Aviation Week

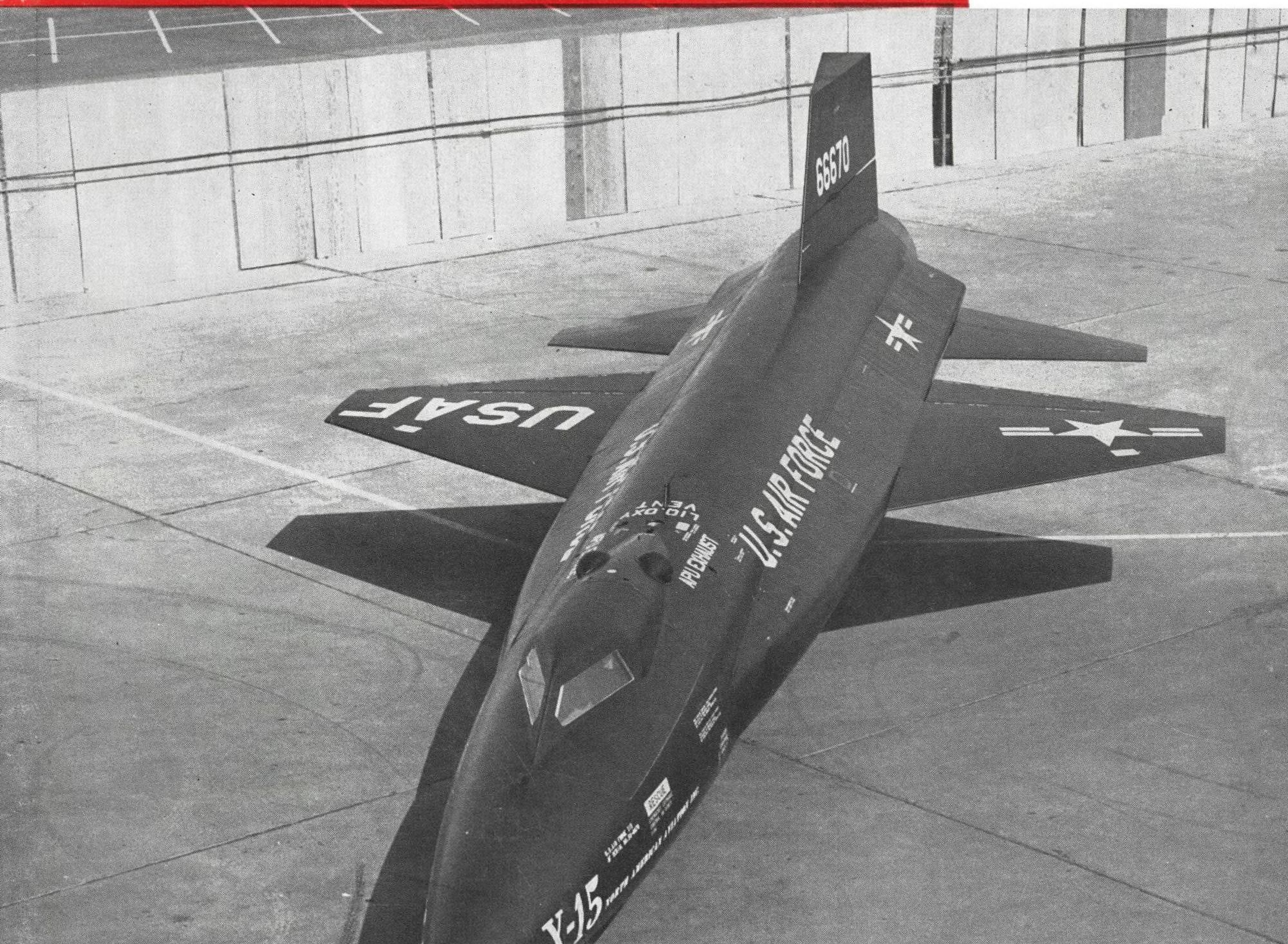
Including Space Technology

75 Cents

A McGraw-Hill Publication

October 27, 1958

Pyrophoric Fuel Ramjet Drone Design Proposed



North American X-15

BRUNSWICK TURNS OUT SHAPES WITH FANTASTIC FIDELITY

Brunswick has revolutionized the technology of fiberglas laminates with its exclusive new Strickland B Process (SBP). This unique method not only creates components with extremely high strength-to-weight ratios and heat resistance (up to 600°F.), but it also opens up a mass production system that meets fantastic new standards for precision.

SBP filament-wound laminates can be mass produced by fully automated machines. Whether one or one thousand . . . simple or compound configurations, including monocoque structures, SBP laminates meet the most rigorous space age specifications for precision and uniformity in skin thickness, size, dielectric constant and contours.

Brunswick research and development groups continually work to extend upper temperature limits and other unique features of SBP laminates. They also offer you skillful help solving problems in design, development and fabrication. Write The Brunswick-Balke-Collender Co., Defense Products Division, 1700 Messler St., Muskegon, Michigan.

BRUNSWICK

MAKES YOUR IDEAS *WORK*

Tough Fabrics for Tough Jobs

HOW RUBBERIZED FABRIC, PIONEERED BY GOODYEAR, WORKS TO SERVE AMERICA'S DEFENSES

HOW TO ENGINEER A SAFE "AIR DROP" OF HEAVY, SENSITIVE EQUIPMENT

Lightweight, low-cost "ground bumpers," engineered by Goodyear, kill shocks, deliver material in operative condition—ready to go.

SAVING TEST MISSILES FOR ANOTHER DAY

Inflatable Goodyear Recovery Bags, made from rugged rubberized fabric, fold easily within missiles—inflate to "ground impact cushions" for landings.

RUBBER HOUSING FOR RADAR INSTALLATIONS

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A COLLAPSIBLE, PORTABLE FUEL SUPPLY

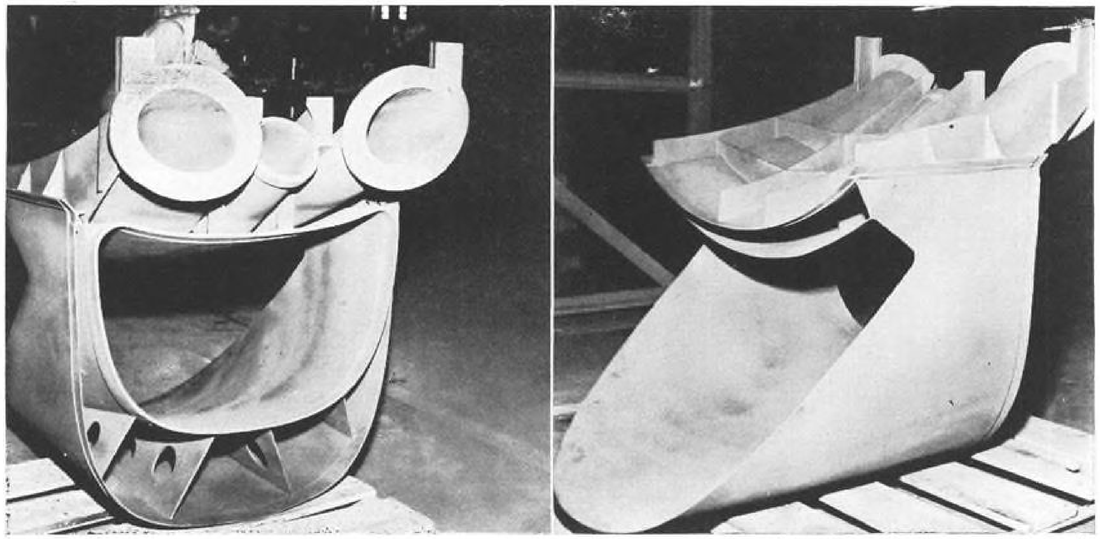
Pillow Tanks roll up like rugs when not in use—can be set up and pumping in minutes. And they hold up to 50,000 gallons.

BUILDING STRUCTURES WITH FABRIC AND AIR

A completely inflatable airplane made entirely from Air Mat Fabric, the miracle fabric which makes possible a new concept for designing lightweight collapsible structures.

Got a problem for which rubberized fabric might provide the answer? Why not talk it over with Goodyear—pioneer in tailoring rubberized fabric to fit any application. Address: Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

GOODYEAR
AVIATION PRODUCTS



Engine air scoop casting made by R. H. Osbrink Mfg. Company, Los Angeles

MAGNESIUM "SUGAR SCOOP" HELPS REGULUS II BREATHE

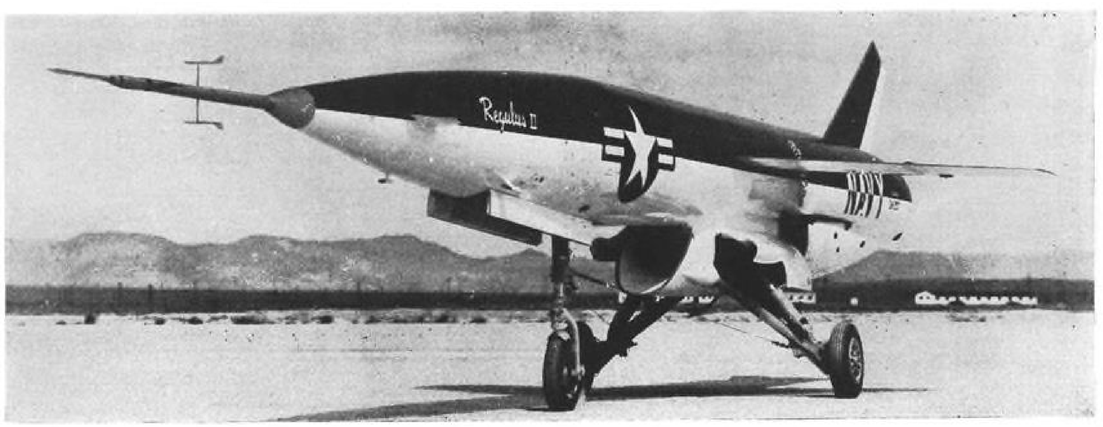
Huge thin-wall magnesium casting satisfies appetite for air

At supersonic speeds more than ten miles above the earth, Chance Vought Aircraft's Regulus II consumes enormous quantities of air through a 150 lb. magnesium casting.

This complex, close tolerance magnesium casting supplies air for the Regulus' powerful J-79 jet engine. It also provides ducting for boundary layer control and for air conditioning. Nominal thickness on walls and webs is 0.24 inch and the solid leading edge tapers to a 0.015 inch cast radius. Casting tolerance is + or −0.03 inch on dimensions up to 12 inches, with an additional + or −0.002 inch per inch on dimensions above that. That's real casting accuracy!

This air scoop is an excellent example of the versatility and usefulness of magnesium alloy castings in aircraft design. Thin-wall casting designs can be produced in magnesium to replace complicated, costly fabrications involving several production operations.

For more information about magnesium sand castings and their use in aircraft design, contact your nearest magnesium foundry or Dow sales office.



MAGNESIUM DESIGN, a 235-page handbook, discusses in detail: properties, structural design, product design including castings and mill products, fabrication and finishing. Large section of tables on properties, sizes, tolerances, etc. For your copy contact a Dow sales office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1463K-2.

YOU CAN DEPEND ON DOW

AVIATION CALENDAR

Nov. 3-7—Fifth Institute on Electronics in Management, American University, Washington, D. C.

Nov. 3-7—15th Biennial Convention, Air Line Pilots Assn., Carillon Hotel, Miami Beach, Fla.

Nov. 6—Regional Technical Conference, Society of Plastics Engineers, Sheraton Hotel, Philadelphia, Pa.

Nov. 6-7—13th Annual Symposium on Applied Spectroscopy, Hotel New Yorker, New York, N. Y.

Nov. 6-7—Quarterly Regional Meeting, Assn. of Local & Territorial Airlines, Honolulu, Hawaii.

Nov. 6-7—Fifth Annual Meeting, Institute of Radio Engineers Professional Group on Nuclear Science, Villa Hotel, San Mateo, Calif.

Nov. 6-7—National Specialist Meeting on Dynamics and Aeroelesticity, sponsored by Institute of the Aeronautical Sciences, Texas Section, Texas Hotel, Ft. Worth.

Nov. 9-12—13th Annual Convention and Logistics Forum, National Defense Transportation Assn., Sheraton-Jefferson Hotel, St. Louis, Mo.

Nov. 10—Aviators' Post 743 Veterans Day Dinner, Advertising Club, New York, N. Y. Principal speaker: Lt. Gen. Samuel E. Anderson.

Nov. 10-12—International Conference, Physics and Medicine of the Atmosphere and Space, sponsored by the School of Aviation Medicine, San Antonio, Tex.

Nov. 10-13—11th Annual International Air-Safety Seminar Flight Safety Foundation in cooperation with Airways Modernization Board's National Aviation Facilities Experimental Center, Atlantic City, N. J.

Nov. 10-21—12th Air Transportation Institute of the American University, Washington, D. C.

(*Continued on page 6*)

AVIATION WEEK Including Space Technology

October 27, 1958
Vol. 69, No. 17

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AVIATION CALENDAR

(*Continued from page 5*)

Nov. 11-14—19th Annual Convention, National Trades Assn., Pfister Hotel, Milwaukee, Wisc.

Nov. 12-14—Eighth Aircraft Hydraulics Conference, sponsored by Vickers, Inc., Park Shelton Hotel, Detroit, Mich.

Nov. 12-14—1958 Annual Meeting, Society for Experimental Stress Analysis. Hotel Sheraton-Ten Eyck, Albany, N. Y.

Nov. 16-21—Conference on Scientific Information, Mayflower Hotel, Washington, D. C. Co-sponsored by USAF Office of Scientific Research, National Academy of Sciences, National Science Foundation and American Documentation Institute.

Nov. 17-18—Sixth Annual Aircraft and Missile Division Conference, American Society for Quality Control, Biltmore Hotel, Dayton, Ohio.

Nov. 17-21—13th Annual Meeting and Astronautical Exposition, American Rocket Society, Hotel Statler, New York, N. Y.

Nov. 17-21—Eighth National Plastics Exposition, International Amphitheatre, and Plastics Conference, Hotel Morrison, Chicago, Ill.

Nov. 19-20—Northeast Electronics Research and Engineering Meeting, Mechanics Hall, Boston, Mass.

Nov. 19-21—32nd Meeting, Aviation Distributors and Manufacturers Assn., Statler Hilton Hotel, Dallas, Tex.

Nov. 21-22—Third Symposium on Magnetohydrodynamics, Lockheed Missile Systems Division's Research Laboratory, Palo Alto, Calif. Attendance by invitation.

Nov. 28—Fourth Convertible Aircraft Congress, the Franklin Institute, Philadelphia, Pa.

Nov. 28-30—Snowbird Soaring Meet, Harris Hill, Elmira, N. Y.

Nov. 28-Dec. 4—First Electronic Computer Exhibition and Symposium, Olympia, London, England.

Dec. 2-4—Third Conference on Reliable Electrical Connection, sponsored by Electronic Industries Assn., Dallas, Tex.

Dec. 3-5—Second National Symposium on Global Communications, sponsored by the Institute of Radio Engineers and American Institute of Electrical Engineers, Colonial Inn, St. Petersburg, Fla.

Dec. 3-5—Eastern Joint Computer Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

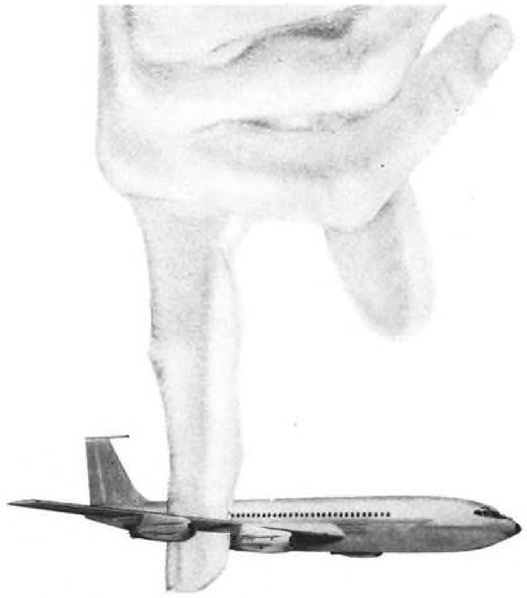
Dec. 5-7—Annual Convention, Texas State Aviation Assn., Ft. Clark, Tex.

Dec. 9-11—Mid-American Electronics Convention, sponsored by Kansas City Section, Institute of Radio Engineers, Municipal Auditorium Arena, Kansas City, Mo.

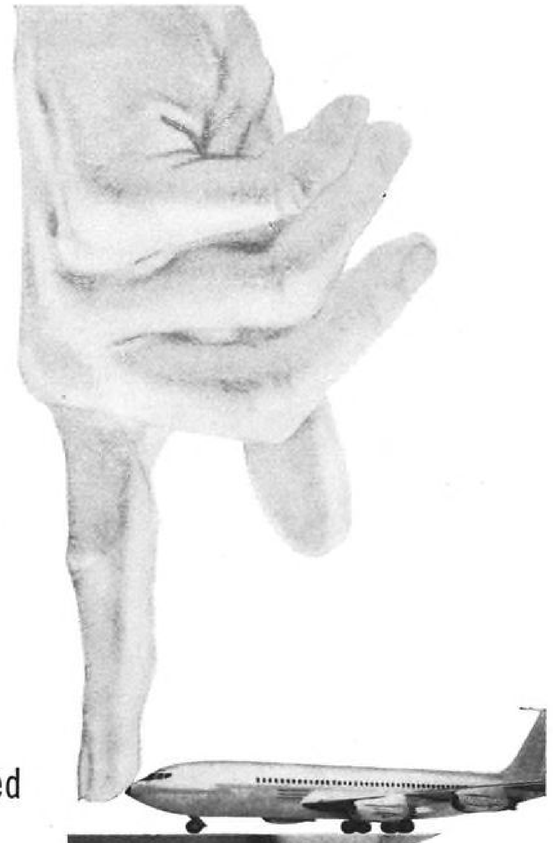
Dec. 17—22nd Wright Brothers Lecture, Maurice Roy on French aeronautical research, Natural History Bldg., Smithsonian Institution, Washington, D. C.

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.

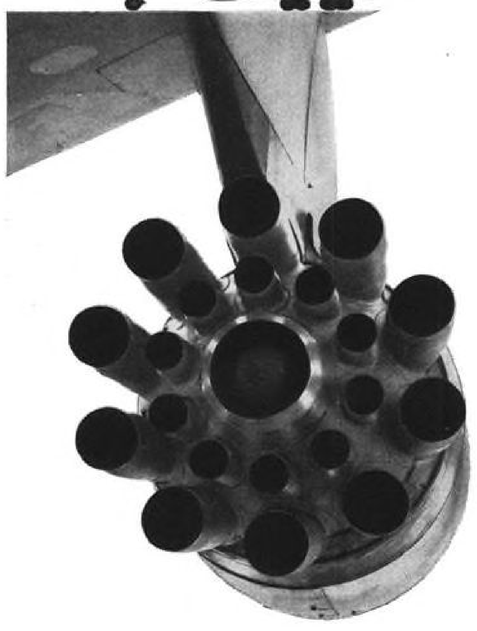
Jan. 26-29—27th Annual Meeting, Institute of the Aeronautical Sciences, Sheraton-Astor Hotel, New York, N. Y. Honors Night Dinner, Jan. 27.



hushing the jet roar



halting the jet speed



To reduce the jet sound to an acceptable level, and reduce the jet landing speed within an acceptable distance, the Boeing 707 is equipped with this

ROHR-BUILT SOUND SUPPRESSOR-THRUST REVERSER

Built by Rohr to Boeing design and specifications, this precision unit is an important addition to the jet power pods and other major aircraft components being built by Rohr for America's fleets of jet airliners.

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Reliability

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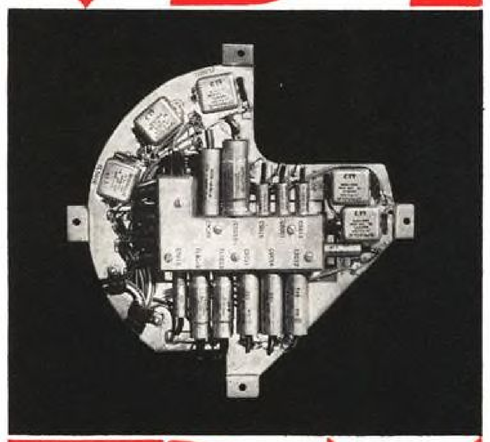

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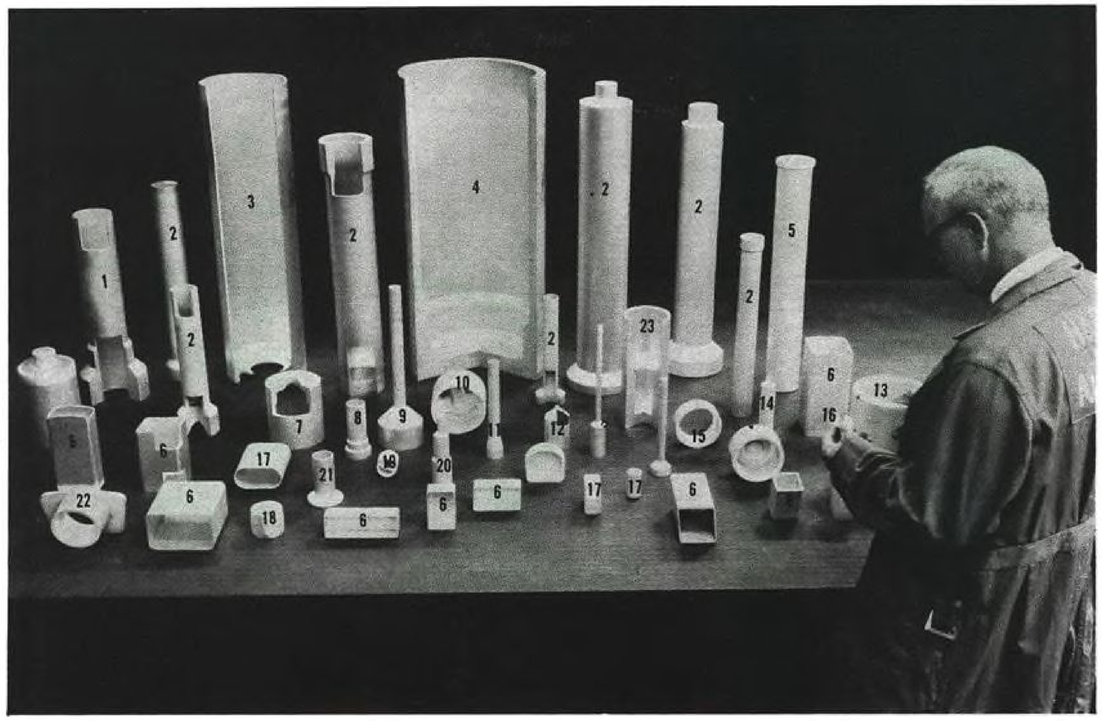
. . . to match any configuration

The efficient and economic way to handle hard-to-specify space is to call in a Sprague Interference Control Service Engineer. He'll give you complete details on Sprague's wide assortment of filter elements and the more than four thousand proven filter designs.

Sprague's individual building-block elements can be *ordered right off the shelf and wired in any configuration which available space dictates.* You can assemble the filter elements yourself, or else you can have Sprague do the entire job for you. In either case, you're sure to cash in on Sprague's many filter designs, research and development studies, complete interference test and measurement facilities, field consulting service, and mass production facilities at Visalia, California, and North Adams, Massachusetts.

If you want the most for your filter dollar, pick up your phone and call your nearest Sprague Electric Interference Control Service Laboratory. They're located at 12870 Panama Street, Los Angeles 66, Calif. (TExas 0-7531); 224 Leo Street, Dayton 4, Ohio (BAldwin 3-9187); 327 Marshall Street, North Adams, Massachusetts (MOhawk 3-5311, ext. 486).

see **SPRAGUE®** for filters



IMPACT EXTRUSIONS... any type

...from Harvey Aluminum

Advantages of Impacts

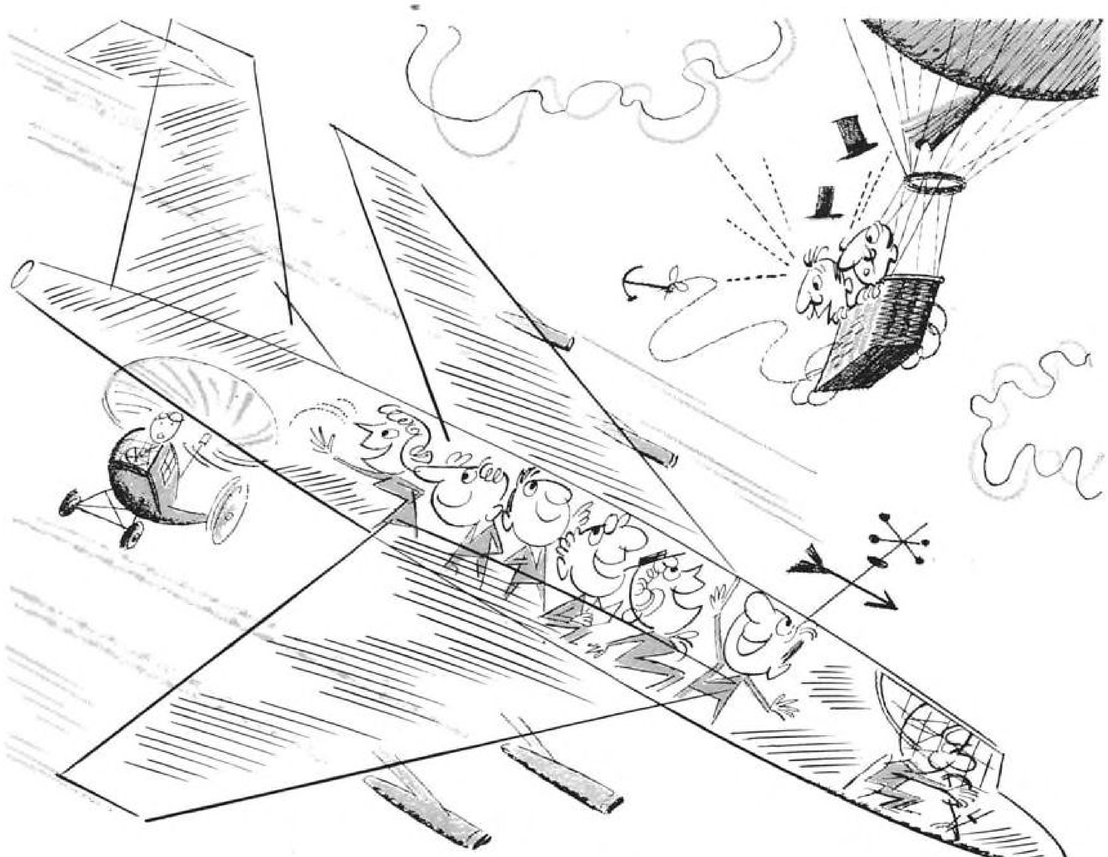
- **Close Tolerances**
- **Low Unit Cost**
- **Smooth Surface**
- **Design Variations**
- **Material and Alloy Selection**

Typical examples where engineers, designers, and production managers found it economical to use Harvey Aluminum Impact Extrusions: 1. rocket motor orifice — 2. aircraft landing gear hydraulic members — 3. motor oxygen tank — 4. missile aft section — 5. distress light case — 6. aircraft structural fittings — 7. missile control gear case — 8. mechanical sleeve — 9. hydraulic pump shaft — 10. internal combustion piston — 11. rifle scope tube — 12. fractional horsepower motor cover — 13. jet motor cap — 14. pressure gage body — 15. propeller lock nut — 16. nut shell holder — 17. electronic control covers — 18. flexible tube coupling nut — 19. lawn mower motor pistons — 20. rocket fin housing — 21. rheostat control sleeve — 22. bulk head fitting — 23. oil gear housing.

For more information and technical assistance on impact extrusions, contact the nearest Harvey Aluminum factory branch listed under "Aluminum" in your classified directory, or write directly to the general offices of Harvey Aluminum, Torrance, Calif.

A major independent producer of quality aluminum in all alloys and sizes: Pig, ingot, billet, rod and bar, pipe, tube, hollow sections, press forgings, forging stock, hand forgings, impact extrusions, electrical bus bar, structurals, special shapes, light and heavy press extrusions, screw machine and other aluminum products. Similar products in titanium, zirconium, and steel. HARVEY ALUMINUM SALES, INC., Torrance, California.

HARVEY Aluminum



how far can you design with glass?

Glass has amazing properties, but it naturally has application limitations. You'll be time and money ahead if you call in an L·O·F technical adviser, right from the start.

Depending upon formulation and manufacture, glass can be made even stronger than some metals . . . made to close tolerances . . . lighter than aluminum . . . sensitive (or insensitive) to light, heat or electricity . . . corrosion resistant, nonabsorbent, and low in contraction and expansion.

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And, as one of the world's largest producers of flat glass, we can supply you with "grid photo-tested", top-quality glass at reasonable prices.

If you have any question concerning the latest developments in aircraft glass, send it to Aircraft Division, Dept. 73108, Libbey·Owens·Ford Glass Company, 608 Madison Avenue, Toledo 3, Ohio.

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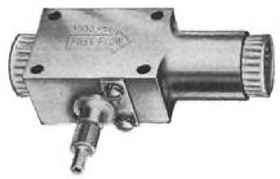
POWER BOOSTED MASTER BRAKE CYLINDERS—HYDRAULIC

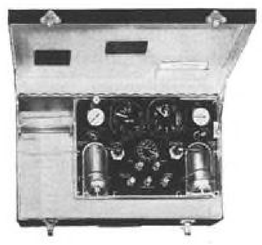
4-WAY SOLENOID SELECTOR VALVES—HYDRAULIC

3-WAY SOLENOID SELECTOR VALVES—HYDRAULIC



CONTROLLABLE CHECK VALVES—HYDRAULIC

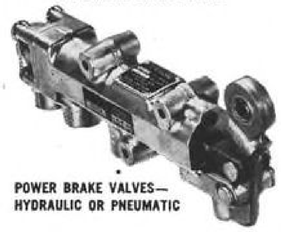
RESTRICTORS AND CHECK VALVES



PITOT-STATIC TESTERS

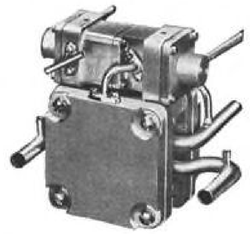
SEQUENCE VALVES—HYDRAULIC OR PNEUMATIC

QUADRUPLE 3-WAY SOLENOID SELECTORS—PNEUMATIC OR HYDRAULIC



POWER BRAKE VALVES—HYDRAULIC OR PNEUMATIC

4-WAY SOLENOID SELECTOR VALVES—PNEUMATIC



AUTOPILOT SERVO AMPLIFIERS—PNEUMATIC

MEMO TO AIRCRAFT AND MISSILE DESIGNERS:

Call on Tactair for dependable hydraulic and pneumatic components

Does your job include the design or procurement of hydraulic and pneumatic components for aircraft or missile control systems?

If so, it will pay you to investigate the advantages of working with Tactair. Solving the unusual problem, meeting ultra-critical performance specifications, providing precision, high-pressure, high-performance valves of the utmost dependability is our job. To do this requires a rare combination of creative engineering and specialized manufacturing skills. To these must be added precision equipment and long experience with weapons system components. Tactair has all these essentials.

A wide variety of Tactair valves and components are performing essential functions in today's aircraft and missiles. Typical components produced by Tactair include: solenoid selectors, brake controls, master brake cylinders, sequence valves, manual selectors, controllable checks, restrictors and check valves. Tactair has also developed a servo amplifier for the first completely pneumatic autopilot for business aircraft and is the sole producer of a commercial pitot-static tester—a portable laboratory of indicating instruments that makes possible the flightline testing of pitot and static systems in aircraft.

We welcome the opportunity of assisting you with your next precision valve problem. Every job we do is done on a personalized basis; it has been that way for 18 years. Tactair Valve Division, Aircraft Products Company, Bridgeport, Pa., BRoadway 5-1000.

CONTROL, SELECT, BRAKE, RESTRICT, CHECK . . . with **TACTAIR®**

RADAN®
SYSTEMS

ground speed & drift angle
any time, anywhere, any weather

One look and the pilot KNOWS. In a glance he reads actual ground speed and drift angle, displayed on his flight panel – automatically and continuously.

The system operates entirely without ground aid or celestial fix.

RADAN is the result of GPL's harnessing of Doppler for air navigation—an achievement comparable in magnitude to the breaking of the sound barrier.

...and now for everyone

The wraps are off RADAN! The civilian counterpart of GPL's famous military Doppler auto-navigators, is ready and available *now* – for anyone and everyone!

RADAN Systems have behind them millions of miles of experience in transcontinental, oceanic and polar flights . . . save precious time and fuel . . . provide a priceless margin of safety.

- **RADAN** – accurate: within 1% for ground speed, within ½° for drift angle
- **RADAN** – small: 4.4 cu. ft.–light: 89 lbs.
- **RADAN** – operates without ground or celestial aids
- **RADAN** – virtually maintenance-free

Now in quantity production, RADAN Systems are manufactured by GPL, who developed and is the nation's leading producer of Doppler air navigation systems. Address inquiries to: General Precision Laboratory Incorporated, Pleasantville, New York.

GPL — GENERAL PRECISION EQUIPMENT CORPORATION

ENGINEERS – GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.

"TURN SIGNALS" FOR A BALLISTIC MISSILE

BURROUGHS ELECTRONIC COMPUTER "MASTERMINDS" THE ATLAS INTERCONTINENTAL BALLISTIC MISSILE

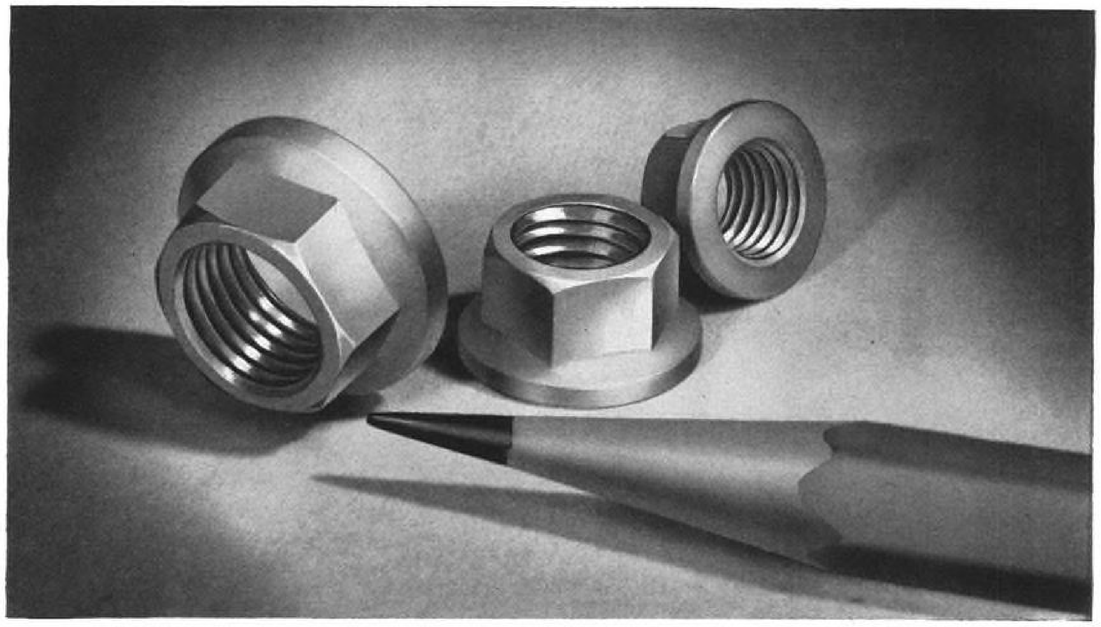
Steering the 250-mile-per-minute Atlas into the precise trajectory required for the missile to accurately strike its target 5,500 miles away, calls for incredibly close computation. And that's where Burroughs comes in—with an electronic computer specially designed to receive complex information, compare it with the pre-calculated direction, and signal the missile necessary changes to set it unerringly on its course.

Important contracts are not new to Burroughs Corporation with its 70 years of demonstrated competence. But it is the recent defense projects that serve best to underscore Burroughs' breadth and complete capability, from research through mass production to actual field installation and service. Burroughs Corporation, 6071 Second Avenue, Detroit 32, Michigan.

BURROUGHS CORPORATION

THE FOREMOST NAME IN COMPUTATION

Burroughs B



New FN-12 Series Featherweight Locknuts provide 125,000 psi minimum at temperatures up to 550°F, yet weigh 12% to 72% less than comparable sheet metal (NAS 679) and AN Series nuts. The FN-12 is installed with standard tools, incorporates new burr-free locking feature which permits highly accurate torquing.

New SPS Featherweight locknuts save you up to 72% in locknut weight

Smaller hex also requires less installation area —helps you design more compact bolted joints

Designed for fastening structural skin and panel assemblies, the new SPS FN-12 Series Featherweight Locknut offers you weight savings of 12% to 72% over widely used sheet metal and AN Series nuts. Yet despite its light weight, the cold forged FN-12 sacrifices none of the static or dynamic properties of its heavier counterparts. Meeting all requirements of MIL-N-25027, it has a tensile strength exceeding 125,000 psi. Its vibration resistance is 150% of specification minimum. And it gives greater bolt tension-tension fatigue strength than any other lightweight locknut tested.

Besides offering you valuable weight savings combined with high strength and reliability, the FN-12 locknut, because of its new configuration, can be installed closer to vertical bulkheads than any other aircraft nut now in use. This permits further weight reductions through miniaturization of joints to be fastened.

FN-12 Series Featherweight Locknuts are available in heat treated alloy steel in sizes #4 through ⅜ in. They are furnished cadmium plated, with optional molybdenum disulfide coating. For complete information request new Bulletin 2426. Aircraft/Missiles Division, STANDARD PRESSED STEEL Co., Jenkintown 3, Pa.

We also manufacture precision titanium fasteners / *write for free booklet*

SPS Jenkintown • Pennsylvania

Standard Pressed Steel Co. • The Cleveland Cap Screw Co. • Columbia Steel Equipment Co. • National Machine Products Co. • Nutt-Shel Co. • SPS Western • Standco Canada Ltd. • Unbrako Socket Screw Co., Ltd.

WEIGHTS OF FN-12 AND COMPARABLE LOCKNUTS

(all weights expressed as pounds per 1000 pieces)

Size	FN-12	NAS 679*	% Weight Saved by FN-12	AN Series†	% Weight Saved by FN-12
#4-40	0.4	0.8-1.0	50%-60%	1.3	69%
#6-32	0.7	1.3-1.7	50%-60%	1.8-2.5	61%-72%
#8-32	1.2	2.1-2.5	43%-52%	2.8-4.2	57%-71%
#10-32	1.5	2.5-2.8	40%-47%	3.3-4.6	55%-67%
¼-28	3.5	3.9-4.7	12%-26%	5.4-8.5	35%-59%
5/16-24	5.4	6.4-7.2	16%-25%	8.7-11.8	38%-54%
⅜-24	7.3	9.3	21%	11.5-19.5	37%-63%

*Range of four most commonly used sheet metal nuts of NAS 679 type
†Range for AN 363, 364, 365

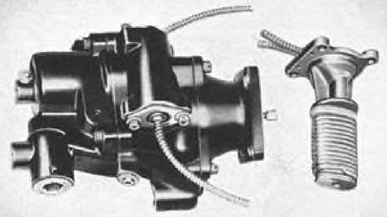
HIGH RELIABILITY

SPS research is continually developing fasteners with higher standards of predictable performance. By installing SPS high-reliability fasteners in your assemblies, you increase overall product reliability.

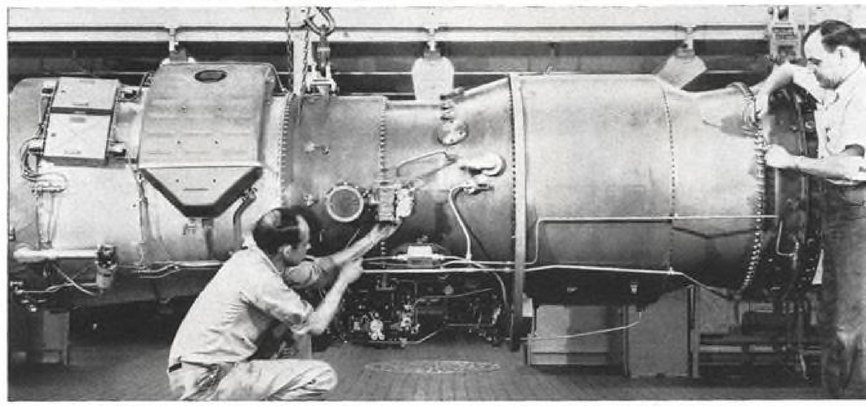
For more information on the full meaning of reliability, write for a copy of the new SPS booklet "High Reliability."

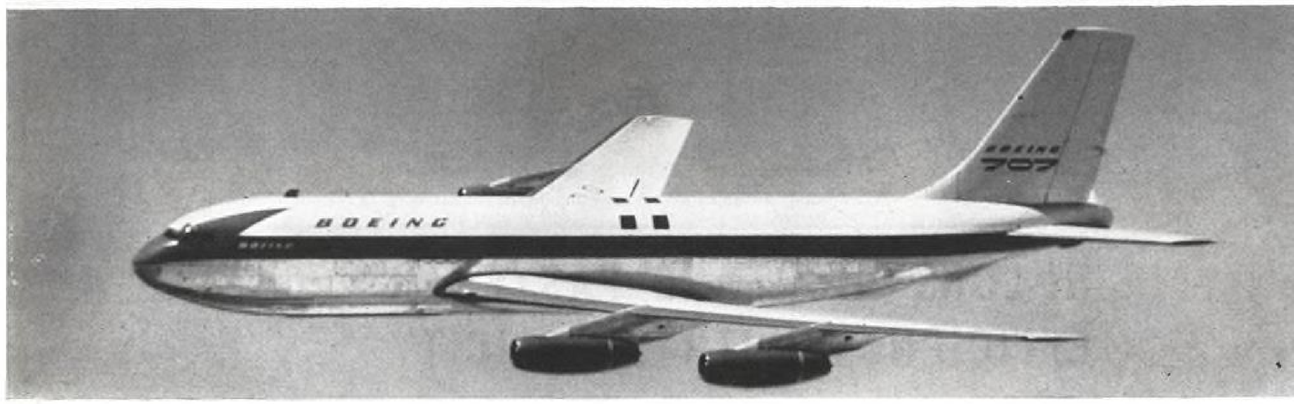
Holley engine controls selected for JT4 engines on America's first jet airliner

BLEED PISTON ACTUATOR



COMPRESSOR BLEED GOVERNOR





Powered by four JT4 Pratt & Whitney Aircraft engines, the Boeing 707-320 will carry 131 first class passengers from New York non-stop to the Continent in just over six hours! Each of these new engines, commercial counterparts to the J-75 which drives many of America's latest jet fighters, delivers up to 15,000 pounds of thrust. Ability to pack so much added power into a relatively small space is the result of designing engine components which will operate at higher efficiency, require less area and reduce over-all weight.

Holley Carburetor Company, working closely with Pratt & Whitney Aircraft engineers, carried out this exacting assignment on such vital engine components as: the compressor bleed governor, and the bleed governor actuator. For single and multi-engine military aircraft, the Holley main fuel control is a companion unit to the Holley governor and actuator.

For military applications, the Holley main fuel control (right) is a companion unit to the governor and actuator.

A-26

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Leader in the Design, Development and Manufacture of Aviation Fuel Metering Devices

October 27, 1958

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COVER: Configuration of North American X-15 out-of-atmosphere research aircraft confirms accuracy of Aviation Week artist's conception first published in Feb. 3 issue (p. 27). Large fuselage fairings hold propellant and control lines. Aircraft will land on steel skids and dual nosewheel. For other pictures, turn to p. 88.

PICTURE CREDITS
Cover—North American; 27—U. S. Army; 28—Hughes; 31, 33, 73, 78—Lockheed; 39—Boeing; 41—Convair; 61—Ohio State; 64—Dynex; 88, 89, 98—North American; 97—Thiokol Chemical; 100—Convair; 109—Canadair; 119—Koppers Co., International Aerocoustics, Air Logistics; 121—Kittell-Lacy.

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EDITORIAL

Spotlight on the Army

The national spotlight was on the Army of the United States last week as its official supporters of the Army Assn. rallied round a Jupiter C flagpole in the courtyard of a Washington hotel at their annual meeting (see page 28). There was no lack of controversy and divergent viewpoints on almost every phase of the Army's activities during this rally on a Washington hilltop.

In Los Angeles President Eisenhower said:

"Our Army is modernized, mobile and prepared to repel aggression."

In Washington, Gen. Lyman Lemnizter, Army vice chief of staff, told the Army Assn.:

"In terms of dollars, approximately 60% of the Army's inventory today was procured during World War II or the Korean War. Ten per cent of it is of pre-World War II vintage. As a result, many items have reached a point where they are no longer economical to maintain or are no longer adequate in light of current requirements."

Commenting on the Army's lack of mobility, Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, told the Army Assn.: "When I speak of mobility, I am thinking of both rapid movement and fast reaction. The Redstones, Corporals and even Honest Johns of today are not really mobile in the sense of rapid movement in a battle area. Nor do they yet possess the capability for fast reaction. Firepower is not much good unless it can be applied quickly and flexibly. Emphasis must be placed on insuring improvements in these characteristics in the follow-up models such as Pershing and Sergeant."

Gen. Twining also touched on the critical weakness of the Army's plea for more airlift capacity, noting that little of the Army's equipment could be air transported now because of emphasis on protective armor. He urged that this design emphasis be switched to concentrate on speed and firepower combined with air transportability characteristics.

Nobody will seriously contend for an instant that there is not a vital need for a modern, mobile ground force. However, there is a growing feeling that the recent leadership of the Army has been tossing up a cloud of space dust and missile bombast, concealing the pathetic lack of modern technology applied to the Army's genuine mission. While the Army has been trumpeting about its achievements in outer space and long-range ballistic missiles, it has been badly neglecting the use of modern technology to solve its problems on the ground. One of the principal areas where modern technology offers a variety of solutions is to free the Army from dependence on wheeled transport limited to improved roads. Contrast the self-propelled caterpillar track missile launchers displayed by the Soviets in Red Square last fall with the wheeled, road-dependent vehicles used with Redstone, Corporal and Honest John. Contrast the lightweight air transportable Soviet tanks that also rattled through Red Square with the cumbersome efforts to squeeze the Army's heavy armor into a Douglas C-124 or parachute it from a Fairchild C-119.

It is encouraging to note that the Army is gradually easing off from its old-fashioned arsenal concept of research, development and production in favor of more direct relationships with the vast American industrial complex. This trend is most pronounced in the area of new missile developments such as the Pershing and the ABC requirements for the next generation of tactical missiles. It is also beginning to plough some fertile ground in the new crop of experimental STOL and VTOL type aircraft now reaching prototype stage with a wide variety of industrial firms under Army research contracts.

This switch in Army policy is already beginning to attract an increasing volume of competent industrial organizations to the potential Army market. For example, at the Army Assn. meeting, there were more than a score of aviation firms, many not previously associated with Army development, who were eager to show their wares and apply their capabilities to Army's future problems.

Gen. Twining also urged the Army to extend its technical development activities across the entire spectrum of its military problems, citing specifically such areas as rapid and reliable communications, accurate target acquisitions, simplified logistic techniques, low-yield nuclear weapons and human engineering to make new weapons simple and easily handled from the viewpoint of an average operator.

In an obvious oblique reference to the Army's current row with the National Aeronautics and Space Administration, Gen. Twining also urged Army to "look closely at some of the non-combat activities of the Army. Are research and development programs, which are certainly limited dollar-wise directed properly to providing a compact hard-hitting Army?"

We think Gen. Twining's remarks to the Army Assn. comprise some of sharpest, yet genuinely friendly, advice the Army has received in some time. It must increase the pace and sophistication of its technical development if it is to remain a vital factor in future military planning.

Again, let us emphasize that we too are not unsympathetic to the requirement for a modern, effective ground force nor the need for an extensive research, development and industrial program to support the introduction of new and modern weapons suitable for its mission. But the Army's case for a larger place in the military sun would be immeasurably strengthened by a determined concentration on the genuine areas of its mission, the development of a more sophisticated technical approach to its future and a greater application of industrial technology to its problems.

—Robert Hotz

WHO'S WHERE

In the Front Office

Frederick R. Lack, former Western Electric Co. executive, a director, Hazeltine Corp., Little Neck, N. Y.

Alvin G. Heckman, a director and vice president-administration, Babcock Radio Engineering, Inc., Costa Mesa, Calif. Also: **Henry J. Gross,** attorney, a director.

W. C. Loeman succeeds **R. W. Cornell** as president of Parker Aircraft Co., Los Angeles, a subsidiary of Parker-Hannifin Corp., Cleveland, Ohio. Mr. Cornell, Parker-Hannifin vice president, is returning to Cleveland to handle planning and marketing.

Donald H. Kunsman, president, RCA Service Co., a division of Radio Corporation of America, New York, N. Y.

Clifford A. Sharpe, senior vice president, American Bosch Arma Corp., Hempstead, N. Y.

Alexander Black, vice president-sales, Defense and Technical Products Division, Rheem Manufacturing Co., Downey, Calif.

Dr. Wendell B. Sell, a vice president, Marquardt Aircraft Co., Van Nuys, Calif. Dr. Sell continues as general manager of Marquardt's newly acquired Pomona Division.

Clifford E. Willis, general manager, Cleveland Pneumatic Tool Division, Cleveland Pneumatic Industries, Inc., Cleveland, Ohio. Mr. Willis continues as vice president of Cleveland Pneumatic Industries.

Herchel M. Richey, vice president-manufacturing, Roller Bearing and Rock Bit Divisions, The Timken Roller Bearing Co., Canton, Ohio.

Capt. Mell A. Peterson succeeds **Capt. W. W. Wilbourne** as Commander, U. S. Naval Ordnance Laboratory, Silver Spring, Md.

Honors and Elections

Richard E. Fell, vice president and Washington, D. C. manager of Butler Aviation, has been elected president of the National Aviation Club. **Russell B. Adams** of Pan American World Airways and **Samuel J. Solomon,** president of California Eastern Airways, were elected vice presidents; **Emery F. Johnson,** president of Air Cargo, Inc., was elected secretary-treasurer.

James H. Kindelberger, chief executive officer of North American Aviation, Inc., has received the Carnegie Institute of Technology's Distinguished Achievement Award for outstanding professional achievement.

Changes

Robert C. Main, engineering manager, Missiles & Space Systems Division, United Aircraft Corp., East Hartford, Conn. Also: **George I. Willis,** administrative assistant, Missiles & Space Systems Division.

John S. Overholser, director of research engineering Tamar Electronics, Inc., Los Angeles, Calif. **Kenneth E. Wilcox** succeeds Mr. Overholser as chief engineer, and **Rex C. Bean** succeeds Mr. Wilcox as assistant chief engineer.

(*Continued on p. 117*)

INDUSTRY OBSERVER

► Air Force's next lunar probe vehicle, scheduled for launching between Nov. 7 and Nov. 10, is already on the pad at Cape Canaveral, Fla., undergoes a trial countdown daily. Payload may be fitted with an extra vernier rocket engine as one of the scheduled modifications. Probe requires only eight minutes to fuel on the pad.

► **Radio signal on one of the Sputnik frequencies, 40.007 megacycles, was monitored continuously for three hours from an Air Force Missile Test Center installation at Cape Canaveral recently. Frequency has not been used in any of the U. S. satellite experiments to date.**

► New Soviet delta-wing bomber first reported by AVIATION WEEK last May 5 (p. 23) and later confirmed by Air Force Secretary James Douglas (AW Oct. 6, p. 28) is now in operational service. Six-jet bomber, a replacement for the subsonic Bison, will have a top speed in the Mach 2 range and intercontinental capability. NATO code designation is "Bounder".

► **North American X-15 out-of-atmosphere research aircraft (see page 88) will have its interim Reaction Motors' XLR15 rocket engines removed at Edwards AFB, Calif., for continuation tests that cannot be performed with the powerplants installed.**

► Bell X-1B rocket-powered research plane used by National Aeronautics and Space Administration in experiments with jet reaction controls has been grounded by fatigue cracks in the welded aluminum liquid oxygen tank. Experiments have yielded information that was incorporated in the control system design of North American's X-15 and will be applied to the Dyna-Soar orbital bomber and other extreme altitude air and space craft. NASA is now fitting reaction controls to a Lockheed F-104 for continuation of the program.

► **Ninety-four contractors attended a recent Army bidders' conference at White Sands, N. M., to learn details of a competition for a supersonic high- and low-altitude missile target drone system. Bids are due Dec. 1.**

► Republic Aviation Corp.'s recent $25.2 million contract for SD-4 Swallow advanced reconnaissance drones covers 20 vehicles. Delta-winged supersonic vehicle is rocket-boosted and powered by the Pratt & Whitney JT12 engine. Drone could use photo, radar, infrared, television and chemical reconnaissance.

► **Beech Aircraft Corp. contract from Army calls for 600 KDB-1 propeller-driven target drones. Recoverable drone, powered by McCulloch O-150-4 engine, has a speed of 300 kt. and a ceiling of 43,500 ft. Navy also is interested and has used the target for air-to-air missiles at Pt. Mugu, Calif.**

► Missile guidance system that uses new passive radar technique is being developed by AC Spark Plug Division of General Motors. Passive radar technique, first revealed by AVIATION WEEK (July 1, 1957, p. 62), detects electromagnetic energy radiated by all objects similar to infrared but at lower microwave frequencies. AC's system matches passive radar picture of terrain with a master type of map, an approach similar to that employed by Goodyear Aircraft's Atran guidance system used in Mace surface-to-surface missile, which employs conventional active radar.

► **Convair Division of General Dynamics Corp. is making a study of the feasibility of equipping the Saunders-Roe Princess flying boat with nuclear powerplants. Similar Martin Co. study for Navy also is under way.**

► System that would enable Army liaison aircraft to guide Lacrosse surface-to-surface missile to targets not visible to present ground controllers is under study by Cornell Aeronautical Laboratory.

► **Vanguard satellite rocket program, which has contributed the second and third stages and the spin rockets to the USAF lunar probe program, will have cost a total of $111 million from its beginning in Fiscal 1956 through Fiscal 1959. This is 1/6th of one per cent of the cost of the military missile program through the same period—$18.443 billion.**

Washington Roundup

Von Braun in Space

Discount Washington reports that Wernher von Braun, Redstone arsenalist, will join the National Aeronautics and Space Administration to head its Man-in-Space program. Von Braun has been quietly directing a campaign toward this goal while publicly and officially deploring the proposed transfer of any Redstone civilian personnel to NASA's jurisdiction. NASA officials have been more impressed with von Braun's salesmanship on space than with his technical Man-in-Space program philosophy. Chances are strong that some key Army civilian personnel from the Cal Tech Jet propulsion Laboratory and Redstone Arsenal will be transferred to NASA despite Army's official resistance to the proposal (see page 28).

New AIA Name

Aircraft Industries Assn. is moving ponderously toward a new name to reflect the changing character of the aviation business with more emphasis on missile work and space technology. Ball was originally tossed to AIA public relations advisory council. The public relations directors were unable to come up with an agreeable title at their mid-October meeting in Los Angeles and recommended that AIA's board of governors select an outside public relations counsel to develop the new name. Board of governors are expected to decide at their Nov. 18 meeting in Phoenix whether to spend money for an outside counsel or to buck the problem back to the public relations men already on their payrolls.

Cutting Talk

Some straight talk from Air Force Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, during the Assn. of the U.S. Army's annual meeting almost brought a demand by association members for a public clarification of his remarks.

Gen. Twining, citing his own 30 years in the Army, called for more attention to lighter, faster, more powerful ground equipment; missiles with more mobility and faster reaction time; proper direction of research and development funds and programs, etc. But he said the Joint Chiefs, in trying to keep a proper military balance, "have no alternative but to accord airlift and these other items lower degrees of priority."

A resolution—No. 13—citing "certain interpretations" of the speech and asking for a public clarification of the interpretations was presented for a vote. Other delegates, however, pointed out that Twining had emphasized that his remarks applied to all the services, that censuring speakers would end straight talk at the meetings and that Gen. Twining should not be held accountable for "interpretations" of what he said.

The resolution was tabled—or, in other words, killed.

Fiscal 1960 Budget

Department of Defense expects to ask for a Fiscal 1960 budget $1 billion to $2 billion higher than the $41 billion for the current fiscal year, according to Deputy Secretary of Defense Donald A. Quarles.

Before going to Congress, however, the request must be passed on by the Bureau of the Budget, now taking a rigid position against increased outlays in view of the estimated $12 billion deficit low in the offing. Part of the need for additional funds, Quarles says, is due to inflation, although, he added, the 3 to 5% inflation increase in defense costs each year over the past several years is expected to ease to a 1% increase in Fiscal 1960. Other factors also dictate a budget increase next year, and probably for the next several years.

The Defense Department has asked the three services to try and keep their Fiscal 1960 budgets at their Fiscal 1959 levels—but admits that it doubts that this can be done.

Television Range Stretch

In-flight refueling is not necessary to make the Boeing B-52 jet bomber an effective intercontinental weapon, according to Air Force Secretary James H. Douglas. The following exchange took place last week on the National Broadcasting Co. on the television program "Meet the Press:"

Mrs. May Craig: "Mr. Secretary, you have just admitted that overseas bases are an essential part of our grand design for defense and retaliation. What makes you think we are ever going to get to use those overseas bases?"

Secretary Douglas: "Mrs. Craig, I didn't say they were an essential part. I said they greatly increased our effectiveness and that without them we have intercontinental capability both with our heavy bombers and our medium bombers."

Mrs. Craig: "Are you telling me we have an intercontinental bomber that can reach the enemy and return without refueling?"

Secretary Douglas: "We have such bombers in the B-52."

Mrs. Craig: "And return?"

Secretary Douglas: "Correct."

Mrs. Craig: "Without refueling?"

Secretary Douglas: "Correct."

In Congress

Action on Capitol Hill includes:

• **House Antitrust Subcommittee** has received a report from Civil Aeronautics Board stemming from the subcommittee's 1957 report criticizing Air Transport Assn. activities, including ATA's close relations with CAB (AW Sept. 2, p. 41). Subcommittee chairman Rep. Emanuel Celler (D.-N. Y.) has not yet released it.

• **Senate Antitrust Subcommittee** chairman Sen. Joseph O'Mahoney (D.-Wyo.) has asked Justice Department to investigate the aviation insurance industry and submitted to the Department comprehensive data already gathered by the subcommittee. "If, after completing your study, you conclude that practices inimical to the best interests of free competitive enterprise . . . are escaping effective supervision because of any defect in federal laws, I shall expect that you will bring your views to the attention of the Congress with appropriate recommendations," O'Mahoney wrote Victor R. Hansen, Assistant Attorney General in charge of the Antitrust Division.

—Washington staff

IATA Deadlocked on Jet Airliner Fares

Disagreement at Cannes meeting may force 60-day recess to avert open-rate crisis on North Atlantic.

By L. L. Doty

Cannes—Sharp disagreement on jet transport fares at International Air Transport Assn. conference here is forcing a two months cooling off recess to prevent an open-rate crisis on North Atlantic routes.

Unless some compromise solution is reached in the closing hours of the conference to break the tight deadlock, all other decisions made by the conference on rates and fares will be held in abeyance until a ruling on jet fares is made when the group reconvenes, probably in January or February.

As in the past, fear that traffic conference activities will be taken over by the governments of airlines involved if no decision is reached, prompted the move to recess. In addition, the group was determined to prevent an open rate situation which might degenerate into a price cut war on the North Atlantic.

Key to the problem has been a bitter conflict as to whether a surcharge shall be applied on all flights served by turbojets. The conference, scheduled to end last Saturday after being bogged down for five weeks of argument, was unable to find any middle ground, as of late last week, that would satisfy proponents and opponents of the surcharge plan. Leaders of two opposing forces are British Overseas Airways Corp. which refused to give ground in its fight against the surcharge, and Alitalia, which is under virtual mandate from the Italian government to demand the surcharge feature.

Italy's Objective

Italy wants to protect the airlines piston engine service against jet competition by making it more costly for passengers to fly jets. Behind the jet surcharge lies the second issue at stake: the creation of a fare differential that will answer the demands of some governments for reduced fares yet permit carriers to realize additional revenues that will compensate for the presumably high cost of jet operations. However, a trend toward higher fares gained momentum as the meeting progressed.

In the cargo field, a fight over new low developmental cargo rates contributed to the meeting's deadlock. Seaboard and Western's demands for lower promotional rates were resisted by other carriers which claimed such rates would be uneconomical and premature at this stage of cargo traffic development.

Despite the conflict on a jet surcharge and lower cargo rates, these fares will be adopted by the conference and approved when it reconvenes:

- **North and South Atlantic** fares generally will be adjusted only slightly although new promotional rates such as special excursions will be introduced.
- **New York-London** economy, tourist and first-class fares will be increased $5. De luxe fares will be hiked $15.
- **Economy fares** will be introduced between Mexico and Spain.
- **Europe to India** fares will be raised 5% and Europe-Australia rates will be increased 7½%. All revisions are to be effective April 1.

In its position on the jet surcharge, BOAC has been naturally backed by Trans-Canada Air Lines and Qantas Empire Airways. Among the U.S. carriers, only Pan American has sided with the British in attempts to persuade the conference to drop demands for a surcharge.

As the conference moved into its final days of discussion, here is how the situation stood on the jet surcharge and fare differential plan:

- **Alitalia stood pat for** a 30% surcharge on jets over and above the present fare level. The airline emphasized during the discussions that this conference represents the last hope for other carriers (those not now operating jets) to survive the competition created by the jets.
- **BOAC and Pan American,** as the only airlines operating jets at the present time, opposed a surcharge of any type. BOAC took the lead in battling against moves for any fare increase with the backing of other commonwealth airlines, SAS and Pan American.
- **Attempts to arrive** at a fare differential structure have been sidetracked by the surcharge flight. Civil Aeronautics Board is known to advocate a fare structure that will call for a slight reduction in the general fare level now in effect; perhaps a cut of 5%, and a similarly small increase above the present fare level for jet aircraft. Although it is not generally known, this is the formula the Board will probably adopt in handling tariff filings of domestic carriers.

Strong attempts by the conference chairman, Philip C. F. Lawton of British European Airways, to bring delegates around to some accord on the surcharge issue drew the conference talks into late night sessions and all day meetings on Saturdays and Sundays. During the course of the conference, Lawton continually called for more give and less take in settling differences among carriers. He is considered by traffic men here as one of the forces who has pushed the conference through a complicated and lengthy agenda without allowing it to break down completely at crucial points.

Tourist Fare Doomed

Most airlines now anticipate an end to international tourist fares on North Atlantic routes within another year with all low fare traffic moving on the economy fare adopted last April 1.

The economy fare sandwich menu will be wiped out April 1 as an unnecessary adjunct to the economy plan. It will be replaced by a cold plate of meat, fish, cheese and salad with bread and butter. Breakfast will consist of cereal with bread and butter. Beverages—coffee, tea or milk, will be served free.

One traffic official told AVIATION WEEK his carrier paid $1.85 for one tourist meal and $1.80 for a sandwich tray. He added that since overhead costs such as hostess service and maintenance of galley are fixed requirements on a mixed configuration aircraft, savings on sandwiches compared with tourist meals were practically negligible.

Chief reason behind the disagreement on fares is the competitive power of newer and more modern aircraft. For example, British European Airways met some resistance from European carriers in its drive for lower fares on intra-continental routes. BEA believes it will be able to profit from lower fares once it can introduce a high density seat arrangement on its routes in Europe. The Vickers Vanguard, which the airline will receive by 1960, is expected to serve that purpose. Most other carriers believe that such a program will not generate additional traffic to the degree tourist fares have developed new traffic in the U.S. due principally to the entirely different travel character of the two continents. They say European traffic is limited to certain areas and does not receive impetus from widespread economic production and distribution features peculiar to the U.S.

On the subject of jet surcharges, TWA refused to stand by Pan American and urged the conference to adopt an "orderly relationship" between fares for piston engine planes and fares for jet aircraft. The carrier said such a charge was now necessary because there has yet been no way of determining actual operating costs of jet aircraft and, therefore, no method of figuring break-even costs.

The airline also pointed to airport modification costs which must be absorbed in jet operations plus additional costs of duplicate facilities such as fuel storage requirements.

On this point, Pan American noted that costs of new facilities for jets will probably not be allocated only to jet operations but will also be covered by piston engine revenues. The airline added that the speed of turbojets on North Atlantic routes was not so much greater than the speed of modern piston engines that a surcharge was justified on this score.

In answer to Alitalia's charge that comfort of jet transports would lure passengers away from piston engine planes, Pan American questioned the right of any carrier to require passengers to pay more for additional comforts and asked: did we assess passengers because we introduced cabin pressurization for more comfort? BOAC forecast that costs per passenger seat mile will be lower than generally believed and added that in two years, carriers will be seeking reduced fares.

Seaboard and Western favored a surcharge and said that where length of haul is sufficient there should be a compensating difference in fares and rates. Reasons given by the airline for this stand were to permit operators of jet transports to take in additional revenues in accordance with extra services, assure piston engine operators of a share of the traffic and ensure reasonable residual value to owners of propeller planes.

In backing a surcharge, Iberia Airlines of Spain said it operated DC-4s on the South Atlantic at fares 30% lower than standard but passengers continued to favor the more expensive but more comfortable DC-6B.

Misrair (Egyptian airline) sought a compromise solution by suggesting abolition of free baggage allowance, 10% discount and children fares on turbojet operations in lieu of a surcharge. Delta and El Al both supported the surcharge.

SAS opposed a surcharge on grounds that it was against the best interests of the industry. The carrier said it was convinced that passengers want only lower fares as a result of its experience in competing against airlines offering a 15-20% reduction on standard fares. SAS added that it lost traffic to these carriers despite the relatively higher speed and additional comfort of its fleet.

Rate war in the South American area has been deferred for further discussion at the annual general meeting in New Delhi later this week. Fares in the Pacific area were closed with the provision that discussions of a jet surcharge would begin after actual jet operations were inaugurated. Northwest Airlines came out in favor of a jet surcharge so that disagreement with Pan American on Pacific area rates can be expected when discussions are resumed.

Foreign Flag Jets

Cannes—New studies of jet equipment programs by foreign flag carriers may be forthcoming. The IATA traffic conference brought home the importance of entering the jet race as soon as possible if the foreign carriers are to compete successfully for jet-age traffic.

IATA Public Relations

Cannes—International carriers are beginning to develop inner company educational programs designed to explain to employes the purpose of IATA. One problem is to clarify to personnel why conferences meet in such lush resorts as Miami Beach, Cannes or Honolulu—where the traffic conference meets next year.

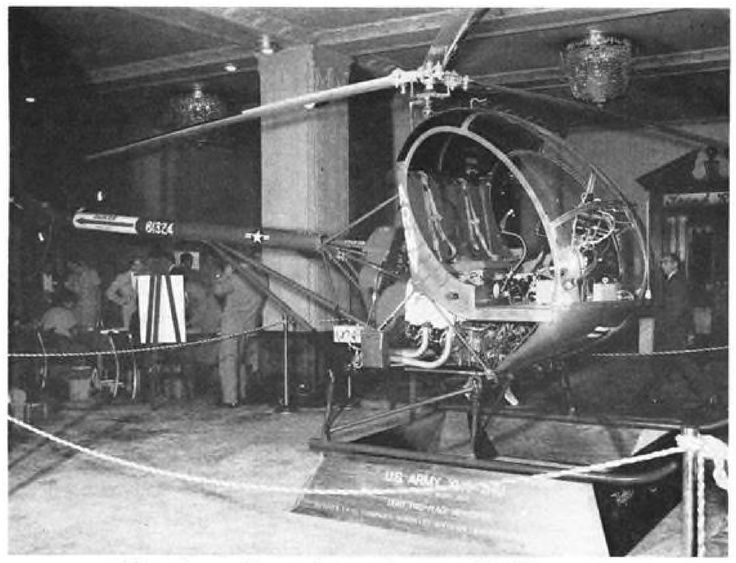
Answer is that hotels in such areas offer low rates during off seasons and impose no time limits on how long delegates may hold accommodations. Time limit factor is an advantage since it is never possible to determine the number of weeks a conference will consume.

Convair Developing Re-Supply Missile for Army

Lobber missile, a ballistic re-supply vehicle under development by Convair Division of General Dynamics Corp., is designed to supply food and medical supplies to front line troops and during emergencies. Lobber has a range of from 6 to 8 mi. and can carry a payload of about 150 lb. Missile is cut away to show food packing section and parachute slowing device at rear. Army's Quartermaster Corps says Lobber can carry 30 meals per load.

Russian Passengers

Cannes—Air France and Sabena are reporting fairly high connecting tourist traffic from the United Kingdom and the United States to Moscow but only official business from Moscow to the west. However, Sabena estimates 25,000 Russian tourists visited the Brussels Fair this year in carefully controlled groups.



Hughes Develops Army Helicopter

Hughes Model 269A helicopter, designated by U. S. Army as YHO-2U, is light, two-place observation and reconnaissance aircraft. Five are scheduled for delivery to Army in November for performance and evaluation testing; two will go to Edwards AFB and three to Army Aviation Board at Ft. Rucker, Ala.

Space Technology

Army Fight to Hold Space, Missile Roles Dominates AUSA Meeting

By Evert Clark

Washington—Army's strong determination to keep its space and missile development team intact rather than have any part of it transferred to the National Aeronautics and Space Administration dominated the 1958 annual meeting of the 60,000-member Assn. of the U. S. Army last week.

Army officers were outspokenly opposed to any organizational changes despite official restrictions placed on what they said. The organization itself adopted a resolution saying that dissipation of the nation's "leading" missile and space development team "may destroy a proven major foundation of the nation's capabilities."

Presidential Level

Because the question is about to be carried to the presidential level for decision, top Army officials at first spoke cautiously about the proposed transfer.

Maj. Gen. John B. Medaris, chief of Army Ordnance Missile Command, began his part of a panel discussion on the Army's future by saying that "restrictions of classification and some others that are imposed from time to time will hamper some of my remarks."

But at a press conference later, he said the delay inherent in transferring part of the Army's team to the new NASA "would be rather disastrous," in his opinion.

Medaris and Lt. Gen. Arthur G. Trudeau, chief Army Research and Development, proposed the alternative of leaving the team intact and having NASA simply assign missions and funds to it as the Advanced Research Projects Agency has done in satellite, lunar probe and super rocket booster projects.

How NASA would make use of Army's space capabilities currently is being discussed by Army Secretary Wilber Brucker, Deputy Defense Secretary Donald A. Quarles, and NASA Director T. Keith Glennan. Nucleus of Army's team is composed of some 2,000 scientists at Army Ballistic Missile Agency in Huntsville, Ala., and the Army-owned Jet Propulsion Laboratory operated by California Institute of Technology. Medaris pointed out, however, that the so-called team includes many other Army and government laboratories and a large part of industry.

Decision will be made by the National Aeronautics and Space Council (AW Sept. 29. p. 27), of which President Eisenhower is chairman. Next meeting is expected this week.

Since Brucker is not a member of the council, Army must depend upon Quarles, sitting as alternate to Defense Secretary Neil McElroy, to present its side of the case if the matter reaches the council before McElroy's expected return from abroad on Nov. 5.

Volunteer Shift

The majority of Naval Research Laboratory's Vanguard satellite development team recently transferred to NASA on a voluntary basis. The situation is not directly comparable to Army's situation because ABMA scientists, according to Medaris, are devoting less than 10% of their effort to space work and the remainder is spent on missiles.

Trudeau said no Army funds are now being used for space work. All funds are being supplied by ARPA, he said. Jet Propulsion Laboratory, in spite of "its very great contribution in space work," is devoting no more than 5% of its work to space, according to the general.

Medaris suggested ABMA scientists might be included in a space advisory group established by NASA to determine capabilities and project assignments, and that NASA then might assign missions and funds to the Army organization.

Medaris also:

- **Called for a "coordinated** space defense system which can detect hostile space activities, assess their capabilities and effectively neutralize them." Army is exploring the need for "a satellite intercept capability" in terms of guided missile systems, he said.
- **Asked service and industry** members of the association to continue to consider use of rockets for transportation of men and material.
- **Urged earlier integrating** of general requirements into strategic and tactical planning and less organizational and procedural restriction on developers, both military and industry.
- **Said it "is becoming** a serious question whether the technician is out in front of the strategist and the tactician" in space work and said this challenge "plainly indicates urgent need for a change in concepts so that we avoid refining specific items of military hardware we want, and instead express it in terms of what we need."

Weight Limit

Trudeau said the 5,000 lb. empty weight limit on the size of Army aircraft "has about as much place in 1958 as the covered wagon, and I hope that will soon be recognized at proper levels."

He said Army needs heavier aircraft for battlefield reconnaissance, equipped even with atomic weapons, and "we must have aircraft under the immediate control of the battlefield commander, and I mean the Army commander."

Referring to the NASA transfer, Trudeau said Army's satellite launching team "is still batting .600 and that is tops for any team as far as I know—but it is surprising how long in Washington some people will continue to bet on the Senators against the Yankees. Sentiment is one thing but cold facts and hard dollars are another thing that must be considered here."

Trudeau said 90% of Army's research and development work is done by industry "and let's not forget this in the charge that all our work is done by arsenals—it isn't. Most of it is in the hands of industry."

Earth Shape

Dr. Ernst Stuhlinger, director of ABMA's research projects laboratory, said measurements of the precession of Explorer satellite orbits, coupled with other information, have indicated that the earth is more nearly spherical than previously assumed. This does not necessarily mean any change in previous ideas about the pattern of the earth's magnetic field, he said, because uncertainty as to the magnetic field's shape still is greater than the change in the calculation of the earth's shape. Ratio of the earth's polar diameter to the equatorial diameter has been expressed as 293 to 294.

The ratio now should be expressed as 295 to 296, based on Explorer findings, Stuhlinger said.

Radiation measurements indicate every square centimeter of atmosphere at high altitudes is hit in every second by about 100 million particles—either electrons or protons—with velocities close to the speed of light, Stuhlinger said.

High Flux

Even though flux is high, density is low and would be about one particle per square centimeter at any one time.

Stuhlinger said the solar battery-operated transmitter in the small Vanguard satellite launched last March now has operated for six and one-half months. "This in itself is an achievement of the highest significance," he said.

"It proves that radio transmission and solar batteries can operate for this period without being disturbed by micrometeorites or anything else in space."

The association's meeting, attended by 2,700 persons, included 122 industrial exhibits.

Some 50 major corporations are sustaining members of the association, which now has 91 chapters and 46 AUSA-ROTC companies.

What Army Wants

Washington—Army should have the responsibility for air defense missiles plus more strategic airlift, no limit on gross weight of its aircraft, faster modernization of ground equipment, more manpower and better pay for technicians, Assn. of the U. S. Army said last week.

In addition to a resolution aimed at keeping Army's missile and space research team together (see story 28), the association resolved at its 1958 annual meeting that:

- "Army be charged with the responsibility of land-based surface-to-air defense" and that full use be made of Army's missile defense capability here and overseas. Referring to development of defensive missiles "at minimum cost" and the advanced state of development of the Nike Zeus anti-missile missile and the Plato field version of Zeus, the resolution said "conduct of air defense using missiles launched from the ground has logically and traditionally been entrusted to the U. S. Army." Allocation of funds between Army's Nike Hercules anti-aircraft missile and USAF's Bomarc interceptor missile now is under study (AW Aug. 11, p. 21), and Army has the greatest responsibility for anti-missile development.
- "Army must be equipped with sufficient transport aircraft with priority to permit the movement of at least one-half of the Strategic Army Corps." Air Force, "now charged with the responsibility of providing an adequate airlift, has not so done," the resolution said.
- Present 5,000 lb. gross weight limit on development, procurement and use of Army aircraft should "be eliminated."
- "Army should be modernized at a rate and to an extent that will assure the U. S. qualitative superiority in all weapons and equipment." Russia "is producing modern ground equipment at a rate alarmingly greater than that of the U. S.," permitting it "to equip not only its own forces but also those of its satellites and allies."
- Army's increased missions require an increase in fighting power. The association recommended not less than 1 million men in active service, a drill strength of 300,000 reserves and a National Guard of not less than 400,000.

Labor Bureau Studies Research Spending

Washington—More than half of the $6.45 billion spent by all U.S. industry for research and development in 1956 was spent by aircraft, electronic and electrical equipment manufacturers, and approximately 78% of this $3.25 billion was financed by the government. Governmental financing represented less than half of the total research and development cost of all U.S. industry in 1956.

Figures were compiled by U.S. Bureau of Labor Statistics for the National Science Foundation in the first comprehensive survey ever conducted to determine the extent of industrial research and development effort. Figures were released through Electronic Industries Assn.

Other figures from the Labor Department survey include the following:

- **Aircraft and associated parts** manufacturers spent a total of $2.08 billion for basic research, applied research and development in 1956, nearly one-third of the total for all U.S. industry and an increase of 174% over the $758 million spent in 1953. Government financed 87% of the 1956 figure, compared to 84% in 1953, and a 49% figure for all U.S. industry. Dollar figures include salaries of scientists and engineers, their supporting personnel and other direct costs, plus attributable overhead expenses such as administration, depreciation and rent but do not include capital expenditures or patent expenses.
- **Electronic-electrical systems,** parts manufacturers spent a total of $1.17 billion in 1956 for basic research, applied research and development, an increase of 58% over 1953 and a little over half that spent in 1956 by aircraft manufacturers. Government financed 61% of total research and development costs in 1956, compared to 53% in 1953. Dollar figure for government financing increased 77%, from $404 million to $711.6 million.
- **Electronic research and development** effort totalled $1.39 billion, with 48% of the total being spent by electronic-electrical systems, parts manufacturers; 19% by aircraft manufacturers; 13% by machinery (including computers) manufacturers, and 10% by telecommunications and broadcasting industry. Remainder was scattered among other U.S. industries.

Bureau of Labor Statistics survey used its obsolescent standard industrial classifications which has no electronic industry category as such. Many electronic manufacturers are classified under "Electrical Machinery, Equipment and Supplies," which EIA has labeled "Electronic-Electrical Systems, Parts."

SAC Demonstrates Bombing Proficiency

By Russell Hawkes

March AFB, Calif.—Two direct hits, indicating a miss distance of 6 in. or less, were scored out of 492 simulated bomb drops during the 10th annual Strategic Air Command bombing and navigation competition here.

No missions were aborted in flight and no take-offs were made off schedule because of failure of men or equipment during the competition in over 1,150 hr. of flying time.

The competition pitted 156 selected SAC crews and eight crews from Royal Air Force Bomber Command against each other in a severe test of the performance and reliability of men and hardware.

Navigational errors in the celestial navigation leg of each mission were measured in tenths of a nautical mile (600 ft.).

Miss distance on bomb runs was measured to the nearest foot.

Simulated Runs

Simulated runs were scored by SAC radar crews with highly accurate gun-laying radars located near the three targets. Target acquisition for the scoring radars was made simple by the pinpoint navigation of the air crews since radar operators held copies of the flight plans and could predict quite exactly where and when the incoming aircraft would appear on their scopes.

The bombers carried no radar beacons to assist the scoring teams in acquisition and were picked up at distances of 50 mi. and more.

Motivation of the picked air and ground crews in the competing teams was intense, not only because of the highly competitive spirit within SAC and Bomber Command, but because of the beneficial effects of success upon individual careers. During the awards ceremony at the end of the contest, the aircraft commander of the highest scoring crew received a spot promotion from captain to major.

Twenty enlisted ground crewmen were also promoted.

Vital importance of technical specialists to total aircraft performance and reliability was formally recognized by SAC and informally recognized by their fellow crew members during the four day bomb-nav competition. Ground crewmen worked 18 and 20 hr. days to keep the airplanes and their systems in top condition and participants in the competition give them much of the credit for the unusual record of equipment reliability.

Performance on the celestial navigation leg was considered to be a critical part of the final score by most competing crews and some of them went to extreme lengths to keep their radar-navigators out of the hot sun and free of psychological tensions.

Umpires who rode with each crew to make sure that they followed the rules of the competition exactly were debriefed by members of the 3908th Strategic Standardization Group who are full-time checkriders responsible for maintaining SAC crew competence at a high level and teaching the best proven techniques in the air crew trades.

Umpires were specifically alerted to look for non-standard procedures used by the prize crews collected for the competition which might account for their excellence and which could be adopted by SAC as standard procedures.

On Nov. 1, USAF will begin awarding proficiency pay to its most skilled enlisted specialists. It is intended to boost the re-enlistment rate in specialties in which the various commands consider themselves to have been hurt most by the loss of skilled men to industry. Bomb wing commanders and officers of the 3908th SSG interviewed by AVIATION WEEK reported that in SAC about 98% of the proficiency pay grades will go to avionics experts. SAC headquarters decided on this lopsided distribution despite the scarcity and importance of such specialists as engine mechanics because of the growing dependence on electronic countermeasures, avionics-controlled airplane systems and electronic means of communication, navigation and armament control.

The loss of one of these can be equivalent to the loss of the airplane from the standpoint of military capability and they require the best of maintenance to give an acceptable in-flight failure rate.

Bomb-Nav System

The ASQ-38 bombing and navigation integrated system built by International Business Machines Corp., was used in the SAC bomb-nav competition for the first time this year. The system was installed on about half the competing Boeing B-52s and included a Doppler navigator which could be used in all parts of the contest mission except the celestial navigation leg. It has been operational for less than a year. It is a package installation consisting of the ASB-4 bombing and navigation system, APN-89 Doppler navigator, AJ-81 two heading transmitter, MB-1 astro compass and N-1 compass.

Specifications on ASQ-38 were actually not as tightly written as those on the K-system and its derivatives. Primary requirement for ASQ-38 and strongest motive for its creation was to get better reliability than that of earlier systems.

During the competition only one minor failure was recorded against the units in use. It did not cause the loss of a single good run because the system has an emergency or manual mode of operation to cope with the failure of any single component.

Performance of the system against stiff competition was considered very good. Its Doppler navigation system was the only one in use on SAC aircraft, though all RAF Bomber Command Vickers Valiants have used Doppler since 1954 and were using it during the competition.

No B-52 equipped with ASQ-38 lost a good bomb run by getting off course as happened to several other aircraft. The unit uses radar map matching as an aid to navigation and target identification.

However, improved performance and accuracy were not important goals in the making of ASQ-38. The MA-6A bombing and navigation systems installed in earlier B-52s and the similar MA-7A systems installed in B-47s were generally considered good in these respects and ASQ-38 is not expected to be much better.

Field Maintainability

Field maintainability of ASQ-38 is improved over that of earlier systems by use of the modular replacement concept in its construction. SAC armament and electronics officers believe the depot maintenance problem is about the same as that for the earlier systems, though new test equipment is used and there will be a brief rise in costs due to the necessity of partially retraining technicians.

Valiants of No. 3 Group, RAF Bomber Command, headed by Air Vice-Marshal K. B. B. Cross, did well in the bomb-nav competition considering the weight of numbers against them.

One RAF team of four crews placed seventh in the over-all standings and another placed in the top 20.

The British detachment of eight Valiants flew from England to March AFB with one refueling stop at Goose Bay, Labrador. The Doppler-equipped Valiants reached Goose Bay after crossing the North Atlantic with a navigation error of only half a mile. This performance exceeds RAF requirements which ask only that the equipment be able to bring the aircraft within one mile of its destination at the end of a 1,000 mi. track.

British Bomb-Nav System

Air Marshal Cross told AVIATION WEEK that the performance of RAF's navigation and bombing system, Mark II, used in the competing Valiants, is quite similar to that of comparable USAF equipment. He said he believed American equipment to have a slight edge in reliability due to its more recent design and its use of mechanical analog computing units in some places where the British counterpart used electronic analog. During the competition, one of the RAF aircraft lost a bomb run due to the failure of a relay which stopped the scanning motor of the radar bombsight.

Air Marshal Cross' No. 3 Group is the first RAF organization to get the Douglas Thor IRBM. First of the missiles has already been delivered and is in use as a training model (AW Sept. 29, p. 22). Air Marshal Cross predicts that maintaining ballistic missile crew competence and building of the intense motivation which characterizes the bomber crews will be two of the most difficult tasks facing the commanders of ballistic missile units because of the difficulty or impossibility of running frequent combat equivalent exercises.

Gen. Thomas S. Power, SAC commander-in-chief, told a post-competition press conference that ballistic missile wings would probably compete someday in a contest similar to that now held for the SAC and RAF units.

Gen. Power said the Convair B-58 is not expected to fly in next year's SAC bomb-nav competition. Air Marshal Cross flew from England to March AFB in a Handley-Page Victor, the latest and best of RAF's "V" bombers. He said that if RAF is invited to compete again next year, it may be equipped with Victors. The crescent-winged, T-tailed bomber has exceeded Mach 1 accidentally in a test flight and the pilot of the airplane said handling characteristics were unchanged. The Mark II version of the Victor will be powered by four Rolls-Royce Conways and will be operationally capable of supersonic speeds. It is thought unlikely that the Mark II Victor will be well enough integrated in Bomber Command squadrons to compete next year.

Norad Backs Nike Zeus Automatic Controls

Utica, N. Y.—Nike Zeus anti-missile missile system must function completely automatically from detection of an incoming missile to its destruction—with all basic human decisions made in advance and programmed into the systems computers—in the opinion of North American Defense Command (Norad) leaders.

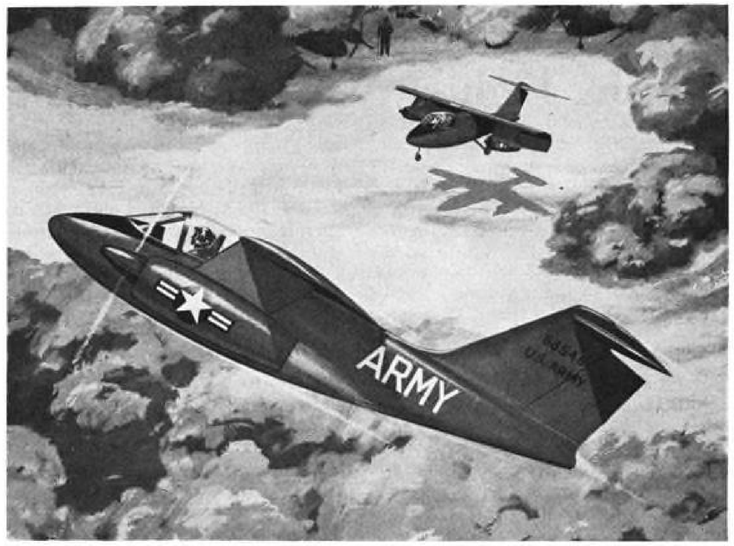
Engineers attending the fourth national Aero-Com Symposium here last week were told by Brig. Gen. Francis F. Uhrhane, deputy chief of staff, Norad communications and electronics, that there would be only seconds, to destruction after acquisition, of an ICBM by Nike Zeus.

"These considerations make two things self-evident," he said.

"First—complete integration of all elements of the Ballistic Missile Early Warning System is mandatory.

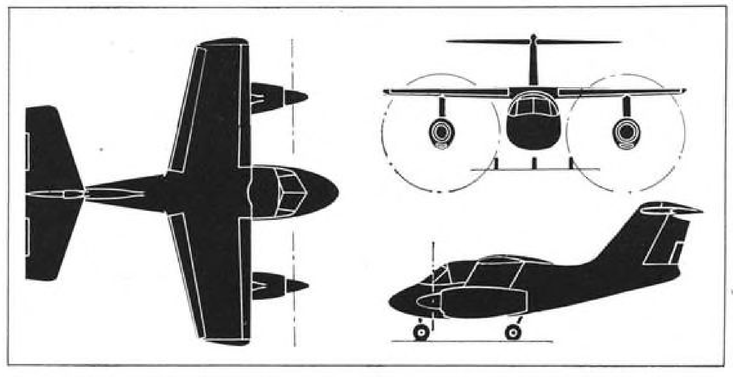
"Second—the design concept of all parts of the system must be based on all basic human decision having been made in advance. We in Norad believe, for example, that the complete sequence of events from the first detection to missile destruction should be accomplished on a completely automatic basis—with no human decisions in real time. We believe there should be a capability for continuous human evaluation of the data and for human override capability."

The implication of these statements is that the launching and detonating of nuclear-warheaded anti-missile missiles that might mark the beginning of a possible World War III—and perhaps the counter-barrage of Atlas and Titan ICBMs—could be the decision of an electronic brain.



Lockheed Proposes Army VTOL-STOL

Lockheed has proposed to the Army a VTOL-STOL turboprop reconnaissance aircraft with better performance than a World War II fighter. Aircraft, designated the CL-379, is designed to penetrate well beyond the edge of a battle area. It would be equipped with Lycoming T53 engines of about 1,000 shp. each. Vertical lift would be achieved by increasing wing incidence about 20 deg. Flap system would provide moderate slipstream deflection. CL-379 would take off vertically or with short takeoff run, and would hover.



TAC's Effectiveness Illustrated During Fighter Weapons Contest

Nellis AFB, Nev.—Tactical Air Command effectiveness in those phases of combat which would fall to it in case of limited war—local air superiority, tactical ground support and interdiction bombing missions behind enemy lines—was illustrated at the USAF Worldwide Fighter Weapons Meet here.

High degree of aircraft and systems reliability in Tactical Air Command's principal weapon delivery vehicle, the North American F-100 Super Sabre, was demonstrated in the tactical phase of the meet.

Working with various models of the F-100, teams from the U.S., Far East and Europe competed in air and ground gunnery, conventional bombing and special weapons delivery. Firing on Dart targets in high aerial gunnery was officially part of the competition for the first time, although some firing on sleeve targets also was conducted.

Special significance was attached to the special weapons delivery portion of the meet, since it was officially acknowledged some time ago that the F-100 can carry weapons of megaton yield, enhancing TAC's capabilities.

Over-all, the meet illustrated TAC ability, including missions to distances behind enemy lines with conventional bombs, or low or high yield nuclear weapons.

Although TAC makes use of other strike aircraft such as the Douglas B-66 and Martin B-57 in its composite strike force concept, the backbone is the F-100 with its multi-mission capability.

Using standard radar, gunsights and 30 mm. cannon, F-100s demonstrated ability to beat up ground targets as in ground support missions. In aerial gunnery, targets traversing fixed paths at known speeds did not yield valid results.

In special weapons delivery, application of correction factors and other computations were applied to scoring to obscure actual miss distances. Although final scores indicated relative abilities to place a weapon in a desired area, and indicate over-all effectiveness of nuclear bombing, which appeared high for units which scored best in this phase of the competition, one special weapons delivery course covered a distance which required an aerial refueling during the run, preceding the actual bomb run.

An outstanding feature of the meet was daily demonstrations for spectators, including Sidewinder and Bullpup firings from Lockheed F-104 and F-100 aircraft. Sidewinder was fired from both F-104 and F-100, while Bullpup was fired from F-100.

Infrared Sidewinder, of which pilots said that a shot from 5,000 ft. distance was a sure hit, and from up to 7,000 ft. a high probable, was launched against a target drone carrying flares from the F-104, and against a 5-in. HVAR from the F-100. In the 5-in. rocket demonstration, the HVAR was fired, accelerated to full speed, then the GAR-8, as Sidewinder is designated by USAF, was fired. The infrared missile staged an impressive kill, homing on the HVAR exhaust and slamming into its tailpipe to blow missiles into a cloud of debris.

Bullpup was adapted to be fired from the F-100 in a 28-day period. The Navy pilot-guided missile is carried on standard F-100 adapter and reaches a speed of approximately Mach 2 and has a range of up to approximately 20,000 ft.

The missile is pilot-controlled by two switches—one for pitch and one for roll—and in demonstration firing, two short periods of what appeared to be slight instability in flight may actually have been periods of control direction changes.

Bullpup carries a 250 lb. warhead, becomes in effect a guided, high velocity bomb to be used against such targets as tanks and gun emplacements in ground support missions.

Number of TAC officers viewed the competition in relation to composite air strike force concept which is the current mainstay of TAC operational techniques (AW Sept. 9, p. 85). Rules under which the meet was conducted in relation to the spares level available, and the use of equipment and tools which were brought by teams, were allied insofar as possible with the composite air strike force concept. Operations indicated soundness in technical areas of supply level, maintenance and personnel numbers and training.

Jupiter-C Abort

Washington—First attempt to put a 12-ft. aluminized plastic sphere into orbit to study atmospheric drag and gravitational anomalies was unsuccessful last week when the Jupiter-C launching vehicle failed to work properly.

First indications were that some or all of the solid propellant upper stages of the rocket failed to fire. Telemetry was lost 110 sec. after the launch at Cape Canaveral, Fla. Last station to track the vehicle was in Cuba, only a short distance down range.

The inflatable sphere was designed by National Aeronautics and Space Administration. Launching was conducted by Army Ballistic Missile Agency. Inflation of the sphere by a nitrogen cartridge has been successful in vacuum chamber tests and two 12-ft. spheres have been launched, ejected and inflated successfully at lower altitudes by small solid rockets at NASA's Pilotless Aircraft Research Station, Wallops Island, Va. (AW Sept. 22, p. 23).

Excess Profits Charged In Fuel Cell Contract

Washington — General Accounting Office last week charged that Firestone Tire and Rubber Co. made excessive profits on fuel cell subcontracts with Boeing Airplane Co. and Lockheed Aircraft Corp.

GAO, in a report to Congress, said that during the three-year period ending Oct. 31, 1956, Firestone made a profit of about $3 million, or 35%, on the subcontracts for B-52 fuel cells with Boeing and T-33 fuel cells with Lockheed. Air Force and the prime contractors were criticized for failing to obtain cost data from Firestone on which to evaluate the subcontract prices.

"Comparison of prices quoted by Firestone with its prior cost experience would have shown that the prices were unreasonably high in relation to Firestone's incurred costs," GAO said.

Air Force agreed that such data should have been obtained.

Firestone objected that the General Accounting Office gave no consideration to losses incurred on other contracts, including a loss of $234,425 in early years under the B-52 program. GAO countered that, "if the supplier considers it necessary to include in prices on follow-on production, provision to recoup losses or supplement abnormally low profits under earlier contracts, this information should be disclosed to the purchaser and considered in negotiations."

Titan Damaged

Denver—Air Force Titan intercontinental ballistic missile sustained major structural damage last week in its test stand at the Martin Co.'s Denver facility. Damage was due to structural failure of the tankage in the first stage of the missile, which was to have been the first flight model of the Titan. No personnel were injured, and there was no damage to the test facilities.

Officials of Air Research and Development Command's Ballistic Missiles Division said the failure will not delay the Titan test program or the date of the first launch, which is scheduled before the end of the year.

Defense Schedules New Cost Principles

By Katherine Johnsen

Washington—Despite strong industry opposition, Defense Department is expected to issue a new set of "cost" principles covering virtually all types of contracts in the aircraft, missile and electronic fields before the end of the year.

The present set, issued in 1947, applies only to cost reimbursement type contracts used primarily for research and development work. The new set—now up for final consideration by top Defense officials—will apply to all contracts in which "cost" is a factor in the "price," such as price re-determination and incentive types.

Industry is opposed not only to the expanded coverage of fixed cost principles but also changes proposed in the principles by Defense Department staff members.

Presenting the general industry position at a one-day Pentagon session on the principles, was Ernest Leathem, assistant to the president of Raytheon, Inc. Leathem said:

"The current proposals in our sober and considered opinion would, if adopted, mostly be a retrogression with adverse effects so serious upon defense contractors that the national safety might well be imperiled. Therefore, we would all prefer the status quo to continue, in preference to having the presently proposed comprehensive cost principles. . . . Specifically, the proposed cost contract cost principles still fail to recognize that contractors must somehow recover all legitimate and necessary costs of doing business . . ."

Representatives of Aircraft Industries Assn., Electronics Industry Assn., the National Security Industrial Assn. and other industry spokesmen presented a united front at the Oct. 15 session. Defense Department staff supported the new principles. Present in a judicial capacity were W. J. McNeil, Assistant Secretary of Defense, Comptroller; Perkins McGuire, Assistant Secretary of Defense for Supply and Logistics; Dudley C. Sharp, Assistant Secretary of the Air Force for Materiel, and Frank H. Higgins, Assistant Secretary of the Army for Logistics.

Key controversial points are:

• **Applicability.** Expanding fixed and detailed cost principles to all negotiated contracts, the industry objects, will require industry to hire "a whole army" of lawyers and accountants for contract administration and require the Pentagon to do the same. Defense Department staff members, on the other hand, claim that administration will be far simpler and that there will be less argument and treatment to all contractors will be equitable.

• **Reasonableness.** Industry insists that any cost which is "reasonable" in the performance of a contract is a legitimate cost. Defense Department proposes to itemize costs which are not in line with "public policy" and therefore not allowable under any circumstances. These include "product" or "institutional" advertising in general circulation publications and entertainment expense, except a limited amount of employe relations. Costs will continue to be allowed in technical and scientific publications.

• **Interest charges** are banned as a contract cost and are not to be taken into consideration in the allowance of profit or fee. "We do not care where a manufacturer obtains his financing—from stockholders who receive dividend payments or from banks which receive interest payments," a Defense spokesman said.

• **Training costs chargeable against** government contracts are spelled out. AIA estimates that, under the provisions, some liberal educational programs of manufacturers would be curtailed.

• **Research and Development.** General basic research would be an allowable cost. Applied research and development would have to be along the same product line in order to be charged against a production contract.

• **Bonuses and other types** of incentive payments would be legitimate costs. The yardstick would be whether the total remuneration—salary plus all other types of payment—is "reasonable." This is already Army and Navy policy, but the Air Force now arbitrarily disallows bonuses as costs.

• **Advance agreement on costs** that are "unusual" or "difficult to determine" is required. These include costs to be incurred for compensation for personal services, use charges for fully depreciated assets, deferred maintenance costs, precontract costs, research and development costs, travel costs. Industry representatives object that it is impossible to estimate such costs beforehand with any degree of accuracy.

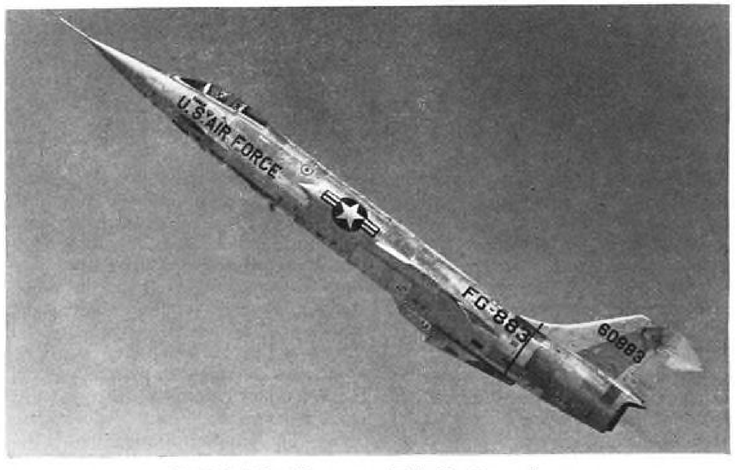
Top Defense officials may modify some of the proposals to some extent.

Countering the industry efforts to keep the status quo is strong pressure on Defense Department from the House Appropriations Committee and the General Accounting Office to issue cost principles uniformly applicable to all contracts—except competitive bid.

GAO will review the set of principles agreed upon by Defense and may urge even stiffer cost terms to contractors.

Assistant Secretary McGuire assured the House Appropriations Committee at hearings last spring that the cost principles would be issued. The first draft of Defense Department's proposals were presented to industry in Oct., 1957.

McGuire told the committee in April: "This is an extremely controversial area, but we got it out for comment by industry. I have been exposed to a lot of buzz saws and bumble bees in my time, but this one certainly has not been outdone. I personally believe that this subject is one that must be settled and the sooner we get it settled, the better off for us and the industry."



F-104C Enters TAC Service

Carrying six-barreled General Electric T-171 Vulcan 20 mm. cannon (port is under U.S. insignia), Lockheed F-104C has entered Tactical Air Command service. Ventral fin, used on F-104A models, is for increased stability. For story on F-104 sales drive, see p. 73.

Pioneer Failure Detailed

Washington—Failure of Pioneer satellite to reach the vicinity of the moon (AW Oct. 20, p. 30) apparently was not due to a first stage autopilot error as initially announced.

Dr. Louis G. Dunn, president of Space Technology Laboratories, said in a press conference the day after launch that programming of the rocket 3.5 deg. too high "very readily" accounted for loss of 600 fps. of the total 800 fps. velocity deficiency.

"I think on a more refined calculation we will probably find that the total difference was attributable to this higher programming," Dr. Dunn said.

Autopilot in the Thor first stage apparently actually programmed the missile only 2.1 deg. off the desired trajectory, and this was within the three degree tolerance. Engine burned for 160 sec., delivered 99% of available thrust and gave the missile more thrust than Thor has had in almost any firing.

Integrating accelerometer in the second stage was set to cut off the engine at 1,000 fps. lower than it was set for in the August shot, apparently in the expectation that the third stage engine would deliver 1,000 fps. more than planned in August.

This caused the second stage engine to shut down with some 1,500 fps. of thrust still remaining.

In addition, spin rockets are believed to have thrown upper stages off trajectory by a number of degrees. This would help account for poor trajectory that resulted in lower temperature inside the instrument package than desired.

Some observers do not believe that 35F to 36F internal temperature would account for battery failure. Before launch, the relay that switches command receiver from one channel to another was not working properly and another was substituted.

Although the substitute worked properly in pre-launch checkout, there is a possibility that it failed to function properly when command signals, intended to fire the retrorocket, were sent to it from the ground many hours later.

Pioneer was tracked for more than seven hours after launch by the 60-ft. TLM-18 tracking antenna operated by Radiation Inc. from its Malabar, Fla., site near the Cape Canaveral, Fla., launch site. It was lost when it passed in front of the sun, where solar radio noise at 108 mc. drowned out the satellite's telemetry signal.

Airline, Union Wage Negotiations Fail to Find Compromise Solution

Washington—Airline labor problems continued to smoulder late last week with no quarter being given in the Capital Airlines-International Assn. of Machinists strike over the wages recommended by a special Presidential Emergency Board.

Outcome of the Capital strike was being watched closely by Eastern, Trans World, Northeast, Northwest and National, all of which accepted a White House recommendation that IAM union members be granted a 20 cent-an-hour raise over a two-year period.

Union negotiators for all six airlines have rejected the recommendation and are continuing their discussions with the individual companies. Most observers believe the Capital settlement will provide a pattern for the final outcome of negotiations under way at the remaining five carriers.

Capital reported that it had offered to increase the salary raise by an additional six cents but intended to withdraw the extra sum at the rate of one cent per day for each day IAM refused to accept the offer.

In England, an 11-day strike by British Overseas Airways Corp. maintenance personnel came to an end last week after union representatives at BOAC failed in attempts to have 1,000 British European Airways workers join in the dispute.

Meanwhile, the "third-crew-member" issue remains the key to talks between the Air Line Pilots Assn., and Eastern, American, Pan American, Trans World, United, Western and National Airlines. ALPA called off a threatened Oct. 4 strike at Eastern and negotiations were suspended indefinitely. Direct negotiations were being conducted between the union and TWA while the subject of the Pan-American-National jet plane lease and crew complement will be discussed this week between ALPA and National. Pan American is now operating under National Mediation Board jurisdiction. United and Western are expected to meet this week with union representatives. While pilots at American have received strike vote authority, no date has been set and talks are continuing.

News Digest

Boeing has received an $80 million subcontract from North American Aviation to build wings for the B-70 bomber in the Seattle area, according to Sen. Henry Jackson (D.-Wash.). Neither industry nor Air Force officials would comment on the report last week.

Industry proposals to Airways Modernization Board for an airport height surveillance radar (AHSR) capable of providing information on altitudes of individual aircraft at ranges up to 50 mi. were due at the end of last week. Total of 24 avionics manufacturers attended an earlier bidders' briefing session.

British research aircraft, constructed of stainless steel, is under construction by Bristol Aeroplane Co., according to Ministry of Supply. Aircraft will have speed of about 2,000 mph. Official designation is T-188.

Vickers-Armstrongs Ltd. aircraft plant at Swindon, Wiltshire, England, will be devoted entirely to nuclear engineering when contract to build the Vickers Scimitar jet fighter for Royal Navy is completed in about 18 mo.

Grumman Aircraft Corp. has received an $86,000 study contract from the Flight Control Laboratory of Wright Air Development Center to determine the basic maneuverability requirements of aircraft destined to fly future Air Force missions. Contract calls for detailed analyses of roles of future interceptor, reconnaissance and strategic bomber aircraft. Research data will be concerned specifically with determining optimum roll performance requirements.

Air Force has extended time between overhauls on Pratt & Whitney J57 turbojets in Boeing B-52 bombers from 1,000 to 1,400 hr. and in Boeing KC-135 tanker transports from 800 to 1,400 hr.

French Snecma Flying Atar VTOL (AW July 7, p. 27) will be developed by Bayerische Motorenwerke. German Ministry of Defense arranged agreement and is subsidizing program.

Thirty-one persons were killed last week when a British European Airways' Viscount turboprop transport and an Italian Air Force F-84 collided in midair over the Anzio beachhead of World War II fame at a point approximately 35 mi. from Rome. The F-84 pilot managed to eject safely, but all 26 passengers and five crewmembers aboard the Viscount were killed.

Slump in Profits Faces IATA Members

New Delhi meeting centers on carrier fare conflicts; rising jet-turboprop transport is competitive factor.

New Delhi—High operating costs, dwindling profit margins and unsettled differences on fare structures were focal points of discussion today as more than 250 top airline officials and their aides met in the Vigyan Bhavan to open the 14th annual meeting of the International Air Transport Assn.

Chiefs of some 86 airlines plan to tackle these and other problems that now threaten a general breakdown of unanimity within the industry. For behind the three main issues lies the key to the conflict building up among the carriers; a widening gulf between small and large airlines and countries that has developed as a direct result of the imminence of competition between turbine powered aircraft and piston engine aircraft which will be held over by many carriers for a number of years.

This factor was one of the basic reasons that the IATA traffic conference on fares and rates bogged down for more than a month in Cannes. Although agreement was reached by the conference last week, a number of small carriers privately feel they were asked to make severe economic sacrifices in arriving at a fare level acceptable to the entire industry.

It is this same competitive factor that smaller carriers fear will wipe out any traces of operating profits they have been able to squeeze out of traffic available to them in today's piston engine market. These airlines suggest that high operating costs of turbojets and turboprops will force the larger carriers to operate at a peak rate of utilization thus substantially boosting available seat miles over the current level within two years.

Hildred Report

In his annual report delivered today in the opening sessions of the meeting, IATA's Director General, Sir William P. Hildred, made these points in a direct move to pave the way for a working relationship between small and large carriers during the course of the conference:

• **Served warning** that there are dangers in the assumption some countries do not need airlines. Hildred suggested that, if such an assumption had any basis for fact, it could apply equally well to large countries as well as small.

• **Criticized** International Civil Aviation Organization for forecasting an excessive seat and space capacity on international airlines once jet transports were introduced in number. Hildred told the delegates that the basis on which this forecast was made was "highly questionable."

• **Admitted costs of purchasing** and introducing jet equipment will be high but added that because the jets are larger and faster, "their earning potential should reduce costs per seat mile and make them a more attractive commercial proposition than their piston-engine predecessors."

• **Called for a stronger** promotional effort in the development of air cargo as a prime means of increasing revenues of all carriers. According to officials attending the meeting, cargo sales fall far short of potential and, as one delegate noted, cargo capacity of aircraft on the large majority of international routes is substantially below a 50% load factor.

• **Urged the airlines** to continue to drive for lower fares. He said, ". . . there is a vast and virtually untapped market for air travel, and the key to this is the fare—the price of air transport."

Hildred gave his report to the meeting following a brief talk by Dr. Thomas Delgado, president of Iberia Airlines of Spain, who is being succeeded as president of IATA by J. R. D Tata, chairman of Air India International. An official welcome was extended to the delegates by Prime Minister Jawaharlal Nehru of India.

Attacks Critics

In his report, Hildred attacked critics who have charged that jets will bring about radical changes in the competitive relationship and internal problems of smaller airlines to force them into a restricted regional type of operation. He added that such a theory could be turned against any large country or airline and said;

"For example, a case could be made that the United States, a great continental and centrifugal power with only a small percentage of its gross national revenue derived from foreign trade, needs no airlines overseas beyond Hawaii, Puerto Rico and Panama. It is the right of everyone to do the best he can at what he does best."

He also hit at charges that some countries maintain airlines only for the purpose of international prestige. He answered this criticism by noting that no country with commercial and national defense interests "can afford to trust its primary communications to strangers or to leave this lifeline to the vagaries of other countries or the vicissitudes of other carriers."

On this point, he chose to make one of his only two references in the report to user charges. He declared that he supported the principle of airlines paying their own way but added,

". . . I cannot deny that an airline which loses a dollar a passenger to bring to its country tourists who will spend $500 each while there, is still an asset, rather than a debit, to the national economy."

Traffic Control Plea

He strongly repeated his plea made at previous IATA meetings for a better air traffic control system and called upon the governments of the world to integrate military and civil traffic control systems and to provide any other facilities needed to fill the gaps in the present system.

In urging reduced passenger rates, Hildred emphasized the impact that economy fares introduced last April

American 707s Approved

New York—Port Authority of New York last week authorized American Airlines to operate its Boeing 707 jet transports in and out of Idlewild International Airport under conditions identical to those made earlier for Pan American World Airways 707s and British Overseas Airways Corp. de Havilland Comet 4s.

The conditions, which sparked a major controversy, call for a mandatory runway use system under which about half the takeoffs are made over water, under normal weather conditions, with a minimum altitude of 1,200 ft. reached over neighboring communities. American will not evaluate the restrictions until it has had a chance to test them with its own jet aircraft.

American's 707s, will initially be used here for proving and familiarization flights. The airline plans to start scheduled service between New York and Los Angeles on Jan. 11 (AW Oct. 20, p. 39). Its first 707, provisionally certificated because its passenger accommodations are not completed, was delivered last week at Seattle and was scheduled to arrive in New York last Saturday.

have made on the growth of North Atlantic traffic. He said that during the quarter of the year prior to the effective date of the economy fares, passenger volume increased by 4% over the same quarter of the previous year. He admitted that this drop in the rate of increase could be attributed to the business recession and a decline in immigrant traffic but added once the economy fares were introduced, "bookings for the summer months were 35% ahead of 1957, and actual carryings were up 24.6%."

He said economy fares now account for 59.6% of transatlantic traffic compared to 21% for first-class business and 19% for tourist traffic. He admitted much of the potential tourist traffic had been carried over into the lower economy class fare but said this disadvantage was offset by the advantage of expanding the market potential. He concluded his talk on the fare structure by strongly recommending an even lower fare than the economy rate which is $110 less than tourist and $330 less than first class on the London-New York route.

On the problem of bringing jet transports into the international field, Hildred said there was no way of determining exact operational costs of the planes until more operational experience is gained. He warned, however, that a major preoccupation during the years ahead will be "to ensure that high rates of utilization are achieved" as the key to operating the jets at a profit.

Industry Advertising

In another reference to user charges, he called attention to suggestions offered by some members of International Civil Aviation Organization that advertising expenditures be diverted to cover costs of airways facilities. On this point, the IATA head took a firm position in support of the industry's advertising programs which reached an annual total of $120 million last year.

"Word of mouth and traditional buying habits are not enough for the supplier who wishes to tap" the mass air travel market, according to Hildred. He went on to say that ". . . consumer habits, habits of life as well as buying habits, are increasingly molded by advertising. It is a means of communication, a quick method of reaching large numbers of people, and an effective method of educating consumers to want, to use and to appreciate new products."

He reported that the world's scheduled airlines last year carried a total of 87 million passengers, a 13% increase over the previous year. Dips in the rate of increase in traffic during the year were more evident on domestic routes than on international routes, he said.

Passenger traffic on the North Atlantic showed a 22% increase in 1957, Hildred reported.

He noted that revenues reached an estimated $4.1 billion during the year but warned that estimated increases in expenses may leave a profit margin of only $50 million "or a mere 1.2%." Expenses, he said, have climbed 25% compared to a representative 17% rise in revenues to create a 40% drop in operating profits.

As in the case of the Madrid meeting last year, no Russian observers from Aeroflot airline were present.

Northeast Check Opens CAA Crackdown

By Glenn Garrison

New York—Tightening of Civil Aeronautics Administration air carrier safety procedures may be foreshadowed by a two-months special inspection of Northeast Airlines' operations now being completed.

Similar inspections of other airlines are planned, AVIATION WEEK has learned, although this is officially denied by CAA's Joseph D. Blatt, administrator of Region One.

At least nine Northeast captains so far have been found to require additional instrument training as a result of the inspection, which began in August and has involved all phases of the airline's operational activities. Among the major CAA recommendations which will follow the inspection are changes in Northeast's crew training.

The captains who must be re-examined, and the captains not yet checked by CAA, will be restricted to visual flight rules operations until the CAA finds their instrument training satisfactory. The special inspection is being carried out by CAA's Air Carrier Safety Division, First Region.

Officials of the region, including Blatt, attribute the inspection to Northeast's large and sudden expansion of routes, personnel and equipment. While not routine, regional spokesmen say, the checkup is not unique and similar inspections have been made previously.

They deny any intention on the part of CAA to re-evaluate its own check procedures, but AVIATION WEEK has learned from Washington sources that a shakeup in the CAA's Air Carrier Safety Inspection System is pending.

Washington observers point out that the Northeast pilot situation could not have reached the stage revealed by the CAA inspection without serious deficiencies in the operation of air carrier safety inspection throughout CAA.

Three fatal crashes involving Northeast aircraft have occurred within the past two years, all during instrument conditions. The first of these occurred Feb. 1, 1957 on Rikers Island, N. Y.; the second Sept. 15, 1957, at New Bedford, Mass.; and the third Aug. 15, 1958; at Nantucket, Mass.

The across-the-board inspection of Northeast was not a punitive action in any sense, but a precautionary move prompted by the rate of the carrier's growth, according to the regional CAA officials. First phase required six weeks, and the flight check aspect, still under way, is expected to be completed within a week or so.

To handle the checkup, additional inspectors were sent to the Boston safety office to help examine all operational activities including training, manuals, facilities, records, dispatching, and management's delegation of authority to supervisory personnel.

No formal recommendations have yet been made to Northeast, but CAA says it will help the airline accomplish these long-range improvements, among others:

- **Training scheduled** in a more orderly manner. "We feel that with the rush-rush-rush to meet expanded schedules, there has been insufficient continuity in assigning people to training," a CAA official told AVIATION WEEK. Because persons are pulled in and out of training somewhat erratically, a lot of basically sound training is lost, he explained. Also needed is "more formal" training of dispatchers.
- **Availability of aircraft** better coordinated with availability of crews.
- **Increased coordination** between operations and maintenance. Example: follow-through of pilot discrepancy reports in aircraft logs.
- **Better office facilities** for supervisors. Situation may improve in the near future if Northeast's chief dispatcher and chief pilot offices are moved from Boston to Idlewild.

During flight phase of the first six weeks of the special inspection, CAA inspectors observed Northeast check pilots examining the captains in type-rating checks, en route inspections, and six-month instrument checks. After evaluating its findings, the agency advised Northeast that 47 pilots were cleared for instrument flying. By last Wednesday, about 90 captains had been cleared out of the airline's total of about 125, and checks of those still untested by CAA were continuing.

The investigation is being supervised by Thomas Walsh, Air Carrier Operations Inspector of CAA's Washington offices. A team of three inspectors was assigned to Boston for the checkup in addition to Boston's normal complement of four operations inspectors, two maintenance inspectors, and one electronic inspector. There are 80 inspectors of all categories in the CAA First Region.

Normal method of monitoring the airline's pilot examinations is for CAA inspectors to spot check the flight tests by Northeast's own checkpilots, who are designated by CAA.

Officials of CAA stress the point that they intended no condemnation of Northeast's operation in opening the special investigation, but believed the carrier's unusual expansion merited a close over-all look. Hope was expressed that the tests could be completed with the least economic penalty to the airline. Northeast has cooperated fully in the inspection, CAA noted.

Northeast reported that except for a few weekend flights there has been no interruption of schedules. In a statement issued last week, Alfred A. Lane, vice president-operations, said the results of the re-examination of Northeast captains for instrument flight procedures and pilot proficiency had so far been "gratifying." The re-evaluation, Lane said, had "re-affirmed the company's opinion that our pilots are among the best qualified in the industry."

Those few pilots who required refreshing on certain flight procedures, Lane said, should be ready to complete their re-examination later this month. Northeast has welcomed the opportunity to have CAA conduct the checks, he added, "as we feel this type of activity can materially strengthen public confidence in the operation of air transportation."

Regarding the expected CAA recommendations concerning Northeast's various operations activities, the airline told AVIATION WEEK that "we haven't got it in writing yet" and therefore would withhold comment.

Federal Aviation Agency Moves To Staff Top-Level Positions

Washington—First move made by the Federal Aviation Agency to staff its top level positions was made last week when Administrator Elwood R. Quesada selected a general counsel for the agency and began an industry-wide recruiting program to fill 10 key positions.

Named to the counsel position was Daggett H. Howard, now deputy general counsel of the Air Force and former member of the Civil Aeronautics Board's general counsel staff.

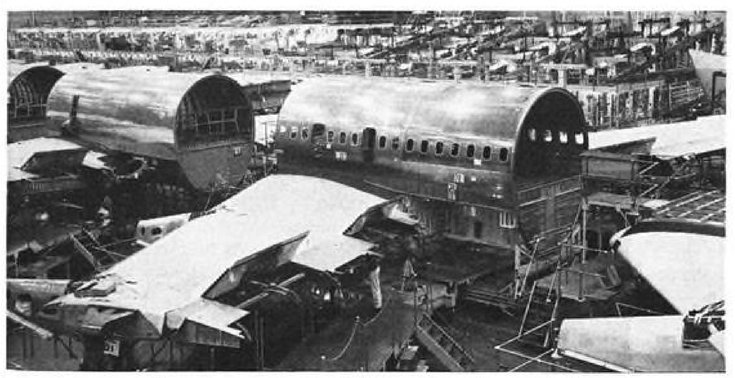
FAA is presently concentrating on filling the 10 special super Civil Service grades authorized by Congress for the agency and has distributed an estimated 200 letters, setting forth the desired qualifications for the $19,500 a year-maximum jobs to all phases of the aviation industry and to government agencies that might suggest candidates. It has requested replies by Nov. 1 to allow time for screening and a final selection by Jan. 1.

While this process is admittedly aimed at obtaining the best talent outside the existing government aviation agencies, FAA officials are careful to point out that its use is supplemental to plans for personnel selection from within its own ranks. Many positions will require experience possibly available only in present government aviation ranks.

Initially, the Federal Aviation Agency expects to make an estimated 15 appointments—of which five would serve as deputies—by the Jan. 1 deadline. Officials point out, however, that these men would constitute an organizational nucleus that would later be expanded to cover the full 104 super grade and scientific positions in the $17,500-$19,500 class, most of which were carried over from the Airways Modernizations Board and the CAA.

As tentatively planned, FAA expects to utilize its cadre of top-level assignments in the manner of cabinet members answerable only to the administrator as the final authority in all plans and decisions of the agency. Quesada has indicated that FAA will group its forces into the following pattern, with the top 10 men selected to administer these general categories:

- **Legal division already** is largely settled with appointment of counsel.
- **International coordination.** Considered by FAA as one of the most important divisions, it would bear the brunt of the agency's global activities involving plans and discussions on any foreign aviation matter with the Civil Aeronautics Board, Air Coordinating Committee, Department of Defense, the International Civil Aviation Organization and other groups.
- **Management services** would be responsible for administrative control of all FAA expenditures.
- **Planning.** FAA says it needs a staff of "forward thinkers" in this field to stay ahead of such problems as air traffic control.
- **Research and development** would assume the same functions now being handled by the AMB.
- **Personnel,** a wide category which FAA claims has "peculiar problems" as evidenced by the present difficulty in filling traffic controller vacancies. The agency feels present controller training programs should be expanded and emphasis placed on radar operation.
- **Rules and standards** would form and enforce rules and standards for the certification of both men and equipment under engineering and medical subdivisions. In particular, emphasis is expected to be placed upon the medical aspect with the appointed head serving on an equal basis with the head of this division or possibly being named to administer a separate department on a level with other top positions.
- **Traffic control** function will remain much the same as the present except that appointment of a top-level leader would place it at the right hand of the FAA administrator and on an equal footing with other major categories.



Continental's First Boeing 707

Wing has been joined to center body section of first Continental Air Lines Boeing 707 on Boeing's Renton, Wash., production line. Continental has four 707-120s on order, with delivery starting next spring. Boeing 707 orders now stand at total of 187 aircraft.

Seaboard & Western's Outlook Improves

New York—Outlook for Seaboard and Western Airlines has improved over the early months of this year, when the carrier's losses were high and its cash position poor.

Seaboard, only all-cargo scheduled airline on the North Atlantic, ran into trouble in the third quarter of 1957 with a loss for the period of $176,000. The situation worsened during the last quarter of the year and reached its low point during the first four months of 1958 when losses totaled $1,900,000 and scheduled ton-miles dropped 8.3% from the same 1957 period.

Net loss for 1957 was $401,554. The carrier's cash balance at Dec. 31 was $263,000, with a negative current position of $3,100,000 and a negative current ratio of four to seven.

Contributing to Seaboard's condition were less-than-expected common carriage freight business and falling off of the non-scheduled and leasing activities which provide the bulk of the carrier's revenues.

But a turn for the better began last May. The second quarter of 1958 showed a profit of $301,955, cutting the loss for the first six months of this year to $1,223,269. Operation is still running in the black.

Comeback Factors

Among the factors helping Seaboard to a comeback:

- **Authority to carry** U.S. mail, granted in May under an exemption while Seaboard's application for certificate mail authority is being considered by Civil Aeronautics Board.
- **Sharp pickup** in scheduled freight business. Despite the decrease of the first four months of this year, ton-miles for the first eight months were 15% over the same period of 1957. Result was due to a 41% jump during the four-month period May through August.
- **New lease contracts,** including wet lease arrangements with Irish Airlines and Sabena (wet lease includes flight crews and sometimes maintenance as well as the airplane).

During the period of severest financial strain, Seaboard was forced to curtail the development of its scheduled freight service. Personnel were cut from 1,020 to a low of 853 in March. A number of unproductive scheduled flights were canceled. During the period January through May, 1958, 44 cancellations were made out of a total of 144 eastbound scheduled flights. Another 39 of the flights were delayed.

Most of the cancellations took place on weekends when freight volume was lowest.

By July 31, however, Seaboard had brought its personnel total to 1,121, higher than the total before layoffs began.

In addition to the above economies, Seaboard improved its immediate cash position by purchase of the stock of Seagull Air Transport Corp. for $1 million. Of the total, $200,000 was paid in cash, $200,000 by the issuance of note at 5½% interest, and the balance in cash and Seaboard common stock at $8 per share.

Seaboard also retired $404,100 of Seagull debentures outstanding. Result of acquiring Seagull's assets was a net cash improvement of $600,000 for Seaboard and acquisition of a Lockheed Super Constellation which Seaboard had leased from Seagull at $35,000 monthly. Of course, long-term debt was increased.

Main cause of Seaboard's financial troubles was the U. S. business recession, Arthur V. Norden, Seaboard executive vice president and treasurer told AVIATION WEEK. Aside from the mail authority, the improvements in Seaboard's position have been possible only because of an upswing in the general economy, Norden said. The whole airfreight industry is enjoying the effects of this upswing, he added.

One way in which the recession hit Seaboard was in falling off of wet lease business because its potential customer airlines were having their own problems. Revenues from this source declined from $2,283,781 in the second quarter of 1957 to $749 in the third quarter and to nothing in the last quarter of 1957 and the first quarter of 1958.

This business has picked up again, and 1958 wet leases include a long-term agreement with Irish Airlines, effective last April, and wet leasing of three Super Constellations to Sabena for four and a half months, the latter transaction worth about $3 million in income to Seaboard. The cargo line also has arranged to buy a 25% interest in Irish Airlines at a cost of $1.4 million. Raising the cash to consummate this deal is not an immediate problem, however, as CAB consideration of the agreement only recently reached the pre-hearing stage.

Another item of recent business was the dry lease, effective in March, of an airplane to Portuguese Airlines involving $625,000 in charges.

The wet lease business, Norden said, should offer great potential during the airlines' transition to jets. For example, an airline with jets on order for 1961 delivery may be faced with need for greater capacity to handle traffic in the meantime. Rather than tie up funds in the purchase of additional piston equipment, it might decide to lease planes and crews to take care of the expansion until the jets arrive.

Seaboard no longer has immediate cash problems, Norden said, and most of the airlines' difficulties are now under control. Growth of the scheduled freight business, the long-term Irish Airlines deal, and the carriage of U. S. mail provide three areas of forecastable income, Norden pointed out. In addition, over-all increase in Military Air Transport Service business from $57 million in 1957 to $80 million set for this year offers the strong possibility of a "reasonable amount" of income for Seaboard from this source.

The mail authority, Norden said, has meant revenues of $80,000-$90,000 a month for Seaboard. If the airline had been authorized to carry U. S. mail last year, he said, it would have wound up in the black.

Competitor Objections

Seaboard's application for amendment of its certificate to authorize the carriage of service-rate mail has been opposed by Pan American World Airways and Trans World Airlines, on the grounds that Seaboard's service is not needed, diversion of mail revenues to the cargo carrier would hurt PanAm and TWA, and that Seaboard is not fit, willing and able to perform the service.

CAB Examiner Richard A. Walsh, however, recommended last month that the Board approve Seaboard's application. The examiner reported that Seaboard's service had already provided substantial benefits in the transatlantic air mail service—indirectly including a change in a Pan American all-cargo schedule from 6 a.m. to 3 a.m. to meet the service offered by Seaboard's 4 a.m. departure from New York.

Regarding diversion of mail revenues, the examiner contended that an estimated $1,011,013 annual diversion from Pan American and $674,764 from TWA would represent only .7% of Pan American's Atlantic Division revenues of $134,647,409 for the year ending June 30, 1958, and only .9% of TWA's international revenues of $73,364,656 for the same period.

In his report, the examiner said Pan American cited a decline in Atlantic Division profits from nearly $12 million in 1956 to $328,000 for the first seven months of 1958. TWA's international operation loss for the 1958 period, the examiner noted, was reported as $4,640,000. The carriers imply, the examiner said, that certification of Seaboard for mail service "will be the ultimate factor that will cause them to return to subsidy. . . ."

As to Seaboard's fitness to perform the service, the examiner noted improvements in the carrier's financial position and suggested that further improvements would follow from an upsurge in business which in July increased Seaboard's load factor from 35 to 70%.

According to the examiner's view, mail revenues should enable Seaboard to continue the development of its transatlantic freight service by ensuring schedule stability. Although the airline does not concede that U. S. mail authority is necessary to continuation of scheduled service, the examiner feels that with the mail insurance, Seaboard will be able to operate many schedules which otherwise might have to be canceled because of insufficient freight business. The airline currently operates six weekly roundtrips to Europe.

Norden told AVIATION WEEK that the "cornerstone" of Seaboard's business is the scheduled operation, which the airline has been flying since April, 1956. "This is where we have chosen to make our living," Norden said, and future potential lies in the scheduled business.

Seaboard's scheduled service revenue in 1957 was $3,725,555 and revenue from other sources was $15,278,223. In the first quarter of 1958, scheduled revenue was $1,008,193 and non-scheduled revenue was $2,579,685.

The carrier flew 11,034,000 revenue ton miles last year in its scheduled operation out of a total of 25,925,074 available ton-miles, for a load factor of only 43%.

About the same load factor persisted during the first half of 1958. Average 1957 ton-mile yield was 33.76 cents, against operating expenses of $5,808,000, for a loss in the common carriage operation of $2,082,000.

Seaboard flew 8,071,000 ton-miles during the first eight months of this year. This 15% increase over the same period of last year compares with an 11.6% increase in total transatlantic freight ton-miles during the period.

Seaboard reports it carried during the same period 14.9% of all tonnage flown by all carriers between the U. S. and Europe; 45.8% of all tonnage flown over the route in all-cargo aircraft; and 66% of all tonnage flown by U. S. flag carriers in all-cargo aircraft over the route.

The airline's fleet consists of four owned Super Constellations; seven leased Super Constellations; two owned Douglas DC-4s and two leased DC-4s.

Norden said Seaboard is interested in new equipment such as the turboprop Lockheed C-130 with rear-loading doors—a feature of great importance, he believes, because of the vital element of ground time for loading.

"But we want to get healthy first before we go into the question of new equipment," he added.

High-Speed Taxiways Recommended by AMB

Washington—Airways Modernization Board last week recommended high-speed taxiway turnoff speeds of 65 mph. as one of the most feasible methods of increasing runway acceptance rates for landing aircraft.

Reporting on the results of a 10-month study of taxiway locations and design tests conducted by the University of California at McClellan AFB, Calif., under a $65,000 contract, AMB said the higher turnoff speed could be utilized safely by both civil transport and military aircraft on wet or dry pavements. Providing turnoff angles ranging from 30 to 45 deg. as compared with the conventional 90 deg. taxiways under the new criteria could reduce the runway use time of each landing aircraft by an estimated 20 sec., the board said.

Actual test results were based on operations conducted by Air Force and Navy planes and crews, both at McClellan and the Wright Air Development Center in Dayton.

Military aircraft equivalent to the Convair 240, Super Constellation and the Boeing 707-120 were used in the test flights along with the F-100, B-47 and B-52.

Taxiway researchers also determined that yellow reflectorized stripes would afford the most effective daytime taxiway guidance. Nighttime guidance, they said, should be based upon a system that shows both the edges of the pavement and the taxiway centerline as a continuous line of light.

AMB said it regards as an "extra dividend" a special "button" lighting system developed during the project for runway-taxiway centerline experiments.

The buttons, disk-shaped lights about 6 in. in diameter, proved invulnerable to weather and damage from aircraft during the tests.

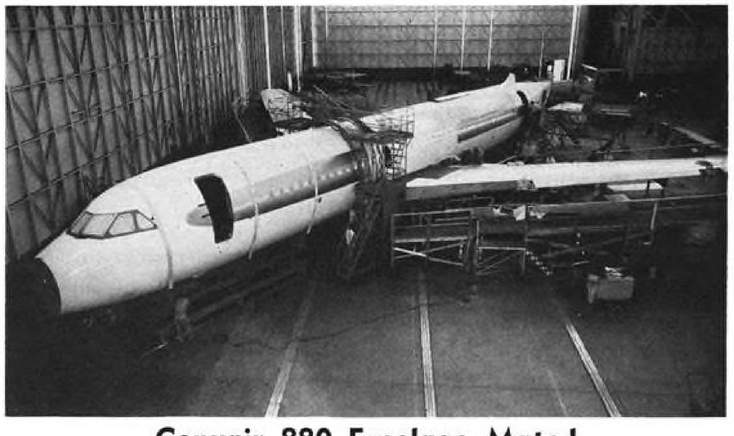
Extension of its contract with the University of California was also announced by the board to provide further research on taxiway and runway lighting in connection with the new taxiway design criteria. A major portion of the new study will concern the spacing and brightness of lights for the centerline and threshold of the runway, including artificial fog tests at the school's fog chamber.

Further plans call for a practical test of the button system by installing a centerline system on San Francisco's airport runway 28R, and centerline and edge lighting on one of the airport's existing taxiways, AMB added.

First Two Electras Delivered to Eastern

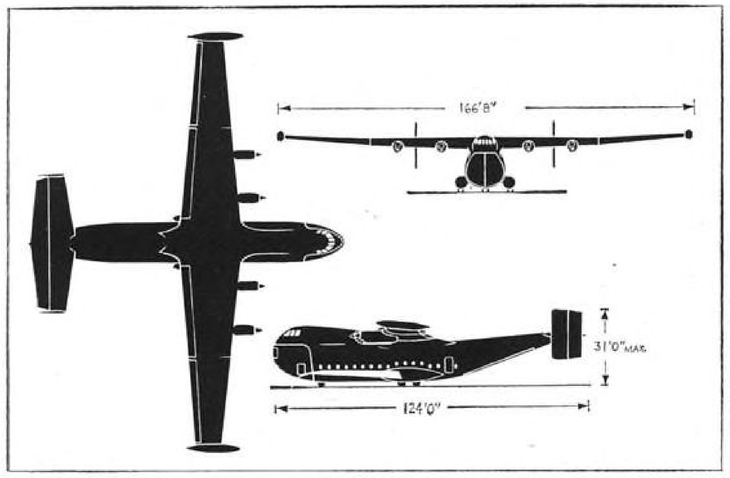
Washington—Eastern Air Lines received the first two of its fleet of 40 Lockheed Electras last week and announced the turboprop transports will go into scheduled service Dec. 1.

American Airlines last week accepted delivery on the first of its order of 30 Boeing 707 jet transports. Now being used for training purposes, the aircraft will be used on American's first coast-to-coast jet service in January. The airline also has ordered a total of 25 Boeing 707-023s for delivery through 1960-1961.



Convair 880 Fuselage Mated

Forward fuselage section of first Convair 880 jet transport has been mated at San Diego plant of Convair Division of General Dynamics Corp. Initial aircraft will be used with two others for extensive flight test program; another will be used as proof test aircraft. Fuselage equipped with stub wings will be used for a year of pressure cycling tests. First three aircraft are Trans World Airlines configurations; airline has ordered 30 Convair 880s. First flight will be early next year.



Blackburn B.107A Turboprop Transport

Three-view drawing of Blackburn B.107A turboprop transport shows large fuselage which has nearly 9,000 cu. ft. cargo capacity. Design uses Blackburn Beverley wing and empennage mated to fuselage. Transport powerplants are four Rolls-Royce Tyne turboprop engines rated at about 5,000 eshp. each. Maximum payload is 58,000 lb. carried for 1,300 naut. mi. range at altitudes up to 30,000 ft.

Congressional Support of Subsidy Hampers Local Service Rate Bid

Washington—Congressional support for indefinite continuance of subsidy payments to local service carriers may block the airlines' hopes for victory in the Local Service Rate of Return Case.

The carriers are basing much of their plea for a higher rate of return on the premise that it will aid in eventual independence from subsidy, which, they contend, hampers attempts to attract capital for equipment purchases.

Their argument, however, is handicapped by congressional urgings that the Civil Aeronautics Board continue such financial aid.

Added indications that subsidy may emerge as a key to the defeat of local service demands were contained in recent comments by the Board's bureau counsel who already has recommended a rate of 9.5% based upon investment as opposed to airline requests for a 14% return on an operating margin (AW May 12, p. 40).

Framework for the bureau counsel stand is a "cost of capital" formula designed to determine the final rate which is 1.5% above that presently allowed the 13 local carriers. Basing a rate on investment worth is not acceptable, the carriers claim, because of their weak financial condition and lack of modern aircraft. They also add that their present inability to attract investment capital makes the "cost of capital" approach unworkable.

Replying to local service complaints that subsidy constitutes a liability since investors are wary of risking capital in an industry characterized by high capital turnover, the bureau counsel said availability of Section 406(b) of the Civil Aeronautics Act outlining subsidy provisions makes such a risk "virtually nonexistent."

"Whatever impression the carriers want to give on the record, the best evidence as to how they regard the availability of Section 406(b) is afforded by the promptness and frequency with which they have invoked this protection in the past," the bureau counsel said.

Calling attention to past government support of subsidy and "indications that it will be even greater in the future," the bureau termed such payments a "guarantee" against loss which "unquestionably lessens the investor's risk."

In rebuttal, the local service operators say that subsidy only serves to underscore the financial weakness of their industry, ties profits directly to regulatory action of the Civil Aeronautics Board, restricts the opportunity for high profits sought by investors and limits the attractiveness of local service securities to the Board's subsidy policy.

As evidence that subsidy has failed to aid in attracting investors, the carriers said they have been unable to secure long-term debt financing and have been forced to rely on higher interest short-term loans with repayment schedules ranging from 30 days to about three years.

During the past eight years, they said, local service carriers have obtained more new capital by increasing their accounts payable than by new common stock equity. While the common stock equity during the period increased by only $3.5 million, the local carriers said their working capital has shifted from a positive base of $620,000 to a negative working capital of $4.6 million, leaving a total increase in working capital of $5.2 million.

National Reports Loss After FY 1958 Profit

Washington—National Airlines last week reported a net loss of $605,316 for the fiscal year ending June 30 as compared with a profit of $3,133,499 for the previous year.

Operating revenues decreased from the $56.8 million of 1957 to $53.8 million for the previous year, while operating expenses of $54.7 million represented an increase in costs of nearly $4 million.

National had an operating profit of $6 million in 1957 as compared with an operating loss of $905,499 for the past fiscal year.

Much of the increased expense level was carried by depreciation and amortization charges of $7,423,546, which were 24% higher than the $6 million incurred in 1957, National said. Increase in this expense resulted from the purchase of four Douglas DC-7B and four Lockheed 1049-H aircraft during the year.

Pacific, West Coast Get Route Extensions

Washington—West Coast Airlines and Pacific Airlines have gained new route extensions as a result of tentative Civil Aeronautics Board approval in the Pacific Northwest Local Service Case.

Pacific will be granted an extension north from Crescent City, Calif., to Portland, Oregon.

West Coast would be permitted to add Salem, Bend-Redmond, all in Oregon, and Newport-Toledo, to its present Portland-Klamath Falls, Ore., route which would be extended south to Sacramento and San Francisco-Oakland. Service to the east would be expanded by an extension from Klamath Falls to Boise, Idaho, by way of Lakeview and Burns, Ore. In the north, Omak, Wash., would be added to the West Coast system with Northwest Airlines authority to Wenatchee cancelled.

Airline Income & Expenses—August, 1958

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income (Before Taxes)
DOMESTIC TRUNK								
American	25,182,418	536,703	2,597,484†	.....	89,236	28,518,689	24,075,723	4,809,072
Braniff	4,617,722	123,324	55,300	179,237	6,346	5,071,483	4,594,082	421,010
Capital	8,505,965	187,471	118,535	143,010	19,634	9,092,021	8,410,015	689,006
Continental	2,675,896	19,206	17,885	67,634	54,657	2,942,187	2,664,969	277,218
Delta	6,290,006	145,065	99,188	294,229	89,239	7,054,067	6,543,273	461,790
Eastern	19,471,771	316,300	818,901†	.....	3,018	20,745,094	18,668,318	1,940,601
National	3,572,896	74,907	23,505	117,528	140,368	4,006,485	4,160,854	−148,695
Northeast	2,133,788	25,548	12,420	38,411	5,299	2,253,679	2,482,380	−41,138
Northwest	6,402,803	155,696	443,947†	.....	24,947	7,061,097	5,690,786	1,390,311●
Trans World	19,607,152	382,390	1,025,189†	.....	14,418	21,117,692	17,977,851	2,892,804
United	26,177,377	752,045	2,145,633†	.....	190,235	29,460,484	23,396,044	5,841,443
Western	4,060,171	71,709	32,000	86,812	35,375	4,326,834	3,456,594	787,412
INTERNATIONAL								
American	632,072	3,252	63,525†	.....	.....	718,061	589,294	127,445
Braniff	629,733	7,570	.....	36,497	.....	704,867	658,032	39,014
Caribbean-Atlantic	196,556	1,950	5,212†	.....	2,244	212,631	173,811	38,901
Delta	501,027	5,110	.....	10,319	45	539,772	473,382	62,097
Eastern	2,306,790	32,332	74,374†	.....	66,480	2,482,506	2,069,991	376,823
Mackey	135,025	.....	.....	1,362	.....	140,863	136,529	4,334
National	416,224	3,315	1,884	13,204	18,573	460,785	333,996	125,749
Northwest	2,403,631	526,137	317,139†	.....	122,624	3,456,739	2,421,391	1,035,347●
Pan American								
Alaska	361,000	13,000	43,000†	.....	9,000	429,000	418,000	3,000
Atlantic	13,458,000	670,000	1,052,000†	.....	289,000	16,038,000	13,069,000	2,827,000
Latin America	6,247,000	180,000	1,177,000†	.....	223,000	8,247,000	8,061,000	88,000
Pacific	5,190,000	541,000	675,000†	.....	498,000	7,176,000	5,596,000	1,582,000
Panagra	1,079,000	46,000	.....	173,000	.....	1,501,000	1,580,000	−68,000
Resort	.....	.....	.....	.....	.....	559,839	497,510	44,745§
Trans Caribbean*	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	7,638,714	515,797	400,884†	.....	228,053	9,071,372	7,741,679	1,262,784
UMCA	4,286	.....	1,088†	.....	.....	5,389	10,087	−4,698
United	1,706,786	47,015	28,953†	.....	.....	1,794,878	1,211,600	570,957
Western	131,573	1,324	.....	296	9,270	143,965	150,509	−10,996
LOCAL SERVICE								
Allegheny	586,196	11,112	8,758	15,884	716	1,497,653	811,058	685,595●
Bonanza	231,746	3,145	1,356	6,508	1,233	386,726	383,915	5,204
Central	169,544	6,336	1,902	5,719	3,809	400,627	403,975	−3,168●
Frontier	331,457	207,110‡	3,000	27,189	1,689	580,246	630,739	−53,497
Lake Central	178,371	3,965	7,963†	.....	949	344,330	313,823	30,507●
Mohawk	556,635	7,142	6,426	10,174	56,427	975,766	761,626	214,140●
North Central	882,932	19,657	16,000	.....	40,231	1,233,773	1,174,032	56,701
Ozark	434,326	233,709‡	8,197	14,327	212	697,774	679,406	14,342
Pacific*	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont	586,749	9,927	8,885	7,811	.....	842,653	751,548	95,275
Southern	231,737	7,197	4,685	5,921	.....	454,912	414,651	40,261●
Trans-Texas	312,300	9,574	3,740	14,061	4,182	603,687	565,848	38,003
West Coast	271,835	3,481	2,285	6,849	3,599	433,516	424,319	9,197●
HAWAIIAN								
Hawaiian	677,622	3,507	64,152†	.....	.....	1,032,990	753,858	261,327
Trans Pacific	280,182	606	.....	6,373	7,995	297,531	237,086	60,446●
CARGO LINES								
AAXICO*	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	135,811🌢	.....	.....	.....	26,764	165,128	153,777	9,147
Flying Tiger	.....	7,525	1,073,339†	.....	2,579,163	3,662,274	2,834,075	754,448
Riddle	.....	5,293	438,965†	.....	346,665	792,800	893,839	−15,270●
Seaboard & Western*	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	.....	756,774	985,750	667,909	214,147
HELICOPTER LINES								
Chicago Helicopter	69,049	129,699‡	.....	.....	.....	198,735	158,008	35,942
Los Angeles Airways	19,783	10,084	8,294	.....	.....	118,552	97,052	19,800
New York Airways*	.....	.....	.....	.....	.....	.....	.....	.....
ALASKA LINES								
Alaska Airlines	257,947	47,108	991	46,347	126,400	637,114	589,411	70,728
Alaska Coastal	121,936	8,975	.....	9,270	12,711	196,038	143,405	52,632●
Cordova	17,752	9,553	.....	5,315	15,306	86,929	94,725	−7,796●
Ellis	69,462	4,963	.....	6,344	9,091	115,182	93,150	22,033●
Northern Consolidated	112,617	28,242	.....	47,026	20,360	328,208	206,693	121,515●
Pacific Northern	973,691	66,119	102,613†	.....	610	1,291,923	941,794	335,676
Reeve Aleutian*	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	170,483	48,686	.....	30,277	206,575	511,702	473,276	38,466●

* Not available. † Property figure. ‡ Includes federal subsidy.
● Net operating income. § Net income or loss. 🌢 Common carriage.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

SHORTLINES

► **Alaska Airlines** has accepted delivery of its third Douglas DC-6 and expects to place the aircraft in service in December on its Portland/Seattle-Fairbanks-Anchorage route. An airline official also reports that, during August and September, Alaska's share of the traffic from the Pacific Northwest and Fairbanks increased from 11% in September, 1957, to 44% in September of this year.

► **American Airlines** flew 9,485,000 ton miles of airfreight during September for, it says, a new domestic industry record. The September figure also represents the second consecutive month American has flown more than nine million ton miles of airfreight.

► **Flying Tiger Line** reports September airfreight revenues of $1,126,390, a gain of 56.3% over the same month of 1957. Flying Tiger's nine-month figures for airfreight reached 8,421,890, an increase of 19.7% over the corresponding period in 1957.

► **Scandinavian Airlines System** began nonstop service between Anchorage, Alaska, and the three Scandinavian capitals on Oct. 22 using Douglas DC-7C aircraft. The airline has been using Anchorage only as a fuel stop on its polar route from Europe to the Far East but will now make Anchorage a regular passenger stop.

► **Seaboard & Western Airlines** has received a Military Air Transport Service contract totaling $2 million for the transport of military freight between the U.S. and Europe. The airline will fly 2,100 tons of freight during the next six months from Dover AFB, Del., to Chateauroux AFB, France. Seaboard & Western transatlantic air freight traffic totaled 4,275,578 ton miles during the quarter ended Sept. 30, an increase of 68.5% over the third quarter of 1957. Seaboard's nine month airfreight figures stand at 9,441,707, a 20.8 increase over the same period of last year.

► **Southern Airways** plans to begin nonstop service between Atlanta, Gadsden, Ala.; Anniston, Ala., and Memphis on Dec. 1. The Georgia-based local carrier will begin nonstop service between Huntsville, Ala., Atlanta and Memphis on Dec. 1 and will add a roundtrip flight between Huntsville and Atlanta on Jan. 5. Also on Jan. 5, Southern will add a second roundtrip nonstop flight from Eglin AFB, Fla., to New Orleans in addition to its flight scheduled to begin on Dec. 1.

AIRLINE OBSERVER

► Watch for a new management-level shakeup at Trans World Airlines. Shakeup may be one of the first moves of new TWA President Charles Thomas. Recently returned from a tour of TWA's international routes, Thomas is expected to coordinate the move with Board Chairman Warren L. Pierson.

► **Trunkline passenger load factors hit a three-year low of 58.82% during the 12-month period ending in September, according to latest Air Transport Assn. figures. First-class domestic load factor slumped to 57.43%, coach service to 60.97%. Revenue passenger miles climbed to 24.62 billion; available seat miles totaled 41.85 billion.**

► Merger speculations between Cia Mexicana de Aviacion and Aeronaves de Mexico are growing. Observers say the Mexican government would approve such a union which could provide a powerful bargaining argument in its hopes to back a major overseas flag line during bilateral talks with the U.S. this winter. While neither airline will verify the merger possibility they recently combined all equipment on the West Coast routes from Mexico City to Los Angeles in a bid to boom the tourist trade.

► **Final settlement of the Qantas Empire Airways application to enter the U.S. domestic market (AW Oct 20, p. 46) promises to be lengthy and hotly debated. Civil Aeronautics Board attorneys are still studying the legal implications of the Australian carrier's application and will not rule upon the bid until comments have been received from the Department of State. If decided against Qantas, the case could be carried to the Supreme Court for a ruling. Another alternative would involve direct consultations between the U.S. and Australia and, if still unsettled, a final determination through arbitration moderated by International Civil Aviation Organization.**

► Weather continues to pose the greatest threat to small aircraft, which last year were involved in 3,758 accidents, 371 of them fatal with a total of 721 fatalities resulting. Civil Aeronautics Administration said last week that of the 3,758 accidents, 403 were attributable in some way to weather conditions. Although last year's accident tally is higher than the 3,147 recorded in 1956, the fatality rate per fatal accident remained at approximately the same level.

► **Delta Air Lines has begun construction on a new $100,000 air-freight terminal at the Atlanta Airport. Scheduled for completion by January, the new facility will cover 5,000 sq. ft. of floor space with dock space for eight trucks and three cargo aircraft.**

► Russian officials, in a rare departure from their policy of remaining silent on aircraft crashes that occur within the Soviet Union, last week announced the crash of a Tu-104 jet airliner on Oct. 17, an estimated 360 mi. east of Moscow. Radio Moscow announced that 65 passengers and five crew members lost their lives when the twin-jet crashed on the final leg of a Peiping-Moscow flight. Soviet cabinet ordered a top-level investigation.

► **Although not connected with the recent crash, European observers say the most notable operational flaw in the Tu-104 is the jet airliner's tendency towards tire blowouts on landings. The problem, witnessed in Europe on several occasions, also was evidenced in the U.S. in February when the Russian jet blew two tires on touchdown at Baltimore.**

► U.S. Weather Bureau realized a major step forward in its five year modernization plan last week when the Civil Aeronautics Administration announced the award of a $2.1 million contract for high-speed teletypewriter systems. Designed to replace manual machines now in use, the new systems will allow transmission of 600 words per minute and may later be increased to 1,000 words. Manufactured by the Teletypewriter Corp. of Chicago, initial installations of the new units will be at Cleveland, Atlanta, Kansas City, Fort Worth, San Francisco, Salt Lake City, Denver, New Orleans, Chicago, Washington and New York.

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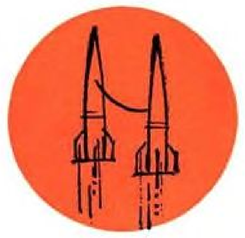

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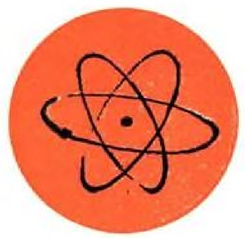

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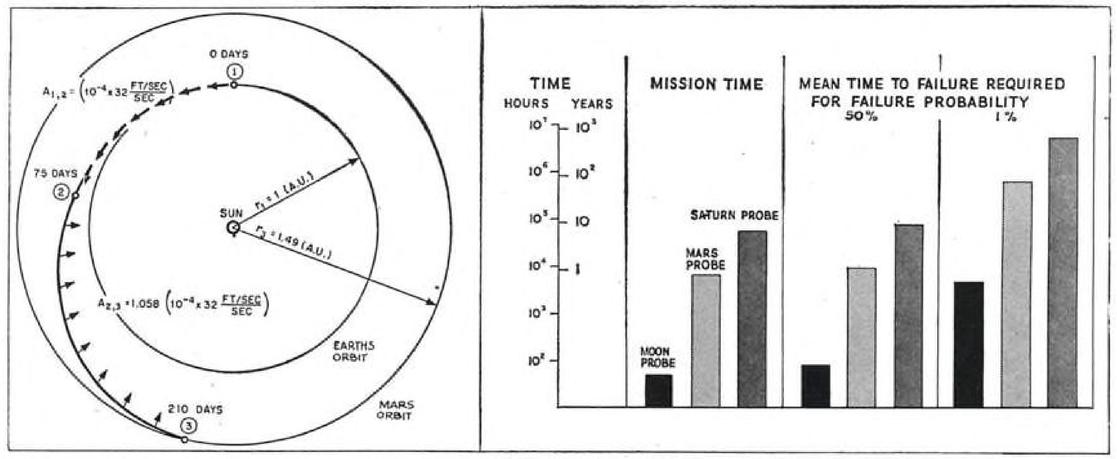


INTER-ORBITAL transfer phase of Mars probe by ion-propelled vehicle is most difficult phase of the mission for navigation computer which must determine the precise point where the direction of vehicle's thrust is shifted (2, left) to bring it into Mars orbit. Most difficult problem in computer design for Mars probe vehicle is to obtain sufficient reliability for a long mission. The computer must have a mean life to failure of near 70 years to offer 99% probability of not failing.

Space Computers Need More Reliability

By Philip J. Klass

Washington—Design of a digital computer required for navigation and control of even the more difficult interplanetary space probes appears to be well within capabilities of the present state of the art, except in the area of reliability where large improvements are needed.

This conclusion, by C. F. O'Donnell, chief, Weapon System Analysis, North American's Autonetics Division, is based on an analysis of the computer requirements for a mission which imposes the most difficult variety of tasks on the space-borne computer. This is an orbital probe of Mars and return to earth, using a rocket-launch to place vehicle in orbit around the earth and ion propulsion to take it to Mars and place it in orbit around the planet.

Computer Accuracy

The analysis indicates that the required computer accuracy, speed and capacity can be achieved using existing solid-state devices and techniques. However, unless "giant strides" are made in improving reliability of computer's component parts, O'Donnell says, an extensive supply of spares must be carried aboard the vehicle and the computer must be accessible to crew in flight to permit repair and servicing.

A similar conclusion is reached by Wright Air Development Center's Flight Control Laboratory in a reliability analysis of a brief moon probe which lasts for less than 11 days, compared with the 1½ years required for the Mars probe. WADC Technical Note 58-156, by Ronald O. Anderson, estimates that there is a probability of only 0.000045 of a digital computer operating without failure for 10.6 days required for the moon probe. By way of comparison, WADC estimates that the attitude gyros would have an 0.87 probability of performing 10.6 days without failure, or roughly 20,000 times the reliability of the digital computer.

In the Autonetics analysis, a seven-phase mission to Mars and return was considered:

- **Phase 1:** Rocket-launch into orbit around the earth.
- **Phase 2:** Acceleration to breakaway (escape) velocity by ion propulsion.
- **Phase 3:** Inter-orbital transfer to the orbital radius of Mars.
- **Phase 4:** Placing vehicle in orbit around Mars.
- **Phases 5, 6, 7:** Breakway from Mars, inter-orbital transfer back to earth and establishing vehicle in orbit around earth, using aerodynamic forces to dissipate energy.

Use of a vehicle-borne computer to establish the initial orbit around the earth is quite similar to the problem of guiding a long-range ballistic missile and thus should pose no difficult problems. The computer obtains information from accelerometers and gyros, computes vehicle velocity vector magnitude and direction, generates steering signals to properly orient vehicle and then cuts off power when the desired terminal velocity is reached.

Terminal velocity must be controlled to within one part in 5,000 to establish a suitable orbit, or to within 5 ft./sec./sec. at a 25,000 ft./sec. terminal velocity. Since the vehicle will be accelerating at around 300 ft./sec./sec. (10 Gs) at this time, the computer must require something less than 1/60th of a second to perform its computation if cutoff velocity is to be held to within 5 ft./sec./sec. This suggests a computer with a solution time of approximately 10 milliseconds or less, O'Donnell says.

Since most small general-purpose computers require 3 to 10 milliseconds just to make a single multiplication, O'Donnell believes that some form of incremental computer is required to achieve required computational speed. (An incremental computer does not recalculate the entire problem from scratch each time, but calculates only the change that has taken place since the previous computation, subtracts or adds this to previous answer.)

Breakaway

During the breakaway phase of the mission, vehicle's ion propulsion provides an acceleration of the order of only 0.0001G, approximately 1/10,000th the acceleration during initial launch. This requires a drastic rescaling of the digital computer (and accelerometer sensors) if this accelera-

tion is to be measured, integrated and used to determine vehicle's position in space.

An easier solution, O'Donnell suggests, would be to use earth-bound radar and a transponder aboard the vehicle to determine its position in space, then transmit such information by radio to the vehicle at periodic intervals to correct for accumulated errors in the vehicle-borne inertial system.

However, this raises a new problem for an incremental type computer (digital differential analyzer), O'Donnell points out, because the latter is not well adapted for accepting input information which varies in separate jumps—such as the position fixes periodically transmitted from the earth. To get around this, he suggests the addition of a general-purpose whole-number computing section, with both sharing a common memory storage. The general-purpose section would accept earth-transmitted position information and substitute it in the storage for the last vehicle-borne computer calculated position, while the digital differential analyzer goes on with its incremental computations using the new initial conditions.

Perhaps the most difficult part of the mission, from the standpoint of guidance and control, is the inter-orbital transfer phase. To move outward from earth's orbit into that of Mars, the vehicle must accelerate, increasing its angular velocity relative to the sun. When the vehicle arrives in the Mars orbit, its velocity vector must be oriented perpendicular to a line connecting the vehicle with the sun, and its velocity must match that of Mars in its orbit around the sun.

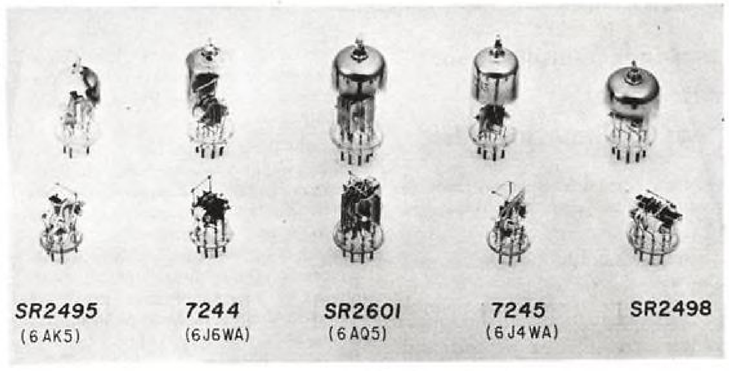
To simplify computer calculations, O'Donnell suggests that ion thrust initially be applied in a direction perpendicular to a line connecting the vehicle and the sun. When the computer determines that the vehicle's angular momentum matches that of Mars (Point 2), the direction of thrust will be redirected toward the sun.

O'Donnell points out that the problem involves careful timing in order to intercept the target planet and is further complicated by the fact that the Mars orbit around the sun is not perfectly circular, nor does it lie in the same plane as that of the earth.

A combination celestial-inertial navigation system is suggested for establishing vehicle attitude and position during the inter-orbital transfer phase of the mission. A gyro-stabilized platform, mounting three accelerometers, would serve as a mount or reference for two or more optical star-planet trackers.

One optical tracker, sighted on the sun, would be used to establish the direction of the sun radius vector—corresponding to the solar system vertical—while two optical sights on distant stars could then be used to establish vehicle position. Radio or stadiametric ranging would be needed to determine vehicle's distance from sun.

Angular measurement of the lines of sight of the optical trackers must be made to an accuracy of a fraction of a minute of arc if any error in vehicle



Rugged Stacked Tubes

Stacked ceramic tubes in glass envelopes, with novel construction that gives greater rigidity under vibration and far less microphonics, are now available in two types with several additional types slated later this fall and next spring. Stacked tube exhibits average of only 1 millivolt microphonic when excited with 2½G at 25 cps, compared to 25 to 200 mv. of conventional tube, Sylvania says. Company says stacked tubes have survived several hundred hours of fatigue testing at 15G. Currently available are types 7244, dual triode counterpart of the 6J6WA and 7245, single triode counterpart of 6J4WA. Type SR-2601, beam power amplifier similar to 6AQ5 will be available this fall and low and high-mu double triodes are slated to be available next spring, equivalent to types 6111 and 6112. Sylvania also is working on SR-2495, and RF pentode similar to 6AK5. For specifications, write Sylvania Radio Tube Division, Emporium, Pa.

position determination is to be kept within a few thousand miles at the time that its thrust direction is altered.

Computing accuracy of the order of one part in 100,000 is required during this phase, corresponding to approximately 17 binary bits, although another order of accuracy, corresponding to 20 bits, may be desirable.

For terminal guidance of the vehicle, O'Donnell suggests the use of an optical scanner to match vehicle velocity with that of Mars so that the closing speed is less than escape velocity. Since the approximate diameter of Mars is known, stadiametric ranging can be used to determine distance to the planet and from this the computer can obtain the first derivative—closing velocity. A suitable scanning arrangement will be incorporated to enable the optical device to establish direction to the center of Mars in order that the computer can generate steering signals. Computer will determine what change in ion propulsion thrust magnitude and direction are required to bring the vehicle into orbit around Mars at the desired altitude.

Return trip to earth is essentially a reversal of the first half of the mission, and therefore will require no new computational provisions or procedures, except for vehicle recovery. However, here it will be possible to utilize earth-based guidance and control to assist in re-entry.

Operation of a space vehicle computer in a vacuum offers both advantages and disadvantages, O'Donnell points out. There should be no problems with moisture condensate on circuit boards and connections, and a cracked seal in a vacuum tube would only serve to improve its internal evacuation. However, liquid-filled capacitors which can continue to operate for some time in air despite an imperfect seal might deteriorate much faster if operating in a vacuum.

Magnetic memory drums, which employ read-write heads that are floated on air bearings, would have to be pressurized in order to operate in the space environment. Rotating or moving devices that require lubrication will face the problem that the lubricant evaporates faster under vacuum conditions. This suggests that portions, perhaps all of the computer, might be located in pressurized crew quarters.

Problem of radiation, both from cosmic sources and from the nuclear power plant which the vehicle probably will employ, may force designers to use tubes and magnetic devices instead of transistors in the computer. With proper techniques this may not be as great a handicap as it first appears for the digital differential analyzer which can achieve high computation rates using magnetic devices.

FILTER CENTER

▶ **Defense Electronics Spending Up**—Defense Department electronics procurement for Fiscal 1958 is estimated at $4.05 billion, an increase of approximately 15% over previous year's $3.50 billion, according to Electronic Industries Assn. EIA's estimates are based on fixed rule-of-thumb percentages applied to total Defense Department procurement for aircraft, missiles.

▶ **Sputnik III Tracked by Infrared**—Aerojet-General reports that it has successfully tracked Sputnik III over southern California using its Model S8 infrared tracker mounted on a Navy gun mount. Purpose of the experiment was to obtain radiation characteristics of the Russian satellite, possibly for design of infrared trackers for Advanced Research Projects Agency's passive satellite tracking network.

▶ **Satellite Tracker**—Cubic Corp., San Diego, reports that its COTAR (Correlation Tracking and Ranging) system and its SECOR (Sequential Collation of Range) system were able to track Navy's unsuccessful May 27 Vanguard from launch through apogee to pre-

dicted point of impact, using single island site in British West Indies instead of a chain of tracking stations as previously required. Cubic's COTAR-SECOR system, used earlier on Army's Explorer III, was first to report the satellite in orbit, company says.

► **No-Wearing Bearing**—Gas-bearing for use in inertial guidance systems gyros has been spinning continuously for six years without failure at North American Aviation's Autonetics Division, company reports. North American's Autonetics Division, Ford Instrument and Army Redstone Arsenal are among the proponents of hydrodynamic (gas, air) bearing gyros.

► **When in Rome**—Rome Air Force Depot, which is responsible for procurement, distribution and maintenance of USAF ground-based avionics equipment, has installed new Remington Rand Univac File-Computer for use in processing huge volume of statistical and record data involved in carrying out its responsibilities.

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

• **Farnsworth Electronics Co.,** subcontract from Sylvania Electric for design of automatic test equipment for checking out electronic countermeasures equipment for Convair B-58 Hustler.

• **Marconi's Wireless Telegraph Co. Ltd.,** Great Britain, reports order from Norwegian Ministry of Defense for powerful long-range radars. Order is for approximately $2.8 million.

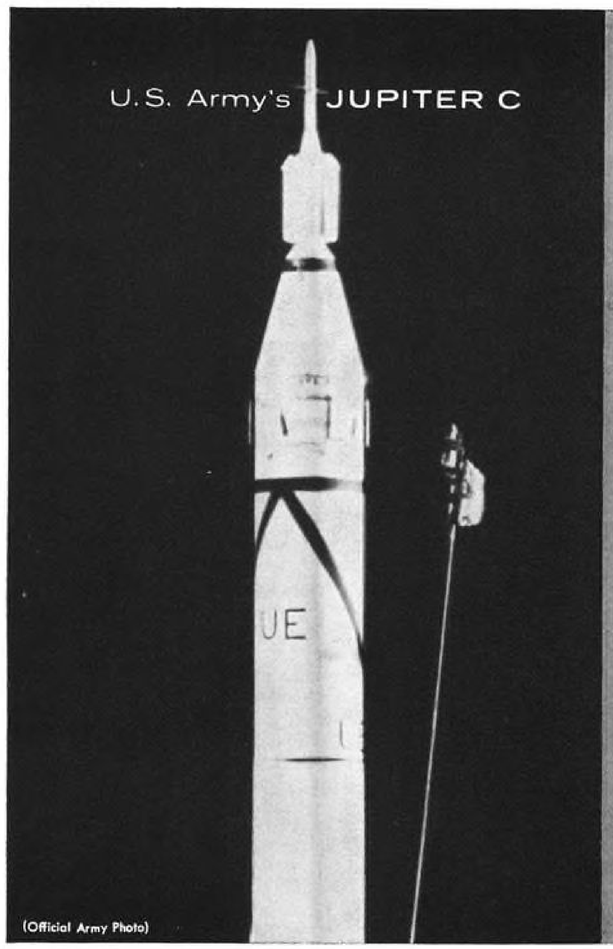
• **Servomechanisms, Inc.,** Hawthorne, Calif., reports additional funding of $101,000 from Douglas Aircraft for continued research in high temperature materials as part of Douglas-Navy instrumentation program.

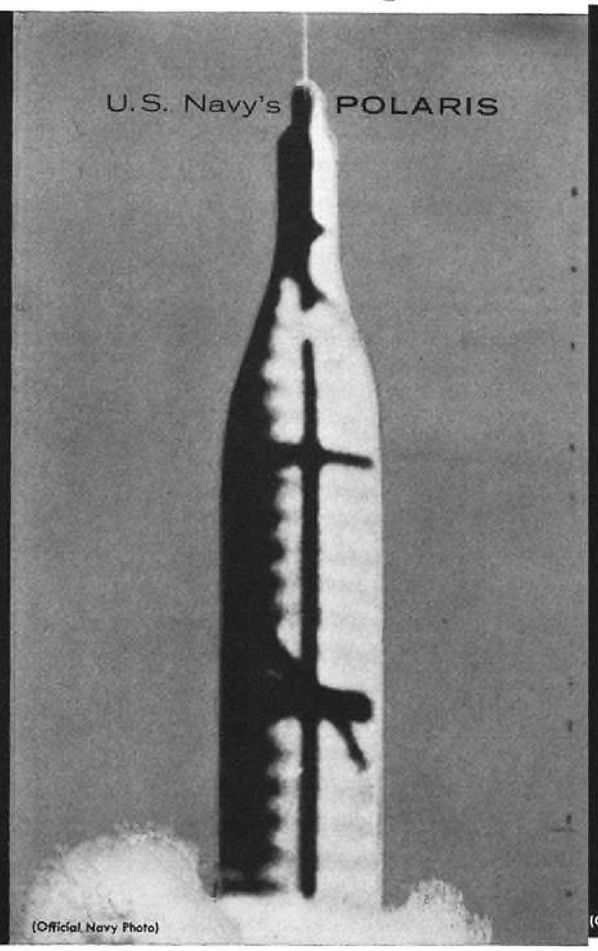
• **Detroit Controls Division,** American-Standard Co., government contracts totaling more than $4½ million for navigational systems for use in Polaris- and Regulus-carrying submarines and gyro devices for use in Convair F-106A.

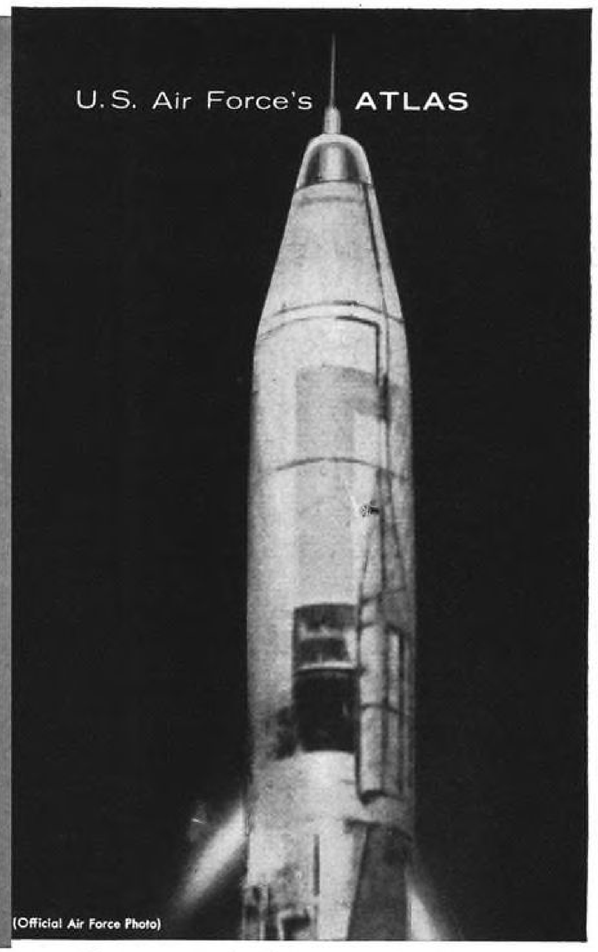
• **Olympic Radio & TV Division,** the Siegler Corp., $350,000 from Rome Air Development Center to develop AN/TPQ-11 ground-based radar. New radar, operating at 35 kmc., will provide continuous indication and record of height and density of cloud layers for instrument approach use. Radar is based on experimental work performed by Cambridge Research Center.

• **Ryan Aeronautical Co.,** $1 million letter contract from Army Signal Supply Agency, for production of Ranav Model 120A integrated automatic Doppler navigator and flight control system, for use on Army fixed-wing aircraft and helicopters.

Republic is the world's largest producer of Missile Metals







Many types of missile metals are required to meet the severe demands of the space age. Metals to resist heat, to reduce weight, to add strength. Production of these flight weight metals is a Republic specialty.

Stainless steel protects missiles and rockets from the searing heat of air friction. Titanium alloys offer the highest strength-to-weight ratio of any construction metal. Republic produces both of these metals in billets, hot rolled and cold finished bars, plates, sheets, and strips.

Republic Alloy Steels are continuing to play a prominent part in the development of operating and structural parts free from excess weight, yet tough and strong to withstand shock, impact, strain, and vibration.

As rapid development in the missile field increases demand for these high-strength, select formula steels, Republic is keeping pace through research and new production facilities.

Republic metallurgists and engineers will be glad to work with your personnel in developing the most advantageous use of Republic Stainless Steels, Titanium and Alloy Steels. There's no obligation. Check and mail the coupon if you would like a Republic specialist to call at your plant.

REPUBLIC'S NEW HIGH STRENGTH POWDER, TYPE 6460, opens the way for sinterings for highly stressed parts in aircraft and missiles. Type 6460 can be used with existing operating equipment. It provides a minimum tensile strength of 60,000 psi at 6.4 density as sintered, and 100,000 psi heat treated. Type 6460 maintains its dimensional characteristics after sintering—less than .004 inches per inch shrinkage from die size at 6.4 density. Available in production quantities up to and including 12 tons, or multiples thereof. Mail coupon for technical data sheet on Type 6460 Powder.

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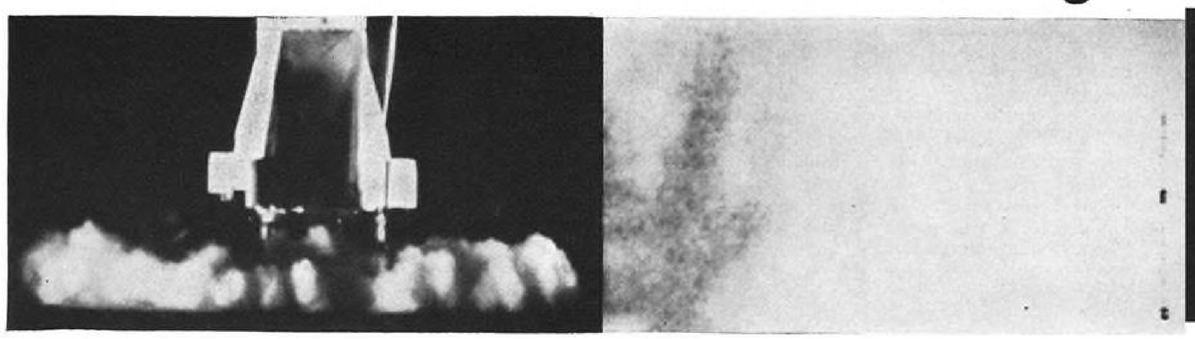

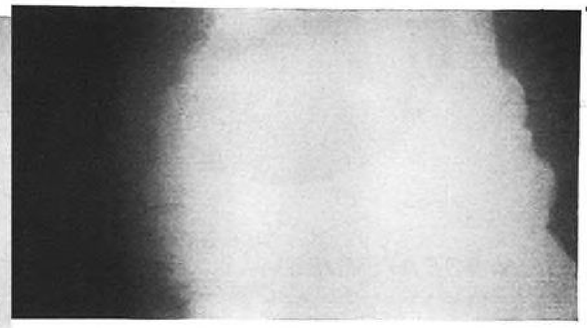

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ILS Antenna May Allow Lower Approach

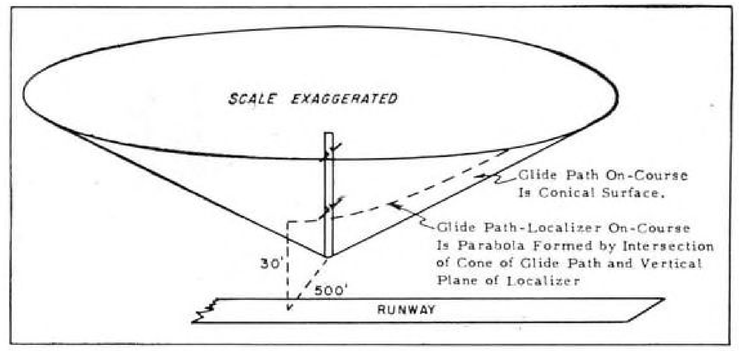
By Richard H. McFarland

(Mr. McFarland is a scientist associated with the Ohio State University Antenna Laboratory).

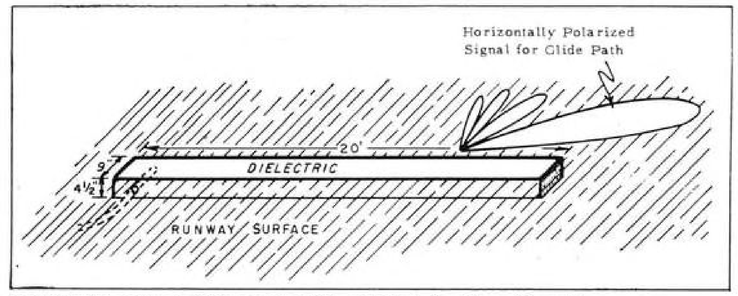
An instrument landing system glide slope antenna which may permit use of glide slope beam for instrument approaches to lower altitudes, possibly even touchdown, has been developed by Ohio State University Antenna Laboratory under Civil Aeronautics Administration sponsorship.

New glide slope antenna, which will undergo CAA evaluation tests soon, can be flush-mounted in the airport runway, whereas the present antenna is mounted atop a 25-ft. high structure which must be located to one side of the runway.

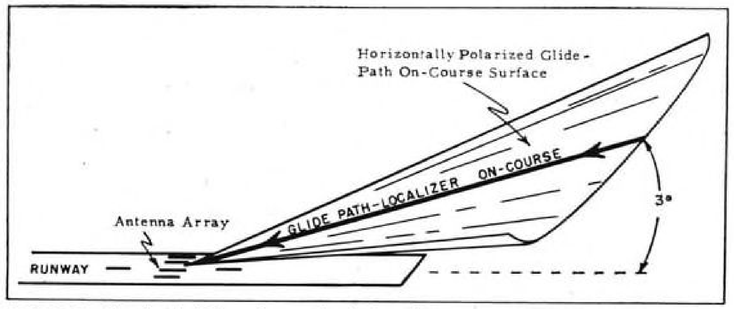
Although the radiation provided by existing antenna results in a glide slope path which by itself is a conical surface that extends down to the ground, the combination of glide slope and localizer on-course flight paths is a parabolic-shaped pattern which opens upward with its vertex about 30 ft. off the runway, because of the off-set location of the proposed glide slope antenna. (See top fig.)



GLIDE path of presently used null-reference system; on-course signal is conical surface.



PROTOTYPE antenna utilizes horizontally polarized signal for glide path.



PROPOSED directional glide path array has 3 deg. glide angle on final approach.

Lower Vertex

There have been previous attempts to lower the vertex of this parabola by using "modifier antennas," but these did not provide acceptable results.

Another problem exists at airports where there is rough, non-level terrain in the approach area ahead of the runway. Ground reflections from these irregularities can produce distortions of the glide slope beam at lower altitudes.

Engineers at CAA's Technical Development Center, under L. N. Spinner, achieved improvement in the low-altitude converge by means of a Yagi antenna installed about three feet above the ground. However, this still required antenna to be offset-located from the runway which resulted in undesirable close-in path structure of the glide slope.

Flush Mounting

In 1957, Technical Development Center asked Ohio State's Antenna Laboratory to investigate possibility of an antenna which could be flush-mounted in the runway itself to eliminate all these former and bothersome difficulties.

Out of this work has come a traveling wave type antenna that produces approximately endfire radiation. It consists basically of a trough in the runway, approximately 20 ft. long 9 in. wide and 4 in. deep which is filled with a dielectric material and covered with a radome material for protection. Glide slope transmitter energy is fed into the trough by means of a probe located near one end.

Radiation produced by the antenna depends upon the depth of the trough. To achieve the desired goal of maximum radiation at low elevation angle, and a minimum at higher angles, the exact cavity depth is selected to produce a ratio of approximately one between the speed of light and the phase velocity in the trough.

At least two such trough antennas are required to produce the new directional glide slope beam.

If broader azimuth beam coverage is desired, an array of four, six or more additional trough antennas are installed.

Existing airborne glide slope receivers require no modification for use of new directional glide slope beam. When airplane is on prescribed flight path, equal quantities of 90 and 150 cps. signal are received, while 90 cps. (or 150 cps.) signal will predominate if airplane is above (or below) desired path.

Basic array of two trough antennas was test-flown earlier this year by CAA engineers with very good results. Further flight evaluation is planned, using larger arrays to produce broader glide slope beam.

ROLLS-ROYCE DEVELOPMENTS

Thrust Reversers For Turbo Jets

Rolls-Royce have been developing thrust reversers for turbo jet engines since 1954, and are producing reversers for the Avon engines of the de Havilland Comet 4. Similar units are being tested for the Conway engines of the Boeing 707-420.

Units designed for the Avon have accumulated more than 1,600 hours running time, including 150 hours in the reverse thrust position, and over 4,500 reversal cycles have been completed on the test bed, in a specially modified Hawker Hunter and in the Comet 3.

A reverse thrust equal to 50% of the forward thrust of the engine is achieved with these units. The stopping power of this, on the Comet, is approximately equal to that of the aircraft brakes in favourable conditions. The performance loss arising from the thrust reverser is three-quarters of one per cent of engine thrust at take-off.

—another technical advance in

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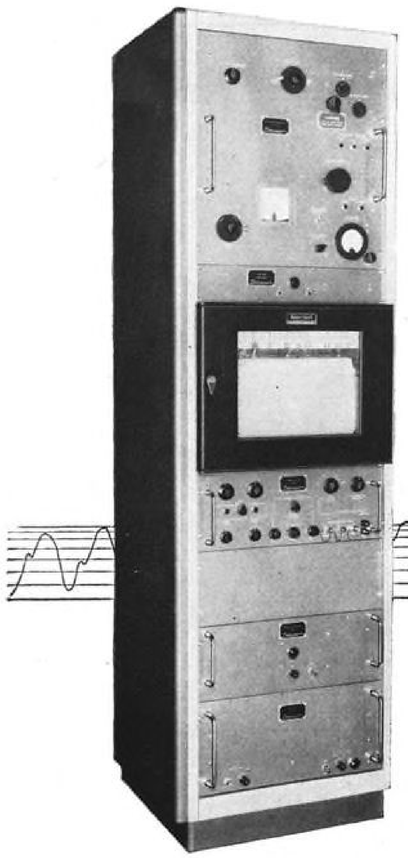

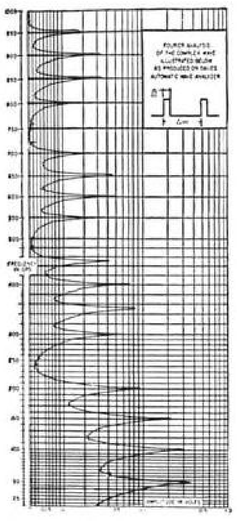

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Automatic high-speed frequency analysis of taped data . . . permanently charted

Do you have the problem of analyzing quantities of data from vibration, noise, shock or flutter analysis of vehicles, aircraft, missiles or ships? . . . or seismic recordings, powerline disturbances, or other phenomena characterized by fluctuating data? Preserve test results with a Honeywell Universal Magnetic Tape System. Then, feed this recorded information to a Honeywell Automatic Wave Analyzer, flip the switch, and a complete Fourier series is automatically plotted and printed in permanent record form.

Honeywell Automatic Wave Analyzers can accurately plot these data as either amplitude-versus-frequency or power-versus-frequency. Honeywell Analyzers are also equipped with a "quick-look" facility. Series 9020 provides a quick analysis across its frequency range of 3 to 2,000 cps in only 15 minutes. Series 9050 will span 3 to 10,000 cps in just 15 minutes. Higher frequency data can be analyzed by reducing tape playback speed. Linear or square law output, as desired, is recorded by a Brown *ElectroniK* Potentiometer.

Multi-channel inputs permit analysis of as many as six channels simultaneously. By adding the Honeywell Input Switching Panel, a serial analysis of up to 14 channels can be made.

The Honeywell Automatic Wave Analyzer can process data in as little as 3% of the time required by digital methods, thus permitting the analysis of large samples, resulting in statistically reliable information.

For more information on the Automatic Wave Analyzer, as well as on record and playback systems, call your nearby Honeywell field engineer . . . he's as close as your 'phone. MINNEAPOLIS-HONEYWELL, 10721 Hanna Street, Beltsville, Maryland.

Honeywell

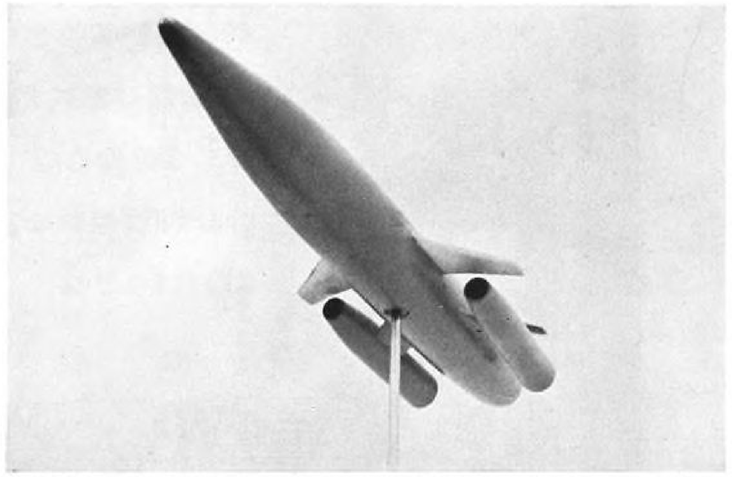
First in Control

Pyrophoric Fuel Ramjet Drone Designed

By Michael Yaffee

Hasbrouck Heights, N. J.—Dynex, Inc., a research and development firm here, is undertaking development of a relatively inexpensive ramjet target missile designed to have a Mach 3 capability at 90,000 ft. To get the combination of high speed and low cost, company engineers are counting on lightweight pyrophoric-fueled powerplants now under development by leading ramjet manufacturers (AW Sept. 22, p. 23).

Company's recent proposal to the military calls for the fabrication of two prototype vehicles: one high altitude model and one low altitude model. In production, each vehicle would cost only $15,000 and would have both high and low altitude capability through use of two different but interchangeable wing configurations.



RAMJET drone by Dynex Inc. will use pyrophoric fuel to reach Mach 3 at 90,000 ft.

Drone Design

As currently planned, the Dynex drone will be 12 ft. long and will have an all-up weight of 766 lb. Body will be made of glass fiber, fins and stabilizer of magnesium and ramjet engines will be fabricated from aluminum and Hastelloy.

In addition to two side-mounted ramjets, the drone will have an internal rocket engine to get it off the ground. Configuration will somewhat resemble that of a small Boeing Bomarc.

The target missile will be launched at a 58 deg. angle from a zero length launcher. Nitrogen at 5,000 psi., which will be stored in a spherical container midway between the fuel and oxidizer tanks, will be used to pressurize the fuel. At takeoff the fuel, probably triethyl aluminum or triethyl boron, will be injected into both the rocket and ramjet engines. The oxidizer, probably liquid oxygen, will be located in the rear, just forward of the rocket combustion chamber, and will be used as an adjunct to pitch control. As the oxidizer is consumed, the drone's center of gravity will shift forward and vehicle will tend to level. Once the oxidizer is gone, fuel flow to the rocket chamber will be cut off and the drone will fly on its ramjets alone. Control will be by command radar.

There are many advantages to the use of pyrophoric fuels, says James Burnett, vice president of Dynex. Spontaneously flammable in air, they require only a rudimentary and lightweight flameholder in a ramjet engine. Because they burn more completely in a shorter distance, there is no need for long, heavy engines. Wall thickness can be shaved as a result of smoother burning and lower resonance.

(On March 24, p. 19, Aviation Week reported the following figures for a pyrophoric ramjet engine designed by Curtiss-Wright Corp. for high altitude work: length, 24 in.; diameter, 7½ in.; weight, 18 lb.; speed, Mach 1.5.)

Pyrophoric Fuels

Pyrophoric fuels will burn smoothly at 300F, says Burnett, while JP-type hydrocarbons have no combustion stability below 500F. Each drop of pyrophoric fuel, in effect, carries its own igniter. Started into a ramjet engine at takeoff, it will keep sparking until it reaches 300F. As a result, a pyrophoric-fueled ramjet engine will provide positive acceleration very quickly after ignition.

Among other things, this means that rocket power is needed for only a brief period, probably no more than 55 sec. For this, it is possible to go to a lightweight, uncooled rocket engine. Also, Burnett plans to use the same fuel for both the rocket and ramjet engines and thereby save the weight of an additional fuel tank. Considering over-all vehicle performance and weight, he believes he can get better than a 4-to-1 advantage over a conventional ramjet vehicle on thrust-to-weight.

On the other hand, pyrophoric fuels have some serious drawbacks. They are expensive to make and production is limited. They are difficult and dangerous to handle. They are highly toxic and their flammability, which is considered an asset, can also be a heavy handling liability.

But Burnett considers these drawbacks highly overrated. Production will increase and prices can be expected to drop as demand increases. Too, lower vehicle cost and improved performance, he believes, more than balance out higher fuel cost. And as far as handling goes, he points out, a person would be breathing fire before he could ingest any toxic vapors. Moreover, the fuels can be prepackaged, a characteristic which should prove valuable.

On Right Track

Others in the field feel that Burnett may be overly eager but that basically he is on the right track. They prefer to emphasize the simplicity and reliability of ramjet engines designed to use pyrophoric fuels and to go easy, at least for the time being, on the possibility of making large savings in weight and cost.

Among others, Callery Chemical Co., Koppers Co, Inc., Olin Mathieson Chemical Corp., Allison Division of General Motors, Wright Aeronautical Division of Curtiss-Wright and Marquardt Aircraft Co. are working on pyrophoric fuels and engines that will use them.

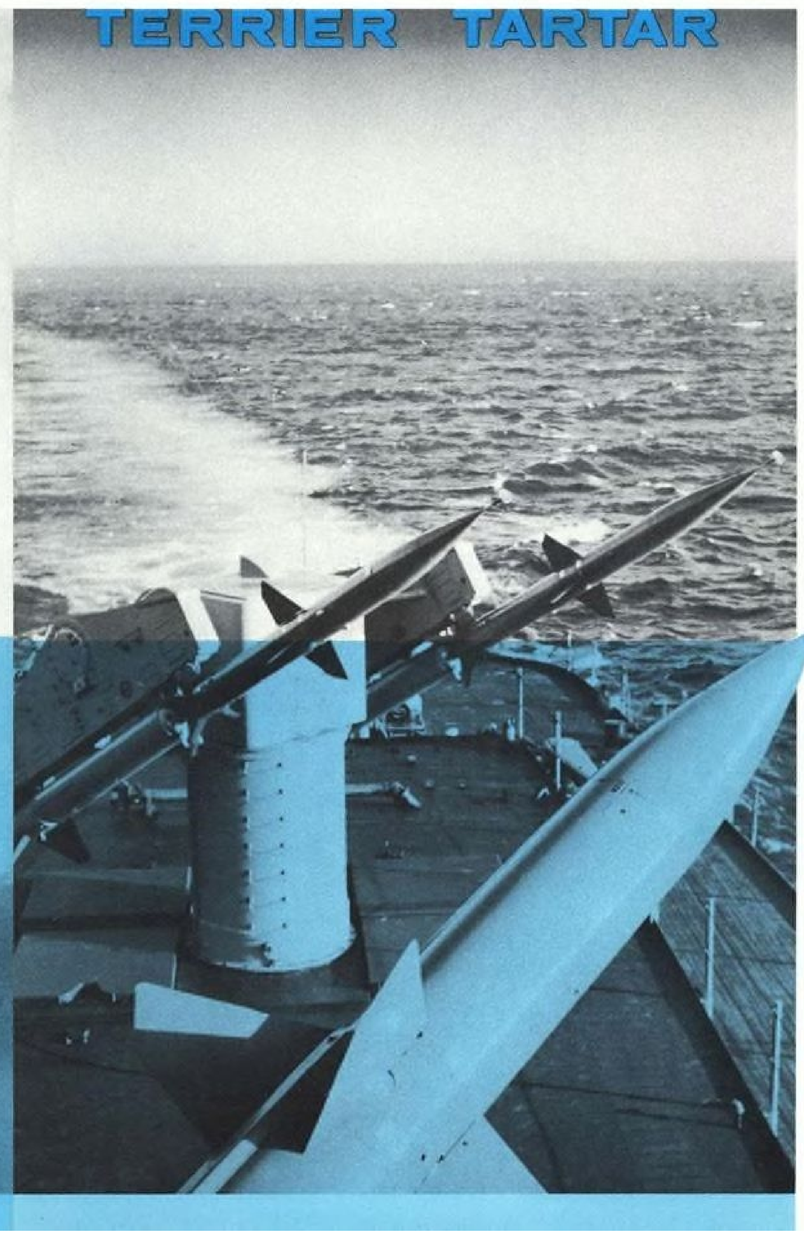
Much of the work and many of the results are classified. But by and large the results are admittedly promising and the pyrophoric program appears to be picking up momentum.

FORD INSTRUMENT missile experience...

includes systems, subsystems and components for many of our country's most advanced missiles

Ford Instrument Co. is currently engaged in research, development, and production on a wide variety of missile projects. Notable among these are the complete inertial guidance and control systems for the Army REDSTONE and JUPITER missiles; many such components for the satellite-launching JUPITER C; launching and control order computers for the Navy's TERRIER and TARTAR missiles; Air Force missile projects, including a no-gimbal inertial system; and a wide variety of ground support and production test equipment.

Today, Ford Instrument has the experience, facilities, and capabilities to enable it to undertake complex missile contracts of every type from component or subsystem to complete weapons system. And, as a Division of Sperry Rand Corporation, Ford Instrument's own weapons skills are backed up by the resources of a vast and diversified organization of complete technical and financial responsibility.



TERRIER Missiles on U.S.S. Boston. Ford Instrument-built computers solve launching and control order problems for this beam-riding missile. U. S. Navy Photo.

U. S. Army JUPITER (left) and REDSTONE Missiles. Cover shows satellite-launching JUPITER C. The guidance and control systems for these ABMA missiles were developed and produced by the scientific team at the U. S. Army Ballistic Missile Agency and Ford Instrument Co. U. S. Army Photos.

More than four decades of military systems engineering insure operational equipment... whether systems, subsystems or components

FORD INSTRUMENT

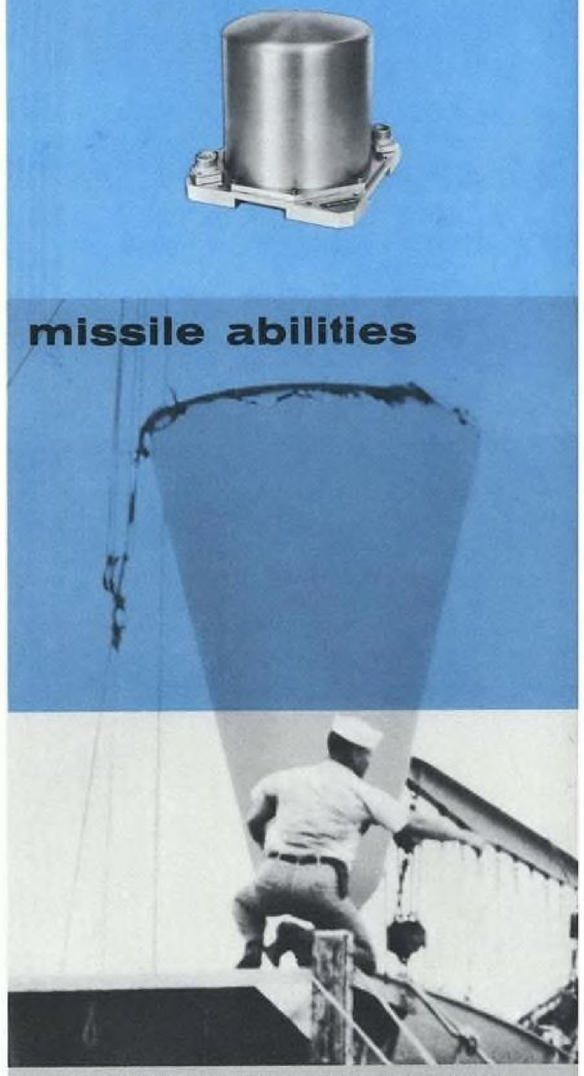
A unique combination of electronic, electrical and mechanical skills, devoted since 1915 almost exclusively to furtherance of military science, is the basic strength of Ford Instrument Co. Almost all of Ford Instrument's existence has been devoted to research, development and production of highly complex equipment, with laboratory precision and accuracy, yet able to withstand the rigors of military environments.

The proven reliability and extreme accuracy of the REDSTONE and JUPITER missiles, which employ guidance and control systems built by Ford Instrument—as well as the record of the JUPITER C—indicate clearly the company's capabilities in the area of guidance and control.

Another recent example of this type of work is Ford Instrument's design and manufacture of intricate warhead safety, fuzing and arming devices capable of withstanding the roughest environments. Few manufacturers are willing or able to undertake projects such as this and to carry them to completion. Ford Instrument has earned the reputation—which we are proud to acknowledge—of being able to do the "toughest jobs" in missile development and manufacture.

Contracting agencies or industries, with requisite security clearance and "need to know," are invited to examine further Ford Instrument abilities in difficult phases of missile research, development and production . . . whether for complete systems or specialized subsystems and components.

missile abilities



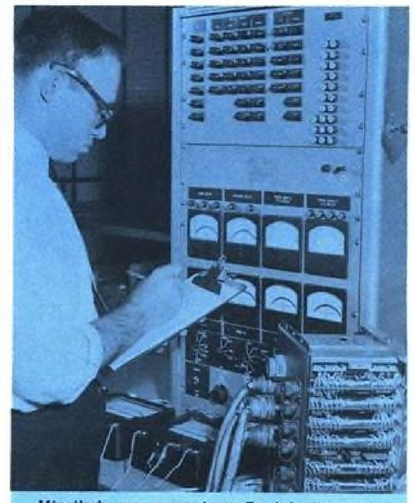
Warhead devices for missiles and other modern weapons. This precision warhead device (inset) made by Ford Instrument, successfully withstood atmospheric re-entry in the nose-cone of an Army JUPITER missile, shown here shortly after recovery from ocean.

Stable platforms. Technicians here are performing test operations on a stable platform for the U. S. Army JUPITER Missile; these platforms are in quantity production at Ford Instrument.

Launching and control order computers for TARTAR Missiles. Electronic and electromechanical portions of this all-transistorized modular computer are shown at left and right.

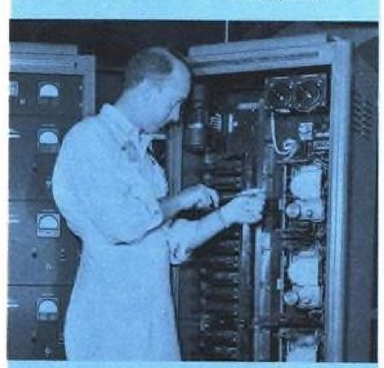
Actuators for jet vanes, air control-surfaces. This rotary actuator is driven by 1 hp d-c servo motor (shown in foreground with cable attached). Both motor and actuator are made by Ford Instrument.

Missile-borne inverter. Vital missile component gets rigorous, precision performance checkout at console. All of the missile products delivered by Ford Instrument undergo full and complete testing procedures.



Missile-borne computers. Ford Instrument computer experience covers every phase of ballistic missile guidance and control. Typical is this control computer, shown during test, for U. S. Army JUPITER.

Specialized gyros and accelerometers. Ford Instrument pioneered in the quantity production of air-bearing gyroscopes and accelerometers. Air-bearing gyro here undergoes final test in special Ford-built test equipment.



Ground support equipment. Here pre-launch computer undergoes final adjustment. Modular techniques enabled this unit to be produced and delivered in less than 6 months.

current missile projects and equipment

SYSTEMS
- Inertial guidance and control systems and related ground support equipment
- No-gimbal pure integration inertial system
- Launching and control order computers
- Command guidance systems (for both missile and drone applications)
- Trajectory data system
- Missile velocity indicating system for test range applications
- Target locating system
- Radar target prediction and interpretation systems

SUBSYSTEMS (Missile-Borne)
- Safety, fuzing and arming devices
- Stable platforms
- Computers (control computers, guidance computers)
- Programming devices
- Inverter-regulators
- Transmitters

GROUND SUPPORT EQUIPMENT
Maintenance area, launch site and monitoring equipment, including:
- Impact prediction computer
- Aiming correction computer
- Pre-launch computers
- Test panels for computers and stable platforms
- Shipboard dynamic testers
- Monitor panels for guidance, stable platforms, alignment, and laying
- Test fixtures for a wide variety of components
- Combined sensor displays

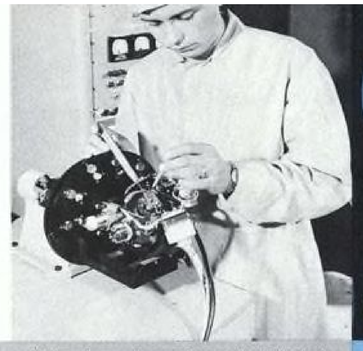
PRODUCTION TEST EQUIPMENT
Systems and component test equipment including:
- Special environmental test units
- Quantity production test units
- Planetary test stands

SPECIALIZED COMPONENTS
- Gyroscopes
- Accelerometers
- Actuators
- Mechanical integrators
- Transistorized amplifiers
- Relay packages
- Computer modules, both analog and digital, for a variety of missile problems
- Timing devices
- Shipping and storage containers

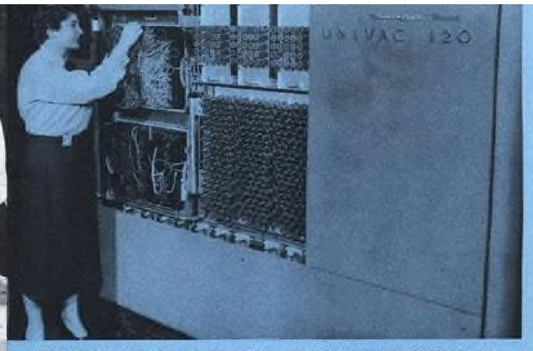
Drafting. One of Ford Instrument's many drafting departments, where topflight design draftsmen and technicians support research and development and also produce production drawings.

Technicians perform final checks on stable platforms for U. S. Army REDSTONE Missile in ultra-clean assembly area.

Missile-borne tape programmers being assembled. Continuous development in this field is under way at Ford.



Air-bearing gyro accelerometer is tested here in Ford designed and built special fixture.



"Univac" computer is one of the general-purpose high-speed digital computers at Ford Instrument for engineering computations.

FORD INSTRUMENT

Extensive production and laboratory equipment implement engineering skill

Ford Instrument physical facilities make it one of the largest high-precision shops in the United States, fully equipped to handle every phase of development and production of complex missile systems. Initial studies, research, development, design, prototype construction and testing, final quantity production and quality control are expedited and facilitated by the most modern and highly developed equipment available for precision work.

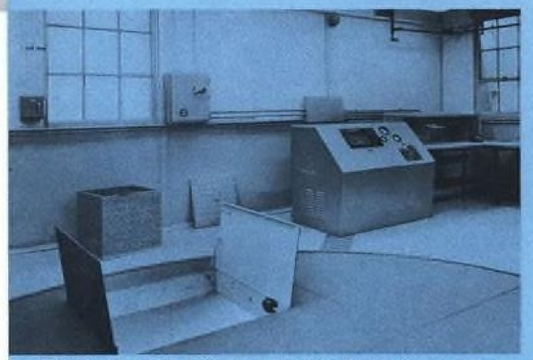
Contracting agencies and industries possessing requisite security clearance are invited to make an on-the-spot inspection of Ford Instrument facilities.

Equatorial test stand, built by Ford Instrument for its own laboratory facilities, is used for conducting basic drift error research. This type of unit can also be built to contractor order.

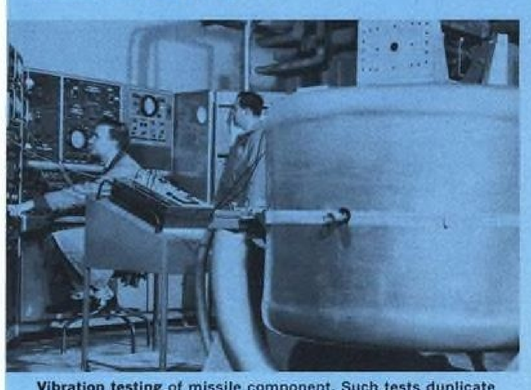
missile facilities

Typical of Ford Instrument Facilities:

- More than 30 laboratories for research, development and design in electronics, hydraulics, magnetics, mechanics and nucleonics, including fully equipped, ultra-clean gyro facilities.
- Advanced digital computing facilities with high-speed general purpose computers, including a Remington Rand "Univac." Ford Instrument scientists also have access to computing facilities of the Remington Rand Univac Division.
- An engineering shop, as large as many small manufacturing concerns, staffed by expert machinists and technicians, working under direct engineering supervision. The company also has fully staffed and equipped "short run" and prototype shops.
- Full production facilities—machine tools, shops, finishing and inspection facilities—for *large-scale* precision manufacture.
- A series of "clean rooms" for assembly of missile components. These rooms are dust-proof, temperature and humidity controlled areas with full environmental control procedures.
- Complete, elaborate environmental and other test facilities.

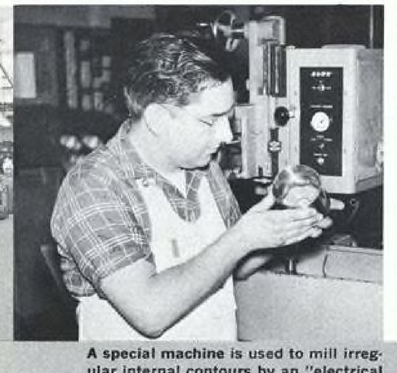


Giant centrifuge in special building at Ford Instrument can attain 60G's. Complete stable platforms—as well as components—are tested in this unit.



Vibration testing of missile component. Such tests duplicate inflight environments that components undergo when missiles are fired.

Many hundred standard machine tools, a few of which are shown here, are available at Ford Instrument for missile applications, as well as a wide variety of special machine tools.



A special machine is used to mill irregular internal contours by an "electrical discharge" method, with extreme dimensional accuracy.

Technician grinds gyro part to a length within 20 millionths of an inch—typical of tolerances being met in missile work at Ford Instrument.

Engineering Shop. This shop makes breadboard models and other experimental products. It has much specialized equipment, e.g., toroidal coil winders, lapping equipment, in addition to standard machine tools.

Lockheed Pushes for NATO F-104 Sales

By Richard Sweeney

Burbank, Calif.—Driving to sell its F-104 Starfighter to NATO and SEATO governments, Lockheed Aircraft Corp. has built its sales campaign around the aircraft's high performance, combined with economical maintainability.

The company stresses that the F-104, current holder of world speed and altitude records, is a "little" airplane with attendant lower initial and operational costs, which has better performance than currently operational types and equal to aircraft being developed.

With the F-104A operational using a General Electric J79-3 turbojet engine, two-place F-104B coming into service using a J79-7 engine, an updated single place C model also using a J79-7 powerplant and a later two-place D model also coming along, Lockheed feels it has a good backlog of experience with the airplane. Also, as more airplanes are built, the company is further down the learning curve, resulting in lower costs.

USAF Funding

Lockheed cites the fact that the company has accomplished $80 million worth of USAF-funded flight testing and that USAF conducted additional testing, yielding the most thoroughly tested aircraft ever to enter the service of the U. S. Air Force. Working from this base, Lockheed is developing another F-104 which aims to be the best airplane of its class operational in 1960, target date for operational capability of prospective F-104 customers. It will be a multi-mission aircraft which will have new fire control and other systems and yet retain the airplane's present economy.

Lockheed has developed a combat philosophy around the F-104, keyed to defining aircraft performance in terms of acceleration ability to catch the target and get into position to deliver the weapon. The company has matched roles the F-104 can play to its basic philosophy outline.

Implicit in basic requirements for 1960 and Europe and Asia is its all-weather capability, an inherent part of the multi-mission concept.

Philosophy the company has evolved makes use of two sets of requirements, functional and environmental, prevailing in the operational year. Functional requirements are under three primary categories, each with subsidiary aspects:

- **Cold war,** which calls for (1) air surveillance; (2) investigation; (3) reconnaissance; (4) probing.
- **Hot limited war,** which calls for (1) interception; (2) tactical air (attrition, air superiority, interdiction, close support); (3) reconnaissance.
- **All-out war effort,** which calls for (1) retaliation; (2) and mobile forces.

Environmental requirements in the concept are labeled:

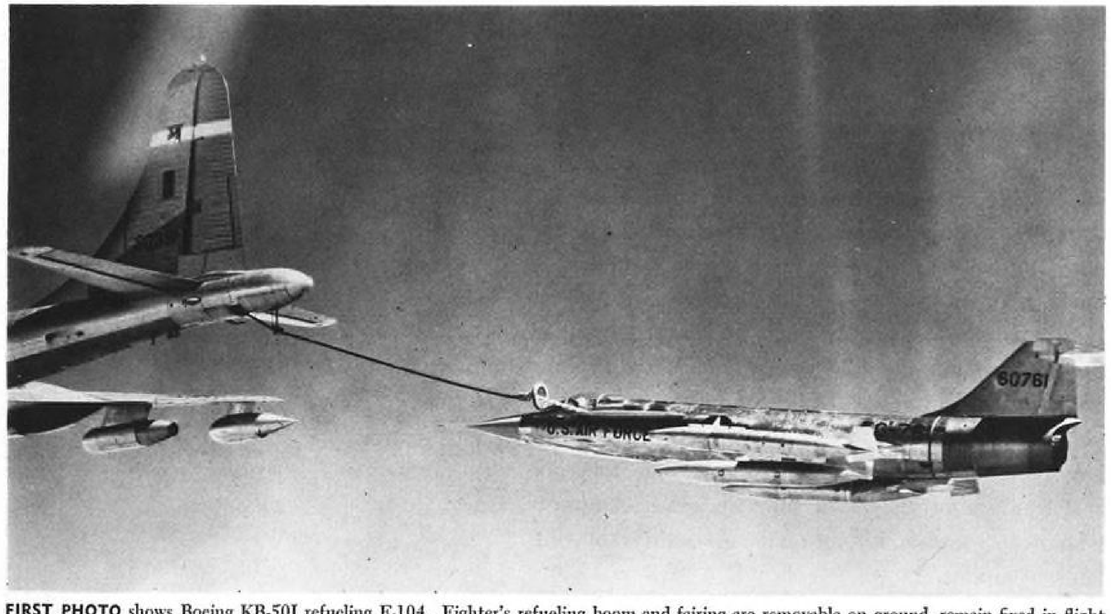
- **Economics.**
- **Weather.**
- **Distance.**
- **Runways.**
- **Countermeasures.**
- **Ground control.**
- **Terrain.**

Lockheed foresees the 1960 F-104 as meeting nine of the functional requirements, leaving out only the air surveillance of the cold war, which is accomplished by ground radar, close support portion of tactical air in hot limited war, mobile forces in the all out world conflict.

Acquisition of Equipment

Additional considerations Lockheed feels play a part in acquisition of defense equipment by any nation is a feeling of confidence—that it is buying the best equipment available. And although cost of some weapon systems is higher than others, combinations of governments such as NATO can acquire more and better weapons than one alone.

Lockheed says that with the F-104, it is giving prospective customers the confidence they are buying the best available, that they are buying a weapon which can be an effective deterrent in keeping a cold war, and if attacked, a



FIRST PHOTO shows Boeing KB-50J refueling F-104. Fighter's refueling boom and fairing are removable on ground, remain fixed in flight —boom is not retractable. F-104's external stores can be either fully or partially filled. F-104 can also refuel from outboard refueling pod on KB-50J. For very long range missions, F-104 could carry full external fuel stores and belly-mounted high yield weapon and could utilize air refueling by taking off with external tanks nearly empty, replenish them to full fuel load once airborne, avoiding high gross weight takeoff.

Focalized Facilities

FOR MAJOR WEAPONS SYSTEMS

• RESEARCH • DEVELOPMENT

• MANAGEMENT

Providing a new systems approach that follows through from initial plan to final production, the Bendix Systems Division serves as the *focal point* for the twenty-five strategically located divisions that constitute the Bendix Aviation Corporation. The new building, designed for engineering and managing of major weapons systems, is adjacent to the Graduate Engineering School of the University of Michigan in Ann Arbor.

This structure and its additions will accommodate a staff of 1,000 including engineers and scientists who will explore new concepts in such fields as communications, guidance and control, infrared, data processing, aerodynamics and propulsion, radar, acoustics, and countermeasures.

Weapons systems now being developed by this Bendix division include air defense network improvements, global weather reconnaissance, special radar applications for detecting ballistic missiles and low-flying aircraft, underwater surveillance, mission and traffic control, and a supersonic aerial target system for testing operational capabilities of the latest weapons.

THE BENDIX SYSTEMS DIVISION PROVIDES

System Management
System Design
System Development
Technique Investigations
Feasibility Demonstrations
Operations Research

IN SUCH FIELDS AS

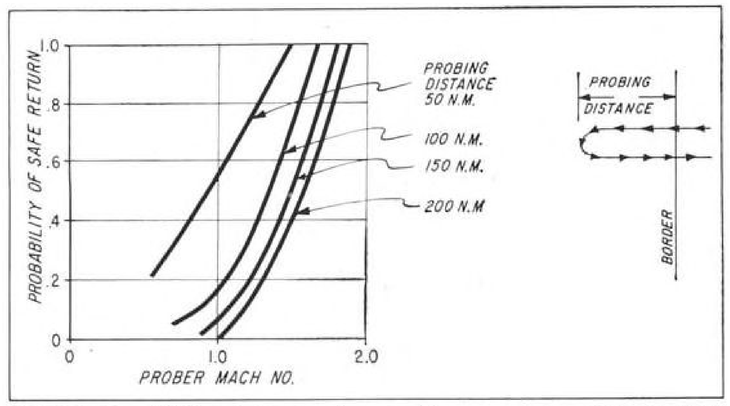
Data Processing and Display
Communications
Navigation
Guidance and Control
Radar
Infrared
Acoustics
Countermeasures
Aerodynamics and Propulsion
Support Systems

FOR PROGRAMS INVOLVING

Automatic Checkout
Computers
Data Links
Decoys
Digital Techniques
Displays
Electromagnetic Propagation
Electronic Warfare
Game Theory
Geophysical Instrumentation
Human Engineering
Hypersonic Flight
Inertial Guidance
Information Theory
Infrared
Magnetohydrodynamics
Meteorology
Missiles
Mission and Traffic Control
Nuclear Weapons
Radar
Radiation Effects
Radio Communications
Recorders
Satellites
Simulation
Space Technology
Target Drones
Underwater Acoustics

OPENING NEW DOORS to engineers and scientists who desire to engage in the development of advanced weapons systems with the opportunity of daytime classes at the University of Michigan.

Bendix **SYSTEMS DIVISION**
Aviation Corporation
Ann Arbor, Michigan



CURVES depict probability of safe return from a probing reconnaissance mission. Goal is to obtain as high a probability of return as possible by varying Mach numbers and distances.

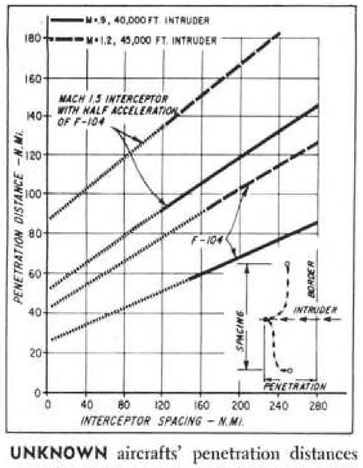
weapon which can play a large part in keeping a limited war limited, and help win it at the same time.

In the philosophy on cold war, the company sees air surveillance as a ground radar function which shifts to the F-104 when a contact is made.

A contact on ground radar calls for investigation, unless clearly identified by IFF as friendly, but as jet airliners with performance approximating that of high subsonic bombers become prevalent, investigations will be required frequently.

Here, the company indicates, the high performance and ability to accelerate to catch the target becomes imperative. Minimum time must be consumed in breaking off a routine subsonic cruise patrol to accelerate to required velocity to catch up with and identify the unknown aircraft.

A set of curves showing penetration distances of unknown aircraft, spacing of F-104 aircraft on patrol and their relationship, has been developed by Lockheed, against which are plotted



UNKNOWN aircrafts' penetration distances are related to spacing of F-104s on patrol.

penetration distances obtainable against fighters with less speed and acceleration.

One graphic point on the curve shows that with F-104s spaced 200 naut. mi. apart, an intruding Mach .9 airplane would penetrate 68 naut. mi. before the intercept (with first contact and call for the intercept when the intruder arrives at the border). Slower intercepting planes must be spaced much closer, requiring more airplanes, to hold the penetration distance to the same figure, Lockheed points out.

For cold war reconnaissance, airplanes must match the performance of any expected enemy interceptor to adequately patrol borders.

Aircraft Probing

Additionally, reconnaissance in a cold war often turns to probing, in which the aircraft is sent on a fast run over areas which it is to photograph. The F-104 can substitute cameras for this mission easily in the multi-mission version, with full performance retained.

In probing, the goal is to obtain as high a probability of return as possible at varying Mach numbers and distances of probing. Here again Lockheed has developed a set of curves with the probability of safe return plotted as a function of the intruder Mach number. Curves were plotted with a Mach 2 interceptor defense mounting one attack every three minutes, also assuming there was no firing involved or that missiles were jammed. An unsuccessful mission is predicted upon prober being forced down.

Lockheed says that having high speed and performance equal to or better than the expected opposition generates a feeling of confidence in pilots which counts heavily toward ensuring a successful mission.

In the case of a hot limited war, interception becomes the priority job. With the F-104, this can be accomplished with aircraft on routine patrols

and with the aircraft's high rate of acceleration from high subsonic patrol cruise to required intercept speed of Mach 2 plus.

Also, in cases such as in Germany, proper planning can turn training missions into combat patrols, since if two-place F-104s are used, they have full fighter capabilities along with the training function.

Tactical air phase of a limited hot war covers a number of aspects in which the F-104 has outstanding capabilities, the company points out.

In a battle of attrition, the goal is to strike the enemy in his aerial staging areas, at home air bases, and kill enemy bombers en route to, at, and returning home from the target, to ensure that although a successful raid has been staged this time, the bomber will not return.

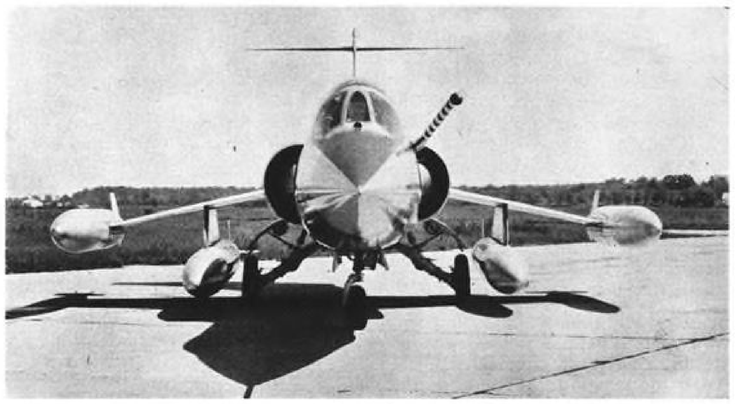
Airplane against airplane fights are not dead, jet age or not, Lockheed feels, pointing out that in Korea, jet fought jet despite high speeds, and this will be true again in a limited shooting war.

Interdiction will be required against enemy supply dumps and lines, against his troop and materiel staging areas Here, high performance counts in a swift strike and fast escape, both contributing heavily to successful mission, and the multi-mission F-104 can accomplish the fighter-bomber tasks.

Close support is not for the F-104, it is a job for airplanes such as the NATO strike fighter, an airplane designed to loiter around troop areas and be called in when and where required to apply firepower in support of ground soldiers.

For the reconnaissance phase of hot limited war, performance again counts —the mission is to speed in, photograph objectives or damage and get out as fast as possible. Another type of reconnaissance is to spot and assess enemy electronic countermeasures.

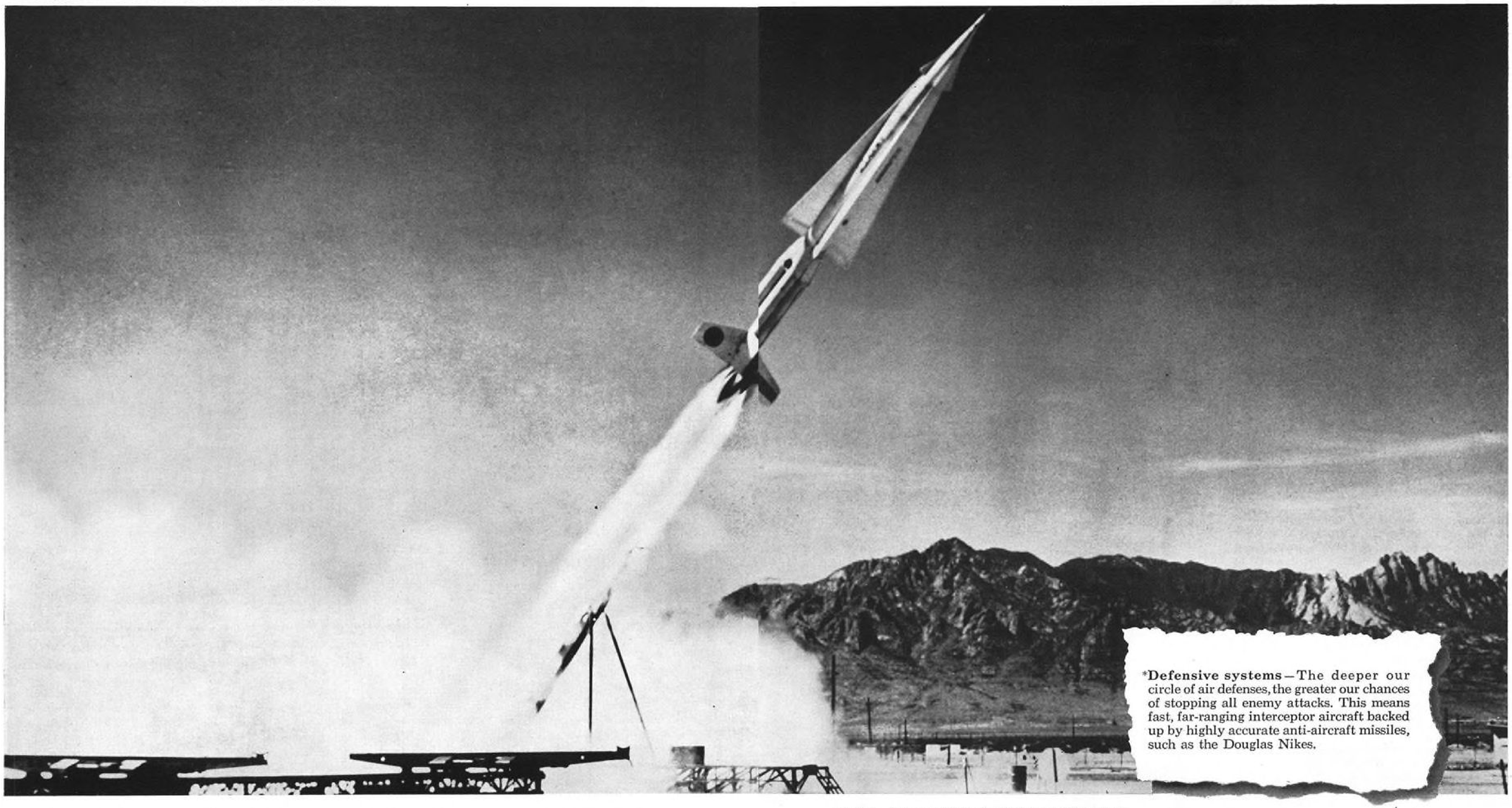
In the case of the all-out war, the goal is retaliation. And although exact performance of the F-104 still is classified, the company declares the airplane can carry a large (yield) bomb a long



F-104's standard external fuel stores are 195-gal. pylon tanks and 170-gal. wingtip tanks.

REFUELING probe can be removed when F-104 is used for short-range missions.

Modern defense in action:*



*Defensive systems—The deeper our circle of air defenses, the greater our chances of stopping all enemy attacks. This means fast, far-ranging interceptor aircraft backed up by highly accurate anti-aircraft missiles, such as the Douglas Nikes.

Nike Hercules missile blocks sneak attacks

Practice firing at White Sands Proving Ground of the Army's new medium-range Nike-Hercules interceptor missile

On guard at the outskirts of all major American cities and industrial centers, missiles of the Douglas Nike family are designed to intercept and destroy attacking aircraft—despite the most vigorous evasive action.

Nike-Ajax was the Army's first supersonic anti-aircraft missile. The basic design readily lends itself to new developments as anti-aircraft requirements change.

Nike-Ajax batteries are now being integrated with a newer Nike—the Hercules, developed through the joint cooperation of Douglas, Western Electric and Bell Telephone Laboratories. It has twice the range and speed of its predecessor. Armed with an atomic warhead, Nike-Hercules can blast entire attacking fleets of aircraft with a single shot—without damage to surrounding terrain.

Designed primarily for the inner line of our overall air defenses, Douglas Nike missiles are radar guided from ground installations. Within seconds of the first alert, they can be off towards their target—with deadly aim.

Depend on

DOUGLAS

The Armed Services' partner in defense

way, giving it a place in the retaliatory arsenal.

Troop mobility is another area where no single-place airplane figures.

Economic aspects of environmental requirements call for a single airplane to do as many jobs as possible with a big probability of success and safe return.

First, cost has several factors, such as developmental costs, plus government furnished equipment. At least $200 million has been spent in F-104 airframe development, with testing accounting for the $80 million noted earlier.

The F-104 airframe is light, a significant cost factor. Also, Lockheed declares, the airplane being offered prospective customers is one which the company foresees as being built under license in foreign countries without the advantage of heavy industry found in the U. S.

The fire control system, a GFE item on USAF F-104s, will be according to customer requirements.

For maintenance, the F-104 features "service centers" which offer access to the plane's various systems. Costs per flight hour, Lockheed claims, are down from those of other high performance airplanes.

Fire Control

The forthcoming F-104C uses an RCA ASG-14 fire control system, while for the 1960 airplane, Lockheed wants, and feels it will get from one of several prospective sources, as sophisticated a system as possible to perform the multimission role, which is consistent with desired initial costs and reliability.

Cost of starting a squadron of 25 airplanes is broken down by Lockheed this way—aircraft, 40%; training, flight and ground, 20%; base facilities, assuming a base already using high performance (F-86-class) aircraft, 14.4%; aircraft spares, 11.1%, and other miscellaneous items making up the remainder.

In annual costs, personnel pay and allowances account for 32% (maintenance man-hours are a large factor here); personnel replacement, 15.6%; aircraft attrition, 14.6%; aircraft fuel and lubrication, 8.8%; depot aircraft maintenance labor and materials, 8.8%; installations and equipment (for the F-104), 6.3%, plus other standard costs of any military unit.

All told, Lockheed figures, the total yearly cost of F-104 procurement and operation, with procurement amortized over a four year period, should be on the order of 60% of larger current competitive aircraft.

Under the weather portion of environment, all-weather capability is obvious. For 1960, a choice must be made of weapons for operations in all types of weather (with economics a

factor), weapons suitable for cold, hot limited and all-out war.

Although forward hemisphere, lead collision course attacks are today's standard tactics, Lockheed believes that the old lead pursuit, chase 'em, catch 'em, will be used again despite the more exotic approaches, and in this, high speed is a must.

Distance is no longer purely a nautical mile scale, Lockheed says, but now is a time scale stretching from the ground to the weapon dispatch point. In Europe, with F-104 performance, dispersal of aircraft is possible on a 200 naut. mi. basis, Lockheed contends.

Lockheed talks about runway requirements for the F-104 in two terms—one that the airplane can use the same runways as the F-100, F-86 and F-84F for peacetime operations.

In the other term, dispersal, the F-104 can have zero launch capabilities for this era, along with other proposed aircraft and existing airplanes. However, Lockheed feels that even this approach has limitations for any combat aircraft, namely the limits imposed by fuel supply, armament and other logistics and supply of trained maintenance personnel. The company contends F-104 dispersal capabilities are very high by any standards.

In electronic countermeasures work, Lockheed engineers feel the best approach is to have high performance. Should some of the airplane's electronic equipment be jammed, the pilot still will be able to change plans or switch systems to accomplish the mission, or change missions.

Ground control will play a large part in cold or limited hot war but may not remain effective very long in all-out war, and manned interceptors will have the best remaining capabilities as the ground control situation deteriorates, due to tactics which can be used with manned aircraft.

Concerning terrain factor, which brings up the twin versus single-engine approach, Lockheed says it learned its twin-engine interceptor lesson with the P.38 Lightnings in regard to maintenance and mission aborts due to one-engine malfunction. The best approach now, engineers feel, is to develop a single-engine aircraft with a highly reliable powerplant.

Acknowledging the problems which have arisen in the F-104/J79 combination, the company feels that the old axiom holds true—any new airplane has troubles, any ne wengine has troubles, and the combination of new engine and airplane brings more than either one singly. However, Lockheed feels that by the time the 1960 airplane becomes operational, the weapon system should be well beyond any bugs.

Generalizing on the airplane's suitability for NATO and SEATO nations, Lockheed points out that the design (AW Feb. 10, p. 66), is responsible for the low maintenance per flight hour and that service centers for systems and packages-according-to-mission in electronics gear with fast interchangeability due to plug-in type units have yielded highest availability rate of any Century Series aircraft.

Additionally, the question of fuel costs is smaller than has been advanced, Lockheed points out, with less than 9% of total annual cost absorbed here. Admitting that high performance takes more fuel when the airplane is in combat, the company cites the fact that the larger financial outlay every year is involved in serviceability and maintainability of the aircraft. For the F-104, effective training aids have been developed, the airplane's systems and systems performances are thoroughly known and documented, easing the training development costs and requirements, a financially more significant point than fuel costs on an over-all basis.

Although not dwelling on the fact, Lockheed points out that the F-104 can be operated in dispersal by a zero length launch and very short landing using proper techniques and perhaps some portable aids. The airplane can be operated from training type fields, Lockheed claims, saying that the present number and size of runways in Germany are adequate for peacetime training operations with the F-104.

Another role in which the F-104 has not been thought of in the past is as a fighter bomber, but Lockheed points out that such a capability is developed for the airplane. External weapons stores can accommodate bombs of various type and warheads.

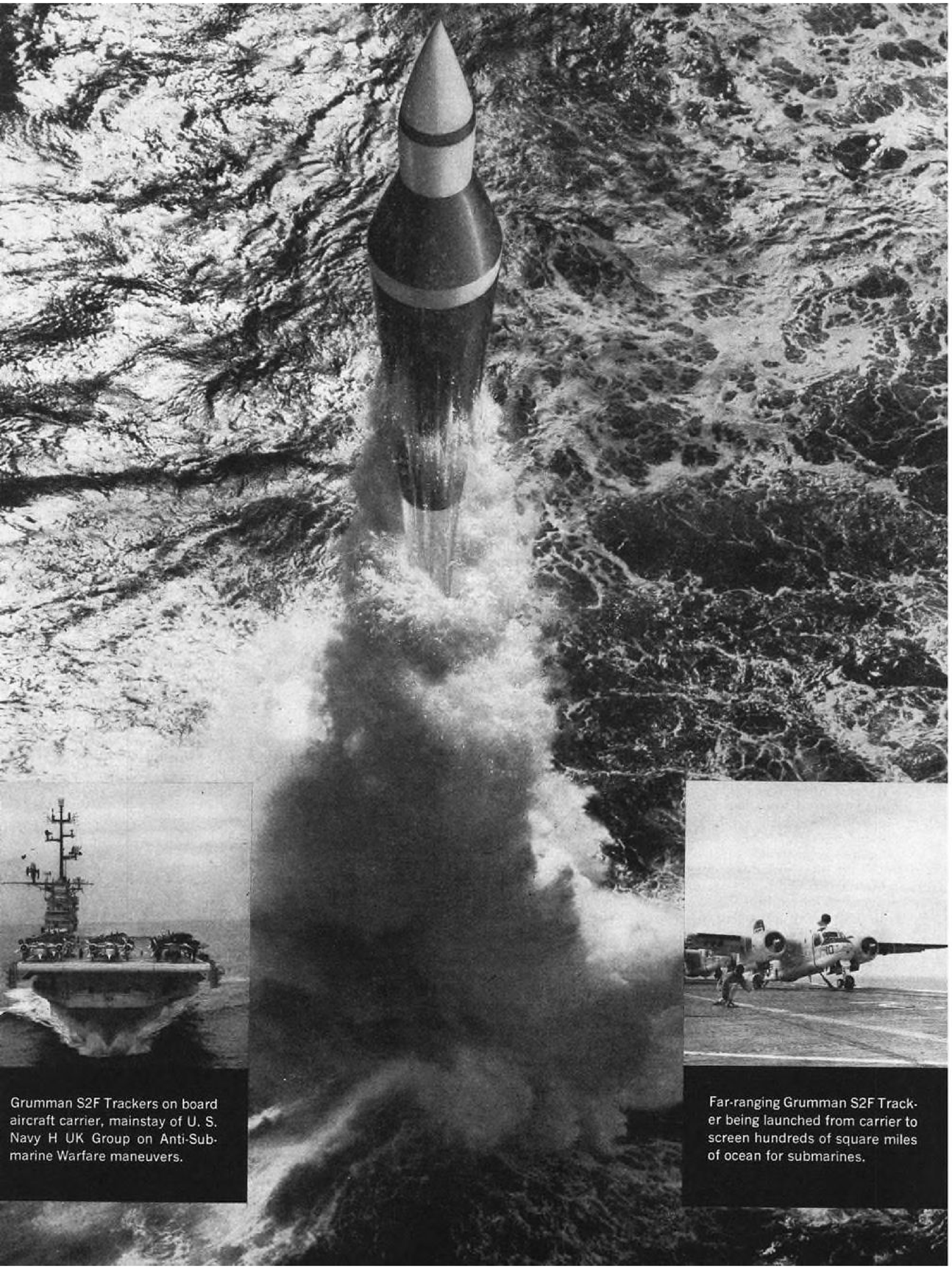
Jet Ignition Problems Hold Airline Interest

Toledo, Ohio—Airline interest in jet ignition problems experienced by the military was apparent at the Aviation Spark Plug and Ignition Conference sponsored here by the Champion Spark Plug Co.

Greatest portion of the agenda was devoted to problems concerning spark plug reliability and service life with particular emphasis being placed on the performance of the Champion RHA 29E plug in the Curtiss-Wright R3350 turbocompound engine.

Airlines were unanimous in condemning the 3,000 hr. overhaul limit on TC18 ignition manifolds on the Wright R3350 engine. Cases of manifolds removed in good condition after 4,500 hr. were cited by operators.

Representatives of more than 30 airlines, including a number of foreign operators, attended the conference.



Grumman S2F Trackers on board aircraft carrier, mainstay of U. S. Navy H UK Group on Anti-Submarine Warfare maneuvers.

Far-ranging Grumman S2F Tracker being launched from carrier to screen hundreds of square miles of ocean for submarines.

NO NEAR MISS

There are no near misses with missiles armed with nuclear warheads. There is no protection from distance. Subs off our shores could attack our cities. Even if they lack advanced-type missiles launched from under the sea, subs could attack us with existing short-range missiles, even primitive pulse-jets.

Thus submarines are the danger. To deny these mobile missile launchers sanctuary under thousands of square miles of ocean the U. S. Navy hunts with killer groups. Grumman S2F Trackers catapulted from carriers screen vast areas with the most sophisticated electronic detection gear. Once contact is made and retained, they can pin-point a submerged sub and sink it.

S2F Trackers are another example of Grumman helping to make the U. S. Navy our best protection against submarines, plus our most effective police force in cases of international delinquency.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
Bethpage · Long Island · New York

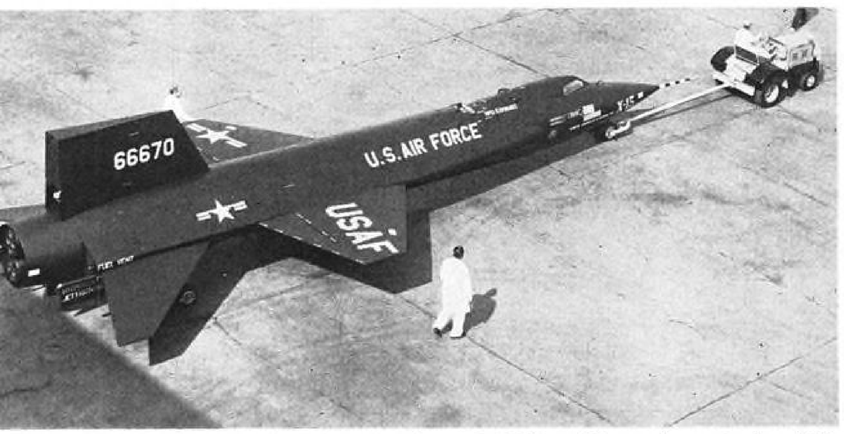
S2F's sensitive gear can detect sub's disturbance of earth's magnetic field. S2Fs also carry all types of detection gear.

Combat Intelligence Center receiving S2F report of contact and the dropping of detection devices to pinpoint submarine.

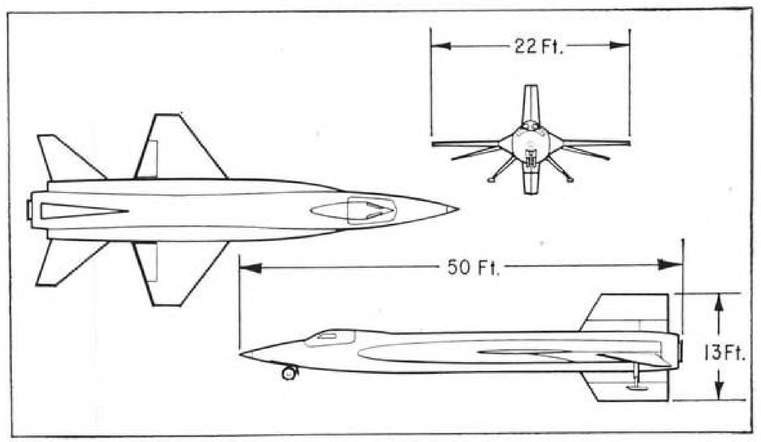
S2F returning to carrier after "sinking" submarine in war games with depth charges and an ingenious homing torpedo.

UNFINISHED X-15, with canopy hood removed and tail section unpainted, moves to hangar for final assembly.

X-15 Design Reflects Hypersonic Mission



SPEED brakes are fitted on aft section of vertical stabilizer with actuating mechanism visible from rear (above). Note steel skids in extended position on drawing (below).



By Irving Stone

Inglewood, Calif.—North American Aviation has engineered a simple, straightforward structure to meet stringent operational demands of the hypersonic out-of-atmosphere research aircraft. Highlights of the structure are:

• **Wing is approximately** a 5% thickness structure, about 102 in. at root chord, sweeping back at a leading edge angle of about 25 deg. to a tip width of about 34 in.

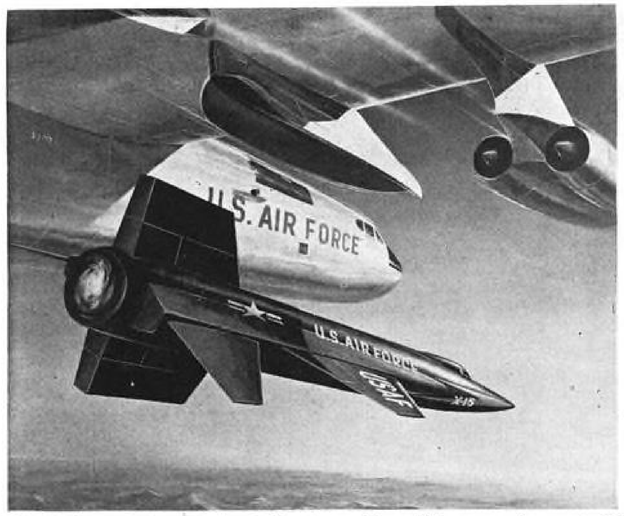
• **Upper and lower wing skins** are Inconel X, fabricated as "single" sheets by two spanwise converging fusion welds which are almost impossible to detect after machining operation. Skin tapers from about $\frac{3}{32}$ in. thick at root to approximately $\frac{1}{16}$ in. thick at tip. Lands are provided for attachment to main spar, wing nose section and tip rib.

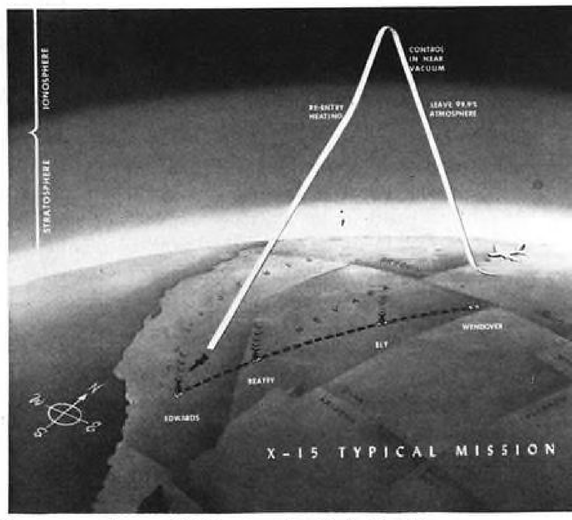
• **Box structure has multispar makeup** incorporating formed sheet metal and extrusions. Materials include Inconel X and titanium A110-AT.

• **Nine attach points** are used for wing-to-fuselage connection. Fittings are riveted to skin and spars and wing is attached to fuselage structure by bolts.

• **Solid leading edge on wing** is about 1 in. wide and about $\frac{3}{4}$ in. thick. Integral skin extends from nose section aft to front spar. Span of nose section from root to tip incorporates six individual sections.

• **Landing flap,** only movable surface on wing, starts where wing root meets large fuselage side fairing and extends outboard about 57 in. Inboard width is about $28\frac{1}{4}$ in., outboard width is $12\frac{1}{2}$ in.





X-15 is dropped from Boeing B-52 wing pod in artist's conception; note B-52 camera enclosure. Flight arc and path is at right.

• **Reaction control jet** on wing top and bottom surfaces is positioned about 26 in. inboard from tip and 12 in. back from leading edge.

• **All-movable horizontal stabilizer,** a conventional spar and rib structure, is pivoted at about the middle of its root chord, which measures about 85 in. Tip chord is about 25 in.

• **Leading edge** of horizontal stabilizer also is made up of six individual sections. Nose, like leading edge in wing, also appears solid, and leads into front spar with integral sheet extending back about $4\frac{1}{2}$ in. from nose. Horizontal stabilizer leading edge sweep is considerably more than wing sweep.

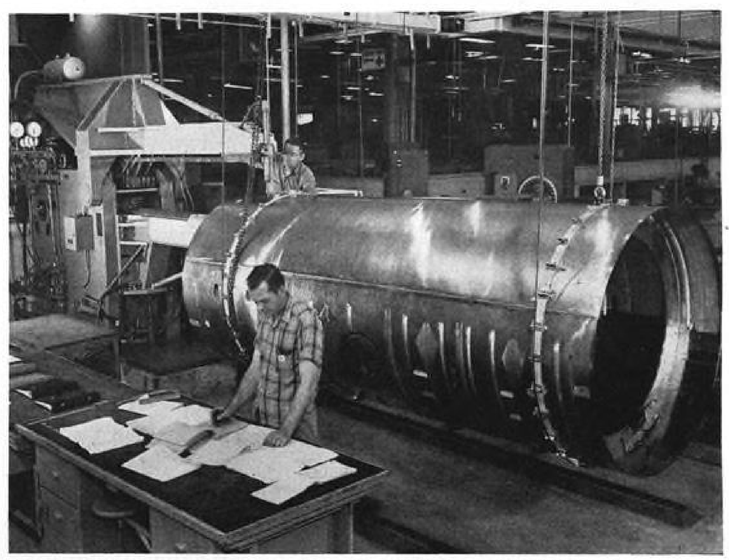
• **All-movable vertical stabilizers**—positioned above and below fuselage—are large box spar and rib structures with outer portions pivoted about one-third back from leading edge. Thickness of each stabilizer at rear of base is about 23 in., tapering slightly to top. Beaded closure pieces seal off trailing edge of movable portions of vertical stabilizers.

• **Speed brakes,** comprising aft section of the vertical stabilizer fixed portion adjacent to the fuselage are surfaces about 2 in. thick, incorporating vertically beaded inner skins and horizontally beaded end closure pieces. Speed brakes are hinged about two-thirds aft from leading edge of vertical stabilizer. Actuating mechanism is housed between opposite surfaces and is visible from rear of airplane.

• **Movable portion** of lower vertical stabilizer, jettisoned before landing because of limited ground clearance for aft fuselage, is attached to fixed portion of lower stabilizer after the aircraft is hoisted onto the Boeing B-52 mother ship.

Fuselage gives an unusual impression of length in comparison with the

PILOT Scott Crossfield, of North American Aviation, stands by low-slung fuselage.



SPECIAL welding technique was developed for X-15's Inconel X fuel cylinder.

X-15 Pilot Suit Readied for Tests

Individually fitted suit, known as MC-2, for pilots of North American X-15 will be tested on all men scheduled to fly the rocket research aircraft. Aluminized suit and occupant will be tested in flight environment in a specially instrumented Convair TF-102 trainer.

First X-15 pilot to receive the suit was Scott Crossfield, who recently participated in a test at Edwards AFB Flight Test Center's altitude chamber to check pressure equipment. Early flights, in addition to providing data on the suit, also will determine whether the TF-102 is correctly equipped to handle the tests. Altitudes and pressures that pilots will face in actual flight can be closely simulated in the specially modified aircraft. Pilots will undergo at least 100 hr. in the suit before the actual X-15 flight.

Data on suit action at extreme altitudes to be attained by the X-15 will be primary objectives of the research. Tests will determine if the suit will protect pilot if there is loss of cabin pressure at altitude and whether pilot can fly the aircraft or eject and be protected from cold and lack of oxygen of the upper atmosphere. Mobility of the suit must be determined, as well as visibility of cockpit instruments, area around the aircraft, and pilot's visibility through his helmet visor.

In the denser atmosphere, a conventional ejection will be possible, even at altitudes above 60,000 ft. Pilot's pressure suit will provide breathing oxygen, compatible pressure environment and wind blast protection during ejection. New, stabilized ejection seat will prevent tumbling at excessive G forces. Separation from seat and chute opening will be automatic.

Outside of the suit is made of aluminized finish to resist heat generated as the aircraft re-enters atmosphere. Suit, manufactured by David Clark Co., Worcester, Mass., requires over 60 individual measurements for construction.

Suit's ventilation and pressurization will be provided by eight compressed air bottles, cooling body-generated heat. Data on the suit, helmet and cabin pressures will be telemetered and recorded on oscilloscopes and strip charts.

relatively stubby wings of the X-15. Low to the ground, the body extends 50 ft. from the conical nose back to where rocket exhaust will emerge from the fuselage tail. Close inspection of the fuselage reveals these features:

• **Approximately 22 in. aft** of the fuselage nose tip, reaction control jets are arranged in a cruciform pattern—on both sides and top and bottom of the nose.

• **Short nosewheel strut** is positioned about 60 in. back from nose tip.

• **Cockpit, not available** for inspection, appears through side panes to be a "tight" area with every inch of volume utilized. Cockpit side panes are relatively small transparent sections, about 8½ in. wide and 26 in. long, extend almost the full length of the cockpit.

Fuselage Fairings

Large fuselage fairings, which house propellant and control lines, begin just aft of where cockpit hood fairs into top of fuselage and extends back to trailing edge of vertical stabilizer. Closure piece for aft end of fuselage fairing is a horizontally beaded skin from which a ⅝-in.-diameter fuel vent and 3-in.-diameter hydrogen peroxide fuel jettison pipe protrude on the right fairing and a fuel jettison pipe only from the left fairing.

Two camera installations—one on either side of longitudinal center line—face aft from cockpit hood, probably for viewing, in flight, the tops of the wing and horizontal stabilizer and vertical stabilizer. Another pair of cameras are positioned in the underside of the fuselage, probably focusing on undersurface of horizontal stabilizer, on lower vertical stabilizer and on steel skid main landing gear.

Auxiliary power unit exhaust is located on right side of fuselage skin in cockpit area, with instructions to push button to open door, then pull T-handle to jettison canopy.

Hydraulic reservoir site gages are located on right side of fuselage, aft of cockpit hood. Also in this area are B-52 mother ship services, such as hot air and nitrogen disconnects. External electrical power disconnect also is provided. On the left side of the fuselage in this area is another hydraulic reservoir level site gage, B-52 mother ship breathing oxygen disconnect, and ground pressure test heating and ventilating fitting.

Helium filler connection is located about 2 ft. aft of wing root leading edge on fuselage fairing.

Fuel filler connection is positioned in fuselage fairing under landing flap trailing edge.

Housings for main landing gear skid, located on either side of longitudinal center line on underside of aft fuselage, is about 70 in. long, indicating the general length of the steel skid, which was not extended for observation; aircraft was supported at rear by a wheeled dolly. With respect to its relative position, skid housing positioned forward from about one foot aft of vertical sta-

bilizer leading edge to approximately middle of horizontal stabilizer area.

Some of the equipment revealed for the X-15 includes an advanced airborne flight data system developed by Sperry Gyroscope Co. This installation will direct the pilot from instant of launch throughout high velocity acceleration phase, also provide data enabling the pilot to control aircraft during re-entry.

First systems are scheduled under Air Force contract for delivery in November, in time for planned National Aeronautics and Space Administration checkout in a supersonic McDonnell F-101 Voodoo. Delivery of the first system for X-15 use will be in mid-December, in advance of first powered flights of the research craft.

Feature of the Sperry inertial system is three-gyro stable platform providing attitude, velocity, distance and altitude sensing. Platform contains its own power supplies and amplifiers.

The lightweight computer digests and interprets this data, displays it pictorially on cockpit instruments.

System components will take accelerations of more than 10G's and is designed to function perfectly in the weightless environment the X-15 will pass through in flight from Wendover, Utah, to Edwards AFB, Calif. Flight instruments Sperry has developed for the X-15 include altimeters, velocity, and vertical rate indicators.

System's sensors and computer will provide data for airborne and ground-based recorders for permanent charting of each flight. The system is designed to accept velocity signals from Doppler navigation system in the B-52 mother plane until the moment of launch, then functioning as inertial system.

Lear, Inc.'s, Grand Rapids Division is supplying special three-axis flight director-attitude indicator for X-15. The instrument is a modified version of Lear Model 4060 (ASTRA) indicator.

Lear indicator will supply several kinds of information for the pilot. Pictorial-type sphere will give pilot the attitude of his aircraft with respect to earth in terms of pitch, roll and yaw. Vertical needle shows sideslip of aircraft, horizontal pointer indicates angle of attack. Yaw and pitch angles will show displacement between direction in which aircraft is pointed and direction in which it is moving. Horizontal needle indicates angle of attack movement. Turn-and-bank indicator located at bottom of the sphere warns of deviations from flight path at high speeds

X-15 Development History

Resolution passed by NASA directing laboratories to initiate studies of problem areas likely to be encountered in space flight signalled the start of the X-15 project. These moves then followed:

- May, 1954—NASA team establishes characteristics of an airplane suitable for exploratory flight studies of aerodynamic heating, stability, control and physiological problems involved in hypersonic and space flight and the feasibility of building such an airplane.
- July, 1954—NASA representatives meet with the Air Force and Navy development groups to present proposal.
- December, 1954—Invitations issued to contractors to participate in design competition for X-15.
- January, 1955—Formal briefing on specifications.
- May, 1955—Contractors submit bids.
- December, 1955—North American Aviation, Inc., designated winner of the competition. "Go-Ahead" given for construction of three X-15s.
- October, 1956—First conference report by the Research Airplane Committee.
- December, 1956—Development engineering inspection board meets.
- September, 1957—Construction started on X-15.
- July, 1958—Mating and equipment installation. Second conference report by the research airplane committee.
- October, 1958—Rollout and delivery to flight test.

X-15 program, through completion of third vehicle, is expected to cost some $120 million in direct contract costs, plus sizable additional indirect costs consisting primarily of laboratory and wind tunnel testing done by NASA and Air Research and Development Command.

Direct contract costs, by fiscal year, were funded as follows:

- FY 56—Air Force—$8.8 million, Navy—$.5 million.
- FY 57—Air Force—$18.3 million, Navy—$1.8 million.
- FY 58—Air Force—$39.1 million, Navy—$2.1 million.
- FY 59—Air Force—$36.3 million, Navy $1.0 million.
- FY 60—Air Force—$13.6 million (estimated).

Total amount of Air Force funding is $116.1 million, Navy total funding is $5.4 million.

HOW MODERN **T58** *POWERPLANT HELPS PROVIDE . . .*

Most Payload Capacity, Highest Performance Capability

GENERAL ELECTRIC T58's GIVE NEW VERTOL 107 GREATER CAPABILITY THAN POSSIBLE WITH ANY OTHER AVAILABLE GAS TURBINE

The U.S. Army's recent announcement that it had purchased a quantity of T58-powered Vertol 107 (YHC-1) helicopters was further evidence of the growing trend to employ the General Electric T58 when seeking the powerplant which provides helicopters with highest performance capability.

What makes the T58 so attractive? Compared with other gas turbine engines in its class, the twin-T58 powerplant gives the YHC-1 *at least . . .*

18% MORE INSTALLED POWER—The T58 is guaranteed to deliver 1050 shp.

7% LOWER SPECIFIC FUEL CONSUMPTION—The T58's SFC rate is guaranteed at a low 0.64 lb/hp-hr.

300 LBS. LESS ENGINE WEIGHT, PLUS INSTALLATION WEIGHT SAVING—The compact T58 weighs only 271 lbs.

These outstanding features of the T58 make it the engine with the highest power-to-weight, lowest SFC of any turboshaft flying today—the only gas turbine now available which provides the Vertol YHC-1 with:

OUTSTANDING RANGE AND PAYLOAD—Light weight, high power, low SFC of T58's give YHC-1 increased range, added cargo- and passenger-carrying capability.

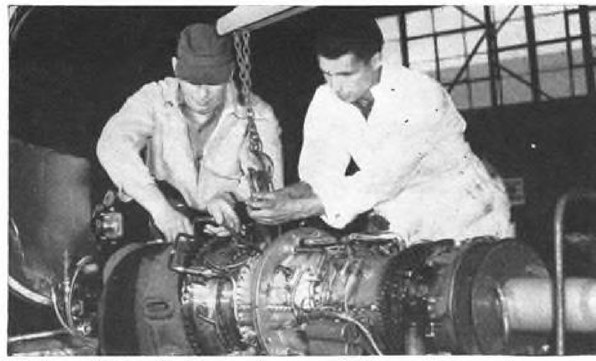
SUPERIOR HOT DAY AND HIGH ALTITUDE PERFORMANCE—Twin T58's have "reserve power" to operate at higher than standard temperatures and altitudes without offloading payload.

UNPARALLELED ONE-ENGINE-OUT CAPABILITY—Even with one engine inoperative, YHC-1 will still be able to continue missions with the power available from a single T58.

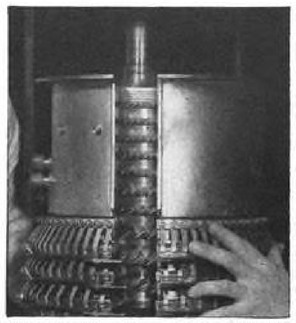
In addition to these operating advantages, T58's are designed for fast and easy maintenance, minimizing helicopter "down-time." When T58-powered Vertol YHC-1's are delivered, they'll give the U.S. Army a full-time airborne mobility never before possible with rotary-wing transports.

For new brochure, "What Does Engine Weight Mean in Dollars To Helicopter Operators," write to General Electric Co., Section 233-19, Schenectady 5, N. Y.

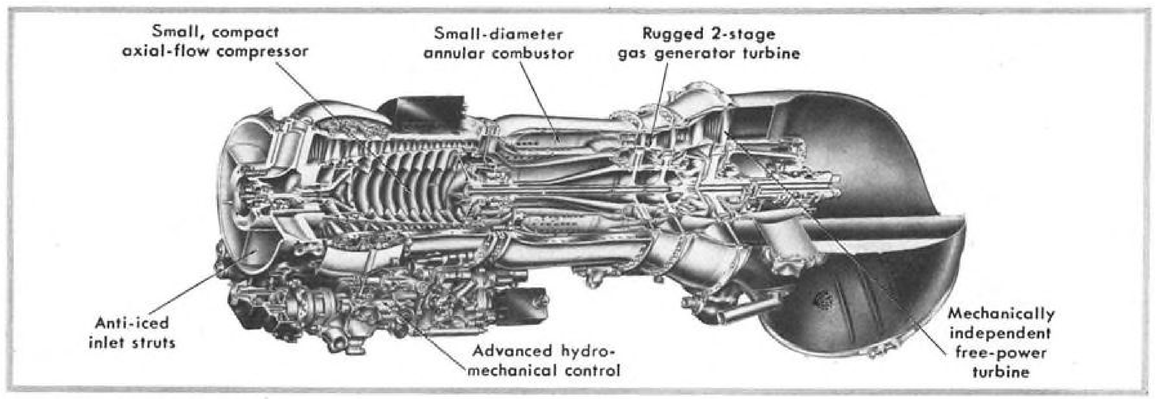
SOME REASONS WHY THE T58 IS EASY TO MAINTAIN



T58 is easily handled due to its low weight, small size, and unit package design of gas generator and power turbine assemblies. Major components can be disassembled with standard tools and a minimum of special equipment.



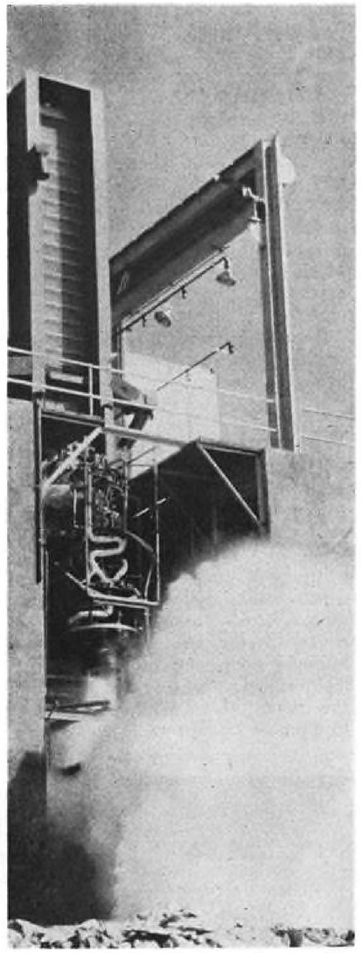
T58's split compressor-casing (left) permits easy access for changing compressor blades. Split combustor-casing (right) facilitates combustion liner inspection and fuel nozzle replacement. In the field, these operations can be performed without removing engine from the helicopter.



General Electric T58's near 4 to 1 power-to-weight ratio, 0.64 SFC assure top helicopter performance. Modern aircraft gas turbine design principles and development techniques incorporated in the T58 result in proven ruggedness, reliability. T58 gas turbine state-of-the-art provides helicopter designer and operator with a powerplant with "years ahead" ability.

Progress Is Our Most Important Product

GENERAL ELECTRIC



ENGINE for X-15 is tested by Reaction Motors Division in 1 million lb. thrust stand at Denville, N. J. Both horizontal and vertical tests are being made.

and helps in coordinated turns at low speed.

Lear also will supply a rate gyro from which the turn indicator gets its reference, director control box which feeds pilot commands to vertical and horizontal needles, and pitch angle set control which allows pilot to preselect a pitch angle compound display.

More than 1,300 lb. of instrumentation, involving approximately 600 temperature pickups and 140 pressure pickups, will be carried by the X-15. Provisions for strain gages have been made at strategic locations to measure structural and aerodynamic loads.

Also aboard will be equipment to accurately measure pilot reaction on the controls.

Pressurization and air conditioning system for the pilot and critical equipment has been developed by Garrett Corp.'s AiResearch Mfg. Division. Be-

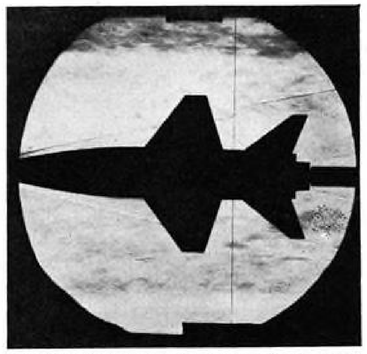
cause dense air of conventional altitude will not exist in the high environment the X-15 will traverse, a self-contained element has been devised to take over jobs formerly done by air. Liquid nitrogen, contained at approximately —300F will be used on the X-15 in vital areas for adequate pressure and to counteract high temperatures developed. In addition to its refrigerant characteristics, liquid nitrogen does not possess fire and explosive hazards, is relatively easy to maintain in liquid state.

Nitrogen Use

Applications include pressurizing and ventilating the cockpit and pilot's flight suit, cooling and pressurizing electronic equipment and inerting its environmental atmosphere, cooling of plane's nose, and operating pneumatic installations. Nitrogen will be applied as a liquid and as a spray, as well as being converted to gas to meet separate requirements.

A positive method of expulsion for nitrogen is provided to assure a constant flow to needed areas. Pressurized helium, used to expel the nitrogen, is contained in a spherical chamber at 4,000 psi., but is reduced to an operating pressure of 70 psi.

The X-15 was extensively wrung-out in scale model tests in various tunnels over conditions representing a broad band of operational conditions. Some of the models used include:



SHOCK waves form off nose of X-15 model in this picture, taken during series of tests in supersonic wind tunnel.

• **Heat transfer and pressure model,** .0667 scale, tested at NASA Langley unitary tunnel from Mach 2.3 to 4.7; NASA 8 ft. transonic tunnel from Mach 0.6 to 1.2; Arnold Engineering Development Center B-minor tunnel at Mach 7.

• **Rotary derivative model,** .09 scale, to determine aerodynamic damping due to dynamic motion. These tests were run at NASA's Ames 12-ft. tunnel from Mach 0.2 to .94; Ames unitary tunnels from Mach 0.7 to 3.5; and North American Aviation's 7.75-ft. x 10-ft. tunnel at Mach 3.

• **Air Force model** (original and revised configuration), .02 scale. Tests were conducted at Langley 11-in. hypersonic tunnel at Mach 6.9; Langley 9-in. supersonic tunnel at Mach 3 to Mach 4; Ames 10 x 14 in. Hypersonic Laboratory from Mach 3.5 to Mach 6.3; Ames 2 x 2 ft. transonic tunnel at Mach 0.6 to 1.4; Massachusetts Institute of Technology Naval Supersonic Laboratory at Mach 1.5 to 3.5; and North American's Supersonic Aerodynamic Laboratory at Mach 1.5 to 3.2.

These tests were to determine static stability, control effectiveness and configuration choice.

Westinghouse Forms Space Technology Group

Westinghouse Electric Corp. has created a Space Technology Section in Lima, Ohio, responsible for development of advanced electrical systems, which would include auxiliary power units driven by turbine, nuclear or solar energy. Section will also have responsibility for devices and products for space flight vehicles. Section will be part of the Small Motor Division's Aircraft Equipment Department.

AMC Contracts

Wright Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Crosley Division, Avco Manufacturing Corp., Cincinnati, type ASG-15 fire control system, bomber flexible tail defense (for B-52 airplane), (DOD item #A-1a-4863c), RFP-622592, 622592-1 and 622592-2, (PR-622592-1 and -2), $3,741,137.

Hycon Manufacturing Co., South Pasadena, Calif., computer, power supply, type LA-15, Aerno 74-0776, for use with simplified camera control system, (PR MO-8-6760-1419), $73,335.

Sperry Gyroscope Corp. Division, Sperry-Rand Corp., Great Neck, N. Y., four (4) improved low-drift rate gyros (non-floated type) and necessary modifications to a government furnished stabilizer unit (Sperry P/N 620636) to incorporate said improved gyros plus specifications, drawings and spare parts. End use is MA-7A bombing navigation system, possibly in B-47 aircraft, (PR PE-8-11A-2441), $66,975.

The Liquidometer Corp., Long Island City, N. Y., oil quantity measuring system, capacitance type for service test on the C-133 aircraft, (PR PE-8-ST-3593), $31,457.

Sperry Gyroscope Co. Division, Sperry-Rand Corp., Great Neck, N. Y., product improvement of AN/APN-59 radar set of the component indicator, IP-239/APN-59, (PR PE-8-15K1-3707), $135,500.

The Morse Instrument Co., Hudson, Ohio, EN-33(X) automatic dodging projection printer, (PR 13603), $112,893.

Small Aircraft Engine Dept., General Electric Co., West Lynn, Mass., T58 engines for Department of the Army H-107 helicopter, (MIPR R58-778-134 NOas)., $600,000.

Sperry-Phoenix Co. Division, Sperry-Rand Corp., Phoenix, Ariz., components for DSCE-80 system, plus spares for the QF-80 aircraft, (PR MA-8-05F-307 and 308), $756,999.

General Electric Co., Utica, N. Y., AN/APS-81 radar sets (for B-52 aircraft), (PR PE-8-11E-3454), $5,000,000.

Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J., R1820-84B engines, (MIPR R58-749-122), $63,472.

Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J., R1820-82A engines, (MIPR R59-1912-2), $1,144,-582.

Collins Radio Co., Cedar Rapids, Iowa, AN/ARC-58 high frequency single sideband radio set for B-52G and KC-135A aircraft, (PR PE-8-16A-3537, 3537-1, 3537-2, 3537-3 and MD-8-16A-20692), $7,404,006.

Admiral Corp., Chicago, Ill., control, radio set, C-1904/ARC-27 for supply-retrofit, (PR MD-8-16A-20657 and amendments 1, 2 and 3), $1,366,611.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., main wheel assemblies for C-97, KC-97 and B-50 aircraft, (PR 00-8-03B-1115), $1,309,640.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., wheels and brake assemblies for F-101B aircraft, install retrofit and spares, (PR PE-3644 and 3674), $729,929.

Aeronautical Equipment Division, Minneapolis-Honeywell Co., Minneapolis, Minn., calibrators for F-100D and F-100F aircraft, (PR WR-8-1280-577), $86,678.

B. F. Goodrich Aviation Products Division, B. F. Goodrich Co., Dayton, Ohio, spare wheels and data for B-47 aircraft, (PR 00-8-03B-1550), $3,409,728.

Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J., R3350-32W aircraft engines and data for P2V-7 aircraft, (MIPR R58-735-113-NOas and MIPR R59-1914-4-NOas), $9,044,404.

Electronic Systems Division, Sylvania Electric Products, Inc., Waltham, Mass., ECM attachments to the AN/GPS-T2 radar target simulator, (PR XR-8-28-7248 and PH-8-28-7118), $346,572.

Small Aircraft Engines Department, General Electric Co., West Lynn, Mass., J85 engine compatibility engineering, (PR PE-8-02A-3368), $149,990.

The Goodyear Tire and Rubber Co., Akron, Ohio, brake assembly, main wheel and spares for L-20A, L-19A, D, E, H-21C and L-23A, B and D aircraft, (MIPR R58-3413-TCSMC-A, R58-3394-TCSNC-A and R58-3413, TCSMC-A), $56,902.

Motorola, Inc., Chicago, Ill., design and development of variable compression receiver, plug-in unit for receiver transmitter, type RT-324A/APS-64, for B-52 aircraft, (PR PE-8-16K2-3438), $71,029.

Sundstrand Machine Tool Co., Sundstrand Aviation, Rockford, Ill., transmissions, gear boxes and spare parts for the F-106 aircraft, (PR PE-8-031-3631), $2,087,698.

Fairchild Camera and Instrument Corp., Syosset, L. I., N. Y., spare parts applicable to aerial cameras and A-2 viewfinder, (MIPR R58-183/ASO/12NSF/F2/1), $38,-838.

Patterson-Moos Division, Universal Winding Co., Jamaica, L. I., N. Y., infrared gas detection cell, (PR PE-8-11E-3564), $98,-053.

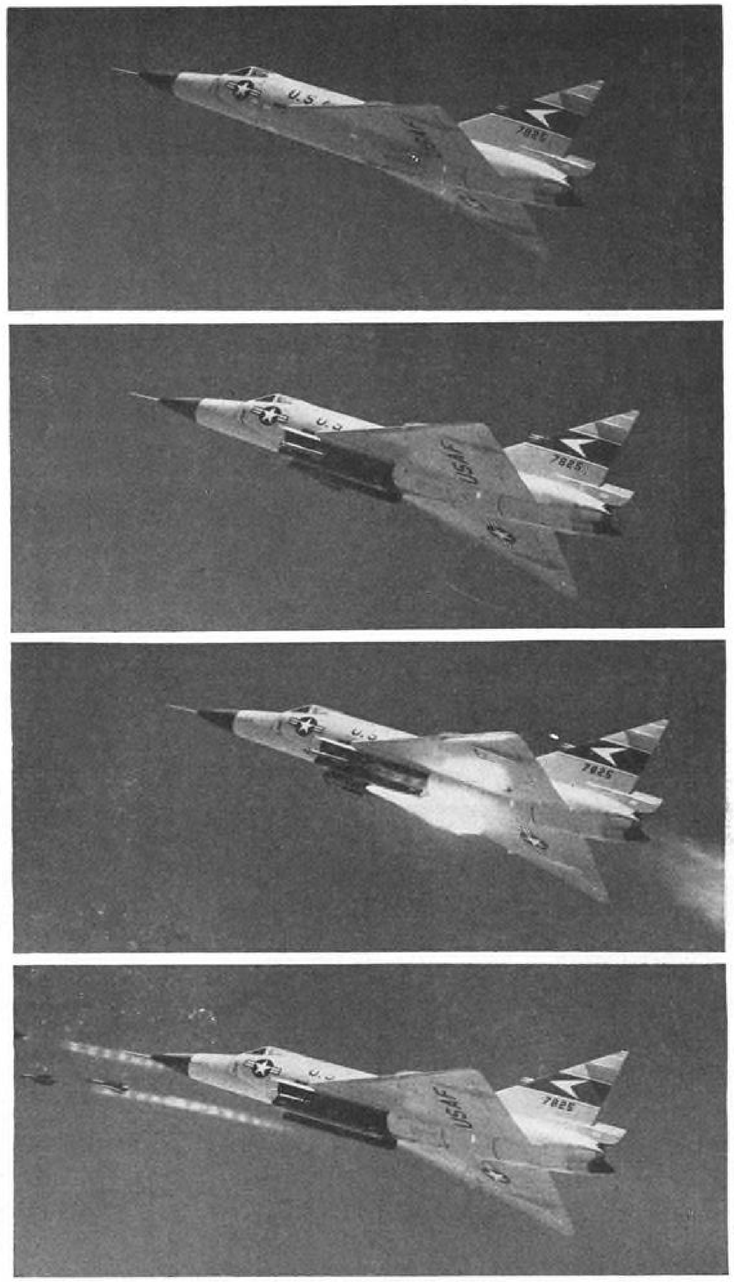
Lear, Inc., Grand Rapids, Mich., automatic flight control system type MC-1 used in the KC-135A aircraft (PR PE-8-05F-3246 and amendments 1, 2 and 3), $3,400,001.

Kollsman Instrument Corp. Division, Standard Coil Products Co., Inc., Elmhurst, N. Y., type M-4 true airspeed indicators for B-50D, F-89C and B-57E aircraft, (PR MA-8-05C-116), $138,292.

The Goodyear Tire and Rubber Co., Akron, Ohio, wheel and brake assemblies, installations, initial spares and spare parts for F-105D/E aircraft, (PR PE-8-03B-3474 and amendment no. 1), $76,120.

Documat, Inc., Belmont, Mass., microfilm viewer, type AR-10, spare parts and ground support equipment, (PR MO-8-10B-728), $213,275.

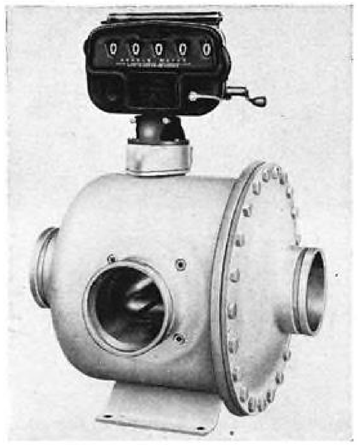
Motorola, Inc., Chicago, Ill., radio set AN/URC-10(XA-2), (PR PE-8-16A-3466), $98,608.



F-102 Launches Falcons in Weapons Meet

First photos show the sequence in which Hughes Aircraft Co. Falcon air-to-air missiles are launched from the Convair F-102. The all-weather interceptor fired the missiles during USAF's sixth annual world-wide weapons meet at Tyndall AFB, Fla. In top photo the F-102 begins a firing run. Next photo shows belly doors snapped open, revealing three Falcons. Elapsed time is less than three seconds. Third photo in the sequence shows the three missiles as they are fired automatically at 50-millisecond intervals on command from the F-102's armament control system. In the bottom photo the three Falcons trail shock waves. Firing cycle is completed two seconds later when the missile bay doors close. GAR-1D Falcon homes on radar (AW Sept. 29, p. 23) and is powered by a Thiokol solid propellant rocket engine. Twelve USAF interceptor teams competed in the Air Defense Command meet.

NEW AVIATION PRODUCTS



Jet Fueling Meter

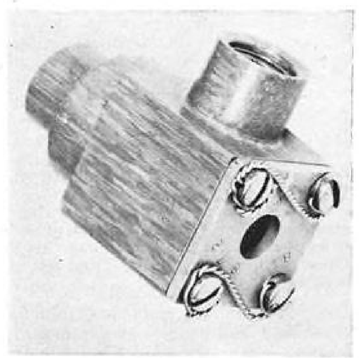
Meter for jet fueling and defueling is said to provide accurate measurement at maximum fueling rate required for the largest jet aircraft.

Model B-80C Birotor meter has 750 gpm. positive displacement; working pressure is 150 psi. Unit is designed for use on tank trucks, trailers and hydrant metering carts and may be equipped with counters, printing counters and preset gallonage devices.

Ralph N. Brodie Co., San Leandro, Calif.

Pneumatic Exhaust Valve

Pneumatic exhaust valve is designed for rapid exhaust of air downstream of the valve upon a drop of air pressure upstream. Valve, with Teflon check, is used in pneumatic systems involving long pneumatic lines.



Valve operating pressure is 1,000 psi. and temperature is from −65 to +160F. Flow factor is 0.10. Envelope dimensions are $\frac{7}{8}$x1$\frac{3}{8}$x1$\frac{37}{64}$; weight is $\frac{1}{10}$ lb.

Walter Kidde & Co., Belleville 9, N. J.

Vibration Isolation System

Pneumatic vibration isolation system guards delicate units such as missile controls, aircraft components and sled test instrumentation devices from damage caused by large and rapid G load changes, the manufacturer says.

Isolation system accomplishes this by maintaining its desired low natural frequency while limiting relative displacement at various load conditions. System consists of three independent sets of servo-controlled gas springs, each set absorbing a component of the vibrational and acceleration loadings along one of three mutually perpendicular axes.

Walter Kidde & Co., Belleville 9, N. J.

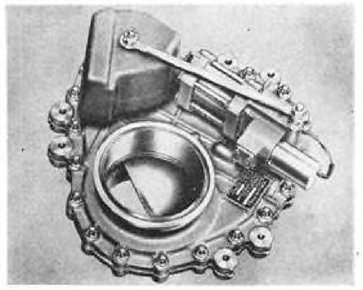
Cylinder Compression Tester

Cylinder compression test kit is designed for compression checks on light aircraft engines. Kit contains six testers.

Accro-Matic testers are installed in each cylinder, and the engine is cranked

with the starter. Each tester will register and retain the maximum pressure in its respective cylinder.

Gabb Special Products, Inc., Windsor Locks, Conn.



Cryogenic Gate Valves

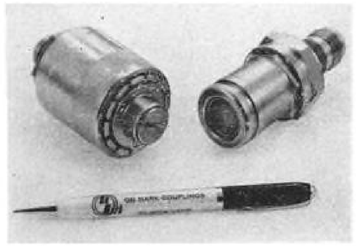
Gate valve is designed for liquid oxygen and other cryogenic fluids as well as standard aircraft and missile fuels and oxidizers. Operating as a pre-valve or fill valve, the gate valve has an ambient temperature capability from −320 to +250F at pressures to 60 psi.

Koehler Aircraft Products Co., 409 Leo St., Dayton 4, Ohio.

Quick Disconnect Coupling

High pressure quick disconnect coupling for hydraulic and fuel lines for aircraft and missiles withstands burst test pressures to 22,000 psi., the maker states.

Type 5-5002-8 coupling may be connected or disconnected manually under high pressure with little loss of pressure.



Remotely actuated couplings also are available. End fitting may be altered to suit various applications.

On Mark Couplings, Inc., 4440 York Blvd., Los Angeles 41, Calif.

WHAT'S NEW

Telling the Market

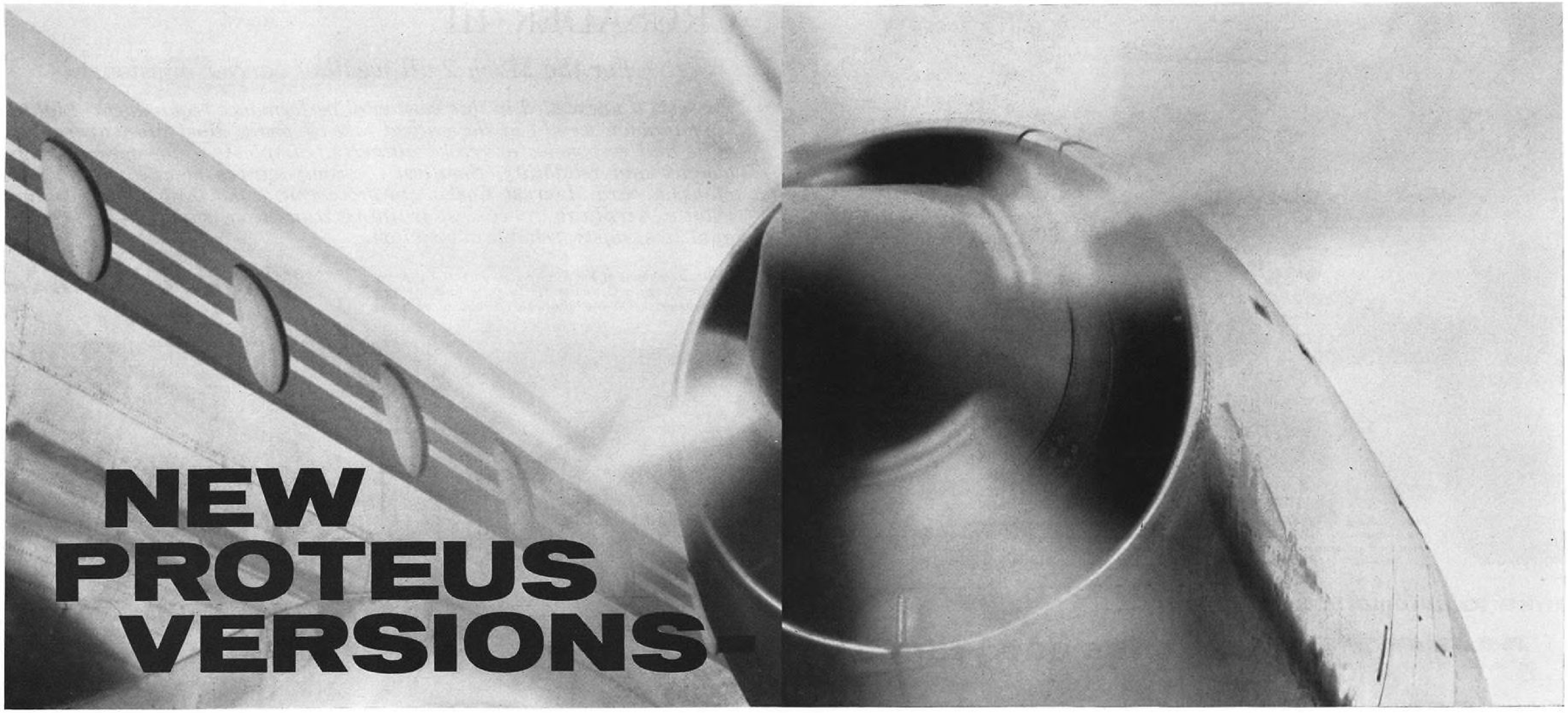
Bulletins 1581A, 1610 and 1573A give description, operation and specifications of **Type 6-201 Primary Pressure Standard, Type 4-260 Accelerometer and Type 4-340 Sound Pressure Level Pickup** respectively. Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena, Calif. . . . Dimensions, schematic and wiring diagram, table of standard dials, and electrical ratings of **"Atcotrol Duo-Set" repeat cycle dial timer,** Bulletin N-80, Automatic Timing & Controls, Inc., Dept. 202, King of Prussia, Pa.

Details on the operation, construction and features of the **Model 210 Data Processing System,** Beckman Systems Division, 325 North Muller Ave., Anaheim, Calif. . . . **Dynamic Analysis of an Aircraft Arresting Gear System,** Application Bulletin No. 6, Electronic Associates, Inc., Long Branch, N. J. . . . Detailed component data on **radiating systems and components,** Engineering Brochure No. RS 100, Electronic Specialty Co., 5121 San Fernando Rd., Los Angeles 39, Calif.

Description, applications and specifications of **High Q-Low Frequency Precision Decade Inductors,** Bulletin LP 121.1, Computer Engineering Associates, Inc., 350 North Halstead, Pasadena, Calif. . . . Bulletins 58-120, 58-123 and 58-125 give technical description of **nuclear laboratory instrumentation,** BJ Electronics, Borg-Warner Corp., 3300 Newport Blvd., Santa Ana, Calif.

Illustrated brochure of the **products, facilities, and staff capabilities,** Edgerton, Germeshausen & Grier, Inc., 160 Brookline Ave., Boston 15, Mass. . . . Design Bulletin No. 7 describes **advances made in the state of the art of chemically milling castings,** United States Chemical Milling Corp., 1700 Rosecrans Ave., Manhattan Beach, Calif. . . . Application drawings and detailed description of the **operation of load cells and transducing elements** used with various cells, Bulletin 581, A. H. Emery Co., Pine St., New Canaan, Conn.

Test reports, providing procedures and results, on the **Series 6900 and 7900 Deutsch Drive-Pin Blind Rivet,** Bulletins No. 6 and No. 7, Deutsch



use even less fuel and deliver even more power

The Bristol Proteus, one of the world's most powerful turboprop engines, has already a lower specific fuel consumption than *any other gas turbine in service in the world.* And it is proving to be one of the world's most reliable aero-engines—the overhaul life of the Proteus 705 has been raised to 1,600 hours in less than 18 months from its entry into passenger service, a rate of increase unequalled in the history of aviation.

Now Bristol announce a further development—the Proteus 760 series. There are three new versions:—

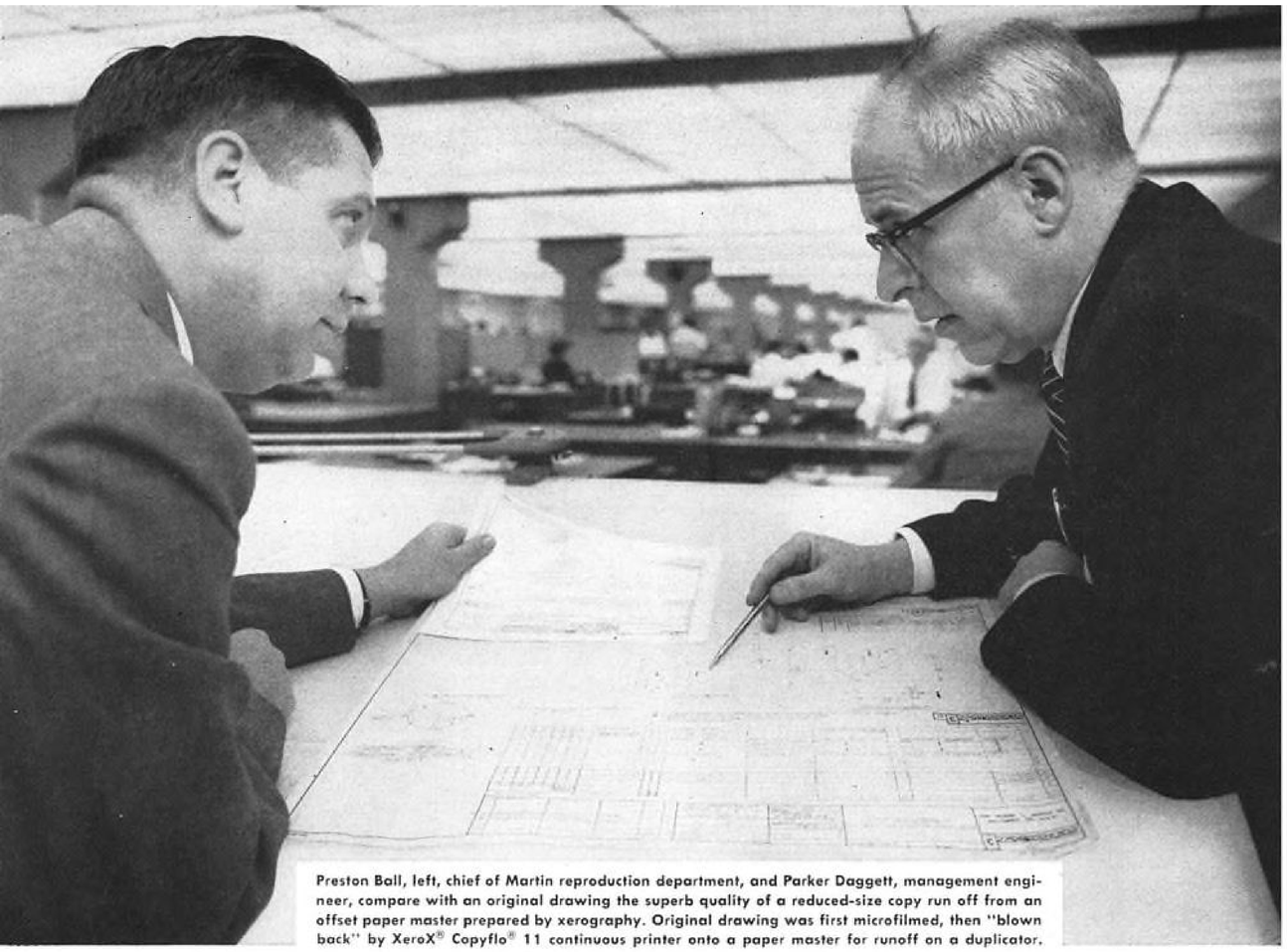
PROTEUS 761. Already in airline service, this engine shows an improvement of nearly 3% in cruising specific fuel consumption compared with the Proteus 755—the first engine installed in Britannia 300 and 310 airliners. Take-off power is similar to that of the Proteus 755.

PROTEUS 762. An intermediate rating, the Proteus 762 has the same cruising power and fuel consumption as the 761, but has a higher take-off power, enabling a 4,000-lb increase in payload to be lifted out of high-altitude or tropical airfields.

PROTEUS 765. Fully rated version, with 4,445 ehp for take-off and similar increase in cruising power, but retaining the lower specific fuel consumption.

Bristol Siddeley

ENGINES LIMITED



Preston Ball, left, chief of Martin reproduction department, and Parker Daggett, management engineer, compare with an original drawing the superb quality of a reduced-size copy run off from an offset paper master prepared by xerography. Original drawing was first microfilmed, then "blown back" by XeroX® Copyflo® 11 continuous printer onto a paper master for runoff on a duplicator.

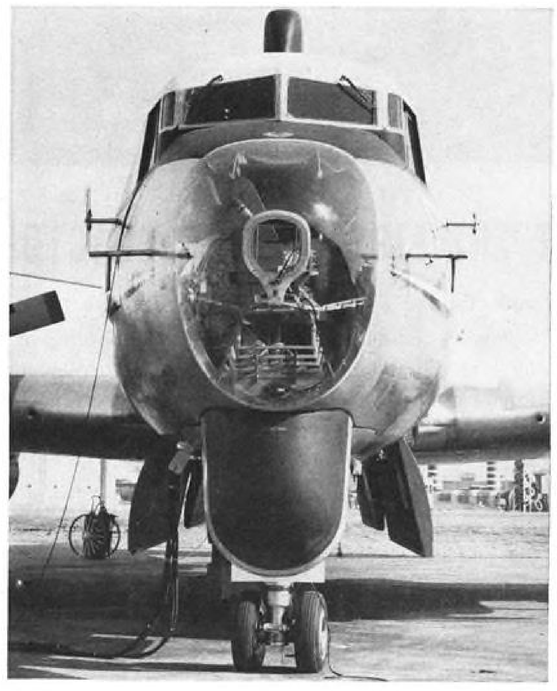
Fastener Corp., P. O. Box 61072, Los Angeles 61, Calif. . . . Photographs, description, mechanical characteristics, electrical rating and mounting dimensions of the **ISXI-T precision, snap-action switch,** Data Sheet 148, Micro Switch, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Photographs and construction, performance and environmental specifications of **precision potentiometers, incremental stepping motors and synchros and pressure switches,** Composite Sheet, G. M. Giannini & Co., Inc., 918 East Green St., Pasadena 1, Calif. . . . Illustrated description of **equipment and methods for sealing openings for pressure testing,** Bulletin 658, Mechanical Products Corp., 168 North Ogden Ave., Chicago 7, Ill.

Illustrated description and specifications of **2-micron filters for hydraulic fluids, fuels,** etc., Engineering Data Sheet No. 100, Bendix Filter Division, Bendix Aviation Corp., 434 West 12 Mile Rd., Madison Hgts., Mich. . . . Brochure on the **Autocollimation Eyepiece for the Kern Theodolite** designed for precise alignment of jigs, fixtures, etc, Kern Instruments, Inc., 120 Grand St., White Plains, N. Y.

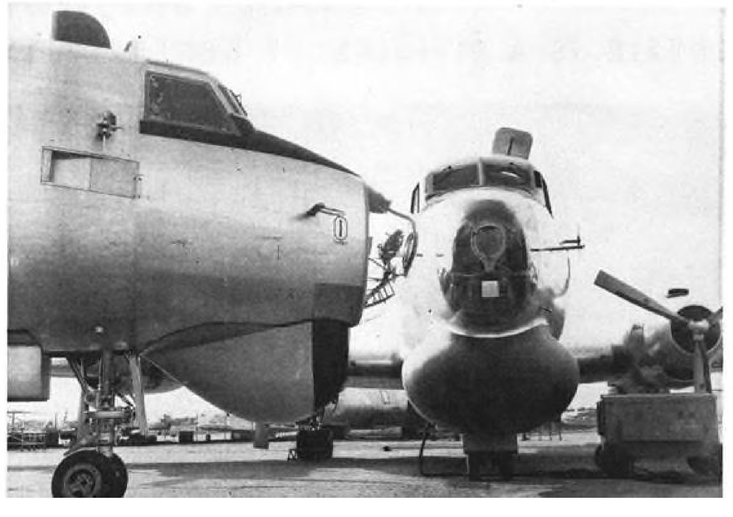
Electronic and Electromechanical Sampling Devices for Multichannel Instrumentation, illustrated booklet on the selection and application of sampling devices, General Devices, Inc., P. O. Box 253, Princeton, N. J. . . . Diagrams, specifications and applications of **pressurized and waterproof plugs and receptacles,** catalog, H. H. Buggie, Inc., P. O. Box 817, Toledo 1, Ohio. . . . Specifications, drawings and modifications of the **26-volt, 400-cycle Size 8 Servomotor-Rate Generator,** Data Sheet 1402, Helipot Division of Beckman Instruments, Inc, Helipot Technical Information Service, Newport Beach, Calif.

Description of the **Miller Radar Antenna Calibration System,** Technical Bulletin M-105, Miller Research Laboratories, 2215 Russell St., Baltimore 30, Md.



Radome Change Cuts Argus Weight, Drag

Radome of Canadair CL-28 Argus anti-submarine aircraft has been redesigned to effect major savings in weight and aerodynamic drag. New radome (top, left) compares with former type (top, right) fitted on first production CL-28 (AW May 26, p. 32). Antenna on top of Argus cockpit is used to detect any radio or electronic transmissions made in the area of the aircraft's operations. Picture at right shows side view of both new radome and cockpit antenna installed on first Argus in Mark II series. Royal Canadian Air Force has accepted 13 Argus' and 17 have been rolled out.



SAFETY

CAB Accident Investigation Report:

DC-7C Propeller Loss Traced to Fatigue

No. 1 propeller of Scandinavian Airlines Flight 912, a DC-7C, Danish Registry OY-KNB, oversped about two hours after departure on a direct flight from New York, N. Y., to Copenhagen, Denmark. The flight, which had departed New York International Airport (Idlewild) at 1516[1] on Oct. 29, 1957, was diverted to Boston, Mass. where the crew of nine and 50 passengers deplaned safely. The aircraft received substantial damage.

HISTORY OF THE FLIGHT

SAS Flight 912, a scheduled passenger operation, departed Idlewild, Oct. 29, 1957, at 1516 on schedule. The crew consisted of Capt. Kaare Herfjord, First Officer Erik Falkenberg-Nielsen, Navigators Henning Arthur Agerholm and Kurt Alborg Olsen, Flight Engineers Carl Emil Woehlk and Erling Halseth, Purser Poul Willy Kramath, Steward John Brandt, and Hostess Elli Rieneck. The gross weight at takeoff was approximately 138,000 lb., 5,000 lb. under the maximum allowable. The load, including approximately 7,000 gal. of fuel, was properly distributed.

The IFR (Instrument Flight Rules) flight plan called for routing via Cod, Sable Island, Tarpon, Great Circle to Prestwick, Scotland, and airways to Copenhagen. The alternate was Oslo, Norway. Departure was made in accordance with ARTC (Air Route Traffic Control) clearance and the flight made routine reports while climbing to its cruising altitude of 21,000 ft., which it reached when passing Nantucket at 1606.

At approximately 1715, while about 200 mi. off the Maine coast, engine roughness developed. Shortly thereafter, engine instruments indicated malfunctioning of the No. 1 powerplant. The BMEP (brake mean effective pressure) dropped rapidly to zero, manifold pressure dropped to 20-25 in., the oil temperature increased, and the oil pressure dropped. Just as the crew was about to feather the propeller the engine overspeed to nearly 4,000 rpm. Actuation of the propeller feathering system produced no results. Despite all efforts of the crew the propeller windmilled at high rpm. Sparks and flame appeared in the area of No. 1 engine exhaust and cowling.

At approximately 1728 the flight made an emergency radio transmission and was cleared by ARTC to descend 8,000 ft., later to 6,000 ft., with routing for a return to Idlewild. At 1756 the flight crew reported they were about to dump fuel.

A Coast Guard aircraft departed Quonset Point, R. I., at 1804 to intercept Flight 912. Communications between the Coast Guard and Flight 912 were established at 1836 and interception was made at 1942. At approximately 1905, SAS 912 requested ARTC clearance to Boston and this was granted immediately. During the Boston approach descent from 6,000 ft. to 4,000 ft., the No. 1 propeller separated from the engine and dropped into the sea. Sparks and flame accompanied the separation and one bank of fire extinguishing agent was used at that time. The time of the propeller separation was between 2026 and 2030.

After a radar-controlled final approach the aircraft made a successful three-engine landing at 2044 on runway 22L, Logan Airport, Boston. At the end of the landing roll waiting airport fire equipment covered the No. 1 engine and left wing with foam as a precautionary measure.

It was not necessary to deplane the occupants by emergency means. Twenty minutes after the aircraft landed, all passengers, with the exception of four who had left earlier by the crew door, deplaned safely via a loading ramp taken to the aircraft.

Boston weather at 2045 was: Measured ceiling 8,000 broken; visibility 13 mi., wind south 2 kt.; altimeter 30.09.

INVESTIGATION

Examination of the aircraft disclosed that except for a small puncture in the left wing leading edge all damage was forward of the No. 1 engine firewall. Accordingly, the Board's investigative activity was first directed to that area.

The engine was removed from the aircraft and transported to the SAS hangar at Idlewild Airport, New York. It was observed initially that a major portion of the propeller shaft had broken away from the engine.

The propeller governor, when removed and disassembled, was found to contain small metal particles. The pilot valve of this governor was stuck or seized in the "on speed" condition.

Operation of the feathering pump was normal. Fire or excessive heat damage was confined to the area where the nose case had broken away. The portion of the nose case remaining showed discoloration from heat. There was no fire damage around the cylinders, ignition wiring or push rods.

The propeller shaft was broken off at the flange which is just rearward of the propeller oil transfer bearing. The most forward portion of the ring cowl (left side) was torn and flattened rearward.

After preliminary examination at Idlewild the engine was taken to the manufacturer's plant for complete disassembly. This revealed damage from overheating and heavy accessory drive gear damage throughout. The impeller drive system was completely destroyed as a unit; the various parts revealed damage consisting of gear tooth wear, breakage and discoloration typical of excessive heat.

A laboratory analysis revealed that the failure of the impeller intermediate drive gear was caused by fatigue fractures.

All of the cylinders remained on the crankcase. Cylinder skirts, in general, were distorted and broken. All connecting rods and the master rods were broken. The crankshaft counterweights were heavily peened and scored, and the leading edges were worn away. The rear counterweight was jammed against the rear crankcase. Two of the pistons were broken up completely and all others were damaged. The cylinder heads were gouged and peened consistent with damage to the tops of the pistons.

The center main bearing, discolored by heat, was in place. Both the front and rear main bearings were nearly destroyed. The shafts of all three PRT (power recovery turbine) units were broken and the drive assembly between the PRT and the crankshaft showed overheat discoloration. Crankshaft drive gear teeth were gone from approximately 230 deg. of the circumference.

Testimony of the flight crew was that the first indication of trouble was a sensing of engine roughness and that before the rough engine could be identified by the use of the ignition analyzer, the BMEP indicator of No. 1 engine dropped to zero and the No. 1 manifold pressure gage dropped to 20-25 in. of mercury. This was followed by a rise in oil temperature to 90-95C with a drop in oil pressure to 55-60 psi. The engine rpm. increased to approximately 3,500-4,000. Throttle closing had no effect on the high rpm. Feathering was attempted without success. The captain and flight engineer stated that all these events and actions took place during approximately one or two minutes. Subsequent attempts to feather, using the feathering button and manual toggle switch, were equally unsuccessful. The loadmeter indicated that the feathering pump was functioning normally.

The mixture control was then placed in the idle cutoff position and the engine rpm. as indicated by the tachometer dropped to zero but the propeller continued to turn at a very high rate.

An emergency (MAYDAY) call was made as airspeed was reduced. The autopilot was turned off and the aircraft was thereafter flown manually. After descending to 8,000 ft. altitude and dumping approximately 2,800 gal. of fuel, the aircraft was not able to maintain altitude; 6,000 ft. was requested and granted and with the dumping of approximately 700 more gallons of fuel this altitude was maintained at an airspeed of 140 kt. At this speed the propeller rpm. and noise were noticeably reduced.

When the position of the aircraft was accurately determined the destination was changed to Boston, 120 mi. nearer than New York. Capt Herfjord stated that although he had considered diverting to Halifax, Nova Scotia, he did not do so because of an overcast there and the short runways. He was able to remain clear of all clouds during his return to Boston.

As the flight approached Boston, about 3 hr. 15 min. after the overspeeding occurred, the No. 1 propeller tore lose and fell into

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

the sea. According to the captain flames and sparks were flying off the engine and one bank of Freon (fire extinguishing agent) was used. A three-engine landing was made at Logan Airport, Boston.

The captain decided not to use emergency evacuation after the landing since he was advised by ground personnel that there was no danger of fire. Use of a regular loading ramp for deplaning eliminated possible hazard to the passengers. The emergency deplaning chutes were ready for use had they been needed.

Testimony of the crew and investigation indicated that there had been no signs of engine difficulty prior to the engine roughness. The crew stated that engine starting and runups, takeoff and climb were all made with normal indications. The previous flight crews reported no abnormal conditions. A review of maintenance records of OY-KNB disclosed no discrepancies or deferred items.

ANALYSIS

The initial failure is believed to have been the fatigue fracture of the No. 1 engine impeller intermediate drive gear (P/N 145316N). All governor malfunctions resulted from contamination by fine metal particles which were generated and introduced into the oil supply by the gear failure. The overspeed and inability to feather the propeller were caused by the governor pilot valve seizing in the "on speed" position.

Disruption of the gear train driving the fuel pump and tachometer occurred early in the failure sequence. This allowed the tachometer to register zero even though engine rotation causing extensive damage in the power section continued for approximately three hours.

The rear counterweight had partially separated during the continued rotation and the rear, half was found jammed against the crankcase diaphragm. It is believed that sudden jamming occurred and caused the already heated propeller shaft to fail, permitting the propeller to separate from the engine.

There is no indication of operational discrepancies in the conduct of the flight. After the propeller overspeeding occurred the captain was able to maintain control of his aircraft while reducing speed and altitude. Feathering procedures were initiated promptly by the flight crew but were unsuccessful. Communications, traffic control requests and navigation were properly handled. The cabin attendants continued to serve meals to the passengers, who, according to testimony, remained calm during the return to Boston. The decision to delay evacuation after the landing seems reasonable in view of the extinguishing measures taken and the safer exit offered by the standard loading ramp.

The dumping of fuel, ordered by the captain, enabled the flight to maintain its assigned altitude of 6,000 ft. and reduced the gross weight of the aircraft below its authorized landing weight.

Windmilling of the propeller did present a definite hazard during the three-hour return flight. However, at the captain's request, a U.S. Coast Guard amphibian aircraft intercepted the flight and assistance was present had it been required. The Coast Guard aircraft escorted the DC-7 to the landing at Boston.

Based on the investigation of this accident, and similar failures, the Board recommended to the Civil Aeronautics Administration that an Airworthiness Directive be issued requiring the earliest possible replacement of the P/N 145316N gear. Accordingly, AD-57-24-1 was issued on Dec. 2, 1957, requiring replacement of this gear at the next overhaul and not later than July 31, 1958. In addition, the Board is currently preparing a notice of proposed rule making concerning means for preventing propeller overspeeding and inability to feather. The proposed regulation is intended to require the application of improved design principles to the propeller governing and feathering systems.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The crew, the aircraft, and the carrier were currently certificated.
2. The takeoff weight of the aircraft was less than the maximum allowable.
3. The flight was properly dispatched.
4. The flight was routine until the impeller drive gear failure and subsequent engine malfunction occurred.
5. The propeller speed could not be controlled nor could the propeller be feathered.
6. The propeller separated inflight without striking the aircraft.
7. The emergency was well handled by the flight crew.
8. Weather was not a factor in the accident.

PROBABLE CAUSE

The Board finds that the probable cause of this accident was fatigue fractures in No. 1 engine impeller drive gear, resulting in an overspeeding propeller, loss of the propeller, and the subsequent emergency landing.

By the Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident the night of Oct. 29, 1957. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions were taken at the Federal Building, New York International Airport, New York, on Jan. 24, 1958.

Scandinavian Airlines System is operated under a consortium between Danish Airlines, Norwegian Airlines and Swedish International Airlines. The principal offices of the System are located in Stockholm, Sweden. The headquarters of the North American Division is New York, N. Y. Under the Bilateral Air Transport Agreements of 1945, Scandinavian Airlines System was granted two air routes to the United States Nov. 24, 1947. These routes, including the one over the North Atlantic, are operated by SAS under a foreign air carrier permit issued by the Civil Aeronautics Board and an air carrier operating specification issued by the Civil Aeronautics Administration.

Capt. Kaare Herfjord, age 38, was employed by SAS Feb. 15, 1946. He held a currently effective airman certificate with rat-

ing of airline transport pilot. His flying hours total 8,324, of which 821 were in the type aircraft involved. His last line check was on Mar. 23, 1957, and the last instrument check on Sept. 4, 1957. The date of his last CAA physical examination was Aug. 13, 1957. Time last 30 days, 79 hr.; last 90 days, 229 hr.

First Officer Erick Falkenberg-Nielsen, age 29, was employed by SAS April 16, 1952. He held a currently effective airman certificate with rating of airline transport pilot. He had a total of 2,119 pilot hr. with 294 in the type aircraft involved. The date of his last CAA physical examination was July 11, 1957. His last instrument check was on March 14, 1957, and the last line check on Sept. 20, 1957. Flying time in last 30 days, 75 hr.; last 90 days, 256 hr.

Flight Engineer Carl Emil Woehlk, age 34, was employed by SAS Jan. 2, 1947. He held a currently effective flight engineer certificate. Flying hours totaled 5,433 of which 151 were in the type aircraft involved. The date of his last physical examination was Feb. 14, 1957.

Flight Engineer Erling Halseth, age 33, was employed by SAS Jan. 16, 1947. He held a currently effective flight engineer certificate. Flying hours totaled 2,587, of which 291 were in the type aircraft involved. The date of his last physical examination was Sept. 24, 1957.

Navigator Kurt Alborg Olsen, age 35, was employed by SAS Nov. 29, 1946. He held a currently effective flight navigator certificate. Flying hours totaled 8,915, of which 759 were in the type aircraft involved. His last physical examination was Nov. 25, 1956.

Navigator Trainee Henning Arthur Agerholm, age 31, was first employed by SAS April 16, 1953. He held a current radio operator license and had flown 170 hr. as a navigator trainee. His last physical examination was Feb. 23, 1957.

Purser Poul Willy Kramath, age 27, was employed by SAS Mar. 1, 1956. Steward John Brandt, age 29, was employed by SAS Feb. 1, 1957. Miss Elli Rieneck, hostess, was employed by SAS April 21, 1954.

Douglas DC-7C, OY-KNB, manufacturer's serial number 44929, was delivered to Scandinavian Airlines System on Sept. 19, 1956. Total flying time since manufacture was 3,815 hr. The aircraft was powered by four Wright model 988TC18EA-1 engines. Time since overhaul of the four engines was 664, 928, 145, and 891 hr., respectively. The serial number of the No. 1 engine was 704516; total time 1,514 hr. The engines were equipped with Hamilton Standard model 34E60 propellers and model 7019-2 blades. Time on the propellers since overhaul was 1,298, 1,760, 1,199 and 1,286 hr., Nos. 1 to 4, respectively. Total time on No. 1 propeller was 3,267 hr.

Air Force Awards Kaman Crash-Rescue Contract

New $10-million "follow-on" contract for H-43B crash-rescue helicopters has been awarded to Kaman Aircraft Corp., Bloomfield, Conn, by U.S. Air Force. Previous production contract also was for $10 million. Follow-on contract includes provisions for spare parts, ground handling equipment and technical data.

WHO'S WHERE

(*Continued from page 23*)

Changes

Felton H. Havins, director-sales engineering, Anadite, Inc. of Texas, Hurst, Tex.

Louis De Lalio, chief engineer, Filtors, Inc., Port Washington, N. Y.

Dr. George E. Valley, Jr., director of development planning, Melpar, Inc., Falls Church, Va.

Delbert L. Mills will head the management of the consolidation of International Telephone and Telegraph Corp.'s Federal Telephone and Radio Co., Clifton, N. J., and Farnsworth Electronics Co., Fort Wayne, Ind., formerly separate divisions. Headquarters will be in Clifton, N. J. **Vernon L. Haag** will be general manager of the consolidated operation in Fort Wayne, Ind.

Clyde W. Kaericher, director of administration, Minneapolis-Honeywell's inertial guidance plant, St. Petersburg, Fla.

C. J. Stratton, experimental superintendent-Manufacturing Department, Rocketdyne Division of North American Aviation, Inc., Canoga Park, Calif.

Dr. Ralph A. Burton, senior research engineer-Department of Engines Fuels and Lubricants, Southwest Research Institute, San Antonio, Tex.

J. M. Norris, factory manager, Marquardt Aircraft Co.'s ramjet manufacturing facility, Ogden, Utah.

Erich M. Helbig, Dayton, Ohio, manager for Summers Gyroscope Co., Santa Monica, Calif.

Robert F. Zumwalt, engineering manager, and **Edward V. Ryan,** sales manager, newly established Space Technology Department, Aeronautical Division, Firewel Co., Inc., Buffalo, N. Y.

William C. Walter, assistant sales engineering manager, Avro Aircraft Limited, Malton, Canada.

J. M. Miller, director of engineering, Bendix Products Division-Missiles, Bendix Aviation Corp., Mishawaka, Ind. Also: **E. F. Lapham** and **W. E. Worley,** assistant directors of engineering.

D. R. Greenberg, chief development engineer, Control Instrument Co., Inc., Brooklyn, N. Y.

R. P. Hartley, assistant general manager, Central African Airways.

William S. Aiken, manager, Project Engineering Department, Engineering Division, the Thompson-Ramo-Wooldridge Products Co., Los Angeles, Calif. Mr. Aiken also was named acting manager of the Division's Programming Department. Also: **Dr. Thomas M. Stout,** manager, and **Charles G. Laspe,** associate manager, Process Applications Department, Engineering Division, the Thompson-Ramo-Wooldridge Products Co.

Nelson G. Spoth, manager, Kolcast Industries, a division of Thompson Products, Inc., Cleveland, Ohio.

Maj. Gen. Merrill D. Burnside (USAF, ret.), West Coast special corporate representative, Philco Corp., Palo Alto, Calif.

Peter H. Morganson, assistant chief engineer, Veeder-Root Inc., Hartford, Conn.

Herbert H. Cooper, quality control manager, and **Louis J. Casillo,** production manager, Bridgeport Thermostat Division, Robertshaw-Fulton Controls Co., Milford.

George Beuttner chief chemist, Rockbestos Products Corp., New Haven, Conn.

Everett H. Teare, Jr., Washington, D. C., sales representative, Defense and Technical Products Division, Rheem Manufacturing Co., Downey, Calif.

Jack R. Isken, chief-reliability and quality engineering, International Resistance Co., Philadelphia, Pa.

W. S. Hyler, technical assistant to the vice president-research, Huck Manufacturing Co., Detroit, Mich.

Jack I. Stahl, production manager, Manufacturing Division, Servo Corporation of America, New Hyde Park, N. Y.

Thurman C. Erickson, assistant division manager, Subsystems Division, Servomechanisms, Inc., Hawthorne, Calif. Also: **J. H. Reid,** chief engineer, Subsystems Division.

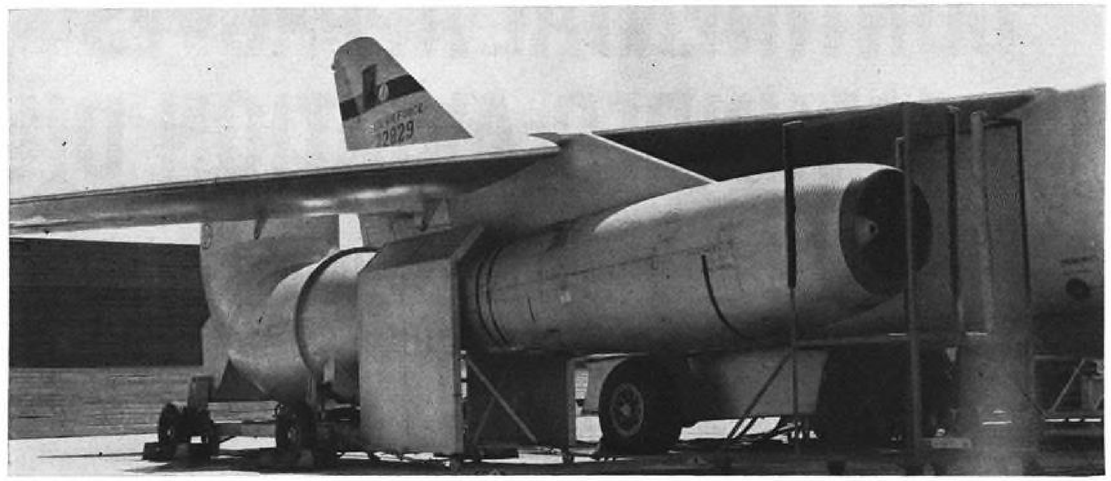
S. N. Lev, manager, Airborne Systems Department, Defense Electronic Products, Radio Corporation of America, Camden.

Donald H. Alder, assistant to the general manager, Pacific Automation Products, Inc., Glendale, Calif.

George F. Johnson, manager of customer engineering, Photocircuits Corp., Glen Cove, N. Y.

Ward B. Dennis, corporate director of development planning, Northrop Aircraft, Inc., Beverly Hills, Calif.

Forrest G. Hogg, resident representative of Motorola Military Electronics Division's newly established permanent area office, Sierra Vista, Ariz.



PORTABLE noise suppressor built by Koppers Co., Inc., undergoes evaluation with Allison J71 engine of Douglas B-66 tactical bomber.

Airlines Shop for Portable Jet Silencers

By Barry Tully

New York—Airlines planning jet service are shopping for portable jet noise suppressors.

First quantity order for such equipment is from American Airlines, which is buying six units from Kittell-Lacy, Inc., Los Angeles. Pan American World Airways has purchased one suppressor from the Maxim Silencer Co., Hartford, Conn., for evaluation and expects to take delivery next month.

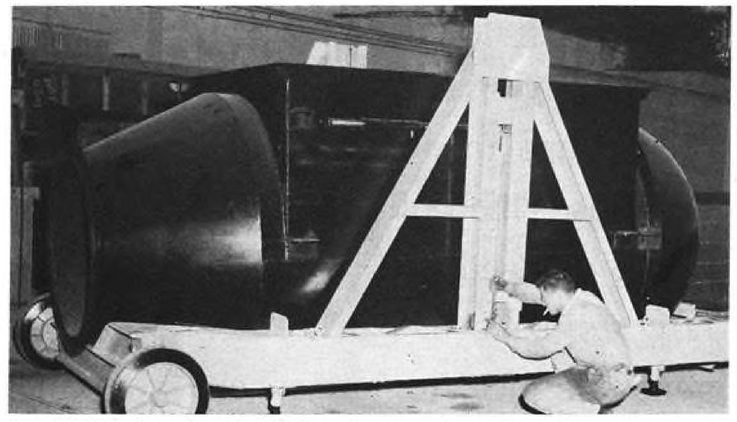
Suppressors are designed to reduce jet ground runup noise 30-35 decibels to protect maintenance personnel and to avoid disturbing airport neighbors. The airlines recognize the need for the ground mufflers in connection with their noise abatement programs. They point out, however, that the physical layout of each airport will determine the necessity for the units.

American Airlines says the airline's six suppressors will be used at intermediate overhaul bases. Initially, scheduled jet flights will operate only out of these bases, as jet service is expanded.

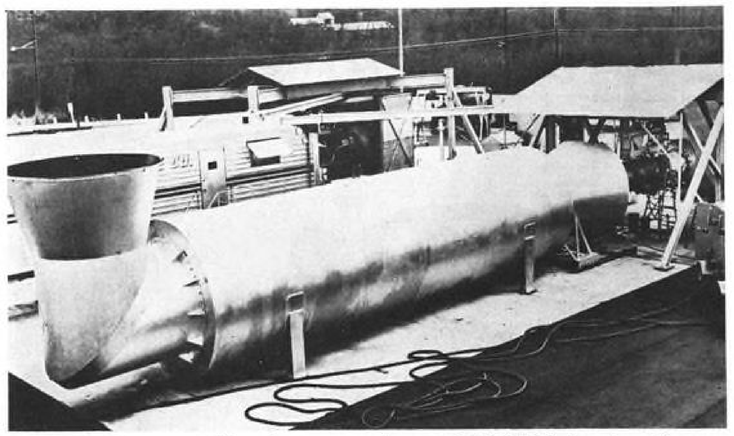
Pan American says that in addition to certain attenuation requirements it will require a 1,000 hr. service life and the ability to withstand exhaust forces without attachment to the ground or the aircraft.

The airline is interested in intake suppressors. Designed to suppress intake air and compressor whine, portable intake units do not have to cope with the heat and pressure of jet exhausts. Pan American is reportedly considering building its own intake suppressors.

The cost of developing portable



SUPPRESSOR, above, is readied for Navy delivery at International Aerocoustics, Inc. Air Logistic's suppressor, with watercooling adapter ring, is shown below in position behind afterburner equipped J57 engine. Note anchoring tiedowns.



KITTELL-LACY non-portable noise suppressor is mounted behind test engine. Company is offering a portable version for use by commercial airlines.

noise suppressors has been partly underwritten by the military. The Navy, which has a severe noise problem on the limited area of its carrier decks, has let several contracts for both research and development of portable suppressors. Bureau of Aeronautics has contracted with five companies to supply 132 portable suppressors under contracts totaling more than $1.4 million. Design restrictions on weight (10,000 lb.) and size indicate Navy's intention to use suppressors for carrier operations. The Air Force also has let a contract for studies of portable suppressor designs along with some pure research contracts on noise studies.

Military requirements for ground runup suppressors include resistance to the heat effects of afterburner operation without water cooling adapter rings. The use of water cooling restricts the mobility of the suppressor.

Afterburners place a severe test on a portable suppressor. Noise level is increased to 160 db., heat rise to 3,000F can produce thermal shock, and exhaust forces are increased almost 50%. The Navy contract for portable mufflers called for 15 sec. afterburner operation and a maximum 1 hr. cooling time.

Even without the afterburner problems, suppressors designed for the air transport industry have inherent design problems. At best the portable ground units are a compromise between maximum attenuation "hush houses" and portability of in-flight suppressors.

These problems include:

• **Maximum attenuation** in all frequencies must be provided without constricting the aerodynamic flow of the turbojet. This requires that the suppressor create minimum back pressure on the engine. Suppressors are either of the Pratt & Whitney multi-jet diffuser type, reactive, or absorption devices or a combination of the three.

• **Making the unit mobile** places a ceiling on the suppressor's weight if it is to be efficiently moved about.

• **Fixing the suppressor** in one spot is a problem in that some airlines insist that the units be capable of operating anywhere on the ramp without being connected to the ground or the aircraft. Suppressor also should allow for the movement of engine nacelle as thrust is varied.

• **In-flight noise suppressors** tend to reduce the effectiveness of ground mufflers. Mixing nozzles and "petal" configuration attachments hasten the mixing of jet exhaust and the ambient air by breaking up the exhaust cone. This makes the exhaust more difficult to suppress immediately aft of the tailpipe.

• **Service life** of the portable units is something of an unknown factor. Judging by the wear and tear on engine test cells, however, it is a very real problem. The intense heat and high velocity exhaust has a deteriorating effect on sound absorbing materials. The use of high quality steels is important in this respect.

Suppressor Manufacturers

Confidence in the market for portable ground runup suppressors is bringing an increasing number of companies into the field. Among these companies are:

• **Kittell-Lacy, Inc.,** Los Angeles, is building a diffuser-type portable suppressor. Basic unit weighs 25,000 lb., costs $16,750 with running gear and elevating jacks extra. In addition to its American Airlines sale, the company reports it has sold two units to Boeing for use with the 707. Kittell-Lacey also is working on research and construction of a unit for Wright Air Development Center.

• **Maxim Silencer Co.,** subsidiary of Emhart Manufacturing Co., Hartford, Conn., will supply the Navy with 24 suppressors under a $225,000 BuAer

contract. The company reports it will make delivery of its suppressor to Pan American in four or five weeks.

• **International Aerocoustics, Inc.**, New York, N. Y., will furnish the Navy with 24 suppressors under a $304,216 contract. Company's suppressor, Pratt & Whitney multiple diffuser type, will be marketed in the commercial air transport field. International Aerocoustics has a $250,000 Navy contract devoted to developing a suppressor capable of withstanding sustained afterburner operation without the necessity of cooling water.

• **Koppers Co., Inc.**, Metal Products Division, Baltimore, Md., is marketing a portable noise suppressor containing design innovations developed by the Martin Co. Koppers will supply the Navy with 30 of these suppressors under a $300,000 contract. Koppers reports that it will deliver seven portable units to North American Aviation for suppressing the Pratt & Whitney J52 powerplant of the Hound Dog air-to-surface missile. Koppers is making proposals to airlines and says that it will ship a unit to Seattle for test on the Boeing 707.

• **General Sound Control, Inc.**, Los Angeles, will supply the Navy with 30 portable suppressors of the multi-jet diffuser type. The company has contracted to supply portable suppressors to the Air Force and is working on this in conjunction with Douglas Aircraft Co. The company states that it will furnish Convair with four suppressor systems, including intake suppressors, for work in connection with Convair's 880 and 600 jet transports.

• **Air Logistics, Inc.**, Los Angeles, is marketing a suppressor in addition to its tow vehicles and other ground support equipment. Model 11,000 suppressor is currently being tested at various Air Force bases and one unit will be shipped to Republic Aviation Corp. for test on the F-105. Air Logistics reports that a water cooling adapter can be fitted for afterburner operation.

• **Curtiss-Wright Corp.** is producing 24 suppressors for the Navy under a $300,000 contract. Wright is also doing work on inlet choke suppressors to reduce high frequency compressor whine. Navy exhaust suppressors are being built at Curtiss-Wright's Princeton, N. J., and South Bend, Ind., facilities. Experimental work on the inlet choke is being conducted at the company's Quehanna, Pa., research and development center.

• **Silence, Inc.**, Farmingdale, N. Y., is a company formed to handle noise suppression projects. The firm is currently designing a suppressor for the commercial field. The first unit is scheduled to be completed in six months. Company reports that its first model will be designed for non-afterburner use, but that it is planning a suppressor to withstand this heat range.

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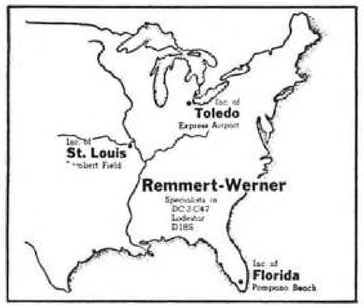

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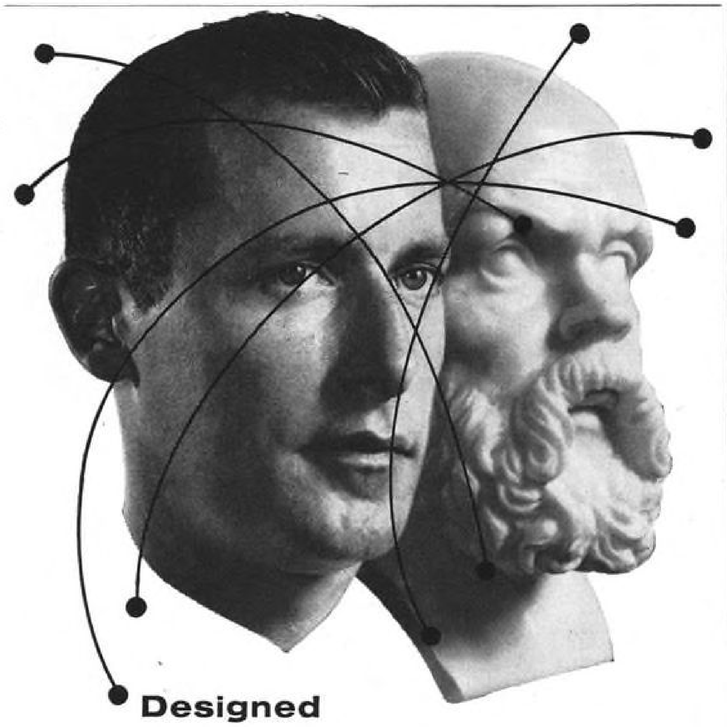

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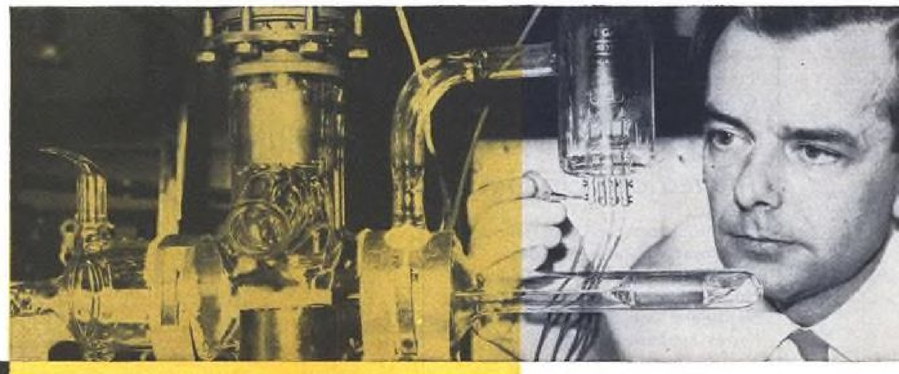

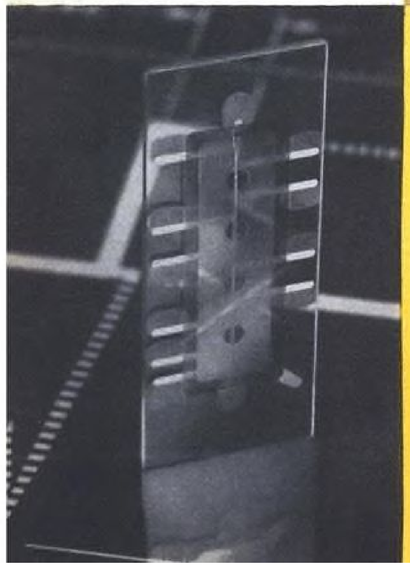

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ADVERTISERS INDEX

LETTERS

Erroneous Information

The Navy lieutenant may have been a bit brash in his letter, but he certainly had a point. The airline pilots do not look out for other aircraft as well as they should. It also seems that they invariably expect the other aircraft to avoid them.

When a collision does occur between transport and military aircraft, the military aircraft is universally condemned by the airlines, newspapers and aviation publications. To the general public the accusations against the military aircraft seem justified, but in many cases they are based on incorrect information.

In one recent case, newspapers stated that military aircraft were breaking the law by flying on the airways. This erroneous impression is gained from statements made by airline representatives attempting to whitewash themselves.

In all fairness responsible aviation publications should report the correct and lawful aspects of air collisions. Specifically, that in VFR conditions it is the responsibility of pilots to avoid collisions.

Anything military is a popular scapegoat in the United States so it is only natural that everyone should rush to blame them in a controversial case. Many military pilots are youthful and inexperienced but to blame them solely for a collision during VFR conditions is just plain unfair. CAA investigators usually conclude that pilots must share the blame equally.

M. J. Thompson
Palo Alto, Calif.

Swivel Neck Replies

In reading the comments to my Swivel Necking letter published in your excellent magazine, I find that most of the comments were devoted to name calling and showed the caliber of some men now holding high positions (AW Sept. 8, p. 118).

I would like to refer to the September, 1958 issue of "Approach" which is published each month by the U. S. Naval Aviation Safety Center in Norfolk, and which points out that midair collisions, like all other accidents, don't just happen—they're caused.

They're caused by a multitude of factors, factors which sometimes cancel each other out and produce only a near miss, and which sometimes compound to produce a tragic headline.

Many of the causes can be eliminated by design for better visibility, wide procurement and use of modern high-performance ground radars, delineation of off-airways training areas with suitable navigational facilities, and airborne anti-collison warning devices.

The best warning device currently available is the being, human, MK1958, w/head, swiveling. Current effort toward minimizing midair collisions is primarily in the area of better seeability—fluorescent paints, rotating beacons, flashing lights—all of which require a very basic participation on the part of every aviator. He must be looking if he is to see them.

Long gone are the days when one could climb above 10,000 ft. and relax because "there's no one else up here but me"; before the year is out the high altitudes which were once the military flyer's private domain will include high-flying commercial jet transports. For a time, they too may be lulled into the false complacency that high altitudes induce.

The upper reaches of the sky are no less demanding of constant vigilance; with ever-increasing traffic in the higher regions it behooves every aviator to look out for himself by looking out for others.

The airlines' concern for growing threat of space-time-reaction is evidenced in the current development of a Doppler radar to provide adequate forewarning of the approach of other aircraft. And let it not be said that the military fly-boys are any less thoughtful of their health.

CAA is also test-flying a variable frequency flashing white wingtip light for transport use; the light will flash at different rates when seen from forward, abeam, and astern, and should provide the viewer with more clues as to the relative heading of the sighted aircraft. Note once again though, you've got to be looking out the window to see it.

Pending some all-seeing gadget to nudge you into action, be your own safety gadget, and don't allow a situation to develop.

To completely ignore the problem before us, as most of the people today have a tendency to do, is asinine. They are afraid to face the basic truth and do nothing but pass the blame when faced by it. Some of the cockpits today, it is true, do not afford the needed visibility. Should this condition cause us to look out less? On the contrary, it should make us double our efforts.

Until the situation is corrected, we all must use the best available tool—our eyes.

Navy Lieutenant
Oxford, Miss.

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.

VFR Vigilance

Perhaps one more commentary on the avoidance of midair collisions is desirous to sum up some of the letters and articles to Aviation Week and their answers, as we see it from here.

In the Las Vegas accident, the Grand Canyon crash, and others, as has been pointed out, the airlines pilots still have not been relieved of the responsibility of maintaining a VFR lookout when VFR conditions exist although they have filed an IFR flight plan. However, their attitude seems to be similar to the ostrich who pokes his head in the sand to avoid detection. "Swivel Necking," as has been rightly pointed out, is as applicable to the DC-7 as to the T-6, and the attitude taken in such letters as written by some pilots to Aviation Week shows they stubbornly maintain their attitude that when filed IFR they don't have to maintain vigilance, and even go so far as to put the blame in the design stage where it may partially belong but certainly not entirely. I, personally, feel and am sure others feel they want no part of flying in aircraft where all precautions are not taken to avoid midair collisions, and I'll bet that in 99.4% of the cases where collisions are avoided that the corrective action was taken because the approaching aircraft was seen and not heard. No pilot or copilot is so busy, especially with flight engineers aboard, that he cannot scan the horizon when in VFR conditions, and any other attitude taken by any pilot constitutes a safety of flight breach of faith by the operator that should never be condoned or tolerated.

H. B. Davis
Burbank, Calif.

P. S. I am obviously one of the many who have avoided sure tragedy by varying from the norm when to comply would be fatal.

Airline Pilots

You recently printed a self-righteous letter by a Mr. Hudson (AW Sept. 15, p. 134) who defended airline pilots as a sacred and highminded group who are truthful, dedicated, and jutjawed. I tremble while raising my voice against such super beings.

However, after reading again the transcript of the Specht case, I feel safe in supposing that there are a few of their group who are not exactly godlike.

In order that Mr. Hudson may not dismiss my comments as being those of a "boastful tyro" I will humbly state that I have 22 years flying experience in 29 types, not including seven helicopter types. I feel that I am as dedicated to the betterment of aviation as even the most impoverished airline captain.

My accusation against the airliners is the same as that voiced by the Navy Lieutenant (AW Aug. 18, p. 118), basically, that the airline pilots do not keep a proper lookout for other aircraft. Apparently they feel that an IFR clearance is a magic wand that will wave aside all other aircraft even on the brightest VFR day. Mr. Hudson cites the restricted visibility of the new aircraft in defense of the pilots. I could not agree more heartily that the visibility from the cockpit is appallingly poor, but don't lay the blame at the doorsteps of the designers; they designed these cockpits on the recommendations of the oldest and best of the airline pilots. I also concur with Mr. Hudson's righteous indignation at the accusation that airline pilots read funny books while flying. This is absolutely untrue. Everyone knows that they read Playboy nowadays. What other conclusion can one make when they bear down on you in bright, sunny weather in violation of the right-of-way? They couldn't possibly be sweating over an instrument approach. There must be some other answer. If these highminded creatures aren't reading magazines what does keep their attention riveted inside the cockpit? Chess, perhaps?

J. Caldwell
Sunnyvale, Calif.

(Aviation Week has printed letters from airline, military and private pilots on the subject of visual clearance. The airline pilots have made their points earlier. Here, "Swivel Neck" and some observers have the opportunity to express a last word on the subject —Ed.)

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