Aviation Week

Including Space Technology

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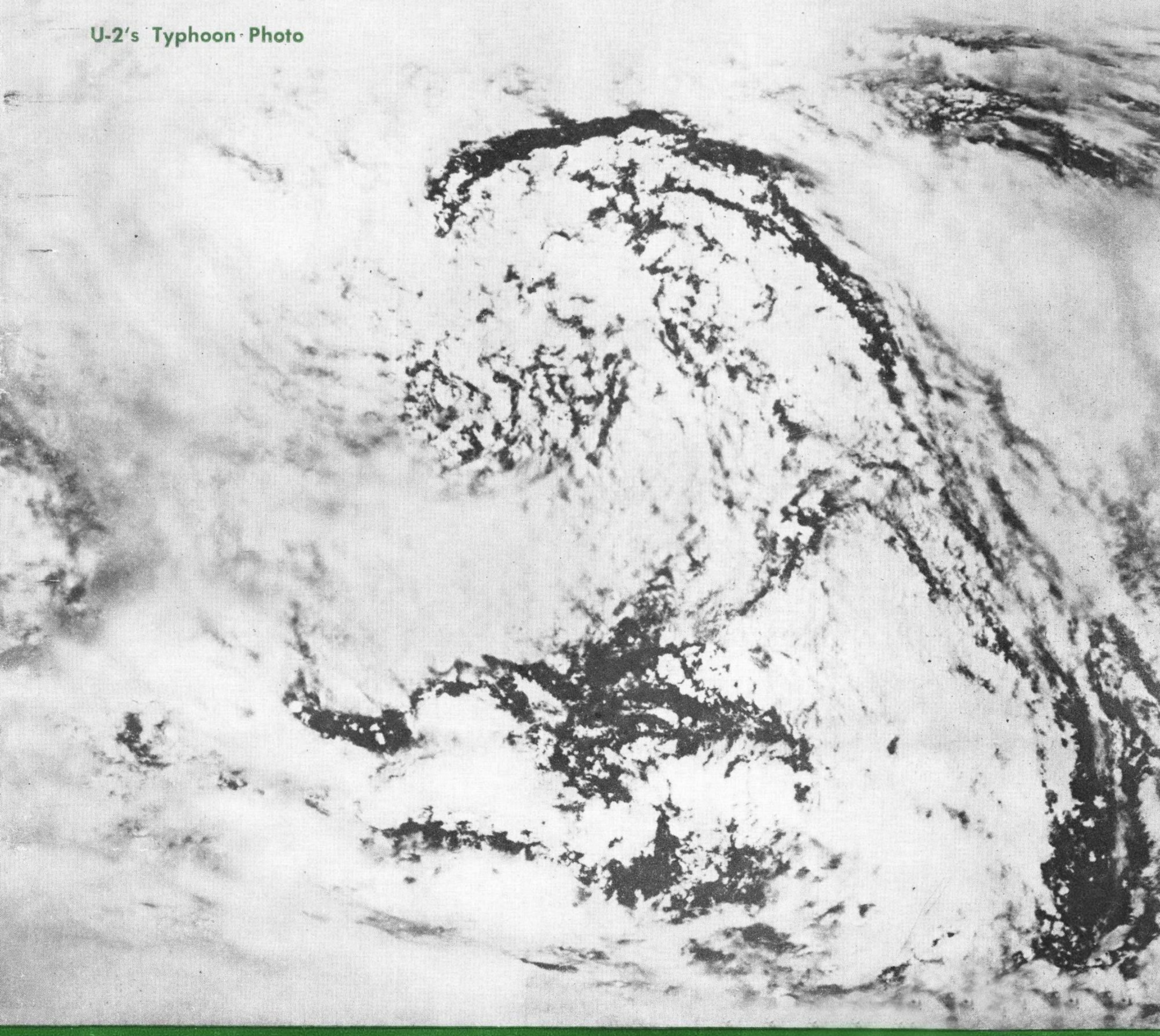
A McGraw-Hill Publication

December 15, 1958

NEW BUSINESS PLANES:

- **Piper Pawnee**
- **Cessna 310C**

U-2's Typhoon Photo



Russians Reveal Sputnik

AVIATION CALENDAR

Dec. 17—22nd Wright Brothers Lecture, Maurice Roy on French aeronautical research, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Dec. 27-30—Fifth Annual Meeting, American Astronautical Society, Hotel Statler, Washington, D. C. Meeting will be held in conjunction with the 125th Annual Meeting of the American Assn. for the Advancement of Science.

Dec. 27-30—Fifth King Orange International Model Plane Meet, Miami, Fla.

Jan. 12-14—Fifth National Symposium on Reliability and Quality Control in Electronics, Bellevue-Statler Hotel, Philadelphia, Pa.

Jan. 12-16—1959 Annual Meeting and Engineering Display, Society of Automotive Engineers, Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

Jan. 13-14—Symposium on Cathode Ray Tube Recording, sponsored by Systems Development Corp., Engineers Club, Dayton, Ohio.

Jan. 19-21—11th Annual Convention, Helicopter Assn. of America, Villa Hotel, San Mateo, Calif.

Jan. 21-23—South West Electronic Exhibit, Arizona State Fairgrounds, Phoenix, Ariz.

Jan. 26-29—27th Annual Meeting, Institute of the Aeronautical Sciences, Sheraton-Astor Hotel, New York, N. Y. Honors Night Dinner, Jan. 27.

Jan. 27-29—Fifth Annual Radar Symposium (classified), Rockham Bldg., University of Michigan, Ann Arbor, Mich.

Jan. 27-30—15th Annual Technical Conference, Society of Plastics Engineers, Hotel Commodore, New York, N. Y.

Jan. 28-29—Fifth Annual Midwest Welding Conference, sponsored by Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Feb. 3-5—14th Annual Technical and Man-

(Continued on page 6)

AVIATION WEEK Including Space Technology

December 15, 1958

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AVIATION CALENDAR

(*Continued from page 5*)

agement Conference, Reinforced Plastics Division, Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago.

Feb. 12-13—1959 Solid State Circuits Conference, sponsored by Institute of Radio Engineers' Professional Group on Circuit Theory, American Institute of Electrical Engineers' Committee on Electronics and University of Pennsylvania, Philadelphia.

Feb. 21-22—13th Annual Pacific Coast Mid-Winter Soaring Championships, Torrey Pines Gliderport, San Diego, Calif.

Feb. 26-March 1—1959 Engineering Exposition, Balboa Park, San Diego, Calif. Address inquiries to: 422 Land Title Bldg., San Diego 1, Calif.

March 3-5—1959 Western Joint Computer Conference, sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and Assn. for Computing Machinery, Fairmont Hotel, San Francisco, Calif.

March 5-6—Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Hotel Carter, Cleveland, Ohio.

March 5-7—Western Space Age Conference and Exhibit. For information: Domestic Trade Dept., Los Angeles Chamber of Commerce, 404 South Bixel St., Los Angeles 54, Calif.

March 8-11—Engineering meeting on the turbine in action, sponsored by Gas Turbine Division of the American Society of Mechanical Engineers, Cincinnati, Ohio.

March 16-20—11th Western Metal Exposition and Congress, American Society for Metals, Pan Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

March 23-26—National Convention, Institute of Radio Engineers, Coliseum and Waldorf-Astoria Hotel, New York, N. Y.

March 31-Apr. 2—Polytechnic Institute of Brooklyn's Ninth International Symposium. Subject: Millimeter Waves. Auditorium, Engineering Societies Bldg., New York, N. Y. Cosponsors: Department of Defense Research Agencies and Institute of Radio Engineers.

March 31-Apr. 3—National Acronautic Meeting, Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 5-10—1959 Nuclear Congress. Municipal Auditorium, Cleveland, Ohio. For information: Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

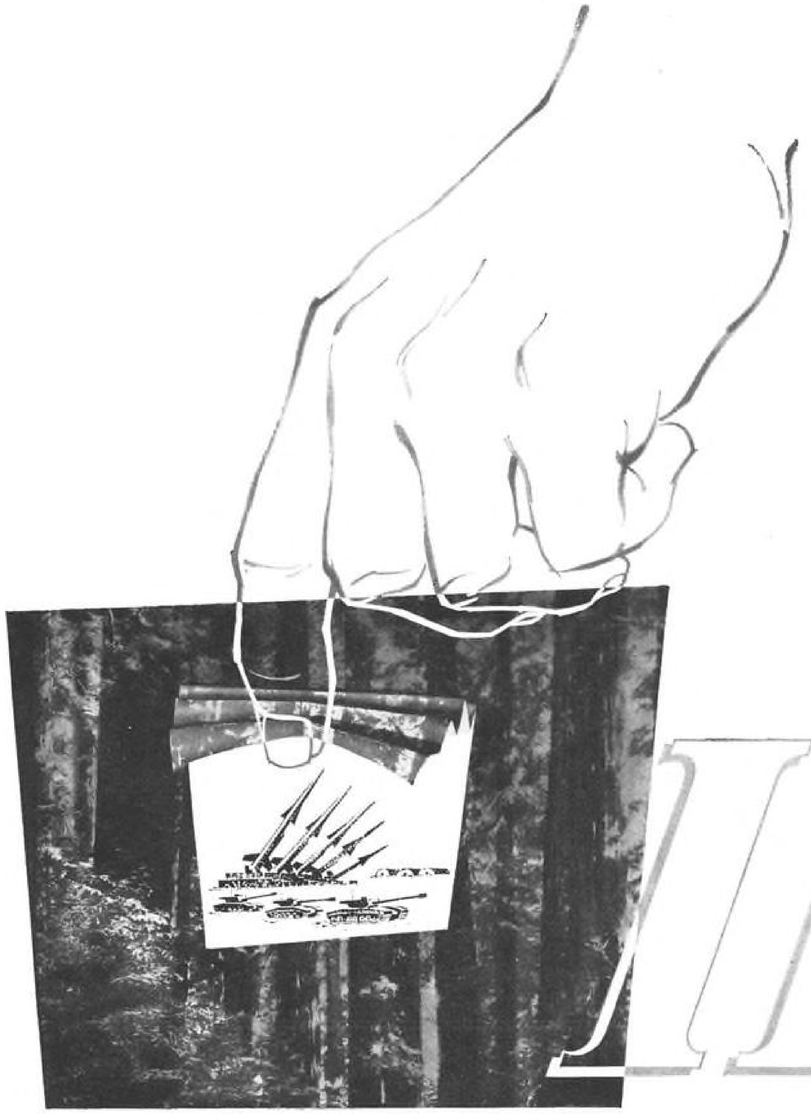
Apr. 7-10—1959 Welding Show and 40th Annual Convention, American Welding Society, International Amphitheatre and Hotel Sherman, Chicago, Ill.

Apr. 12-19—Air Force Assn.'s World Congress of Flight, Las Vegas, Nev.

May 4-6—National Aeronautical Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 4-7—Fifth Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle Section, Olympic Hotel, Seattle, Wash.

May 6-8—1959 Electronic Components Conference, Benjamin Franklin Hotel, Philadelphia, Pa. Sponsors: Institute of Radio Engineers, Electronic Industries Assn., American Institute of Electrical Engineers, West Coast Electronic Manufacturers Assn.



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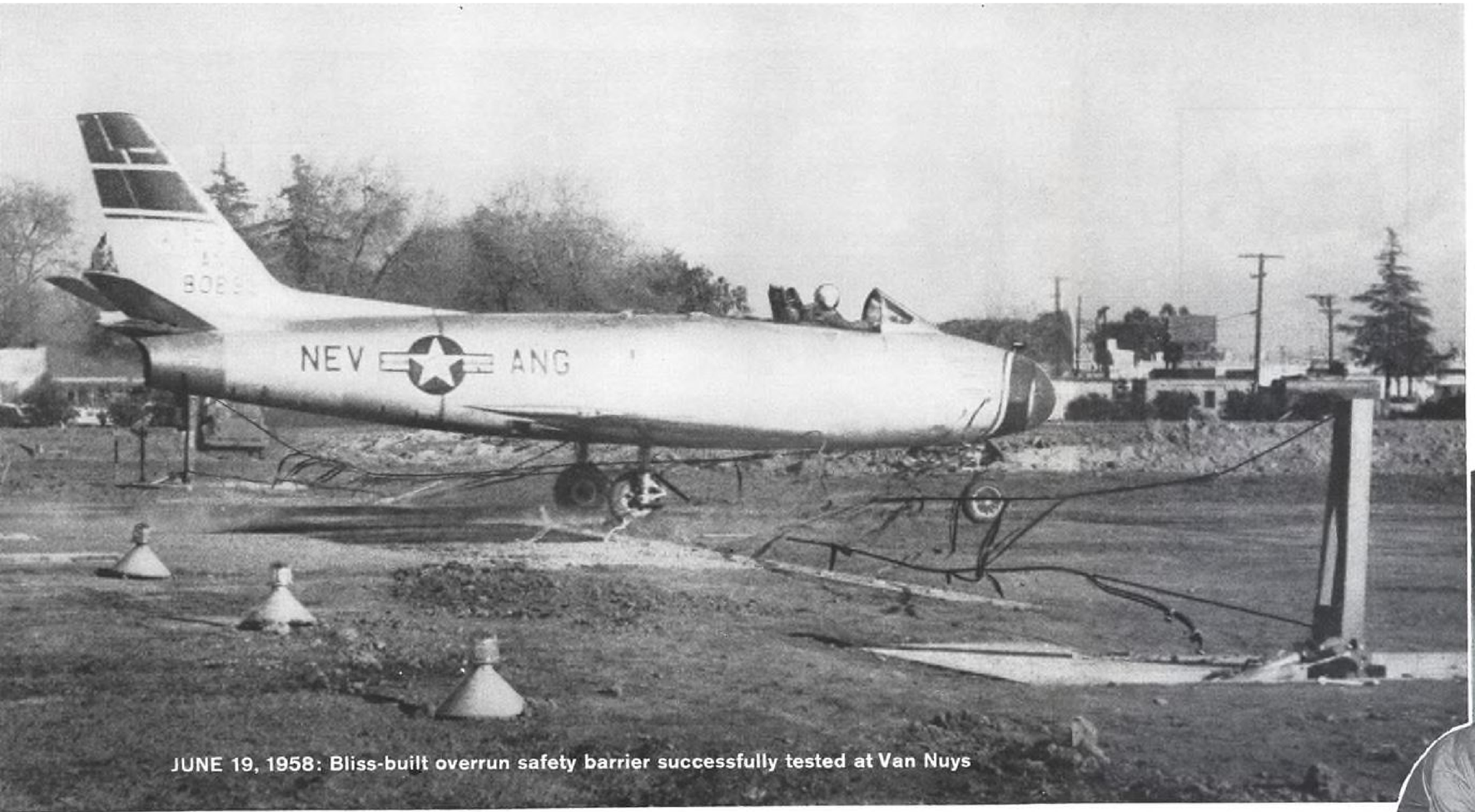

JUNE 19, 1958: Bliss-built overrun safety barrier successfully tested at Van Nuys

"A night landing... my brakes failed... and I was eating up runway at 70 mph. I engaged the barrier way off center but she held firm, bringing me to a stop two hundred feet out... just two hundred feet short of a 30-foot deep highway excavation and a steel blast fence!"

Lieutenant McGirl, pilot of the F-86 Sabre Jet, tells a member of his squadron what it is like to engage the barrier.

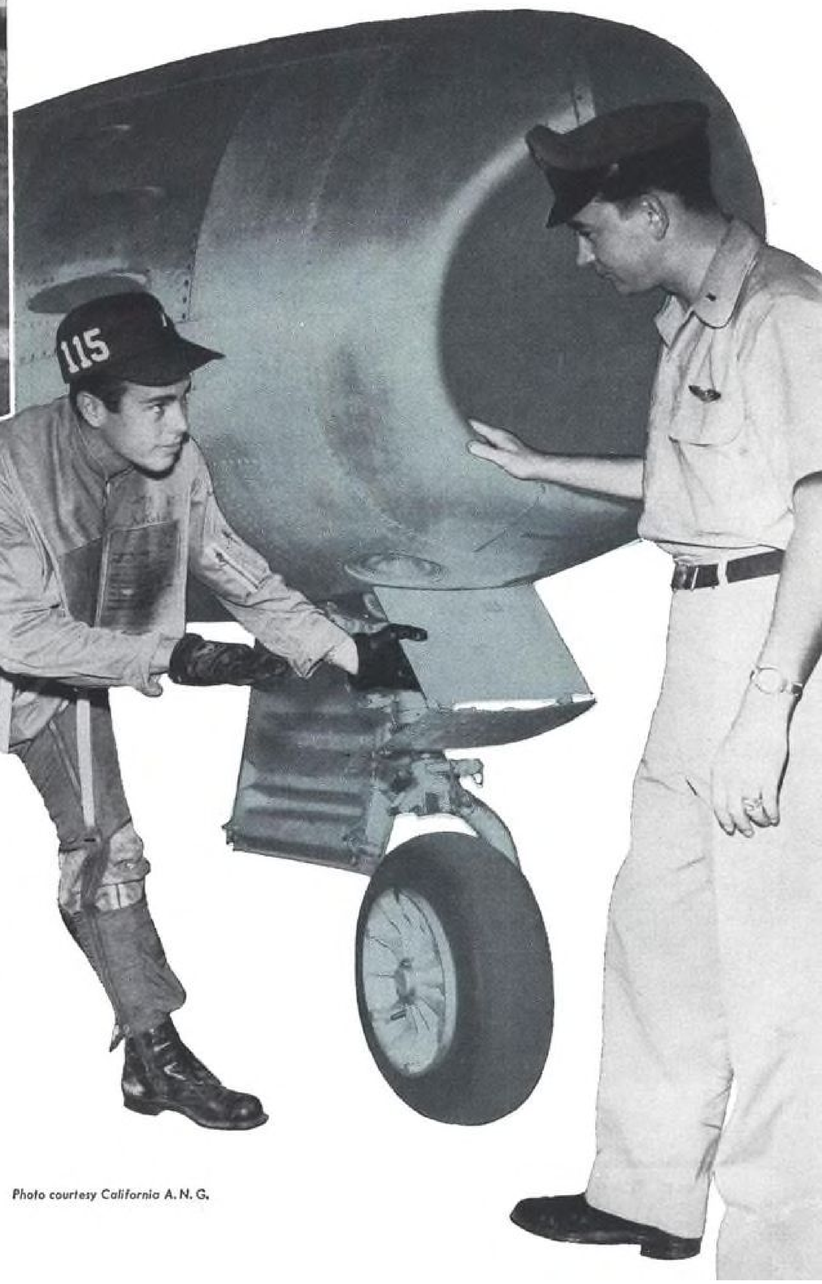

Photo courtesy California A. N. G.

SEPT. 30, 1958: Barrier snags runaway Sabre Jet—saves both pilot and plane!

This one engagement alone has saved more dollars than the entire cost of the installation!

The only type of jet arresting mechanism of its kind in use today, the Bliss Barrier was first tested at Bliss' own Woodbine Airport, then installed and tested at California Air National Guard Field at Van Nuys. During the Van Nuys tests, an F-86 hit it at 78 mph and was stopped in 191 feet. In another test, the nine-ton plane hit it at 106 mph and was halted 248 feet out. "A gentle, smooth but positive stop," said the test pilot, "like hitting a big pillow..."

But the real test came when Lt. McGirl, of the CANG made a night landing without brakes and hit the barrier off center at 70 mph! Even though extremely off center, the unique Nylon transmission belt flipped the steel cable up just right to engage the plane and pull it to a sure, straight stop without damage—just 200 feet short of a 30-foot deep highway excavation.

Bliss-built catapults are used aboard the nation's aircraft carriers. And the contributions of our engineers to arresting gear are a matter of record. It now seems likely that barriers will become basic to land-based operation, too. Not just for the military, but for commercial operations as well, where there is a problem of landing heavier, faster planes on hemmed-in runways. If you'd like to learn more about Bliss-built barriers, why not drop a line to *E. W. BLISS COMPANY*, INTERNATIONAL AIRPORT, PHILADELPHIA, PA., or to our general offices.

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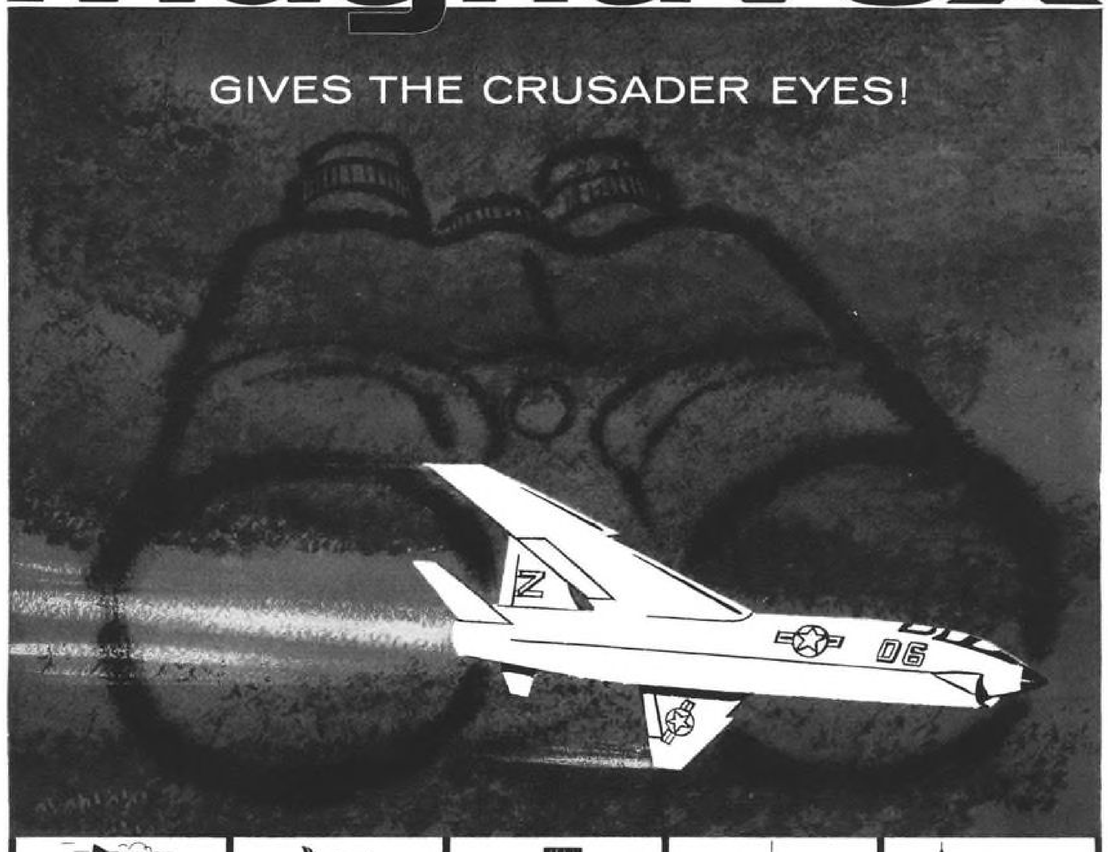

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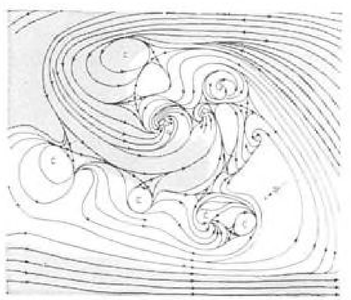

COVER: First panoramic photo of the eye of a typhoon was made from a Lockheed U-2 weather reconnaissance aircraft which flew over Typhoon Kit at about 55,000 ft. altitude north of Luzon. Horizontal analysis (left) shows nine cyclonic swirls (marked "C") within the 30 mi. wide eye; scientists also could see sea waves through holes in clouds. Cloud tops on left of photo rose to 48,000 ft. Camera was designed and built by Perkin-Elmer Corp., and has a rotating prism to wipe the image on film (AW Sept. 16, 1957, p. 76).

PICTURE CREDITS

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75,188 copies of this issue printed

EDITORIAL

A Ceiling on America?

*(We feel that the following editorial from the Washington Post and Times Herald is one of the most penetrating analyses of the problem facing this country and its future that we have seen in the public prints. Therefore, we are reprinting it in full for the benefit of our readers outside Washington—***RBH.***)*

The Administration is reported to be seeking a budget for Fiscal 1960 that may be as much as $4 billion lower than the $82 billion spending total now in sight for the present fiscal year. If such a reduction could be achieved through such means as increased efficiency, elimination of the remaining postal deficit and a reduction of the runaway farm price support program while allowing for rising defense costs, a lower budget might be considered an objective of moderation. But from all indications the net $4 billion retrenchment will involve drastic cutbacks in essential non-defense spending and repudiation of urgent and expert recommendations on defense made during the past year.

On the defense front, it is evident that Secretary McElroy has been fighting with his back to the wall for a minimum budget perhaps a scant $1 billion higher than this year's $40.8 billion, a rise sufficient only to offset inflation and to hold real spending at pre-Sputnik, 1957 levels. This compares with recommendations of the Gaither Committee and of the Rockefeller study group for a steady advance in defense expenditures over the next several years. For Fiscal 1960, these recommendations would mean at least $10 billion more than the President apparently intends to allow. Evidently there has been no relaxation of the rigid Eisenhower dictum on military spending: add nothing new until you can throw away something old.

The list of new requirements is huge, and includes many costly but vital steps to maintain the strategic deterrent in the face of Soviet missile and air defense advances. Literally billions are required to harden and disperse bomber and intercontinental missile bases, all the more important with the recent decision to limit the once ambitious plans for intermediate range ballistic missile bases in Western Europe. Much more money could be used to speed development of advanced, less vulnerable missiles employing solid fuels. To provide a stopgap supplement for the present bomber force, more supersonic, rocket-bearing bombers and some of the more advanced air-breathing missiles should be high priority items. Surely the Polaris submarine program ought to be accelerated at least to the level provided for by Congress but cut back partly in the interest of economizing. The badly confused and inadequate continental air defense and warning system needs a modernization and revamping on a vast scale.

There is little to throw away—certainly nothing that compares in cost with the new weapons. The capability for fighting limited wars has eroded steadily, until now, with the extensive manpower cuts, there is more than ever a need to replace vintage Army equipment with modern rifles, tanks and tactical atomic weapons. Adequate air lift capacity long has been neglected. Of course to the extent that the economy campaign forced the timely abandonment of obsolete missiles and other programs it could be useful; but if these savings were merely pocketed and not diverted to more promising projects, the steady attrition of American military power would be assured.

Why the rigid determination to avoid any increase in defense spending, whatever the needs? The Committee for Economic Development, anything but radical in its general outlook, has declared:

"The risk that defense spending of from 10 to 15% of the gross national product or, if necessary even more, will ruin the American way of life is light indeed. . . . We have not reached a point at which anxiety over the healthy functioning of the economy demands that defense expenditures be slashed regardless of the dictates of military prudence. We can afford what we have to afford."

Currently the military budget is less than 10% of the national product, and with reasonable progress toward full employment in the coming year, the figure might be 9% by the time the President's Spartan budget takes effect. By the end of the next fiscal year, a $42 billion defense budget could well be little more than half the size that the CED suggests would be virtually riskless as far as its general economic impact is concerned. What, then, is the President afraid of? Merely of the tax increases—or reforms in the tax structure—that might be necessary to divert this modest portion of the national product better to insure our survival?

There are some tricks by which a lower budget could be presented in January and the Democratic Congress be thus obliged to fill in the missing items and take the "blame" for continuing deficits. We trust that the Administration is above that sort of foolishness. Even with spending held to $78 billion, it would be unrealistic to submit a balanced budget, a hope to which the President reportedly has been clinging. This would require a $10 billion spurt in tax receipts over this year's anticipated $68 billion and a much faster rate of recovery than is suggested by lagging employment and other economic indicators.

Instead of trying to operate at or near the present income ceiling and all but wreck vital federal programs, the Administration ought to lift its sights to the longer-term outlook. With some broadening and improvement of the present tax structure, perhaps in part along the lines suggested in two sensible speeches in New York the other day by Chairman Wilbur Mills of the House Ways and Means Committee, and with a firm dedication to defense and domestic spending programs adequate to meet national needs, the nation might soon achieve an annual growth rate of 4 or even 5%. This would produce enough revenue to get the budget back in balance at a considerably higher, adequate level, in two or three years; and that should be soon enough.

Since 1947, the government has run a net cash surplus of about $5 billion, even allowing for this year's big deficit. A year-by-year balance is not critically important, and a deficit of a few billions in the next two years would have a relatively minor inflationary effect that could be offset in other ways.

Why court military catastrophe? Why deny the nation the federal services it wants and requires? Why make today's tax receipts the measures of tomorrow's opportunities? The United States of America and its people are worthy of a better vision, a stronger leadership, a nobler goal.

WHO'S WHERE

In the Front Office

I. E. Weston, board chairman and chief executive officer, Weston Hydraulics, Ltd., a subsidiary of Borg-Warner Corp., North Hollywood, Calif. **Fred O. Hosterman** succeeds Mr. Weston as president and general manager; **A. E. Shumate** succeeds Mr. Hosterman as executive vice president and continues as assistant general manager.

H. G. Taylor, board chairman, Precision Rubber Products Corp., Dayton, Ohio. **R. E. Allen** succeeds Mr. Taylor as president, and **W. A. Smith** succeeds Mr. Allen as vice president.

John F. Cain, a director and also general manager, Greer Hydraulics, Inc., Jamaica, N. Y.

John Hilldring, board chairman, General Aniline & Film Corp., New York, N. Y. **Philip M. Dinkins** succeeds Mr. Hilldring as president.

Ellis D. Slater, board chairman, Emery Air Freight Corp. **John C. Emery,** president, continues as chief executive officer.

Karl J. Springer, president and managing director, Pacific Western Airlines Ltd. Also: **R. H. Laidman,** vice president and general manager, and **D. D. McLaren,** executive vice president.

Datagraphic Systems, Inc., Santa Monica, Calif., a jointly-owned new business enterprise of Douglas Aircraft Co. and the Ozalid Division of General Aniline and Film Corp., has named **Russel A. Ellsworth** as general manager. The following were named as the board of directors: **Mr. Ellsworth, J. Edwin Coates, Matthew M. Gouger, Walter A. Hensel, James T. McMillan, Francis Nivens** and **George Schoner.**

V. C. Horner, vice president and general manager, BJ Electronics, Borg-Warner Corp., Santa Ana, Calif.

R. S. Strickland, vice president-general manager, and **R. E. Klare,** vice president-operations, Bearing Divisions of Federal-Mogul-Bower Bearings, Inc., Detroit, Mich. Also: **R. W. Muzzy,** general manager of the Federal-Mogul Division.

Ward W. Beman, vice president-research and development, Telecomputing Corp., Los Angeles, Calif. **Joseph Kleiman** succeeds Mr. Beman as vice president-general manager of Telecomputing's Whittaker Gyro Division.

Dr. Carl E. Barnes, vice president-research, Minnesota Mining & Manufacturing Co., St. Paul, Minn.

J. A. McIlnay, vice president-marketing, The Electric Storage Battery Co., Philadelphia, Pa. **Owen R. Slauson** succeeds Mr. McIlnay as vice president-domestic sales, Ray-O-Vac Co., a division of Electric Storage Battery, Madison, Wisc.

Linwood L. Leftwich, vice president, Feedback Controls, Inc., Waltham, Mass.

John Ryan MacKenzie, Chief, Office of Legislative Liaison, Federal Aviation Agency, Washington, D. C.

William J. Patterson, comptroller, Ford Instrument Co., a division of Sperry Rand Corp., Long Island City, N. Y.

Arthur A. Varela, vice president-director research, Aero Geo Astro Corp., Alexandria.

(*Continued on page 109*)

INDUSTRY OBSERVER

► Pentagon's Advanced Research Projects Agency is expected to award a contract to Convair this week for its Centaur project using an Atlas missile booster plus Pratt & Whitney liquid hydrogen fueled rocket (AW Nov. 10, p. 26) as a second stage to put a manned capsule into orbit. Krafft Ehricke of Convair probably will head the project team.

► **Two avionic companies, Radio Corp. of America and Hughes Aircraft Co., submitted bids last week in competition with Boeing, Convair, Douglas and Lockheed for Air Force's new early warning and control aircraft contract designated Weapon System 214-L. If RCA wins, it will use a Douglas airframe; Hughes partner is not known. Another unusual twist is that Convair proposes to manage avionic subsystem development itself if it wins the contract but will use the CL-44 airframe made by Canadair, a sister division of General Dynamics Corp. Thompson Ramo Wooldridge is avionics manager for Boeing's proposal, General Electric for Douglas, while Lockheed proposes to handle both airframe and avionics management.**

► Air Force is moving to accelerate its evaluation of proposals and reduce the cost of preparing them by limiting the maximum number of pages that can be submitted. Bids for USAF's new airborne early warning and control aircraft, limited to 50 pages each, normally would have run from 500 to 2,000 pages. Rome Air Development Center was one of the first to try the new policy which has been favorably received by industry as well as military evaluators.

► **Army's Mauler anti-aircraft missile program is entering its final competitive design phase prior to weapon system development contract award. General Electric, Martin, Sperry and Convair have made specific system proposals for a field-portable missile requirement to Army Ballistic Missile Agency at Redstone Arsenal.**

► Dyna-Soar concept being worked on by the Boeing Airplane Co. team is based on use of solid rockets to boost the glide vehicle into orbit. Martin Co.'s team is planning its Dyna-Soar around use of the liquid-propellant Titan intercontinental missile. Aerojet-General Corp. is propulsion contractor on the Boeing team and also on the Titan.

► **Guidance for Navy's Eagle long-range air-to-air missile will be provided by Sanders Associates, Nashua, N. H. System is believed to be new coherent pulse-Doppler radar which is capable of extremely high target resolution.**

► Promising new technique for ICBM detection designated Project Pin Cushion probably will be funded soon by the Advanced Research Projects Agency.

► **Strategic Air Command will install new Collins Radio Co. control system which will enable the SAC commander to use a dial telephone to select any one of many remote site transmitters, optimum frequency and antenna orientation for direct radio contact with in-flight aircraft. Radio transmitter sites may be located hundreds of miles away.**

► Marquardt Aircraft Co. recently flew a ramjet engine using hydrogen as fuel. Fuel was carried in gaseous state under high pressure rather than in liquid cryogenic condition. Engine probably was standard 28-in. ramjet which powers the Boeing Bomarc. Another Marquardt ramjet engine using HEF-3 exotic fuel was flown on a Lockheed airframe at about the same time General Electric was flying a J79 with afterburner modified for and using the same exotic fuel (AW Nov. 24, p. 23). Marquardt also is again experimenting with hydrogen and hydrogen compounds as fuels for rocket engines.

► **Air Force is now firing Thor intermediate range ballistic missiles from Cape Canaveral, Fla., under simulated operational conditions. In the shots, the missiles are being launched "dry" from pad slabs without water cooling for flame deflection such as that provided in test firings.**

Washington Roundup

CIA Technical Shakeup

Central Intelligence Agency is shaking up its technical evaluation section as a result of military criticism of its work on Soviet missile and aircraft development in recent years. Military services have complained that CIA has misinterpreted and watered down technical intelligence data submitted to it in the reports it distributes to top-level government officials. Biggest sore spot has been the treatment of raw data on Soviet missile test activities gathered by the U.S. technical monitoring network using radar, infrared and other techniques. Long lag between the time raw data is submitted and CIA reports reach top-level officials also has been subject to criticism.

ICBM Fund Battle

Bitter battle is being fought in the Pentagon over continuing the Martin Titan intercontinental ballistic missile development program in the Fiscal 1960 budget. At stake is about $280 million in Air Force Fiscal 1960 funds. Defense Secretary McElroy and his deputy Donald Quarles are linked with presidential scientific adviser James Killian in a campaign to eliminate Titan and concentrate on the Convair Atlas ICBM as the principal weapon in this category. USAF air staff is supporting the Defense Department position with opposition coming from Air Force Secretary James Douglas, the Ballistic Missiles Division of ARDC headed by Maj. Gen. Bernard Schriever; Space Technology Laboratories, Inc., BMD's technical advisers, and Richard Horner, USAF assistant secretary for research and development.

USAF is now considering a proposal to delay operational capability of its solid-propellant Minuteman program by as much as two years to make room for Titan as an operational weapon. Rand Corp. recently submitted an ICBM study supporting expanded Atlas program and recommending elimination of the Titan, originally planned as a back-up program in case Atlas failed to meet operational requirements.

Humphrey Reports

Sen. Hubert H. Humphrey (D.-Minn.), after an eight-hour visit with Soviet Premier Khrushchev in Moscow, reported to the State Department and the President last week that Russia has an 8,700-mi. ballistic missile, a five-megaton bomb, a hydrogen bomb that is 95% clean and a hydrogen and atomic bomb stock pile that is larger than its actual operational needs. The long-range ballistic missile, Khrushchev told Humphrey, is being static tested by Soviet technicians but has not been flight tested since there is no test range in the USSR long enough to accommodate it.

Later, the President showed little concern over the report, pointing to U.S. accomplishments in similar fields. In response to a press conference question asking if Humphrey had given him such a report and how he evaluated it in relation to U.S. achievements, the President replied:

"Well, first of all, following my usual practice, I would not repeat the details of any conversation with anyone who had come to my office for a personal or confidential mission.

"Now, I do know, and have seen these reports, as a matter of fact, I saw it in a headline this morning, an 8,500-mi. missile—I would know no reason whatsoever why this could not be done.

"We know that they have a very fine technique, and we know also they have exploded bombs of over a megaton in size.

"We have done the same. We have also successfully tested an intercontinental ballistic missile of sufficient range and, therefore, I would know no reason to attempt to refute any statement that you have seen in the paper of this kind."

Nuclear Projects

Joint Congressional Atomic Energy Committee during the coming session will focus on the small nuclear weapons program, plans to survey plutonium supply available for production. Other projects:

- **Committee will scrutinize the funding** for Project Pluto nuclear ramjet project in particular (AW Oct. 13, p. 33). Members report the project has substantial opposition at the Bureau of the Budget level which would like to give it a very low priority.
- **Deputy Defense Secretary Donald Quarles** probably will be asked to testify before the group by the end of January on the U.S. nuclear aircraft project, if he does not volunteer testimony beforehand. Last March, when Quarles presented the President's rejection of a "fly early" program at a session of the committee, he assured the group that there would be a re-evaluation within a few months (AW Mar. 17, p. 26), commenting at that time that "the Soviets . . . might seek to obtain propaganda value by demonstrating manned nuclear aircraft flight even though in doing so they abandoned military utility as an objective."
- **Committee's staff is now making** a study of the effects of budget limitations on the research and development and production programs of Atomic Energy Commission. A report on the findings is scheduled for March 1.

FAA Consolidates Research

Federal Aviation Agency made a long anticipated move last week and announced the consolidation of all existing research and development functions within the recently established Bureau of Research and Development and the transfer of Civil Aeronautics Administration's Technical Development Center at Indianapolis, Ind., to the agency's R&D testing center at Atlantic City, N. J. Complete transfer of all TDC functions and personnel is expected to be completed by June 30. FAA will retain its lease on the Indianapolis buildings pending a final study on their possible use. E. R. Quesada, FAA administrator, feels that the consolidation of functions and transfer of facilities will aid agency's budgetary problems, speed its five-year plan of air traffic control improvement.

Job Review

Meanwhile, review and evaluation of candidates for top-level positions in the Federal Aviation Agency will begin tomorrow when a three-man advisory group meets here to consider individuals recommended for the posts by approximately 100 different industry and business organizations. Advisory council will make its recommendations for the jobs to FAA Administrator Quesada when the evaluation study has been completed.

—Washington staff

Space Technology

Manned Satellite Test Plans Detailed

NASA now evaluating booster vehicle configurations submitted in competition between about 20 bidders.

Washington — First programmed rocket firings to prepare for placing a manned satellite in orbit will be initiated by the National Aeronautics and Space Administration within six months at NASA's Pilotless Aircraft Research Station at Wallops Island, Va.

Booster vehicle configurations and related data to start the program are now being evaluated by NASA's Langley, Va., Research Center in a competition involving about 20 bidders.

Broad aim of the development test project is to push initial research which ultimately will lead to the determination of man's ability to function in regimes associated with launch into space, environment of space and reentry to the earth's atmosphere.

General aspects of the preparational program for manned orbiting are:

• **Full-scale capsule models** incorporating realistic shape and sophisticated structure will be used to meet conditions and objectives of the development program.

• **Capsule will not be manned** during any of the development tests conducted with the basic Sergeant-Recruit-T55 retrorocket solid-propellant booster propulsion system that will be used to kick off the program. Program will involve at least six firings with this booster, which will be known as a transport vehicle for the satellite capsule.

• **Rocket flight tests** also will include components of the manned capsule.

• **Aerodynamic stability,** load measurement and heating phenomena data will be developed.

• **As the program is accelerated,** test conditions will become increasingly severe by adapting more powerful propulsion systems until the maximum anticipated conditions will be imposed on the capsule. Conceivably, the program would lead to an ultimate phase which would use a booster approximating the operational configuration together with a capsule that would carry a man on an initial venture into space.

• **Tests will begin with the satellite** capsule transport vehicle (booster) which will be comprised of a cluster of solid propellant rockets, unguided but aerodynamically stable.

• **NASA's bid requirements** specified the need for seven transport vehicles and one launcher. One of the seven boosters will be used for type approval; the other six will be used as transports.

• **Bidders in the competition** to supply the initial transport vehicle have been limited to a cylindrical body configuration incorporating four main improved Sergeant rocket motors, four auxiliary Recruit rocket motors and four T55, or equivalent, retrorockets. A clustered configuration of this type would be between 6 and 7 ft. in diameter.

• **Firing sequence will start** with ignition of two diametrically opposed Sergeants in the cluster. The four auxiliary Recruit rockets will then fire within one second. Remaining two Sergeants will be ignited during the final thrust period of the first two Sergeants fired. Four retrorockets will be fired together to separate the satellite capsule from the booster. A destruct provision will be included.

• **Launcher will be powered** to supply a change in elevation from 90 to 70 deg. and to give 90 deg. of horizontal action. Simplicity of the handling scheme will permit conventional cranes to place transport vehicles into position on the launcher. While the launch probably will not be made under wind conditions exceeding 15 kt., NASA specifications indicate that the transport vehicle during assembly on the launcher may encounter squall gusts of up to 60 kt.

• **Timetable will require** the successful bidder to supply NASA with an engineering layout and preliminary load analysis of booster and launcher within two months after the contract is awarded. Launcher will have to be delivered within 100 days after the contract award.

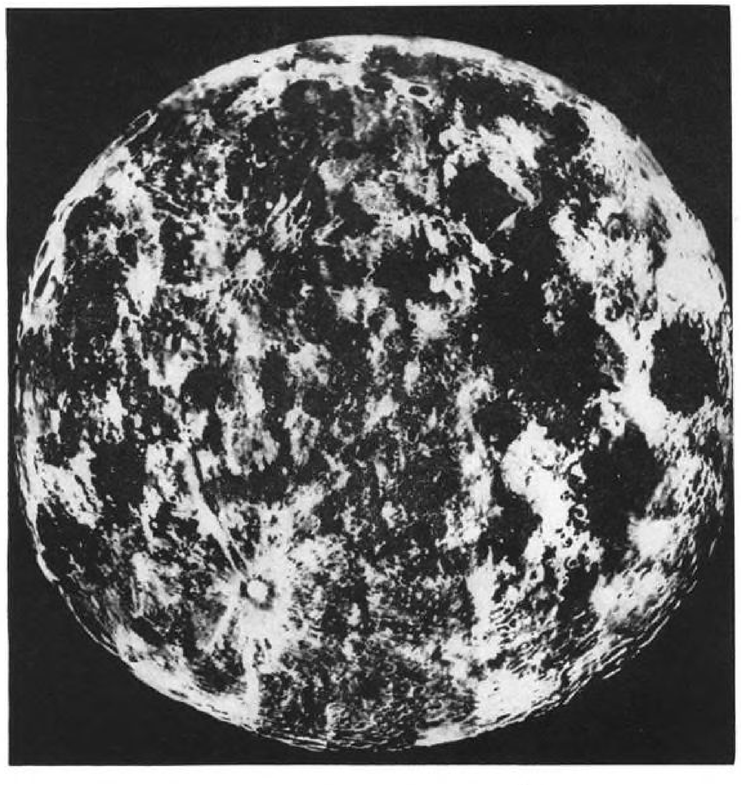
• **First unit will be required** to pass acceptance test within 120 days after the contract award, and the remaining six units will be required approximately three weeks thereafter.

NASA has required that the winner of the contract to make the manned satellite capsule for the Man-in-Space program must plan on delivering the first complete system within nine months of contract data. Bidders on the contract delivered proposals last week. The manned capsule contractor will also be responsible for mating the vehicle with its Atlas-D booster.

Rocket motors and other equipment will not be jettisoned during or at end of boost phase; transport vehicle remains intact during entire flight.

NASA is using this transport vehicle for the preparational phase leading to the manned satellite program, because it is an inexpensive way of accumulating data and using off-the-shelf propulsion units. The capsule model used with the transport vehicle might come from the capsule contractor or be constructed by NASA technicians. Tunnel tests undoubtedly will be conducted in NASA facilities to correlate this data with actual firing trials.

Operational schedules at Wallops Island for the firings in the preparational phase leading to the manned satellite capsule will probably require assembly of the transport vehicle in all kinds of weather.



ARDC Moon Photo

Moon's surface appears much rougher in composite photograph taken with Air Research and Development Command's "Cat-Eye" electronic light-amplifying system (left) than in ordinary photo (right). "Cat-Eye," conceived by Radames K. H. Gebel of Wright Air Development Center's Aeronautical Research Laboratory, has sensitivity more than 1,000 times greater than television camera, is 10,000 times faster than best film. System is coupled with 10-in. refracting telescope.

NASA Satellite Plans

Washington—Eight more Juno II vehicles will be used for satellite shots in 1959-1960 and eight to 10 Redstones will be used for sounding rocket tests in connection with the Man-in-Space program. Negotiations also are under way for several Atlases for use in the Man-in-Space program. In addition to these, at least two more Thor-Ables and four Vanguards are to be fired in the next few months for space research.

Western Bloc Pushes Anti-Missile Scheme at 'Surprise Attack' Meet

By David A. Anderton

Geneva—Roughed-out characteristics of an anti-missile system have been presented by Western experts as part of their over-all argument in the 'surprise attack' conference here.

Specifically, the Western anti-missile system presupposes that the striking weapon is a large number of land-based intermediate or intercontinental range ballistic missiles, requiring considerable logistical preparation and launched in salvos. Detection schemes would be applied to both pre-launch and in-flight conditions near the site.

Proposed system was cited as only one illustrative possibility and was not to be considered as a prototype of any workable system. It would use all current detection techniques ranging from human observers with binoculars through mobile teams for ground and aerial inspection to infra-red and radar means. Data from detectors would be fed into a complex computer system to determine the magnitude and direction of the attack and to alert the recipient, in time for retaliation.

Basic difficulties probably trace to a misunderstanding by either the Russians or the United States at a political level well above that of the meeting here. The U.S. went into the meeting on the stated assumption that disarmament measures were out of the scope of the conference, and that the meeting was to be at a technical level.

The Russians sent a political team instead of a technical one, and have so far refused to separate broad political schemes from detailed techniques of detection and prevention of attack.

Three specific illustrative proposals have been submitted by the United States on behalf of the Western group of Canada, Great Britain, France, Italy and the U.S. Each dealt with a possible method to detect and to prevent a surprise attack; the first covered long-range aircraft as the weapon, the second considered ballistic missiles, and the third, ground troops.

The Russians have made no response to any of these specific recommendations, but have countered with a version of the 'open skies' scheme which the Western bloc says leaves much to be desired.

Heading the U.S. team is former Deputy Secretary of Defense William C. Foster, who was acting chairman of the panel which produced the now-famous and still-hidden Gaither Report. With Foster are Dr. George B. Kistiakowsky, a member of the President's Science Advisory Committee, and Gen. Otto P. Weyland, commander of Tactical Air Command.

Communist delegation is headed by V. V. Kuznetsov, first deputy minister for foreign affairs of the USSR. Other delegates are from Poland, Czechoslovakia, Rumania and Albania.

Eisenhower's Nuclear Bomber Comment

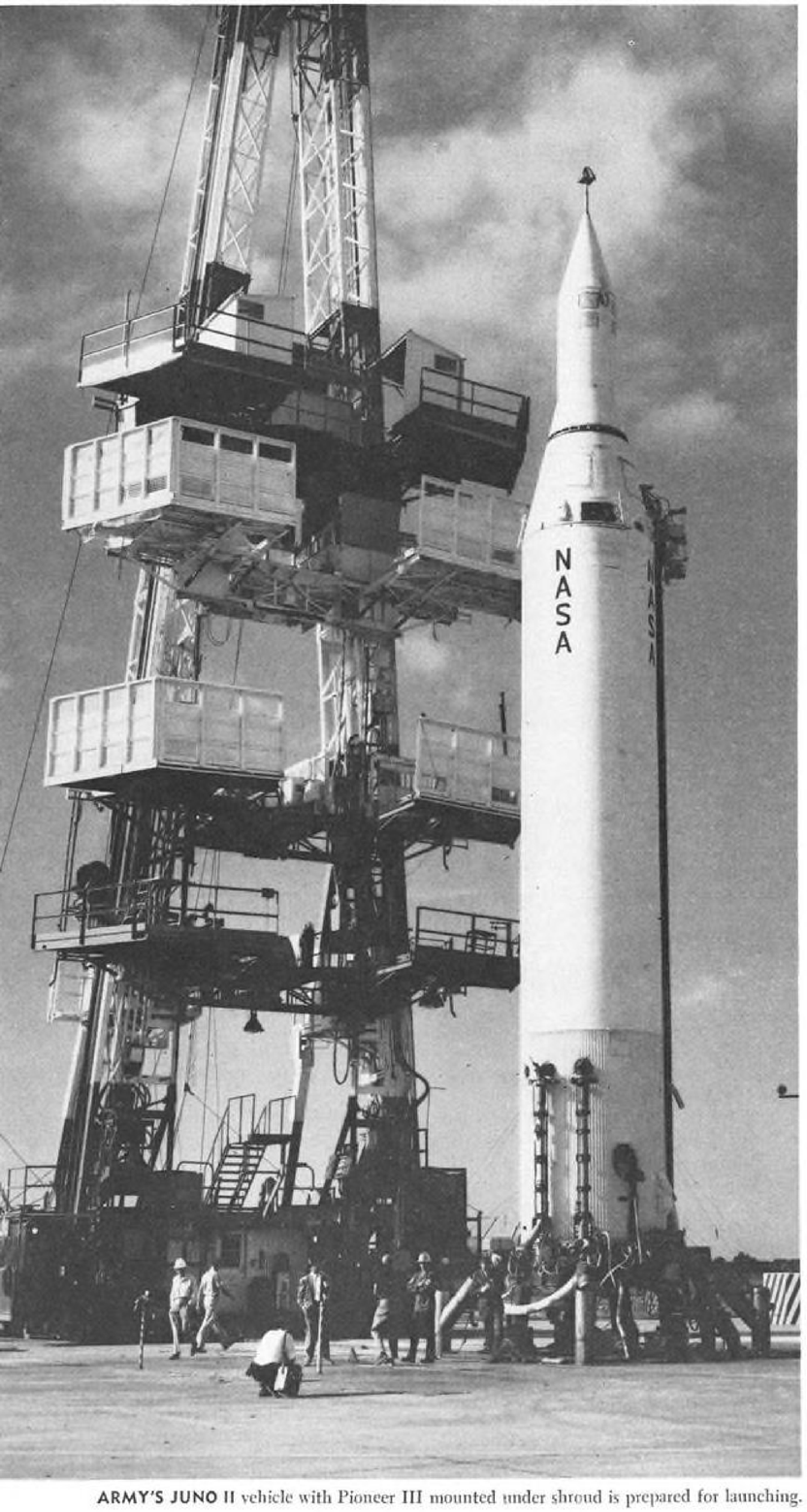
Washington—Here are President Eisenhower's comments on the exclusive Aviation Week report of Dec. 1 (p. 26) detailing initial Soviet test flights of a nuclear-powered aircraft. The remarks were made during a Presidential press conference:

• Merriman Smith, United Press International: "Mr. President . . . we hear from time to time of rather startling advances that have been made by the Russians, sometimes not officially. A recent report had to do with the Russians test-flying a nuclear-powered plane.

"First, I would like to ask you, do we have any reason to believe such a report and, second, how you feel generally about these unofficial reports of rather extensive Russian accomplishments?"

• President Eisenhower: "Well, there is absolutely no intelligence, no reliable evidence of any kind, that indicates that the Soviets have flown a nuclear-powered airplane, and I think to show why I discount it, even if there were some piece of evidence along the line, there has been the experience of our own technicians.

"I think our own scientists believe that if you merely wanted to get an airframe off the ground with a nuclear-powered unit of nuclear power, you could possibly do it. But in the present state of the art and of science, there is no usefulness that anyone could possibly see for such a plane and, therefore, our own research efforts have been developed toward the production of a model of an airplane that will have satisfactory performance characteristics, either for some peaceful or a military purpose, but we do not abandon the basic research on the power plant and its, you might say, transmission, which is the basis of the whole thing. And we just merely say that there is no use of going into a field where the whole purpose would be to get a plane a few hundred feet off the ground."



ARMY'S JUNO II vehicle with Pioneer III mounted under shroud is prepared for launching.

LAUNCH of Pioneer III came only 12 sec. past target time of 12:45 a.m. EST Dec. 6.

Radiation Belt

By Evert Clark

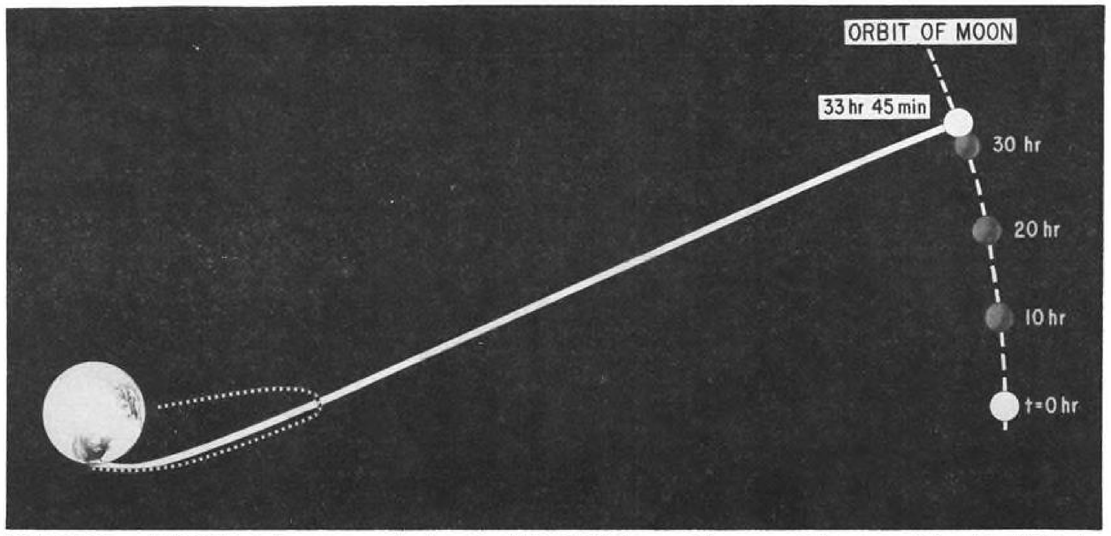
Cape Canaveral, Fla.—Army's Pioneer III lunar probe made two long instrumented passes through the radiation belt surrounding the earth and provided the most extensive survey thus far of the belt's extent and intensity on a 38 hr. 6 min. trip that carried it 66,654 mi. into space.

Although the probe failed to pass the moon and travel into a solar orbit as it was intended to do, it provided telemetry data for about 25 hr. of its trip and apparently penetrated far enough into space to define the belt and confirm beliefs that its maximum intensity is reached at no more than 20,000 mi. altitude.

Pioneer III was launched only 12 sec. after its target time of 12:45 a.m. EST Dec. 6. It traveled an elliptical path and burned on re-entry into the earth's atmosphere over French Equatorial Africa at an estimated time of 2:51 p.m. EST Dec. 7. Estimated re-entry point was 16.4 deg. N. latitude and 18.6 deg. E. longitude.

Juno II launching vehicle, consisting of a modified Jupiter intermediate range missile booster and three solid propellant upper stages almost identical to those used in the Jupiter-C Explorer satellite launchers, produced two errors that caused the faulty trajectory.

Injection angle was to have been 68 deg. from the vertical. Actual angle was about 71 deg. to 71.5 deg. Desired velocity at burnout was about 36,537 fps., which was about 525 fps. above



PIONEER III traveled 66,654 mi. into space, passing through radiation belt twice, providing survey of its extent and intensity. Flight time was 38 hr. 6 min. Proper trajectory would have carried probe across moon's orbital path in 33 hr. 45 min.

Explored by Army's Pioneer III Probe

escape velocity for the planned burnout altitude of 138.6 mi. But a depletion of one propellant 3.7 sec. too early caused a deficiency in velocity of approximately 1,037 fps.

Proper trajectory and velocity would have carried Pioneer III to a point coincident with the moon's orbital path in about 33 hr. 45 min. Since this was the first firing of a lighter Jupiter with an extended burning time, which meant higher acceleration near burnout, new problems of fuel mixture ratio control were raised.

Head suppression valve in the fuel line, designed to ensure that fuel pressure did not become excessive under higher accelerations, may require a different setting in later shots, according to Dr. Wernher von Braun, head of the Army Ballistic Missile Agency project team.

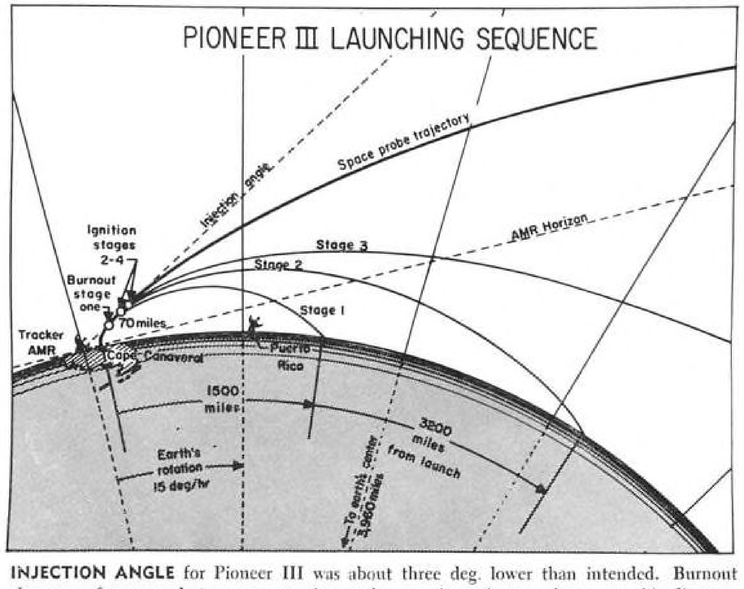
First indications did not reveal whether RP-1 fuel or the liquid oxygen was depleted too rapidly. Spherical gas generator of more than 2,500 hp. uses main propellants to drive a turbine that runs twin pumps. These force fuel and oxidizer through the Rocketdyne engine at flow rates of approximately 4,400 gal./min.

Normal burning time of 157 sec. was extended to about 180 sec. in planning this launching.

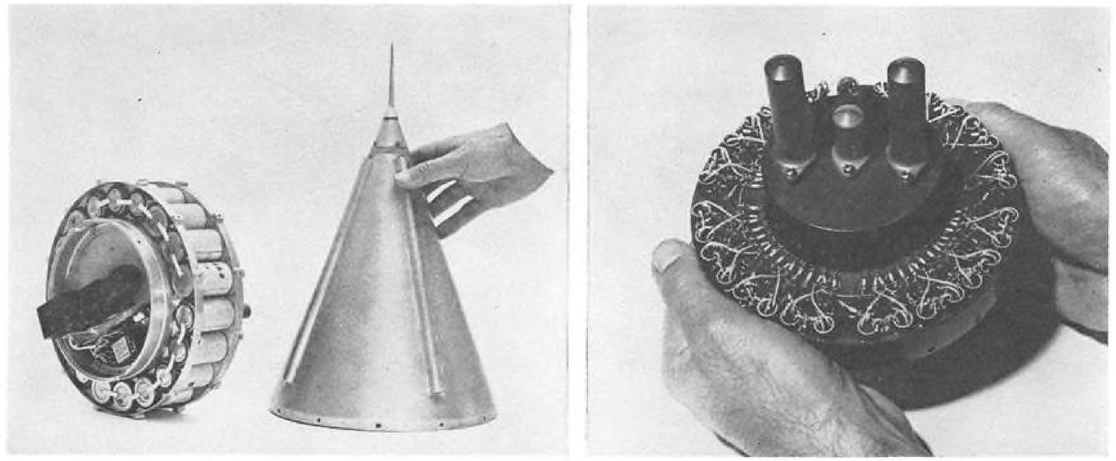
Pioneer III was launched under the direction of the National Aeronautics and Space Administration as an International Geophysical Year project. ABMA and NASA's newly acquired Jet Propulsion Laboratory designed the vehicle (see story on page 29). Striped white paint pattern on the gold-washed, 12.95 lb., 23-in. conical probe was designed to control temperature between 10 and 50C. Telemetry showed that the temperature reached 43C (100F) shortly after the launch and remained there.

Tracking during the initial period was done by four ABMA stations at Army's Ballistic Research Laboratory, Aberdeen, Md.; Ft. Stewart, Ga.; ABMA's installation at Air Force Missile Test Center here, and Miami, Fla.

About five minutes after launch, a JPL station at Mayaguez, Puerto Rico, designed and built by Collins Radio Co., picked it up. Once the probe rose above the California radio horizon about six hours after launch, it was to have been tracked for the next 12 hr. by a special 85-ft. parabolic antenna built atop a 110 ft. tower at Camp Irwin. Goldstone was to lose the



INJECTION ANGLE for Pioneer III was about three deg. lower than intended. Burnout also came few seconds too soon, causing probe to miss trajectory shown on this diagram.



GLASS FIBER PROBE and tip acted as antenna for Pioneer III (left). Photoelectric sensor beneath ring of batteries was tested as trigger for future scanning devices. At right, Geiger-Mueller tubes for measuring corpuscular radiation flank voltage supply tube.

probe at about 16-17 hr. after launch.

A "blackout" of approximately 12 hr. in tracking was expected if the probe had followed the proper trajectory, because of the location of the two tracking stations. Actually, the blackout time was some 10-13 hr.

Both the 108 megacycle frequency used in Vanguard and Explorer satellites and earlier Pioneers, and the 960.05 megacycles used by Pioneer III are interim assignments and other frequencies may be chosen for later shots.

Part of the Air Force tracking network used for Pioneer I and II shots was to have been used as an informal back-up, even though this required modification, since USAF had used 108 mc. USAF stations at Millstone Hill, Mass.; Manchester, Eng., and in Hawaii were provided with nominal trajectories.

When the probe did not follow that trajectory, stations attempted to pick up actual trajectory. Millstone Hill tracked the probe briefly but obtained no data. Manchester tracked it for a portion of the flight but suffered a temporary equipment failure.

Question of what frequencies and what stations will be used in future tracking is unsettled, but it is known that the space probe tracking network will be enlarged.

Two-hundred ton Goldstone antenna is expected to be able to track to a range of 40 million miles by 1960 and to four billion miles by 1962, as its efficiency is increased and more powerful transmitters are installed in space probes. Leach Corp. developed three 60-cycle generator installations, consisting of power unit and control panel, and allowing precise operation to plus or minus variation of less than one cycle.

Extrapolation of the degeneration of Pioneer III's signal for the distance it traveled indicates the antenna now can track to half a million miles.

One per cent speed error in Army's 33 hr. probe would have meant an eight-hour error in arrival time at moon. Sensitivity for Air Force's 60 hr. Pioneer probe was about twice as great—14-15 hr. arrival error for a 1% variation in speed.

Probable error that was allowed for in the Army launching was about .5% which would have meant a probable error of about 3½ hr. on arrival.

Short flight was chosen for the Army shot partly to ensure that the probe would pass the moon sometime within the 10 hr. per day period that Goldstone is able to receive signals. A longer flight plan would have carired too great a chance for error. This requires higher velocity and dictates a lower payload.

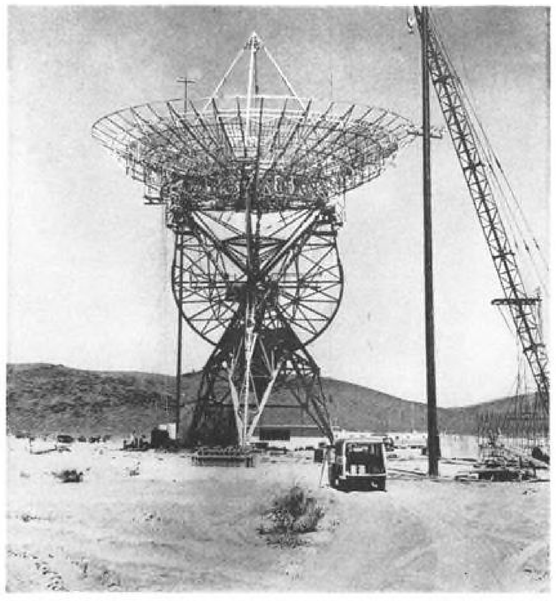
IBM 704 computer at Jet Propulsion Laboratory's tracking center prints out coordinates for the Puerto Rico station in azimuth, elevation, distance and rate of chance of the coordinates.

Goldstone station uses astronomical coordinates, and the computer prints these in declinations, hour angle, and range and rate of change.

Computer also can print out apparent position in any coordinate system for a number of stations. It also converts speed into a predicted Doppler signal which would be heard by radio receivers at various stations.

To estimate signal strength for these stations, the angle between the axis of the probe and the direction to station must be known because the probe is directionally sensitive.

PUERTO RICAN tracking station, built by Collins Radio Co., tracked Pioneer III on both upward and downward passes.



GOLDSTONE tracking station at Camp Irwin, Calif., uses 85-ft. radio telescope, can track probes to half a million miles.

Probe Firing Sequence Described

Cape Canaveral, Fla.—Vehicle that carried Pioneer III into space was a 76.7 ft., 121,000 lb. Juno II consisting of a modified Jupiter first stage topped by three solid propellant upper stages. Details of the vehicle and the firing sequence, which is quite similar to that of the Explorer launching vehicle (AW Dec. 1, p. 49), include:

• **First stage.** Jupiter intermediate range ballistic missile booster, elongated to carry extra tankage. Booster was fabricated by Army Ballistic Missile Agency. Chrysler Corp., Jupiter prime contractor, provided engineering services and some hardware. Planned burning time for the Rocketdyne engine, which used RP-1 and liquid oxygen, was about 179.8 sec. Normal burning time for this engine in Jupiter and Thor missiles is about 157 sec. Planned azimuth was approximately east-northeast, and desired injection angle was 68 deg. from the vertical. Angle of attack meter on nose probe functions in first 120 sec. of flight.

• **Instrument compartment.** During 1 min. coasting time after first-stage burnout, booster is separated by explosive bolt and spring arrangement and slowed by a small retrorocket. Tub-like instrument compartment remains attached to upper stages. Guidance and control systems employ gyroscopes and a stabilizing platform for constant alignment. Prior to first-stage cutoff, gyros control roll, pitch and yaw systems. After booster separation, the same gyros provide control signals to operate compressed air nozzles mounted in the tail of the truncated instrument compartment to align the remaining stages properly. All controls are programmed. Only ground-to-missile control is the destruct system. Guidance contractor is Ford Instrument Co., division of Sperry-Rand Corp. Forward of the instrument compartment are two electric motors that spin the bucket-like upper stage assembly to 250 rpm. before takeoff to stabilize them. Velocity is increased to 400 rpm. after launching.

• **Shroud.** Conical shroud covers payload, and a cylindrical shroud support assembly with a flared bottom covers the upper stage rockets and part of the guidance equipment. Shroud is aluminum coated with heat-resistant plastic. It is separated by explosive bolts and springs after first-stage cutoff, kicked ahead of the missile and to one side by a lateral thrust rocket attached to the shroud's inner wall. Shroud support assembly has 12 plastic windows about 15 in. square to facilitate transmission of tracking signals to ground stations. It also has vents near its base to provide for exhaust when second stage rockets fire.

• **Second stage.** This is a ring of 11 scaled Sergeant rockets 42.5 in. long and 6 in. in diameter. Base of the bucket that holds the rockets is mounted on a bearing above the two electric motors. Stage weighs 207 lb.

• **Third stage.** Three more scaled Sergeants within the ring of the second stage. Weight is 207 lb.

• **Fourth stage.** A single scaled Sergeant topped by the payload. Weight is 59 lb. It is separated from the payload by a small explosive charge and spring. Time from ignition of second stage to burnout of fourth stage is 27 sec. Burning time for each upper stage is about 6 sec.

• **Payload.** This is a thin glass fiber cone 23 in. long and 10 in. at maximum diameter, covered with a gold wash to make it electrically conducting and painted with white stripes to control internal temperature. Tip probe and cone itself serve as antenna. Weight is 12.95 lb. The 1.1 lb. transmitter operated on 960.05 mc., delivering a phase-modulated signal of 100 milliwatts. Modulated carrier power is 80 mw.; total effective radiated power is 180 mw. Timer controls the transmitter power release and other power-supplied instruments. Instruments included:

• **Two Geiger-Mueller counters.** One counter saturates at about 10 roentgen/hr. The second saturates at about 100 roentgen/hr. and gives an integrated output. Dr. James A. van Allen of State University of Iowa and Louis Frank, an undergraduate assistant, calibrated the detectors. Van Allen said the counters can count radiation strikes up to 200,000/sec.

• **De-spin mechanism** consisting of two seven gram weights fastened to the ends of 60-in. wires. About 10 hr. after launch, hydraulic timer was to pay out the wires, letting rotation of weights slow the spin of the probe from 400 rpm. to 6 rpm. Weights and wires were to be released.

• **Photoelectric sensing "trigger"** that could be used with scanning devices in later probes. At about 20 hr. after launch, two small apertures mounted in the barrel of the sensor and opening into two photoelectric cells were to be armed by a hydraulic timer to make them sensitive to light images. On normal flight, probe would then have been at 140,000 mi. from earth. Earth would have offered too small an image to activate both cells. If the probe were pointed properly on a pass near the moon, only the moon's light would form a large enough image to enter both apertures at once and trigger both cells simultaneously.

Upper stages, using recently improved propellants, and the probe itself were designed by National Aeronautics and Space Administration's newly-acquired Jet Propulsion Laboratory of the California Institute of Technology. Reynolds Metals Co. built the shell of the rotational launcher.

Soviet Moon Plans

Washington—Russia plans to launch a half-ton moon satellite, another that will land on the moon and a third that will return to the earth after orbiting the moon, according to a recent statement by Prof. Vitaliy Bronshtayn, a scientific adviser to the Moscow Planetarium. First launching was imminent and the next two were due in the near future, according to this report.

Bronshtayn was quoted in an official Polish magazine as saying two improved models of the launching rocket motor were built to calculations made by V. Yegorow of the Mathematical Institute of the Academy of Sciences. Bronshtayn said the thrust has been thoroughly calculated to avoid the "blunder" committed by U.S. scientists which resulted in the failure of the first Pioneer probes.

Military Global Communications Needs All-Out Systems Approach

By Philip J. Klass

St. Petersburg Beach, Fla.—All-out systems approach is badly needed for military global communications to obtain increases in speed, capacity and flexibility, Air Force and Army spokesmen warned at the Second National Symposium on Global Communications.

Plans by Air Force and Army to modernize and expand their global communications reported at the conference revealed many similarities in thinking and approach. This explains why the Joint Chiefs of Staff are weighing the possibility of a single joint-service program (AW Dec. 8, p. 30).

Here are some of the innovations and improvements called for in Air Force's 456-L global communications program and Army's UniCom systems:

• **Automatic switching:** Existing slow manual switchboards for routing messages from point of origin to destination will be replaced with automatic switching which can seek out the optimum routing, taking an indirect route if necessary to by-pass busy circuits. Automatic switching is expected to greatly increase utilization of available radio, land-line circuits.

• **Variety of services:** In addition to present voice and teletype, new systems are to be able to transmit facsimile, closed-circuit television digital communications which will permit exchange of data between computers thousands of miles apart.

• **Automatic encryption:** Coding and decoding of classified messages will be handled on an "on-line" basis, to eliminate long delays now involved.

• **Priority routing:** Extremely important messages will be able to pre-empt circuits from low priority messages which will be stored on tape, automatically transmitted later.

• **Automatic error detection:** Teletype and digital communication circuits will have built-in error detection provisions.

Present military communication systems, many of them serving individual specialized functions and commands, must be integrated into an automatic global system not unlike the present domestic Bell Telephone system but with the added problem of safeguards to prevent enemy jamming and/or eavesdropping, Col. George P. Sampson said. Sampson is chief of Army Communications Service Division.

Although automatic switching and system integration is expected to greatly increase traffic capacity of existing radio and cable links, a sizable increase in the number of channels will still be needed to handle growing military communication needs, Charles A. Strom, of Rome Air Development Center, said.

For example, Air Force requirements called for 25 channels in the 1954-56 period, a figure that had increased five-fold to 125 channels in 1956 and now stands at 240 channels. By 1962, Air Force will need 600 channels, Strom said. However, the use of new tropospheric scatter, switching and digital data transmission techniques should achieve a 10-to-20-fold reduction in the cost per channel per mile, according to Strom.

Tropospheric scatter and radio-relay will form the backbone of future Air Force communication systems, Strom said. Army will rely upon high frequency (HF) radio, using new digital data transmission techniques, new lightweight cable that can be laid by helicopter at speeds of up to 50 kt. Army also seeks an alternative of HF for long-distance use and is considering use of satellites as well as more conventional scatter communications, Col. Sampson said.

Satellite Scatter

A General Electric study of future trends in global communications suggests that by 1970 there will be so many satellites in orbit around the earth that very high and ultra high frequency (VHF, UHF) communications will largely become "satellite scatter communications." This will extend the range of these nominally line-of-sight range frequencies out to several thousand miles, GE's James E. Hacke, Jr. reported. He predicted that VHF and UHF energy reflected off numerous satellites would be far more powerful than energy scattered by the ionosphere and troposphere.

Other possible future trends suggested by the GE study include:

• **Displaced-carried single sideband,** in which a single powerful transmitter broadcasts a reference carrier for use in demodulating suppressed-carrier SSB signals would permit significant simplification and improved intelligibility.

• **Airborne teletype** for use in transmitting the bulk of air-ground and ground-air communications may find widespread use. Several airlines flying the North Atlantic are now trying out airborne teletype for routine messages.

• **Combined modulation methods** used simultaneously may provide an increased number of communication channels without increased radio spectrum use. Hacke suggested possibility of transmitting additional set of sidebands in phase quadrature to conventional sidebands, or the possibility of transmitting an additional signal that is polarized at right angles to conventional one, providing the transmission path preserves polarization. Combination of two techniques could permit transmission of four pulses in frequency spectrum now required for one.

• **Dynamic frequency programming,** in which each radio station would request and receive specific frequency allocation prior to each transmission, could provide a more effective utilization of radio spectrum. Frequency allocation authority would employ computer to instantly search out available frequencies.

Although the prospect of using satellites to extend the range of VHF and UHF to intercontinental distances offers many attractive advantages over existing HF radio, sizable problems must first be solved before satellite relays becomes economically feasible. Passive satellite relays, which require no electric power within the vehicle, probably will be the first to come into use.

Using a 100 ft. aluminum sphere, such as National Aeronautics and Space Administration proposes to place in orbit, and a 177-ft.-diameter antenna on the ground, the ground transmitter power required per kilocycle of channel bandwidth provided at an operating frequency of 1,000 mc. will be 0.2 to two megawatts, depending upon receiver sensitivity, according to Dr. Morris Handelsman, Rome Air Development Center scientist, reported.

This means that a ground transmitter power of 0.8 to eight megawatts would be required to provide a single four kilocycle voice channel and a power of 800 to 8,000 megawatts to provide a single four mc. TV channel, Handelsman said. An eight to 10-fold reduction in power would be possible by operating at 3,000 mc., or power needed could be reduced by using larger antenna and/or satellite.

Using a satellite with a directive reflecting surface could further reduce power requirements but raises new satellite orientation problem, Handelsman stated (AW Oct. 20, p. 85).

Aircraft and Related Procurement Funds

First quarter contracting for aircraft, missiles and related procurement by Air Force and Navy has steadily declined over the past three years. Department of Defense figures show that new contracting for the July-September period declined from $2.8 billion in Fiscal 1957 to $1.4 billion in the current Fiscal 1959 year. The low in procurement orders of $282 million in Fiscal 1954 reflected large-scale contract cancellations and production stretchouts by the incoming Eisenhower Administration.

Following are details. Figures are net. Obligations reflect new orders, less cancellations.

Obligations
(Millions of Dollars)

First Quarter (July through September) Fiscal Year	Navy	Air Force	Total
1951	1,249	1,305	2,554
1952	1,386	3,514	4,900
1953	741	4,968	5,709
1954	170	112	282
1955	262	711	973
1956	281	—30	251
1957	839	2,009	2,848
1958	229	1,529	1,758
1959	295	1,155	1,450

Expenditures
(Millions of Dollars)

1951	136	307	443
1952	243	743	986
1953	351	1,276	1,627
1954	532	1,581	2,113
1955	435	1,565	2,000
1956	440	1,499	1,939
1957	411	1,504	1,915
1958	614	1,910	2,524
1959	591	1,602	2,192

House Group Urges Acceleration Of Military Contract Decisions

Washington—House Armed Services Investigating Subcommittee is prodding the military services to speed their decision-making on procurement contracts. Two new developments now include:

• **Hearings held by the group** headed by Rep. Edward Hebert (D-La.) disclosed that 797 cases are before the Armed Services Board of Contract Appeals. Some of them have been pending for three years. The backlog pending before the Air Force panel of the board built up from 133 cases in mid-1956 to 261 at present.

• **Hebert, noting that contractors** must file appeals from the decision of a contracting officer within 30 days, urged the service secretaries to also put a time limit on decisions by the military representatives.

Built-in Peril

"There is built-in peril in the fine print of contracts," Hebert declared, "but contractors ought not to be subjected also to delays in getting decisions."

He said the subcommittee has received numerous complaints, adding that a further investigation of the situation will be made.

Hebert noted that the bulk of decisions are made at the contractor-contracting officer level. Of eight million military procurement contracts totalling $41 billion awarded during the fiscal years 1957-58, only 800 found their way to the Contract Appeals Board. The amount claimed by contractors totalled $26.7 million. The Board denied $12.8 million, sustained $6.4 million in contractor claims, and referred $7.5 million to further negotiation.

The Air Force panel during the two-year period ruled on $6.8 million in contractor claims. The major portion—$3.9 million—was denied; $1.4 million was sustained, and the remainder referred for further negotiation.

George W. Crawford, chairman of the Air Force Panel, blamed contractors for delays in processing cases. "This is to be expected," Crawford told the subcommittee.

"The individual case will normally have an importance to the contractor which may sometime exceed the dollar amount involved. . . . Neither he nor his counsel is disposed to be rushed into a hearing until satisfied that they are fully prepared to proceed. Government counsel can be depended upon to take as expeditious action as possible for the reason that an orderly and prompt disposition of cases is necessary for the proper administration of the appeals. . . . The problem is particularly acute in the case of the big claim."

The subcommittee focused on the still-pending $5.5 million appeal of Curtiss-Wright Corp. as an example of slow-motion in settling contract issues. It relates to rental charges on the use of government facilities in commercial production at the Wood-Ridge, N. J., plant of the Wright Aeronautical Division since 1950.

It was not until December, 1955, that Air Force estimated that approximately $5.5 million was the amount due. Hearings on the case before the Air Force Panel of the Contract Appeals Board were held in January of this year after the General Accounting Office protested to Congress and the Hebert subcommittee held a public hearing on the case. In September, the panel ruled that Curtiss-Wright did owe rental charges but questioned the amount. A further hearing scheduled for last week to determine the amount due was postponed while Air Force and corporation representatives continued negotiations.

Swiss Military Deny Hunter Difficulties

Geneva—Recent rumors of difficulties with British-built Hawker Hunters for the Swiss Air Force have been inaccurate, according to military sources here.

Rumors started with the loss of a Swiss Hunter during a test flight. They continued with reported forced landings of a number of the Hunters and reached a high when the Hunter T. 8 was recently grounded in England during the Royal Navy's investigation of the Vickers Supermarine Scimitar.

Spokesman for the Swiss Military Department said the first Hunter was lost when a blade broke in the first stage of the Rolls-Royce Avon engine compressor.

Thrust loss was too great for the pilot to return to base at Thun and he ejected successfully.

Hunter T. 8 grounding in England was due to suspected trouble in the ejection seat, which later was found blameless.

Swiss military test pilots have terminated either acceptance or delivery flights of their Hunters six times recently, due to minor squawks. Swiss say for production aircraft this is the rule rather than the exception.

WING of Hiller X-18 vertical takeoff and landing aircraft is in position for horizontal flight; engines are two Allison T40 turboprops, producing 5,535 eshp. each. Engine in aft section is 3,400-lb. thrust Westinghouse J34 turbojet, used for pitch control.

X-18 Rollout Accentuates VTOL Research

X-18 WING is in short takeoff and landing configuration. Company said the aircraft can clear a 50 ft. obstacle in 500 ft. with moderate overload in STOL uses.

By Richard Sweeney

Moffett Field Calif.—Hiller Aircraft Corp. last week rolled out its X-18 research vehicle, which is expected to supply realistic flight test data upon which requirements for future VTOL aircraft may be based.

Aircraft will undergo engine run and tethered liftoffs at Moffett starting early next year, primarily as systems shakedown work. It then will go to Edwards AFB for the first flight next spring. First flight work will be flutter investigation and gathering of other basic data about the aircraft itself prior to starting tilt wing work.

William Weitzen, Deputy Assistant Secretary of the Air Force for Research and Development, principal speaker at rollout ceremonies, said USAF foresees a large role for such aircraft. He said that the X-18 will provide a realistic flight vehicle to get data to design

NOSE AND TAIL sections are adapted from Fairchild C-123 transport; note horizontal stabilizer dihedral. Propellers are dual-rotating Curtiss-Wright turboelectric unit from Navy Pogo VTOL program.

propeller-driven tilt wing aircraft which will take off and land vertically, and yet operate like a conventional aircraft having a high forward speed and carrying heavy loads.

Basic fact stressed by Hiller is that X-18 is not a helicopter but is an airplane which has vertical takeoff and landing capabilities with its fuselage remaining in horizontal plane. Control systems are designed along this philosophy; cockpit arrangement and control system operation by the pilot also follow this line.

Although developed purely as a research tool, the X-18 design is unique in several respects:

• **Gross weight,** at 33,000 lb., is considered high enough to simultaneously prove out the concept and demonstrate that useful payload can be carried.

• **Existing hardware** was combined into the X-18 to cut design and fabrication time, and reduce costs. Allison T40A-14 powerplants and 16 ft. 1 in. diameter Curtiss-Wright electric contra-rotating propellers were obtained from Navy's Pogo (Lockheed) and (Convair) VTOL planes and logistics seaplane (Convair R3Y) programs. Vertical and horizontal stabilizer group was taken from USAF Fairchild C-123 transport, as was the nose section. Additionally, the jet engine which is used to provide pitch control in vertical flight regimes is a Westinghouse J34, a proven powerplant.

Funding of $5 million will carry the X-18 through 12 months of flight test, from inception, a low cost today.

Use of known hardware also speeds research work—not as much preliminary flight testing must be devoted to completely debug, gather required basic engineering data on vehicle's components, systems and subsystems, prior to initiation of programs for which the vehicle was intended.

Carrying known quantities further, the aircraft uses standard NACA 23015 airfoil sections. Aspect ratio is fairly low, 4.36 for the current configuration. Under the proposal submitted and approved for the X-18 design, the wing is submerged in propeller slipstream, but Hiller X-18 project engineer Percy Dowden said he sees no reason why higher aspect ratios, of the order of 8 to 10 cannot be used effectively.

Aircraft's tilt wing has normal incidence of 4 deg., which changes to full 90 deg. Actual vertical takeoff setting is 87 deg., for at a full 90 deg., lift component would actually cause the airplane to travel backward.

Wing tilt is accomplished by hydraulics, with two actuating cylinders used, one on each outer edge of fuselage. Maximum airspeed at which the wing can be tilted is 155 kt. Wing rotates about the 35% chord line.

The airplane has two completely independent hydraulic systems, driven from the gearbox of each engine. In this way, should one of two gas generator sections used in each engine be shut down in flight, hydraulic power still is available. Wing tilt actuators are connected one to each hydraulic system. Each actuator alone is capable of accomplishing wing tilt up to maximum wing tilt airspeeds. Additionally, there are cross manifolding provisions, and should one hydraulic system malfunction, either system can drive both struts. Or, should a right hand hydraulic system fail and left side actuator malfunction, the left hydraulic system can drive right side actuator cylinder.

The wing structure is completely conventional, with torsion box incorporated. This box is so designed that it remains intact across the wing rotation point. Structural strength is incorporated to add 6 ft. to each wing tip, getting a higher aspect ratio, improving range and load capabilities in STOL operations. Ailerons currently are submerged in the propeller slipstream; on extended wing version they would still be partially in the slipstream, and would continue on out to wing tips.

Control system of the X-18 is designed as a transport type, so that if a regular fixed-wing transport pilot were put in left seat of a VTOL of this type, he would not be ill at ease. A conventional transport wheel is used in roll control in forward and vertical flight. Yoke fore and aft movement controls pitch in both regimes. Rudder pedals are yaw controls in both situations. Only unconventional control in cockpit is a lever which tilts the wing; it is on the center control pedestal. Only added activities in X-18 are starting jet engine for vertical flight pitch control and operating wing tilt line.

The wing has a mechanical lock in the down position; intermediate positions are locked hydraulically in actuating cylinders, while the vertical position stays secure by its natural tendency.

Flight controls have stability augmentation built into roll and pitch axes. Hydraulic boost is used in ailerons and jet diverter which is pitch control in vertical flight. Each of these has dual actuators, one connected to each hydraulic system.

Only one actuator is needed to operate each of the controls, the second is a backup provision. The rudder has a servo tab boost.

Simple mechanical mixer unit, mounted in the wing, changes controls in transition from vertical-to-horizontal-to-vertical flight. The design provides the same control moments throughout the entire transition regime, and mixing control functions proportionately as required, according to the wing tilt angle. Controls change in function during transition is as follows:

• **Pitch control** changes from horizontal stabilizer and elevators to the jet exhaust section. Proportion of jet exhaust and horizontal tail to retain standard moment is provided by the mixer.

• **Yaw control** shifts from rudder in level flight to ailerons in vertical flight. Again, the mixer provides proper proportion of rudder-aileron according to

NATO Selects Anti-Sub Group

Paris—A group of five European aircraft companies, led by France's Breguet, reportedly has won technical approval of a standard NATO anti-submarine warfare aircraft, though question of financing the program still remains to be settled.

Late last week, a special NATO committee was slated to hold an initial meeting on the financial aspect of the contest. Latter involves an ASW aircraft tailored to NATO European needs. Aircraft reportedly will be in the 75,000 lb. class and will be powered by two Rolls-Royce Tyne turboprop engines. It would be a replacement for the Lockheed P2V series currently on duty with several NATO military units including the Netherlands, Italy and France (AW July 28, p. 18).

No official announcement has been made by NATO. Last week, however, two Paris newspapers reported that the contest, closed last June 21, was won by a group including Breguet and Sud Aviation, France; A. V. Roe and Co., Ltd., England; Fokker, the Netherlands, and Dornier-Werke GmbH., Germany.

Informed sources in Paris did not deny the newspaper reports but noted that the Breguet group had won approval only of a special NATO technical committee headed by Henry C. Bloss, head of the aircraft section, Production and Logistics Division of the NATO Secretariat. The next question of how the program is to be financed probably won't be settled until next month, sources said.

In the meantime, some U. S. industry observers expressed doubt that the program eventually would reach the production stage. It was thought this could only come about if U. S. funds were pumped into the project, a prospect which these sources consider unlikely. U. S. companies are arguing that if NATO wants an ASW aircraft it would be wiser to retrofit later model piston aircraft which are being dumped on the second-hand market. In this manner, U. S. sources claim, NATO would get both an ASW and an early-warning type of aircraft.

how much the wing is tilted.

• **Roll control** shifts from ailerons in level flight to powerplants in vertical regime, and this is most ticklish situation in entire flight regime. Control functions change according to the wing tilt angle because this is the most reliable base of derivation. Horizontal and vertical speeds may change in transition flight pattern according to pilot desires or emergencies, or according to air temperature, aircraft weight, and any device based on the large number of variables would be complicated and less reliable.

Very early in flight test at Edwards, the X-18 single-engine minimum control speeds will be determined and all control system dynamics verified, according to George Bright and Bruce Jones, test pilots for X-18.

Calculations show now that in case of an engine malfunction in vertical flight, the wing can be lowered from full vertical to horizontal position and aircraft accelerated to minimum control speed in 5 to 6 sec. Complete engine power cessation is regarded as all but impossible, therefore in a malfunction, some thrust will still be present, somewhat easing criticality of an engine-out problem. It has been determined at Hiller that if one power package went to zero-thrust-zero-drag instantaneously, and if the other powerplant were at flight idle, the roll rate still would be 270 deg./sec., illustrating gravity of the problem.

Although powerplants have undergone modification since their use in earlier programs and reliability upgraded, complete monitoring will be used in the flight test program. Current plans will have complete telemetry on power packages, recording vibrations, temperatures, pressures, their amplitude, magnitude, and frequency. Operating range for these parameters will be almost zero at first. Any changes will immediately result in the wing being lowered. Ground observers at Edwards' telemetry facility will monitor the tests.

Vertical flight testing regimes will start with the airplane making a conventional takeoff and climb to altitude, where the wing will be tilted in perhaps 5 deg. increments, and all data gathered in each position before wing tilt is increased. Most especially, the control system dynamics will be verified step by step. Thrust required, stability investigations will be performed.

Performance of X-18 in forward regime is limited to 220 kt. indicated airspeed, the limit imposed by C-123 windshield strength.

With the thrust-weight ratio of X-18, which slightly exceeds the 1-to-1 required for vertical flight, it is contemplated that forward flight cruise will be made at 60% rated power. In this, most probably one gas generator in each engine will be shut down for normal flight.

In initial climb as an airplane, the X-18 will have climb rate which is estimated at 8,000 to 10,000 fpm.

In vertical takeoff, it has been calculated that the X-18 will derive 6,000 to 8,000 lb. lift from the bottom of the fuselage as the propeller slipstream impinges. Aerodynamic design in no way attempted to gain this lift; it just came along as a bonus, Hiller engineers explained.

According to Convair data gained during the Pogo flight test program, Hiller engineers anticipate no recirculation problem in the X-18. Air strikes the ground, fans out, but hugs the ground as a boundary layer effect.

Additional research will be done in the realm of control moments. Investigations will be made in jet thrust requirement for pitch control in vertical flight, seeking to determine whether a jet engine such as the X-18 carries is really necessary, or whether requirements can be met by main engine bleed air or perhaps by a smaller accessory gas turbine unit.

One possibility would be use of automatic flaps to keep aircraft at zero pitching moment throughout entire flight regime, lessening the requirement for jet flow at the tail.

Current disk loading on X-18, with gross weight at 34,000 lb., is 92.5 lb. This could be increased considerably, Hiller engineers feel. While current aircraft does not have it, Hiller engineers think that optimization of a practical airplane would include cross shafting of propellers in case of gas generator failure, and four disk areas. In addition, development of an automatic rate control for wing tilt angle could be accomplished, which would further optimize flight conditions.

Extensions of VTOL aircraft would have the variable mission capability as a built-in feature. A typical mission might go this way:

• **Aircraft is in a small valley,** mountains 500 ft. high surrounding, longest possible takeoff run available would be 300 ft., and a payload to be airlifted of several thousand pounds.

• **Cranking in atmospheric conditions,** pilot would compute optimum wing angle setting to fly the aircraft out of the valley and deliver cargo.

• **At destination,** plane would have to land vertically and take off same way to return to base for another trip.

One area wherein extended performance VTOL development is blocked, Hiller engineers believe, is in propellers. Development in this field has all but ceased, they point out, and to realize real potential of VTOL planes and turboprops in general of higher powers, much research should be done.

Eagle Award

Washington—Navy has formally named Bendix Aviation Corp. as winner of the design award for Navy's new Eagle high-performance, long-range air-to-air guided missile. Developmental contract will be made final with Bendix in the near future and the company will be named prime contractor. Grumman Aircraft Engineering Corp. will be responsible to Bendix for development of the Eagle airframe (AW Dec. 8, p. 23).

The Eagle has been in the planning stage for about three years, according to the Navy. Rear Adm. Robert E. Dixon, chief of the Bureau of Aeronautics, said "the launching aircraft for the Eagle may be relatively slow since, in this system, we are building the high performance into the guided missile instead of into the manned airplane."

Launching aircraft for the Eagle probably will include the Grumman A2F now under development.

News Digest

Republic Aviation personnel are working with Petroleum Helicopters, Inc., to determine cause of recent crash of one of latter's Alouette turbine-powered helicopters into Gulf during flight from Cameron, La., base from offshore oil rig. All four occcupants, including pilot, were killed. There were no radio transmissions from pilot indicating trouble prior to crash. Weather was clear except for some haze offshort caused by smoke. Petroleum Helicopters has been operating two Alouettes in the Gulf area (AW Dec. 1, p. 86).

North American X-15 research vehicle will carry a radio beacon for chase planes to home in upon. X-15's speed makes visual rendezvous at the end of mission impossible.

Photographic map of moon that should provide more detail than available through U. S. observatories is being made for Air Force by Toulouse University Observatory in France. Heights of lunar mountains are expected to be determined within 100 ft.

System to control position of shock waves set up by Mach 3 speeds in engine inlets of North American's B-70 bomber will be designed, developed and manufactured by Hamilton Standard Division of United Aircraft under a contract from North American.

Boeing Airplane Co. has been awarded a multi-million dollar contract to engineer and manufacture the wing of the Air Force B-70 intercontinental Mach 3 bomber (AW Oct. 27, p. 34).

Most Trunklines Complete Jet Financing

Assuming operating revenues and cash flow remain high, all but three lines seem to be over first hurdle.

By William H. Gregory

New York—Bank and insurance company loans last week for Eastern Air Lines and National Airlines brought airline jet and turboprop orders and financing for these orders into a rough sort of balance.

Assuming operating revenues and cash flow remain high, all but three of the domestic trunk lines, and Pan American World Airways as well, appear to have completed their basic jet financing. The three lines:

• **Delta Air Lines.** Delta is close to obtaining the necessary loans, it is understood in financial circles here. Delta's dropping of options for two Douglas DC-8s is regarded here as a preliminary to arranging financing.

• **Trans World Airlines.** TWA technically has no jets on order; all are orders in the name of Hughes Tool Co. but assignable to TWA. The airline, furthermore, is not obligated to take the airplanes and the numbers on order also are subject to revision.

• **Capital Airlines.** Capital has no firm orders for pure jets, but is still paying for its Vickers Viscounts. Capital has obtained a moratorium on payments for these airplanes and its president, David H. Baker, is in England reportedly attempting to work out the situation. Capital still is negotiating an order for Convair 880s.

• **Northeast Airlines** has not ordered pure jet equipment. It has purchased Vickers Viscounts, part of an order deferred by Capital but has ordered no other equipment.

These conclusions are guarded because of the many uncertainties. Eastern Air Lines' forecasts, for example, could be upset by the strike situation. Ground equipment also remains a question mark in some cases.

Financing Trends

Two trends have emerged in the pattern of financing which at first seem contradictory but which actually have been expected by financial analysts:

• **Bank loans** have been made generally on favorable terms.

• **Equity financing,** financing involving sale of stock to the public, has encountered stiffer terms.

Two reasons account for the more favorable bank terms, according to one official close to airline financing. Banks and the airlines were able to get together in the 1940s when other sources of funds declined to deal with the industry. The airlines now tend to turn to the banks, the banker said, and the banker's door is open because the earlier dealings turned out well.

A second factor is that airline cash flow—the amount of cash available before depreciation deductions, taxes, etc., —is high and banks are repaid from this source. The stockholder is paid a return only out of earnings, and the discouraging outlook for airline earnings has brought frequent warnings from Wall Street (AW Dec. 8, p. 42) that there would be trouble in attracting public funds for airlines.

Terms of the new Eastern financing point out this contrast:

• **Equity financing,** indirect in the form of a $25 million promissory note purchased by the Prudential Insurance Co. and convertible into common stock at $41 a share anytime until Dec. 1, 1968. The interest rate is 5%, and the conversion price is not far above the current price of about $35 a share. Eastern can repay the loan as a means of effecting conversion if the market price of the stock rises 20% higher than the conversion price.

• **Bank financing** arranged with a group of 18 banks led by the Chase Manhattan calls for a revolving line of credit of $50 million at interest rates 1% above prime commercial rate at the time of borrowing, with a minimum set at 3½% and a maximum at 4½%. Funds outstanding at the end of 1961 can be converted into a term loan payable in 12 equal quarterly installments.

Stiff Terms

Analysts did not regard the Eastern equity terms as unduly severe, but the closeness of the conversion price to the current price of the stock makes for more stiffer terms than might be ordinarily expected for an airline that has been as good a financial performer as Eastern.

A more pronounced case is that of Northwest Airlines which offered a convertible preferred stock issue last week.

Here the interest rate is 5¼% and the conversion price is $26 a share, approximately equal to the current price of the common stock. Sale of the preferred stock to raise at least $10 million is necessary for Northwest to conclude two loan agreements for $72.5 million (AW Dec. 1, p. 43). Considering the state of airline finances, one banker thought Northwest had done an excellent job of arranging this financing even in the face of relatively stiff terms for the preferred stock sale.

National Airlines arranged a $40 million loan with the Chemical Corn Exchange Bank and the First National City Bank, both of New York, at an undisclosed interest rate. The interest, however, was believed to be in the range of other bank loans to airlines—½ or 1% above prime.

Interim Loan

National must use this to pay off a $15 million interim loan due this year, leaving a balance of $25 million to apply to 23 Lockheed Electras and three Douglas DC-8s on order. One banker said this would be sufficient to finance the purchase, based on National's cash flow and operating revenue projections. Its interchange with Pan American to provide Boeing 707-120 service New York to Miami is expected to be an important favorable factor (see p. 38).

Eastern's total Electra and DC-8 orders, and estimated ground equipment, total $235 million. Deducting the $28 million Eastern has paid in advanced payments and the $75 million in new financing, there is a balance of $132 million which Eastern expects to pay out of depreciation reserves, profits, and retained earnings.

Eastern recognizes this figure is a hefty chunk, the largest it has attempted to finance out of its own revenues. However, the program was built on conservative forecasts—especially profits. Eastern must make money to handle the $132 million, but the margin does not have to be a large one necessarily.

Eastern's total re-equipment program —a $425 million fleet expansion begun in 1955—assumed a growth rate of 12%. This was conservative in the light of 1954-55-56 rates, but will be high for this year.

Eastern feels it still is a reasonable figure for the long pull.

The $132 million payout will carry over the period of turbine-equipment deliveries which end in 1961, with the bulk concentrated in 1959 and 1960.

Financial men feel that the first big financial hurdle in buying jets has been passed fairly successfully. But little of the financing has been easy. Some of the negotiations, they report, have been in progress as much as a year.

National, PanAm Coordinate Jet Service

By Glenn Garrison

New York—First U. S. domestic jet service, inaugurated last week by National Airlines, with leased Pan American World Airways planes, will call for peak coordination with PanAm if both airlines are to meet their schedules with the Boeing 707-120s.

By Dec. 16, when National plans to begin flying two daily round trips between New York and Miami, the two carriers will be meeting a total of four schedules out of New York every day except Monday. Fleet will number five 707-120s unless PanAm's sixth and final 120 is delivered by that time, which is doubtful at this point. National is not leasing planes on a full-time basis, but is taking them between PanAm schedules and using them in the overseas carrier's markings and configuration.

Add time out for maintenance and training flights, and there is not much room for delays in the utilization cycle. On the other hand, the necessarily high utilization resulting from the lease arrangement best satisfies the economic demands of jet operation.

Under the arrangement, PanAm performs all maintenance of the aircraft at Idlewild, services the jets and turns them over to National at the gate and ready to go. At Miami, National turns the planes around in 2 hr. 15 min.

Press Flight

National took a pre-inaugural press flight to Miami Dec. 5 in two and a half hours, takeoff to touchdown. This was over the 2 hr. 15 min. scheduled service time, but the press flight was delayed by a traffic control deviation from course, headwinds and a promotional pass over Miami Beach before landing. Flight took off at 200,000 lb. gross with 60,000 lb. of fuel and 109 passengers and crew. It used Runway 25 at Idlewild; other traffic was using the longer Runway 31R, but National, like Pan American and British Overseas Airways Corp., must abide by Port of New York Authority anti-noise priorities. Unlike PanAm, National won't suffer by the restrictions, because of the lower gross weights required for the shorter trip. About half of the 60,000 lb. fuel load on the press flight was reserve.

Since National has no fuel problem in the New York-Miami service, it plans to sacrifice some fuel economy for speed and operate at 28,000-30,000 ft. instead of at higher altitudes. This will cost 4-5,000 lb. of fuel per trip, but will provide a 25-30 mph. speed advantage.

The domestic jet flights are under radar surveillance all the way, through a special assignment of Civil Aeronautics Administration personnel to Air Defense Command radar sites along the route. Traffic delay to the press flight was caused by weather. It involved a clearance-required deviation of 60 mi. from course to separate the jet from piston engine traffic. Climb was also slowed down for separation purposes.

National gets the aircraft in the same 109-passenger configuration Pan American uses in its transatlantic service. Aft compartment, with 65 three-abreast seats, is PanAm's economy section. Forward compartment, with 44 de luxe seats, is two-abreast. National's service is all first class, and the airline has added $10 to the $80.80 fare for passengers who want forward compartment seats. Otherwise service is exactly the same both forward and aft.

The airline will handle the run with five flight crews, which it estimates cost $40,000 each to train. Captains get 15-20 hr. of flight time in training, copilots 5-10 hr.

National's first daily flight leaves Idlewild at 9:25 a.m. and the second will leave at 1:55 p.m. Northbound departures will be at 1:55 p.m. and 6:25 p.m. Pan American's daily-except Monday London flight departs at 10 a.m., and the daily Paris flight departs at 7 p.m. The eastbound transatlantic arrivals are scheduled at 2:45 p.m. and 9:25 p.m. respectively.

The 120s go into terminal service every 50 hr., or approximately every three transatlantic round trips. This service takes 8 hr. A 36-hr. equalized maintenance operation is performed every 200 flight hours.

Normally, therefore, there is an overnight cushion between arrival of two planes at Idlewild and their National schedules next day. If one jet was in maintenance and another was temporarily out of action with an engine change, however, the cycle would get a bit tight.

Peak utilization time when National is flying two schedules will occur at 3 p.m. every day. With the exception of Mondays, there will then be four planes in the air and one will just have landed at Idlewild. Low point will come at midnight, with only two planes away from home base.

National plans to add a third daily flight next January, but the sixth airplane will be in service by that time.

The airline's pre-Christmas bookings are running well ahead of last year's, partly because of the jet service, but also because of the Eastern Air Lines strike. National says its traffic at this time is normally about 4,000 passengers a day but this is now hitting around 7,000. The jet flights are about 90% booked for the next two weeks. Overall New York-Miami load factors are about 87%.

The first National jet schedule, incidentally, was booked full but departed eight passengers under capacity, due to no-shows.

Eastern originally had hoped to begin New York-Miami Lockheed Electra turboprop service Dec. 1 and work up to three round trips three days a week and four round trips four days a week by the end of 1958. The carrier's Electras will carry 70 first class passengers including four sold lounge seats.

Pilot-Training Delay

But even before the crippling dual mechanics-engineers strike Eastern was falling behind schedule because of delays in pilot training. The pilots would not take flight training until an agreement on the third man issue was reached.

Eastern now has eight Electras and expects to get about a plane a week from now on. Scheduled flight time on the New York-Miami run has been set at 3 hr. 15 min. but a time of 2 hr. 50 min. has been accomplished on route proving runs, which are now being flown.

Eastern naturally is not at all happy with the unexpected straight jet competition on the lush Florida route. It has fought unsuccessfully to obtain Civil Aeronautics Board disapproval of the National-PanAm deal.

National President G. T. Baker told AVIATION WEEK his airline had tried to get early Electra deliveries but had been unable to because of Lockheed's commitment to Eastern, which Eastern insisted be maintained. He therefore had to look elsewhere for competitive equipment, Baker said, and the result was the deal with Pan American.

Broad Travel Card Plan Considered by Airlines

Washington—Sweeping changes in the scope of the Universal Air Travel Plan that will strengthen the competitive position of the airline credit card system in the credit field are under consideration by the air transport industry.

Chief purpose of the new plan is to raise the use value of the air travel card to a level above that of other credit card systems now crowding the personal credit market. If the scheduled carriers decide to support the proposed program, it will be put into effect July 1. Here are the details of the plan as it is now being discussed:

- **Card holders may purchase tours,** excursions, package vacations, weekend excursions and other promotional tours under the universal air travel plan (UTAP). At present, only straight first-class, tourist and economy fare tickets can be charged with a UTAP card.
- **Arrangements will be made** to permit the use of the UTAP card as a credit card at hotels, motels, restaurants and night clubs.
- **Card may be used for car rentals** and air freight charges. It also will serve as credit identification for check cashing privileges at airline offices.

Under the proposed plan, new cards will be issued. They will be made of plastic with raised letters recording the full address of the individual card holder. At present, the airlines carry about 87,000 UTAP accounts and over one million individual credit cards are outstanding.

Need for addresses on the cards is to permit organizations accepting cards for credit to bill the customer under their own accounting systems. Such credit systems as the Diners Club and American Express Credit Plan handle all billings for hotels and restaurants participating in the plan. Unlike these systems, however, the airlines will not charge a commission to companies extending credit through the UTAP. Most credit plans impose a 7% commission on all charge purchases to cover billing costs.

Majority of the airlines now feel that the plan will have a strong appeal to restaurants and hotels wishing to participate in the plan since losses resulting from unpaid accounts under the UTAP average less than 1% a year. As yet, the plan does not have the unanimous support of the industry.

One objection raised has been the possibility that a number of businesses may oppose the extension of additional credit through the card to their representatives. Such objections probably will be ironed out by the airline industry by extending credit privileges to certain designated card holders only or by producing an entirely separate UTAP card for such purposes.

Airlines supporting the program feel the revamped system will create new business sources for the industry and will increase the promotional effectiveness of the UTAP.

The $425 deposit requirement, which has been in effect since 1936 when the plan was originated, will be retained under the revised system. Proponents of the proposed plan point out the extended credit privileges will provide more justification for the deposit requirement. They add that the $425 deposit is a non-recurring charge compared to the average $6 per year charged for most other plans. The $425 is refundable when the account is dropped.

Turboprop Vickers Vanguard Rolls Out

Vickers Vanguard turboprop transport is rolled out of Vickers-Armstrongs (Aircraft) Ltd, main plant at Weybridge, Surrey, England. The 139-passenger aircraft is expected to make its first flight Dec. 20. This will be a new flight from a small airfield in Brooklands, adjacent to the factory, to a Vickers airfield at Wisley where the Vanguard will undergo additional checkouts before beginning flight test. The Vanguard (AW Nov. 24, p. 39) is powered by four Rolls-Royce Tyne R.Ty.11 turboprops with takeoff power rated at 5,525 ehp. each at 15,250 rpm. The transport is scheduled to begin service with Trans-Canada Airlines and British European Airways in 1960. Double-bubble fuselage has two underfloor cargo holds with a combined volume of 1,360 cu. ft. Wingspan is 118 ft.; over-all length is 122 ft. 10.4 in.

Four Airlines Win New Route Awards

Washington—Four major airlines have been awarded new route awards as a result of a tentative vote announced by the Civil Aeronautics Boards in the Chicago-Milwaukee-Twin Cities Case.

Northwest under the plan will be granted authority to overfly Chicago on flights between Minneapolis-St. Paul or Milwaukee to provide nonstop service to the southeast points of Atlanta, Tampa, St. Petersburg and Miami awarded the carrier in the recent Great Lakes-Southeast Service Case.

Eastern will be permitted to extend its present route system from Chicago into Milwaukee and the Twin Cities with the proviso that the carrier's flights serving the latter cities could only begin or end as far south as Nashville or Roanoke, Va., and that such flights also would serve at least two intermediate points north of these two cities.

Capital will be authorized to serve Chicago, Milwaukee and the Twin Cities on the same flight, plus operating shuttle service between these points, the Board said.

United would be permitted to serve Chicago and Milwaukee on the same flight but would be subject to a requirement that such flights extend as far east as Cleveland and as far west as Omaha.

Hong Kong Is Converted to Key Facility

By L. L. Doty

Hong Kong—Completion of a single $25 million runway to replace the earlier twin runways has converted Hong Kong's Kai Tak airport from an operating hazard to a key facility on Far Eastern routes.

The new runway is a causeway-type construction that juts into Hong Kong harbor from the mainland peninsula of Kowloon. Original field, located on the land area adjacent to the end of the new runway, will soon be covered with hangars and a new terminal building.

Because of its location, the new runway permits straight-in-line approaches as compared with the old runways which called for tight turns and steep descents on all approaches. Although the new runway was officially opened for operations on Aug. 30, full implementation of navigation and air traffic facilities has not been completed, and operations are still conducted under strict VFR procedures.

However, the dubious thrill of cutting through narrow passes or climbing at sharp angles to clear the crests of surrounding mountains no longer accompanies takeoffs as it did in flights from the old airport.

Actually, Kai Tak will never be described as a good airport. Terrain of the British Crown Colony of Hong Kong, ideal as protection for a sea harbor, contradicts virtually all accepted principles covering airport design.

Except for the Lei-U-Mun sea pass, which is about 500 yards at its base, the colony is walled in by high mountains. As a result, the glide slope through the pass will always begin at an altitude of no less than 900 ft. to cover the two miles distance from the pass to the end of the runway.

All letdowns are conducted above small islands outside the colony periphery with the aid of non-directional radio beacons. The two main let-down areas are constricted to unusually narrow sectors—about four miles long and three miles wide—because of the surrounding sea border limits controlled by Red China. As it is, the Chinese Communists periodically jam Kai Tak's radio aids to complicate further landing and approach procedures from such nearby islands as Lemay and Sa Mon which they control.

The prevalent southeasterly winds dictate the use of Lei-U-Mun for approach and takeoff about 65-70% of the time throughout the year. Alternate approach is across the relatively low mountain area from the northeast.

Only advantage of the old airport was the fact that the dual runways permitted more freeway in selecting approaches. However, most pilots agree that the surrender of a choice of approach corridors for one glide slope that is in-line with the runway is a worthwhile sacrifice.

The new runway will be 8,340 by 200 ft. when the final 600 ft. addition now under construction is completed sometime next year. It is designed with a 400,000 lb. weight stress as compared with the maximum takeoff gross weight of 130,000 lb. established for the old runway.

The weight factor required a number of aircraft to offload passengers immediately prior to the flight because the gross had been exceeded. In addition, the sharp turns and steep climbs often forced long delays or even cancellations of flights if winds dropped below set standards.

At present, operations are still confined to a dawn to sundown period. But fulltime operations can be expected after April 1, target date for complete implementation of approach lights, ground control approach (GCA) and instrument landing systems (ILS). Installation of surveillance radar and precision approach radar next year will cover both the Lei-U-Mun and the overland approaches to the runway.

For the latter approach, approach lights are being mounted on high towers through the settled area of Kowloon. The lights, a modified Calvert system, will require a slightly curved approach track to the runway once they are installed.

Radars will be installed in the hills northeast of the runway. Location of VOR facilities is still undergoing study. Runway is being equipped with flush-type flood-lights.

Some difficulty has been experienced with the ILS localizer system. Because of the narrowness of Lei-U-Mun pass, some distortion of the ILS has been encountered by aircraft making an approach through the pass. Solution apparently lies in widening the gap to prevent any physical blocking of the system. Already, a large part of the rocky mountain sides forming the pass

American Airlines' First Electra

American Airlines has taken delivery of its first Lockheed Electra turboprop transport. The airline, which has ordered 35 Electras for its short-to-medium routes (AW March 31, p. 46), will initially use the 68-passenger aircraft for training and familiarization at Ft. Worth. American will start its first Electra service between New York and Chicago, Jan. 23.

has been shaved for this purpose by blasting.

Let-down for the pass approach is conducted over Wang Lan island about eight miles from the end of the runway. At Tathung Point, near the pass itself, pilots reach the "point of no escape," which means that, once committed to the approach, there is no turning back.

A non-directional beacon also is located on Cheng Chau to handle let-downs for the southwest or overland approach. Cheng Chau is located about 11 mi. from the end of the runway. Approach is now conducted under VFR from Cheng Chau on a 205 deg. course five miles to Kau island where a turn to 240 deg. is made for the final leg. Both approaches remove the necessity of the sudden dips in descent required in landing at the old field.

Despite the complicated approach procedures, Kai Tak has a clear safety record so far as crew or passenger fatalities are concerned. However, the new runway was opened two days prior to the official opening date because the old field was effectively closed by a Douglas C-54 that undershot its assigned runway, hit the seawall with its landing gear, sprung its tanks and caught fire nose down at the intersection of the dual runways. All aboard escaped with only minor injuries. The new runway was opened almost immediately after several hundred Chinese coolies removed obstructions that kept traffic off the new field.

Diversions because of weather are few considering the navigational problems posed by Kai Tak. Pan American World Airways averages about five or six diversions each year. Tainan, Taiwana and Manila are alternates to Kai Tak.

Because of the navigational difficulties in operating into Kai Tak, Pan American, Cathay Pacific and Hong Kong Airways base pilot crews at Hong Kong to reduce the number of check flights that would otherwise be required. To qualify pilots for the operation into Kai Tak, Civil Aeronautics Administration has approved for crew training purposes a motion picture film taken from the cockpit of a plane operating through the area.

Correction

Leading edge slots are installed on second DC-8 off the production line—not leading edge flaps as incorrectly reported in the first and fourth paragraphs of the story on p. 49 of last week's issue of Aviation Week.

The installation of the slots was rightly described elsewhere in the story. Leading edge flaps are used on Boeing's 707-120.

CAB Schedules Oral Arguments On Airline Mutual Aid Agreement

Washington—Emphasizing the powerful effect the controversial airline aid pact may have on government participation in labor-management disputes, Civil Aeronautics Board last week set a date of Jan. 14 for oral arguments on the agreement signed by American, Capital, Eastern, Pan American, Trans World and United airlines (AW Nov. 10, p 40). Under the pact, an airline closed down by strike can receive financial aid from the other signers of the agreement.

Stuart G. Tipton, president of the Air Transport Assn., speaking at a meeting of the Aviation Writers Assn. here last week criticized the "lop-sided bargaining strength which now exists in favor of labor" and urged the government not to impede airline efforts designed to provide for the development of balanced collective bargaining.

Tipton said that while he could "find no quarrel" with the procedural form outlined by CAB in considering the agreement, labor unions are not bound as tightly by regulations as the airlines, as evidenced by union action last month when the International Assn. of Machinists, which has recently struck three major carriers, announced increased financial help for its striking members.

"No filing was necessary with the government," Tipton said. "No government approval was necessary. And certainly there was no forum for any airline to effectively oppose it."

Pact in Effect

Meanwhile, the six-member airline aid pact remains legally in effect, with Capital already reported to have collected a substantial payment as a result of the 37-day strike by the IAM. It is qualified to receive an additional amount to cover the portion of its strike for the first three weeks of November. Trans World which recently settled a two-week strike with IAM, also is eligible as well as Eastern, which has been strikebound by both the IAM and the Flight Engineers International Assn., since Nov. 24. American, facing strike threats from the Air Line Pilots Assn., would be the fourth member of the pact to collect aid funds if the carrier is struck.

In practice the mutual aid pact provides that when any member is strikebound, the remaining signers will rebate a portion of their earnings realized as a result of the strike to the shutdown carrier. Announcement of the agreement, which failed to disclose how the members would determine the amount of traffic considered excess or on what formula payments to a strikebound member would be based, was regarded by most observers as an indication that top airline managements are willing to lay aside much of their competitive differences to present a united front in opposition to growing labor strength.

Under pressure from both the airlines and unions for a ruling on the pact, the Civil Aeronautics Board has determined that its final decision will depend on the answers to the following questions:

- **Does the agreement violate** any applicable provisions of the Railway Labor Act?
- **Will it improve or impair** labor-management regulations in the industry?
- **Will the agreement discriminate** in restraint of trade against other air carriers not parties to it?
- **What effect will it have upon** administration of the mail-pay program?
- **What effect, if any,** will the agreement have upon the extent of government participation in labor-management disputes?

"The resolution of these questions," the Board said, "requires careful determination of important issues, since the agreement, if approved, may have a very substantial impact upon employers, employes, air carriers who are not a party to the agreement, and the general public. The Board also realizes that present impairment of service to the public by the suspension of operations of certain air carriers and the threatened suspension of others because of labor disputes, together with the effect which Board action on this agreement may have on labor-management relationship in the airline industry, makes prompt action by the Board desirable."

The CAB further ordered the six carriers to submit all available details of the pact, or any addition to it, that may bear on the following:

- **Determination of when** employe demands exceed or oppose recommendations set forth in applying the Railway Labor Act when a strike has been called before exhaustion of procedures of the Act, or when a strike is otherwise unlawful, and who would make such a determination.
- **Method of measuring** the increased revenues attributable to a strike and the added direct expenses to be deducted from airline payments.
- **Procedures followed** for routing of traffic to non-strikebound carriers.
- **Listing of mutual aid payments** made along with the amount paid by each carrier member and which member received the payment.

SHORTLINES

► **Allegheny Airlines** carried 42,580 passengers over more than 7.7 million passenger miles in November, a 29% increase over November, 1957. During the three-month period ending Nov. 30, the airline's traffic was about 17% ahead of 1957. The airline also registered a 59% increase in air freight over last November.

► **Avensa International Airways** of Venezuela has opened an office in New York's Rockefeller Center to handle passengers planning to fly the airline from Miami to Jamaica and Venezuela. The new office, designed to handle passenger traffic throughout the Northeast and as far west as Chicago, is the third U.S. office opened by Avensa. Others are in New Orleans and Miami.

► **Irish Air Lines** reports a 34% increase in operating surplus for its European services during the first half of its Fiscal 1958-59 year which ended Sept. 30. During the period, the company registered earnings of $998,800, based on total revenues of $6,972,000, as compared with $735,600 based on total revenues of $5,549,600 for the April-September period of 1957. IAL carried 348,272 passengers during the first half, up from 307,056 last year, and 3,526 tons of air cargo as compared with 3,013 tons carried during the 1957 period.

► **Lockheed Aircraft Service-Overseas,** Ontario, Calif., has received a contract from Garuda Indonesian Airways to provide technical assistance for the operation and maintenance for the airline's Lockheed Electra turboprop transports. The state-owned airline operates throughout Indonesia and also serves Singapore, Manila and Bangkok.

► **Mohawk Airlines** has been granted $689,032 in temporary back mail pay for the July 1, 1955-April 30, 1958, period in an order issued by the Civil Aeronautics Board. The CAB order raises Mohawk's total mail pay for the three-year period to $5,043,569, or approximately $150,000 per month.

► **United Air Lines** has ordered 16 tow tractors for ground handling of Douglas DC-8 and Boeing 707-720 jet transports. Eight of the tractors will be manufactured by Frank G. Hough Co., of Libertyville, Ill., and eight by the Kenworth Motor Truck Co. Division of Pacific Car & Foundry, Seattle, Wash. Scheduled deliveries are for July, 1959. The tractors will be about 8 ft. wide, 20 ft. long and 5 ft. high, with a wheel base of 110 in.

AIRLINE OBSERVER

► International Brotherhood of Teamsters' bid to represent the airline industry is gaining strength through its support of the Flight Engineers International Assn.'s strike against Eastern Air Lines. Acceptance of a $200,000 loan with no strings attached by the engineers from the teamsters appears to be paving the way for a more direct association. Most observers now feel the teamsters will make their entry into the airline picture through organization of airport concessionaire and allied workers.

► **Capital Airlines has taken on loan a total of 24 Eastern Air Lines stewardesses for the duration of the Flight Engineers' strike against Eastern. The stewardesses will wear their Eastern uniforms while on duty with Capital.**

► Civil Aeronautics Administration will establish "airspace review teams" for the purpose of studying and taking inventory of the actual use of allocated airspace. Review teams will be headed by the 12 air traffic supervisors of CAA's Office of Air Traffic Control who are responsible for airspace and traffic control problems within areas covered by Air Route Traffic Control Centers.

► **Air France and Scandinavian Airlines System will begin Caravelle turbojet service on May 15. Air France will use its initial fleet on the Paris-Rome-Athens route. SAS has not yet determined the routes on which it will operate the aircraft. Later, Stockholm-Copenhagen-Paris service will be operated by the two carriers on a pool basis.**

► First Russian four-turboprop Antonov An-10 Ukraina transport has been placed in cargo service on the Kiev-Sverdlovsk, Kiev-Tashkent and Kiev-Moscow routes. Several more An-10s will be used for the same type operation out of Kiev before the end of the year. Russian reports again point up the long delays experienced by Aeroflot in getting the An-10 into regular passenger service. First flown several months before the four-turboprop Il-18 Moskva, the An-10 now lags more than two months behind the Moskva's flight test program (AW Oct. 13, p. 44). Under present plans, the An-10 will begin passenger service nearly a year behind the original target date.

► **Federal Aviation Agency has been assigned a total of 36 military officers for active duty beginning Jan. 1. Orders have been cut for 18 Air Force officers, 12 naval officers and six officers from the Army.**

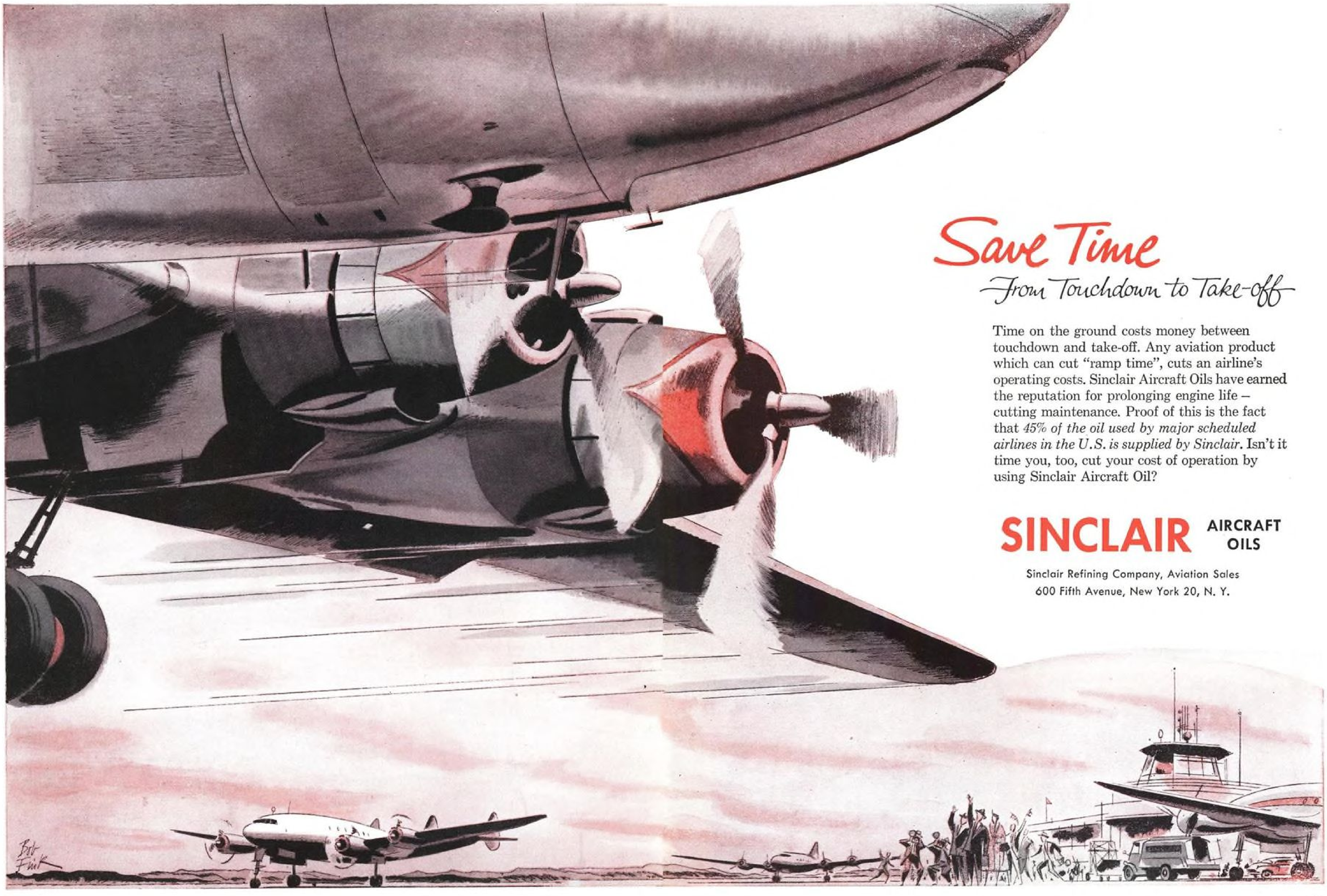
► Scheduled airlines last year spent $24 million for advertising in newspapers, or four times the amount spent by U.S. railroads.

► **Capital Airlines has been granted a 1,700 hr. overhaul period on its Rolls-Royce Dart engines by the Civil Aeronautics Administration, expects the span to be increased to 2,000 hrs. shortly. Engines are used on Capital's Vickers Viscount turboprop transports.**

► Military Air Transport Service has operated 45 overseas flights since Nov. 21 to handle airlift commitments contracted to Trans World Airlines in October. MATS took over the flights as a result of the International Assn. of Machinists strike against TWA.

► **KLM Royal Dutch Airlines expects to be the first European carrier to receive the Lockheed Electra in 1959. Delivery schedule calls for KLM to receive its first Electra by October, 1959, with future deliveries estimated at four-week intervals. KLM says the American turboprop will be ideal for many of its European and Near and Middle Eastern routes based on flight tests which indicate an elapsed flight time of only 2 hr., 20 min. from Amsterdam to Rome as compared with 3 hr., 45 min. for the Lockheed Super Constellation.**

► Civil Aeronautics Board has adopted amendments to Civil Air Regulations that provide new standards for altimeter settings. Under the revised ruling which will become effective Jan. 15, flights operating below altitudes of 23,500 ft. will set altimeters to the setting of a station within 100 mi. For flights above 25,000 ft., altimeters will be set to 29.92 in. of mercury.



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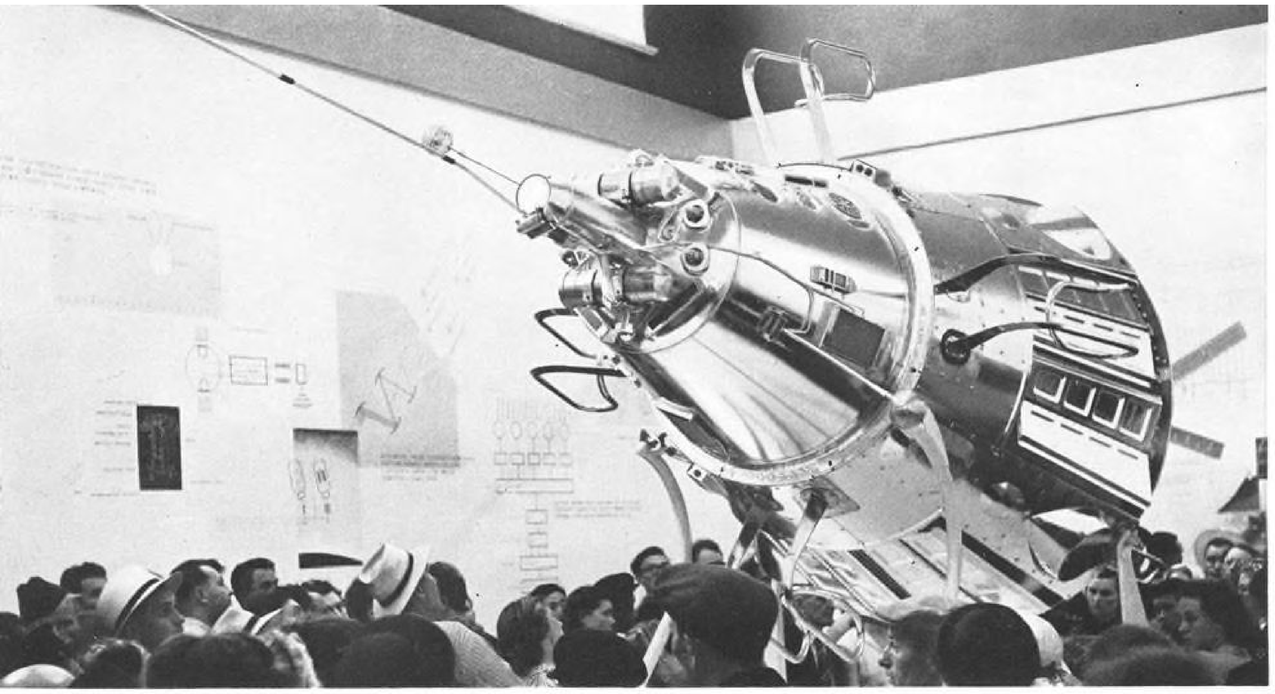
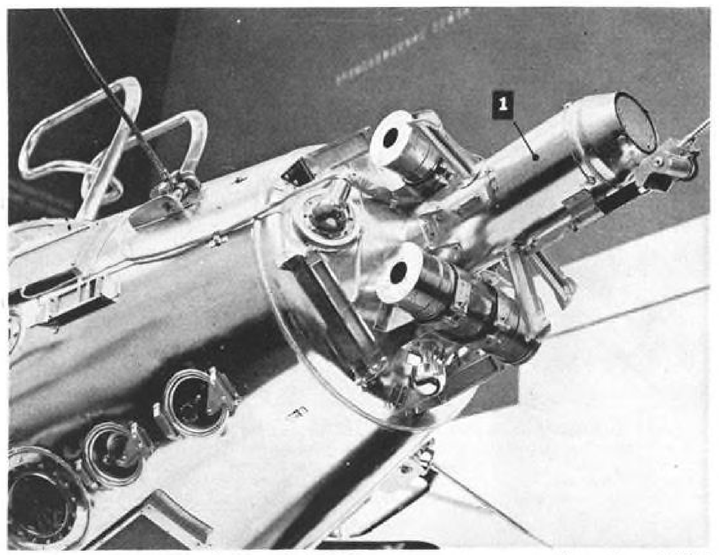
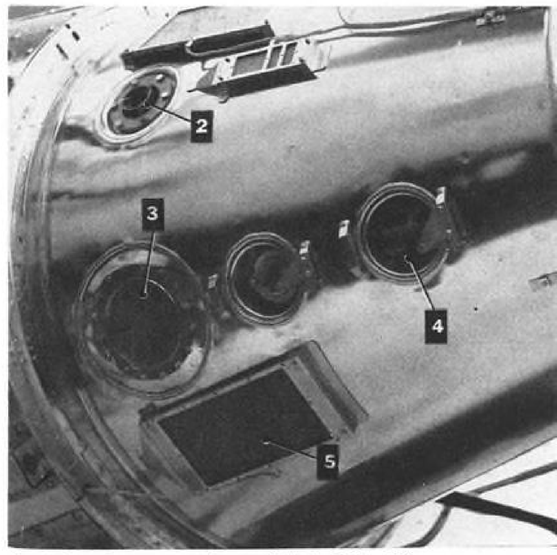


DOORS near conical base of Sputnik III, shown on industrial display at Moscow, swing outward or lie flat to change radiation coefficient and control internal temperatures. Ball microphones measure positive ion concentration. Large bent hooks in front are for telemetry use.





PROTRUDING cylinder at left (1) houses magnetometer to determine satellite's orientation. Instrumentation at right includes (2) mass spectrometer tube; (3) electrostatic measuring device; (4) ionization meter, (5) solar battery or micrometeorite impact measurement device.

Soviets Use Electronic Network to Track Sputnik III

Washington—Soviet scientists claim to have made several surprising discoveries with the mass of instrumentation carried in their third earth satellite, according to the Communist newspaper Pravda.

Pravda also printed what is believed to be the first admission that Russia has an extensive electronic tracking network. Soviets have talked freely about optical tracking stations but have avoided discussion of radio and radar tracking.

In an extensive article describing scientific findings made with Sputnik III, Pravda notes that "for the first Sputnik, 60,000 electronic and 400 optical observations were processed, and for the second Sputnik, 12,800 electronic and 2,000 optical observations. Tens of thousands of observations of the third Sputnik already have undergone processing."

The unsigned article is based on reports made at the World Assembly of the Special Committee of the International Geophysical Year, which was held several months ago in Moscow (AW Aug. 18, p. 32).

Findings Reported

Among the findings reported by Pravda are:

• **New data** on the determination of the ion composition of ionosphere within the range of altitudes from 230 to 950 km. (140-600 mi.). Prevalent ions in this sector are those of atomic oxygen. Ions of atomic nitrogen also were recorded, but they amounted to only about 3 to 7% of the amount of oxygen. No ions of molecular oxygen or nitrogen were observed. The mass spectrometer also registered ions of water vapor. "A very careful analysis . . . indicates that (Sputnik III) itself was responsible for the presence of water," Pravda said, "because it carried a certain amount of it on its surface to the upper layers of the atmosphere. However, the fact of the ionization of evaporating vapors in the upper atmosphere remains puzzling."

• "**A noticeable quantity** of ions was discovered at the altitudes of the order of 1,000 km. (620 mi.) where, according to the previous ideas, the terrestrial atmosphere passes into interplanetary gas."

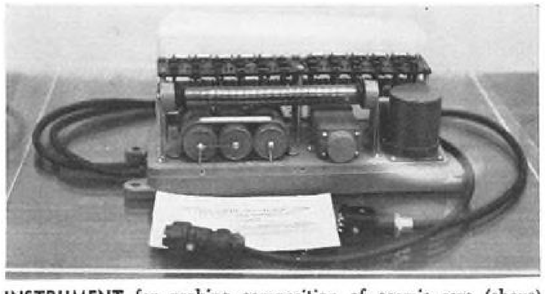
• "**Temperature** of ionosphere electrons is much higher than the temperature of neutral particles and ions present at these altitudes. This is a surprising development which requires further study and explanation. At present the only thing possible is to advance various hypotheses for the explanation of this formerly unknown phenomenon . . . It is quite possible that the high temperature of electrons is due to the existence of alternating magnetic fields." These conclusions are based on measurements made with spherical ion collectors covered with spherical ion screen traps and mounted on rods jutting out to the side of the satellite.

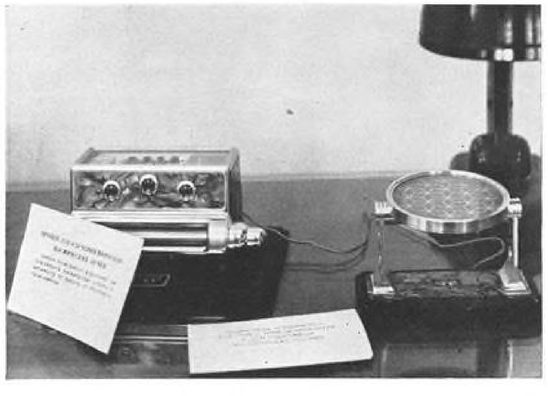
• **Temperature** of electron gas in upper layers of the atmosphere "must considerably exceed the temperature of the neutral gas, which is substantiated by the data obtained by the instrument designed for the measurement of ion concentration. The measured intensity of the field in the upper layers of the atmosphere turned out to be unexpectedly large. Its value exceeds the expected values at least 10-100 times." These remarks were based on measurements made by means of two electrostatic fluxmeters, with their pick-up points installed in symmetrical points on the satellite's surface. Each sensing element consisted of an insulated measuring plate which was uncovered and covered 1,500 times per second by a special shield connected to the shell of the satellite.

• "**For the first time** in history," geomagnetic measurements were made from a satellite "to study the spatial distribution of the constant field of the earth at high altitudes and the comparison of the spatial distribution of lines of magnetic field of identical intensity and the identical intensity lines of cosmic rays."

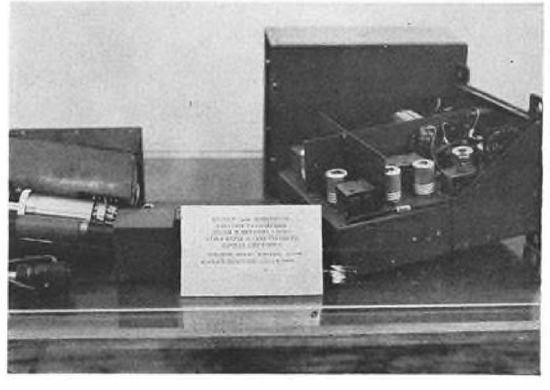
Magnetometer Orientation

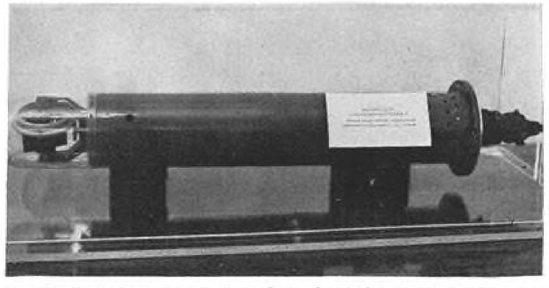
Magnetometer used in Sputnik III kept its measuring element oriented "in the direction of the complete vector of the terrestrial magnetic field, regardless of the orientation of the Sputnik itself." Current passed through a coil mounted on the sensing element in such a direction that the current would fully com-





INSTRUMENT for probing composition of cosmic rays (above) permits measurement of atomic nuclei within the charge. Device to measure radiation (right) is connected to a silicon solar battery (circular instrument at far right).





ELECTROSTATIC fields, including Sputnik's own charge, are measured by instrument at left. Above is nose magnetometer; one end of electromagnet always points the center of earth. As nose position changes, electromagnet turns wheel (left), to feed data.

Three Sputniks' Orbital Deviations

Washington—Orbital deviations of the three Soviet Sputniks as reported in Russia include:

- Precession of the orbits from east to west were 3.157 deg./day for Sputnik I, 2.663 for Sputnik II and 2.528 for Sputnik III.
- Slow shift of the point of perigee to the south was 0.432 deg./day, 0.407 and 0.326 for the three satellites, respectively.
- Altitude of the perigee of Sputnik II decreased by approximately 15 mi. during 1,500 revolutions, while the height of the apogee decreased by more than 300 mi.
- Reduction in the length of the period of revolution in one day in the beginning of the flight amounted to 1.8 sec. for Sputnik I, 3.08 for Sputnik II and 0.75 for the third satellite.
- Sputnik II, which carried the dog Laika (AW May 26, p. 28), precessed about an axis that formed an angle of 86 deg. with the satellite's longitudinal axis. Period of this precession was about 206 sec. Deductions on the rotation were based partly on observations of the period of the change in brilliance. Axis of precession of Sputnik III was located at an angle of 84 deg. to the longitudinal axis, and period of precession amounted to approximately 140 sec. Period of rotation about the longitudinal axis was about 18 min. Spatial direction of the precession axis also was ascertained, according to Russian sources, but it was not reported.

pensate for the terrestrial field in the volume taken by the sensing element, and served as a measure of the magnetic field and its fluctuations.

Two potentiometric sensing elements on the magnetometer's orientation system made possible the determination of the orientation of the satellite in respect to the terrestrial field, and of the speed of Sputnik's rotation around its axis.

Based on this, Sputnik III rotated on its axis with a speed on the order of 0.36 deg./sec., and at the same time precessed around an axis that does not move in space. This motion was accomplished within the period of 140 sec. From this data, Pravda said, "it is possible to determine the absolute spatial orientation of the Sputnik in relation to a specific system of coordinates."

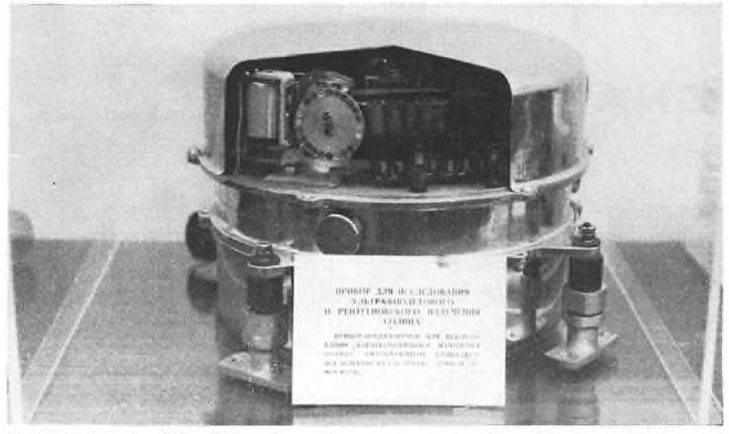
Because of the precessional nature of the satellite's motion, the basic part of the deviational error caused by other instruments in the satellite can be eliminated. This effect already had been determined experimentally and under laboratory conditions.

"Knowing the maximum value of magnetic deviation," Pravda said, "it can be deemed that the Sputnik's magnetometer realistically measures the intensity of the terrestrial magnetic field and the projection of the vector of magnetic interference in the direction of the terrestrial magnetic field."

Magnetic Anomaly

Analysis of magnetograms dealing with the area of the Eastern Siberian magnetic anomaly "demonstrates that this anomaly recedes with altitude very slowly. This experimental fact speaks not in favor of geophysic hypotheses based on the supposition that the sources of this continental anomaly lie in the upper layers of the earth's crust," Pravda said.

"Scanning of the data also provides the discovery of special points which are characterized by comparatively short-



ULTRAVIOLET and X-radiation from the sun was measured by this type of instrument. Casing was cut away to show detail. Satellite's instrument payload weighed 2,134 lb.

period but rapid fluctuations of the magnetic field."

These coincide in time with passage of Sputnik through the F_2 layer of the ionosphere, and may be tied to "the assumed systems of currents in the upper layers of the atmosphere." This must be checked by analysis of all statistics, Pravda said.

"The question of whether these current systems really exist is of an exceptional importance for numerous problems of geophysics and astrophysics."

Radiation Findings Agree

Cosmic and corpuscular radiation findings made with Sputnik III instrumentation generally agree with U. S. findings made with Explorer satellites. Soviets measured charged particles, photons and heavy atomic nuclei.

Photons were measured with a luminescent counter, basic part of which was a photomultiplier connected with a crystal of sodium iodide. The instrument was linked to the "Mayak" (beacon) radio transmitter. It measured both the total ionization in the crystal and the number of impulses for energies above 35,000 electron volts released in the crystal. These values were transmitted by means of changes in the length of signals sent by the transmitter.

Sharp change in the number of photons was recorded around 60 deg. N. latitude. On the south- to north-pass, the intensity comprised 300-500 photons/sec. and then sharply increased. On the north-to-south flight, very high intensity was observed at first, but this rapidly decreased beyond 60 deg.

If the particles that cause polar lights include electrons with energies of several hundred thousand electron volts, landing of these on the skin of the satellite results in formation of hard X-ray radiation, which is recorded by the luminescent counter, the article said.

Even more intense fluxes of charged particles were observed in the equatorial zone. Intensity increased sharply with altitude and with approach to the equator. The number of particles in these fluxes exceeded several thousand times the number of particles in the flux of cosmic rays. Pravda said phenomena similar to this "halo" of swiftly moving particles retained by the magnetic field "may be observed near other celestial bodies that possess magnetic fields."

Heavy Atomic Nuclei

Gage to record heavy atomic nuclei in the primary cosmic radiation was able to record nuclei beginning with the value of the charge over 16, and for the other group of nuclei, beginning with the value of the charge over 30.

Counter is a photoelectronic multiplier and a plastic glass detector. This

Navy Project Squid

Groups and individuals desiring to obtain grants under the Navy's Project Squid for basic and applied research program in the field of jet propulsion have been requested to submit their proposals by Jan. 31, 1959.

Proposals should be sent to Project Squid Headquarters, James Forrestal Research Center, Princeton University, Princeton, N. J.

Project Director Dr. John B. Fenn suggests that those interested contact him first on an informal basis to discuss the proposed projects. This will enable Dr. Fenn to tell potential applicants beforehand whether or not it is worthwhile for them to apply.

Sponsored by the Office of Naval Research, and managed by Princeton University, Project Squid is concerned primarily with fundamental research on the conversion of energy to thrust. Material studies, even though related, are handled by another branch of ONR. Most of the Squid programs, since the project's inception in 1946, have been in the areas of fluid flow, combustion and heat transfer.

Because of its emphasis on fundamental research, Project Squid generally favors university applicants. Present contracts range from $5,000 to $60,000 with the average contract between $20,000 and $25,000. Owing to their long range nature, most Project Squid programs normally are continued for more than one year.

registered only atomic nuclei with very high energy, exceeding 300 million electron volts for each component part of the nucleus (proton or neutron).

Average number of nuclei with a charge above 16 was 1.2/min. Only one nucleus with a charge over 30 was recorded. The number of atomic nuclei heavier than that of iron was approximately 1/10,000 of the number of nuclei of iron, nickel and cobalt.

Ionization of the upper atmosphere is affected by hard electromagnetic solar radiation and by corpuscles—fast protons, alpha particles, electrons, etc. Effect of corpuscles is especially intense at high geomagnetic latitudes, the article said. If their penetration happens at night, polar lights develop simultaneously with the increase of ionization.

Fluorescent screens, covered with aluminum foils of various thicknesses, were used to measure corpuscular radiation but electron streams were sometimes so intense that they exceeded upper limits of the device and the device "went scale-less." Based on readings on the calibrated scale, Soviet scientists "suppose that the energy of electrons reached the value of 10,000 electron volts.

"If we ascribe to electrons the above

stated energy, then the energy flux at the threshold of response comprised about one millionth of the total solar energy that falls on 1 sq. cm. of the global surface," the article said.

"At the moment when the readings went beyond the calibrated scale, this value increased to 1/1000th. The intensity of the electronic stream constantly changed—increased with altitude and over high geomagnetic latitudes.

"These electrons cannot directly be solar corpuscles, because their speed is much higher than the speed that has been established for solar corpuscles from observations of polar lights.

"Rather, they can be explained by the above-mentioned process of acceleration of electrons in the external atmosphere by the alternating geomagnetic fields."

Cosmic Photons Unrecorded

Instrument for recording cosmic photons could not record them because of interference from X-radiation developed by irradiation of the satellite's shell by hard electrons.

Instead, it provided "valuable additional data on not-too-hard electrons of the outer atmosphere, the existence of which was formerly seriously doubted." This phenomenon "may explain several anomalies in the ionosphere and may turn out to be a supplemental source of heating of upper atmosphere over the polar regions," Pravda said.

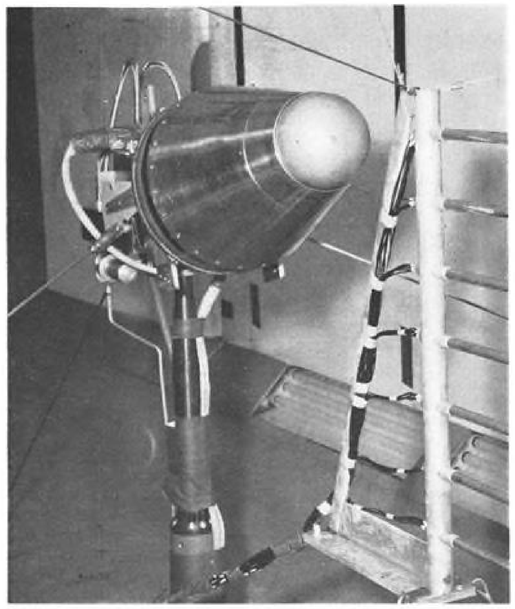
In addition to nine small solar battery sections used to power the beacon radio, Sputnik III carried experimental solar batteries placed at two opposite sides of the satellite's shell.

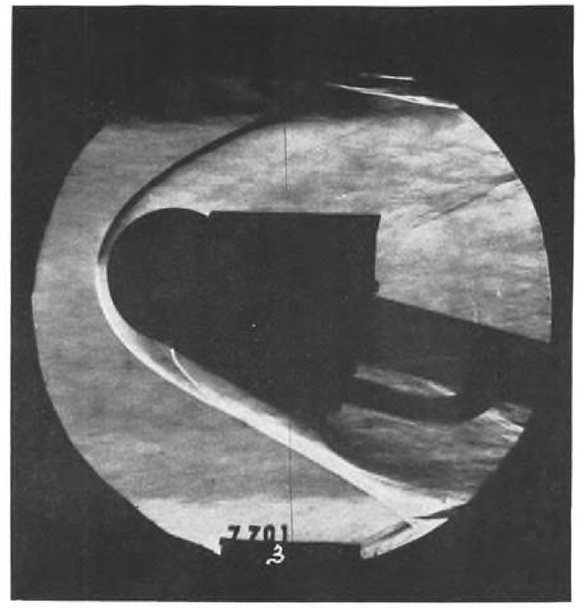
Four of the power batteries were placed on the front frame, four on the side and one on the rear. All were connected in parallel with diodes.

Experimental batteries were placed at two opposite sides of the shell. They used a super-pure monocrystallic silicon photoelement in plate form, less than 1 mm. thick. Plate consists of two sections possessing opposite conductivity mechanisms. Coefficient of conversion of solar energy was 9-11% while voltage of one element amounts to 0.5.

Rhodesian Radio Group Supplies Satellite Data

One of the best sources of telemetered data from U.S. satellites is an amateur station in Salisbury, South Rhodesia (Africa), operated by members of the local radio society, according to University of Iowa scientists who analyze data from all ground telemetry stations. The station has operated without U.S. financial support until recently when arrangements were made to supply magnetic tapes for recording satellite data.





TOTAL impact pressure port on Q-Ball (left) is positioned directly into relative wind to pick off q at the stagnation point. Schlieren photo (right) shows Q-Ball at 16 deg. angle of attack at Mach 6.8; note slight secondary shock wave along lower edge of lip.

Q-Ball Designed for Control in Space

By Russell Hawkes

Los Angeles—Promising solution to the key space flight problem of directional and angle of attack control during re-entry is a device called Q-Ball (AW Nov. 10, p. 29), designed by Nortronics Division of Northrop Aircraft, Inc., to a requirement stated by National Aeronautics and Space Administration for the North American X-15.

Q-Ball is a servo-positioned, gimbaled sphere which keeps a stagnation pressure port pointed into the relative wind. In the X-15, cockpit indicators of the orientation of the sphere relative to pitch and yaw axes of the airplane will be among the pilot's primary flight instruments at extreme altitude and during re-entry. Angle of attack and angle of sideslip will have to be closely controlled because of their important effects upon speed, range, duration of flight, angle and rate of descent, structural loads and aerodynamic heating. Direct measurement of dynamic pressure or "q" at the true stagnation point will also supply valuable information to the pilot since it will control the limits upon speed and angle of attack.

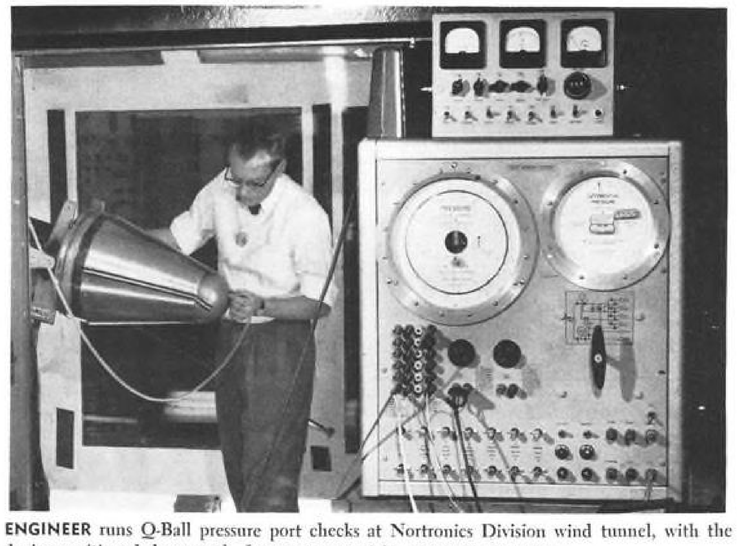
First flights of the X-15 will be made with conventional boom-and-vane sensors rather than Q-Ball which will not be ready in time. That part of the program is not expected to explore environmental extremes for which Q-Ball was designed and in which vane-type sensors will not operate or survive. The pressure-nulling spherical sensor is especially designed to be useful through an unusually wide range of temperatures, altitudes and speeds.

ABMA Interest

Army Ballistic Missile Agency has expressed interest in Q-Ball, presumably for missile applications. Comparatively little development would be needed to tie the sensor into an autopilot loop to provide good automatic control of aerodynamic attitude in typical ballistic missile environments.

The Q-Ball system consists of an inner positional servo loop controlled by an outer, unity feedback, differential pressure control loop.

Inner position loop advantages are:



ENGINEER runs Q-Ball pressure port checks at Nortronics Division wind tunnel, with the device positioned downward. Instrument at right measures pressures.

Q-Ball Specifications

Sphere positional accuracy	±0.25 deg. (nominal)
System threshold	0.001 psi. max.
Frequency response	Flat to approximately 10 cps.
Velocity capability	120 deg./sec. (except at extremely high "Q" saturation)
Velocity error	1 deg. @ 60 deg./sec.
Q-compensation	Gain compensated for operation over dynamic pressure range of 15.0 to 2,500 psf.
Stagnation temperature capability	4,000F max.
Altitude capability	Sea level to 300,000 ft.*
Mach capability	Subsonic to M = 10*

* Limited to Q = 15.0 to 2,500 psf. and stagnation temperature = 4,000F.

• **Null stability** of outer control loop is unaffected by null shift with temperature which occurs in the electrohydraulic control valve of the positional loop.

• **Change in gain** of electrohydraulic valve in positional loop due to variation of fluid viscosity with temperature is reflected in control loop as a change in a dynamic term of the outer open loop transfer function rather than as a change in outer loop gain.

• **Complete positional loop** can be operated in pre-flight check without simulating actual dynamic pressure.

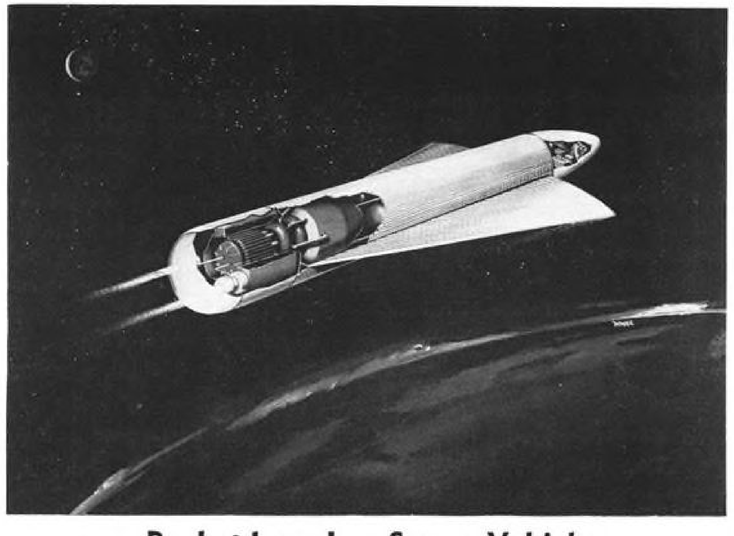
Transistorized Circuits

Electronic circuits of both loops are completely transistorized to cut size and power requirements, reduce the amount of heat to be dissipated and improve reliability. Drift in the outer loop is minimized by retaining and amplifying 400 cps. output of the differential pressure transducer and gain changing amplifier circuits.

Q-Ball is intended to work within an extremely wide range of dynamic pressures extending from 15 psf. to 2,500 psf. Outer open loop gain change of 167 to 1 is needed to correspond with this variation and is provided by gain changing amplifier network. Unusually accurate instrument servo makes network's resistance change a function of dynamic pressure.

The servo is programmed by the output of a differential pressure transducer which measures the difference between total stagnation point pressure at the center port on the sphere and the pressure at one of the sideslip ports 43 deg. around the sphere's surface. Outer loop differential pressure was selected to get desired null stability and low threshold.

Transducers are located in the fixed part of the installation and pressure from the ports is carried to them through flexible tubing and a manifolded bulkhead. Electrohydraulic actuation of the ball-positioning servos offers the advantages of high torque output, low threshold, fast response and small size. Use of rotary actuators which are coupled directly to the ball eliminates backlash which exists in gimbaling and conventional actuators.



Rocketdyne Ion Space Vehicle

Discharge of ionized particles would provide propulsive force in this artist's conception of an ion rocket vehicle for space flight, prepared by Rocketdyne Division of North American Aviation, Inc. Vehicle would be 80 ft. long, 8 ft. in diameter; ion engines could generate ½-lb. thrust each, with power coming from a nuclear reactor. Wing-shaped attachments are radiators to reject excess heat. Direction would be controlled by swiveling rockets. It would take the 10,000 lb. vehicle about three months for a trip to the moon and about nine months to Mars. Chemical takeoff booster would produce 50,000 lb. thrust for 6 sec.

Fellowships Offered For Space Studies

New York—Annual screening for fellowships for graduate study in astronautics, rockets, jet propulsion and flight structures has started here.

Eighteen to 20 fellowships will be given for study during 1959-60 at the Daniel and Florence Guggenheim Jet Propulsion Centers at California Institute of Technology and Princeton University, and the Daniel and Florence Guggenheim Institute of Flight Structures at Columbia University.

Six to eight fellowships are awarded for advanced study at each center and the institute. They provide tuition and payment of $1,500 to $2,000, depending on the student's advancement.

Applicants must file with the university of their choice by Mar. 1, 1959.

Navy Heat Tests Use Simulated Human Skin

New York—Material simulating human skin will be part of a device to develop proper clothing for pilots exposed to radiation from direct sunlight at extremely high altitudes.

Material would be laid over a metal cylinder, which would be instrumented to measure temperatures above and below the "skin" surface. Investigation will be in an area where tolerance-limiting factors are in pain and thermal blistering, according to a paper presented to the Society of Mechanical Engineers annual meeting here by Alice M. Stoll, physiologist, and Leon C. Greene, senior research pharmacologist, both of U. S. Naval Air Development Center of Aviation Medical Acceleration Laboratory, Johnsville, Pa.

In another report, L. P. Herington, of John B. Pierce Foundation, New Haven, Conn., said tests to determine effect of complex air and radiation temperatures on humans have been conducted at a 40-105F range on a man-shaped model. The model, used in conjunction with other methods, is electrically heated and is coated with copper.

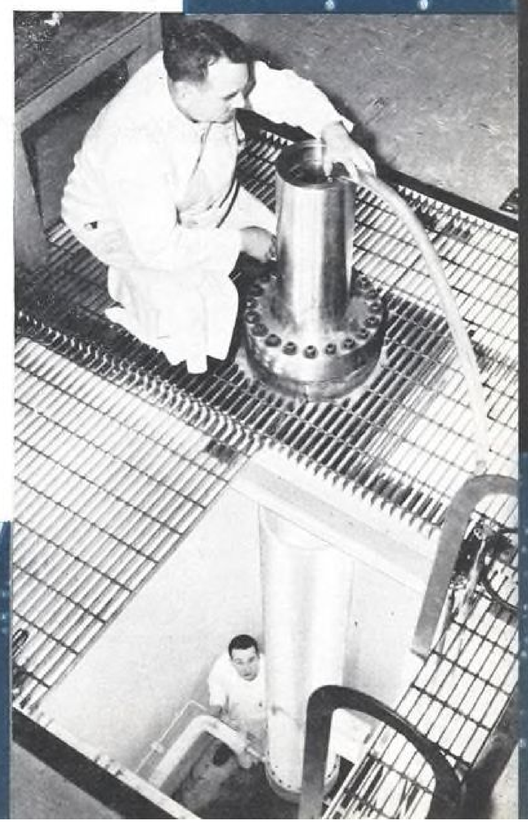
TAPCO INTEGRATED FACILITIES

provide components and assemblies for propulsion systems and complete auxiliary and accessory power sub-systems

Over 50 years of experience in developing metals and designing components for power plants gives the Tapco Group a vast experience in research, development and manufacturing of assemblies and components for propulsion and power systems and sub-systems.

Now, Tapco's capabilities have been broadened to include most phases of nuclear-power plants and accessories. Control rod drives, fuel-handling systems and other types of mechanisms are designed, built and tested within the Tapco Group.

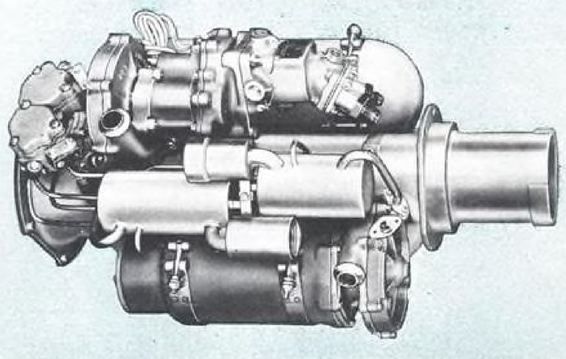
Complete environmental test facilities are used to research special metallurgical problems associated with radiation, high temperatures and pressures. Autoclaves with supporting equipment and controls simulate conditions found in pressurized water reactors.

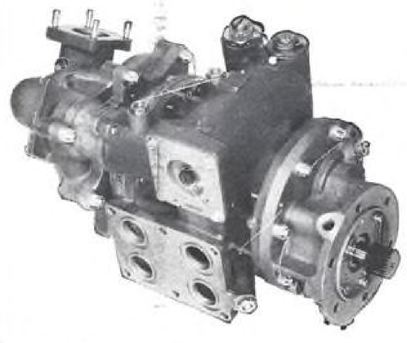


Functional testing of nuclear reactor control rod drive mechanisms in an autoclave is part of Tapco's continuing research program on nuclear components and control systems. ▶

◀ Special techniques of forming, heat-treating, and resistance welding used in producing this large weldment for jet engines contribute to the broad background of the Tapco Group in manufacturing rocket engine cases by hydrospinning and other methods.

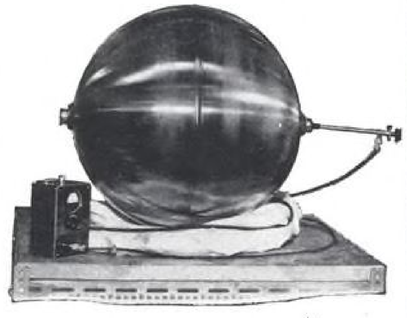
Self-contained solid-propellant auxiliary power unit designed and built at Tapco to produce electric and hydraulic power. ▼





At left: Combination main and afterburner engine-driven fuel pump now providing thousands of hours of trouble-free service in production fighter aircraft.

At right: Titanium missile-borne pressure vessel designed and fabricated at Tapco. Fully-qualified for use with gaseous helium under operating conditions of 5,000 psi at -320°F.



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OTHER INTEGRATED SERVICES FROM TAPCO INCLUDE DESIGN, DEVELOPMENT AND PRODUCTION IN THE FIELDS OF STRUCTURES, ELECTRONICS, METALLURGY AND NUCLEAR POWER.

Metal-Base Fuels Tested for Turbojets

By Michael Yaffee

New York—Use of more refined scientific yardsticks for rating high energy fuels appears to strengthen the position of metal base materials but doesn't diminish the problems involved in trying to use them in operating jet engines.

Substitution of certain metal base fuels for current hydrocarbon fuels during part or all of a flight mission can yield significant improvement in aircraft performance, according to J. R. Branstetter of National Aeronautic and Space Administration's Lewis Flight Propulsion Laboratory.

In particular, the use of magnesium slurries or boron hydrides can increase net thrust up to 30% or extend operating range by lowering specific fuel consumption as much as 39%. It can also reduce the danger of flameouts, owing to the high chemical reactivity of the fuels and, as a result of the increased thrust, improve flight maneuverability and shorten takeoff distances, according to Branstetter.

The general attractiveness of metal base fuels has been evident for some time, Branstetter said. But until recently, these fuels have been judged primarily on the basis of heating value. Heating value, however, is a crude yardstick, he said, and skips over some important factors. A better approach is through an examination of the thermodynamic behavior of the combustion products.

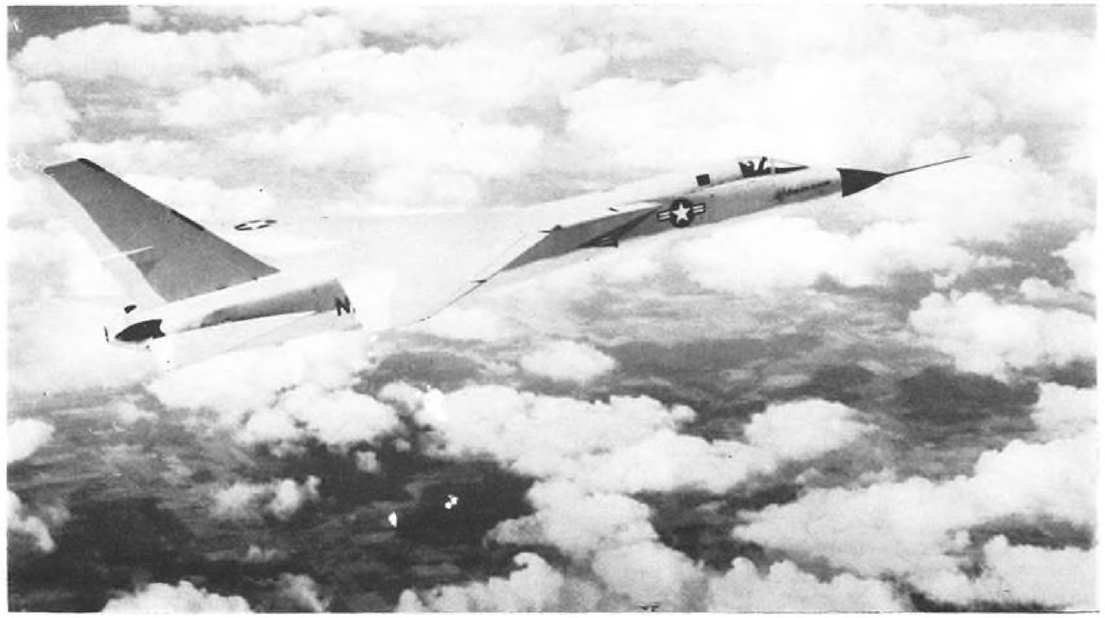
Using this approach, Branstetter investigated diborane, pentaborane, boron-JP slurries and magnesium-JP slurries. Aluminum, attractive because of its high energy per unit volume, unfortunately presents a severe deposit problem, said Branstetter; this alone is enough to eliminate aluminum from serious consideration. Aluminum burns to aluminum oxide which has a melting point of 3,720F. The oxide impinges on the cooler combustion surfaces, which are at temperatures less than 2,000F, and forms a sintered mass that cannot be melted off without damaging the engine parts.

Exhaust Product

Beryllium, which also ranks higher than JP fuel on an energy per unit weight basis, is not considered either. For one thing, its exhaust product, beryllium oxide, is extremely toxic. Too, the availability of the metal is comparatively low. On the other hand, magnesium is relatively plentiful and, slurried with conventional JP fuel, provides a significant increase in thrust capability. At a Mach 2 flight condition, a 60% magnesium slurry at a fuel/air ratio of 0.18 provides a 30% net thrust improvement over the maximum thrust obtainable from JP fuel alone. While magnesium burns to a high melting point oxide (about 5,000F), Branstetter said, deposits of magnesium oxide on engine surfaces do not present a serious problem.

At the same time, however, magnesium slurries have a lower heat of combustion than straight JP fuel and this results in a higher specific fuel consumption. Thus, an engine burning magnesium slurries can achieve high thrust outputs but only at the expense of high fuel consumption and foreshortened operating ranges.

In the case of the boron-containing fuels, flight range considerations or low specific fuel consumption are the main selling points. At air specific impulses below about 125 sec.; i.e. in the turbojet operating regime, the boron slurry gives a lower specific fuel consumption



A3J Undergoes Flight Test Program

North American Aviation A3J Vigilante flies to Palmdale, Calif., from Columbus, Ohio, for continued flight tests. The Navy bombing attack weapon system is powered by two General Electric J79-2 turbojets developing 15,000 lb. thrust each (AW May 19, p. 27).

than JP fuel for a given thrust level. Above 154 sec. or in the ramjet and afterburner regime, the slurry has a heating value 19% higher than JP fuel but results in greater fuel consumption than the petroleum fuels. Moreover, the boron slurries exhibit poor chemical reactivity.

As a result, Branstetter concludes that slurries show little promise as aircraft fuels.

Diborane and pentaborane, however, give a lower specific fuel consumption than JP fuels at all thrust levels of interest. In the turbojet operating region (from about 100 sec. to 125 sec. air specific impulse), diborane and pentaborane offer fuel savings, on a weight basis, of 39% and 31%, respectively; in the afterburning and ramjet regimes (from 135 sec. to about 165 sec. air specific impulse), of 34% and 27%, respectively. At an air specific impulse of about 155 sec., however, the boric oxide formed during combustion starts to vaporize, absorbing approximately 2,000 Btu/lb. in the process and thereby increasing specific fuel consumption.

In addition to low fuel consumption, the boron hydrides exhibit high chemical reactivity, a combination, Branstetter said, particularly desirable for long range, high altitude flight.

At the same time, he warned his listeners that his calculations for the boron-containing fuels were based on several assumptions which, if proven in error, could significantly alter the performance results. He stressed particularly the need for establishing the accuracy of the thermodynamics of combustion products containing boric oxide and the kinetics of boric oxide condensation.

In fact, Branstetter declared, the

F8U-3 Configuration Changed

Vertical fin of first Chance Vought F8U-3 Navy fighter (AW June 9, p. 21) has been widened to improve stability. Air scoop has been added in front of vertical fin to improve afterburner cooling, thereby increasing performance. Tail cone has been slightly lengthened.

actual products of borane combustion at high temperatures may even differ substantially from those assumed, which are primarily boric oxide and water. Despite a great deal of work in the area, details of the actual combustion mechanism are still not considered well defined.

There are problems too of a very practical nature that must be solved before the first borane-burning jet engine takes to the air. Important among these are the boric oxide deposits that form in passageways of combustor liners and on turbine blading.

Less severe a problem than that presented by aluminum oxide deposits, it still requires more research before boron fuels can be used with confidence in turbojet engines, according to Branstetter.

Oxide Flow

These deposits of boric oxide, (which has a melting point of 840F) build up an insulating layer on cool engine surfaces, reaching a point at which the deposited oxide flows off at the same rate it is laid down. This equilibrium point depends upon a number of factors and is not at any set thickness. Some method of controlling the deposits must be found in order to keep the thickness of the oxide films within design tolerances, according to Branstetter.

On turbine rotor blading, where centrifugal force acts on the deposited film, it is easier to control deposit dimensions than on a stator cascade. But an actual quantitative description of boric oxide deposition is what is needed, Branstetter added, before any reliable method of controlling film deposits in jet engines can be developed.

Boron Hydrides

Boron hydrides are also difficult to handle. They react spontaneously with air and water at room temperature. To prevent excessive decomposition, they must be stored at or below room temperature.

They are also very toxic. The maximum concentration of boron hydrides permissible in a work area is measured in parts per million.

However, the handling problems of the hydrides can be eased, said Branstetter, by the introduction of a hydrocarbon group such as an ethyl radical into the boron hydride molecule. And this is the approach now being taken by the two present producers of boron-based high energy fuel, Olin Mathieson Chemical Corp. and Callery Chemical Co., which reportedly are making triethyldecaborane and triethylpentaborane.

These alkylated boron hydrides, according to Branstetter, possess energy values intermediate between the pure hydrides and JP fuel.

BOEING B-47 jet bomber is jacked up and optically aligned at Oklahoma Air Materiel Area hangar at Tinker Air Force Base, so that the wing is within 1/30,000th of an inch of its original configuration. The wing then is clamped in this position during the Project Milk Bottle modification program, to ensure that it will be in the proper placement when the modification kit is installed and the wing is recommended to the fuselage. Modification shop is nearly a mile long.

B-47 Wing Project Nears Completion

By Craig Lewis

Oklahoma City—Modification program in which the wings of the Boeing B-47 were beefed up so the bomber could take the strains of toss-bombing operations is now phasing out here at Tinker Air Force Base.

Called Project Milk Bottle, the program has handled 1,800 of Strategic Air Command's B-47 medium bombers since it was launched last April. Milk Bottle cost the Air Force about $30,000 to strengthen the wings of each B-47.

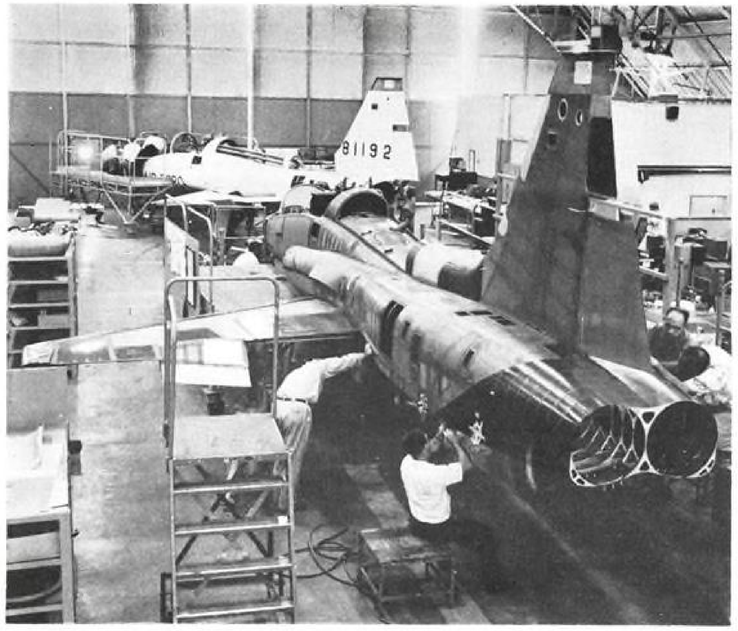
Prime manager for the program was Oklahoma City Air Materiel Area; work also was done at Sacramento Air Materiel Area and at Douglas Aircraft Co., Lockheed Aircraft Corp. and Boeing Airplane Co. facilities. OCAMA has handled over 800 B-47s in its share of the program.

Maj. Gen. Thomas P. Gerrity, commander of OCAMA, calls Project Milk Bottle a striking demonstration of the organization's flexibility and adaptability. This quick response capability is important here, Gen. Gerrity feels, because OCAMA is responsible for logistics support of SAC and is prime manager for 95% of SAC's aircraft.

Accident Analysis

Project Milk Bottle stems from analysis of accident investigation data and aircraft inspections which indicated that some B-47s were developing structural weakness in the wing area. In the older aircraft, which started coming off the production line in 1951, this condition could be ascribed to fatigue from hard use and old age. B-47s average only 400 to 500 fight hours a year now, but the

BALANCING the aircraft to high tolerances is part of preparation for the Project Milk Bottle modification program. Tinker's Ernest L. Rolland (above) uses optical device to check hydraulic jack positions. Modification kits were designed by Boeing Airplane Co. About 1,800 B-47s have been modified.



Northrop T-38s in Final Assembly

Two Northrop T-38 supersonic jet trainers are shown in final assembly line at Hawthorne, Calif., plant. U. S. Air Force has placed a $16,926,000 order for manufacture of T-38As, first production model of the twin-jet trainer (AW Dec. 8, p. 34). Aircraft is powered by two General Electric J85 engines; first T-38 will make its initial flight next month.

figure was much higher during the initial training period.

Second major factor was the fact that SAC was using the B-47 for toss bombing missions which, in effect, requires a bomber designed for high altitude missions to do fighter type work. With the Low Altitude Bombing System, the bomber comes toward the target at high speed and at about 500 ft., then makes a sharp pull-up, releases its nuclear weapon and reverses its flight path to escape the blast.

This violent maneuver when the bomb is tossed imposes heavy strains on the bomber's wings. Other strains come from the unaccustomed turbulence encountered at the extremely low altitude involved in the LABS operation.

Not all B-47s developed structural problems, but there was enough evidence of potential trouble that last April the Air Force decided to modify all of them. Col. Carl V. Ekstrand, Director of Maintenance Engineering at OCAMA, told AVIATION WEEK the program was corrective in the case of the older aircraft, some of which were nearing the limit of their fatigue life in certain wing areas, and preventive in the case of the newer B-47s.

Boeing did the engineering work on the modification and developed the kits. OCAMA managed the program and scheduled 34% of the work into its own depot here. Sacramento Air Materiel Area was assigned 14% of the B-47 fleet; Douglas at Tulsa, Okla. and Lockheed at Marietta, Ga., each did 23% of the work, and Boeing at Wichita, Kan., did the remaining 6%. Douglas and Lockheed were doing maintenance on the B-47 at the time, and the project dovetailed with their established capability.

Boeing B-52 Bomber Makes Practice Hookup

Test aerial refueling hookup is made by Boeing B-52G missile platform bomber on its first flight (AW Nov. 3, p. 32) with Boeing KC-97 tanker. Aircraft, soon to enter Strategic Air Command service, is designed to haul North American GAM-77 missile.

At the height of the program, nine aircraft a day were delivered from the OCAMA depot, although the rate is now down to five a day as the program phases out. Turnaround time for a B-47 was 18 days at the program's peak. At one time, nearly 500 B-47s were down in various stages of Project Milk Bottle, but many of these could have been returned to duty within 48 hr. if needed.

At OCAMA, the Milk Bottle operation started when the B-47s were delivered, disarmed and refueled on the ramp. Fuel cells were removed and fuel systems made safe for inside work. Then the aircraft moved into the hangar for modification.

In the hangar, the B-47 was jacked up to a calibrated position to relieve stresses in the body and wing. The wing

was optically aligned so that it was within 0.030 in. of its original configuration, and it was clamped in that position so that it would retain the proper configuration when the modification was finished.

The name for Project Milk Bottle came from the hinge pin that attaches the wing to the fuselage structure and which is very similar in size and shape to a quart milk bottle. This hinge pin installation was one of the three areas where the B-47 wing structure was beefed up.

Wing Strain

In the area where the wing joins the body, most of the strain occurs at the rear of the wing. At the rear on each side of the center section is one of the pins which attach wing to fuselage and form the hinge point for wing movement. Some of these pins were developing small fatigue cracks which encouraged corrosion.

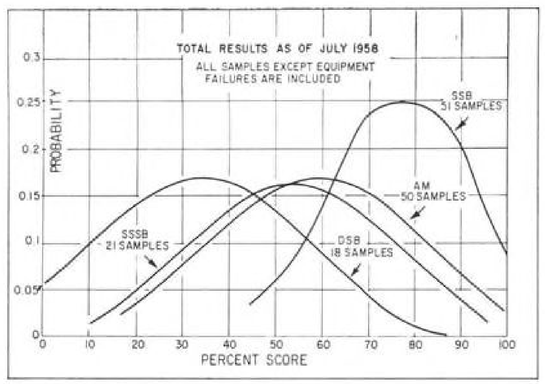
The milk bottle pins were removed by a specially designed hydraulic puller, and a large, right-angled boroscope was used to inspect the inside surface of the forging. Then the hole was bored out, increasing its diameter by $\frac{1}{8}$ in. Pin hole was brought back to its original size with a new bushing.

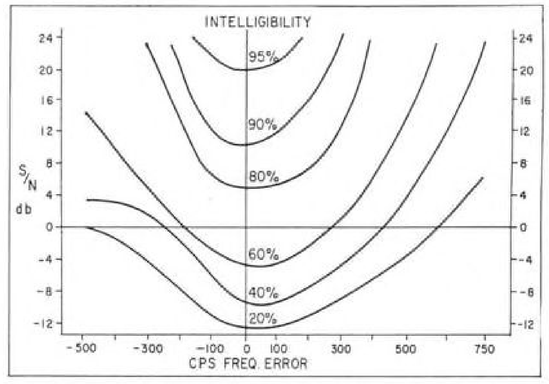
Most of the milk bottle pins were in good enough condition to be replated and put back in the aircraft. Those which showed scoring from wing motion were discarded.

In the wing box area, new plates were installed across the rear section to reinforce the wing where it starts to sweep back and where the stress is greatest. Old splice plates along the line where the wing meets the body were replaced with new plates with protruding fingers which reach away from the joint and spread stress loads over a greater area. Bolt holes were reamed oversize to eliminate small imperfections.

Third area of rework was at the point where the inner and outer wing sections are joined. Small cracks and enlargement of bolt holes were detected in some B-47s in this area. Splice plates inside the wing were removed, and all bolt holes were reamed. Inside plates were replaced, and new plates were installed outside this wing junction to give it greater strength.

After the modification was completed, the aircraft were checked for alignment and inspected, then reassembled. The bombers were put through a flight test program before they were returned to SAC. OCAMA delivered more than 800 B-47s to SAC during Project Milk Bottle, including a number of aircraft that came through for inspection before the kits were ready, then returned later for modification.





PER CENT scores of the single word intelligibility tests (left) plotted on the basis of the average and the standard deviation place both the double sideband suppressed carrier and synchronous single sideband systems below conventional amplitude modulation systems. Plot of Doppler shift vs. intelligibility (right) indicates that for signals with greater than 16 db. signal-to-noise ratio, 90% message reliability can be achieved for much more than a 100-cycle shift. Seventy per cent intelligibility equals 100% message reliability.

USAF Evaluates Single Sideband System

By James A. Fusca

Rome, N. Y.—Change from amplitude modulation to single sideband communications systems for long range ground-air communications by the military services has received increased encouragement from results of evaluation tests conducted by USAF's Rome Air Development Center.

Commercial and civil operators, however, consider military ground-air communications needs to be different from theirs and will resist any immediate shift to single sideband systems both for economic reasons and because no final agreement as to system specifications exists.

The series of tests compared equipments employing conventional amplitude modulation, double sideband suppressed carrier, single sideband, and synchronous single sideband. Results of the tests were presented at the recent meeting of the Airlines Electronics Engineering Group in Denver, Colo., by Dr. Joseph H. Vogelman, who heads the Rome Center's Directorate of Communications.

The most surprising feature of the results was that, while the single sideband technique achieved the anticipated significantly higher single word intelligibility score than amplitude modulation, both the double sideband suppressed carrier and synchronous single sideband systems rated below amplitude modulation on the same basis.

The test program was arranged so that each of the four high frequency communications systems would transmit for five minutes in succession from a common transmitter site to an aircraft equipped with receivers for the four systems.

The information transmitted consisted of phonetically balanced word lists prepared by human engineering scientists at Harvard University which were used to measure speech recognizability or intelligibility.

Transmitter Site

The equipment at the transmitter site consisted of an AN/ARC-58 manufactured by Collins Radio Co., a double sideband suppressed carrier system of the General Electric Co., and a TMC 750 transmitter that could operate as an amplitude modulation transmitter with a program amplifier or as a synchronous single sideband system with a Motorola exciter. In the aircraft, single sideband and amplitude modulation were received by the AN/ARC-58 system, which includes a separate amplitude modulation receiver actually built into it.

Double sideband suppressed carrier was received on an R-390A receiver furnished with a General Electric adaptor, and synchronous single sideband with a Motorola receiver.

The outputs from these receivers were successively switched to a tape recorder as the signals transmitted from the ground were changed. The recordings were usually made over major cities which could be identified by the test crew without question so that position and distance to the trans-

Articulation Comparison Test Data

Aircraft Locations	Date	[1]DSBSC	[2]SSSB	[3]SSB	[4]AM
		% score			
Davenport, Iowa	14 Oct. 57.....	46	–	58	52
Davenport, Iowa	14 Oct. 57.....	38	–	56	42
Davenport, Iowa	14 Oct. 57.....	70	–	70	46
Nashville, Tenn.	12 Mar. 58.....	72	54	88	70
Nashville, Tenn.	12 Mar. 58.....	80	68	82	88
Nashville, Tenn.	12 Mar. 58.....	74	72	96	54
Terre Haute, Ind.	20 Mar. 58.....	–	76	86	90
Terre Haute, Ind.	20 Mar. 58.....	–	66	84	86
Terre Haute, Ind.	20 Mar. 58.....	–	56	66	56
Tulsa, Okla.	21 Mar. 58.....	–	32	64	56
Springfield, Mo.	21 Mar. 58.....	–	34	70	52
Springfield, Mo.	21 Mar. 58.....	–	46	68	78

[1]DSBSC: Double Sideband Suppressed Carrier
[2]SSSB: Synchronous Single Sideband
[3]SSB: Single Sideband
[4]AM: Amplitude Modulation

mitter site were known for each test.

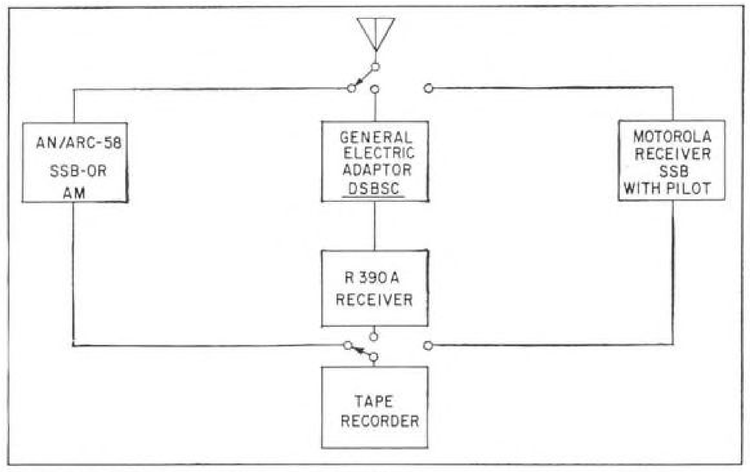
During the first part of the test program outage time on the General Electric and Motorola equipments, which were prototypes, limited the number of tests on which they could be used. Later in the program, however, these manufacturers assigned engineers to keep the equipments in operation during repeats of the earlier tests.

Program Results

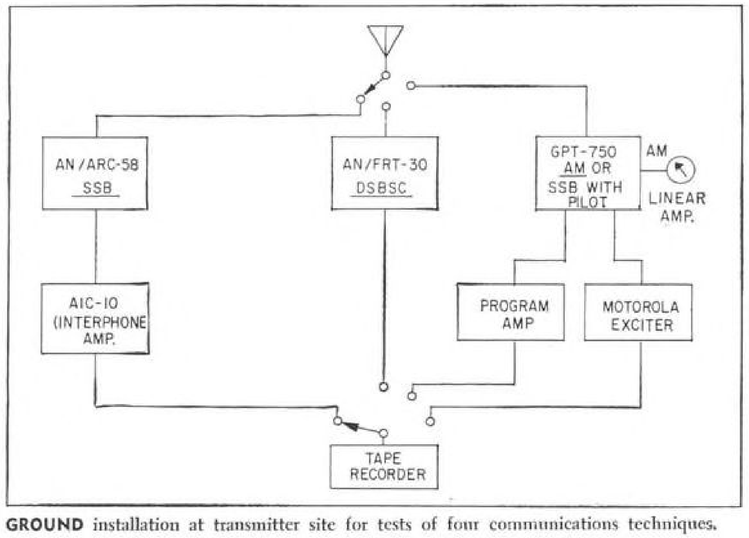
A sample tabulation of the results of the flight test program is given in the box on page 77. These are some of the scores made by taking the tapes and playing them for an audience of trained listeners who would write down the words. Results from all four systems are included. Where no results are given, the particular equipment does not in the opinion of Rome scientists produce tape suitable for running scores.

Total results of the first part of the program are also shown in the graph on page 77 (left). During the later part of the test flight program, no appreciable changes were noted, although scores for both the double sideband suppressed carrier and the synchronous single sideband did improve by two or three percentage points.

The scores are plotted on the graph on the basis of the average and the standard deviation, moderately smoothed, producing a curve that follows a Gaussian distribution. The results show what advantage might be obtained by changing from amplitude modulation to single sideband. Single sideband shows a single work intelligibility score of 78%, and displays a relatively small standard deviation;

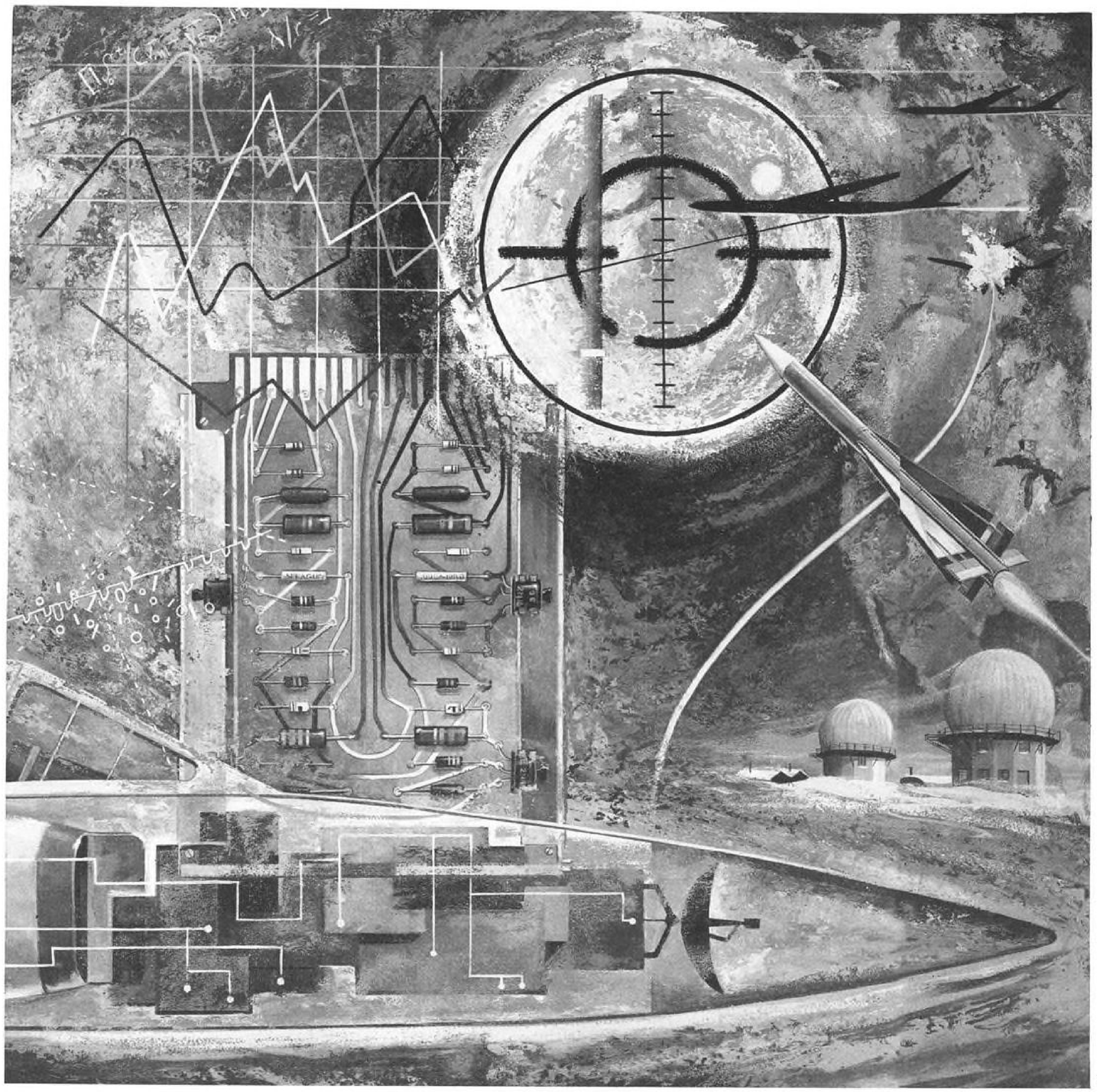


AIRBORNE installation for tests of four different communications systems.



GROUND installation at transmitter site for tests of four communications techniques.

What makes the "weapons system concept" click?



Not so very long ago a plane was built to perform a single task—fly higher, faster or farther. If armament was necessary, guns or rockets were added. If a navigation or communications system was needed, these also were added.

No longer will that old approach work. The problems are too complex. The consequences are too severe. The timing is too critical. The electronics in the modern aircraft perform as vital a function as the carrier itself. In fact for many missions the plane is primarily a vehicle to transport the electronic systems.

To achieve the integration of these many elements into a single working unit is the "weapons system concept."

It takes competent TEAM MANAGEMENT *to make this "weapons system concept" click!*

Hughes has the experience and capability to manage a team of systems specialists. The Hughes MA-1 Integrated Electronic and Control System, combined with the Falcon air-to-air guided missiles in the Convair F-106 all-weather interceptor, represents the first successful approach of this concept.

This Hughes system provides automatic mission control of all vital functions from take-off to touch-down. It provides automatic navigation, automatic flight control, automatic data link, automatic attack and weapon control and automatic landing system by Digitair, the first airborne application of a digital computer.

It took competent TEAM MANAGEMENT *to make this "weapons system" click!*

Over 6000 highly trained scientists and engineers provide the "think" at Hughes. They form the motivation behind the 30,000 Hughes people dedicating their efforts to the electronics "systems concept."

The experience of these people in the research, development, manufacturing and field service of advanced electronics systems makes Hughes ideally suited as an electronics weapons system team manager.

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First Airline Tests

First airline tests of the Comparative Single Sideband (CSSB) system developed by Kahn Laboratories has gotten under way with installation at Aeronautical Radio's Long Island (N. Y.) station, which serves Caribbean and Latin American regions. Kahn CSSB provides some saving in bandwidth, improved intelligibility, and can be operated with existing airborne high frequency receivers, according to the manufacturer. Arinc installation permits transmitter to be quickly switched from conventional AM to new CSSB for side-by-side comparisons.

90% of the data is above 60% on the intelligibility score.

Amplitude modulation, on the other hand, has a much wider distribution and the 90% point is at 30% intelligibility. It has a maximum of approximately 60% intelligibility.

A fourth new communications technique, the Kahn compatible single sideband system, has been proposed for test and may be tested at some later date, but no equipment was made available during this evaluation program.

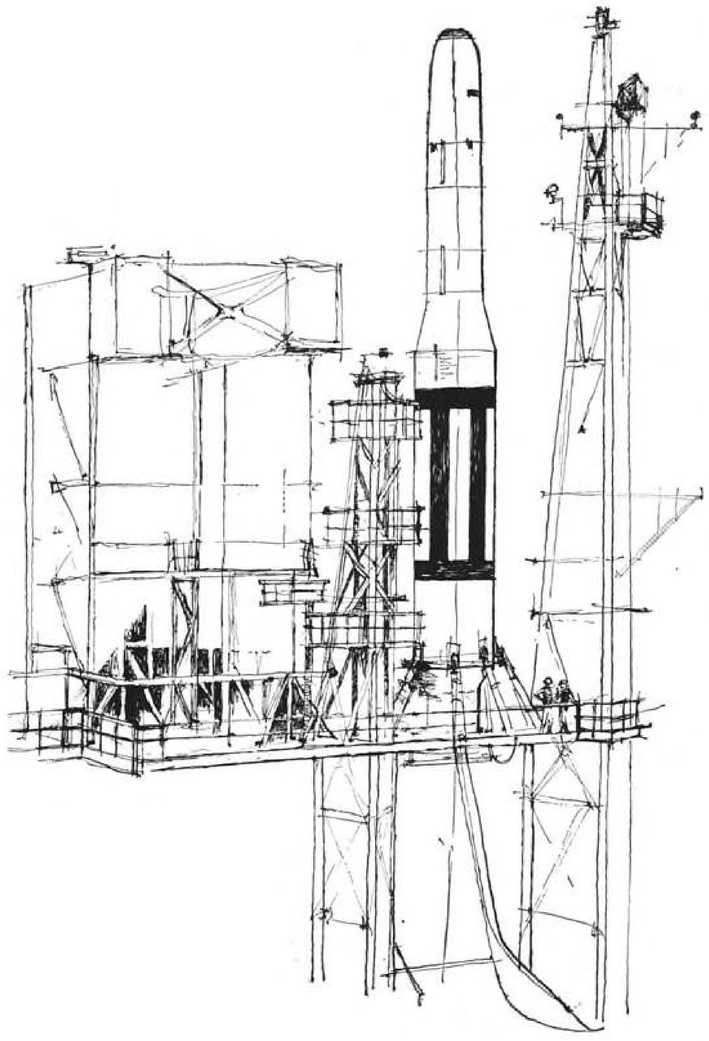
Doppler Shift

Because the single sideband technique centers transmitted power within a very narrow band of frequencies by suppressing the carrier and one sideband, the problem of Doppler shift arises for ground-air-ground communications with high speed commercial and military jet aircraft. This Doppler shift amounts to approximately one cycle per Mach number per megacycle.

Therefore, another part of the test program was to determine the effects of Doppler shift; that is, the amount of Doppler shift that can be tolerated in the presence of different signal-to-noise ratios. This part of the program was performed by psychologists at Montana State College.

They used a record player which played lists of phonetically balanced words recorded by a non-regional voice. The output was processed through an audio frequency filter to cut out all signals below 300 and above 5,000 cycles and fed into a single sideband modulator driven from a modulating oscillator. The output then fed a single sideband demodulator driven from a separate oscillator, through another 300-5,000 cycles audio filter, and recorded on an Ampex recorder.

As this was done, different errors of Doppler shift were introduced. Through this process, a total of one hundred different combinations of Doppler shift and signal-to-noise ratio were obtained. A listener test was then



run to obtain a plot of Doppler shift versus intelligibility.

The listener test employed a General Radio Co. noise generator and an audio frequency attenuator to set up a noise level of 80 db. above one millibar noise pressure to the listener. The output of the tape recorder was combined at varying levels, using audio filters to keep within the bandwidth normally associated with airborne equipment, then amplified to the listener. Each listener received a five hour training period to become familiar with the test procedure. Sixteen tests were run at each combination of signal-to-noise ratio and Doppler shift.

The results of these listener tests are shown in the chart on page 77 (right). The signal-to-noise ratio is along the ordinate. The frequency error runs from zero to plus 750 cycles and from zero to minus 500 cycles. The curve representing 95% intelligibility coincides closely with the curve that would be obtained for the same information transmitted over a standard interoffice telephone line going through only one local switchboard; 85% is as good as is obtained on high grade toll quality telephone lines.

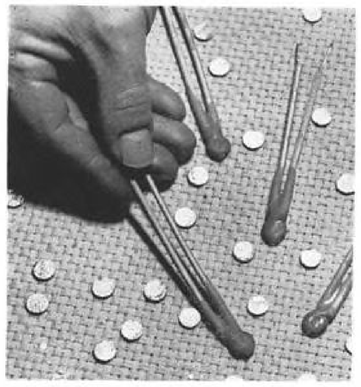
Single word intelligibility of 70% is considered to be the region in which 100% reliability results for English sentences; that is, 70% word intelligibility gives 100% message reliability. Therefore, for a 100 cycle Doppler error and zero decibel signal-to-noise ratio an acceptable intelligibility score is obtained which has a high reliability in message content.

For greater than 16 db. signal-to-noise ratio, 90% reliability is achieved for much more than a 100 cycle shift. It appears on the basis of these figures that a 100 cycle tolerance is acceptable for message intelligibility, although for numbers only word reliability will be attained. For the message "climb to 9,000 ft.," the reliability of the "9,000" which is the significant part of the message would be 60% and may have to be repeated several times.

FILTER CENTER

▶ **Radar Altimeter for Convair B-58**—The AN/APN-110 radar altimeter for B58 Hustler has an error of only 25 ft. plus 0.025% at any altitude from 200 ft. to 60,000 ft., according to Radio Corporation of America which developed the unit. Entire radar altimeter, including flush-mounted antennas, weighs only 35 lb., RCA says.

▶ **New Switching Thermistor**—Novel type of thermistor, with positive temperature coefficient, whose resistance increases abruptly when any specified



desired temperature is reached, enabling it to perform function now requiring bi-metallic element, has been developed by Westinghouse Electric Corp. Initial quantities of the new switching thermistor will be used in Westinghouse motors for over-temperature protection. The latter will provide a 17:1 change in resistance at temperature between 100 and 125C, but Westinghouse says it can control both the switching temperature and residual (cold) resistance by varying thermistor composition during manufacture.

► **Oh, Say Can You SEE**—Sperry Echo Enhancer, called SEE for short, makes a small target drone appear as large as a bomber to the radar of an attacking interceptor or Bomarc missile. The device, which includes Sperry traveling wave-tube, power pack and antenna, weighs less than 20 lb., company says. Unit has been tested at altitudes above 50,000 ft.

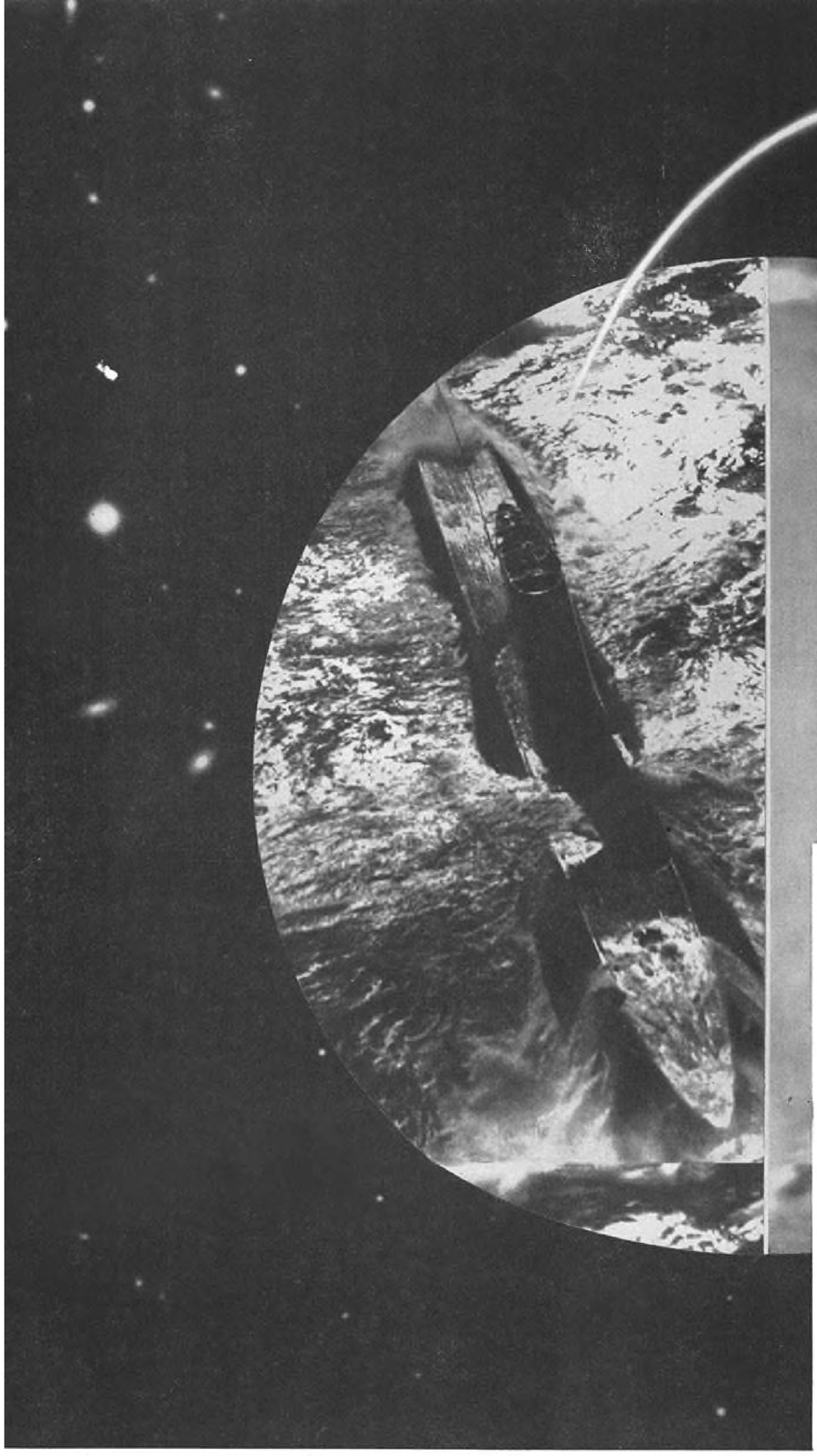
► **Signed on Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **General Precision Laboratory**, $1.2 million Air Materiel Command letter contract, for components of the AN/APN-81 Doppler navigation system, for use in Boeing B-52 and KC-135 and Douglas RB-66 aircraft.

• **Collins Radio Co.**, contract for more than $1 million from Vickers-Armstrongs for flight control systems, communications and navigation equipment for use on Trans-Canada Air Lines' 20 new turboprop Vanguards.

• **Aircraft Armaments, Inc.**, Cockeysville, Md., $2.9 million contract from Civil Aeronautics Administration for development of air traffic control simulator, scheduled for delivery in May, 1960. New equipment will be able to simulate 60 aircraft and four radars.

• **Bendix Radio** reports that Panagra has ordered full complement of its avionic equipment for airline's new Douglas DC-8 jet transports, including X-band radar, communication and navigation equipment.



POLARIS MISSILE DESIGN & DEVELOPMENT TEAM

SPECIAL PROJECTS OFFICE
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LOCKHEED
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AEROJET GENERAL
Propulsion

GENERAL ELECTRIC
Guidance

MASS. INST. of TECH.
Guidance System Development

Also working under the direction of the Special Projects Office, U.S. Navy, on various phases of the POLARIS weapon system are: U.S. NAVY BUREAU OF SHIPS, SPERRY GYROSCOPE CO., WESTINGHOUSE, and over 200 sub-contractors—a team composed of America's topmost scientific talent with vast technological resources, working together on one of the Navy's top-priority defense projects.

Every military target on earth ultimately will be within range of Polaris, the Lockheed space-age missile, now under development for the U.S. Navy—to be launched from Navy submarines hidden in ocean depths that cover three-fourths of the world's surface.

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HIGH COCKPIT provides good visibility over sloping nose. Pawnee uses numerous Piper standard components to ease maintenance.

Pawnee Ag-Plane Stresses Pilot Safety

Lock Haven, Pa.—Production of the new low-wing Piper PA-25 Pawnee agricultural airplane, designed to provide operators with a low cost aircraft capable of carrying a high payload and incorporate numerous pilot safety features, will be started on a limited basis in the first quarter of 1959.

Initial quantity will be allocated to operators in a wide variety of areas to provide maximum utilization and evaluation of the Pawnee and its chemical dispersing equipment while tooling design and production is completed. Full tooling at Piper's Lock Haven plant is expected to be completed later in the year.

Pawnee is designed to replace the high-wing Piper PA-18-A agricultural airplane, in production since 1951. Some 2,300 PA-18-As have been produced. Basic reasons for PA-18-A popularity have been low initial and operating costs; to maintain large sales volume, Piper will attempt to peg Pawnee price very close to that of the PA-18-A, now selling for approximately $9,100 with both spray and dust dispersal gear.

Pawnee is the first production aircraft to emerge from the company's research and development center at Vero Beach, Fla., directed by Fred E. Weick, private and agricultural airplane specialist. Weick, closely associated, with development of the spin-proof Ercoupe, also was responsible for design of the Ag-1 agricultural airplane during his tenure at Texas A&M College System (AW Nov. 17, p. 98). Ag-1, which has served as a prototype for several postwar agricultural aircraft, including the new Pawnee, featured particular attention to crash-safety design.

Basically the Pawnee is a fabric-covered steel tube structure powered by 150-hp. Lycoming engine. Gross weight is 2,300 lb. and useful load is 1,100 lb. with a hopper capacity of 110 gal. of liquids or 20 cu. ft. for solids. Performance is primarily aimed at providing short field takeoff and landing characteristics, good control during maneuvers at low altitudes necessary for agricultural work.

Safety aspects play an important role in Pawnee design considerations since agricultural flying is an unusually hazardous operation compared with other forms of general aviation. Three major considerations studied by Weick's engineering group on the Pawnee project were to:

- **Decrease likelihood** of accidents by providing pilot with ample visibility and good lateral control at low speeds. Approximately 50% of fatal aerial application runs are the result of collisions with trees, wires and other obstructions, Piper engineers report. By placing the pilot high behind a sharply sloping nose, good forward and downward view is obtained; low-wing configuration enables the pilot to see during turns close to the ground, and good rearward view is also provided.
- **Sharp leading edges** are provided on landing gear struts to help the airplane cut through wires and tree branches with minimum retarding effect. There also is a cable running from the top of the cockpit to the top of the vertical fin to prevent the tail from being snagged.
- **Pilot protection** in event of a crash is planned around Weick's considerable experience with the Ag-1 and vast material compiled by Crash Injury Research unit of Cornell Medical College, supplemented by data obtained from the military. This primarily involves placing the pilot behind all heavy loads and objects in the airplane, supporting the pilot in a heavy harness to prevent his head from snapping forward into any heavy or sharp object and a cockpit that will not collapse in such a way that the structure injures him. It also provides as much wing and fuselage structure ahead and below the pilot to absorb crash shocks and decelerate the cockpit area as much as possible.

Fuel Tank Placement

Of the 10 major recommendations made by Aviation Crash Injury Research for crash survival design, Piper engineers have conformed to all but one, which objected to locating the fuel tank in the fuselage between firewall and instrument panel.

Their argument is that wing tanks would require a fuel pump and more complicated plumbing, including selector valve, due to the low-wing configuration. Fuselage location permits simple gravity feed and short plumbing. Weick points out that many accidents including fatal ones, have been caused by failure of "complicated" plumbing and misuse of fuel selector. He feels that rearward position of the pilot behind the hopper and his ease of exit, combined with likelihood of remaining conscious and relatively uninjured in a crash (many of which occur at low speeds) favor probability of the pilot being able to escape in event of fire.

To reduce possibility of fatal head injuries, which score high in survivable

crash accident studies, Piper is providing a rounded sheet metal cushion above the instruments to prevent the pilot's head from striking the gages. Instruments consist of a single line of gages including the standard Piper electrical panel. Instruments cases are mounted on shear pins so that they will break away if struck by head.

An extra-heavy seat belt and shoulder harness are anchored directly to structural trusses in the fuselage, relieving the seat of heavy loads and provision has been made for optional inertial reel to support the shoulder harness and provide pilot with freedom of movement. Shoulder harness straps are permanently linked to their respective sides of the seat belt to obviate need for the pilot to collect and fasten four loose ends, permitting fastening of entire belt and harness system with a single buckle.

Cockpit Design

To provide slow, progressive failure of the fuselage structure in the cockpit bay, top longerons are bulged slightly outward so that they will be certain to bend away from this area in event of a severe head-on crash and not pin the pilot. The fuselage is designed to fail progressively from the front to reduce deceleration of the cockpit.

On the recommendations of A. Howard Hasbrook, Flight Safety Research specialist, Piper also incorporated these provisions:

- **Cushioning head rest** is provided to protect the back of the head and cervical spine in event of "whip lash" rear loads.
- **To protect pilot's legs,** a metal floor is provided with 10-in. space between it and the bottom of the fuselage.
- **Projections** have been removed from rudder pedals to protect the ankles.
- **Shoulder harness** follows a horizontal plane from the pilot's shoulders to the point in the fuselage to which the upper torso load is initially transmitted. Longitudinal axis of the inertia reel is set 15 deg. below the aircraft's longitudinal axis so reel will lock when nominal vertical loads are imposed.

The cockpit has a steel tube turnover structure and a Fiberglas and plastic top. Combination windows and doors are hinged at the bottom and the airplane can be flown with them open, or they can be quickly removed. The pilot seat is well upholstered type used in the Piper Apache light twin-engine executive transport to provide comfort over long periods of flight. Apache-type toe brakes are fitted to rudder pedals and a cockpit heater and ventilator are fitted.

Piper has retained as many proven components as possible to hold price down, lessen field maintenance and spares problem. Wings, flaps and ailerons are derived directly from the Super

Cub, beefed up to take gross weight of 2,300 lb. instead of 1,750 lb. Powerplant package is same as the Super Cub, including engine, cowling and engine mount components. Engine mount, however, is hinged to improve accessibility to rear of powerplant and all control, fuel and instrument lines pass near the hinge axis so that engine can be swung without need for disconnecting them. To extend engine life under dusty conditions, a new Fram pleated paper air filter is fitted. This unit has a standard dust removal efficiency of 99.5% as compared with about 85% for present filters when they are in good condition, Piper reports. A Fram full-flow oil filter is also available as optional equipment for use in severe conditions.

Landing gear is similar to the Piper Pacer using an internal Hydrasorb shock absorbing system. Tri-Pacer axles, Comanche wheels and brakes and Apache tires are fitted.

Fuselage is entirely new, being wider, deeper and longer than that of the Super Cub. It is 36-in. wide to provide desired hopper-tank capacity. Hopper-tank has short fore and aft dimension and steep sloping walls to effect easy chemical unloading. The tank is made of polyester reinforced with Fiberglas for freedom from corrosion.

The hopper has a large sealed door which hinges forward and lies flat atop the fuselage during loading. Opening is clear of the wings. Bottom of hopper has a gate designed to seal whether dry or wet loads are carried. Hopper is located approximately on the airplane's center of gravity to minimize necessity of trim changes during operation. Unit is large enough to permit installation of a jury seat so that field personnel can be transported.

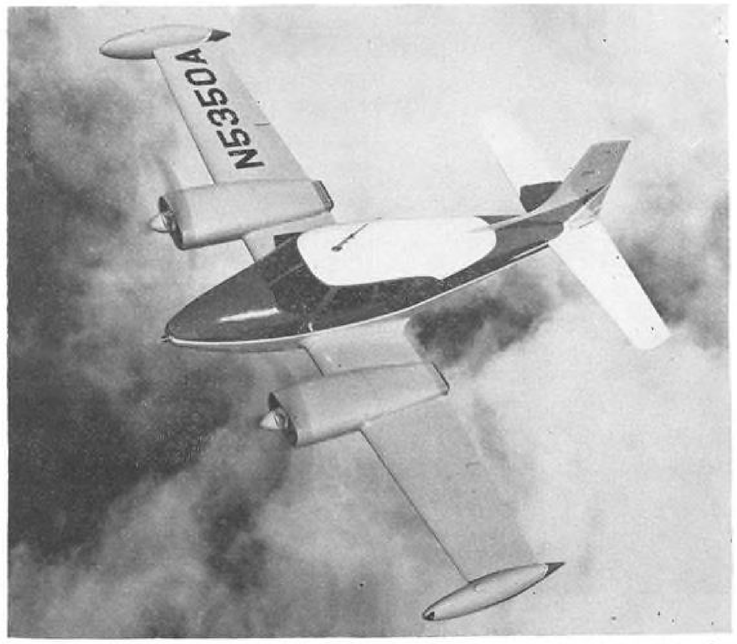
Side fuselage panels can be removed to the forward part of the cockpit and bottom panels are removable all the way to the tail to provide easy access to fuel tank, landing gear shock absorbers, hopper area, rudder pedals and controls. The battery is just inside the right door.

To resist corrosion, tail brace wires, control cables are stainless steel; all steel parts are protected by a corrosion-resistant finish that has undergone considerable testing at Texas A&M College and Vero Beach. Inside of all steel tubing is treated with Lionoil. Ignition switch is a corrosion-resistant type.

Spray dispersal equipment uses the same one-inch Simplex centrifugal pump as the PA-18-A but has improved seals. Nozzles are on a boom located to the rear and slightly above the leading edge of the wing; boom dips under the walkways and fuselage. Location permits pilot to watch operation of nozzles and they are protected from striking trees or brush. A venturi-type distributor is used for dry chemicals.

260 hp. Engines Improve Cessna 310's

By Robert I. Stanfield



CESSNA 310C external changes include extending engine nacelles to wing trailing edge.

New York—Increases in speed, rate of climb and service ceiling, that exceeded specification figures in those phases checked during AVIATION WEEK flight, mark the addition of Continental 260-hp. engines with fuel injection to Cessna's new twin-executive Model 310C.

New six-cylinder IO-470-D engines together generate a total of 520 hp. (at 2,625 rpm. each), an increase of 20 hp. and 25 rpm. per engine over the predecessor 310B. Useful load has increased 75 lb.—from 1,735 lb. to 1,810 lb.—and gross weight is up 130 lb., from 4,700 lb. in the B to 4,830 lb. in the 310C.

Price of the new model—$59,950—remains unchanged. The contributing factor here is a high rate of production. Since March, 1954, when the airplane was CAA-certificated, more than 960 Model 310s have been built, including 160 U-3As (originally designated the L-27A) for the Air Force.

The airplane's fuel injection system injects fuel under pressure into the cylinder head upstream of the intake valve port where fuel and air are mixed. Even distribution of fuel results in maximum power output from each cylinder at any engine speed. The system also eliminates the carburetor and the possibility of carburetor ice, plus the need of timing of fuel injections into cylinders.

The fuel injection system is a multi-nozzle continuous-flow type which controls fuel flow to match engine air flow. A manual metering control and pressure gage, indicating metered fuel pressure, are provided for fuel-air ratios at any combination of altitude and power setting.

Intake System

The engine air intake system has been redesigned for compatibility with fuel injection, engine and cooling requirements. A blast tube for cooling the fuel injection pump, metering unit and fuel strainer is provided to prevent vapor formation in the injection system. The throttle, metering control and control housing are mounted directly on the engine to prevent a change in control settings due to engine surge.

Performance, sensitivity and responsiveness of the 310 were stressed in the first flight evaluation report on this airplane by AVIATION WEEK (AW July 16, 1956, p. 50). Key features evidenced in piloting the new 310C, which has more changes and improvements than any previous 310, included:

• **Noise level.** Normal conversation was maintained during all phases of flight. Reduction of exhaust noise over that of the B-model stems from new muffler installation and extension of nacelles over the trailing edge of the wing, 15 in. mufflers, installed in aft portion of nacelles, have stainless steel outer shells. Fiberglas packing of more than one-inch thickness is installed between inner and outer shells to absorb exhaust noise. Augmenter tubes have been shortened.

• **Centralized panel.** ARC (Aircraft Radio Corp.) type FES-1211 avionic system utilizes a centralized control panel that groups together dual-omni, course director, two independent systems of communications (primary and secondary), automatic direction finder, marker beacon, glide slope, cabin speaker amplifier and radio controls. The panel ties in with Cessna's "eyes on the road" concept, since the pilot can operate avionic equipment and still keep his attention on the direction of flight.

• **Cruise speeds.** At maximum gross weight, specifications show speed increases of up to 10 mph. over the 310B. Evaluation speed runs at high, normal and maximum range cruise at 8,000 ft. —pulling 70, 65 and 42% of power, respectively—produced true air speeds of 238 mph., 225 mph., and 189 mph., well in excess of Cessna specifications.

• **Single engine.** At 7,500 ft., grossing about 4,600 lb. and pulling 22 in. manifold pressure and 2,300 rpm., the right engine was feathered. Prior to feathering, pilot's feet were deliberately removed from the rudder pedals and, with engine out, a slight aileron application alone held airplane on course. The airspeed slowly dropped off and held even at 147 mph. indicated, with no increase in power.

Airplane flown was N6674B, No. 3 off the production line. Along with the AVIATION WEEK pilot was George Derry, regional sales manager for Cessna's Eastern Division, and one passenger. Empty weight of the demonstrator was 3,355 lb. With full fuel tanks—130 gal.—and light baggage, take-off gross weight approximated 4,650 lb.

External Changes

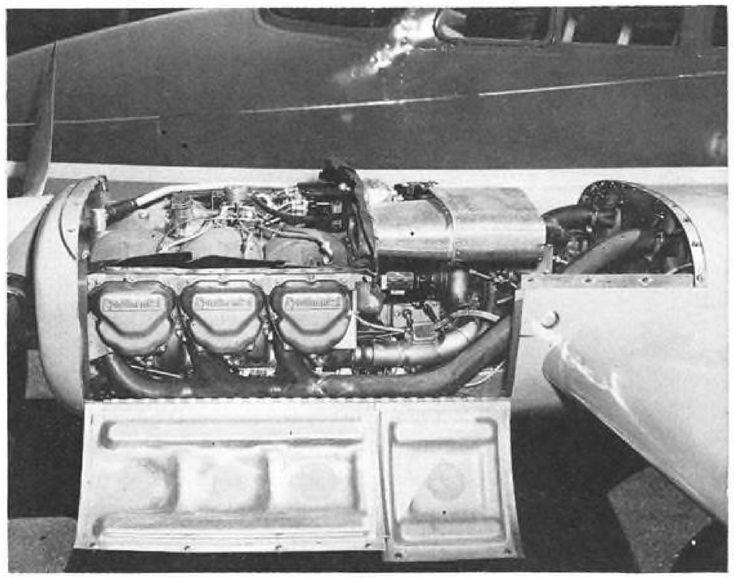
Externally, 310C incorporates these changes: the engine nacelles have been increased from 21.5 in. to 22.5 in. in thickness and extended to the trailing edge of the wing. The cowling incorporates inner-pan type stiffening, replacing lateral-hat-section stiffening used on the 310B cowl. Contour of the cowl top has been slightly rounded to increase stiffness and provide more engine clearance.

Rudder and elevator tab areas of the

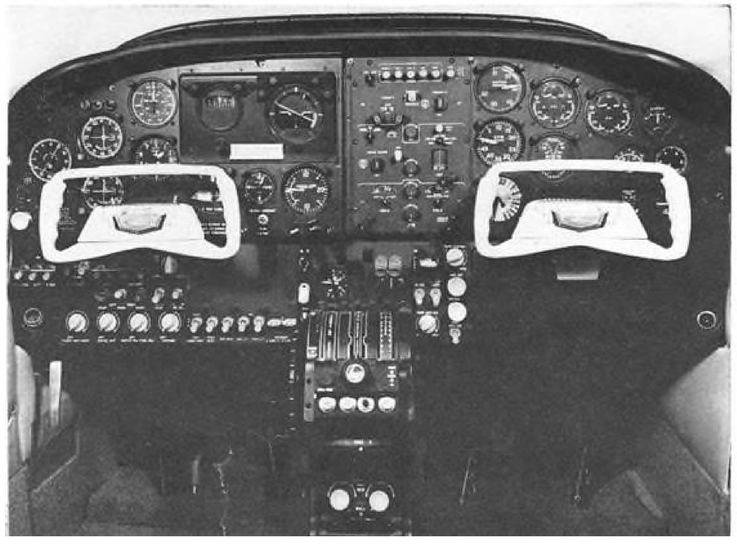
Cessna 310C Performance

Gross Weight	4,830 lb.	4,400 lb.
Speed: best power mixture		
Max.—sea level	242 mph. TAS	244 mph. TAS
Max. recommended cruise, 70% power @ 8,000 ft.	220 mph. TAS	223 mph. TAS
Range: lean mixture		
Max. recommended cruise, 70% power @ 8,000 ft.	825 mi.	840 mi.
100 gal., no reserve	3.8 hr.	3.8 hr.
	218 mph. TAS	222 mph. TAS
Max. range @ 10,000 ft.	1,110 mi.	1,150 mi.
100 gal., no reserve	6.5 hr.	6.8 hr.
	171 mph. TAS	170 mph. TAS
Max. recommended cruise @ 8,000 ft.	1,070 mi.	1,090 mi.
130 gal., no reserve	4.9 hr.	4.9 hr.
	218 mph. TAS	222 mph. TAS
Max range @ 10,000 ft.	1,440 mi.	1,490 mi.
130 gal., no reserve	8.4 hr.	8.8 hr.
	171 mph. TAS	170 mph. TAS
Rate of climb—sea level—twin engine	1,800 ft./min.	2,060 ft./min.
—single engine	440 ft./min.	555 ft./min.
Service ceiling —twin engine	21,300 ft.	22,800 ft.
—single engine	7,700 ft.	9,700 ft.
Useful load: (Including fuel and oil)—without auxiliary tanks	1,810 lb.	1,380 lb.
—with auxiliary tanks	1,794 lb.	1,364 lb.
Wing loading: lb./sq. ft.	27.6	25.1
Power loading: (520 hp.) lb./hp.	9.3	8.5

SEATING arrangements include rear center chair and lounge with adjustable back.



CONTINENTAL IO-470-D engine with fuel injection eliminates carburetor, gives more even distribution of fuel. Cockpit (below) includes centralized avionic panel.



Cessna 310C Specifications

Span	36 ft.
Length	27 ft.
Height	10.5 ft.
Wing area	175 sq. ft.
Gross weight	4,830 lb.
Empty weight	3,020 lb.
Fuel capacity:	
Without auxiliary tanks	102 gal.
With auxiliary tanks	133 gal.
Oil capacity (total)	6 gal.
Baggage	200 lb.
Powerplants:	Two Continental six-cylinder IO-470-D engines with max. continuous rating of 260 hp. each at 2,625 rpm.

310C have been increased 30% over those of the B-model. Circuitry of the fin-mounted rotating beacon has been reworked to provide steady, non-blinking navigation lights when the rotating beacon is in operation.

Interior of the 310C is smartly upholstered with a combination of fabrics, leather, Formica and Royalite. Front seat chairs tilt in any one of three positions and may be individually adjusted fore and aft.

Flight instruments are mounted on the pilot's side of instrument panel; engine instruments are to the right. Avionic controls are centered. New 25 amp. generators replace the 15 amp. generators as standard equipment. Switches for landing, taxi and navigation lights, rotating beacon, pitot heat and cabin heater have been relocated to the left side of the stationary panel. Gear indicator lights include "press to test" and dimming features.

Simple starting procedures and taxi characteristics – nose wheel steering linked to rudder pedals–are similar to those of previous models. At takeoff, sea level pressure was 30.27 in. Outside air temperature was 13C. Wind was from the southeast at 7 kt.

Takeoff Characteristics

Once airborne, speed built up quickly and it wasn't necessary to hold nose down during initial portion of climb. Minimum climb speed of 95 mph. came almost immediately after leaving the runway; normal climb was at 140 mph. and the 310C gained altitude in a hurry.

At maximum gross weight specifications indicate a rate of climb of 1,800 fpm. at sea level; single engine rate is 440 fpm. (both of these respective boosts of 25 fpm. over the 310B). The airplane ascended through 4,000 ft. at 1,300 fpm. at power settings of 24 in. manifold pressure and 2,450 rpm. At 7,000 ft. rate of climb was 1,000 fpm.

The airplane trimmed out neatly dur-

ing climb for hands-off ascent. At 8,000 ft., the 310C was leveled off for speed runs at high cruise, normal cruise and maximum range cruise. Outside air temperature at this altitude was 6C.

It wouldn't be difficult to exceed airspeed limitations in this airplane due to clean design and power, particularly in descent. Airspeed is yellow-lined at 210 mph. and red-lined at 248 mph.

Pulling 22 in. manifold pressure and 2,450 rpm. (high cruise), airplane indicated 208 mph. for true airspeed (TAS) of 238 mph. At 22.5 in. and 2,300 rpm. (normal cruise) indicated speed was 197 mph. for a true reading of 225 mph. Reducing power to maximum range cruise setting for this altitude—17 in. and 2,200 rpm.—the 310C indicated 165 mph. for true airspeed of 189 mph.

Flight characteristics are similar to those of the B-model. The 310C is quickly responsive to light control pressures; sensitive, but not overly so. Stall speeds haven't changed: clean, the airplane stalls at about 84 mph.; with gear and flaps down, the break comes at 74 mph.

Speed builds up quickly during descent. To hold a 500 fpm. rate, power was set at 13 in. and 2,300 rpm. and airspeed at this setting was 168 mph. indicated. Pattern speeds remain the same as those for earlier models. Airplane was flown at 120 mph. on downward leg, 110 mph. on base leg, final approach was made at 95 mph.

New Engines

New engines also incorporate forged, four-ring pistons which Cessna says will give greater lubrication and less wear, as well as improved oil consumption. Silver alloy main bearings have been added. Engine air intake system has been redesigned and incorporates a removable air filter and spring-loaded door which provides an alternate air source automatically if the main air source should become inoperative.

The manual alternate induction heating system control also has been maintained. Two speed auxiliary fuel pumps have been installed in the tip tanks with speed controlled automatically by a dropping resistor and pressure switch.

Cessna plans to produce 253 310Cs this first year. The company has 171 firm orders for the airplane, and present rate of production calls for two airplanes per day. Demonstrator flown by AVIATION WEEK cost $89,300 and was completely equipped with the exception of de-icer boots and oxygen equipment.

Navigational and avionic equipment included one ARC C-77A control unit; dual ARC VHF 15-E navigational system consisting of communications, omni, localizer receiver and course indicator; one ARC T-22 transmitter; one

ARC RT-11A VHF transmitter and receiver.

Other equipment included one ARC ADF-21A radio compass, one ARC F-13A audio amplifier, one headset and microphone, one DGS-20 Dare glide path receiver, one DM-3 Dare marker beacon receiver, a fin-mounted rotating beacon, auxiliary landing light (right wing), taxi light, ground service plug and dual 50 amp. generators and voltage regulators.

All of the above make up Cessna's Group I electronics package, with installed weight of 165 lb. and factory installed price of $17,100. In addition, demonstrator was equipped with Lear L-2 autopilot and ARC CD-1 course director.

In addition to the five place standard interior—two individual front seats and a three-passenger rear seat—four new optional seating arrangements are available. All options have standard pilot and front-seat passenger individual chairs.

Arrangements include: two individual reclining rear seats with a center arm rest; two center chairs which are the same as the pilot and front-passenger seats; two center chairs and one aft single chair which is a stationary version of the pilot's seat.

The demonstrator contained one center chair and a lounge. The latter, located directly behind pilot's seat, has an adjustable back and headrest, plus cushions for back rests. The lounge also will accommodate two passengers; however, side-by-side seating on such is not too comfortable. A curtain, which separates the front seats from the remainder of the cabin, is available as an optional item.

Interiors of the 310C are available in color combinations of brown, teal and green. Exteriors come in combinations of lime and green, blue and green, gray and brown, gray and amber, and gray and red. White is a common color to any of these combinations. High visibility paint is offered as an optional item.

Equipment Liaison Urged For Business Operators

Dallas—Manufacturers of aviation equipment were urged by an oil industry aviation executive to develop better liaison with the ultimate customer for their products in order to help business aircraft operators do a more efficient job of maintaining their fleets.

This plea for a more direct link between manufacturer and operator was made by Henry W. Boggess, director of aviation for Sinclair Refining Co., at a meeting here of the Aviation Distributors and Manufacturers Assn. He said the biggest area for improvement from the fleet operator's point of view lies in

following through and making sure equipment does the job for which it was designed.

Boggess listed a number of factors, including faulty installation, lack of parts and lack of proper knowledge how to maintain and operate equipment, that call for closer liaison between the manufacturer and the customer. He said "it would seem that such liaison is the primary responsibility of the manufacturer."

This improved liaison doesn't necessarily call for a battery of sales engineers. Boggess suggested that much could be accomplished if the customer received with every component a concise manual covering installation, operation and limitations, maintenance and parts availability. Fleet operators could save time with manuals to help them in their service work, and he said that manufacturers would probably save money on service by furnishing such manuals.

Many fleet operators choose to service and maintain their own aircraft, rather than using fixed base operators, and Boggess said that parts availability is a problem in these operations. He criticized manufacturers who refuse to supply detailed parts, like small brushes or bearings, for the equipment they make.

"It is understandable that most manufacturers prefer to deal with public, local repair stations whose employes are supposedly schooled in the maintenance of their products. However, manufacturers should realize that there aren't enough qualified fixed base operators to serve America's business aircraft fleet," Boggess said.

"Many of the larger fleet owners operate their own shops," he added. "They do this in order to avoid delays which are inevitable when depending upon authorized repair stations. Fleet operators employ skilled mechanics and specialists. The maintenance personnel of large fleet operators are usually competent to service and maintain your products. With just a little help from you in making technical information and small repair parts for your merchandise available, our maintenance headaches could be materially lessened."

Shifting to a discussion of merchandising, ADMA members were asked to create a consistent public image of their companies by Edward Marcus of Neiman-Marcus, Inc., a Dallas department store.

Marcus talked of the merits and disadvantages of merchandising established national brands. He pointed out that the distributor of a national brand item has to accept possible price-cutting or a market that may suddenly be taken away or split with other distributors.

In a panel discussion of sales promotion problems, Dave Dows, of Airwork Corp., pointed out that a product has to be merchandized throughout the entire distributive channel and that cooperation is necessary from the point of manufacture all the way through to the customer sale. He reminded the group that the distributor is close to the customer and therefore can give the manufacturer a better idea of how a product is being received, as well as keep the manufacturer's name before the public.

Close scrutiny of cooperative advertising proposals was urged by Al Harting, of Southwest Airmotive. He said that manufacturers should look closely at such ideas before rejecting them because "if we do it for you, we would have to do it for everybody." Harting said such proposals could have value, and the manufacturer should consider accepting them selectively.

Various pleas were made for more help from the manufacturer to the distributor in such areas as advertising, promotion and the preparation of mailing lists. But one delegate countered these arguments with the observation that the reason manufacturers appoint distributors is to avoid this burden.

PRIVATE LINES

Type certification of Italian light Fiat-Nardi F. N. 333 amphibian is nearing completion at Forlanini Airport, Milan, under jurisdiction of U. S. Civil Aeronautics Administration's Paris office. Four-place amphibian has 168-mph. cruise speed, 775-mi. range and 1,014-lb. useful load. Nardi will attempt to sell the aircraft in the U. S.

Piper is marketing its 150-hp. Tri-Pacer under the name Caribbean, offering the airplane in two versions, basic model selling for $8,395 and de luxe version costing $9,350. Primary difference in models is instrumentation.

Tactair Levelair automatic flight system has been developed for Cessna, which is taking entire first year's production from the Bridgeport, Pa., equipment maker. Levelair will be offered as optional factory installed equipment on Cessna's 1959 models 175, 180, 182 and Skylane. Two versions will be available: T-1, primarily an anti-spiral stability aid, priced at $795, and the T-2, which has course selector and heading lock features added, priced at $1,095. Equipment is "building block" type, enabling T-1 owners to add T-2 features and more advanced T-3 autopilot elements as desired.

Soviet Union purchased several Super Aero light twins from Czechoslovakia for three-passenger air taxi services in the Kiev area.

First Details of B-58's Air Conditioner

By Barry Tully

Windsor Locks, Conn.—Convair B-58 Hustler's extended flight envelope, endurance and heavy avionic cooling loads demand an environmental control system described as the most comprehensive on any military production aircraft.

System was developed by Hamilton-Standard, which will develop air conditioning systems for the North American B-70 chemical bomber and F-108 Mach 3 interceptor (AW Dec. 8, p. 34).

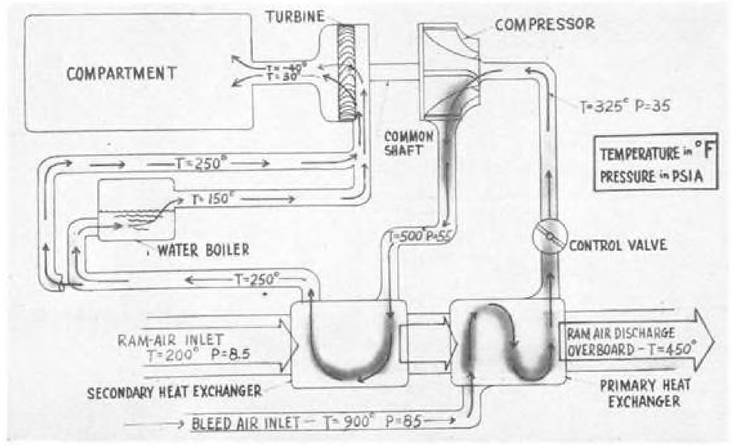
The Mach 2 B-58 utilizes an open air cycle air conditioning system designed to perform the following function with the least ram air drag, thrust loss due to engine bleed and weight addition:

- **Pressurize crew compartment,** some avionic gear and the fuel tanks.
- **Cool avionic equipment,** prevent overheat of interior aircraft structure and maintain comfortable cockpit temperatures.
- **Remove rain** from the pilot's windshield and defog and defrost canopy enclosure.
- **De-ice** the engine inlets.

Warm air manifold to the system serves the secondary function of ducting engine starting air.

The size and density of the B-58 demands an air-conditioning system with a complex air flow distribution and control system. This is further complicated by the necessity of controlling

REMOVAL of upper wing panel over inboard engine exposes water boiler of B-58 air conditioning system.



BOOTSTRAP or bleed-blower refrigeration system of a Convair B-58 is illustrated in schematic diagram. Cooling air is bled from compressor section of General Electric J79 engine through the primary (air-to-air) heat exchanger. Air then passes through compressor boosting temperature and pressure before going through secondary heat exchanger and, if above the ambient boiling point, the air-to-water heat exchanger. Air then powers the turbine-compressor lowering the pressure still further.

temperature of the aircraft's underslung weapon pod.

In evaluating various refrigeration designs, Hamilton-Standard selected a system utilizing a turbine-compressor unit which increases the pressure of engine bleed air rather than a ram-blower configuration in which the turbine powers an exhaust fan to facilitate ram air flow over the heat exchangers.

This "bootstrap" or bleed blower configuration was selected because the increased turbine inlet pressures available with this design permit adequate system performance at low engine power without having to resort to a variable nozzle turbine. Result is a simplification of the turbine compressor and system controls.

Ram Air Flow

The problem of securing adequate ram air flow across the heat exchangers is solved at high speeds by utilizing the relatively high pressure recovery of the main engine inlets. Ram air is taken from the engine intakes, passed over the primary and secondary heat exchangers, and discharged at the trailing edge of the engine pylon. At low speeds and on the ground where less capacity is required, an ejector utilizing compressor bleed air induces sufficient ram air flow.

Bleed air is cooled by ram air in the primary heat exchanger. After modulation, according to flow demands, the air has both temperature and pressure increased by the compressor. Air temperature is reduced again by the secondary heat exchanger and, if above the ambient boiling point, by the air to water heat exchanger (water boiler).

Use of the water boiler requires that 40 gal. of water be carried in the aircraft. Hamilton-Standard says that this weight penalty is offset by the efficiency and small size of the unit. Unit is an aluminum plate-fin construction designed to withstand numerous freeze and thaw cycles. Boiler can handle 270,000 Btu per hr. for heat transfer with 12 sq. ft. of water surface and a weight of less than 10 lb.

Fuel tank pressurization air is taken just upstream of the turbine at pressures appreciably higher than engine bleed air pressure at idle engine power. Air is then expanded through the turbine where heat is extracted and the compressor is powered. At low bleed pressures, the compressor provides the high pressure ratio across the turbine necessary to maintain system capacity, hence the name "bootstrap system."

Air leaves the turbine at temperatures ranging to —150F. Prior to leaving the refrigeration section, the cooled air passes through an impingement-type water separator which removes free water (droplets or ice), preventing the formation of fog or frost in the cockpits.

The system contains two complete refrigeration packages located in the wing and pylon over each inboard engine. Either package can maintain the system in the event of failure of one of the inboard General Electric J79 turbojets.

Output from the two refrigeration packages is joined at the fuselage and is ducted aft to force-cool aft-located avionic equipment and forward to cool the cabin and cabin avionic gear.

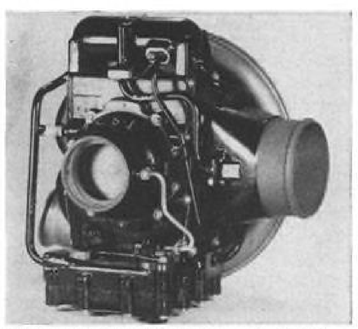
Under normal operating conditions the air is exhausted from the cabin through the avionic compartment, and then overboard through the cabin pressure regulator valve and aft overboard vent in the unpressurized avionics compartment. Pressure regulator valves is among the largest ever built, to satisfy avionic cooling weight flow demands in low density air.

If the crew compartment is not pressure-tight due to combat damage, an open access hatch or other failure, the avionic compartment would overheat under normal flow conditions. To prevent this, the system automatically goes into reverse flow in which the air flows into the cabin through the avionics compartment and then overboard through the pressure leak.

Reverse flow operation is accomplished with a four-port flow distribution valve which has a pressure relief capability. Minimum flow sensor combined with the cabin pressure regulator valve calls for more cabin flow as the valve nears the closed position.

Cooling Effect Simulator

Cooling effect simulator in the system controller switches the system from normal to reverse flow and controls the level of flow to maintain adequate avionic cooling. Simulator contains a heater, sensor and overheat switches and is cooled by air flowing in parallel with air cooling the avionic gear in the cabin. Sensor is connected to the amplifier controlling the system modulating valves, (upstream of the compressor inlet), and modulates the system airflow to maintain a simulator temperature of 200F. The overheat switches are set to put the system in reverse flow at 215F and to light a warning light at 230F.



TURBINE-COMPRESSOR is part of B-58 refrigeration package. Compressor permits fuel tank pressurization at low engine speeds.

Every controller is orificed and calibrated to follow a specification curve of pressure times the drop in pressure versus inlet air temperature for the correct simulator temperature of 200F in normal flow and 150F in reverse flow. Manufacturers of all avionic equipment in the cabin have been supplied these specification curves for design of equipment cooling provisions.

Cabin Temperatures

Comfortable cabin temperatures are maintained by adding heated air to the cold air cabin inflow as required. If the cabin temperature is too hot when the avionic equipment is satisfied, cabin sensor and amplifier will override the avionic sensor and will assume control of the throttle valves. The minimum flow sensor in the cold air line will override both of the other controls if neither calls for sufficient cold air flow to maintain cabin pressurization and ventilation.

Cabin temperature sensor and temperature control knob is located at the pilot's station. Manual controls provide temperature adjustment for the second and third crew stations.

Warm air is used to provide rain removal and defogging of the canopy interior. Hot engine bleed air is mixed with discharge air from the primary heat exchanger by a modulating valve controlled by a pneumatic sensor downstream of the mix point set to control to a nominal 280F. When warm air manifold temperature at the sensor is above 280F, the modulating valve is closed and only primary heat exchanger discharge air is used. Operation of the rain removal system can send temperature of this air to 500F.

Rain removal from the pilot's windshield is attained by venting hot air from a 10 in. flush slot in front of the left forward pane of the windshield. This prevents the formation of ice and the impingement of water droplets on a 150 sq. in. area of the windshield. A pressure of 20 psig. at the slot, minimum temperature of 250F, and a weight flow of 47 lb. per min. were found to be optimum.

Defogging of the cockpit interior is accomplished with a defog valve which modulates warm air from the manifold into an ejector. This entrains cabin air to reduce the over-all temperature. Air from the ejector mixing chamber is blown over the inside surfaces of the four forward panes of the pilot's canopy through nozzles at the base.

Ground cooling is provided by an external air conditioning cart. The high density and large cooling airflow demand of the B-58 causes a pressure drop that is unusually high. The size,

complexity and cost of the ground unit required has caused relocation of the cooling inlet from the wheel well to just aft of the cabin. This has reduced the cooling air demand; however, intelligent scheduling of avionic equipment during ground test is recommended to avoid an overheat condition.

Single Failure Concept

Entire air conditioning system of the B-58 was designed in consideration of the single failure concept. All components in the system are designed and arranged to function with the failure of any single component upstream or otherwise affecting their performance.

Maximum temperatures and pressures imposed by the failure of any one pressure regulating device, pressure limiting or temperature limiting device will not result in system breakdown. This single failure concept also was used in determining design requirements for temperature and proof pressure.

Hamilton-Standard was aided in the selection and development of the bootstrap system by an extensive IBM computer program. Evaluation of various configurations and optimization of the system was computed on an equivalent weight basis. All parameters such as ram air drag, thrust loss due to bleed air usage and weight of water used during a mission were carried as the effect on range of an eqivalent weight.

This weight added to the actual system weight gives an equivalent weight total for one particular system in one particular flight regime.

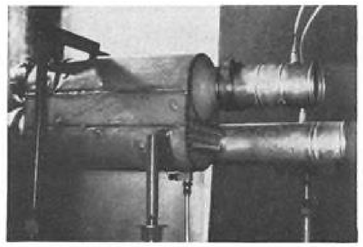
This procedure must be used over a number of typical aircraft missions and the resulting weight penalties compared to determine the optimum system. Effectiveness of this procedure hinges largely on the ability to closely define the aircraft's function.

Flow Analysis

Weight penalty method of system optimization required extensive thermodynamic analysis of the flows, temperatures and pressures in all possible flight regimes. In the complex distribution system of the B-58, this would not be feasible without electronic computing machines. Hamilton-Standard points out that just sizing the ram air heat exchanger, for example, required analysis of six or eight flight conditions for some 15 or 20 heat exchanger arrangements.

Programming job, which involved 24,000 words of instruction on an IBM 704 computer, was accomplished at United Aircraft's computer section at East Hartford, Conn.

The two years since the B-58 made its first flight have brought about certain modifications to the air conditioning system.



IMPINGEMENT-TYPE water separator removes free water from the refrigerated air, eliminating ice or fog in the cockpits.

A total of 16 system components have been redesigned. Transistorization of the system controller resulted in a weight reduction from 18 to 12 lb.

First flights of the B-58 brought complaints from flight test crews about uneven cabin temperatures. A temporary adjustment in the electronic simulator of the temperature controller corrected the situation. However, work is continuing on a redesign of the controller and minimum pressurizing air flow sensor circuitry.

Test Discrepancies

Other flight test discrepancies that have been encountered include troubles with turbine lubrication and the water separator coalescor. External overflow oil system is now incorporated in the turbine and frequent servicing from the lower wing surface ensures a full turbine oil sump. Water separator coalescor bay, which requires changing after each flight, is accessible through a panel on the upper wing surface. Accessibility is a maintenance problem on any system spread throughout an aircraft such as in the B-58 air conditioning system. Convair, however, describes accessibility of the air conditioning system as "not unreasonable."

All tactical B-58s will have a pressure-safe or fail-close pressurization system rather than the fail-open concept originally specified. This change, a departure from usual Air Force philosophy, means that pressurization will be maintained in the event of a valve failure. Purpose of the change is to relieve the crew of the necessity of wearing partial-pressure flight suits, required by regulation on all flights above 35,000 ft. Endurance of the B-58 would make compliance with this regulation extremely hard on flight crews. The Air Force hopes that with a pressure-safe system, the wearing of partial-pressure suits will prove unnecessary.

System change to comply with pressure safe requirements involved turning valves around so that a diaphragm rupture would drive them closed instead of open.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Louis F. Polk, of Bendix Aviation Corp., has been elected president of the American Ordnance Assn. succeeding **Gen. Benjamin W. Childlaw,** of Thompson Ramo Wooldridge, Inc. Also: **Edward G. Uhl,** of the Orlando, Fla., division of The Martin Co., appointed a regional vice president.

Dr. Stanford S. Penner, California Institute of Technology professor of jet propulsion, has been elected Chairman of the Combustion and Propulsion Panel of AGARD, the Advisory Group for Aeronautical Research and Development for NATO.

C. M. Britt, vice president-sales of Southern Airways, has been elected president of the Air Traffic Conference of America, a division of the Air Transport Assn. Currently Mr. Britt is serving as first vice president of the conference, and is a member of the executive committee.

Joseph J. Reino, Washington National Airport Tower, has been elected national president of the Air Traffic Control Assn. Other officers are: **Charles H. Newpol,** vice president, CAA Region 1 Office, New York City; **Cornelius Feyen,** secretary CAA Washington Office; **Joseph C. Few,** treasurer, Jacksonville ARTC Center.

D. H. Hollowell, vice president of Continental Motors Corp., succeeds Francis L. Hine, president of Airwork Corp., as president of the Aviation Distributors and Manufacturers Assn. Elected vice presidents of ADMA: **Paul A. Kennedy** of Southwest Airmotive Co., and **E. H. Fitch** of B. F. Goodrich Aviation Products. Elected directors of ADMA: **William L. Carolla** of Air Associates; **H. Webster Crum** of Avco's Lycoming Division; **Horace A. Smith** of Pacific Airmotive Corp.; **Robert W. Brattvet** of BG Corp.

Changes

Raymond J. Stefany, manager-aviation sales, Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J.

Jules Mersel, manager, Data Processing and Operations Department, Computation and Data Reduction Center, Space Technology Laboratories, Inc., Los Angeles, Calif.

Don Fairchilds, chief of promotion, Electronics Division, Ryan Aeronautical Co., San Diego, Calif.

Philco Corp.'s Government and Industrial Division, Philadelphia, Pa., has appointed the following product managers: **A. J. Vick,** military communications; **Jerry Spiegel,** missiles; **A. T. Pollock,** communications systems; **Gordon E. Frederick,** advanced techniques.

Morris Schulkin, head of the newly created ASW (anti-submarine warfare) Electronics Section, Electronics and Electrical Department, The Martin Co., Baltimore, Md.

R. O. Wolcott director of administration, Aeronautical Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

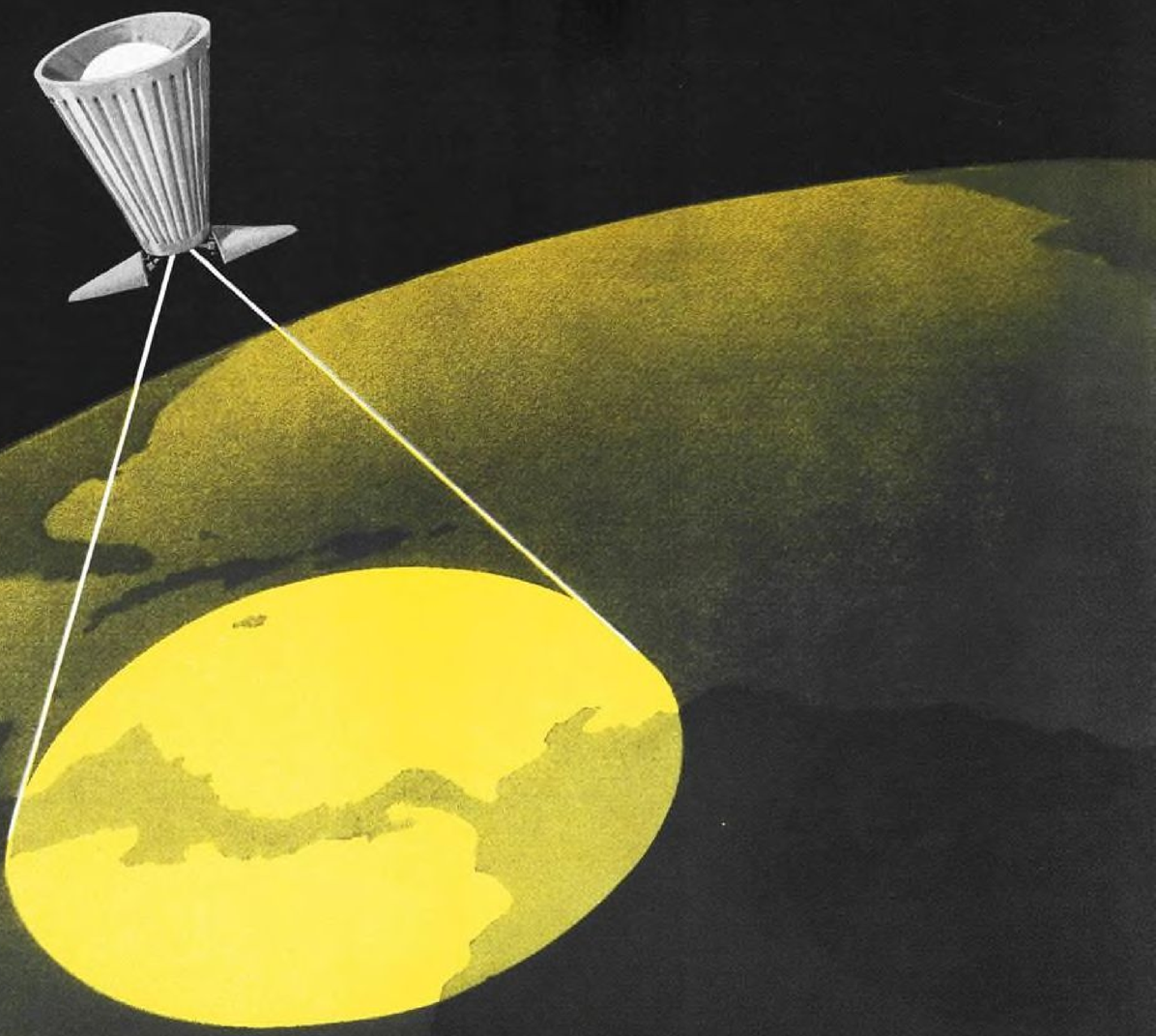
Hercules Power Co.'s new solid propellant plant, Bacchus, Utah, has selected the

(Continued on page 112)

SPACE TECHNOLOGY encompasses all of man's efforts devoted to the exploration of the universe, from his attempts to understand the basic laws of nature and the earth, to travel by men and machines throughout the solar system and beyond.

Man and his machines . . . aircraft—missiles—space vehicles . . . are based on earth, and must deal with the earth's environment in order to reach these distant goals. They must, also, deal with hostile, unknown environments.

Space Technology, therefore, includes every discipline of the physical and life sciences and every facet of engineering necessary to translate these sciences into successful flight through space.



RECONNAISSANCE SATELLITES...

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following for the technical staff: **John H. Main**, design superintendent; **William J. Rue**, production superintendent; **James O. Spitznogle**, ballistic development; **William M. Bogart**, inert components; **Edward P. Whaley**, evaluation; **A. Richard Shoff**, instrumentation; **Dr. Loren E. Morey**, technical specialist; **Gordon W. McCurdy**, technical assistant. **John E. Greer**, works manager, has charge of over-all management.

Dr. Donald G. Wilson, general manager, Stromberg-Carlson, San Diego, Calif., Electronics Division, Stromberg-Carlson division of General Dynamics Corp., Rochester, N. Y.

General Electric's Missile and Space Vehicle Department, Philadelphia, Pa., has named the following managerial team for the Re-Entry Vehicle Projects Operation: **R. L. Hammond**, program office-research and development; **O. E. Enders**, initial operating capability; **R. A. Passman**, preliminary systems design; **I. M. Clausen**, SARV program; **A. E. Buescher**, re-entry vehicle systems engineer; **R. J. Pierce**, systems evaluation; **H. Kimel**, projects technical support; **F. E. Rushlow**, business plans and operations; **Dr. W. Raithel**, advanced engineering; **S. H. Sigler**, administrative engineer; **J. P. May**, project engineering.

Wayne Johnson, director of engineering, Chicago Aerial Industries, Melrose Park, Ill.

L. H. Benzing, assistant to the vice president for operations, Stavid Engineering, Inc., Plainfield, N. J.

John W. Gillings, director of product planning, Aeronautical and Instrument Division, Robertshaw-Fulton Control Co., Anaheim, Calif. Also: **George Schatzman**, director of the Division's fluid controls department.

Ralph S. La Montagne, manager of marketing, Missile Electronics and Controls Department, Defense Electronic Products, Radio Corporation of America, Burlington, Mass. **Frank E. Greene** succeeds Mr. La Montagne as manager of marketing, Airborne systems Department, RCA Defense Electronic Products, Camden, N. J.

Sidney Frankel, director of engineering, Sierra Electronic Corp., a subsidiary of Philco Corp., Menlo Park, Calif.

Edward P. Hofstra, quality assurance manager, Missile Systems Division, Lockheed Aircraft Corp., Van Nuys, Calif.

George E. Tubb, director of marketing, Laboratory for Electronics, Inc., Boston, Mass.

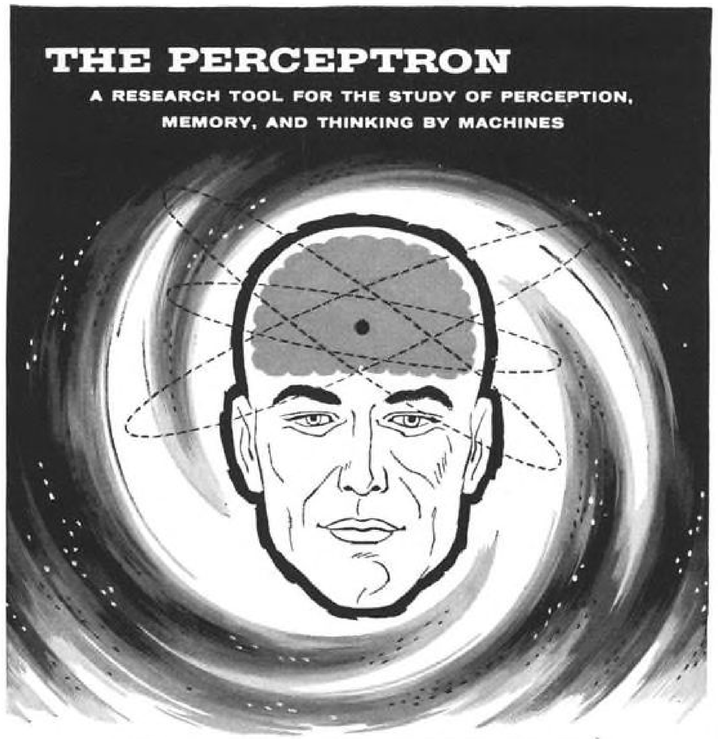
Edward J. Whalen, director of contracts and customer relations, ITT Laboratories, a division of International Telephone and Telegraph Corp., Nutley, N. J.

Ray V. Clute, assistant to the vice president-sales, Huck Manufacturing Co., Detroit, Mich.

Dr. Harry G. Romig, director of reliability, Hoffman Laboratories Division, Hoffman Electronics Corp., Los Angeles, Calif.

Fredrick S. Mitchell, chief engineer-industrial products, Electronics Division, Stromberg-Carlson, a division of General Dynamics Corp., Rochester, N. Y. Also: **William J. Stolze**, manager-technical staff, and **Leslie D. Catlin**, manager-engineering services.

Meril E. Johnson, manager of the Washington, D. C., office of AC Spark Plug Electronics Division of General Motors Corp., Milwaukee, Wisc.



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For complete details, write Technical Personnel Department A-1215, Bendix Systems Division, 3300 Plymouth, Ann Arbor, Michigan.

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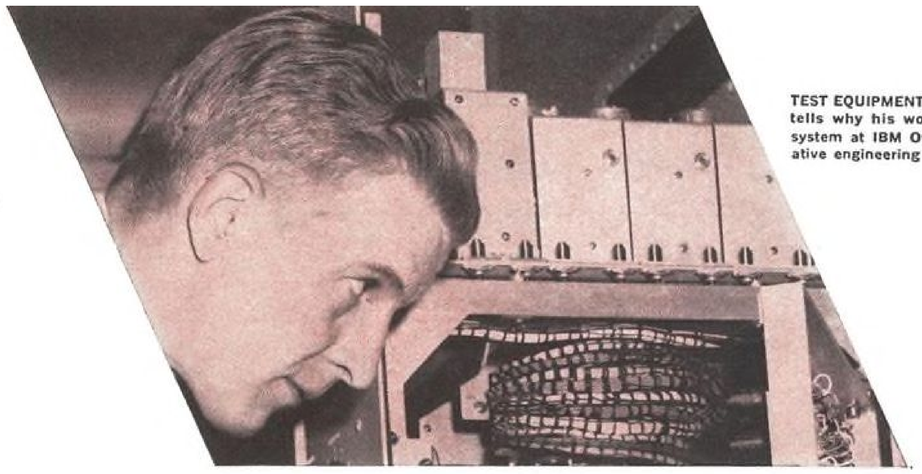
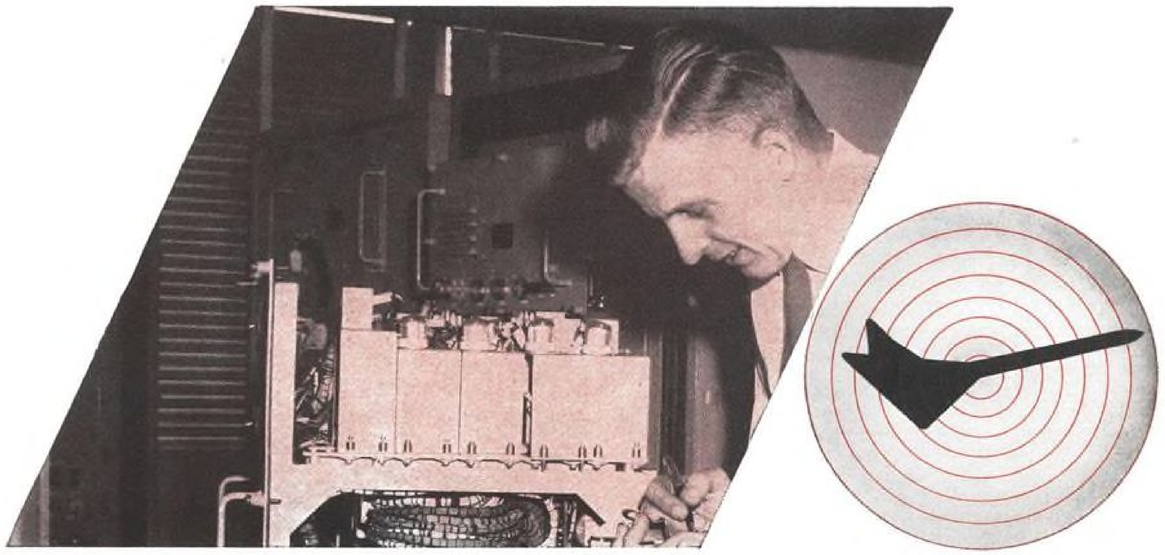


TEST EQUIPMENT ENGINEER John W. Lloyd tells why his work in the B-70 weapons system at IBM Owego affords him the creative engineering career he always wanted.

what's it like to be a creative engineer at IBM?



A wide variety of exciting career opportunities awaits creative engineers and scientists at IBM Owego in applying IBM's computer technology to integrated B-70 bombing-navigation systems. Test Equipment Engineer John W. Lloyd, describing his assignments at IBM Owego, says: "Test equipment engineering is particularly stimulating when it's part of a project as new and important as the B-70, sometimes described as a 'huge flying computer.' Right now I'm coordinating the design of engineering support equipment for an advanced digital airborne computer, part of the B-70's bombing-navigation and missile guidance system. There's a minimum of routine. In order to design test equipment you must know—or learn—about the equipment to be tested; among these are radar, servo systems, digital and analog computers, and inertial guidance. I see my professional growth assured as IBM continues to develop computers for airborne applications."

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PACKAGING ENGINEER to undertake development and design of packaging techniques and mechanical design of electronic equipment; to investigate temperature effects on packaging; to offer design support to computer, radar, and inertial development groups; to analyze present and proposed packaging design and recommend improvements.
Qualifications: B.S. in E.E. or M.E. and experience or advanced knowledge in latest electronic packaging techniques.

RADAR ENGINEER to analyze ultimate limits of present techniques and develop new concepts of providing topographical sensors for advanced airborne and space systems; to design airborne radar pulse, microwave and deflection circuitry; to analyze doppler radar systems in order to determine theoretical accuracy and performance limitations.
Qualifications: B.S. or Advanced Degree in E.E. and 3 to 5 years' experience in radar systems development, including display equipment and circuits, control consoles, and doppler or search radar design.

CIRCUIT ENGINEER to undertake advanced circuit design based on transistor-diode logic for digital systems; to review new circuits for application in digital control systems; to define basic techniques for improving performance characteristics; to participate in advanced analytical studies associated with application of transistor circuitry to pulse and digital systems.
Qualifications: B.S. or Advanced Degree in E.E. and 2 years' experience with pulse circuitry, transistor circuit design or digital techniques.

GROUND SUPPORT EQUIPMENT ENGINEER to assist in planning complete ground support equipment, including flight line, shop and depot equipment, for an advanced airborne weapons system. Must be experienced in development of test equipment for automatic checkout of complex weapons systems, including computers, radar, and inertial equipment.
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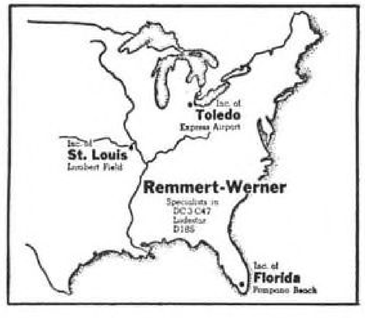

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AVIATION WEEK, DECEMBER 15, 1958

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

LETTERS

ALPA Man's Complaint

The controversial letters to the editor printed in AVIATION WEEK have served a very definite purpose, for which I am very grateful as a loyal ALPA member. They show we have been exceedingly negligent in presenting informed viewpoints so that the public would better understand the piloting profession. Informed editors normally appreciate situations where emotions are eclipsing the facts and correct this by intelligent editorials or by deletion of such trite from their publications.

If the union pilots are losing face with the public through unsavory press articles it is much the fault of the editor for representing these prejudiced articles as reliable openions.

After your ill advised controversy between military and commercial pilots you are now engaging in a new tact to belittle one of the finest and most honored profession of all times by discrediting their association ALPA. Since better than seventy-five percent of all ALPA members aee ex-military pilots they have served the country as no other professional group. What other group has had said about them? "Never before has so much been owed to so few." While this applied to English pilots those same pilots are flying BOAC and are IALPA members. Such a statement would also aply to American pilots.

It was rediculous of you to foment and encourage a controversy between a shoe selling navy pilot and a commercial pilot when only a matter of months may separate one from being the other. (I worked my way through college selling shoes to become a Navy pilot where I learned to rubber neck to better develope the art as a commercial pilot.)

Now you are hacking at ALPA leadership for diminishing stature when they deserve more honor than at any time in their history. Safety records are established never thought possible in aviation. ALPA has stimulated and advised government planning to prepare for future problems always demanding public safety above all else. They have overcome obstacles of poor government planning, unusual weather conditions, and mechanical failures as routine duty. No executive with so much responsibility, skill, and authority over two to five million dollar investments (to say nothing for lives involved) receive so little for their services. The industry is entering a new age which will half the time in which we will do twice the work and produce approximately four times the return and now the press has taken a delight in shocking the public with hypothetical wage demands.

The ALPA is more inteligently governed and advised now than any time since I have been associated. Corrections we are making in crew compliments were errors made by previous ill informed leaders. The effort to correct a situation which must be corrected should be commended rather than condemed.

Where ALPA has lost public appreciation for steering a bold straight course, the press has lost honor in nor correctly evaluation the situation. Your poor editorial policy may serve us, however, by stimulating our need for public education of our profession. If this is the case I will be grateful but I firmly dissaprove of your lack of discretion.

NEWT EDWARDS
Miami Springs, Fla.

(As most readers understand, letters published on this page represent opinions of the authors, not of Aviation Week. Aviation Week has reported the issues of military and civil air traffic control fully and editorially endorsed the principle of single agency airspace control by the new Federal Aviation Agency. Aviation Week also has reported the third crewman controversy but has taken no editorial position on this issue.—Ed.)

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.

'Mickey Mouse' Planes

All too frequently a man with a beef is more likely to bother expressing his views than a contented one—as I have been guilty of on two previous occasions with your fine publication. Though I am interested in nearly everything covered by AVIATION WEEK, I'm a little man in aviation and have been particularly pleased with your coverage of "little" aviation equipment, the lightplanes, standard and experimental.

Now, though I have intended getting off a complimentary letter for several weeks, it's another man's beef that was needed to get me off the dime.

Apparently E. D. Weiner (AW Nov. 10, p. 126) has found himself stuck with some T-28s and F8Fs he can't make a profit with. If so I'm truly sorry, but I can't sit idly by while he throws rocks at some other phase of aviation in the hopes of bettering his own position. A few lines in deference seem in order to counteract his smear. I have owned and flown quite a few "Mickey Mouse" homebuilts, first-flighting several; am a member of the Experimental Aircraft Assn. Being an ancient pilot, I have flown antiques both as near new and antiques, and belong to the Antique Aircraft Assn. Now I won't deny that some true Mickey Mouse homebuilts have been built, but contrary to Weiner's slander the CAA has sense enough to weed them out. I know of two, myself, that were never permitted loose. The ones I have flown for the most part were exceptional airplanes. As for antiques, the fact they have been around long enough to become antiques should speak for itself. If he wants to ground antiques he'd break the back of a few airlines (with excellent safety records).

At the risk of shocking Weiner, there are people who just mess with flying for fun, but I'm broad-minded—perhaps we should ban homebuilts and buy Bearcats.

HARVEY MACE
Sacramento, Calif.

Fighter Responsibility

At the risk of my being redundant, do you think the following would satisfy Airline Captain Heller (AW Sept. 8, p. 118) in regard to contributing something to the issues (midair collisions) at hand?

Suppose, since most of the incidents occur in good visibility, we paint the airliners and the Air Force fighters with a little more Day Glo? Or suppose we turn on the high intensity beacons, or put blinkers in with the landing lights? Or devise a rotating mirror to reflect sunlight? Or, suppose we install short range, low frequency warblers, such as the British used on their mountain peaks during the war? The receiver could feed a speaker above the pilot's head, or feed his headphones, or blink a light on the panel. When the pilot heard the warble or saw the light, then he could swivel-neck (AW Aug. 18, p. 118). The weight and cost of the installation would be a fraction of that of a radar set.

Incidentally, the swivel-necking procedure should be practiced more by the fighter pilot than by the airline captain because the airliner is bigger and easier to see and the fighter has much more window glass up front. The fighter is more maneuverable, I hope, with more horsepower per pound, power controls, higher rate of roll, anti-G suits in some cases, a younger pilot, etc., even if it does have a higher wing loading. The airline captain cannot swivel-neck as much because he cannot see through the 85% upholstery (AW Sept. 15, p. 134). Of course, this does not alibi those who read their morning papers while on duty (AW Sept. 29, p. 90).

Lastly, the obvious reasons why the collisions do not occur in bad weather are that there are fewer planes in the air, they are on IFR flight plans, and everybody knows where everybody else is at.

CLAY STEFFEE
Boite Postale 3
Cayenne, French Guiana
South America

Great Debate

The high positioned folks, on whose desks AVIATION WEEK may be found, would not be embarrassed to be caught with an American newspaper.

Yet, therein are daily examples emanating from some of our most respected authorities that would seem to indicate that the correspondents to the Editor of AVIATION WEEK do not hold the basic or refined patents to name calling, tub thumping, or drivel.

This is not to disagree with Mr. Spengler's thought (AW Nov. 3, p. 110) that AVIATION WEEK (and the world in general) would be better off without such tactics. However, many people find it difficult to make a point without resorting to such practices.

Perhaps the Editor, in a fit of objectivity, did consider that some of the points presented in the great IFR-VFR "debate" were more important than the methods of presentation.

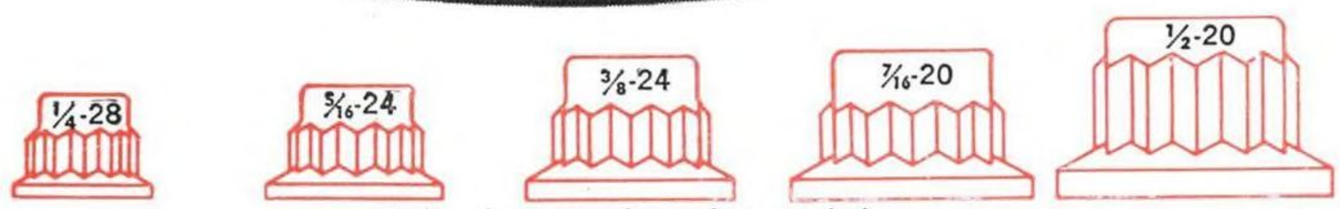
ROBERT E. TRIMBLE
Washington, D. C.

NEW *light-weight*

220,000 psi

ESNA SELF-LOCKING NUT*

for advanced
structural design...
high-tensile bolting



all drawings are shown in actual size

WEIGHT COMPARISON TABLE
in lbs. per 100 pieces

ESNA LH3393 (220,000 psi)	.44	.77	1.20	1.69	2.55
COMPETITIVE Lightest Nut (180,000 psi)	.60	1.00	1.50	2.15	2.82
COMPETITIVE Lightest Nut (220,000 psi)	.95	1.62	2.75	4.25	6.00

Tomorrow's hypersonic airframes must withstand flight stresses and related vibration conditions that would have seemed insurmountable even five years ago. Yet to achieve such speeds these aircraft will have to utilize lighter-weight structural components than their subsonic predecessors.

ESNA Type LH3393 double hex, external wrenching nut now offers the designer of tomorrow's airframes and missiles a structural fastener with the highest strength-to-weight ratio of any currently available self-locking nut.

Design refinements embodied in the LH3393 series consistently develop the full fatigue strength of 220,000 psi high strength bolts . . . yet these nuts are from 10% to 33% lighter, size for size, than even the lightest 180,000 psi locknut.

Additional weight savings are made possible by the smaller envelope dimensions of these new parts, since reduction of wrench clearance requirements permits reductions in the size of other structural components.

LH3393 series nuts are cold-formed from alloy steel, processed with the manufacturing skills and protected by the rigid quality control established during ESNA's 30 years of experience in supplying dependable aircraft quality fasteners. The same military approved, ELLIP-TITE locking device used on ESNA's complete line of NAS parts, assures reliable vibration proof self-locking performance at temperatures up to 550°F.

For specific dimensional, design and test data on ESNA's *new*, lightweight, 220,000 psi nut—Type LH3393, write to Dept. S23-1225, Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey.

ELASTIC STOP NUT CORPORATION OF AMERICA

*U.S. Patent No. 2,588,372