to give Heller's group "a more formal and permanent status."

**Congress also is trying to soften the impact of changes in federal spending and may be able to agree on a legislative approach to the problem next year.**

## Information Scrutiny

**Moss subcommittee next year plans to issue four comprehensive reports on government information policies regarding:** (1) how information was handled during the Cuban crisis and resulting reforms which have gone into what the subcommittee calls the "World War 3" information plan; (2) NASA and Defense Dept. reports on their own and foreign satellites—including heavy criticism of the U. S. policy of not disclosing anything about Russian launches until the Soviets do; (3) use of lie detectors by government agencies; (4) explanations by government agencies—including NASA and Defense Dept.—of their information practices.

## Initial Reaction

**Air Force space enthusiasts are angry about NASA taking the executive order one step further by adding its own monogram to the new name for the Cape Canaveral** launch complex, designating it as the "John F. Kennedy Space Center, NASA" . . . FAA is considering installation of a low-cost instrument landing system for the air strip at President Johnson's Texas ranch . . . Chairman John L. McClellan of the Senate TFX investigating subcommittee still intends to call former Navy Secretary Fred Korth, along with Defense Secretary Robert S. McNamara, as a witness when hearings resume next year . . . Communist press claims Soviet Institute for Aircraft Research has developed variable sweep wing designed for speeds of Mach 8.

—Washington Staff

# Mission Growth Planned for Biosatellite

**System is being designed for in-orbit lifetime greater than 30 days; more complex experiments planned.**

By Edward H. Kolcum

Biosatellite spacecraft system is being designed with the potential for considerable growth beyond the announced 30-day in-orbit lifetime and for more complex experiments than those now planned, according to Vincent C. DeLiberato of General Electric's Re-entry Systems Dept.

DeLiberato provided the first details of the Biosatellite spacecraft and missions Dec. 29 at the meeting of the American Assn. for the Advancement of Science in Cleveland. GE is prime contractor for this National Aeronautics and Space Administration project (AW Aug. 26, p. 33).

Biosatellite flight program will begin in late 1965. Six satellites containing monkeys and other biological research specimens will be launched every three months with Douglas Thor and thrust-augmented Thor launch vehicles.

DeLiberato said the system will use a standard satellite shell, and the interior will be modified for three groups of recoverable experiments:

- **Primate,** in which a monkey will be the passenger. Life support system will provide a two-gas, 14.7 psi. atmosphere. Oxygen content will be 18-22%, and the remaining gas will be nitrogen.
- **Radiation,** using both an on-board radiation source and space radiation to determine the effects on biological specimens.
- **Biorhythm and general biology,** essentially a testbed for a variety of experiments to determine the effects of long-term zero gravity on living organisms. This satellite will include artificial lighting, time-lapse photography and continuous on-board data recording.

DeLiberato said that the 30-day mission can be extended by using the vehicle-satellite adapter section to house in-orbit stores. Non-recoverable experiments can be orbited in this section to increase the system payload capability.

Normal three-day mission spacecraft will weigh 875 lb. Thor Delta can orbit 984 lb. for this period, and the thrust-augmented Delta, 1,318 lb. Similar payload growth can be accommodated in the 21-day and 30-day missions. Biosatellite for the 21-day mission will weigh 896 lb. Delta capability for this time is 964 lb., and the thrust-augmented vehicle capability is 1,264 lb.

Thirty-day Biosatellite will weigh 972 lb., which is beyond the 959-lb. standard Delta capability. Thrust augmentation gives a 1,252-lb. capability to the 30-day satellite.

Recovery weights are 195 lb. for the three-day capsule; 184 lb. for the 21-day satellite, and 242 lb. for the 30-day orbiter.

Normal mission will be a launch from the Kennedy Space Center on a 108-deg. azimuth, inclined 33.5 deg. to the equator. Programed orbit will be 150-200 mi. Recovery will be in the Pacific near the Hawaiian Islands by a ship-based helicopter.

Hydrogen-oxygen ionic membrane fuel cell being developed by GE for the Gemini spacecraft will be used as the prime power source for both 21 and 30-day flights. Silver zinc batteries will be used for three-day missions.

GE Biosatellite evolved from the smaller, recoverable Discoverer capsule, also developed by GE. DeLiberato said the separation, de-orbit, retro, spin/despin, recovery retardation, recovery telemetry and recovery location aids are identical to the subsystems used on the USAF Discoverer capsule. Although all six Biosatellites are designed for water pickup, they can be air-snatched using a technique developed for Discoverer.

One major modification has been the installation of a quick-access breech ring to permit installation of biological specimens within 3 hr. before launch.

DeLiberato described these other major satellite components:

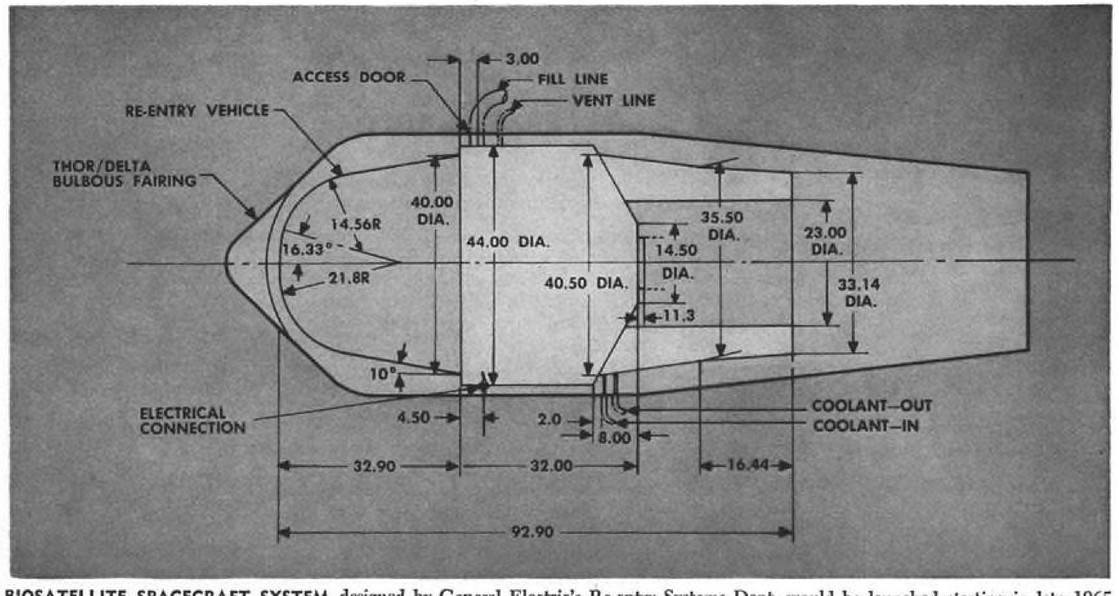
- **Tankage.** Single tank will supply environmental and attitude control nitrogen, and a single tank will supply life support and fuel cell oxygen. Gas will be stored in cryogenic tanks to save weight and volume. All cryogenic tanks are modifications of those in the Gemini spacecraft.
- **Environmental control.** Specified temperatures are 75±2F and 75±5F, depending on the mission. These close tolerances will require water augmentation, and water will be drawn from the fuel cell for cooling.
- **Telemetry, tracking and command.** Pulse-code-modulated spacecraft telemetry system will be used. Discoverer re-entry FM/FM will be used in the re-entry vehicle. Tracking will be accomplished by the NASA minitrack network, and re-entry telemetry will be compatible with that used in the Pacific Missile Range.

Command system will have a capacity of 40 real-time commands and a single stored command. Single stored voice command will control de-orbit.

- **Life support.** In addition to the two-gas atmosphere, this system features lithium hydroxide carbon dioxide absorption; lip-controlled water supply, and sea water cooling after impact.
- **Attitude control.** This will be accomplished by nitrogen cold gas jets, activated when the threshold detector senses the vehicle is exceeding a preselected value. Two infrared sensors will provide pitch and roll reference for re-entry, and a magnetometer will provide yaw reference for this maneuver.

Launch of the Biosatellite payloads will mark a resumption of life sciences space flight programs after what will be a lapse of four years. Last primate flight was made Nov. 29, 1961, when the chimpanzee Enos flew two orbits in the Mercury Atlas-5 capsule.

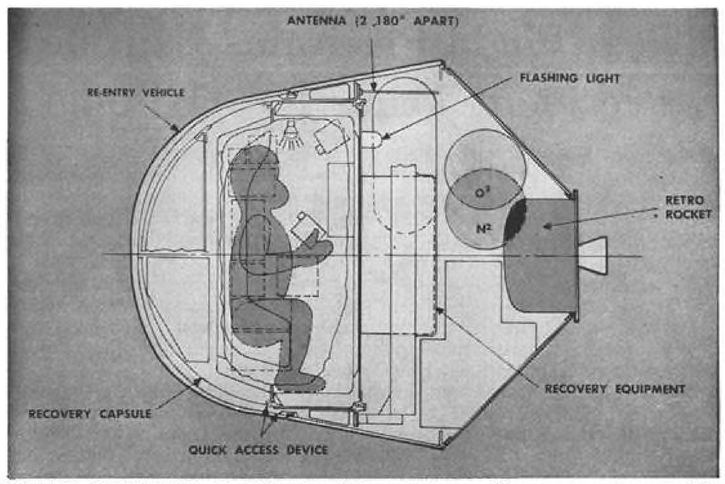
Primate flights were used extensively in developing the Project Mercury system, mainly in Little Joe ballistic missions from Wallops Station, Va. NASA established a policy decision during Mercury that it would not fly animals in either Gemini or Apollo spacecraft developments. Contributing to this decision was the position of the Mercury astronauts, who felt that they should make test flights, rather than monkeys.



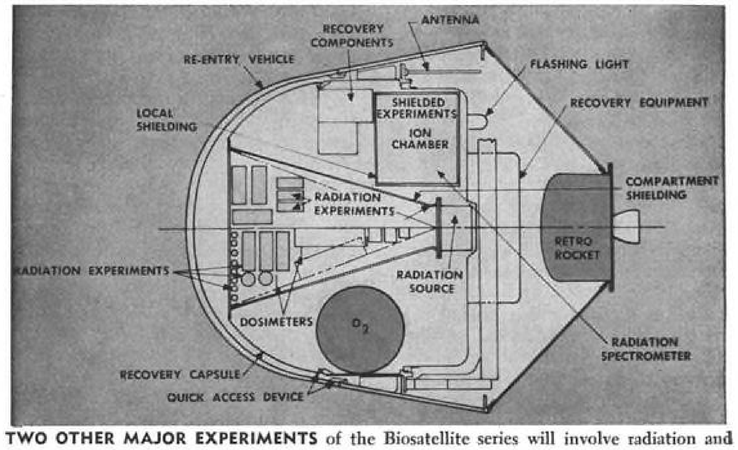

**BIOSATELLITE SPACECRAFT SYSTEM** designed by General Electric's Re-entry Systems Dept. would be launched starting in late 1965 with standard shell surrounding three groups of recoverable experiments. Non-recoverable experiments can be flown in adapter section.

## Gen. Phillips to NASA

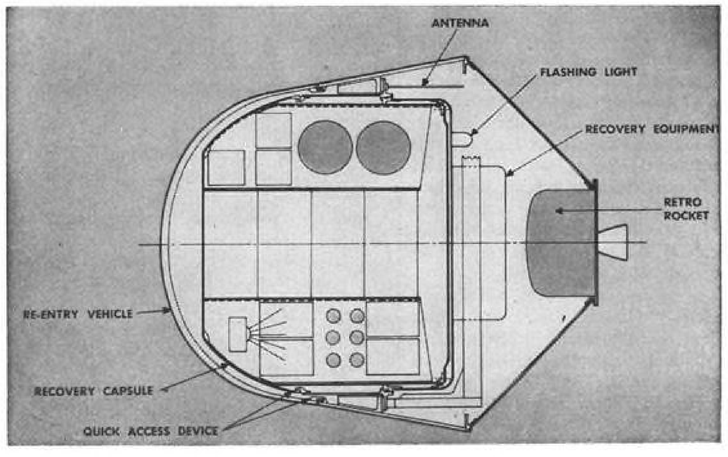
**Washington**—Brig. Gen. Samuel C. Phillips, vice commander of USAF Systems Command's Ballistic Missile Div. and Minuteman program director (see p. 15), will join National Aeronautics and Space Administration as deputy director for Project Apollo on Jan. 15. He will be responsible for management and administration of the manned lunar landing program.




**PRIMATE EXPERIMENT IN BIOSATELLITE** would have a life support system providing a two-gas, 14.7 psi. atmosphere. Oxygen content will be 18-22% and the remaining gas will be nitrogen. The Biosatellite series will be a new start for life sciences space programs.




**TWO OTHER MAJOR EXPERIMENTS** of the Biosatellite series will involve radiation and biorhythm/general biology studies. Radiation capsule, above, will use on-board radiation source and space radiation to determine the effects on biological specimens. Biorhythm/general biology experiments, below, will determine effects of long-term zero gravity on living organisms. They will include artificial lighting, time-lapse photography and continuous on-board data recording.



# Nuclear Flight Programs Canceled As President Trims FY'65 Budget

**Washington**—President Johnson's economy ax last week fell on the Rover nuclear propulsion flight program, military budget requests and the hiring policies of the U. S. government.

Atomic Energy Commission and National Aeronautics and Space Administration in a joint announcement Dec. 24 said the Lockheed Rift (reactor-in-flight test) project is canceled; the Kiwi ground reactor part of the Rover program will continue unchanged, and the Nerva (nuclear engine for rocket vehicle application) development effort will be stretched out.

The joint AEC-NASA Space Nuclear Propulsion Office estimates 1,300 employes will be affected by the cancellation and stretch-out—675 at Aerojet, 400 at Lockheed and 200 at Westinghouse. AEC is expected to save $25 million in Fiscal 1964 and $54 million in Fiscal 1965 while NASA is expected to save $15 million in Fiscal 1964 and $88 million in Fiscal 1965.

These economy efforts, the agencies said, "will save as much as $180 million of planned and programed funds in Fiscal 1964 and 1965." AEC and NASA said that they have invested $450 million on Rover. President Kennedy, after visiting Rover installations in December, 1962, rejected proposals to accelerate the program and approved less than requested (Dec. 17, 1962, p. 28). President Johnson's action shows he too agrees with those advisers who contend it is too early in terms of the nuclear technology to invest heavily in actual space flight vehicles. He is expected to ask about $160 million for Rover in Fiscal 1965, or about $100 million less than the agencies requested.

Los Alamos Scientific Laboratory will continue Kiwi nuclear reactor ground tests through the next 12 months and make a try to develop higher powered graphite reactors under the project name of Phoebus.

The stretch-out of the 1,000 megawatt Nerva engine project, being conducted by Aerojet and Westinghouse, will be accomplished by postponing flight system development. Instead, the contractors will concentrate on reactor engineering and the subsystems needed to develop an operating experimental nuclear propulsion engine. AEC and NASA said they contemplate building a flying version eventually, but did not specify a schedule.

NASA's Marshall Space Flight Center directed Lockheed's Rift project. The agencies claimed "almost all" of the $14 million already invested in Rift is applicable to other programs. No flight hardware has been built. The Rift program called for delivery of the actual flight stages and testing them in 1966 and 1967. Last year the flight date slipped to 1970 because of engineering problems with the Kiwi reactor.

President Johnson discussed other economy moves between meetings with high government officials at his Texas ranch over the Christmas holidays. He said $9 billion in military budget requests was denied. This, however, is not unusual. Defense Secretary Robert S. McNamara said he denied $13 billion in Fiscal 1964 budget requests from service chiefs (AW Jan. 21, p. 26). The other economy move was setting ceilings on the level of employment for all government executive agencies. He said there will be fewer federal employes in 1964 than there were in 1963.

### Minuteman Decision

**President Johnson is to meet with the joint chiefs of staff at his Texas ranch Dec. 30 and then is to decide whether to procure 50 or 150 USAF-Boeing Minuteman missiles in Fiscal 1965.**

**Air Force Chief of Staff Curtis E. LeMay is arguing for the larger number, and Defense Secretary Robert S. McNamara favors the smaller procurement. The President's decision will determine whether the U.S. by mid-1969 has 1,200 or 1,950 Minutemen. Another issue to be discussed is whether to build a jet interceptor for the continental air defense forces.**

### Apollo Guidance Probe

**Washington—Reports critical of the Apollo guidance development program have been turned over to staff members of the House space committee for further investigation.**

**Aviation Week & Space Technology disclosed that members of the committee planned a brief investigation before the Christmas recess (AW Dec. 23, p. 27). Following two meetings last week, Rep. Olin E. Teague (D.-Tex.) said the reports cast enough doubt on the reliability of the system being developed under the direction of the Instrumentation Laboratory of the Massachusetts Institute of Technology to warrant further investigation.**

**NASA maintains that addition of backup on-board computers, which switch on automatically when a failure occurs in the computer system, answers most of the criticisms in the industry reports under study by the House space committee.**

# Boeing to Build Lunar Orbiter

**Washington**—Boeing Co. last week was selected for a $60-million contract from the National Aeronautics and Space Administration to build five Lunar Orbiter spacecraft.

Boeing's proposal was selected after NASA's top management re-examined bids submitted by five firms. The others were Hughes Aircraft Co., Lockheed Missile and Space Div., the Martin Co. and TRW Space Technology Laboratories.

NASA said Boeing's proposal was selected because it offered the greatest assurance of mission success. The Boeing proposal included use of a three-axis stabilization system similar to the one on the successful Mariner 2 Venus spacecraft, an Eastman Kodak-developed camera system and Radio Corp. of America power and communications systems.

Aviation Week & Space Technology learned that Boeing's bid of $60 million was the highest, but that the firm won the contract because of the high reliability factor in the spacecraft design approach.

Of all NASA's programs, the lunar flight program has been the least successful. All three Atlas-Able flights in 1959 and 1960 failed and all five Ranger flights—three of them lunar photography missions—were unsuccessful.

NASA canceled five Ranger flights —Rangers 10 through 14—on Dec. 13, (AW Dec. 23, p. 28), cutting the program back to four remaining flights. Ranger 6, the next scheduled, is to be launched in February.

With the first manned landing still scheduled in late 1968, time is fast running out for the reconnaissance of lunar landing sites by unmanned spacecraft.

Although the remaining Ranger flights and the first of the Surveyor soft lunar landings are scheduled to take place before the first Lunar Orbiter flight in 1966, the Lunar Orbiter is viewed as a determined attempt to insure availability of lunar surface pictures if all else failed.

NASA said the incentive contract with Boeing (AW Oct. 7, p. 32) would provide for a spacecraft of 800-lb. or under to fly on the Atlas Agena rocket. The spacecraft is to carry scientific instruments, as well as cameras, to measure radiation levels and micrometeoroid density.



# Flights Replace Hours as Measuring Unit

By Larry Booda

**Washington**—Number of flights, rather than hours flown, will soon become the standard of measurement for accident analysis and cost effectiveness studies in the Air Force, Navy and Army.

For nearly a year, individual services have been trying to find more realistic ways of measuring aircraft operations so that budget requests can be justified with factual statistics.

Both Navy and Army favor the change and have informally recommended it to the secretary of defense. The Air Force was slow to accept the idea but recently changed its position and now looks favorably on it.

Key factor behind the proposal is flight length. One flight usually accomplishes one mission, regardless of its length. Thus, a number of considerations must be faced by service air procurement and operations planners. Among them are:

- **Exposure to hazards.** The critical portions of a flight are takeoff under full load conditions, early climb, some combat in-flight operations and the final approach and landing. An average flight includes this set of actions, regardless of its duration.
- **Maintenance.** Periodic maintenance and overhaul in the past has been based on hours flown. But maintenance is performed between flights, to check aircraft parts and replace them if needed. Most parts receive greatest wear in takeoff, climb and landing.
- **Cost effectiveness.** Importance of the mission must be weighed against the factors of original aircraft price, cost of maintenance and cost of operations. Again the flight rather than the hour standard fits more readily into this type of cost-effectiveness analysis.
- **Pilot effectiveness.** This has been a center of argument for many years. A jet fighter or attack aircraft pilot who has been flying five years may amass 1,300 pilot hr., a bomber pilot 3,000 hr., and a transport pilot 4,500 hr. The question raised most often is, "Does the pilot with the most hours have the most experience and greatest competence?"

Experience has shown that when analysts compute costs, they find themselves working on the basis of flights rather than hours. In a single flight, the landing gear will be cycled once after takeoff and again before landing. Inspection and maintenance for this subsystem thus is needed on the basis of the number of times used, not how long it was flown. Engines are operated at their maximum power for takeoff and at high power for the climb. Combat aircraft use high power for small portions of their combat missions. For straight and level flight there is little strain placed on the engines.

The one-time-per-flight principle applies to other subsystems as well. Bombs are dropped only once by the large bombers. They are dropped several times by attack aircraft, but each individual bomb rack is used only once per flight. In interceptors, air-to-air rockets are fired one or more times—but each individual launcher is used only once.

Maintenance costs for most subsystems, consequently, are tied more to the number of flights rather than to the times used. Avionics are an exception. Electronic component lives are based on time. But even here the shocks of landing and combat maneuvers encountered on a single flight become maintenance factors.

Accident rates have been tied to hours flown since the early days of aviation. However, most accidents occur on takeoff and landing. Thus the long endurance types of aircraft have much lower accident rates per 100,000 hr. flown. In order to compute accident costs for budget purposes, the use of the flight standard will be more realistic in that it will equalize accident rates between small jet aircraft, large bombers and transports.

Pilot qualifications have also been tied to hours. Pilots in non-flying billets who meet the physical and age requirements for future combat duty must fly 100 hr. per year. One jet pilot explains it this way, "In order to get my 100 hr. I have to fly the T-33 jet trainer. My average time per flight is 2 hr. That means I have to make 50 flights a year. The bomber and transport pilots fly up to 12 hr. or more per flight."

In analyzing cost effectiveness of aircraft, three principal factors are used. One is the sortie, a flight in which a military mission is performed. The second is cost. Third is effectiveness.

Effectiveness is generally stated in terms of percentage of target kill, whether it be percentage of destruction of a bombing target, troops put out of action, vehicles disabled, aircraft destroyed in interceptor missions or ships sunk. During World War 2, the popular system for measuring bomber effectiveness was tons of high explosive bombs dropped on a target. This system was applied to nuclear weapons when they came into the inventory by stating strength in kilotons and megatons. Now it is gradually being phased out in terms of target kill.

One result of applying cost-effectiveness principles to tactical aircraft missions in which conventional bombs, with yields in pounds or tons, is the discovery that a simpler, less complicated aircraft makes a much better score than a complex aircraft. As one officer puts it, "Don't buy a megabuck airplane to carry micromegaton bombs."

### Sprint Nuclear Switches

**Industry proposals for special nuclear switches, designed to protect avionics circuits aboard the Army's Sprint antimissile missile from damage caused by pulses released by nuclear explosions, are being evaluated by Martin Marietta, prime contractor for the high-acceleration missile.**

**The switches probably would temporarily disconnect power to the circuits when they sense brief gamma ray or fast neutron spikes. Nuclear pulses have long been known to have disruptive effects on avionics gear (AW Aug. 8, 1960, p. 58; Aug. 19, p. 93)—particularly digital circuits in missile guidance systems—well beyond normal destructive range of heat and blast effects.**

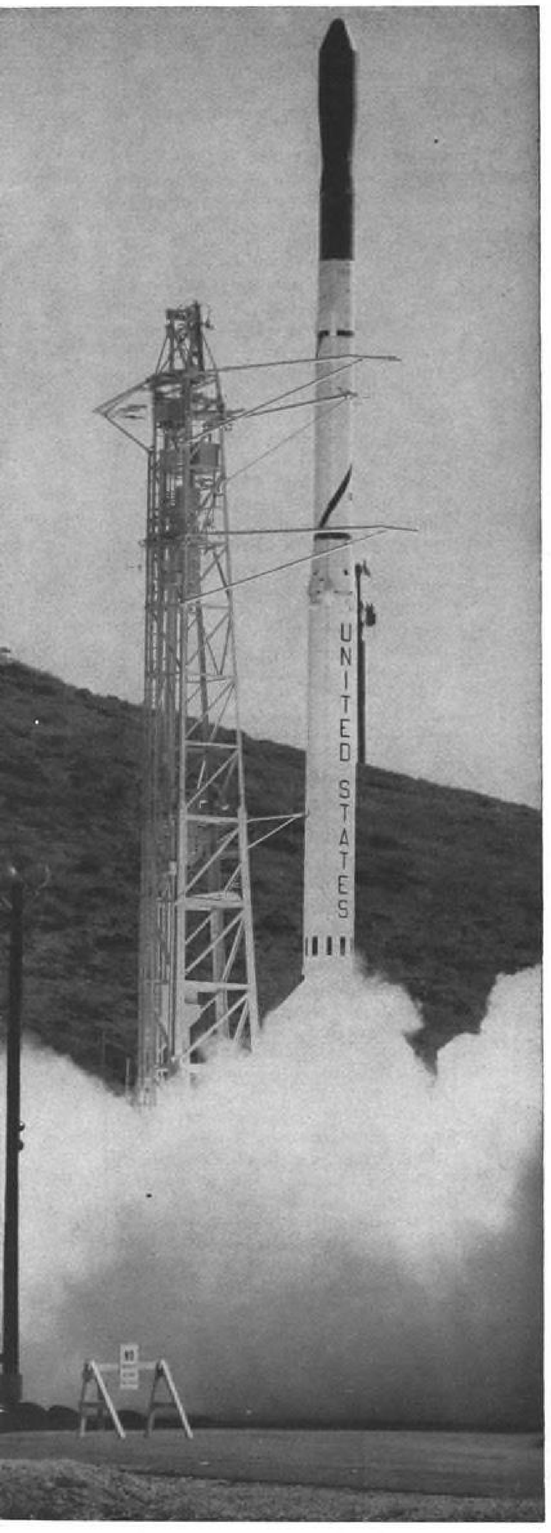
### Mauler Delays

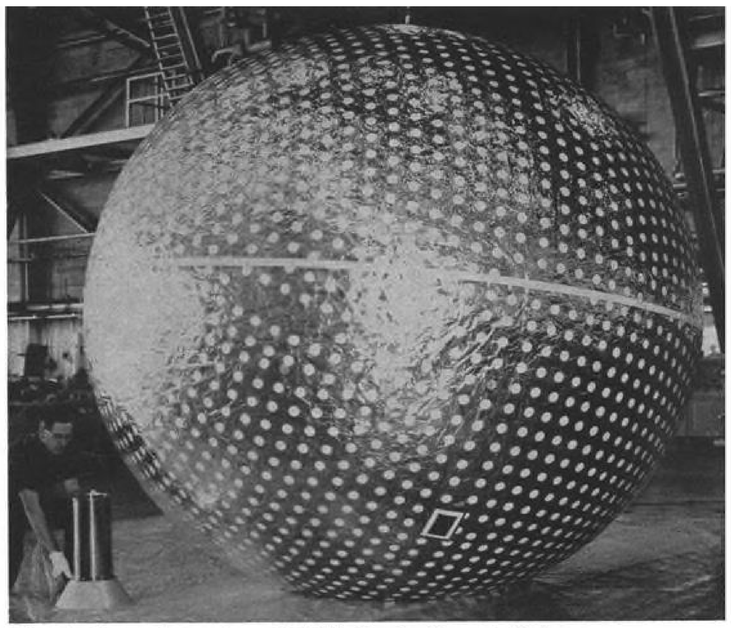
**Washington—Continuing delays and problems in the development of the Mauler tank-mounted air defense missile have caused Army to order a four-month project review and raised doubts over the weapon's future. The program is reported to be about 18 months behind the original schedule, which called for production in Fiscal 1964.**

**Pending completion of the study, Army has cut back monthly funding about 60% from the previous $6.5 million. Prime contractor for the Mauler is General Dynamics/Pomona. Raytheon is supplying the tracking-guidance radar and Burroughs Corp. is supplying the digital guidance computer.**

**Mauler's difficulties reportedly are the result of the operational requirement that the missile be able to hit targets over a wide range of distances, to ranges as short as 500 yards. The troubles are broadly attributed to "guidance difficulties," but this covers a multitude of elements and could include basic aerodynamic instabilities at short ranges.**

**Observers close to the program speculate that it may be canceled unless successful flight demonstrations are made by this spring.**



Inflated sphere undergoes test at NASA's Langley Research Center.

# Scout Launches Explorer 19

**Rigid pre-launch checkout and test procedures were more responsible than vehicle design changes for the successful performance of the Scout rocket on which Explorer 19 was launched Dec. 19 from Pt. Arguello, Calif. National Aeronautics and Space Administration said before the flight it hoped to put the 12-ft. inflated sphere into a near-polar orbit with an apogee of 1,875 mi. and perigee of 375 mi. (AW Dec. 23, p. 39). Actual orbital elements were apogee of 1,490 mi., perigee of 365 mi., inclination of 78.6 deg. and period of 118 min. R. D. Ginter, NASA's small vehicles manager, said that the metal lining in the throat of the Scout first stage nozzle was changed to withstand higher temperatures and an insulation shield was installed around the third stage nozzle to lower the temperature of components within the third stage control system. Scout has had a reliability record of about 60%, and following failure of a re-entry test at Wallops Island on July 20 (see cover), NASA and military Scout launches scheduled in the third and fourth quarters were postponed (AW Nov. 11, p. 34). Launch Dec. 19 was essentially a test flight of the rocket and the air density-drag experiment a bonus. Although the tracking beacon on the sphere did not work, the balloon was sighted by a Moon Watch team in Australia on Dec. 20 and later radar tracking established the orbital elements.**

**Folded sphere fits into a container 19 in. long and 9 in. in diameter.**

## Shareholders Approve Garrett, Signal Union

**Los Angeles**—Final favorable regulatory and tax rulings are all that remain pending prior to the merger of Garrett Corp. into Signal Oil & Gas Co., following approval of the corporate combination by shareholders of the two Los Angeles-based companies Dec. 19-20.

Officials of the two companies expect the merger to become effective early in 1964. Garrett then will become a wholly-owned subsidiary of Signal, retaining its corporate identity and its present management.

In the shareholder elections, the vote to approve at both companies easily exceeded the required two-thirds of outstanding shares necessary for the merger. Approximately 83% of Signal shares, and 79% of Garrett shares, were voted for the merger.

The nearly completed merger marks the end of a sometimes-heated financial chapter which began early in September when Curtiss-Wright Corp. announced an offer to buy 700,000 shares of Garrett stock from shareholders at $50 a share, about $8 above the market price (AW Sept. 16, p. 39). Garrett management opposed this and a subsequent $57 a share offer. The Signal merger is an outcome of Garrett management efforts to fend off the unsuccessful C-W offers, and to forestall possible future efforts to acquire control of Garrett by C-W or some other company not acceptable to Garrett management.

## Johnson Scores Curb On Joint Moon Flight

**Washington**—President Johnson expressed strong disapproval of the congressional curb on any joint U.S.-Soviet Union manned lunar landing program in signing the Fiscal 1964 Independent Offices Appropriations Act.

After signing the bill on Dec. 19, he noted his "concern," and added:

"While it will have no practical effect since there is no chance of our being engaged in a joint manned lunar landing with any other country during the remainder of this fiscal year, I believe such a restriction to be undesirable in principle. It impairs the flexibility which we should seek to retain in our relations with other countries. It may raise some doubts as to our willingness to work cooperatively with other nations in the most important space effort of this decade. Finally, it is unnecessary; the Congress can and should, without need for this provision, play its appropriate role in any arrangements we may make for international cooperation in man's attempt to land on the moon."

## Apollo Fuel Cells Delivered

**Washington—First three prototype fuel cell units for the Apollo command module were delivered last week by Pratt & Whitney to North American Aviation, prime Apollo spacecraft contractor, following acceptance tests in which the cells operated over a range of 500-2,000 w. The fuel cell has been considered a key pacing item in Apollo development.**

**The system will power guidance, communications, environmental controls and other electrical equipment in the command module. In addition, it will furnish drinking water for the crew.**

**Pratt & Whitney said it has operated fuel cells similar to the Apollo prototypes for several thousand hours. System also has been operated under vibrations similar to those in a Saturn 5 launch.**

**Pratt & Whitney is developing a smaller hydrogen-oxygen fuel cell system which will power electrical units in the Lunar Excursion Module.**

# Fifteen Firms Asked to Take Part In Comsat Design Competition

By Katherine Johnsen

**Washington**—Fifteen or more firms are expected to participate in the design competition for a commercial communications satellite. Proposals to Communications Satellite Corp. are due Feb. 10.

The corporation plans to evaluate the proposals and let contracts for actual engineering design by early March. The design effort will last six months, until early September.

In the interim—before mid-1964—the corporation will float stock (AW Oct. 14 p. 34). Fifty per cent will be offered to the public at a maximum price of $100 a share and 50% reserved for purchase by communication common carriers.

Following the six-month design effort, the new board of directors, elected by the stockholders, will decide the award of hardware contracts for the actual building of a satellite system.

In soliciting design proposals for either a medium-altitude or a high-altitude synchronous "basic system," to be operational 1967-68, the satellite corporation raised "the possibility" of an earlier experimental-operational capability. This would involve orbiting a first generation commercial synchronous satellite in 1965. It would have bandwidth and power for television capability; or for facsimile, data, or telegraphic message traffic; or for up to as many as 240 two-way telephone channels.

"Additional synchronous satellites of this type could also be added later if desired," the corporation said.

The corporation set these criteria for proposals for the basic system:

• **For a medium-altitude system,** the design must provide for an initial launch not later than 1966 and for initial global coverage not later than 1967. It must be based on circular orbits of 5,700 mi. to 13,800 mi. The number of satellites for a random system is to be assumed as 18, at 90-deg. inclination. For a phased medium-altitude system, it is to be 12 satellites: two orbit planes of six each at 90-deg. inclination.

• **For a synchronous system,** initial launch must take place not later than 1967, and initial global coverage achieved not later than 1968. It is to involve six satellites in equatorial orbit at 22,300 mi.

The corporation said the numbers of satellites for the three systems were specified solely to provide a common basis for proposals. They do not necessarily represent the numbers for an actual operational system.

Three vehicles were stipulated for either single or multiple launch of the satellites: the Atlas-Agena, the thrust-augmented Delta, or the thrust-augmented Thor-Agena. Designs for other launch vehicles must be approved by the satellite corporation. The cost per shot was given as $8.5 million for the Atlas-Agena, $3 million for the thrust-augmented Delta, and $6 million for the thrust-augmented Thor-Agena.

All the satellites proposed should be designed for an in-orbit operating life of at least three years, the corporation said.

The bidders list for design proposals includes these 15 firms:

Radio Corp. of America; Bendix Corp.; General Dynamics Corp.; General Electric Co.; General Telephone & Electronics Corp.; Hughes Aircraft Co.; International Telephone & Telegraph Corp.; American Telephone & Telegraph Co.; Lockheed Aircraft Corp.; Martin Co.; Motorola, Inc.; Philco Corp.; Raytheon Co.; TRW Space Technology Laboratories and Westinghouse Electric Corp. On request, the satellite corporation may approve other bidders.

# Receiving Kits May Widen Tiros Data Use

By George Alexander

**Cape Canaveral**—Success of the first Automatic Picture Transmission (APT) camera system aboard the orbiting Tiros 8 meteorological satellite has suggested plans for simple, low-cost ground receiving kits with which any local commercial television station could service its community with real-time weather displays and analyses for that particular area.

Radio Corp. of America, developer of the APT system and builder of the Tiros satellite under contract to NASA's Goddard Space Flight Center, is understood to be on the verge of marketing an APT ground kit for regular weather stations which would cost around $25,000. Most of the ground stations purchased by users for the APT program from the Fairchild-Stratos Corp. cost approximately $32,000 each.

Beyond this, RCA is said to be actively considering kits consisting of receiving antenna, photo-facsimile machine and related equipment, which would sell for an as-yet undetermined price but which would be within reach of most commercial television stations. If this market should develop as expected, Fairchild-Stratos and other firms undoubtedly would give RCA competition. In a situation like this, observers believe that a cost of less than $10,000 for a complete kit is possible.

Fairchild-Stratos has definite plans to continue development and marketing of Tiros ground stations of which it has now delivered 47. Production is at serial number 51, and a station has been ordered by the French government, Fairchild said.

Tiros 8 and its APT system were launched from here at 4:30 a.m., EST, Dec. 21 after a week of postponements caused by the Delta launch vehicle (AW Dec. 23, p. 26). The 260-lb. satellite was injected into an orbit whose apogee was 469 mi., perigee of 436 mi., period of 99 min., and an angle of inclination (to the equator) of 58.5 deg.—all well within planned parameters. The satellite carried a conventional 108-deg. lens television camera, two of which have been flown on all previous Tiros spacecraft, but no infrared sensors. The regular TV camera was not working properly after orbital insertion and both NASA and RCA officials were attempting to determine a cause by late last week. Interference from a strong ground radio station was considered as a possible cause.

Demonstration of the APT system's capabilities and of ground stations' ability to receive and use the data transmitted by this system was of prime importance in this flight. The APT flown aboard Tiros 8 is the same type of camera that will be flown aboard the more advanced Nimbus weather spacecraft, the first of which now is slated for launch in the first quarter of 1964 from Pacific Missile Range.

APT was conceived as a simple and reliable camera system which would transmit cloud-cover photographs to ground stations without complex programming circuitry. On a Nimbus vehicle, whose orientation would be changed constantly so that its cameras would always be pointed toward the earth, the APT system would automatically transmit pictures to all ground stations within the 1,500 mi. radial range of its transmitter. A sun-sensor would shut off the system when the satellite passed into the earth's shadow.

On the space-oriented Tiros satellite, however, the APT system carries a programmer so that NASA can command use of the new camera during those times when orientation of the satellite—in relation to the earth—and available sunlight are correct. Control of the camera's duty cycles also permits NASA to extend the approximately 600-800 hr. lifetime of the camera over as much as a one-year orbital period.

The programmer also permits NASA to command the APT system to begin operating when passing over an area—such as Europe or the South Pacific—where orientation and lighting requirements are satisfactory, but where there is no station capable of sending a "turn-on" signal to the satellite. Without this provision, the APT system would come on whenever the sun was in the proper position, regardless of the earth's location. The system therefore could futilely photograph outer space.

As of last week, there were stations in France, the Indian Ocean, England, Australia and Canada equipped with APT receiving kits, in addition to 40 U. S. stations on the continental U. S., Hawaii, Alaska and Puerto Rico, and U. S. military installations in New Zealand, Okinawa, The Philippines, Spain, Germany, Japan and Turkey. Only four U. S. stations—in Alaska, Wallops Island, Va., Pt. Mugu, Calif., and Princeton, N. J.—have the ability to command the satellite to begin remote operations. Remote operations are controlled by a timer aboard Tiros 8 and this can be set to begin up to 3 hr. after receipt of the "on" signal.

The APT camera consists of a special RCA-developed 1-in. dia. vidicon with a photo-sensitive surface. Cloud-cover seen by this camera is etched on this surface, augmented by a polystyrene layer for enhanced image retention, during a 2 millisec. exposure.

An electron beam scanner then reads the image as a series of varying voltages and transmits this data to ground stations over a 5 w. transmitter. Ground stations then convert this 800 line readout on conventional radio-photograph facsimile machines. Total time for transmission of a single picture is 208 sec., with 8 sec. alotted for preparation of the camera, 2 millisec. for exposure and 200 sec. for readout. A ground station can receive as many as three pictures during the overhead pass of Tiros 8.

A second APT camera is expected to be flown aboard Tiros 12 (AW June 24, p. 38). This will be a "wheel" version of the first-generation meteorological satellite and will be spin-stabilized on its horizontal axis. It will travel through space like a spinning wheel and the APT camera will be pointed toward the earth once every revolution. Lifetime of this camera is expected to be about 2,500 hr.

The successful launch of Tiros 8 was the 21st consecutive success for the Douglas Aircraft Co.-built three-stage Delta launch vehicle.

## Avionics Joint Venture

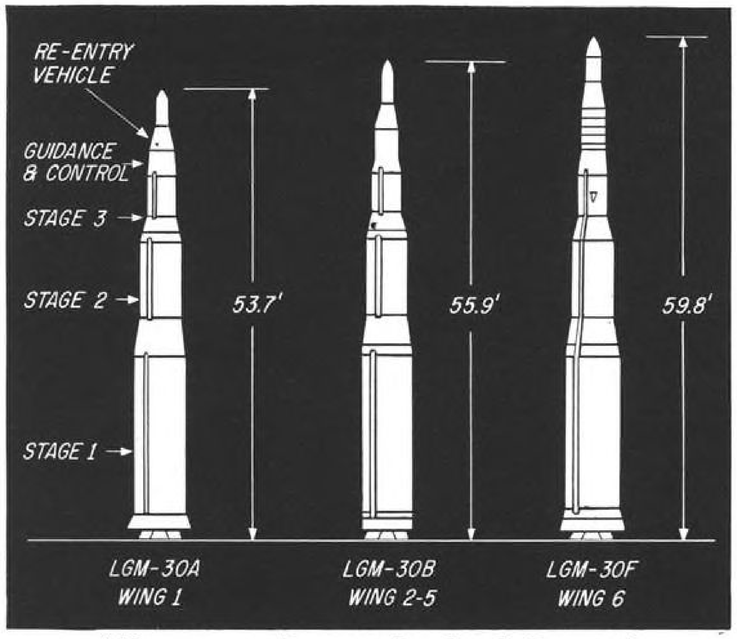
**Martin Marietta and Thompson Ramo Wooldridge have agreed to form a jointly held avionics company, centered about the latter's TRW Computers Div., Canoga Park, Calif., manufacturer of military and process control computers.**

**Martin is expected to provide financing for an expansion of the division's activities as well as extensive marketing capability. Martin presumably will share in the direction and management of the division, which will be renamed.**

**Martin has long been interested in acquiring extensive avionics capability, particularly computer capability. In the past several years, it has attempted to purchase into General Precision and Sperry Rand Corp., both of which have large computer divisions.**

**TRW Computers is prime contractor to the Army for the command and control information systems-70, an Army effort at automating field artillery, including missile fire control. The division sales are believed to be between $15 and $16 million annually.**






## Minuteman Range, Payload Boosted

**Minuteman ICBM, now undergoing its third major change, will have greater range/payload capabilities than ever before. Minuteman 1, or Weapon System 133-A, which is in or scheduled for installation in Wings 1 through 5, consists of two models. Wing 1 deployed near Malmstrom AFB, Mont.,—the closest of all Minuteman wings to potential targets—has the LGM-30A, whose range is below the design objective of 6,300 mi. Wings 2-5 have the LGM-30B model which has the improved titanium second stage (AW Mar. 11, p. 145) and larger re-entry vehicle and is capable of traveling more than 6,300 mi. Wing 6, now under activation near Grand Forks, N. D., will get the LGM-30F, the first model in the new Minuteman 2, or weapon system 133-B, series. LGM-30F will carry a larger second-stage motor with a single-secondary-injection nozzle replacing the four movable thrust vector control nozzles used previously (AW Nov. 18, p. 31; Dec. 2, p. 63) and a new re-entry vehicle. Air Force is holding model letter C, D and E in reserve, possibly for designations of future retrofit models of the A and B configurations. In the official LGM-30 designation, L stands for launch environment, an underground silo; G stands for ground target; M means guided missile; and 30 is the Minuteman design number. The first experimental missiles fired from Cape Canaveral have designation XLGM-30A.**

## NASA to Re-acquire Large Solids Program

National Aeronautics and Space Administration is about to re-acquire the large solid motor program—which it yielded to Defense Dept. in 1962—when responsibility for the 260-in.-dia. motor is transferred from DOD back to the civilian space agency.

NASA is interested in using a half-length 260-in. motor with a Saturn S-4B second stage (AW Dec. 23, p. 48) to boost payloads of 55,000 to 60,000 lb. into low earth orbit. Industry speculation is that the agency would use such a vehicle to fly small space stations or segments of large stations.

Transfer of the program is expected shortly when an agreement between Dr. Robert Seamans, NASA associate administrator, and Roswell Gilpatric, deputy secretary of defense, is formally signed by both men. The program then will become the property of the Office of Advanced Research and Technology (OART) in NASA headquarters, probably under William Cohen, with the Marshall Space Flight Center, Huntsville, Ala., designated the responsible field center.

NASA is expected to seek about $15 million in Fiscal 1965 for the program and about $30 million in Fiscal 1966.

The 156-in.-dia. motor program, the other part of the large solids program (AW Feb. 11, p. 50) and primarily a component test vehicle, will remain a USAF project. It is expected that Defense Dept. will sustain this program through at least demonstration firings, but beyond that, the program's future is said to hinge on the military role in space (AW Dec. 16, p. 30).

## News Digest

**Federal Aviation Agency** last week set May 15 as the deadline for design proposals by U. S. airframe manufacturers for a short-haul, passenger-cargo transport (AW Nov. 4, p. 28). Proposals will be used as a basis for selecting up to three contractors to prepare design specifications for an aircraft suitable for short-haul markets. Contracts will be limited to $100,000.

**C. E. Woolman,** 74, president and general manager of Delta Air Lines, indicated he will relinquish the top post on Jan. 31, 1965, to Earl Johnson, 58, who recently joined the airline as executive vice president.

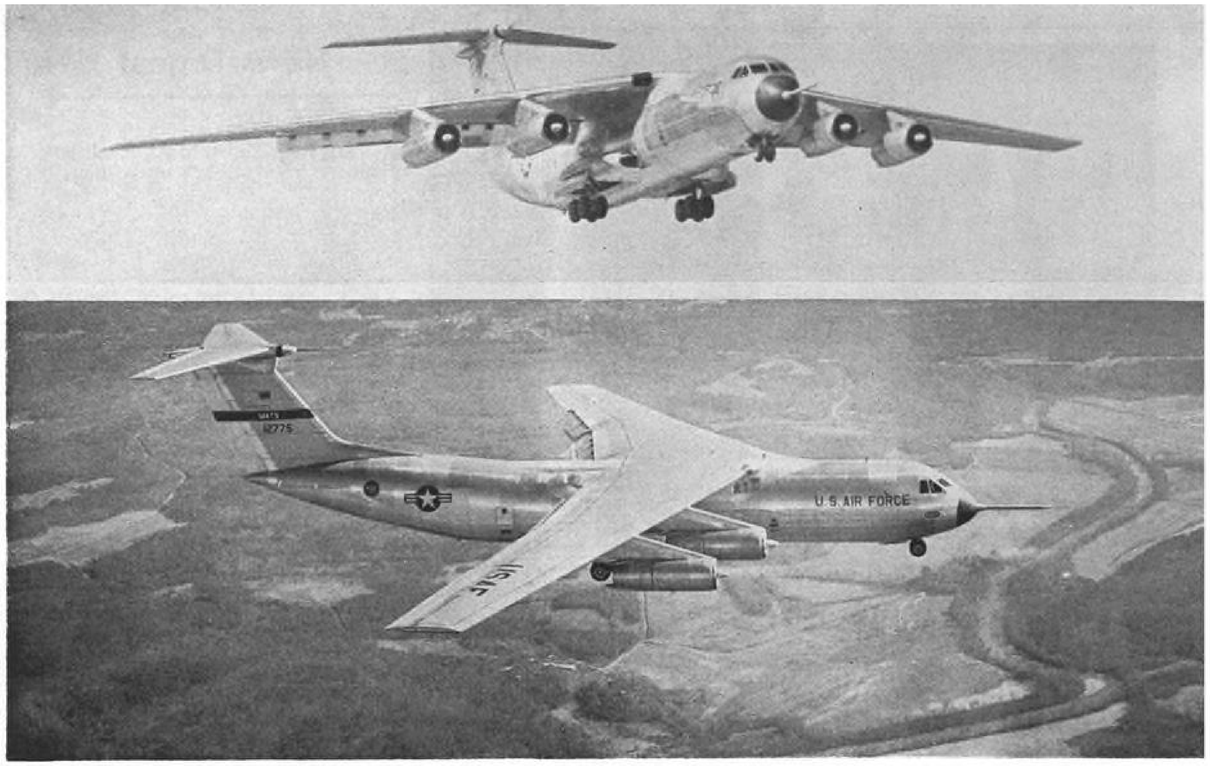
**IBM Federal Systems Div.** will build a one-way, air-to-ground laser communications system, to investigate its feasibility for satellite communication, under an $85,515 contract from NASA's Manned Spacecraft Center. The system, which will use a gallium-arsenide injection laser, initially will be evaluated in point-to-point ground tests followed by aircraft-to-ground tests. System delivery date is late 1964.

**Madagascar** and the U. S. reached agreement last week on installation and operation of a transportable tracking station at Majunga on the island's northwest coast. The station, which will be operated by NASA and Malagasy personnel, will determine whether satellites launched from the Pacific Missile Range have been injected into orbit.

**Electronic Industries Assn.** will abandon its quarterly survey of microcircuitry sales. The action stems from the decision of a major microcircuit supplier to stop its participation in the voluntary industry reports to EIA because summary data leaked to the press (AW Dec. 23, p. 63).

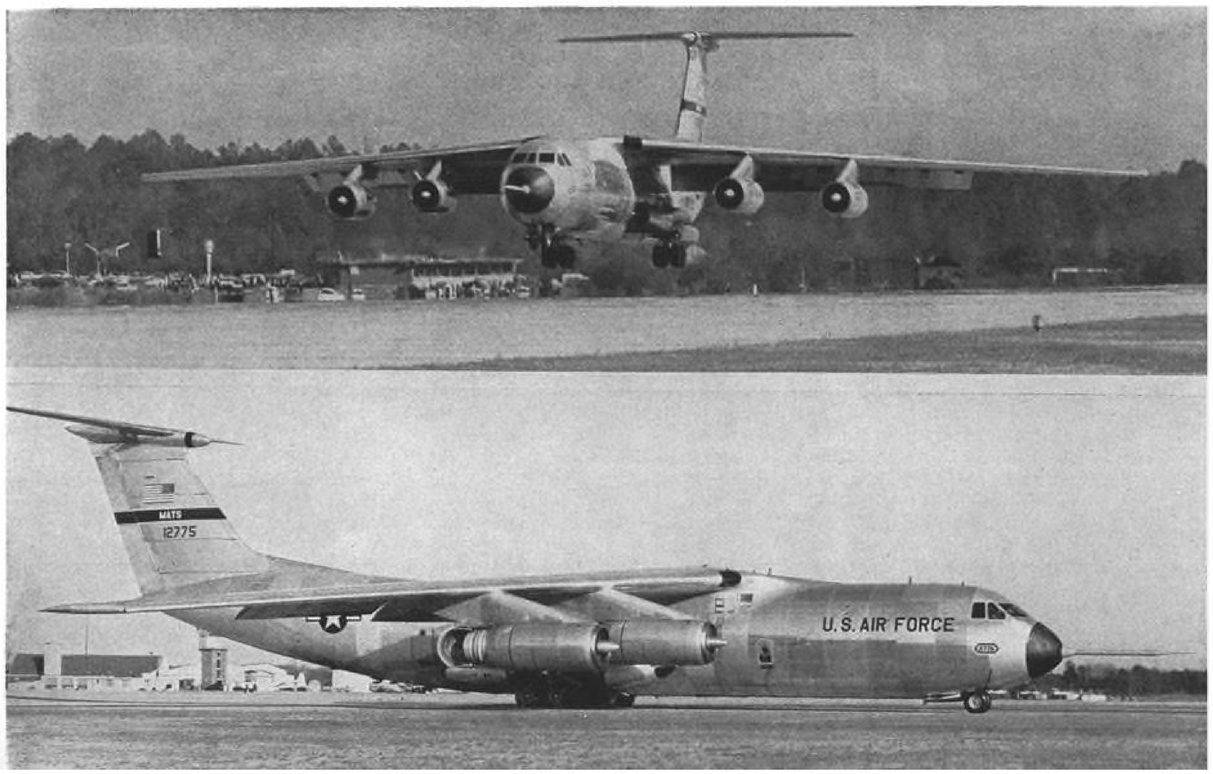
**Motorola, Inc.** last week was awarded a contract to build at least three and possibly 12 S-band receiving subsystems for the deep space and manned space flight tracking networks of NASA. The contract, which could total as much as $6 million, is a follow-on to the one NASA awarded to the firm in March, 1962.

**Kaman Aircraft Corp.** has reported a net loss for 1963 estimated at $1,400,000 and has omitted the stock dividend paid in previous years. Charles H. Kaman said the losses were due to write offs against product improvements, research and development program costs shared with the government, improvements on helicopters being delivered to the services and changes in procurement practices.




## Successful First C-141 Flight Begins Extensive Test Series

USAF-Lockheed C-141 StarLifter, which flew for 55 min. on Dec. 17 during its first flight test, will now undergo an extensive series of flight tests scheduled to run through next year. The Dec. 17 flight was made at a gross takeoff weight of 214,000 lb. The aircraft was rotated at 123 kt., and maximum speed during the flight was 168 kt., with landing gear remaining fully extended throughout the flight (AW Dec. 23, p. 42).






# 1963 Trunk Profit May Pass $100 Million

**Traffic growth of 14% seen; financial outlook is bright for domestic and international airlines in 1964**

By L. L. Doty

**Washington**—Optimism over prospects for growing earnings in 1964 is prevailing throughout the U. S. trunkline industry as early estimates indicate a 14% increase in traffic for 1963 compared with 1962, and a strong possibility that 1963's net profit will pass the $100 million mark.

This Aviation Week & Space Technology traffic forecast, slightly higher than the 11.9% gain predicted in December by the Air Transport Assn., is based on actual operations for 11 months and an estimate for December. The net earnings forecast were projected from the $72.3 million actually reported by the industry for the first nine months of 1963.

Similar optimism for a 1964 improvement is being expressed in the international field. Sir William Hildred, director general of the International Air Transport Assn., last week predicted that the world's scheduled airlines will show a 14% increase in both the number of passengers carried and revenue passenger miles flown in 1964.

Expectation that 1964 will bring about a continued expansion of business is based principally on the present healthy state of the general economy and the steady expansion of airline traffic during the past several years. In 1961, the U. S. trunklines reported a 1% gain and, in 1962, a 7.8% improvement in revenue passenger miles.

International scheduled airlines of the world showed no traffic increase in 1961, a 4% gain in 1962 and International Civil Aviation Organization has estimated a 6% increase for 1963.

W. A. Patterson, United Air Lines chairman, in his year end report, said that ". . . 1964 could be the most rewarding year since the jet age began." He noted that "airline traffic will reflect the strong uptrend most economists predict for business in 1964," and added:

"Revenue passenger miles flown by the nation's trunk airlines probably will increase about 7% over the 1963 total. Earnings should improve as a result of traffic growth and further absorption of costs associated with the initial change from piston to jet aircraft."

George P. Hitchings, vice president economic research and financial relations for American Airlines, also predicted "better-than-average" gains in 1964 if the general economy performs as expected.

Hitchings agreed that the industry's net profit will show an improvement in 1963, but warned that earnings still will be only 2 cents on each sales dollar, barely one-third of the amount required to earn the return on total investment considered reasonable by the Civil Aeronautics Board.

Hitchings also showed concern that the industry may not be as successful in arresting the normal cost increases in 1964 as it was in 1963. Hitchings estimated that 1963's cost increase was 5% for the 11 trunklines. He said:

"It will be difficult to hold expense to as small a rise. Escalation in employe pay and prices of materials and outside services usually adds this much or more to expenses."

Hitchings estimated traffic increases for 1963 at 13.5% and revenues at 8%. For the first nine months of the year, total operating revenues had climbed 8.1% over the same period in 1962, and total operating revenues rose 6.1%. Operating profit for the first three quarters of 1963 was $216.9 million.

Individually, airlines will report substantial gains in traffic during 1963. Eastern Air Lines will show an unusually high increase this year over last, but this is mainly due to the 1962 strike that grounded Eastern between June 23 and Sept. 13. Northeast Airlines' normal traffic was retarded last year because the loss of some of its fleet curtailed operations (AW July 1, p. 37), and the CAB order removing the carrier from the New York-Florida market diverted passengers to competitors (AW Aug. 26, p. 38).

Continental Air Lines is expected to show the highest percentage increase in traffic for 1963. According to Robert F. Six, the airline's president, Continental will have flown more than 1.7 million passengers during 1963, a gain

## Transatlantic Commodity Rates Lowered

Montreal—International Air Transport Assn. has approved a 15-20% reduction in specific commodity cargo rates on transatlantic routes.

The rates, effective for a two-year period beginning next Apr. 1, apply to commodities that comprise the major volume of cargo traffic on the route, and include a variety of especially low rates designed to increase traffic in commodities that currently move by air only in limited quantities.

These are examples of new rates, based on the New York-London route:

- Machines and tools. Previously carried mostly at general cargo rates, these may now be transported as specific commodities ranging from 40 cents per lb. on shipments weighing 110 lb. to 21 cents for shipments of 2,200 lb. or more.
- Automobile and agriculture parts. Rates are 34 cents per lb. at 100 lb. and 21 cents per lb. for 440 lb.
- Office machines and parts. These will be shipped for 33 cents per lb. for 220 lb. and 23 cents per lb. for 440 lb.
- Radios, televisions, electrical appliances and parts. These have a new rate of 40 cents per lb. for shipments of 100 lb. descending to 21 cents per lb. for 2,220 lb.
- Manufactured textile products. Rates are 34 cents per lb. for 99 lb. and 28 cents per lb. for shipments of 1,100 lb. or more.
- Chemicals. The rates are 42 cents per lb. for 100 lb., 40 cents for 220 lb. and 34 cents for 1,100 lb.

General cargo rates remain at the present levels and weights, descending from $1.14 per lb. for shipments under 99 lb. to 39 cents per lb. for shipments in excess of 1,100 lb.

IATA also established minimum rates for aircraft charters for cargo carriage at 12 cents to 16 cents per available ton mile, depending upon the type and capacity of the aircraft.

The new rates were worked out during a special IATA traffic conference earlier this month in Miami.

## Air France Management Defends Policies

Paris—Air France management claims the national carrier is beginning to recover from its financial difficulties which reportedly has led the French government to consider a management shakeup (AW Dec. 16, p. 44).

Air France's President, Joseph Roos, and its managing director, Louis Lesieux, gave a detailed report which showed the carrier's situation began to improve as of last July. They also fielded a series of questions including one relating to reported government intentions to remove top officials (AW Dec. 16, p. 44).

"I do not want to leave," Roos said. "Does the government want me to? If so, that will raise some legal questions. Moreover, every time I ask government officials if my removal is desired they deny it."

Roos's reference to legal questions probably referred to the fact that the president of Air France is named by the government for a period of six years and can be removed only for serious reasons.

Airline officials noted, among other special problems that Air France has had to face, an unusual rise in labor costs. They said that over the past four years employe pay costs at Air France rose 50% compared with 24% for other international carriers.

Air France finances, since last July, have begun to improve, they said. Its operating deficit now is expected to be roughly $19 million compared with a deficit of $22.6 million in 1962.

of 22% over the volume carried in 1962.

Six stressed strong control over costs as a factor in his airline's success this year.

He said that the airline had held costs to a minimum through the final write-off in 1963 of the carrier's five Douglas DC-7 transports to scrap value, and by the standardization of its fleet to turbine-powered aircraft. "Ninety-nine per cent of our daily seat miles are now being operated" with turbine equipment, he said.

Commenting on the future, Six said, "In my opinion we are entering what well may be the most stable period in the company's history. For the first time in 20 years, we do not face the prospect of having our aircraft become obsolete before being fully depreciated. . . ."

Air Transport Assn. has estimated that local service airlines will report a 12.5% increase in the number of passengers carried in 1963 over 1962, and that revenue passenger miles will show a 15% increase.

Certificated helicopter airlines will report a 30.1% increase in the number of passengers flown in 1963, and a 56.7% increase in revenue passenger miles, according to ATA forecasts.

Intra-Alaska airlines will show a 5.5% decrease in revenue passenger miles, but intra-Hawaiian airlines will experience a 8.9% increase for 1963. Domestic all-cargo airlines are expected to report a 29% decline in revenue ton miles for the year.

U.S. international and territorial scheduled airlines will report a 17.2% increase in revenue passenger miles, according to ATA estimates. This group's total revenue ton miles will be 13.9% higher for 1963 than the volume handled in 1962.

## Red China Attacks U.S., Japan on Routing

Communist China has attacked the U.S. and Japan for the latter's refusal to permit a proposed re-routing of Karachi-Tokyo air service (AW Oct. 21, p. 43).

The Red Chinese press charges that "covert pressure by the United States is the real cause of Japan's discriminatory act." It claims that the "inspired discrimination" has made the Pakistani public "equally angry" at Japan and the U.S.

The difficulty arose after Pakistan proposed amendment of its air agreement with Japan so that Karachi-Tokyo flights would serve Shanghai and Canton instead of Singapore. Red China wanted the new routing to shorten the flying distance between Pakistan and Japan and to facilitate air service between China and Japan.

Instead, according to Peking Review, "Japanese authorities bowed to U.S. dictation and rejected the request on the grounds of 'political implications.'"

The Red Chinese organ said that Pakistan has protested and demanded reconsideration. "Officials and political figures in Rawalpindi [Pakistan] as well as businessmen in Karachi are reminding the Japanese government that the refusal can only be regarded as an unfriendly act."

The Peking Review continued: "Recalling adverse U.S. comments on the Pakistan-China air agreement some time ago and the subsequent calling off of an already agreed U.S. loan for Dacca Airport development, the Karachi daily newspaper Dawn asks: 'Could there be a connection between that attitude of Washington and Tokyo's present refusal to let Pakistan International Airlines operate to Japan through Canton and Shanghai?

" 'The Japanese are a proud nation, and one does not like to think that they could be pressured by any other government in matters of policy which fall within their own sovereign jurisdiction. But the coincidence will not go unnoticed.'

"In this, as in many other questions," Peking Review said, "toeing the U.S. line, which is to isolate China, will bring no good to Japan. The move is one of discrimination against Pakistan, and it also undermines Sino-Japanese friendship . . ."

## Total Pan Am-Panagra Merger Is Proposed

New York—Complete merger of Pan American World Airways and Pan American-Grace Airways is proposed in a new Pan American application to the Civil Aeronautics Board (AW May 6, p. 41).

The move changes Pan American's previous proposal that it buy Grace's 50% interest in Panagra, then operate Panagra as a separate company. Panagra is jointly owned by Pan American and W. R. Grace, but Grace has agreed to sell out to its partner if the CAB agrees.

Pan American, in its new application, opposed the CAB's decision to resolve, as a package, an anti-trust dispute between Panagra and Pan American, a possible readjustment of U.S. routes in South America, and the change in Panagra ownership.

"The effect of such a proceeding would be virtually to prejudge, indeed if not actually to determine, the essential character of the future U.S. flag air route pattern serving the West Coast of South America," Pan American officials said.

Instead, Pan American wants the question of Panagra ownership decided separately from the Board's action in the South America Route Case.

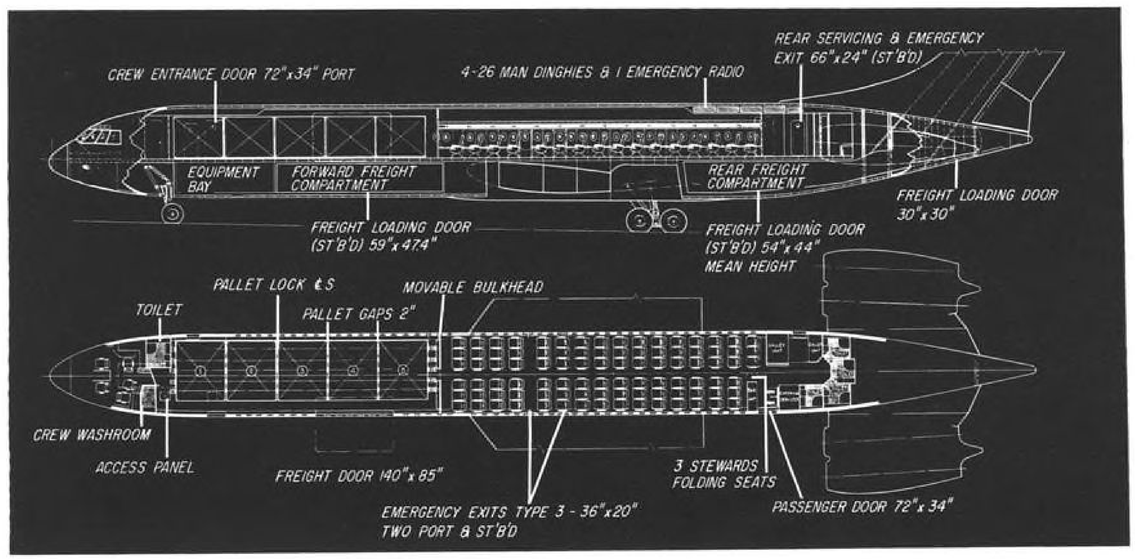
Separate determination would leave the route case open to argument should Braniff International Airways, rather than Pan American, be authorized to buy Grace's Panagra holdings. Braniff has offered to top Pan American's $10,625,000 bid on the shares, arguing that consolidation of Braniff and Panagra would strengthen U.S. competition in South America while preserving two-carrier participation—Braniff in the West and Pan American in the East.

It was Braniff which suggested the CAB consolidate the various aspects of the South American investigation into a single package. This, Braniff said, would settle with one decision the question of U.S. competition on that continent.




## Super VC.10 Flight Nears

First flight is planned early next year for the first Vickers Super VC.10 turbojet transport nearing completion (above) at Vickers-Armstrongs Weybridge, England, production plant. The airplane is one of 30 ordered by British Overseas Airways Corp. Super VC.10 is 13 ft. longer than standard version now undergoing certification and route proving tests. Powerplants are four Rolls-Royce Conway RCo. 43D engines. Super VC.10-CPF (below) is passenger-cargo version specially designed for BOAC's eastern routes (AW Oct. 7, p. 55). Version shown in diagram has five cargo pallets, measuring 108 in. x 88 in., mounted in forward section, with 93 economy class seats at 34-in. pitch. Freight door is mounted forward of leading edge. BOAC will have eight mixed cargo-passenger versions in operation, starting in late 1965.



# Lufthansa Hopes Break-Even Point Near

By Edith Walford

**Cologne**—Lufthansa German Airlines hopes to approach the break-even point this year for the first time in its post-war history, possibly requiring government subsidies for as little as 1-to-2% of its over-all operational costs.

The optimistic 1963 forecast by company officials is based primarily upon traffic results obtained thus far this year coupled with a general cutback in expansion plans and a review of the final 1962 figures, which show a marked decline in losses as compared with 1961.

### Equipment Moves

In its effort to further cut losses while attracting new passenger potential, Lufthansa plans a number of shifts in its present equipment inventory, including the sale to Pan American World Airways early next year of two of its seven Boeing 720-030B turbojet transports.

However, despite progress thus far, Hans M. Bongers, Lufthansa board member and financial director, says the carrier still faces another few difficult years before it re-captures its pre-war position among major international airlines.

Whereas its competitors' share of world air traffic generally equals that of their respective countries' world trade, he says, Lufthansa last year recorded only a 2% share in world air traffic as compared with West Germany's 10% share in world trade.

Final 1962 financial results show a good improvement over the previous year, a fact also largely due to the carrier's slower rate of expansion as opposed to its rapid break into the international market following its reorganization in spring, 1955, plus a reduction from 27.2 to 24 cents per ton/mile in the production cost of capacity offered.

With a loss of $11.2 million including depreciation and amortization charges, the company has reduced by more than half its record deficit in 1961 of $26.7-million, considerably reducing its dependence on German government subsidies to cover its annual losses.

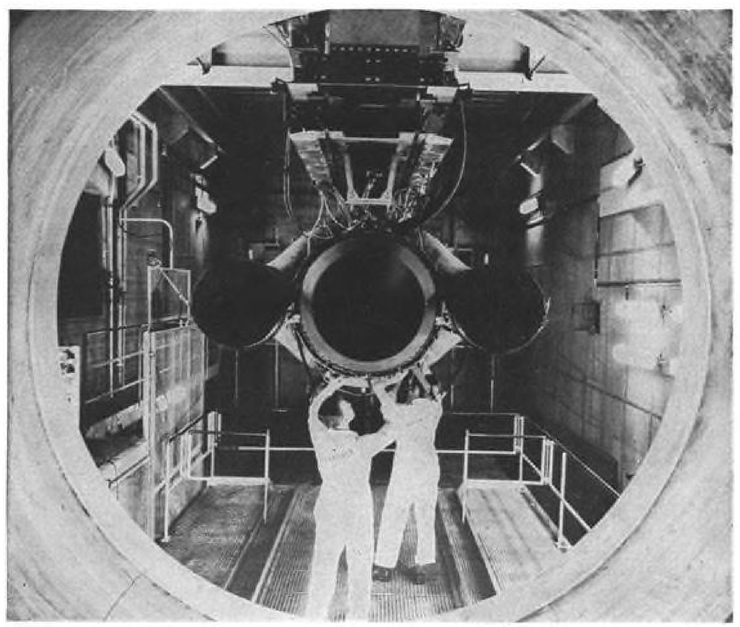
Recently-released final operational figures for last year also show marked advances and include:

- **383.4 million ton miles offered,** an increase of 23.2% over the previous year.
- **203.5 million ton miles sold,** an increase of 21.8% over 1961.
- **1.9 million passengers carried,** an increase of 19.7%.
- **48.1 million ton miles** of freight carried, a 30.5% increase.
- **10.1 million ton miles** of mail carried, a 90.1% gain.

During the same period, Lufthansa achieved an over-all load factor on its North Atlantic route of 54%, the same as the previous year, while on the South Atlantic it fell four points to 63%. The Near East showed a slight increase from 53 to 55%, and on the Middle and Far East network a one point increase to 51% over the previous year was recorded. Over-all load factor on Lufthansa's African network from Mar. 4 to Dec. 31, last year, its initial period of operation, was 32%, while it climbed two points to 54% on the European and four points to 51% on the carrier's domestic services compared with 1961.

On its North Atlantic routes where it offers more than half its total capacity, the carrier says it averaged 76 passengers per flight carried during 1962 and registered a seat load factor of 54%, the best among the 10 major transatlantic operators.

However, the persistent gap between demand and capacity available in this sector of its operations remains a major problem. In Lufthansa's view, a good step towards its solution from which everybody would benefit would be the introduction of a simplified North Atlantic tariff structure.



**REAR VIEW** of one of the four Pratt & Whitney JT3D-3 by-pass engines, which power Lufthansa's Boeing 707-330B aircraft, undergoing trials in the carrier's jet engine test center at Hamburg.

### Total Traffic Share

Lufthansa's 11% share of total air traffic between Europe and South America in 1962 remained the same as the previous year and its 77% seat load factor also remained the same. Seats offered during the same period increased from 17,104 in 1961 to 21,258 last year and the carrier now ranks fourth among a total of 11 airlines operating between Europe and South America.

With the introduction during 1962 of year-round Boeing 720-030B services on Lufthansa's Near East network, the carrier was able to improve its performance in this area considerably, despite political disturbances and local currency and travel restrictions. Compared with 1961, seat load factor increased by five points to 41% although capacity offered rose by 56% during the same period.

However, Lufthansa says that distances between stops over its Near East network are too short and its share of fixed costs too high so that over-all results are still disappointing.

In May, 1962, the airline increased its Frankfurt to Hong Kong round-trip services from two to three times weekly and this route was extended to Tokyo the following October. Seat/mile capacity offered over this route increased 33% last year, while the number of passengers carried also rose from 32,730 in 1961 to 42,544, an increase of 30%. Lufthansa's Frankfurt-Bangkok via Pakistan round-trip service, which the airline had hoped would attract more passengers with the introduction of its Boeing 720B aircraft towards the end of 1961, failed to meet expectations in 1962, primarily because of local foreign currency regulations, which favor national carriers in the area.

### Far East Route

Results on the Far East route have shown an improvement thus far this year, however, although passenger quotas between Bangkok and India and Hong Kong and Japan continue to limit the German carrier's performance here as well. Its seat load factor in the Middle and Far East last year averaged 42%, four points less than the previous year.

In March, 1962, Lufthansa inaugurated its first round-trip service between Frankfurt and Lagos, Nigeria, on a once-a-week basis and had planned to open another route to Johannesburg via Athens and East Africa. The latter project was abandoned, however, when the carrier failed to obtain landing rights in Nairobi and Salisbury.

In order to compensate in some measure at least for the loss of its share of the traffic on the East African route, it extended its existing Frankfurt-Lagos round-trip service to Johannesburg at the beginning of this year, while its East African route now terminates at Khartoum. From Mar. 4 to Dec. 31, 1962, its initial period of operation of the West African service, it recorded a seat load factor of 29%.

In Europe, although competition was severe from the jet services of other carriers, Lufthansa's seat load factor increased one point last year to 55% over its largely Convair 440 and Vickers Viscount 814 operated network. Beginning Apr. 1, 1962, the carrier introduced Boeing 720B jet transports on most of its South-East European services as well as on a second daily round-trip flight between Frankfurt and London. Simultaneously, a second daily round-trip service between Frankfurt and Paris was inaugurated with a Sud Caravelle chartered from Finnair.

From a total of 472,270 passengers carried on Lufthansa's domestic services in 1961, the number climbed to 539,339 last year, an increase of 14%. The corresponding seat load factor was 55%, five points higher than the previous year.

The increase of 30.5% in 1962 over the previous year in the carrier's over-all freight operations was due largely to a continuing upward trend in its North Atlantic cargo services where it recorded a 25% gain in addition to an increase of 38% in freight carried on its European network.

Lufthansa's charter operations last year showed a slight decline compared with the previous year. On a total of 241 non-scheduled flights, it carried 15,295 passengers to 50 different points in the U.S., Europe, Asia and Africa not included in its regular scheduled services.


**FREIGHT IS LOADED** aboard a Lufthansa Boeing 720-030B turbojet transport at Lagos, Nigeria, which the airline serves on a twice-a-week round-trip basis from Frankfurt/Main. The carrier's over-all freight services increased last year by 30.5% over 1961.

On Dec. 31, 1962, total Lufthansa staff including flight personnel numbered 12,434, an increase of 3.8% over the previous year's total of 11,981 employes.

Lufthansa's technical director, Gerhard Hoeltje, says that a decision probably will be reached within the next few months on a suitable replacement for the carrier's aging Convair 440 and Vickers Viscount 814 fleet, which are due to be retired from service towards the end of 1964 and the beginning of 1965 and 1966-67 respectively. Douglas Aircraft Co.'s Douglas DC-9 and the British Aircraft Corp.'s BAC 111 twin-jet transports are still the two major contenders for this order, (AW Mar. 4, p. 45).

### Small-Aircraft Requirement

Lacking German government support, the Ernst Heinkel short-range He 211 B-1 twin-jet design proposal has been abandoned, and Lufthansa now appears to favor the Fokker F-28 twin-jet development to fill its requirement for a small aircraft to serve its planned city-to-city, short-haul route expansion within West Germany.

Next March, the airline will sell two of its seven Boeing 720-030B jet aircraft to Pan American World Airways because of over-capacity in its medium-range network as a result of its failure not only to obtain landing rights in East Africa, but also permission to establish a new route to Central America as well as a third weekly round-trip frequency between Frankfurt and South America (AW Sept. 30, p. 39).

Simultaneously, the carrier will take delivery of a second Boeing 707-330B long-range transport to be used primarily for operation of its non-stop transatlantic services between Frankfurt and Chicago and Frankfurt-Montreal and San Francisco.

The carrier plans later to purchase a third Boeing 707-330B which, in addition to its five Boeing 707-430s, will enable it slowly to close the gaps still missing in its long-range intercontinental network, including new route extensions to Central America, a polar route to Tokyo and other points in the Pacific area.

In spring next year, Lufthansa also expects delivery of the first six of 12 Boeing 727 short- to medium-range jet transports on order, with the remaining six due to arrive in the spring of 1965. They are scheduled for operation over the airline's existing European routes between Frankfurt-London, Frankfurt-Milan, Frankfurt-Rome, Frankfurt-Madrid, Frankfurt-Barcelona, Frankfurt-Stockholm via Copenhagen as well as its Near East service between Frankfurt and Tehran, all of which are presently being operated by Lufthansa's Boeing 720-030B fleet.

The airline says that the steady growth thus far of its new air shuttle flights between Frankfurt and Hamburg introduced for a one-year trial period last April (AW June 10, p. 43), will enable it gradually to extend the service over most of its major internal routes, although not before the latter part of 1964. Between Apr. 1 and Sept. 1 this year, it recorded a total of more than 30,000 people carried on its 86-passenger Super Constellation 1049G transports serving the Frankfurt-Hamburg route segment.

# AIRLINE OBSERVER

► Total of 10 U.S. airlines have notified the Federal Aviation Agency of their intent to evaluate manufacturers' proposals for the design of the supersonic transport. Deadline for submission of these proposals to FAA by manufacturers is Jan. 15. Government and airline evaluations will be formally reviewed in discussions scheduled for Mar. 25 and 26. Airlines participating in the evaluation are: American Airlines, Braniff Airways, Continental Airlines, Delta Air Lines, Eastern Air Lines, National Airlines, Northwest Airlines, Pan American World Airways, Trans World Airlines and United Air Lines.

► **Watch for a move by India next year to expand Air-India routes in Africa.**

► FAA has proposed a rule requiring the installation of cockpit voice recorders on all turbine-powered aircraft by July 1, 1965. Rule also will call for installation of the equipment, which will record flight crew conversations, on all pressurized four-engine piston aircraft by Jan. 1, 1966, and on all other aircraft in commercial service by July 1, 1966.

► **Airlines will install static discharge wicks on all aircraft in response to an FAA recommendation that the devices be installed on all jet aircraft (AW Dec. 23, p. 41), despite wide disagreement over their effectiveness. Of the total of 440 jets operated by U.S. airlines, 117 will be retrofitted with the wicks. The rest are already equipped with them. The 117 aircraft include 48 Boeing 707s, 43 Douglas DC-8s and 26 Convair 990 and 880 models.**

► Russia's Aeroflot is continuing to place twin-jet Tu-124s on more routes despite the usual winter reduction in over-all service. New Tu-124 routes include Volgograd-Kiev, Rostov-Odessa and Gorki-Mineralnye Vody, a Caucasus resort. First scheduled international service with Tu-124s—Moscow to Helsinki, Vienna and Copenhagen—began in November. Aeroflot has also inaugurated Moscow-Chelyabinsk flights with twin-jet 100-passenger Tu-140Bs.

► **Washington National Airport's north-south instrument runway will be closed for four months beginning Apr. 27 to permit resurfacing and installation of touchdown zone and center-line lighting systems. Installation of temporary navigational equipment to permit instrument use of the other two runways is now under consideration by FAA. Operating minimums at the airport are expected to be raised substantially during the construction period.**

► Civil Aeronautics Board has released a tentative proposal for a local service class subsidy rate formula. Proposal represents a staff position on subsidy and has not been passed by the Board. Proposal estimates a total annual subsidy of $66 million compared with the rate established July 1, which was estimated to produce annual gross subsidy of $67.5 million. Staff will hold informal discussions with the carriers on the plan, but any agreements reached are not binding on the Board. Proposal is predicated on a 16% rate of return on equity, 7.5% return on preferred stock and 5.5% on debt.

► **Lease agreement between Pan American World Airways and South Pacific Air Lines, which permits Pan American to operate the Honolulu-Tahiti route for an interim period, has been approved by CAB. Expedited hearing on the joint application for the sale of South Pacific's operating rights on the route to Pan American have been scheduled.**

► British Ministry of Aviation is studying the effect of grass dyed purple or violet to repel birds from airports and runways. Studies indicate that the coloring has some effect on seagulls and other birds, but costing and processing have yet to be worked out. In the latest bird repellent experiment being conducted at Prestwick, Scotland, the Ministry has been using carbide guns, in which a chemical reaction produces a series of loud reports to drive birds off the runway and approach path.

# SHORTLINES

► **American Airlines** flew 151 million ton miles of freight during the first 11 months of 1963, a 6% increase over the volume handled in the same period last year.

► **Bonanza Air Lines** has passed the 500,000-passenger mark in one year for the first time. Total number of passengers carried since Jan. 1 exceeded that figure in early December and the company expects to go over 537,000 by the end of the year, which would represent a 26% increase over the 1962 volume. Bonanza is projecting an increase to more than 600,000 boardings in 1964.

► **Carton of high-quality,** ultra-fragile wine glasses was flown by Pan American World Airways around the world from Vienna, Austria, to determine whether air freight handling for fragile products was practical. Glasses completed the 21,300-mi. trip in two days in perfect condition.

► **Civil Aeronautics Board** has approved a group tour-basing fare proposed by Trans-Caribbean Airways between New York and San Juan, but has ordered an investigation of the tariff. Fare is $95, 22% lower than regular third-class fares and is available to groups of 100 or more persons.

► **New terminal** building at Amsterdam's Schiphol Airport will be equipped with telescopic gangways connecting aircraft with loading docks. Building will become operational in 1966.

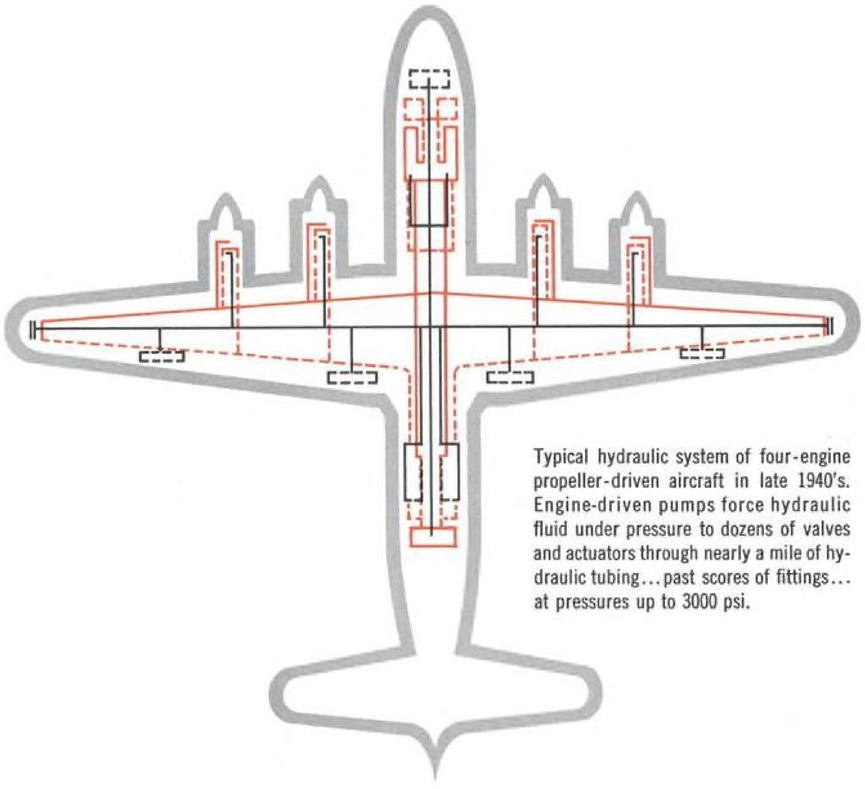
► **Pan American World Airways** was to begin the first one-plane service between the West Coast and Tahiti via Hawaii last week. Initially, schedule calls for a once-a-week flight from Los Angeles using a Boeing 707 jet transport.

► **Passenger facilities** at major Russian airports showed slow improvement during 1963, although completion of major projects at Kiev and Moscow—especially Domodedovo Airport—is lagging. Aeroflot built new airport hotels at Sverdlovsk, Chelyabinsk, Karaganda and Gorki in 1963. Besides the new passenger terminal at Novosibirsk (AW Dec. 9, p. 45), terminals were opened at Penza and Skytyvkar.

► **United Air Lines** has been conducting a sales drive in Japan aimed at stimulating more Japanese tourist travel to the U.S. Carrier estimates that by 1968, some 200,000 Japanese will be traveling overseas with 80,000 of these visiting the U.S.

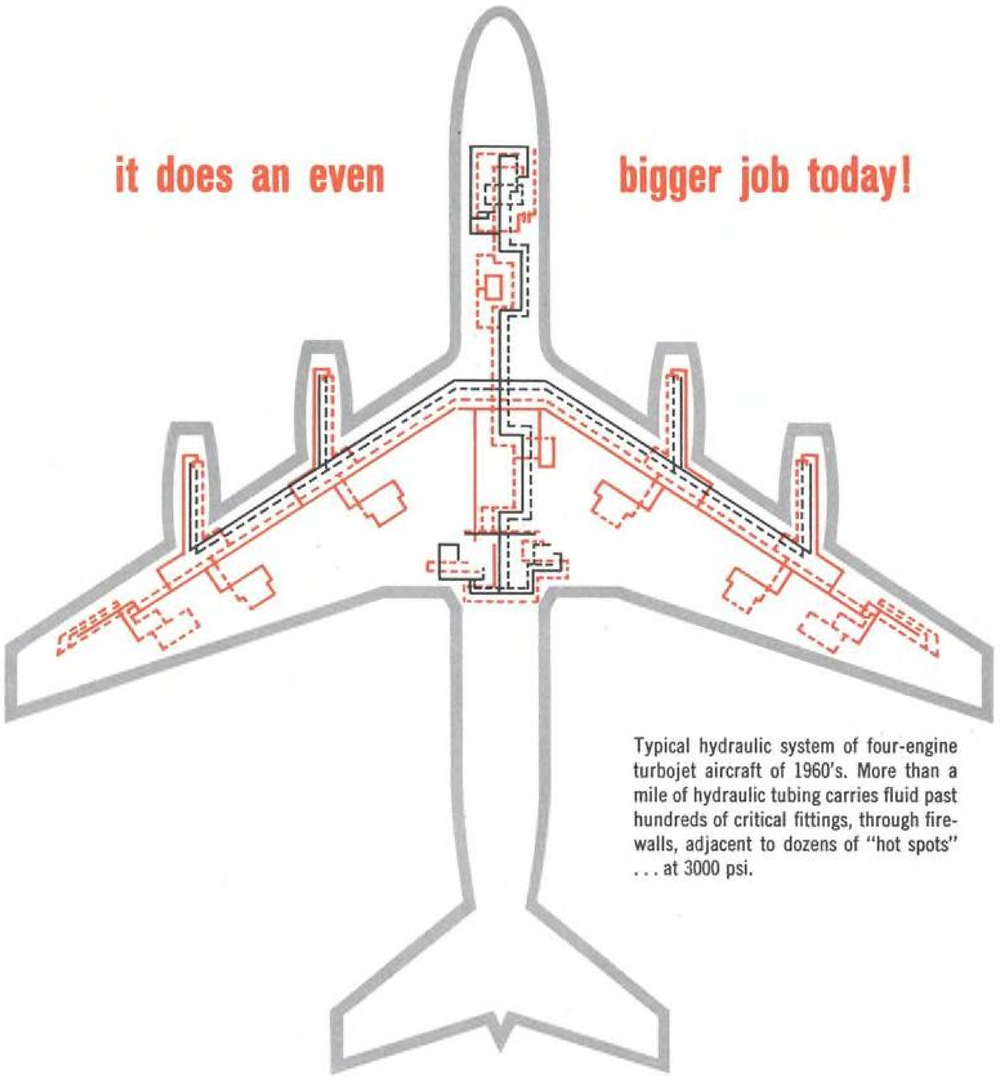

**There were <u>hundreds</u> of them up to 1948 when Skydrol® was introduced . . .**

## Skydrol took on a big job in 1948 . . .



Typical hydraulic system of four-engine propeller-driven aircraft in late 1940's. Engine-driven pumps force hydraulic fluid under pressure to dozens of valves and actuators through nearly a mile of hydraulic tubing . . . past scores of fittings . . . at pressures up to 3000 psi.

## it does an even bigger job today!



Typical hydraulic system of four-engine turbojet aircraft of 1960's. More than a mile of hydraulic tubing carries fluid past hundreds of critical fittings, through firewalls, adjacent to dozens of "hot spots" . . . at 3000 psi.

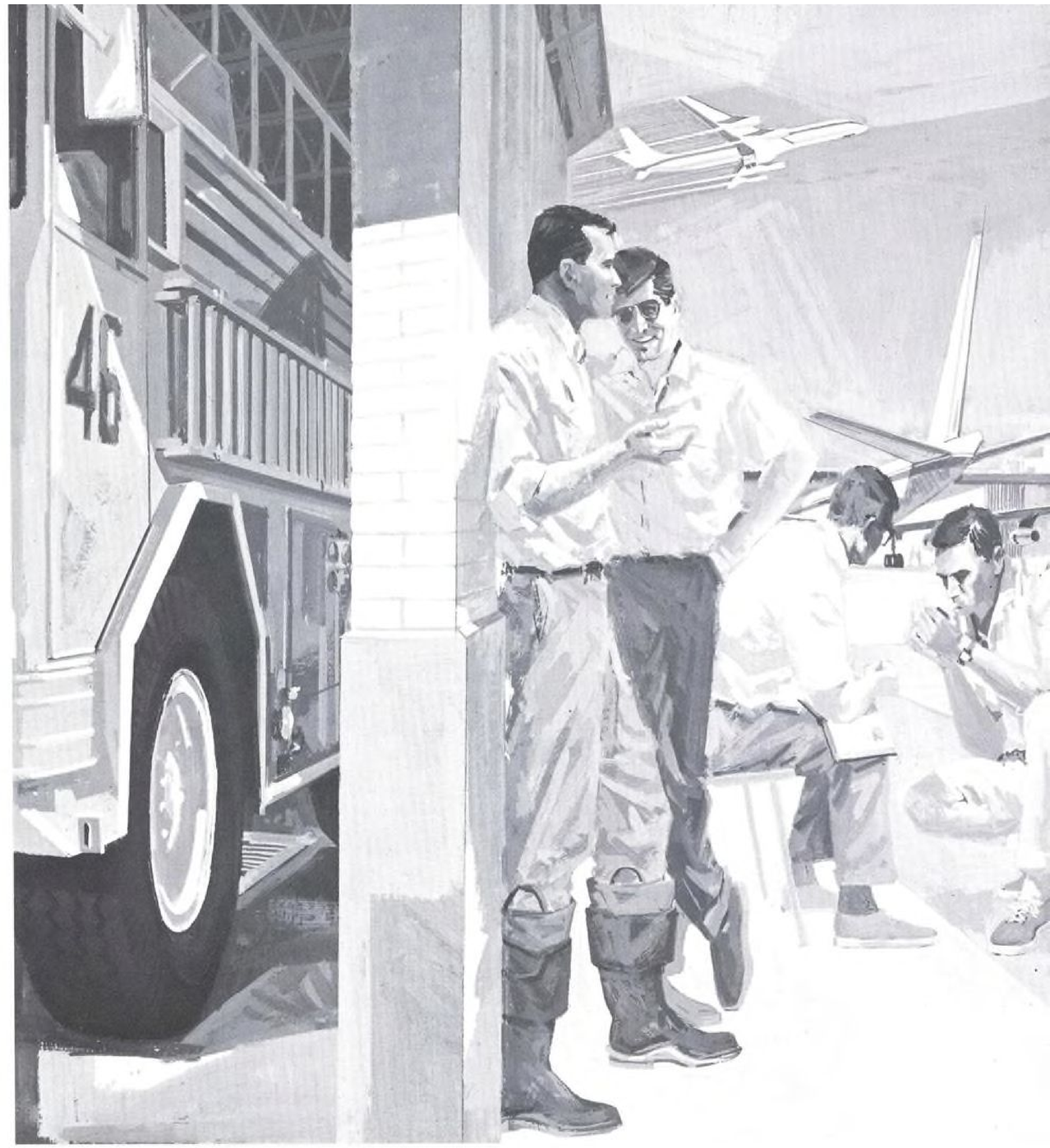
Today's aircraft are bigger. Hydraulic systems are more extensive, more complex. More than a mile of hydraulic lines snake through a modern four-engine jet. They run through firewalls, unavoidably close to dangerous "hot spots". . . possible ignition sources.

Hydraulic leaks are going to happen. Spring a leak anywhere in this mile-long maze of tubing, hoses, couplings and fittings, and high pressure forces the fluid out in a finely divided spray or mist. Run this mist past a super-heated brake drum or any of dozens of other possible ignition sources all over the airplane and you've got an explosive situation on your hands.

With flammable fluid in the hydraulic lines, you risk fire, the safety of passengers and crew, the loss of an airplane.

With fire-resistant Skydrol in the lines, you lose a little fluid. That's ALL.

It's an easy choice, and most of the world's major airlines have made the *decision for Skydrol.*




## . . . but not one since then in a Skydrol-equipped aircraft!

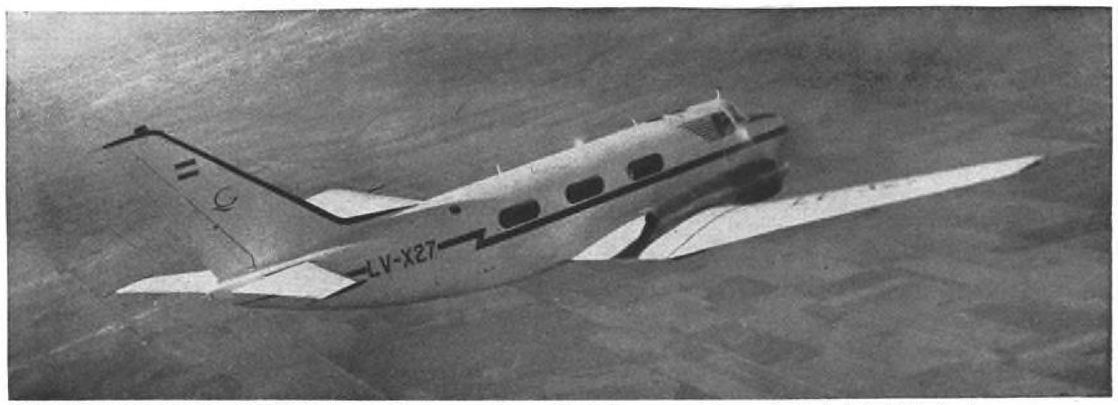
Hydraulic system failures still happen. Leaks still spray hydraulic fluid over super-heated brake drums . . . onto glowing exhaust manifolds . . . past sparking electrical contacts . . . or into dozens of other possible ignition sources. That spells fire when the hydraulic lines carry flammable fluid. But *no* aircraft equipped with fire-resistant Skydrol has *ever* been involved in a hydraulic fluid fire. *Not one!*

# Airline Traffic—October 1963

(IN THOUSANDS OF DOLLARS)

| | Revenue Miles (000) | Originating Passengers (000) | Revenue Passenger Miles (000) | Passenger Load Factor (%) | Total Revenue Ton Miles (000) | Average Over-all Load (Tons) | Scheduled Miles (000) | Performance Factor (%) |
|---|---|---|---|---|---|---|---|---|
| **DOMESTIC TRUNKS** | | | | | | | | |
| American | 11,595 | 779.3 | 636,504 | 60.3 | 81,387 | 7.02 | 11,486 | 99.5 |
| Braniff | 2,700 | 234.1 | 113,339 | 56.5 | 12,876 | 4.77 | 2,659 | 99.3 |
| Continental | 2,405 | 152.1 | 105,347 | 49.9 | 11,935 | 4.96 | 2,394 | 98.9 |
| Delta | 5,200 | 424.9 | 256,308 | 60.0 | 29,344 | 5.64 | 5,220 | 98.5 |
| Eastern | 9,610 | 894.3 | 394,789 | 47.2 | 44,259 | 4.61 | 9,558 | 97.4 |
| National | 2,757 | 177.2 | 132,752 | 47.0 | 14,857 | 5.39 | 2,812 | 97.5 |
| Northeast | 1,195 | 94.7 | 33,593 | 36.6 | 3,468 | 2.90 | 1,367 | 85.6 |
| Northwest | 3,094 | 238.0 | 144,661 | 51.3 | 17,011 | 5.50 | 3,103 | 99.2 |
| Trans World | 8,830 | 526.8 | 482,020 | 54.2 | 56,440 | 6.39 | 8,791 | 99.4 |
| United | 16,369 | 1,095.8 | 756,490 | 53.3 | 91,460 | 5.59 | 16,420 | 98.3 |
| Western | 2,399 | 246.5 | 127,083 | 51.6 | 13,299 | 5.54 | 2,452 | 97.6 |
| **Domestic Trunk Total** | **66,154** | **4,863.7** | **3,182,886** | **53.6** | **376,336** | **5.69** | **66,262** | **98.3** |
| **INTERNATIONAL** | | | | | | | | |
| American | 164 | 9.8 | 9,310 | 52.9 | 1,247 | 7.61 | 164 | 100.0 |
| Braniff | 286 | 8.7 | 11,021 | 39.2 | 1,590 | 5.56 | 284 | 99.0 |
| Caribair | 153 | 48.1 | 3,772 | 56.8 | 399 | 2.60 | 148 | 98.7 |
| Delta | 115 | 2.5 | 4,191 | 40.8 | 481 | 4.17 | 112 | 98.5 |
| Eastern | 1,089 | 40.7 | 59,162 | 41.0 | 6,285 | 5.77 | 1,103 | 98.2 |
| Mackey | 103 | 8.4 | 1,838 | 26.4 | 187 | 1.80 | 90 | 98.7 |
| Northwest | 1,167 | 27.3 | 80,851 | 59.1 | 12,464 | 10.68 | 918 | 99.2 |
| Panagra | 352 | 12.8 | 21,576 | 63.5 | 3,410 | 9.70 | 335 | 98.2 |
| Pan American | 9,693 | 374.0 | 683,833 | 58.1 | 98,703 | 10.18 | 9,272 | 95.9 |
| South Pacific | 22 | 0.3 | 929 | 51.8 | 96 | 4.37 | 22 | 100.0 |
| Trans-Caribbean | 418 | 16.2 | 39,248 | 55.9 | 4,265 | 10.20 | 310 | 77.7 |
| Trans World | 2,590 | 57.2 | 186,121 | 56.1 | 26,359 | 10.18 | 2,415 | 97.8 |
| United | 801 | 25.1 | 62,507 | 65.9 | 7,118 | 8.88 | 773 | 99.3 |
| Western | 188 | 8.7 | 13,315 | 68.0 | 1,687 | 8.99 | 189 | 99.4 |
| **International Total** | **17,141** | **639.8** | **1,177,674** | **56.6** | **164,291** | **9.58** | **16,135** | **96.6** |
| **LOCAL SERVICE** | | | | | | | | |
| Allegheny | 1,009 | 107.6 | 21,271 | 45.4 | 2,331 | 2.31 | 994 | 98.2 |
| Bonanza | 564 | 49.1 | 12,511 | 58.4 | 1,245 | 2.21 | 560 | 99.5 |
| Central | 636 | 35.8 | 7,292 | 41.6 | 776 | 1.22 | 630 | 99.8 |
| Frontier | 1,131 | 50.5 | 14,029 | 36.7 | 1,518 | 1.34 | 1,142 | 98.6 |
| Lake Central | 616 | 47.4 | 7,629 | 43.4 | 827 | 1.34 | 611 | 99.3 |
| Mohawk | 1,081 | 120.3 | 24,672 | 53.1 | 2,550 | 2.36 | 1,064 | 99.1 |
| North Central | 1,220 | 100.8 | 17,938 | 43.2 | 1,975 | 1.62 | 1,186 | 99.6 |
| Ozark | 991 | 80.6 | 15,300 | 51.3 | 1,639 | 1.65 | 989 | 99.5 |
| Pacific | 461 | 48.0 | 10,289 | 52.9 | 1,029 | 2.23 | 466 | 98.8 |
| Piedmont | 992 | 82.2 | 18,757 | 49.0 | 1,954 | 1.97 | 971 | 99.5 |
| Southern | 863 | 60.2 | 11,712 | 42.0 | 1,229 | 1.42 | 826 | 99.4 |
| Trans-Texas | 726 | 41.5 | 9,390 | 42.1 | 990 | 1.36 | 726 | 98.7 |
| West Coast | 573 | 30.6 | 7,262 | 42.0 | 738 | 1.29 | 625 | 91.6 |
| **Local Service Total** | **10,863** | **854.6** | **178,052** | **46.3** | **18,801** | **1.73** | **10,790** | **98.7** |
| **ALASKA & HAWAIIAN** | | | | | | | | |
| Alaska Airlines | 249 | 7.2 | 4,170 | 27.8 | 1,368 | 5.48 | 170 | 97.5 |
| Alaska Coastal | 117 | 7.4 | 612 | 48.0 | 79 | 0.68 | 94 | 93.0 |
| Aloha | 185 | 32.0 | 4,982 | 59.2 | 406 | 2.19 | 166 | 93.2 |
| Cordova | 72 | 1.8 | 222 | 48.5 | 109 | 1.51 | 38 | 95.5 |
| Hawaiian | 306 | 46.1 | 7,333 | 57.6 | 804 | 2.63 | 267 | 92.4 |
| Kodiak | 33 | 0.9 | 61 | 87.1 | 8 | 0.25 | 16 | 98.0 |
| No. Consolidated | 168 | 2.3 | 704 | 33.4 | 323 | 1.92 | 119 | 99.3 |
| Pacific Northern | 357 | 11.4 | 8,940 | 26.3 | 1,690 | 4.73 | 351 | 99.5 |
| Reeve Aleutian | 136 | 1.2 | 1,199 | 30.8 | 519 | 3.83 | 72 | 96.3 |
| Western Alaska | 18 | 0.2 | 12 | 30.0 | 2 | 0.12 | 16 | 97.2 |
| Wien Alaska | 277 | 3.6 | 992 | 29.6 | 404 | 1.46 | 139 | 93.6 |
| **Alaska & Hawaiian Total** | **1,918** | **114.1** | **29,227** | **35.9** | **5,712** | **2.98** | **1,448** | **95.9** |
| **HELICOPTERS** | | | | | | | | |
| Chicago | 26 | 3.4 | 71 | 38.2 | 7 | 0.27 | 19 | 98.9 |
| Los Angeles | 68 | 15.3 | 614 | 44.3 | 67 | 0.99 | 74 | 91.3 |
| New York | 22 | 12.7 | 248 | 52.7 | 25 | 1.16 | 20 | 86.6 |
| **Helicopter Total** | **116** | **31.4** | **933** | **45.7** | **99** | **0.86** | **113** | **91.7** |
| **CARGO & OTHERS** | | | | | | | | |
| Aerovias | | | | Not Available | | | | |
| Flying Tiger | 1,333 | 7.5 | 20,529 | 73.9 | 20,854 | 15.64 | 405 | 100.0 |
| Riddle | 897 | 2.9 | 7,779 | 93.6 | 6,785 | 7.56 | 251 | 93.2 |
| Seaboard | 582 | 6.6 | 25,507 | 94.2 | 9,725 | 16.72 | 334 | 100.0 |
| Slick | 790 | 1.0 | 3,109 | 64.3 | 10,469 | 13.26 | 309 | 99.8 |
| **All Cargo Total** | **3,602** | **18.0** | **56,924** | **83.7** | **47,833** | **13.28** | **1,299** | **98.6** |
| **Industry Total** | **99,794** | **6,521.6** | **4,625,696** | **54.1** | **613,072** | **6.14** | **96,047** | **98.0** |

Prepared by Ray & Ray




**GUARANI 2 PROTOTYPE POWERED** by two Turbomeca Bastan 6A turboprop engines made its first flight in April.

# Argentine Guarani Aimed at World Market

By Ward Wright

**Cordoba, Argentina**—Argentina's first serious attempt to enter the world market with an aircraft of her own design—the Guarani 2 twin-turboprop transport—is well under way with completion of the first steps leading to U.S. Federal Aviation Agency type certification.

The Guarani 2 in standard configuration is a 10-seat transport with a maximum cruising speed of 298 mph., an economical cruising speed of 280 mph. and a stalling speed of 90 mph. The fuselage is unpressurized, but the aircraft has a service ceiling of 41,000 ft. and an engine-out service ceiling of 11,000 ft.

Powerplants are French Turbomeca Bastan 6As rated at 930 eshp. each with 165 lb. residual thrust. Fuel consumption at 10,000 ft. at cruising speed is 48 gph. on each engine.

Brig. Gen. Amilcar San Juan, Argentine director of civil aviation, recently recommended that his foreign office ask the U.S. State Dept. to negotiate the bilateral airworthiness agreement needed before the certification process can be started.

FAA, before issuing a type certificate to a foreign aircraft, first assures itself that the country's aeronautical agency is capable of seeing that regulations are being complied with. Production Guaranis will be built, for example, to FAA's S.R. 422 governing turbine-powered transports.

The Guarani 2 was designed by Argentine Air Force Capt. Hector Eduardo Ruiz, of Argentina's government-directed, autonomous firm of DINFIA (Direccion Nacional de Fabricaciones e Investigaciones Aeronauticas) located in Cordoba. Ruiz is DINFIA's aeronautical engineer in charge of airframe overhaul for the Argentine air force and is chief of the project group of the Military Aircraft Factory—one of DINFIA's three major divisions.

At present one Guarani 2 is flying. Fuselages and components for three additional aircraft are in various stages of completion. Rollout of the first production aircraft is to come in late winter or early spring. Ruiz said he expects later Guaranis to be completed at a rate of 1½ aircraft per month. He hopes for FAA type certification to be completed by the end of 1964.

Although the present Guarani 2 was built by Ruiz's projects group directly under the authority of the Military Aircraft Factory, production Guaranis will be built by the Aircraft Factory (Fabrica de Aviones)—DINFIA's quantity production facility—located only a few doors from Ruiz's shop.

## Tooling Operations

Workmen and engineers are setting up jigs and other tooling for the first production run of 20 aircraft. According to Hilario Francisco Luciano, chief engineer of the production facility, tooling is 75% completed.

DINFIA's shops are not large by U.S. standards, but equipment is modern and workmanship is high of quality. The production facility has had considerable experience in building a series of modern aircraft including, most recently, 48 Morane-Saulnier M.S. 760 Paris liaison aircraft and 75 Beechcraft T-34 Mentor trainers.

"Even though it costs as much or more to build an aircraft under license in here, the government feels the expense is worth it to keep aeronautical skills alive in Argentina," Luciano said. He added: "We have benefited greatly both in knowledge and tooling from production under license."

Another reason for the manufacture of aircraft in Argentina, it was pointed out, is the difficulty of obtaining hard money for procuring aircraft and components from abroad.

## Correcting Shortage

The money problem has been named as primarily responsible for the slippage of the rollout date of the first production Guarani 2 from Nov. 1, to later this winter or early spring. Although DINFIA makes every part of the Guarani except engines, instruments, wheels, brakes and avionics equipment, raw materials have to be imported. There has been some government delay in allotting money for those items—although 40 Turbomeca engines for the Guarani have been bought.

It is felt that this shortage of cash for needed imports may soon be corrected. Observers believe that the new government of President Arturo U. Illia will give more support to the aeronautical efforts of DINFIA in general and the Guarani program in particular. And, as an autonomous organization, DINFIA is free to spend on the Guarani money made on such bread-and-butter items as the motorcycles and automobiles made by its General Production division.

Ruiz said he expects the standard 10-seat version of the Guarani 2 to sell




**NOSE OF THE GUARANI 2** swings open to expose equipment. Pilot escape hatch is located directly over the cockpit.

for about $385,000 complete with avionics equipment and weather radar. Other versions—those for military, ambulance, search and rescue, and aerial photography—will be offered.

"After we complete the first series of aircraft," Ruiz said, "we may consider building a pressurized version." Present Guaranis will come equipped with Bendix liquid oxygen systems for high altitude flying.

## Foreign Inquiries

The first group of 20 aircraft will not be aimed primarily for sale in the U.S. Ruiz feels that FAA certification is necessary for an aircraft to be successful on the world market, but he did not rule out the possibility that DINFIA would allow the aircraft to be built elsewhere under license, or to be sold in the U.S. without engines. They might be furnished by Continental Aviation and Engineering Corp. should it exercise its license to build Bastan engines.

So far, Ruiz has had inquiries about the Guarani 2 from Central African Airways Corp., Salisbury, South Africa; A. E. S. Trading Co., Pty., Ltd., of Victoria, Australia, and a firm in New Guinea.

Ruiz began work on the Guarani 1 (named for the melodic language of the Paraguayan indians) in 1960 after a request from the director general of DINFIA to study the possibility of installing turboprop engines in the piston-powered I. A. 35 Huanquero utility aircraft then built by DINFIA.

In reviewing the problem, Ruiz said available engines dictated a choice between the Bristol Siddeley Gnome turboshaft engine and the Turbomeca 3A. Ruiz said he rejected the Gnome because the rear location of the reduction gearing required a forward-leading power shaft that meant a significant increase in nacelle frontal area.

After the choice of a powerplant, Ruiz identified 17 problem areas that would have to be corrected before turboprops could be installed in the I. A. 35 Huanquero. Result of the study was construction of the Guarani 1, which incorporated about 20% of the Huanquero's structural components including the twin vertical stabilizers and rudders. Before the first test flight of the Guarani 1 in February, 1962, Ruiz had completed a mockup of the Guarani 2 incorporating improvements suggested by the actual construction of the Guarani 1.

Principal modifications to the Guarani 1 were installation of the Turbomeca Bastan 6A engines, complete redesign of the tail unit, a new braking system, a weight reduction program and redesign of hydraulic circuitry in the landing gear to permit positive extension and locking by gravity.

Ruiz said the twin fin and rudder tail leftover from the Huanquero had to be scrapped because of high speed vibrations and insufficient stability during one-engine operation with turbines. Tail was modified to a high sweepback single vertical stabilizer of sufficient area to compensate for asymmetrical thrust caused by loss of one engine.

## Further Modification

Futher modification included combining the new vertical stabilizer with a freshly designed variable incidence horizontal stabilizer. The effect, Ruiz said, is greater aerodynamic efficiency and longitudinal stability. The new tail unit was attached to the old Guarani 1 fuselage which had been shortened 30 in. A plastic fairing was added to smooth airflow under the new tail assembly where the fuselage had been shortened.

For an improved braking system, Ruiz said he demanded disc brakes which could stop the Guarani in 300 ft. from 90 mph. in an emergency. The system also had to be capable of installation without modification to landing gear or nacelle. After consulta-

tion with U. S., French and British manufacturers, a Dunlop braking system which met those requirements was selected.

In the weight reduction program, elevator counterweights were moved as far forward of the hinge axis as possible to reduce use of lead. Nacelles were redesigned for the Bastan 6A engines with an additional weight saving. Passenger seats also were redesigned. Numerous other small modifications, combined with the shortening of the fuselage, have accounted for about a 2,375 lb saving.

Since the Guarani 2's maiden flight Apr. 23, the aircraft has flown about 100 hr. The aircraft was formally demonstrated to President Illia at Buenos Aires' Aeroparque earlier this month.

### FAA Advice

FAA's regional representative, with headquarters in Buenos Aires, has been in unofficial contact with the Guarani's builders to smooth the way to FAA type certification. These informal meetings have led to installation of improved avionics gear as standard equipment and enlargement of escape hatches to conform with FAA regulations.

The test flight program has led to a number of minor modifications including removal of the pitot tube from an extension atop a nacelle and burying it in the leading edge of the wing, installation of an automatic feathering device and changes in the angle of stabilizer incidence. After 25 hr. of flight the cabin air conditioning was modified to include a vent to dump equipment heat overboard. Since then the air conditioning system has performed correctly, Ruiz said.

### Easy Cockpit Access

Guarani's skin and structural members are made of 2024-T3 aluminum alloy. Fuselage is of semi-monocoque construction fitted with a hinged nose which swings to expose all avionics equipment. Removal of the avionics equipment, which is accomplished without tools, in turn gives easy access to cockpit instrumentation.

Standard avionics complement includes this Bendix equipment: two RA-21A 560-channel VHF receivers with a frequency range of 108.0 to 135.95 mc.; two VHF TA-21A 360-channel transmitters covering 118.0 to 135.95 mc.; one RA-21A/MNA-21B navigation system; one GSA-BA-1 glideslope receiver; one Bendix MKA-23A marker receiver; two DFA-72A ADF systems; two ASA-31A audio panels and one RDR-1E weather radar. Additional equipment will include an HF transceiver HRT-10A covering 2 to 15 mc.

**TWO FOLDING TABLES ARE STANDARD** equipment in the 10-passenger executive version of the Guarani. Cabin is trimmed in leather-type material. Sound-proofing also is included. Center windows on each side of the cabin kick outward for escape in emergency.

Bendix dual VOR/ILS system for use with the RA-21/MNA-21B receivers is offered as optional equipment.

Cockpit layout includes standard flight and engine controls and dual instrumentation. Engine controls are French. Others are Bendix, except for the stabilizer attitude indicator which was designed by Ruiz.

Pilot and co-pilot seats are fully adjustable fore and aft as well as for height. Rudder pedals are also adjustable. Seat pedals as with most fixtures in the Guarani are of Argentine manufacture.

An overhead escape hatch is provided in the cockpit for pilots to use in an emergency.

Cockpit windshield area totals about 13.5 sq. ft.

Luggage space is in compartments behind the cockpit and in the rear of the fuselage. Behind the cockpit, about 4 ft. is available between bulkheads on the port side. Opposite space on the starboard side is partially occupied by a small stainless steel galley.

This area is in turn separated from the rest of the cabin by a bulkhead covered with a Formica-like material made in Argentina. Sliding doors recessed into the bulkhead permit access to the cockpit.

The 18-ft. passenger cabin can seat 10 persons in individual airline-type seats in standard configuration. Box spar projects into the aisle but is flanked by steps and carpeted to minimize inconvenience. Ruiz says there are no plans to eliminate the step created by the box spar. Two folding tables attached to the sides of the fuselage serve facing seats in the rear area of the fuselage.

### Passenger Visibility

Cabin interior is trimmed in a leatherette-type material. Sound-proofing is achieved with a polyurethane foam insulation. Three large oblong windows on each side of the cabin give excellent passenger visibility. Center windows on each side now kick out for passenger escape, but all future Guaranis will have enlarged center windows that will open toward the interior to conform with FAA regulations.

A toilet and a small sink are in a compartment on the starboard side between bulkheads at the aft end of the passenger cabin. Daytime illumination is provided through an overhead dead-


## ADJUSTMENT TERMS

**1.** Adjustment will be limited to claims which are presented promptly after tube is found to be defective.

**2.** All tubes claimed to be defective will be subject to inspection and test by RCA.

**3.** Tubes returned to RCA will be considered for adjustment only if return was authorized by RCA and made in accordance with instructions issued by RCA.

**4.** RCA will be responsible for transportation costs on returned shipments provided adjustment is subsequently allowed. RCA, however, cannot accept charges for packing, inspection, or labor costs in connection with tubes returned for inspection or adjustment.

**5.** In all cases, RCA reserves the right to make adjustment by repair, replacement, or credit. Where full adjustment is allowable, adjustment normally will be made by replacement in kind but RCA reserves the right to limit the adjustment period on the replacement tube to the unexpired portion of the original tube warranty. Where pro-rata adjustment is allowable, adjustment will normally be made by the issuance of credit.

**6.** Adjustment credits will be based on prices in effect on date of claim for adjustment.

**7.** Replacements for tubes found subject to adjustment will be shipped F.O.B. city of destination with transportation charges prepaid by RCA to city of destination.

**8.** Adjustment will not be allowed for tubes which have been subjected to abuse, improper installation or application, alteration, accident or negligence in use, storage, transportation, or handling nor for tubes on which original identification markings have been removed, defaced, or falsified.

**9.** Final determination as to whether any adjustment is allowable rests with RCA.

**10.** No warranties or obligations on the part of RCA Electronic Components and Devices, other than the aforementioned, are to be implied with respect to electron tubes, and RCA cannot be responsible for labor or any other charges in connection with the failure or replacement of electron tubes.

## DINFIA Guarani 2 Model I.A. 50

Performance

| | |
|---|---|
| Max. speed | 310 mph. |
| Max. cruising speed | 298 mph. |
| Economy cruise speed | 280 mph. |
| Stall speed | 90 mph. |
| Initial rate of climb | 2,640 fpm. |
| Service ceiling | 41,000 ft. |
| Service ceiling, one engine | 11,000 ft. |
| Takeoff distance over 50-ft. obstacle | 2,200 ft. |
| Landing distance over 50-ft. obstacle | 1,970 ft. |
| Range with max. fuel | 1,550 mi. |
| Range with max. payload | 1,240 mi. |

Specifications

| | |
|---|---|
| Empty (equipped) | 8,650 lb. |
| Max. payload | 2,600 lb. |
| Max. takeoff weight | 15,700 lb. |
| Max. landing weight | 13,800 lb. |
| Wing span | 63 ft. 9 in. |
| Over-all length | 48 ft. 9 in. |
| Over-all height | 13 ft. 9 in. |
| Gross wing area | 450 sq. ft. |
| Powerplants | two Turbomeca Bastan 6As rated at 930 eshp. and 165 lb. residual thrust |
| Total fuel capacity | 500 U.S. gal. |
| Wing tip tank capacity | 85 gal. each |
| Oil capacity | 10 gal. each |
| Passengers (according to version) | 10, 12 or 15 |

light in the starboard side of the lavatory compartment.

Port side space opposite the lavatory serves as an aisle leading from the fuselage door. The door is equipped with a self-contained stairway to the passenger cabin. It is hinged at the bottom and closes upward.

### Cabin Air Conditioning

Cabin air conditioning unit is an automatic 1½ ton French SEMCA unit installed in the lower fuselage beneath the forward baggage compartment. Intake for the air conditioning is located in the port side of the lower fuselage below the pilot's side window.

Flight controls and hydraulic lines are readily accessible without tools through four long inspection covers arranged on the underside of the fuselage near the edges. When open, the covers expose several feet of push-pull bars and hydraulic piping. The area exposed begins roughly on a line 2 ft. ahead of the leading edge of the wing to slightly behind the trailing edge.

Fasteners securing the covers were designed by Ruiz to fit flush with fuselage in flight. The spool-shaped fasteners are opened by placing the fingertips in slight indentations provided and twisting them. When unlocked, the spool pops down into the unlocked position and the inspection covers can be removed.

Tricycle landing gear is forward retracting with a self-locking feature. Each main gear is fitted with two Dunlop wheels mounting tubeless 7.50 x 10 tires. Nosewheel mounts a single 8.50 x 10 Dunlop tire. Wheels can be lowered by gravity in an emergency with an assist from about 145 lb. of aerodynamic drag on the main gear at 100 mph. Shocks are of the oleo-pneumatic type.

Wings are of single box spar construction with a minor spar arranged behind the box. The Guarani employs a straight section from the wing root extending beyond the nacelle where the wing assumes a 7 deg. dihedral. This design allows a shorter gear permitting it to be retracted into the smallest possible nacelle.

Fuel is stored in the area between the box spar and the leading edge in the dihedral section of both wings. Fuel capacity is 250 gal. of JP-1 in each wing. Ruiz said the dihedral sections of the wings have been designed to shear away from the straight wing section in an accident.

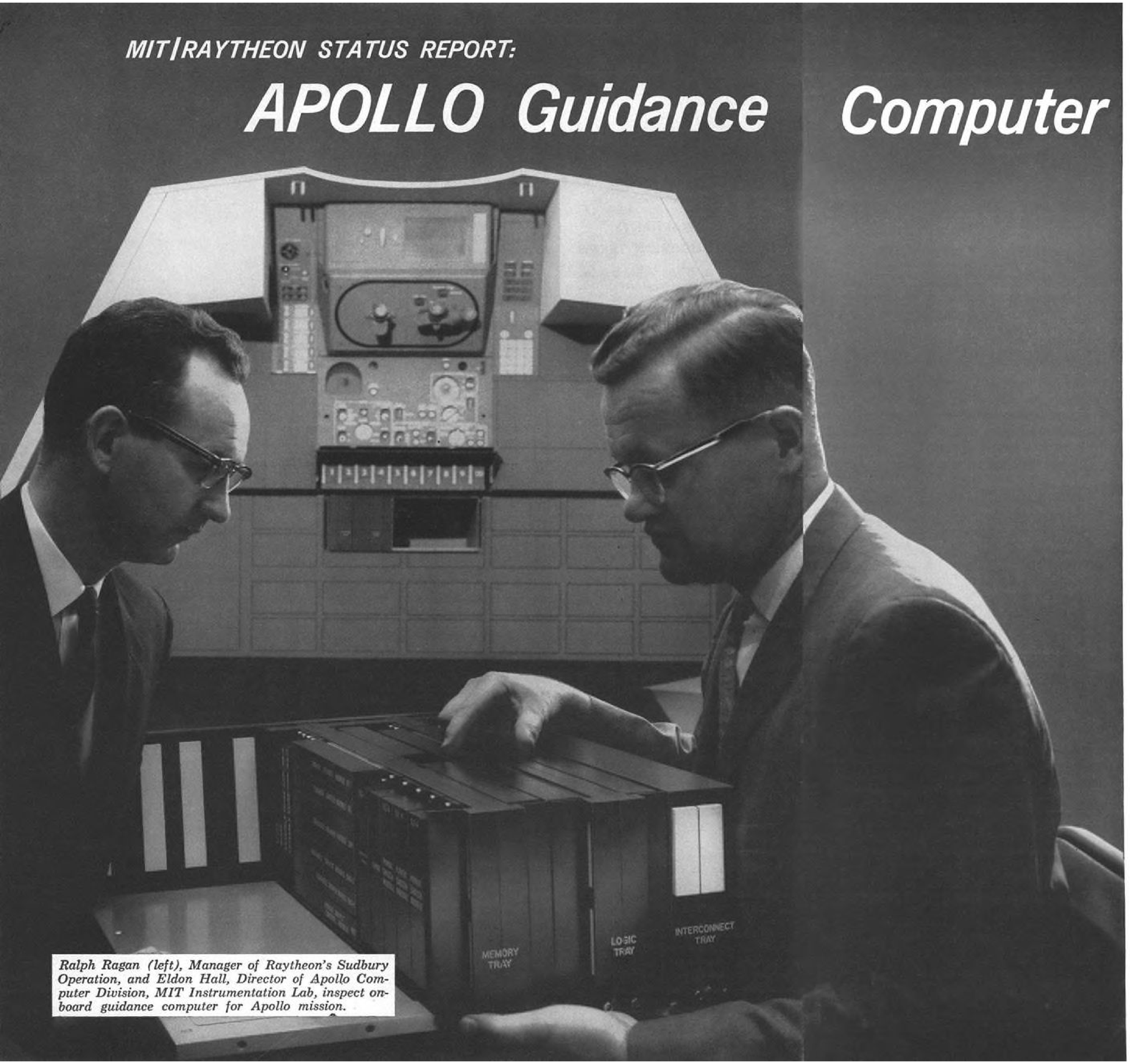
### Optional Tip Tanks

Optional glass fiber tip tanks of about 85 gal. capacity each will be offered for production aircraft. Tip tanks will provide an additional 1 hr. 45 min. flying time extending total flying time from around 5 hr. to nearly 7 hr., Ruiz said.

Ailerons are self-balanced, fabric-covered Frise-type. They are operated by push-pull bars and incorporating

MIT/RAYTHEON STATUS REPORT:

# APOLLO Guidance Computer




*Ralph Ragan (left), Manager of Raytheon's Sudbury Operation, and Eldon Hall, Director of Apollo Computer Division, MIT Instrumentation Lab, inspect onboard guidance computer for Apollo mission.*

## Predicted Reliability Increased More Than 2:1 ... Contract On Schedule

By incorporating the latest rope memory module and integrated micrologic techniques into Apollo's on-board guidance computer, the MIT/RAYTHEON team has *doubled* predicted reliability of the system with no loss in scheduling time.

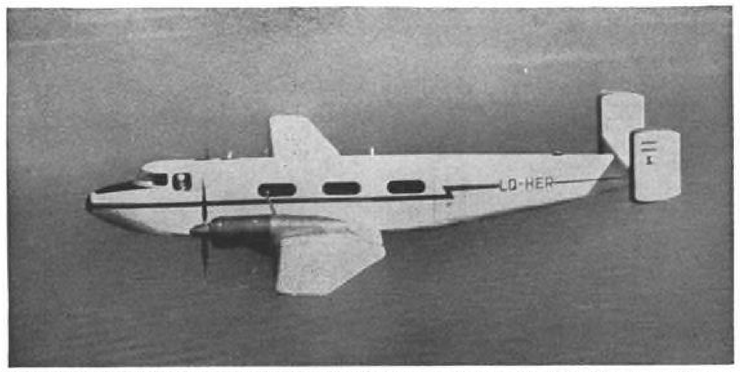
Drawing upon a background of successful joint effort in developing the reliable Mark 2 Polaris missile guidance computer, the MIT/RAYTHEON team is striving for similar fault-free operation of its Apollo guidance system. The operating computer, less than 1 cubic foot in size, will provide midcourse navigation and guidance data for NASA's Apollo spacecraft mission.

The MIT/RAYTHEON-developed computer contains an extremely dense, low-powered, fixed memory of 5,000 bits/cubic inch. In flight, the astronaut will operate the computer through a 16-button coded keyboard. In case of input error or an "unacceptable" order, a light will warn the astronaut to erase the error. When the command is correct, he pushes an "enter" button and the computer will take over, using inputs fed to it automatically from the other subsystems in the craft.

*Keyboard for Apollo's onboard guidance computer.*

The working relationship of the MIT/RAYTHEON team in developing and producing the computer, its displays and keyboard, and its pre-flight ground support equipment, represents a truly unique capability in space age guidance and control. *Space and Information Systems Division, Sudbury, Mass.*

RAYTHEON




**GUARANI 1 PROTOTYPE POWERED** by Turbomeca Bastan 3As first flew in February, 1962. Twin fin and rudder of earlier Huanquero were scrapped to improve one-engine stability. Before first test flight, project engineers had completed a mockup of the Guarani 2 incorporating improvements already considered necessary to the first version.

trim tabs. Hydraulically-actuated split flaps control landing speeds.

Airfoil is NACA 633-218. Aspect ratio is 9. The wing is cranked for stall stability with a 3-deg. angle of incidence at the root diminishing to 1 deg. at the tip. It has no sweepback. Total area of ailerons is 5,500 sq. in. and total flap area is 7,450 sq. in. Gross wing area is about 450 sq. ft.

### Four Air Intakes

The nacelle incorporates a jacket which directs air around the engine and exhaust to keep temperatures within the wheel well from damaging tires. Four air intakes for the air jacket are spaced around the nacelle behind the propeller hub.

On each side of the nacelle, in the straight section, are inspection covers on the underside of the wing back from the leading edge. These are hinged from the front and secured by fasteners designed by Ruiz. The fasteners are designed so they may be easily opened with the fingers but, in flight, are held closed by mechanical as well as aerodynamic pressure.

### Automatic Feathering

Inspection covers on the outboard side of the nacelle permit access to fuel filters while those inboard offer access to engine controls.

Propellers are 9-ft. French Ratier-Figeac FH 86s. Their feathering system is automatic and the propeller has a brake to prevent windmilling. Feathering and brake can be controlled from the cockpit for restarts.

Engines can be started from ground power or the Guarani's French Boltablock nickel-cadmium 28 v. 35 ampere hr. batteries. Two 28 v. 6 kw. starter generators are provided for inflight power.

Tail assembly consists of a variable incidence horizontal stabilizer variable through +2 deg. to −5 deg. to control trim. Incidence is varied by an electrically actuated screw mechanism. Ruiz says the angle of incidence is such that the aircraft can be controlled with the stabilizer in any attitude in an emergency. Elevators fitted to the stabilizer incorporate balance tabs to assist operation.

Vertical tail area is 60.5 sq. ft. with a geometric aspect ratio of 1.23. Sweepback is 52 deg. 30 min. Root airfoil is NACA 0009 and tip airfoil is NACA 0006. Horizontal tail area is 79 sq. ft. with a geometic aspect ratio of 6. Horizontal stabilizer is 21 deg. 50 min. Airfoil is the same as the vertical stabilizer.

While the present Guarani 2 is not fitted with de-icing equipment, production models will be equipped with French Kleber-Colombes and other pneumatic boot type de-icing equipment.

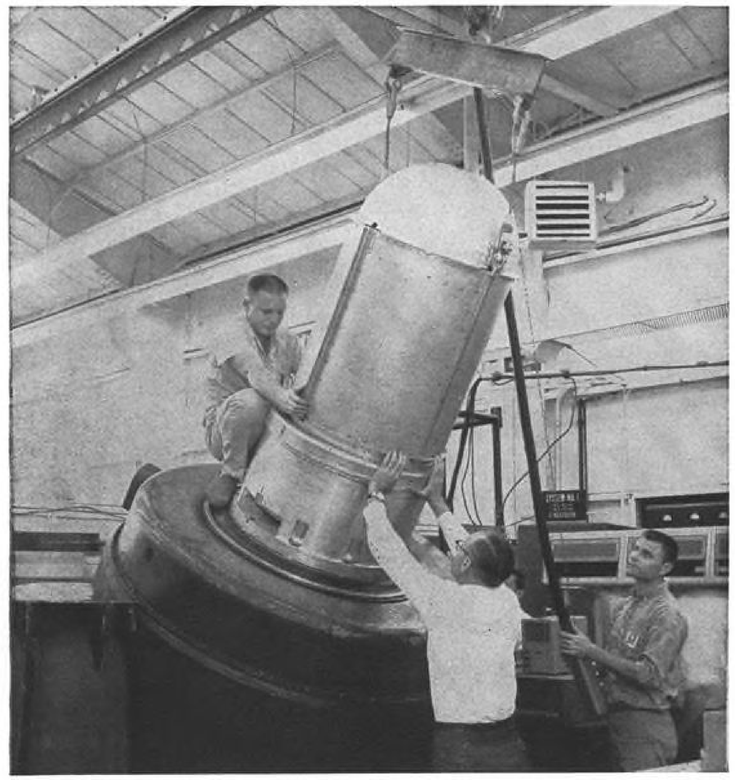
## Three Firms Report Officer Compensation

**Washington**—Following is a list of aerospace industry directors and officers with 1962 salaries above $30,000, and their stockholdings, as they were reported to the Securities and Exchange Commission:

GYRODYNE CO. OF AMERICA, INC.—P. J. Papadakos, president and treasurer, director, $79,262.50 salary, $1,436.19 premium paid by the company on life insurance policy (principal amount of policy payable to Mr. Papadakos' family), 223,349.8 shares of common stock; J. D. Barner, Washington representative, director, 1,033 shares of common stock; N. Xanthaky, secretary and director, 3,386 shares of common stock; W. C. McMahon, assistant secretary and director, 100 shares of common stock; W. J. Butler, Jr., director; J. C. Hilly, director; W. B. Lewis, Jr., director; G. M-P. Murphy III, director. All salary figures are for the fiscal year ending Apr. 30, 1963. All directors were elected Nov. 30, 1962, for the fiscal year ending Nov. 30, 1963. All stock is $1 par value common stock, owned of record or beneficially as of Aug. 16, 1963.

INTERNATIONAL BUSINESS MACHINE CORP.—B. Bromley, director, 150 shares of stock, 15 shares of stock owned by members of Mr. Bromley's family, $160,975 paid to the firm of Cravath, Swaine & Moore, in which Mr. Bromley is a partner, as fees for legal services performed during 1962 for the company; W. G. Buckner, director, 4,000 shares of stock, 92,213 shares of stock owned by members of Mr. Buchner's immediate family and family trusts; P. L. Davies, director, 240 shares of stock; S. M. Fairchild, director, 139,636 shares of stock, 200 shares of stock owned by family trusts, purchases of supplies and equipment by the company from Fairchild Camera and Intrument Corp., Fairchild Stratos Corp., and Fairchild Recording Equipment Corp., of which Mr. Fairchild is chairman of the executive committee and the boards, respectively, amounted to $4,549,566 in 1962; J. C. Folger, director, 962 shares of stock, 962 shares of stock owned by members of Mr. Folger's immediate family; G. Kirk, director, 122 shares of common stock; L. H. LaMotte, director, 11,259 shares of stock, 7,934 shares of stock owned by members of Mr. LaMotte's immediate family; T. V. Learson, vice president and group executive, director of I. B. M. World Trade Corp., director, $101,000 salary, $80,278 percentage compensation for 1962, 2,991 shares of stock, 189 shares of stock owned by members of Mr. Learson's immediate family; W. H. Moore, director, 890 shares of stock; J. G. Phillips, director, 21,477 shares of stock, 7,386 shares of stock owned by members of Mr. Phillips' immediate family; E. P. Piore, vice president-research and engineering, director (elected 1962), $77,267 salary, 1,411 shares of stock, 2 shares of stock owned by members of Mr. Piore's immediate family; G. H. Scribner, director, 837 shares of stock, 129 shares of stock owned by family trusts; A. K. Watson, vice president and group executive, president and director of I. B. M. World Trade Corp., director, $114,300 salary, $88,305 percentage compensation for 1962, 51,212 shares of stock, 62,966 shares of stock owned by members of Mr. Watson's immediate family and family trusts; T. J. Watson, Jr., director and chairman of the board, $143,000 salary, $216,750 percentage compensation for 1962, 35,357 shares of stock, 81,536 shares of stock owned by members of Mr. Watson's immediate family and family trusts; A. L. Williams, president, director, $117,535 salary $176,611 percentage compensation for 1962, 7,094 shares of stock; E. E. Ford, director (deceased Mar. 6, 1963); Mrs. T. J. Watson, honorary director, 12,499 shares of stock. All stock owned as of Jan. 31, 1963.

SUNDSTRAND CORP.—B. F. Olson, president, director, $80,000 salary, $6,000 company contribution during 1962 to retirement plan, 13,690 shares of common stock, trustee of six trusts which own a total of 8,753 shares of common stock; L. H. Schuette, Administrative vice president, director, $60,000 salary, $4,500 company contribution during 1962 to retirement plan, 5,210 shares of common stock, in accordance with the terms



**Satar Vehicle Undergoes Vibration Testing**

Satellite scientific pod prototype of the Satar (satellite for aerospace research) vehicle is maneuvered onto a vibrator at General Dynamics/Astronautics to undergo testing. Satar is designed to investigate space-environment phenomena (AW July 15, p. 69), carrying a 150-lb. payload into an elliptical orbit with a 1,800-mi. apogee, or a 300-lb. payload into a 500-mi. circular orbit. Note hemispherical dome configuration of solar cells.

of an employment contract entered into by the company on May 1, 1959, Mr. Schuette will be continually employed by the company in an executive capacity until his retirement on or after Dec. 31, 1965, at an annual compensation of $60,000 and will continue to be employed in a consultative capacity during his retirement at a compensation equal to $1,500 per month (the contract also provides for reduced payments to his widow during her life, in the event of Mr. Schuette's death); G. J. Landstrom, financial vice president and secretary, director, $38,500 salary, $2,887 company contribution during 1962 to retirement plan, 2,394 shares of common stock, in accordance with the terms of an employment contract entered into by the company on May 1, 1959, Mr. Landstrom was continually employed by the company in an executive capacity until his retirement on May 1, 1963, and will continue to be employed in a consultative capacity during his retirement at a compensation equal to $1,000 per month (the contract provides for reduced payments to his widow during her life, in the event of Mr. Landstrom's death); B. A. Gustafson, vice president in charge of capital goods operations, director, $55,000 salary, $4,125 company contribution during 1962 to retirement plan, 3,651 shares of common stock, trustee of a trust which owns 93 shares of common stock; J. W. Ethington, treasurer and controller, director, $40,000 salary, $3,000 company contribution during 1962 to retirement plan, 1,182 shares of common stock; C. L. Sadler, Jr., vice president in charge of aviation and defense products, director (elected 1963), 2,136 shares of common stock, custodian of 11 shares of common stock for minor child; T. N. McGowen, chairman of the executive committee, director, 2,142 shares of common stock; R. G. DeLong, director, 1,461 shares of common stock, custodian of 27 shares of common stock for his minor children; A. A. Hofgren, director, 5,202 shares of common stock, partner in the firm of Hofgren, Wegner, Allen, Stellman, McCord, attorneys for the company, which received fees of $64,690 during 1962 for legal services; H. H. Monk, director, 511 shares of common stock, president of Howard H. Monk & Associates, Inc., advertising counselors, which received from the company fees of $33,385 during 1962 for services. All stock beneficially owned as of Feb. 28, 1963.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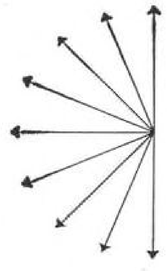

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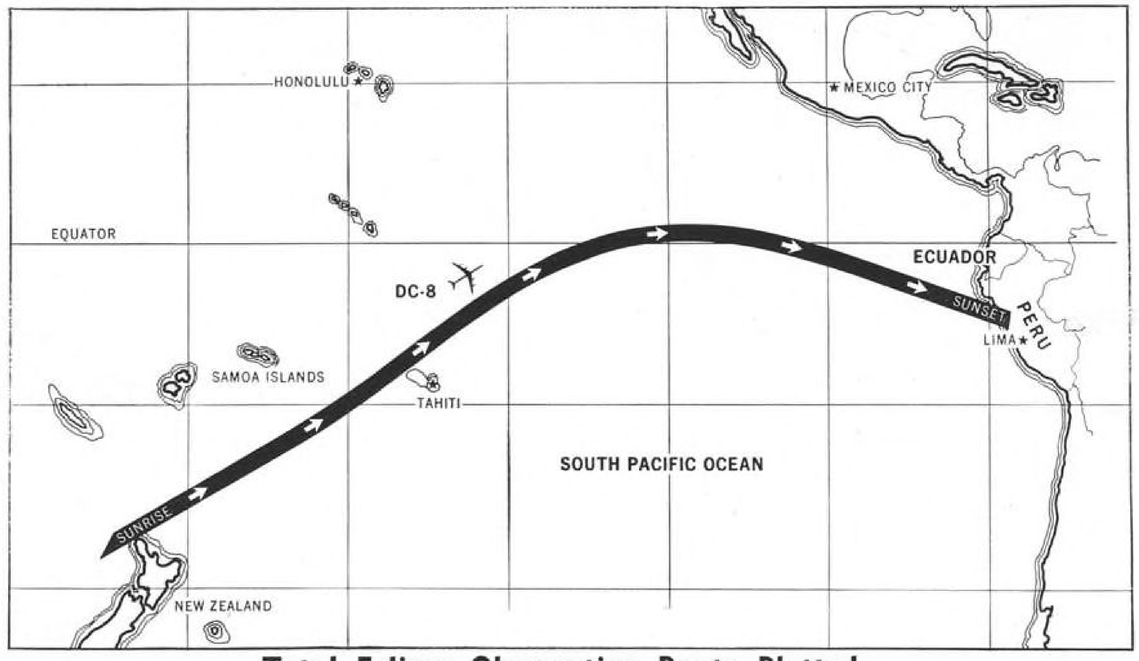



**Total Eclipse Observation Route Plotted**

Route of a proposed airborne observation expedition to photograph the next total eclipse of the sun, expected May 30, 1965, is outlined on a chart prepared by Douglas Aircraft Co. for a recent symposium at Los Angeles, Calif. It was suggested that the expedition use a Douglas DC-8 as the observatory. The DC-8 would fly an 8,000-mi. path following the shadow area cast by the moon. An expedition financed by Douglas and the National Geographic Society observed the last eclipse, July 20, over northern Canada from another DC-8. An over-water flight in 1965 might need two surface ships with beacons to guide the aircraft to the proper point for observation. Douglas said the observation time of a total eclipse could be increased from 5¼ min. on the surface to 8¼ min. from an aircraft. Path of the shadow follows a route from New Zealand past the Samoa islands and Tahiti to Ecuador.

# Navy Launches Second DAC-Roc In Rocket Probe Test Series

Los Angeles — Douglas/Lockheed sounding rocket, launched Dec. 10, was the latest in a series of evaluation tests the Navy is conducting before selecting rocket probes for use in international year of the quiet sun projects.

Most recent of the firings, which are being made at the Naval Missile Facility, Pt. Arguello, Calif., was the second of three planned for the probe, designated DAC-Roc by the Navy. Douglas Aircraft Co., Inc.'s Charlotte, N.C., Div. is prime contractor and airframe manufacturer, and Lockheed Propulsion Co. is propulsion subcontractor for the probe.

This solid-propellant rocket is one of a group of five competing for a production contract in the Bureau of Naval Weapons program.

The Naval Missile Center, Pt. Mugu, Calif., is assigned the evaluation work leading to the production award which is expected to involve several hundred vehicles.

Payload on the recent DAC-Roc shot, conducted by a Navy guided missile unit, consisted of telemetry instrumentation to transmit performance data. Third scheduled shot is tentatively set for late January.

The Douglas/Lockheed system is a single-stage, fin-stabilized ballistic rocket designed to carry a 25-lb. payload to an altitude of 100 mi. and to an impact point some 120 mi. downrange. Lockheed is utilizing a version of its Javelin motor for the DAC-Roc power unit, which is 134 in. long and 9 in. in dia., and produces a total impulse of 90,000 lb./sec. The rocket is 187 in. long, and weighs 575 lb.

Other contractors competing for the production contract and their respective entries are Atlantic Research Corp. —Archer; Rocket Power, Inc.—Thunderbird; Thiokol Chemical Corp.—Seagull, and Canadian Bristol Aerojet Ltd.—Black Brant 3. Archer, Thunderbird and Black Brant have been fired twice in the Navy tests. The Seagull has been fired once.

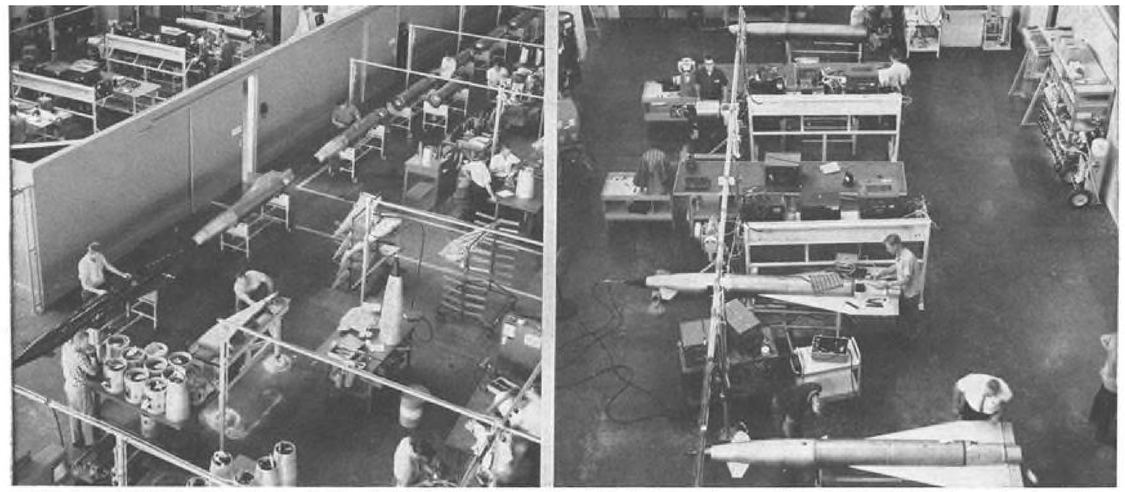
## Life Support Capsule

Los Angeles—An experiment in which a chimpanzee was kept for over eight days in simulated space environment conditions indicates that a life support capsule under development by the Air Force Space Systems Div. could be modified to near-earth orbit capability of from 14 to 30 days, depending on payload and orbit variations.

The life support capsule, designed and built by Lockheed Aircraft Corp.'s Missiles & Space Co. Div., was recently tested at the Lockheed Sunnyvale, Calif., facility using six specially equipped USAF ground checkout trailer vans, including a vacuum chamber van in which the capsule was placed.

An Air Force official said the life support system is being developed for use in future orbital experiments including tests of the effects of extended weightlessness on primates.

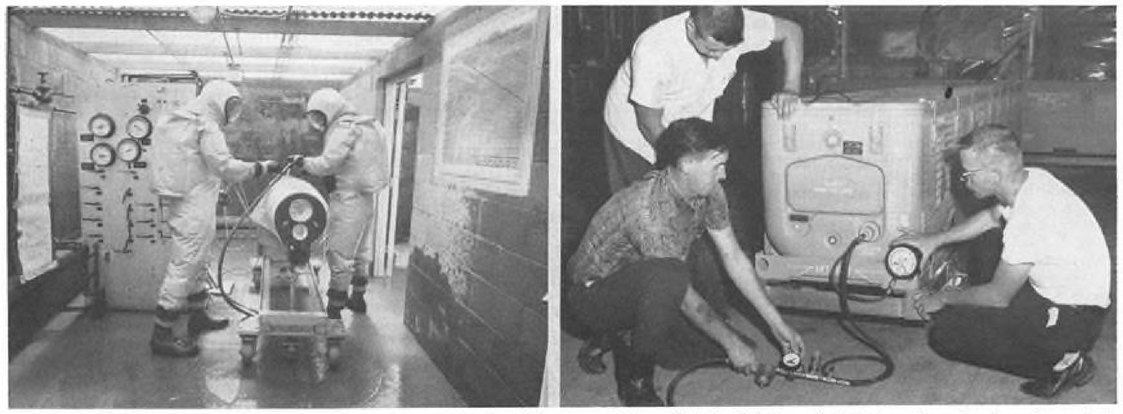
Principal trade-off involved in capsule modification would be the addition of more carbon dioxide absorber (lithium hydroxide) and a decrease in water absorbent capacity. The capsule utilizes an environmental control system fabricated by the Garrett Corp.



Production schedule for Beech Aircraft Corp.'s AQM-37A high-and-low-altitude target drone calls for 400 in 1964. Target has been flown 30 times since May by the Navy, which has placed a $30.9-million order with Beech's Aerospace Div., Wichita, Kan. In final assembly (above, left) targets are diverted into electronics assembly and checkout. Bonded honeycomb wings are inspected in foreground. Final electronics checkout is on a production line basis (above, right). First firings of AQM-37A from USS Midway jets included supersonic launch for gunnery practice.

# Beech AQM-37A Output to Reach 400 in 1964

Fueler team wearing protective suits enters sub-surface fueling area to fill target tanks with liquid propellant. Duplicate storage rooms and fueling cells are on either side of the entrance to separate the hypergolic combination of fuel and oxidizer.



Plastic coating protects target against spillage while inhibited red fuming nitric acid is loaded by suited fuelers whose back packs contain liquid oxygen for breathing and cooling. Leakage in shipping containers is signalled by red or blue indicators.

# Department of Defense Lists Top 100 Prime Contractors for Fiscal 1963

The 100 companies which received the largest dollar volume of military prime contracts of $10,000 or more in fiscal year 1963 accounted for 73.9% of the United States total. This is an increase of 1.6 percentage points from the 72.3% during fiscal year 1962, but a decrease of 0.3 of one percentage point from the 74.2% received in fiscal year 1961. As has been noted in previous reports, a substantial part of the prime contract work of companies on the 100 company list is subcontracted to other concerns. About one-half of the military work of the large concerns is subcontracted, and over one-third of the amount subcontracted is paid to small business concerns.

It may be seen from the following table that the increase occurred in the first 50 companies which received 2.2% more of the total in fiscal year 1963 than in the previous year, whereas companies in the 51st to 100th positions obtained 0.6% less of the 1963 total. The 1963 percentage for the first 25 companies is lower than any year shown except fiscal year 1962, and for the 100 companies it is about the same as the average during the years prior to fiscal year 1962.

| | Per Cent of U. S. Total | | | | | |
|---|---|---|---|---|---|---|
| COMPANIES | FY 1958 | FY 1959 | FY 1960 | FY 1961 | FY 1962 | FY 1963 |
| 1st | 9.8% | 7.2% | 6.0% | 6.5% | 5.6% | 5.9% |
| 2nd | 6.4 | 5.2 | 5.1 | 5.2 | 4.7 | 5.2 |
| 3rd | 3.6 | 4.5 | 4.8 | 5.2 | 4.4 | 4.1 |
| 4th | 3.5 | 4.1 | 4.6 | 4.1 | 4.0 | 4.0 |
| 5th | 3.0 | 4.0 | 4.3 | 3.8 | 3.8 | 4.0 |
| 1–5 | 26.3% | 25.0% | 24.8% | 24.8% | 22.5% | 23.2% |
| 6–10 | 12.4 | 12.0 | 11.3 | 11.8 | 11.1 | 10.9 |
| 11–25 | 19.1 | 17.6 | 17.4 | 18.2 | 17.2 | 17.8 |
| 1–25 | 57.8% | 54.6% | 53.5 | 54.8% | 50.8% | 51.9% |
| 26–50 | 9.1 | 10.7 | 11.3 | 11.0 | 12.6 | 13.7 |
| 51–75 | 4.8 | 5.5 | 5.4 | 5.5 | 6.0 | 5.5 |
| 76–100 | 2.5 | 3.0 | 3.2 | 2.9 | 2.9 | 2.8 |
| 1–100 | 74.2% | 73.8% | 73.4% | 74.2% | 72.3% | 73.9% |

The list for fiscal year 1963 contains 17 companies which did not appear on the fiscal year 1962 list. Most of the new names appear toward the end of the list, but two companies attained a rank within the first fifty. These are Merritt-Chapman & Scott Corp. with contracts totalling $169.9 million in 34th position, and Studebaker Corp. with contracts totalling $83.3 million in 47th position.

Over half of the companies were engaged in missile-space, aircraft and electronics work. The contract work of many of the companies involved more than one major commodity category. Based on the category representing the largest dollar volume of contracts awarded to each company, there were 23 missile-space, 17 aircraft and 13 electronics firms. The remaining 47 companies fell into the following categories: petroleum (11), services (9), tank-automotive (8), ammunition (8), ships (7), construction (2), and construction equipment (2).

The same five educational and non-profit institutions on the fiscal year 1962 list of large prime contractors are included on the fiscal year 1963 list. The group is comprised of the following: Massachusetts Institute of Technology, Johns Hopkins University, Aerospace Corp., System Development Corp., and Mitre Corp. These non-profit contractors are generally providing research, development and training services in the missile-space and electronics programs.

Five companies received prime contract awards of more than $1 billion each in fiscal year 1963. These companies and a brief description of their more important contract work are as follows:

The Lockheed Aircraft Corp. led the list for the second consecutive year receiving $1,517.0 million, or 5.9% of the total. The aircraft contracts included the C-141A Starlifter Jet Cargo Transport, C-130E Hercules Turboprop Jet Transport, F-104 Starfighter Jet Fighter, P2 Neptune Piston-Engine Patrol Bomber, and the P3A Electra Advance Jet Version. It is a principal prime contractor for the Polaris missile, the Discoverer series of polar-orbiting satellites, the Agena space vehicle and other space vehicles. The company and its subsidiaries also received contracts for shipbuilding and electronics.

| RANK | COMPANIES | MILLIONS OF DOLLARS | PER CENT OF U. S. TOTAL | CUMULATIVE % OF U. S. TOTAL |
|---|---|---|---|---|
| | U. S. Total[a] | $25,834.0 | 100.0% | 100.0% |
| 1. | Lockheed Aircraft Corp. | 1,424.7 | 5.5 | |
| | Lockheed Air Terminal, Inc. | 1.3 | [d] | |
| | Lockheed Aircraft International, Inc. | 0.1 | [d] | |
| | Puget Sound Bridge & Dry Dock Co. | 90.9 | 0.4 | |
| | Total | 1,517.0 | 5.9 | 5.9 |
| 2. | Boeing Co. | 1,356.3 | 5.2 | 11.1 |
| 3. | North American Aviation, Inc. | 1,062.4 | 4.1 | 15.2 |
| 4. | General Dynamics Corp. | 1,033.2 | 4.0 | 19.2 |
| 5. | General Electric Co. | 1,021.2 | 4.0 | 23.2 |
| 6. | Martin Marietta Corp. | 766.8 | 3.0 | 26.2 |
| 7. | American Telephone & Telegraph Co. | 163.8 | 0.6 | |
| | Chesapeake & Potomac Tel. Co. | 1.7 | [d] | |
| | Mountain States Tel & Tel. | 0.7 | [d] | |
| | New England Tel. & Tel. Co. | 0.4 | [d] | |
| | New Jersey Bell Tel. Co. | 0.2 | [d] | |
| | New York Telephone Co. | [c] | [d] | |
| | Northwestern Bell Tel. Co. | 0.1 | [d] | |
| | Pacific Tel & Tel. Co. | 0.6 | [d] | |
| | Southern Bell Tel. & Tel. Co. | 1.3 | [d] | |
| | Southwestern Bell Tel. Co. | 0.7 | [d] | |
| | Teletype Corp. | 5.4 | [d] | |
| | Western Electric Co. | 403.7 | 1.6 | |
| | Total | 578.6 | 2.2 | 28.4 |
| 8. | United Aircraft Corp. | 529.9 | 2.1 | 30.5 |
| 9. | McDonnell Aircraft Corp. | 497.0 | 1.9 | 32.4 |
| 10. | Sperry Rand Corp. | 445.5 | 1.7 | 34.1 |
| 11. | General Motors Corp. | 444.0 | 1.7 | 35.8 |
| 12. | General Tire & Rubber Co. | 5.5 | [d] | |
| | Aerojet Delft Corp. | 0.3 | [d] | |
| | Aerojet-General Corp. | 409.8 | 1.6 | |
| | Space Electronics Corp. | 1.9 | [d] | |
| | Space General Corp. | 7.1 | [d] | |
| | Total | 424.6 | 1.6 | 37.4 |
| 13. | Grumman Aircraft Engineering Corp. | 390.5 | 1.5 | 38.9 |
| 14. | Douglas Aircraft Co. | 360.7 | 1.4 | |
| | Astropower, Inc. | 0.4 | [d] | |
| | Total | 361.1 | 1.4 | 40.3 |
| 15. | Radio Corp. of America | 328.6 | 1.3 | |
| | RCA Institutes, Inc. | [c] | [d] | |
| | Total | 328.6 | 1.3 | 41.6 |
| 16. | Westinghouse Electric Corp. | 322.6 | 1.3 | 42.9 |
| 17. | Hughes Aircraft Co. | 312.9 | 1.2 | 44.1 |
| 18. | Raytheon Co. | 290.6 | 1.1 | |
| | Autometric Corp. | 0.6 | [d] | |
| | Machlett Laboratories, Inc. | 3.7 | [d] | |
| | Trans-Sil Corp. | [c] | [d] | |
| | Total | 294.9 | 1.1 | 45.2 |
| 19. | Bendix Corp. | 285.1 | 1.1 | |
| | Bendix Field Engineering Corp. | 4.9 | [d] | |
| | Bendix-Westinghouse Automotive Air Brake Co. | 0.2 | [d] | |
| | Microwave Devices, Inc. | [c] | [d] | |
| | Sheffield Corp. | 0.1 | [d] | |
| | Total | 290.3 | 1.1 | 46.3 |
| 20. | International Telephone & Telegraph Corp. | 145.9 | 0.6 | |
| | American Cable & Radio Corp. | 2.0 | [d] | |
| | Federal Electric Corp. | 80.5 | 0.3 | |
| | General Controls Co. | 0.6 | [d] | |
| | International Electric Corp. | 33.4 | 0.1 | |
| | ITT Communication Systems, Inc. | 0.3 | [d] | |
| | ITT Export Corp. | 1.5 | [d] | |
| | ITT Semi-Conductors, Inc. | [c] | [d] | |
| | Jennings Radio Mfg. Corp. | 0.3 | [d] | |
| | Kuthe Laboratories, Inc. | 0.5 | [d] | |
| | Royal Electric Corp. | 0.3 | [d] | |
| | Surprenant Mfg. Co. | 0.2 | [d] | |
| | Total | 265.5 | 1.0 | 47.3 |
| 21. | Avco Corp. | 253.1 | 1.0 | 48.3 |
| 22. | Thiokol Chemical Corp. | 238.5 | 0.9 | |
| | Shawnee Industries, Inc. | 0.1 | [d] | |
| | Total | 238.6 | 0.9 | 49.2 |
| 23. | Ford Motor Co. | 74.6 | 0.3 | |
| | Philco Corp. | 153.1 | 0.6 | |
| | Total | 227.7 | 0.9 | 50.1 |
| 24. | Northrop Corp. | 194.1 | 0.8 | |
| | Page Communications Engineers, Inc. | 28.8 | 0.1 | |
| | Total | 222.9 | 0.9 | 51.0 |
| 25. | Newport News Shipbuilding & Dry Dock Co. | 221.0 | 0.9 | 51.9 |
| 26. | Ling-Temco-Vought, Inc. | 183.0 | 0.8 | |
| | Altec Companies, Inc. | 0.1 | [d] | |
| | Altec Lansing Corp. | 0.3 | [d] | |
| | Continental Electronics Mfg. Co. | 5.9 | [d] | |
| | Continental Electronics Systems, Inc. | 0.1 | [d] | |
| | F F & M Electronics, Inc. | 0.7 | [d] | |
| | Kentron Hawaii, Ltd. | 4.7 | [d] | |
| | Temco Electronics & Missiles Co. | 10.0 | [d] | |
| | Temco Electronics Display Systems | 0.4 | [d] | |
| | University Loudspeakers, Inc. | 0.7 | [d] | |
| | Total | 205.9 | 0.8 | 52.7 |
| 27. | International Business Machines Corp. | 203.0 | 0.8 | |
| | Service Bureau Corp. | 0.3 | [d] | |
| | Total | 203.3 | 0.8 | 53.5 |
| 28. | F M C Corp. | 199.1 | 0.8 | 54.3 |
| 29. | Litton Industries, Inc. | 6.6 | [d] | |
| | Aero Service Corp. | 4.4 | [d] | |
| | Airtron, Inc. | 0.9 | [d] | |
| | Emertron, Inc. | 1.7 | [d] | [d] |
| | Ingalls Shipbuilding Corp. | 148.5 | 0.7 | |
| | Litton Electron Tube Corp. | 2.6 | [d] | |
| | Litton Precision Products, Inc. | 0.3 | [d] | |
| | Litton Systems, Inc. | 31.2 | 0.1 | |
| | McKiernan-Terry Corp. | 0.9 | [d] | |
| | Monroe Calculating Machine Co., Inc. | 0.2 | [d] | |
| | Poly-Scientific Corp. | [c] | [d] | |
| | Western Geophysical Co. of America | [c] | [d] | |
| | Westrex Corp. | 0.5 | [d] | |
| | Total | 197.8 | 0.8 | 55.1 |
| 30. | Republic Aviation Corp. | 196.8 | 0.7 | 55.8 |
| 31. | Chrysler Corp. | 186.2 | 0.7 | 56.5 |
| 32. | Hercules Powder Co. | 182.7 | 0.7 | 57.2 |
| 33. | Minneapolis-Honeywell Regulator Co. | 170.0 | 0.7 | 57.9 |
| 34. | Merritt-Chapman & Scott Corp. | 4.3 | [d] | |
| | Devoe & Raynolds Co., Inc. | 0.4 | [d] | |
| | Higgins, Inc. | 1.9 | [d] | |
| | New York Shipbuilding Corp. | 163.3 | 0.6 | |
| | Total | 169.9 | 0.6 | 58.5 |
| 35. | General Telephone & Electronics Corp. | 0.1 | [d] | |
| | Automatic Electric Sales Corp. | 2.0 | [d] | |
| | General Telephone & Electronics Laboratories, Inc. | 1.0 | [d] | |
| | Lenkurt Electric Co., Inc. | 7.4 | [d] | |
| | Sylvania Electric Products, Inc. | 152.1 | 0.6 | |
| | Total | 162.6 | 0.6 | 59.1 |
| 36. | Standard Oil Co. (New Jersey) | 0.0 | 0.0 | |
| | Esso International, Inc. | 77.4 | 0.3 | |
| | Esso Research & Engineering Co. | 2.7 | [d] | |
| | Esso Standard Eastern, Inc. | 5.3 | [d] | |
| | Gilbert & Barker Mfg. Co. | [c] | [d] | |
| | Humble Oil & Refining Co. | 70.1 | 0.3 | |
| | Total | 155.5 | 0.6 | 59.7 |
| 37. | Pan American World Airways, Inc. | 154.5 | 0.6 | 60.3 |
| 38. | Textron, Inc. | 2.6 | [d] | |
| | Accessory Products Corp. | 0.2 | [d] | |
| | Bell Aerospace Corp. | 144.5 | 0.6 | |
| | Dalmo Victor Co. | 0.1 | [d] | |
| | Nuclear Metals, Inc. | 0.6 | [d] | |
| | Pittsburg Steel Foundry Corp. | 0.1 | [d] | |
| | Randall Co. | 0.1 | [d] | |
| | Textron Electronics, Inc. | 1.8 | [d] | |
| | Textron Oregon, Inc. | 1.0 | [d] | |

(Continued on p. 62)

| RANK | COMPANIES | MILLIONS OF DOLLARS | % OF U. S. TOTAL | CUMULATIVE % OF U. S. TOTAL |
|---|---|---|---|---|
| | Townsend Co. | 0.2 | [d] | |
| | Total | 151.2 | 0.6 | 60.9 |
| 39. | Collins Radio Co. | 144.3 | 0.6 | 61.5 |
| 40. | General Precision Equipment Corp. | 0.3 | [d] | |
| | G P E Controls, Inc. | [c] | [d] | |
| | General Precision, Inc. | 128.4 | 0.5 | |
| | Graflex, Inc. | 0.7 | [d] | |
| | National Theatre Supply Co. | 0.1 | [d] | |
| | Strong Electric Corp. | 1.9 | [d] | |
| | Total | 131.4 | 0.5 | 62.0 |
| 41. | Texaco, Inc. | 41.4 | 0.2 | |
| | Caltex Oil Products Co.[e] | 39.0 | 0.2 | |
| | Caltex Philippines, Inc.[e] | 0.2 | [d] | |
| | Jefferson Chemical Co. | 0.2 | [d] | |
| | Paragon Oil Co. | 1.8 | [d] | |
| | Texaco Experiment, Inc. | 1.1 | [d] | |
| | Texaco Export, Inc. | 34.1 | 0.1 | |
| | Texaco Puerto Rico, Inc. | 1.0 | [d] | |
| | Texaco Trinidad, Inc. | 0.1 | [d] | |
| | White Fuel Co., Inc. | 1.6 | [d] | |
| | Total | 120.5 | 0.5 | 62.5 |
| 42. | Standard Oil Company (California) | 63.6 | 0.2 | |
| | American Bitumuls & Asphalt Co. | 0.1 | [d] | |
| | California Chemical Co. | [c] | [d] | |
| | California Oil Co. | 12.0 | [d] | |
| | California Research Corp. | 0.1 | [d] | |
| | Caltex Oil Products Co.[e] | 39.0 | 0.2 | |
| | Caltex Philippines, Inc.[e] | 0.2 | [d] | |
| | Pacific Oil Co. | [c] | [d] | |
| | Standard Oil Co. of Kentucky | 1.2 | [d] | |
| | Standard Oil Co. of Texas | 0.4 | [d] | |
| | Total | 116.6 | 0.4 | 62.9 |
| 43. | Thompson-Ramo-Wooldridge, Inc. | 42.4 | 0.2 | |
| | Federal Industries, Inc. | [c] | [d] | |
| | Good-All Electric Mfg. Co. | 0.1 | [d] | |
| | Magna Corp. | 0.1 | [d] | |
| | Milam Electric Mfg. Co. | [c] | [d] | |
| | Pacific Semiconductors | 0.9 | [d] | |
| | Radio Condenser Co. | 0.1 | [d] | |
| | Radio Industries, Inc. | 0.3 | [d] | |
| | Space Technology Laboratories, Inc. | 62.5 | 0.2 | |
| | Total | 106.4 | 0.4 | 63.3 |
| 44. | Curtiss-Wright Corp. | 98.3 | 0.4 | |
| | Abrams Instrument Corp. | [c] | [d] | |
| | Redel, Inc. | 0.1 | [d] | |
| | Target Rock Corp. | [c] | [d] | |
| | Total | 98.4 | 0.4 | 63.7 |
| 45. | Continental Motors Corp. | 85.9 | 0.4 | |
| | Continental Aviation & Engineering Corp. | 11.1 | [d] | |
| | Gray Marine Motor Co. | 0.1 | [d] | |
| | Wisconsin Motors Corp. | 0.1 | [d] | |
| | Total | 97.2 | 0.4 | 64.1 |
| 46. | Morrison-Knudsen & Associates[f] | 84.4 | 0.3 | 64.4 |
| 47. | Studebaker Corp. | 70.4 | 0.3 | |
| | Franklin Mfg. Co. | [c] | [d] | |
| | Onan (D. W.) Sons, Inc. | 2.0 | [d] | |
| | Paxton Products Corp. | [c] | [d] | |
| | Trans International Airlines, Inc. | 10.9 | [d] | |
| | Total | 83.3 | 0.3 | 64.7 |
| 48. | Burroughs Corp. | 76.8 | 0.3 | |
| | Burroughs Control Corp. | 0.7 | [d] | |
| | Total | 77.5 | 0.3 | 65.0 |
| 49. | Aerospace Corp. | 75.5 | 0.3 | 65.3 |
| 50. | Goodyear Tire & Rubber Co. | 22.5 | 0.1 | |
| | Goodyear Aircraft Corp. | 50.2 | 0.2 | |
| | Total | 72.7 | 0.3 | 65.6 |
| 51. | Massachusetts Institute of Technology | 70.8 | 0.3 | 65.9 |
| 52. | Bethlehem Steel Corp. | 0.0 | 0.0 | |
| | Bethlehem Steel Co. | 68.2 | 0.3 | |
| | Bethlehem Steel Export Corp. | 0.2 | [d] | |
| | Total | 68.4 | 0.3 | 66.2 |
| 53. | Hayes International Corp. | 67.1 | 0.3 | 66.5 |
| 54. | Shell Caribbean Petroleum Co. | 37.8 | 0.2 | |
| | International Lubricant Corp. | 1.9 | [d] | |
| | Shell Oil Co. | 26.8 | 0.1 | |
| | Total | 66.5 | 0.3 | 66.8 |
| 55. | International Harvester Co. | 47.5 | 0.3 | |
| | Hough (Frank G.) Co. | 8.7 | [d] | |
| | Macleod & Co. | 1.1 | [d] | |
| | Solar Aircraft Co. | 9.0 | [d] | |
| | Total | 66.3 | 0.3 | 67.1 |
| 56. | Olin Mathieson Chemical Corp. | 65.8 | 0.2 | 67.3 |
| 57. | Johns Hopkins University | 65.5 | 0.2 | 67.5 |
| 58. | Socony Mobil Oil Co. | 64.2 | 0.2 | |
| | Mobil Petroleum Co., Inc. | [c] | [d] | |
| | Total | 64.2 | 0.2 | 67.7 |
| 59. | Lear-Siegler, Inc. | 58.0 | 0.2 | |
| | Hallamore Electronics Co. | [c] | [d] | |
| | Magnetic Amplifiers, Inc. | [c] | [d] | |
| | Olympic Radio & Television, Inc. | [c] | [d] | |
| | Rett Electronics, Inc. | 3.0 | [d] | |
| | Total | 61.0 | 0.2 | 67.9 |
| 60. | Magnavox Co. | 57.7 | 0.2 | 68.1 |
| 61. | American Machine & Foundry Co. | 57.0 | 0.2 | |
| | A M F International Co. | [c] | [d] | |
| | Beaird, Inc. | [c] | [d] | |
| | Cuno Engineering Corp. | 0.1 | [d] | |
| | Total | 57.1 | 0.2 | 68.3 |
| 62. | Universal American Corp. | 0.2 | [d] | |
| | American Cement Corp. | [c] | [d] | |
| | Amron Corp. | 23.8 | 0.1 | |
| | Bohn Aluminum & Brass Corp. | [c] | [d] | |
| | Hardeman (Paul), Inc. | 32.3 | 0.1 | |
| | Total | 56.3 | 0.2 | 68.5 |
| 63. | Garrett Corp. | 55.7 | 0.2 | 68.7 |
| 64. | Kiewit (Peter) Sons' Co. | 54.1 | 0.2 | 68.9 |
| 65. | Kaiser Industries Corp. | 0.0 | 0.0 | |
| | Kaiser (Henry J.) Co. | 0.5 | [d] | |
| | Kaiser Fleetwings, Inc. | [c] | [d] | |
| | Kaiser Jeep Corp. | 43.6 | 0.2 | |
| | Kaiser Steel Corp. | 2.8 | [d] | |
| | National Steel & Shipbuilding Co. | 2.3 | [d] | |
| | Total | 49.2 | 0.2 | 69.1 |
| 66. | du Pont (E. I.) de Nemours & Co. | 10.4 | [d] | |
| | Remington Arms Co., Inc. | 37.5 | 0.2 | |
| | Total | 47.9 | 0.2 | 69.3 |
| 67. | Standard Oil Co. (Indiana) | 0.1 | [d] | |
| | American Oil Co. | 40.5 | 0.2 | |
| | Amoco Chemicals Corp. | 5.0 | [d] | |
| | Total | 45.6 | 0.2 | 69.5 |
| 68. | Kaman Aircraft Corp. | 44.9 | 0.2 | 69.7 |
| 69. | Ryan Aeronautical Co. | 44.2 | 0.2 | 69.9 |
| 70. | White Motor Co. | 44.0 | 0.2 | |
| | Diamond T. Motor Truck Co. | [c] | [d] | |
| | Oliver Corp. | [c] | [d] | |
| | Total | 44.0 | 0.2 | 70.1 |
| 71. | System Development Corp. | 43.9 | 0.2 | 70.3 |
| 72. | Continental Oil Co. | 34.4 | 0.2 | |
| | Douglas Oil Co. of Calif. | 1.0 | [d] | |
| | Malco Products, Inc. | 4.5 | [d] | |
| | Malco Refineries, Inc. | 1.6 | [d] | |
| | Western Oil & Fuel Co. | 1.6 | [d] | |
| | Total | 43.1 | 0.2 | 70.5 |
| 73. | Sverdrup & Parcel, Inc. | 3.8 | [d] | |
| | A R O, Inc. | 38.5 | 0.2 | |
| | Total | 42.3 | 0.2 | 70.7 |
| 74. | Western Union Telegraph Co. | 41.5 | 0.2 | 70.9 |
| 75. | Richfield Oil Corp. | 39.7 | 0.2 | |
| | American Mineral Spirits Co., Western | 0.1 | [d] | |
| | Total | 39.8 | 0.2 | 71.1 |
| 76. | Sinclair Oil Corp. | 0.0 | 0.0 | |
| | Sinclair Refining Co. | 38.3 | 0.2 | |
| | Sinclair Research, Inc. | 0.1 | [d] | |
| | Total | 38.4 | 0.2 | 71.3 |
| 77. | Vitro Corp. of America | 37.0 | 0.2 | 71.5 |
| 78. | Gilfillan Corp. | 37.0 | 0.2 | 71.7 |
| 79. | Eastman Kodak Co. | 35.9 | 0.1 | |
| | Eastman Chemical Products, Inc. | 0.1 | [d] | |
| | Eastman Kodak Stores, Inc. | 0.2 | [d] | |
| | Recordak Corp. | 0.6 | [d] | |
| | Total | 36.8 | 0.1 | 71.8 |
| 80. | Bath Iron Works Corp. | 34.3 | 0.1 | |
| | Hyde Windlass Co. | 0.3 | [d] | |
| | Total | 34.6 | 0.1 | 71.9 |
| 81. | American Bosch Arma Corp. | 33.8 | 0.1 | 72.0 |
| 82. | Union Carbide Corp. | 33.6 | 0.1 | 72.1 |
| 83. | Day & Zimmerman, Inc. | 33.3 | 0.1 | 72.2 |
| 84. | Mitre Corp. | 33.1 | 0.1 | 72.3 |
| 85. | Asiatic Petroleum Corp. | 33.0 | 0.1 | 72.4 |
| 86. | Allis-Chalmers Mfg. Co. | 29.6 | 0.1 | |
| | Consolidated Systems Corp. | 1.6 | [d] | |
| | Total | 31.2 | 0.1 | 72.5 |
| 87. | Sundstrand Corp. | 30.9 | 0.1 | |
| | Sundstrand Aircraft Service Corp. | 0.3 | [d] | |
| | Total | 31.2 | 0.1 | 72.6 |
| 88. | Control Data Corp. | 30.1 | 0.1 | 72.7 |
| 89. | Hazeltine Corp. | 29.5 | 0.1 | |
| | Hazeltine Research Corp. | 0.1 | [d] | |
| | Wheeler Laboratories, Inc. | [c] | [d] | |
| | Total | 29.6 | 0.1 | 72.8 |
| 90. | Dynalectron Corp. | 29.6 | 0.1 | 72.9 |
| 91. | Defoe Shipbuilding Co. | 29.3 | 0.1 | 73.0 |
| 92. | Flying Tiger Line, Inc. | 29.0 | 0.1 | 73.1 |
| 93. | Loral Electronics Corp. | 28.6 | 0.1 | 73.2 |
| 94. | Texas Instruments, Inc. | 28.4 | 0.1 | |
| | Engineering Supply Co. | [c] | [d] | |
| | Metals & Controls, Inc. | 0.2 | [d] | |
| | Total | 28.6 | 0.1 | 73.3 |
| 95. | Air Products & Chemicals, Inc. | 27.7 | 0.1 | 73.4 |
| 96. | Atkinson (Guy F.) Co. | [c] | [d] | |
| | Willamette Iron & Steel Co. | 27.3 | 0.1 | |
| | Total | 27.3 | 0.1 | 73.5 |
| 97. | Carrier Corp. | 26.8 | 0.1 | |
| | Spectrol Electronics Corp. | 0.1 | [d] | |
| | Total | 26.9 | 0.1 | 73.6 |
| 98. | Clark Equipment Co. | 26.9 | 0.1 | 73.7 |
| 99. | U. S. Lines Co. | 26.7 | 0.1 | 73.8 |
| 100. | Phillips Petroleum Co. | 26.5 | 0.1 | 73.9 |

[a] Net value of new procurement actions minus cancellations, terminations and other credit transactions. The data include debit and credit procurement actions of $10,000 or more, under military supply, service and construction contracts for work in the U. S.; plus awards to listed companies and other identifiable U. S. companies for work overseas.

Procurement actions include definitive contracts, the obligated portions of letter of intent and letter contracts, purchase orders, job orders, task orders, delivery orders, and any other orders against existing contracts. The data do not include that part of open-end or indefinite quantity contracts that have not been translated into specific orders on business firms. The data do not include purchase commitments or pending cancellations that have not yet become mutually binding agreements between the government and the company.

[b] The assignment of subsidiaries to parent companies is based on stock ownership of 50% or more by the parent company, as indicated by data published in standard industrial reference sources. The company totals do not include contracts made by other U. S. Government agencies and financed with Department of Defense funds, or contracts awarded in foreign nations through their respective governments. The company names and corporate structures are those in effect as of 30 June 1963. Only those subsidiaries are shown for which procurement actions have been reported.

[c] Less than $50,000.

[d] Less than 0.05%.

[e] Stock ownership is equally divided between Standard Oil Co. of California and Texaco, Inc.; half of the total of military awards is shown under each of the parent companies.

[f] A joint venture of Morrison-Knudsen Co., Inc., Paul Hardeman, Inc., Perini Corp., C. H. Leavell & Co., and Utah Construction & Mining Co.

Office of the Secretary of Defense

*CAB Accident Investigation Report:*

# Go-Around Technique Cited in DC-7 Crash

Eastern Air Lines Flight 512, a Douglas DC-7B, N 815D, crashed during an attempted go-around following an instrument approach to Runway 4R at New York International Airport at 2145 EST, on Nov. 30, 1962. Of the 51 persons aboard, 21 passengers, 3 crew members and an additional crew member occupying the jump seat did not survive.

Flight 512, regularly scheduled from Charlotte, N. C., nonstop to New York International Airport, entered a fog condition near the threshold of Runway 4R. A go-around was initiated; however, the aircraft struck the ground in a slightly nose-high attitude and was virtually destroyed by impact and subsequent fire.

The Board determines the probable cause of this accident was the technique employed by the crew during abandonment of the approach under fog conditions not adequately reported.

## INVESTIGATION

Eastern Air Lines (EAL) Flight 512, a Douglas DC-7B, N 815D, a regularly scheduled passenger flight from Charlotte, N. C., nonstop to New York International Airport (Idlewild), crashed at approximately 2145[1] on Nov. 30, 1962. Flight 512 was attempting a go-around following an instrument approach to Runway 4R at Idlewild. Of the 51 persons aboard, 21 passengers, 3 crew members and an additional crew member occupying the jump seat did not survive.

Prior to the time of departure from Charlotte, routine aeronautical information was published by the U.S. Weather Bureau and the Federal Aviation Agency (FAA) relating to Idlewild. The aviation terminal forecast, valid for the period from 1800 on Nov. 30, to 0600 on Dec. 1, predicted partial obscuration, 3-mi. visibility in haze and smoke with occasional 2-mi. visibilty. FAA publications indicated that the landing aids for Runway 4R at Idlewild included an Instrument Landing System (ILS); sequenced flashing lights; runway centerline, edge and threshold lights; taxiway lights; approach lights and rotating beacon. The Precision Approach Radar (PAR) was declared by a Notice to Airmen (NOTAM) to be out of service.

The EAL forecast attached to the Dispatch Release of Flight 512 indicated clear skies or scattered clouds for Idlewild.

Flight 512 departed Charlotte at 1941 and proceeded in accordance with an Instrument Flight Rules (IFR) clearance.

While en route to Idlewild, EAL 512 was in radio communication with the Atlanta, Washington and New York Air Route Traffic Control Centers (ARTCC). The flight was also maintaining radio contact with EAL on company radio.

The Idlewild forecast was amended at 1927 by the Weather Bureau. This amended forecast was to be valid for the period from 1940 to 0600; it called for "ceiling zero obscuration, visibility zero, fog, variable to clear, visibility 1¼ mi. ground fog." There is no evidence that Flight 512 was advised of this forecast.

Following a chronological sequence, the next events of relevance occurred at the Idlewild Airport. At about 2015 the TEL-autograph transceivers in the FAA control tower cab and IFR room became inoperative. This equipment is utilized to communicate written weather information between the Weather Bureau office and the control tower cab and IFR room. Also, it was discovered that the direct voice communication line (hot line) between the control tower and the Weather Bureau was inoperative.

At 2023 the flight was advised by EAL flight dispatch that "If Idlewild below on arrival, you are cleared to Philadelphia. . . . EAL 512 acknowledged this message and during the ensuing conversation was informed . . . several other flights diverting to Newark."

Meanwhile, the Idlewild Runway Visual Range (RVR) digital readout displays in the control tower[2] for Runway 4R were malfunctioning. The RVR recorder trace located in the Idlewild Weather Bureau offices was operating satisfactorily. The Weather Bureau personnel who maintained the RVR equipment were informed of the outage at 2030.

By 2045 the flight was in radio communication with the New York ARTCC on VHF frequency 123.6 and was then cleared to the Sandy Hook holding pattern at 11,000 ft. At 2052, an Expected Approach Clearance (EAC) time of 2207 was issued to EAL 512 and acknowledged. At 2057, detailed holding instructions were issued to the flight with the advice: ". . . delay indefinite due to weather." At this time aircraft were landing at Idlewild on Runway 22L.[3] Shortly thereafter landing traffic was shifted from Runway 22L to Runway 4R. At 2102 EAL 512 requested the Idlewild weather on company radio. The company advised the flight that the visibility was ". . . now one mile . . . EAL Flight 330 missed approach to Runway 22." At 2107, the New York ARTCC broadcast the following message on the frequency being guarded by EAL 512: "All aircraft this frequency inbound to Idlewild, the latest weather, time 0205 (2105 EST), partial obscuration; a mile and a half with fog; landing runway four right, RVR inoperative."

Subsequently, the New York ARTCC issued a revised EAC time of 2140 to EAL 512, which was acknowledged.

### Company Radio

At approximately 2110, EAL 512 called the company radio and stated: "Coming up on Sandy Hook, have an Expected Approach Clearance time of 40 min. after the hour, altitude 9,000 ft., and understand the visibility is now 1¼ mi." At 2112, while holding at Sandy Hook at 9,000 ft., the flight called company radio and requested Idlewild landing information. The following was transmitted to EAL 512: "The Idlewild Pressure Altitude is 9640, Idlewild U.S. Weather Bureau altimeter is 30.30." EAL responded by stating that his field pressure indicated 30.31.

It should be noted here that five weather observations were recorded by the observer on duty at the Idlewild Weather Bureau office between 2108 and 2153. During that period, the official visibility[4] for Idlewild was that "prevailing visibility" observed by the FAA controllers[5] located in the tower cab.[6] Control tower operators are required to maintain a log of their observations of visibility. There is no documentary evidence that such log was maintained on the evening of Nov. 30 in the Idlewild tower. There was, however, a Weather Bureau record[7] of both prevailing visibility and surface visibility[8] at Idlewild during the evening of Nov. 30.

At 2124, control of the flight was transferred from New York ARTCC to Idlewild Approach Control and the flight changed to the assigned frequency of 119.7. EAL 512 reported its position as in the Sandy Hook holding pattern. The following information was then transmitted to and acknowledged by EAL 512: ". . . Four Right ILS in use, landing Runway Four Right. Wind calm. The Idlewild weather, sky partially obscured, visibility 1¼ mi. with fog. Altimeter setting: three zero three one. Precision Approach Radar not available. Middle marker, middle locator, Runway 4R inoperative; Runway visual range 4R inoperative." At this same time, EAL Flight 620, a turbojet aircraft, landed on Runway 4R at Idlewild. Shortly thereafter, at 2127, United Air Lines (UAL) Flight 500, a DC-6 aircraft, abandoned an approach to Runway 4R due to reduced visibility. The crew of UAL 500 told the Idlewild Approach Control: ". . . that stuff is . . . no more than 50 ft. thick and it is really thick . . . " To which the FAA controller responded: ". . . . we're almost on top of it here in the seventh floor . . . we can hardly see the ground . . . Good old fashioned ground fog . . ." At the time of this conversation, UAL Flight 712, a turbojet aircraft, landed on Runway 4R.

At 2130, a broadcast of weather information was made by Idlewild Approach Control on frequency 119.7. It read as follows: "All aircraft copy. Runway 4R ILS in use. Landing 4R. Wind northeast six, altimeter three zero three one. Idlewild weather, sky partially obscured, visibility is 1¼ mi. with ground fog, and, just got out new visibility, it's 1 mi. now. One mile with ground fog. Runway visual range 4R inoperative. Middle locator 4R inoperative, and Precision Approach Radar not available."

Following this transmission, American Airlines Flight 996, a turbojet aircraft, landed on Runway 4R at 2132.

EAL 512 was laddered down to 6,000 ft. in the Sandy Hook holding pattern, and, at 2133, the flight was identified on radar and was given radar vectors to the ILS final approach course. At about this time, the last weather report available to EAL 512 was broadcast by Idlewild Approach Control to all aircraft: ". . . sky partially obscured; visibility 1 mi. with ground fog; and wind is northeast at six, altimeter setting 30.31." At 2134, American Airlines Flight 910, a turbojet aircraft, landed on Runway 4R.

The Idlewild Weather Bureau observer recorded a special weather observation at 2136 which described the official visibility as ¾ mi. and contained the following notation in the remarks section: "surface visibility ¼ mi." Shortly thereafter, at 2137, Trans World Airlines Flight 46, a turbojet aircraft, landed on Runway 4R. At 2139:11, EAL 512 was advised of its position as 9 mi. southwest of the ILS outer marker and was instructed to contact the tower on 119.1. At 2139:59, Approach Control gave a new weather broadcast of ¾ mi. visibility in ground fog on frequency 119.7. At about 2139, UAL Flight 950, a DC-7 aircraft, landed on Runway 4R. This landing was described by Capt. L. W. Witlow as: "Just after my first officer . . . reported to IDL approach control the IDL 4R LOM (outer marker) inbound he remarked 'I can see the glow of the approach lights', shortly thereafter he remarked 'I can see the approach lights but not the runway.' I then looked out and observed the full line of approach lights and the runway lights on the approach end. From that point on, I made a visual approach referring to my ILS instrument so as to stay on the glide slope, which I did until I was definitely over the runway."

As EAL 512 was approaching the outer marker, at 2141, UAL Flight 164 was landing on Runway 4R. The captain of UAL 164 described his landing as follows: "Either at or shortly after passing the outer marker the glow of the approach lights was visible through the fog . . . The flight was, until this point, made in clear air with clear skies above. Lights were clearly visible either on or very near the airport. Prior to reaching the middle marker, the threshold lights were observed . . . Landing was effected at 2141 EST in visibility that I would judge to be somewhat less than ¾ mi. An accurate appraisal of visibility during the last 20 ft. before touchdown was virtually impossible due to the brilliance of the runway lighting." At approximately this time, a Sabena turbojet aircraft, located on the ground at Idlewild 1 mi. northwest of the threshold of Runway 4R, was cleared for takeoff on Runway 7R. The Sabena crew informed the control tower on VHF radio frequency 119.1 that visibility was ". . . a bit too poor . . ." and requested a delay.

Subsequently, EAL 512 contacted the tower on 119.1 mcs., and advised that it had just passed the outer marker. The local controller then advised EAL 512 that the condenser discharge sequenced flashing lights in the approach light system were being turned on and to inform the tower if the pilot desired them off.

At 2143, the local controller cleared EAL 512 to land. The crew then acknowledged

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

[2] Runway 4R at New York International Airport is equipped with instrumentation which indicates the horizontal distance a pilot should be able to see down the runway from the approach end. This concept of visibility is known as RVR. The primary instrument used to determine RVR is the transmissometer. This instrument consists of a projector and detector, 500 ft. apart, located on the right side of the touchdown point on Runway 4R, and a digital display and recorder which charts the transmissivity of the atmosphere.
The projector of the runway 4R system is located 500 ft. from the runway threshold and 400 ft. east of the eastern edge of the runway. The detector unit is located 1,000 ft. from the approach end of the runway and 370 ft. to the east of the eastern edge of the runway.
The projector emits a high-intensity focused light; the detector measures the amount of this light received as a percentage of the amount that would be received through a clear atmosphere and the meter converts this into a measure of visibility. In essence, the transmissometer samples the visibility along the known 500-ft. baseline and then extrapolates to determine the visibility over a greater distance. The equipment can be set so that it accounts for changes in setting of the high intensity runway lights, and for the existence of day or night.

[3] Runway 22L is the reciprocal of Runway 4R.

[4] Official visibility can be obtained by either of two methods. One is a visual observation of the prevailing visibility which is discussed in paragraph 2210 of the Weather Bureau publication, Circular N, as the greatest measure of visibility observed throughout at least one half of the horizon circle. The other method is through use of RVR.

[5] In accordance with Circular N and the FAA Manual ATP 7230.1, the visibility observations are to be made by authorized FAA tower controllers when the Idlewild visibility is below 4 mi. There are exceptions to this rule, including a condition wherein "the tops of the phenomena are below the level of the tower."

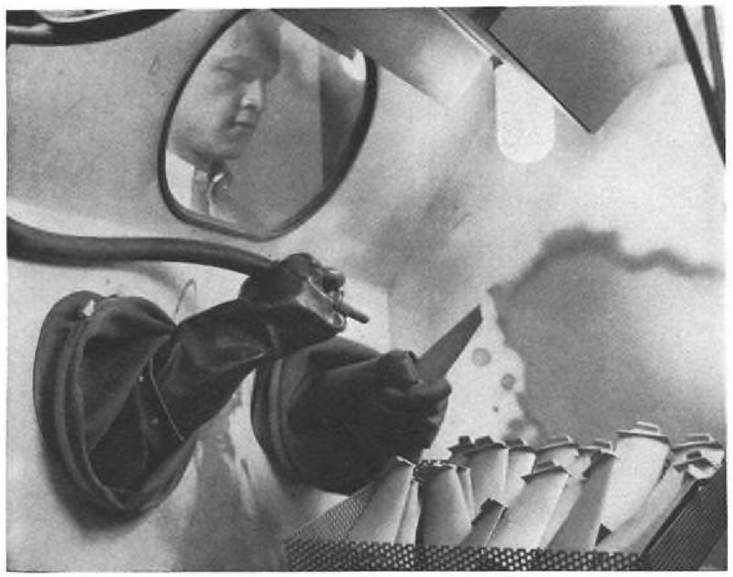
[6] The tower cab is approximately 142 ft. above the surface of the runway, the Weather Bureau is located across the street (in the International Arrivals building.), and the Weather Bureau visibility observation point is about 30 ft. above the surface of the runway.

[7] The WBAN—10 Form of recorded surface observations.

[8] Surface visibility is not described as a method of obtaining "official visibility" in Weather Bureau documents. However, Sec. 2820 of Circular N states that when a Weather Bureau observer obtains a visibility which differs from that of official visibility obtained by the tower, the information must be included in the remarks section of the Weather Report as "Surface Visibility."


**CH-3C Makes Water Landings in Autorotation Tests**

**USAF/Sikorsky CH-3C is shown during water landing tests in the Housatonic River witnessed by Federal Aviation Agency and military officials. Autorotations were performed with both a full aft and full forward c.g. loading, at the aircraft's mission gross weight of 19,500 lb. Numerous height/velocity tests were also made to establish the combination of altitudes and speeds from which safe landings can be made with one engine out, allowing normal pilot reaction time. Approximately 30 water landing tests were included in program.**



## Abrasive Technique Cleans Turbine Blades

**Abrasive cleaning of heat corrosion and deposits on jet engine turbine blades is being performed with this Vacu-Blast technique at United Air Lines' San Francisco maintenance base. The system involves both abrasive spray and shot peening, and uses equipment operating semi-automatically, as well as the manual system shown here.**

with "OK, dim the flashers." The tower controller replied: "Roger, I have to shut them off." He then turned off the flashers. This was the last radio contact with EAL 512.

EAL Flight 406, a turboprop aircraft, was immediately preceding Flight 512 in the landing traffic for Runway 4R. EAL 406 landed at 2144 on 4R. The captain of EAL 406 indicated that approaching the airport the sky was clear and the approach lights could be seen prior to the outer marker. After passing the outer marker he lost the lights temporarily, but they became visible again before the middle marker. From this point, the runway and threshold lights were also visible; however, fog described as variable, was encountered. He stated that ". . . after landing, we ran into very thick fog at the northeast end of the runway causing a little delay in clearing at the end."

At this time, the RVR recorder trace in the Weather Bureau office indicated that Runway 4R visibility was virtually zero. This information was available to the Weather Bureau observer but was not communicated to the tower personnel.

The crew of EAL 512 did not report the runway in sight passing the middle marker, a required report. Two tower controllers observed the red rotating beacon light on the aircraft disappear in a fog condition ¼ mi. from the end of Runway 4R. At 2144 the local controller requested that EAL 512 advise when it was clear of Runway 4R. There was no response.

Two passengers aboard EAL 512 reported seeing the flaps during the approach. One passenger estimated the flaps to be at approximately the 40-deg. position shortly before impact. One passenger saw the landing gear in the down position. Passengers saw colored lights at various altitudes and positions during the approach. Passengers observed the newly painted white bars at the end of Runway 4R as the aircraft crossed over the marks at a slight angle from right to left. A passsenger saw the blue edge lights of a taxiway on the left side of Runway 4R. Passengers perceived the approach to be smooth without noticeable veering, swerving, or turning. A pronounced engine roar was heard coincident with a settling of the tail.

At approximately 2145, tower personnel observed a bright orange flash emanating from the vicinity of the PAR antenna building which is located approximately 400 ft. to the left and 4,200 ft. beyond the threshold of Runway 4R. Emergency procedures were immediately initiated by the tower personnel. American Airlines Flight 8, which had just reported passing the outer marker, asked ". . . we got a bright light ahead of us, appears near the airport—you got any information?" The tower requested that they overfly the runway and report. While over the runway, American 8 advised ". . . Runway 4R appears to be clear, we got a fire in sight down there . . . to the left of the runway."

EAL 512 crashed approximately 2,500 ft. beyond the ILS touchdown point[9] on the left side of Runway 4R at 2145. After the accident, at 2150, a weather observation was recorded with ". . . visibility ¾ mi. in fog . . . surface visibility ⅛ mi." The landing minimums for EAL 512 were 200 ft. ceiling and ½ mi. visibility. The "surface visibility" observations of the Weather Bureau were not communicated by the FAA tower personnel to EAL 512 on any recorded communications frequency. Tower personnel stated that the Weather Bureau observations for the period 2108 to 2150 were not received by them. The Weather Bureau observer at Idlewild did not recall specifically advising any person in the control tower of the "surface visibility." He said: "I do not remember sending out any observations. The only thing I can say is I do not remember not sending out any observations."

The first impact marks made by the aircraft were slashes from the Nos. 1 and 2 propellers. These marks were located 3,460 ft. from the threshold center of Runway 4R, on a bearing of 37 deg. Computations based on reed cuts and propeller slashes indicate a flightpath impact angle of 2 deg. with a 6-deg. bank to the left and an airspeed of 135 kt. A splash mark from the tail skid, commencing 50 ft. before the main impact, indicated an aircraft attitude of 3 to 5 deg. nose high.

Breakup of the wings and fuselage occurred on a mound of earth approximately 3 ft. high, located 3,600 ft. from the threshold center of runway 4R, on a bearing of 37 deg. The left wing failed near the wing root, between the Nos. 1 and 2 engine nacelles, and at the tip. The left wing fuel tanks ruptured, resulting in ground fire which burned a large area just beyond the mound. The right wing separated at the wing root with portions of the upper and lower fuselage skin fairing and structure still attached.

The aircraft fuselage separated at impact in the vicinity of the aft wing spar with the forward portion coming to rest 90 deg. to the wreckage path. This break occurred approximately at the cabin partition between the forward tourist and aft first-class sections. All survivors, 6 tourist, 18 first-class passengers and 2 stewardesses, exited through the main passenger door, aft emergency exit door or windows, or through breaks in the fuselage. They reported seeing fire from the wings immediately on impact, followed by fire inside the cabin a few seconds later. As a result of this fire both stewardesses, who had been seated in the aft lounge, were unable to see forward of the galley area by the main loading door.

The nose landing gear was separated from the aircraft; the actuating cylinder indicated it was fully up at impact. The main landing gear was found in the retracted position. There were no landing gear gouge marks along the wreckage swath. All three landing gears on the DC-7 retract in the forward direction, and retraction time is about 7 sec.

The flap-actuating cylinders indicated the left flap was set at approximately 20 deg. or "takeoff" position at impact. The right flap actuating cylinders corresponded to an approximate setting of 10 deg. Examination of the flap actuator on the flight deck indicated a 20-deg. flap position had been selected at impact. The right flap bus cable turnbuckle was found broken; however, a laboratory examination revealed that this break could only occur to this type of brass when under a tension load, at a very high temperature. Wing flap control valve cable continuity could not be traced to the cockpit controls because of fire damage.

All four engines received considerable impact damage, with various components being torn loose or broken away. Examination of the engines revealed no evidence to indicate pre-impact failure, operational distress or malfunction. Tests of the propeller governors revealed that engine speeds for Nos. 1, 2, 3, and 4 had been 2,474, 2,445, 2,463 and 2,422 rpm, respectively. Propeller shim plate markings indicate blade angles at impact were 37, 37, 36 and 38 deg., respectively, for the Nos. 1, 2, 3, and 4 propellers. At impact, the approximate horsepower being produced by engines Nos. 1, 2, 3, and 4 were 2,035, 1,950, 1,993, and 1,890, respectively. Normal engine horsepower for a landing approach is approximately 1,000 hp./engine.

A few hours after the accident, at 0245 on Dec. 1, 1962, the FAA made a flight check of the complete ILS serving Runway 4R. This check disclosed that the front course of the localizer, glide slope, and markers were operable and within required tolerances at that time. A further check was conducted on Dec. 4, 1962. The purpose of this flight was to determine whether or not a Lockheed Electra L-188 on the instrument runway, or taxiing near the localizer antenna, would affect the presentation of instruments in an aircraft making an approach. Three approaches were made under these conditions and no abnormalities were noted in the localizer course from over the outer marker to the runway threshold. The latter test was prompted by concern that an Electra, which had landed approximately 1 min. before Flight 512, might have interfered with localizer signals.

Eastern Air Lines FAA-approved DC-7B Flight Manual describes the go-around procedure with four engines operating as follows:

"1. Captain applies or calls for power as required usually METO. NOTE: At airspeeds expected at the start of a go-around, the use of T.O. rpm. and power not normally needed. If go-around from balked landing is made with full flaps and gear down and speed reduced to approximately minimum landing, T.O. power and rpm. may be necessary.
2. Wing flaps—TAKEOFF position.
3. Landing Gear—UP.
4. Normal CLIMB POWER after landing gear is UP.
5. Wing flaps may be left at TAKEOFF position or retracted at captain's discretion."

The chief pilot of the Douglas Aircraft Co. was questioned about the DC-7 performance and acceleration characteristics in various configurations. He stated that power application as low as 2,100 to 2,200 hp./engine, instead of METO, at the start of a go-around in the landing configuration, would produce a low rate of climb initially, and a slower transition to a climb. There would be no tendency for the aircraft to roll or yaw if all engines are accelerated evenly. He further stated that with a gross weight of approximately 96,000 lb. and "using the landing configuration of gear down, flaps full and using all four engines at takeoff power, the angle of climb for a speed of 115 kt. would be approximately 3 deg. That's the noseup, and that would be using the airplane fuselage as the reference line on the horizon . . . at the same configuration, speed at 135 kt. the angle would be 2 deg. For configuration of flaps 20 deg., and the gear up, using all four engines at takeoff power, the angle with 115 kt. would be 9 deg. noseup, and 135 kt. would be 8 deg. noseup." If less than takeoff power were used, in the 2,100 or 2,200 hp./engine range, ". . . the angle would be slightly less."

He also stated that with a gross weight of 96,000 lb., brake horsepower of 2,250 and 2,600 rpm. at sea level on a standard day the aircraft would accelerate at a rate of approximately 2 kt./1 sec. Placing the flaps at 20 deg., 40 deg., and finally at 50 deg. flaps and gear down the acceleration would drop to approximately 1.52, 1, and slightly less than 1 kt./sec., respectively. He further stated that using an airspeed of approximately 115 kt., at maximum landing weight, "There would be no problem at all to pull it up and rotate it . . . into . . . a balk-landing climb."

## ANALYSIS

The investigation revealed no evidence of control system, powerplant, or structural failure. The forces to which the aircraft was subjected when it struck the mound of earth near the point of initial impact, undoubtedly contributed to the extensive breakup of the structure.

The system of weather observation and reporting as it concerned the flight deserve special attention. The U. S. Weather Bureau, the FAA tower controllers, and the Eastern Air Lines dispatch organization each had duties relating to weather observation and reporting. The system placed the initial responsibility on the Weather Bureau to observe and record the weather information. Since the official Idlewild visibility was less than 4 mi., the responsibility for taking visibility observations was assumed by the FAA tower controllers. There was an exception in the rules which provided that the responsibility for taking official visibility observations would revert from the tower to the Weather Bureau, when the tower was above the top of the phenomena. However, during the period with which this report is concerned, the tower was observing restricted visibilities which indicated that the top of the phenomena was, in fact, above the tower. The FAA tower controllers furnish meteorological information to aircraft in flight, particularly in the terminal area.

The prime responsibility for furnishing significant weather information to EAL 512 while en route was a duty of the Eastern Air Lines dispatcher.

The information furnished to EAL 512 did indicate that the weather situation at Idlewild was deteriorating. These reports included notification of indefinite delays due to weather; alternate airport information; that company traffic missed an approach and that the visibility was 1 mi. when the flight departed Sandy Hook holding pattern. The information contained in the remarks section of the Weather Bureau observations which indicated that the "surface visibilities" were less than the reported official visibility were not furnished to the crew of EAL 512. Further, the Approach Control broadcast of the 2136 special observation, which included "visibility ¾ mi. in ground fog" was made at 2139:59, or after EAL 512 had been instructed to change to tower frequency.

Owing to the vertical and horizontal separation of the tower cab from the approach end of Runway 4R, the tower visibility observation was not representative of the condition along the runway. However, since the tower RVR was considered inoperative, the governing visibility factor applicable to landing minimums of ½ mi. visibility was that observed by the tower controller. It was on this basis that the airport remained "above minimums" while EAL 512 attempted an approach.

There were two indications of poor visibility which the crew of EAL 512 should have heard during their approach. The crew of an aircraft clearing the runway reported experiencing visibility of 50-60 ft. In addition, the jet flight awaiting departure from Runway 7R requested a takeoff delay for weather improvement. These transmissions all took place on tower frequency, which EAL 512 had been instructed to monitor shortly prior thereto. However, if the crew of EAL 512 was aware of these reports, the knowledge that company traffic had landed immediately ahead of them, at 2144, could have offset any apprehension they may have had regarding the successful completion of their approach.

Since the captain of EAL 406, which landed immediately ahead of EAL 512, stated that he saw the approach, runway, and threshold lights from the middle marker, and since the pilot of EAL 512 requested that the "flashers" be dimmed, it is presumed that he was encountering similar weather conditions. During the approach, EAL 512 should have been at 197 ft. above the field elevation over the middle marker. A decision must have been made at this point either to complete the approach or go-around. Although the transcript of recorded communications did not reflect passage of the middle marker or the captain's intention at that time, it is concluded from the testimony of surviving passengers that the captain elected to continue his approach and effect a landing. From the middle marker to the runway threshold, altitude and airspeed were reduced in preparation for the landing. As the aircraft continued to descend, a rapid deterioration of visual reference was encountered in thick fog. This fog was similar to that observed by crews awaiting takeoff on Runway 7R, and by crews that landed on Runway 4R. When visual reference was lost, the pilot elected to go around.

### Flight Profile

Attached to this report is a drawing depicting the probable flight profile of EAL 512 which indicates that:

1. The aircraft was on the glide path at the middle marker with its gear down, flaps at 30 deg., airspeed at 130 kt., descending at 574 ft./min. and a constant power of 100 BMEP at 2,450 rpm., or 1,040 brake horsepower per engine.

2. As the runway threshold was approached, flap extension from 30 deg. to 40 deg. was initiated at an altitude of approximately 75 to 80 ft. The extension of flaps from 30 deg. to 40 deg. required 2 sec., during which time the aircraft decelerated approximately 1 kt. to 129 kt. A slight deviation above the glide slope occurred when the crew, seeing the threshold and some of the runway lights, began to execute a visual approach.

3. After crossing the threshold, the aircraft continued along a flightpath of 1½ deg. slope downward and about 6 deg. to the left of the runway heading for 8¾ sec. During this period, there was a rapid deterioration of visual reference when thick ground fog was encountered. At the end of this period, the aircraft had decelerated to a speed of 124½ kt. and had descended to an altitude of approximately 25 ft. above the ground. After perceiving the fog and evaluating the situation, the crew of EAL 512 elected to abandon the approach. Without increasing the

[9] See Attachment 1.

rpm., slightly more than climb power was applied, and the landing gear was retracted, coincident with retraction of the flaps to 20 deg. The nose of the aircraft was rotated upwards to between 3 to 5 deg. above the level position. The missed approach procedure was initiated about 1,000 ft. beyond the ILS touchdown point, to the left of the runway, altitude about 25 ft.

Execution of the missed approach procedure by the crew of EAL 512 necessitated a transition to instrument reference due to the loss of visual reference. This had to be accomplished at an extremely low altitude. There was little time or margin for error if the maneuver was to be successfully accomplished.

### Flap Retraction

The DC-7B aircraft in the landing configuration can be transitioned from the landing attitude to a climb without loss of altitude. In order to accomplish this, takeoff power, or even climb power, with aircraft rotation to approximately a 3-deg. noseup attitude is required. The retraction of flaps to 20 deg. during such a transition requires an aircraft rotation to approximately a 9-deg. noseup attitude, in order to compensate for the loss of lift as the flaps are retracted. Surviving passengers did not experience the pronounced change in attitude which would have resulted from aircraft rotation to 9 deg. noseup during the crew's execution of the missed approach. The ground impact splash from the tail skid confirmed a 3- to 5-deg. noseup attitude.

The amount of power application and the degree of aircraft rotation used by the crew of EAL 512 should have been adequate to accomplish the pull-out, had the flaps and gear remained extended. However, inasmuch as flap and gear retraction was effected prior to establishing a positive rate of climb, either one of two actions by the crew would have precluded the aircraft settling into the ground:

1. Additional aircraft rotation, commensurate with the power utilized.
2. Use of the remaining power available.

The Board concludes that additional aircraft rotation was not effected due to a lack of immediate instrument orientation, and that additional power was either not requested, or delayed because of other duties.

### Probable Cause

The Board determines the probable cause of this accident was the technique employed by the crew during abandonment of the approach under fog conditions not adequately reported.

### Recommendations

Following this accident the Board sent recommendations to the FAA and the United States Weather Bureau. These recommendations and the responses thereto were as follows:

1. It was recommended that the Air Traffic Control procedures require the transmission of all operationally significant weather information in terminal areas to approaching aircraft. The FAA, by letter dated Jan. 8, 1963, stated that the necessary procedural changes were being prepared.

2. It was recommended that the RVR instrumentation in the recently commissioned IFR room of the Idlewild tower was inadequate. Also, the Board requested a study of the physical arrangements in all towers where PAR is installed. On Jan. 11, 1963, the FAA stated that corrective action was being taken and that a new program would permit installation of five RVR indicators in a tower facility.

3. It was recommended that an alternate method be developed to determine runway visibility when the RVR is inoperative. This was to be accomplished by utilizing runway observers, certificated by the Weather Bureau. On Jan. 14, 1963, the FAA stated that this procedure would be implemented on a trial basis in New York, Chicago, and Los Angeles. The Weather Bureau indicated concurrence with the recommendation on Jan. 8, 1963.

4. The Weather Bureau was informed that the staffing plan of the Weather Bureau Airport Station at Idlewild was inadequate to maintain proper surveillance of all the weather recording devices available. On Jan. 8, 1963, the Weather Bureau indicated that corrective action would be taken.

5. It was recommended that the Weather Bureau amend their methods of observing and reporting prevailing weather when "partial obscurations" are present. The Weather Bureau indicated concurrence with this recommendation on Jan. 8, 1963.

6. The FAA was informed that there was a period of time on the evening of this accident when no record of tower visibility observations was retained. It was recommended that the responsible activities should be recording and reporting the same values of visibilities at all times and that there should be a written record of all tower visibility observations. On Feb. 4, 1963, the FAA stated that operations procedures were being developed to accomplish this end.

7. It was recommended that the "Remarks" portion of weather reports be broadcast to aircraft. The FAA informed the Board that a priority project had been initiated to standardize the transmission of weather information from ATC facilities to airmen in flight.

By the Civil Aeronautics Board:

ALAN S. BOYD, Chairman
ROBERT T. MURPHY, Vice Chairman
CHAN GURNEY, Member
G. JOSEPH MINETTI, Member
WHITNEY GILLILLAND, Member

## SUPPLEMENTAL DATA

### Investigation and Hearing

The Civil Aeronautics Board was notified of this accident immediately after its occurrence at 2145 on Nov. 30, 1962. Investigators were dispatched immediately to the scene to conduct an investigation in accordance with the provisions of Title VII of the Federal Aviation Act of 1958, as amended. A public hearing was ordered by the Board and held at the International Hotel, New York International Airport, N. Y., on Jan. 14-17, 1963.

### Air Carrier

Eastern Air Lines, Inc., holds a current certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation of persons, property, and mail. It also possesses a valid air carrier operating certificate issued by the FAA.

### Flight Personnel

Capt. Edward J. Bechtold, age 43, was employed by Eastern Air Lines on Apr. 26, 1945, and had accumulated a total of 15,644 hr. flight time, of which 2,700 hr. were in DC-7 type aircraft. He held a currently effective FAA airline transport certificate No. 350329 with numerous ratings, among which was the Douglas DC-7. His last line check in DC-7B aircraft was with a company check pilot on May 10, 1962. His last proficiency check in DC-7B aircraft was on June 14, 1962. Records indicate he satisfactorily passed a first-class FAA flight physical on Aug. 27, 1962, without waivers.

Pilot Julius A. Wagner, age 45, was employed by Eastern Air Lines on Mar. 15, 1951, and had accumulated a total of 9,042 hr. flight time. He had accumulated a total of 1,610 hr. flight time in DC-7 type aircraft, of which 71 hr. were as pilot-in-command. He held a currently effective FAA airline transport certificate No. 66171 with numerous ratings, among which was the Douglas DC-7B. His last line check was in a Lockheed 1049 on June 12, 1962. His last proficiency check in DC-7B aircraft was on Jan. 26, 1962. Records indicate he satisfactorily passed a first-class FAA flight physical on May 11, 1962, without waivers.

Pilot Engineer Robert L. Voorhees, age 31, was employed by Eastern Air Lines on Aug. 26, 1957, and had accumulated a total of 4,080 hr. flight time. He had accumulated a total of 149 hr. as pilot-engineer and 718 hr. as a pilot in DC-7 aircraft. He held a currently effective FAA flight engineer certificate No. 1539829. He also held an FAA single and multi-engine land commercial pilot certificate No. 1349561. He received his last proficiency flight check on Sept. 27, 1962, which was his original qualification on DC-7B aircraft. Records indicate he satisfactorily passed an FAA second-class physical on Feb. 1, 1962, without waivers.

Flight attendant Helen L. Fournier was employed by Eastern Air Lines on Apr. 16, 1962. She completed training on fire-fighting, emergency evacuation and ditching on May 2, 1962, and emergency procedures on DC-6/7Bs on May 7, 1962. She satisfactorily passed a company medical examination in April, 1962.

Flight attendant Patricia J. Richards was employed by Eastern Air Lines on June 24, 1961. She completed training on fire-fighting, emergency evacuation and ditching on June 21, 1961, and emergency procedures on DC-6/7Bs on Oct. 30, 1962. She satisfactorily passed a company medical examination in June, 1961.

### Aircraft

N 815D, a Douglas DC-7B, manufacturer's serial No. 45084, owned and operated by Eastern Air Lines, Inc., 10 Rockefeller Plaza, New York, N. Y., was manufactured in September, 1956, and had a total flying time of 18,411:06 hr. of which 281:91 hr. had been accumulated since the last major inspection. The aircraft was powered by four Wright model 972TC18DA-3 engines with Hamilton Standard, model 34E60-363 propellers. Engine times were as follows:

| *Engine Position* | *Time Since Overhaul* | *Total Time* |
|---|---|---|
| 1 | 1,426 | 16,886 |
| 2 | 92 | 19,142 |
| 3 | 1,707 | 15,635 |
| 4 | 645 | 19,452 |

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# ADVERTISERS IN THIS ISSUE

AVIATION WEEK, DECEMBER 30, 1963



CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.



ADVERTISERS INDEX

# LETTERS

## Kennedy Airport

Is there no end to the rash of bad taste that has afflicted politicians in their rush to re-name places and things after the late President John F. Kennedy? It was bad enough to change 400 years of geography by wiping out the name of Cape Canaveral but now Mayor Wagner and the New York City Council have hit a new low in elbowing a combat hero of World War 1 out of the way to slap the Kennedy name on Idlewild International Airport. Few people may recall that this airport was officially the New York International Airport-Anderson Field. The Anderson designation was to memorialize the late Maj. Gen. Alexander E. Anderson, a World War 1 combat hero of New York's fighting 69th Regiment who died of a heart ailment in 1942 while commanding an infantry division in training for World War 2. Even though the public used the more popular name Idlewild, it is a shabby trick to elbow Gen. Anderson's memorial out of the way to superimpose that of the late President Kennedy.

ROBERT BERGMANN
New York, N. Y.

## TFX 'Damage'

The competitive bidding system has been destroyed by the arbitrary award of the TFX contract.

The Canadian government was brought down.

The British government was almost brought down.

Now the only re-entry lifting body vehicle program has been cancelled and replaced by the addition of a "chunk of iron" attached to the Titan 3/Gemini. This latter only to placate the critics by a feeble attempt to justify Titan 3 expenditures because it was developed for the Dyna-Soar. No mention was made of the fact that the X-15 program is also nullified since it was largely to explore the near space regime as a stepping stone to the Dyna-Soar. In addition, the whole future of flight in the hypersonic regime is now in jeopardy not to mention the destruction of the last vestige of significant AF participation in the space program. Defense in space is now entirely in the hands of a civilian agency. I am alarmed.

D. W. BRINKWORTH
Los Angeles, Calif.

## Fowler Flap

Your Nov. 4 issue has an excellent article on the Boeing 727 production program (p. 50) which showed numerous photographs of the remarkable flap used thereon and which was eulogized in the writeup prepared by Mr. C. M. Plattner.

I feel confident Mr. Plattner and most of AVIATION WEEK & SPACE TECHNOLOGY technical staff are aware that the flap described in this article is the Fowler flap. It is interesting to note that credit is given to the Krueger flap several times. This was a German invention which was not patented in this country. It am wondering the reason for credit being given to the Krueger flap and not the Fowler flap. Can it be that Boeing is trying to imply to the public that my flap is a special development of their own organization?

***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.***

The photos of the 727 flap show long external tracks under the wing, first used on the Martin-Fairchild F-22 in 1934, which indicates the variable area feature which is the basis of my Patent No. 1,670,852 issued May 22, 1928.

In addition, the photos show a lateral control system using spoilers and ailerons on the flap that was first used on the Ryan Dragonfly in 1940 and applied to full span Fowler flaps. Nose slats on the flap and cut-back trailing edge of the wing were first used on the Consolidated Model 31 seaplane.

All these features and numerous others were illustrated in my book "The Fowler Flap" published in 1948. It is essentially a handbook on design and aerodynamics, as well as its historical development, and was widely distributed. This is an invention that goes back to 1916 and took 21 years before the present concept was finally adopted to the Lockheed Model 14 commercial transport.

It should be made clear that all my licensees, except Boeing, and all those not licensed since the patent expired in 1945, have connected my name to the flaps when used on their aircraft, and are continuing to do so even after 18 years since my patent expired. And for this recognition I humbly express my thanks.

The lot of the independent inventor is a long, and sometimes, a thankless job. In this Space Age effort calling frantically for new ideas to place this country in the forefront, it is the individual with imagination and courage of conviction who has made these contributions to its progress. It is not the companies nor the government who make these contributions, for patents protecting ideas are issued only to the inventor, whether he is a private citizen or an employe of any organization.

No doubt there are hundreds, perhaps thousands, of inventors who are making outstanding contributions in this Space-Age efforts whose name will never reach the printed page of recorded history. The reason for this is that these inventors are in the employ of electronics, automotive, industrial, governmental as well as the aircraft engine and frame manufacturers. Consequently, they are obliged to assign all their ideas as a prerequisite to employment. It is a rare occasion when someone is selected and honored for his contribution developed while in the employ of an organization engaged on government contracts.

The military and the Congress have grappled with this problem but so far have been unable to do anything about it. There is a complacency in our American way of life that needs to be aroused. Therefore, it seems only fitting that AVIATION WEEK & SPACE TECHNOLOGY make every effort to recognize the inventor by name and give credit even when others fail to do so.

HARLAN D. FOWLER
Burlingame, Calif.

*(Boeing readily acknowledges that the Fowler concept of trailing edge wing extension is the basis for the 727 flap design but points out that some 80 different configurations were engineered by its own staff before finalizing on the triple-slotted flaps actually used. This triple-slotted design is a long way down the engineering road from the original Fowler flap.—Ed.)*

## Zimmerman Idea

The picture of the generalized design for a counter-insurgency aircraft in the Nov. 25 AVIATION WEEK & SPACE TECHNOLOGY (p. 26) forcibly brought to mind a design of 15 years ago. It had all the characteristics, such as short-field takeoff and landing ability, very high lift in a high speed aircraft, plus an exceptional speed ratio. The plane I refer to was the Zimmerman flying wing, a true induced-lift aircraft, built by Vought in 1947 at Stratford, Conn. It seems to me to still be, even today, a superior design to the picture shown as a generalized design. It was capable of single-engine operation because it had linked propellers operating off a cross-span shafting; as a turbojet, it could draw air off the top of the wing through intakes for even better lift.

The Navy sponsored this excellent design. Whatever happened to it? I suspect it was killed off by 'conventional' thinking which placed the then-growing pure jet engines in 'conventional' airframes, designed by 'conventional' people. I hope this brings about some thinking on the Navy's part; they spent the money on Zimmerman's idea, and flew a test bed as well as a full scale prototype. Why not re-evaluate the Zimmerman design? It may be that the answer to their quest is in the Navy's files.

W. DONALD KUNTZ
Bridgeport, Conn.

*(Reader Kuntz is referring to Charles H. Zimmerman's Chance Vought XF5U [AW Jan. 2, 1950, p. 18.] Zimmerman, formerly a Chance-Vought aircraft designer later director of aeronautical research for National Aeronautics and Space Administration, is now chief engineer for Army Materiel Command.—Ed).*

## U.S. Jet Dominance

If there is any significant merit in Mr. John H. Pratt's attack on the management of U.S. airlines and airframe builders (AW Nov. 25, p. 126), perhaps he can explain the dominant position of U.S. commercial jet aircraft in the international market and the high state of development of the U.S. air transport system.

ROBERT W. CLACK
Manhattan, Kan.

JAN. 21964

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