Aviation Week and Space Technology

75 Cents

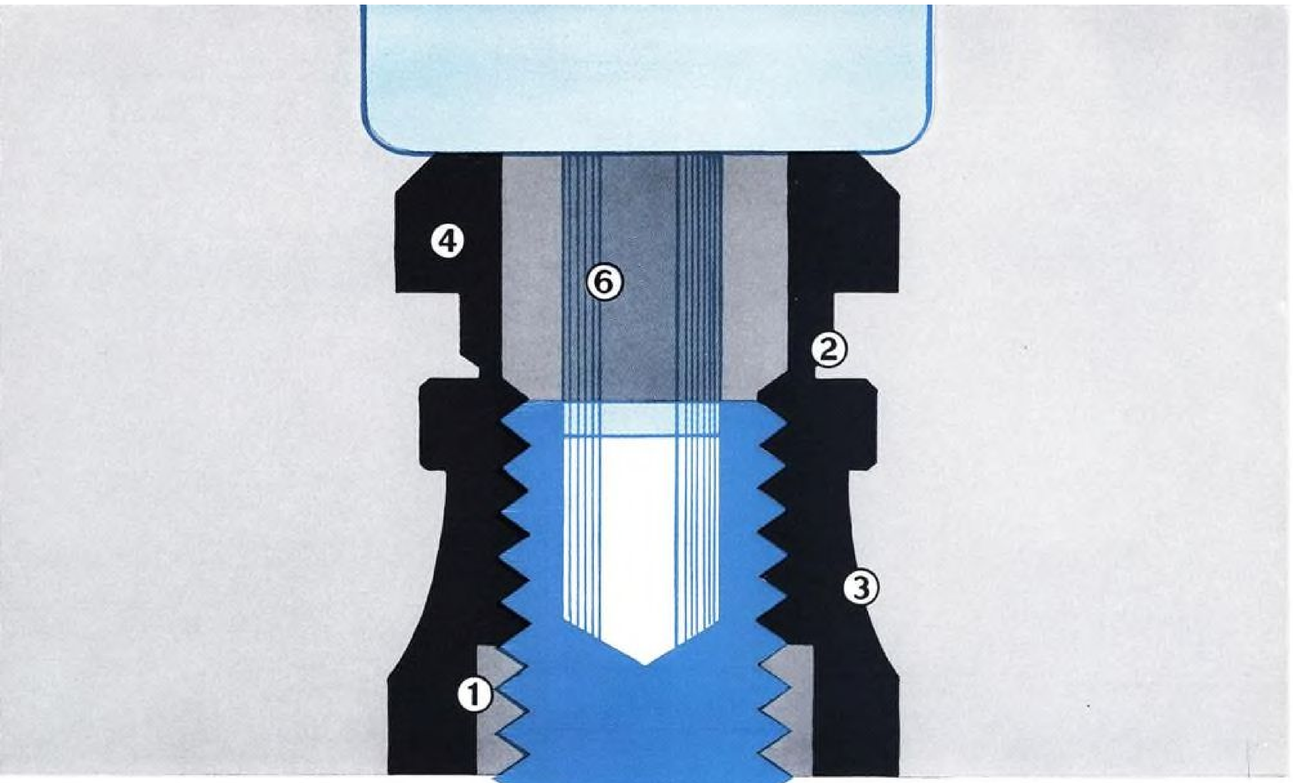
A McGraw-Hill Publication

November 21, 1960

SPECIAL REPORT:

Design Details Of Bell Hustler Rocket Engine

Avco Mk. 5 Re-entry Vehicle On Minuteman



*HI-LOK by VOI-SHAN

❶ Grip coverage: 1/16 inch min. Counterbore absorbs material thickness variation.

❷ Progressive tightening: Hi-Lok cannot over-torque. The collar separates at pre-established torque level.

❸ Weight savings: Hi-Lok is as much as 39% lighter than conventional AN bolt, nut, washer combination.

❹ Clearance: Hi-Lok pin head and collar diameters allow smaller wrench clearance. The "torque-off" hex-wrenching section projects to allow small tool accessibility.

❺ No recess in head: Improves aerodynamic qualities. 100° countersunk, close-tolerance, shear head style and sealing compound are used in wet wing assemblies.

Consistently controlled preload, minimum size and weight, plus speed of installation are outstanding advantages of the new Hi-Lok fastener now being produced by Voi-Shan. The Hi-Lok is the result of a design effort to provide an advanced fastener system incorporating as many desirable features as possible, with the greatest adaptability, in one product. Hi-Lok is driven from one side of the work, thereby saving in installation costs. Power tooling in use adds to time savings. Accurate, automatic torque control is incorporated by means of a closely controlled shear groove in the Hi-Lok collar. Available in a wide range of sizes and material combinations. The Hi-Lok is produced with the accepted Voi-Shan precision workmanship and quality control for maximum performance. Write for further details and specifications.

❻ Silent installation: Automatic and high speed power tool use is fast and quiet. Hand tool installation and removal is easy and permits re-use of the Hi-Lok pin.

VOI-SHAN MANUFACTURING COMPANY

A Division of Voi-Shan Industries, Inc.
8463 Higuera Street, Culver City, California

VSI

⑤

* Trademark Registered & Patent Applied For

GOODYEAR

CREDENTIALS FOR ANOTHER CAPABILITY

TREAD AND SHOULDERS ABOVE THE REST!



Say you're just about to lift a 100-ton jetliner off the runway. Behind you—a full passenger complement—fuel tanks topped off – turbines screaming at full power. Right now – a split second before breaking ground – *your tires will never take more punishment!*

But if they're Goodyear tires, they'll take it time after time. For these are the tires engineered to withstand higher loads and hotter temperatures for longer periods than any others. Whether the challenge is a 225-mph landing or an extended taxi run under load, Goodyear tires deliver performance beyond requirements. And the extra margin of reliability they provide in high-speed service, plus their longer tread and retread life, is money in the bank for airline operators.

Four major reasons account for Goodyear's commanding lead in aircraft tires:

1. Most advanced research, development, testing, and quality control facilities in the world.
2. Continuous rib treads that deliver the ideal life and stopping-power combination under both wet and dry runway conditions.
3. Unrivaled record of performance on all types of high-speed commercial and military planes.
4. Largest staff of expert aviation tire consultants, available for on-the-spot service everywhere.

Today Goodyear is fully capable of meeting *all* requirements for high-speed aircraft tires—for the jetliners flying now and tomorrow. Call your nearest Goodyear field office for complete details. Or write on company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. W-1715, Akron 16, Ohio. Remember—lots of good things come from Goodyear.



World's fastest 'runway" for advanced testing of aircraft tires is Goodyear's new multistage dynamometer system. First to accurately duplicate *all* tire operating conditions, system qualifies tires up to *320 mph*, tests materials at *500 mph*. Today it's checking out designs for 1970's tires!



Toughest jet tire is Goodyear's famous fabric-reinforced-tread tire. Diagram shows how extra-strong nylon fabric "belt" is built into tread just below surface. Fabric helps maintain tread integrity during brutal stress of high-speed landings and takeoffs.

AVIATION PRODUCTS

GOODYEAR

a message to men who are not alone in their thinking . . . Leonardo da Vinci, engineer, scientist, theorist, was the victim of an age when three centuries had to pass before many of his concepts could be regenerated by other men of vision. ☐ Today's quick minds are the fortunate product of an era when methods, materials and machines can be mated to their needs—an age when a spark of inventiveness ignites a fury of progress. ☐ If such a chain reaction of creativity is characteristic of your group, we invite you to discover how Ex-Cell-O can fuse into your operation a reliable source for precision products amply backstopped by research, development and manufacturing facilities, plus the experience required to help you meet the challenge of your own thoughts. ☐ Contact the Ex-Cell-O Representative in your area, or if you wish, call or write direct to our Aircraft Division's central offices, Detroit.

Artist's conception of Leonardo da Vinci's 15th Century spring-driven aerial screw, predecessor of today's helicopter.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN 60-11
Aircraft Division



MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O AND ITS SUBSIDIARIES BRYANT CHUCKING GRINDER CO., CADILLAC GAGE CO., MICHIGAN TOOL CO., SMITH BEARING CO. ☐ *EX-CELL-O FOR PRECISION* XLO

AVIATION CALENDAR

Nov. 27-Dec. 2—Winter Annual Meeting, American Society of Mechanical Engineers, Statler Hilton Hotel, New York.

Dec. 5-8—15th Annual Meeting and Astronautical Exposition, American Rocket Society, Shoreham Hotel, Washington, D. C.

Dec. 6-8—Annual Meeting, National Aviation Trades Assn., Oklahoma-Biltmore, Oklahoma City, Okla.

Dec. 6-8—10th Annual Meeting, National Air Taxi Conference, Oklahoma Biltmore Hotel, Oklahoma City, Okla.

Dec. 12-15—Atomic Industry Exhibition, California Masonic Memorial Temple, San Francisco, Calif., concurrent with the Atomic Industrial Forum's Annual Conference (Fairmont Hotel) and the American Nuclear Society's Winter Meeting (Hotel Mark Hopkins).

Dec. 13-15—Tenth Annual Eastern Joint Computer Conference, Hotel New Yorker and Manhattan Center, New York, N. Y.

Dec. 16—Army Aviation Contract Services Symposium, National Aeronautical Services Assn., Mayflower Hotel, Washington, D. C.

Dec. 17—24th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Dec. 26-31—127th Meeting, American Association for the Advancement of Science, New York, N. Y.

Dec. 28-30—Seventh King Orange International Model Plane Meet, Miami, Fla.

Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 9-13—International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Jan. 16-18—Seventh Annual National Meet-

(*Continued on page 6*)

AVIATION WEEK and Space Technology
November 21, 1960
Vol. 73, No. 21

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

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D&M's *New* NI-8 Antenna

THE CUSTOMED COMPLEMENT TO YOUR ***DME SYSTEM***

Whether you sell airplanes for executive or private use . . . or DME and Beacon systems, D & M's reliable NI-8 Antenna fits in perfectly to complete your equipment picture.

A versatile L-Band antenna, the NI-8 is the blade that makes the grade for DME or Beacon equipment operating between 960 and 1220 mc. Weighing 3½ oz. and only 3⅛ inches high, this unique little sealed unit does an all-round giant's job, unhampered by dust, moisture or other atmospheric elements.

Engineered and produced to the same high standards by which D & M antennas have continuously met rigid military and commercial aviation specifications, the low priced NI-8 provides the ultimate in dependable antenna performance for business and private aircraft.

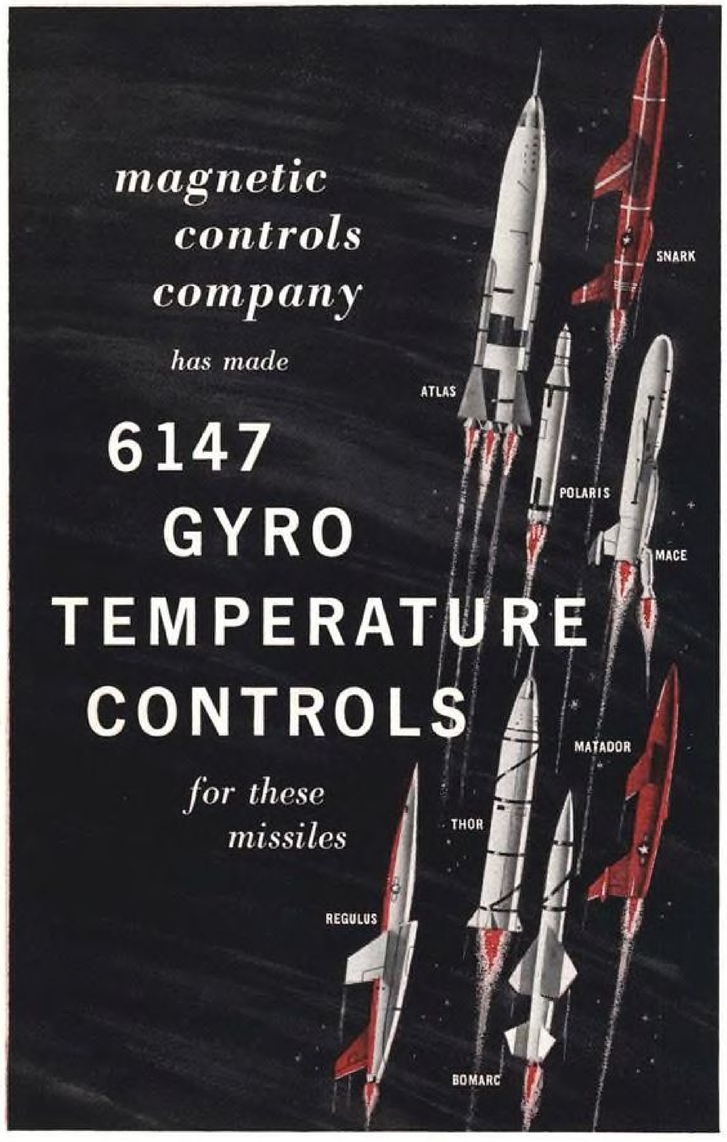
Full details available on request.

NOTE TO AIRLINES:
The NI-8 will soon be available with a Type C connector, making it the ideal replacement for antennas used with ATC Transponders.

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Heat Control Systems • Static Inverters • Voltage Monitoring Systems

AVIATION CALENDAR

(*Continued from page 5*)

ing, American Astronautical Society, Dallas, Tex.

Jan. 17-19—Winter Instrument-Automation Conference & Exhibit, Instrument Society of America, Jefferson Hotel and Kiel Auditorium, St. Louis, Mo.

Jan. 23-25—29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 24.

Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.

Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel, Philadelphia.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-15—Flight Testing Conference, American Rocket Society, Los Angeles.

Mar. 13-16—Test, Operations and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 5-7—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

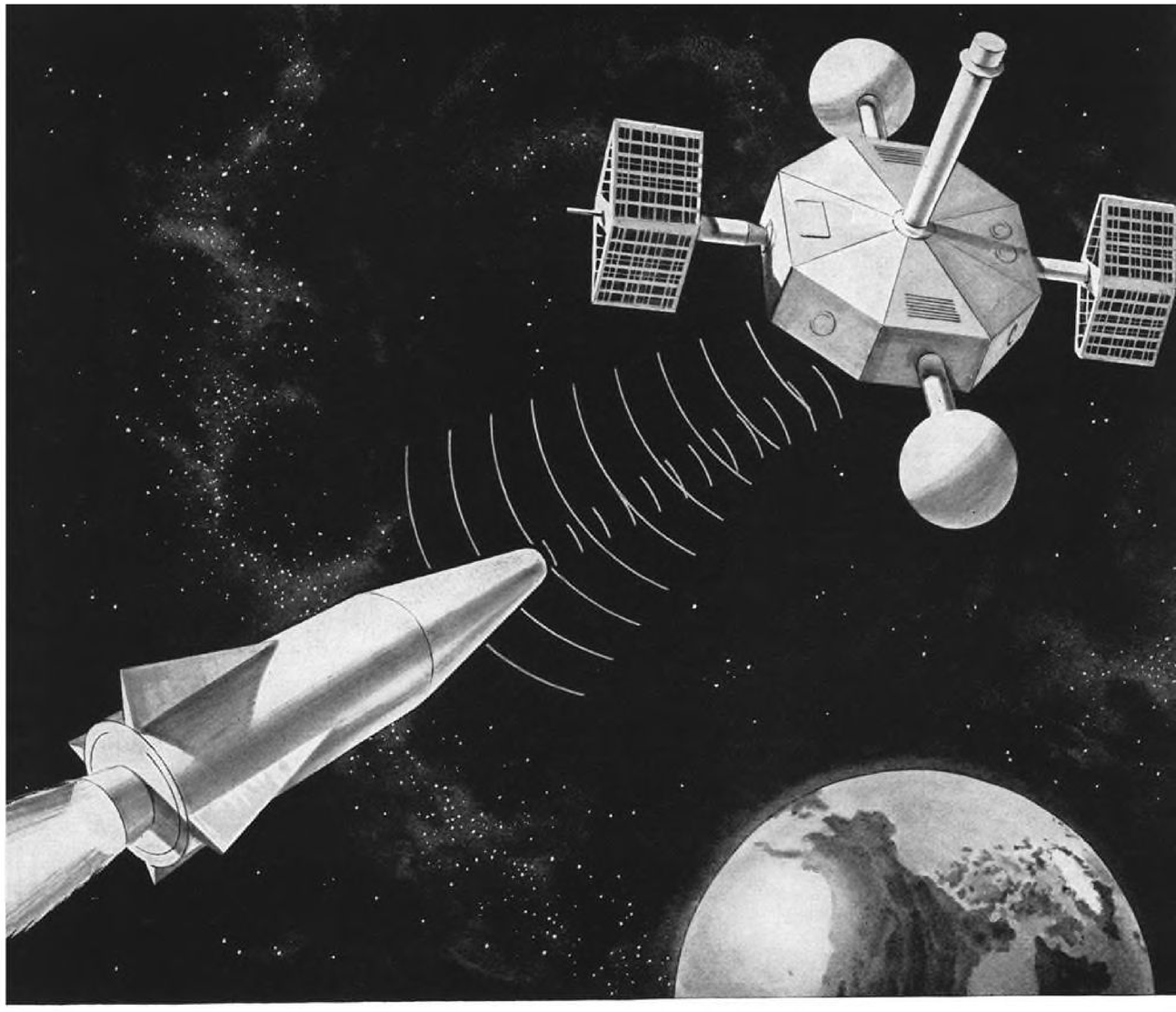
Apr. 26-28—Detonation & Deflagration Phenomena Conference, American Rocket Society, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aero-Space Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 22-24—National Telemetering Conference, Hotel Morrison, Chicago, Ill.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.



For Space Applications, Raytheon offers proven, off-the-shelf techniques in CW Radar

Raytheon has been investigating, developing and producing Continuous Wave Radars for more than ten years. Impetus for the program was the anticipated problems of clutter rejection, ever-increasing intercept velocities, and low weight-high reliability requirements in the aero-space era.

This pioneering effort has resulted in several dramatic achievements: multi-kilowatt, low noise transmitters; unique antennas that transmit and receive simultaneously; a feed-through nulling device that adds isolation to the antenna; precise, highly sensitive Doppler data processors.

Raytheon CW Radar Systems incorporating these advances are light weight, low volume and low cost. They are also simple, reliable, and require considerably less input power.

For satellite intercept, space rendezvous, lunar or planet soft landings . . . for any space application requiring velocity data . . . Raytheon can now offer *empirically proven* CW Radar techniques. Existing Raytheon CW hardware is now operational in Missile Guidance, Altimetry and Doppler Navigation Systems.

For CW Radar Brochure, write:

DIRECTOR OF MARKETING,
Equipment Division,
Department L-1, Raytheon Company,
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RAYTHEON EQUIPMENT DIVISION

EXCELLENCE IN ELECTRONICS

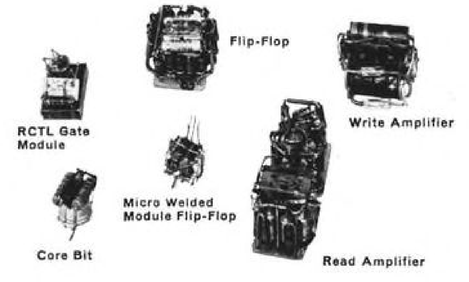
New Honeywell "blockhouse" means more accurate and reliable computers!



New computer "blockhouse" houses Honeywell's expanding inertial guidance computer programs. Located in St. Petersburg, Florida, the building adds to Honeywell's main St. Petersburg facility (shown in background). This is the only facility in the world built specifically for the design and development of inertial guidance systems.

Honeywell's basic computer building block modules.

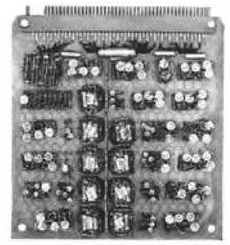
The Honeywell building block modules at right can be assembled in various combinations to provide exactly the computer functions required. Building block construction from on-the-shelf modules assures wider flexibility, greater reliability, faster delivery and lower cost.



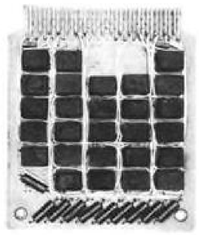
Honeywell's new computer building provides the most perfect environment possible for the development of more accurate and reliable inertial grade computers.

Within this new blockhouse, Honeywell now has under test or in production two advanced types of General Purpose Computers and two Incremental Computers. Three of these new computers are especially designed around Honeywell's new standard welded module computer building blocks. This welded module construction permits a high degree of miniaturization. Standard Flip-Flop module packing density, for example, is greater than 100,000 components per cubic foot. For the new Honeywell Micro Welded Module Flip-Flop, the packing density is 660,000 components per cubic foot.

These computer building blocks consist of two basic types of units —Aero-Space and Marine—as shown below.



AERO-SPACE UNIT



MARINE UNIT

To each of these units is added one of three Honeywell environmentally-suited memory drums shown. These drums feature:

- Up to 200 bits per inch
- 25 tracks per inch
- Multiple head assemblies for minimum adjustment
- T.I.R. Less than 50 millionths of an inch
- Head electrical characteristics compatible with solid state circuitry



2.5 inch rotor
56,520 bits



5 inch rotor
312,000 bits



8.56 inch rotor
161,200 bits

Honeywell has been developing a wide variety of Aero-Space and Marine Inertial Grade Computers since 1954. The company is fully qualified to develop and build environmental whole-number and/or incremental computers of an advanced nature to meet your special requirements. To learn how Honeywell can solve your inertial grade computer problems, contact your nearest Honeywell representative. Or write: Honeywell Aeronautical Division, Dept. AW-11-178, 13350 U. S. Highway 19, St. Petersburg, Florida.

Honeywell

H Military Products Group

Invent a nuclear way to make electricity?

We've a good mind to do it at ALLISON

DIVISION OF GENERAL MOTORS, INDIANAPOLIS, INDIANA

Imagine a nuclear power plant that can be sealed in a vault and produce electricity for years . . .

A regenerative, silent, portable power source with no moving parts . . .

An electricity-producing liquid metal fuel cell one-tenth the size of other types of cells generating equal amounts of power . . .

Allison researchers have applied for patents covering their discovery of such a power plant—the Thermally Regenerative Fuel Cell.

It can be used in submarines, power stations, space platforms, magnetohydrodynamic propulsion devices and in many other areas.

And this is but one of the research and development projects we're putting our minds to at Allison. In the nuclear area alone, we are working on a nuclear rocket engine, direct conversion systems, and, with the Nuclear Development Corporation of America under an AEC contract, on the Mobile Compact Reactor. Our efforts are aided by our Scientific Advisory Committee, American and European consultants, plus every resource General Motors commands.

Whether your problem is concerned with the heavens, the earth, or the oceans, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others, we could do it for you.

Illustrated is a laboratory model of a thermally regenerative liquid metal fuel cell for the conversion of heat to electricity, jointly developed by Allison and Delco-Remy Divisions.

ENERGY CONVERSION
IS OUR BUSINESS



Key positions open for nuclear scientists and engineers. Write: Mr. V. A. Rhodes, Scientific Personnel Recruitment.

Kodak
TRADEMARK

Recording the situation and environment



When aeroplanes had struts and guy wires, Kodak got its start making automatic aerial recording devices, the first of which may even have been marvelous.

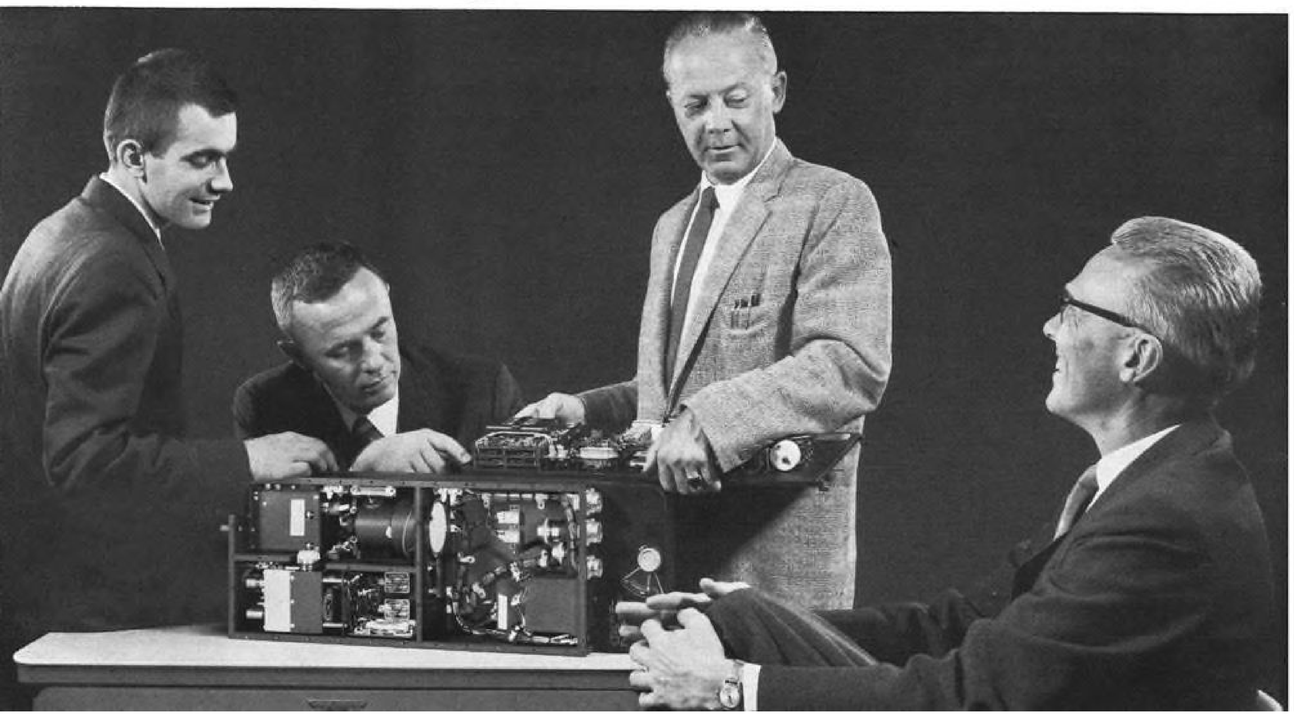
This is a picture of one, a K-1 Aero Camera. It could with one loading deliver 100 sequence exposures of the ground at an automatic fast or slow rate, depending upon the air speed of the plane it was flying in.

Motive power for the not-too-intricate but workable and automatic film-advance and shutter-clicking mechanisms being supplied by a gear train driven by a flexible shaft and air turbine arrangement. The turbine being attached outside of the plane in the windstream (importance of drag being then not what it is today).

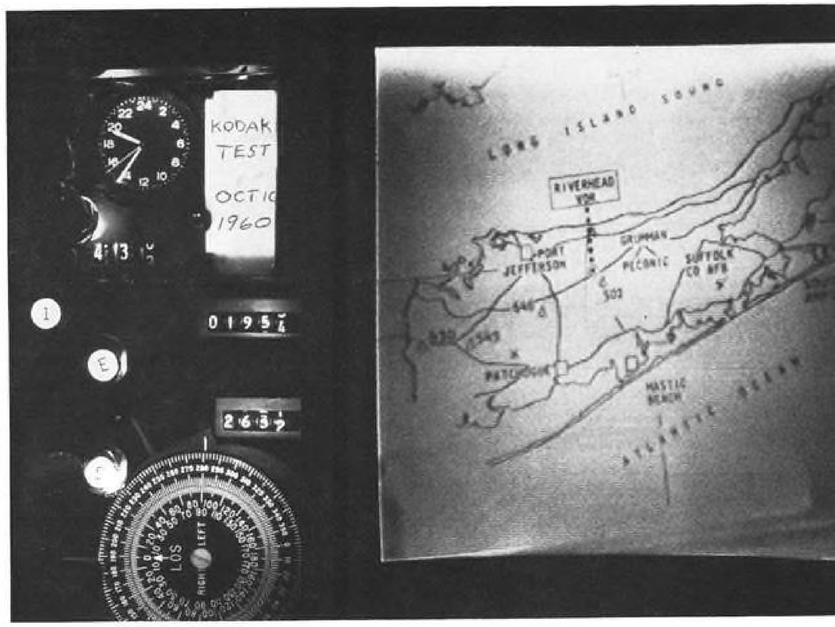
Another version—similar camera—was nicknamed "Whistling Jim," because its propeller-driven flexible shaft whistled eerily while it worked in the plane's slipstream. "Jim" worked well enough to justify government faith, and we were encouraged.

We are still encouraged, now that aeroplanes are called jets and rockets are called birds, to be asked to make some automatic photographic recording devices that can hardly be called mere cameras. Among these is a radar recorder we have just completed.

This is a picture of the complete package, along with some of the Kodak people who make up the *force in being* that created it.



–Kodak style



This is the kind of picture that Kodak built the radar recorder to deliver, though it never pokes a lens outside the confines of its aluminum honeycomb box.

Our invitation to invent a device like this probably came about not just because we have a reputation for wrapping up electronics, precision mechanics, optics, and photography into one package. We think we got the bid because somebody wanted to end up with a *good picture.*

The logic circuitry in this radar recorder is what allows the CRT display to present one and only one TV frame to the recording camera while the camera shutter is open exposing one and only one film frame. Fairly routine magic for a good magician, but it makes for nice, usable pictures.

Nested in amongst other Class II equipment somewhere in the bowels of the Grumman-designed A2F-1 "Intruder" for the U. S. Navy, this radar recorder will go about its business of converting electrical signals into CRT displays, receiving and registering analog data, and presenting digital data—placing all on stage at the same time to be photographed automatically on signal, at a rate of 1 picture per minute or 2 pictures per second. All this takes place in a little more than a cubic foot of space and costs only 31 lbs. in weight.

Later on, when training officer or debriefing officer wants to know the who, what, where, when, why, and how of the flight, a bit of film will tell much, much that human eyes had not even known they had seen.

In this case, the bit of film happens to be Kodak Plus-X Pan Film, 35mm.

That Plus-X is currently a popular film name was no criterion. Our Photorecording Methods Division makes recommendations only after consulting a big list of Kodak *films in being*, the popular as well as the special-duty.

Have you ever heard of *Kodak Linagraph Shellburst Film,* which can pick out certain bright objects amid other objects of similar brightness? Or a special Kodak plate made flat to 0.00002" per linear inch for recording the paths of light-blinking flying objects against the stars on a clear night? Or *Kodak Linagraph Pan Film,* which is equally adept at seeing the point of inflection of a transient trace on a CRT or the condition of what has whizzed by on a supersonic sled track? Or *Kodak Linagraph Ortho Film,* an extremely high-contrast film, recently doubled in speed, which reads green-phosphor CRT displays with no strain?

And these make only a beginning to the story. No mention of new high-speed Kodak color films which reveal subtle and significant color distinctions, of aerial films for mapping and reconnaissance and the set of circular slide rules we put out for computing proper exposure of aerial films under all conditions. Or those Kodak films and papers with the unique capability of bringing an image to light immediately after exposure.

Information about these, any and all, is obtainable from *Kodak, Photorecording Methods Division, Rochester 4, N. Y.*

We pay good money to tell you about the radar recorder Kodak built and a few Kodak films not because we would like you to put on your hat and go out to buy one or the other. Rather, we would like to make an impression on anyone who thinks he has a problem in either instrument recording photography or any related device, invented or still to be invented, which ultimately must deliver a photographic version of events. We hope to leave the idea with you that at Kodak there exists a *force in being* which has the knack of finding good answers to such problems, and knows what to expect from photographic film, paper, and plates.

PHOTOGRAPHY
OPTICS
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For a booklet that succinctly summarizes our work in co-ordinating these fields, write Government Contracts Department.



Shall we meet and talk of the connection between our capabilities and your problems?

EASTMAN KODAK COMPANY, *Apparatus and Optical Division, Rochester 4, N. Y.*



High pressure, high temperature butterfly valve.



Hot gas control valve.



High temperature pressure regulator.



Ice pre-sensing and control devices.

PRECISION PRODUCTS DIVISION

WG

WESTERN GEAR CORPORATION

WESTERN GEAR ENTERS VALVES, CONTROLS FIELD

by R. B. WORL
Sales Manager
Precision Products Division

Precision Products Division of Western Gear has aggressively entered the controls field and now makes available a complete line of electro-magnetic valves, hot air and gas valves, time and pressure switches, pressure regulators and related control equipment and specialized test equipment for application in missile, rocket and aircraft systems.

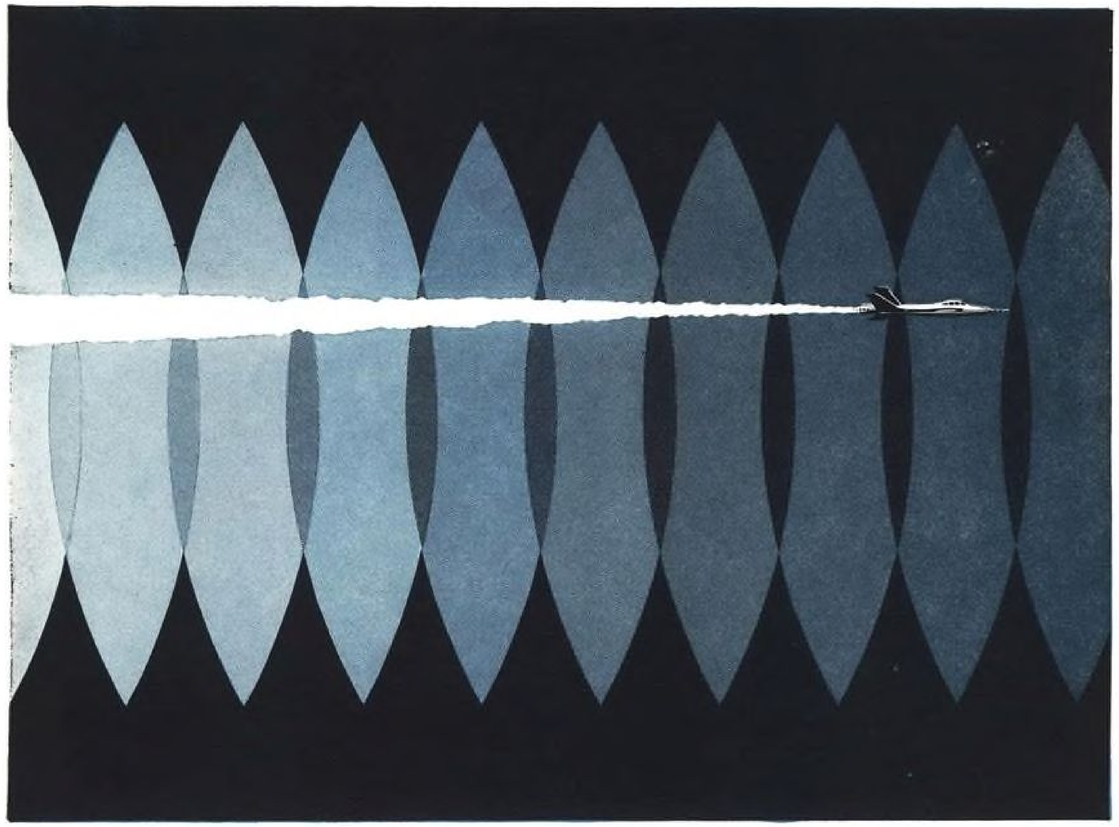
Precision Products Division will utilize designs and products of Teddington Aircraft Controls Ltd., recognized leader in the controls field throughout the world, under terms of a cooperative sales, service, engineering and manufacturing agreement.

Present applications include Rolls-Royce powered DC-8s, Boeing 707s, Fairchild F-27s, Caravelles, and numerous missiles.

Western Gear's Precision Products Division has long specialized in aircraft, rocket and missile components and systems as well as ground handling and test equipment.

For full information on Western Gear valves and controls, call or wire collect: Precision Products Division, P.O. Box 192, Lynwood, California; NEvada 6-0911.

Metallurgical Memo from General Electric



How a super alloy will hit Mach 3 from a vacuum start

Metallurgical Products Department reports on
René 41*—and how it combines workability with high strength
in high-stress components for jets

When jet-engine and structural component specifications call for the "impossible" – top strength combined with high temperature resistance and minimum weight – a vacuum-induction-melted alloy may be the answer. An outstanding example: René 41!

Made by the General Electric vacuum-induction-melting process, René 41 is virtually free from impurities; can be successfully forged, welded, or formed. With greater tensile and stress rupture strengths, René 41 permits higher operating temperatures and provides increased engine efficiency in jet aircraft. No alloy with comparable mechanical properties can approach the workability of René 41!

Got a design problem? Choose from General Electric's variety of high-purity, vacuum-induction-melted alloys in sheets, bars, billets, wire, or castings. For detailed information – or the assistance of one of our engineers – write today to: *Metallurgical Products Department of General Electric Company, 11107 E. 8 Mile Road, Detroit 32, Michigan.*

**René 41 is a trademark of the General Electric Company*

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS



Why the aircraft industry uses more Cutler-Hammer switches and power relays than any other brand

When human lives and huge investments of money are at stake, infallible operation of all component parts is essential. There is no place for a switch or power relay which doesn't perform with complete reliability.

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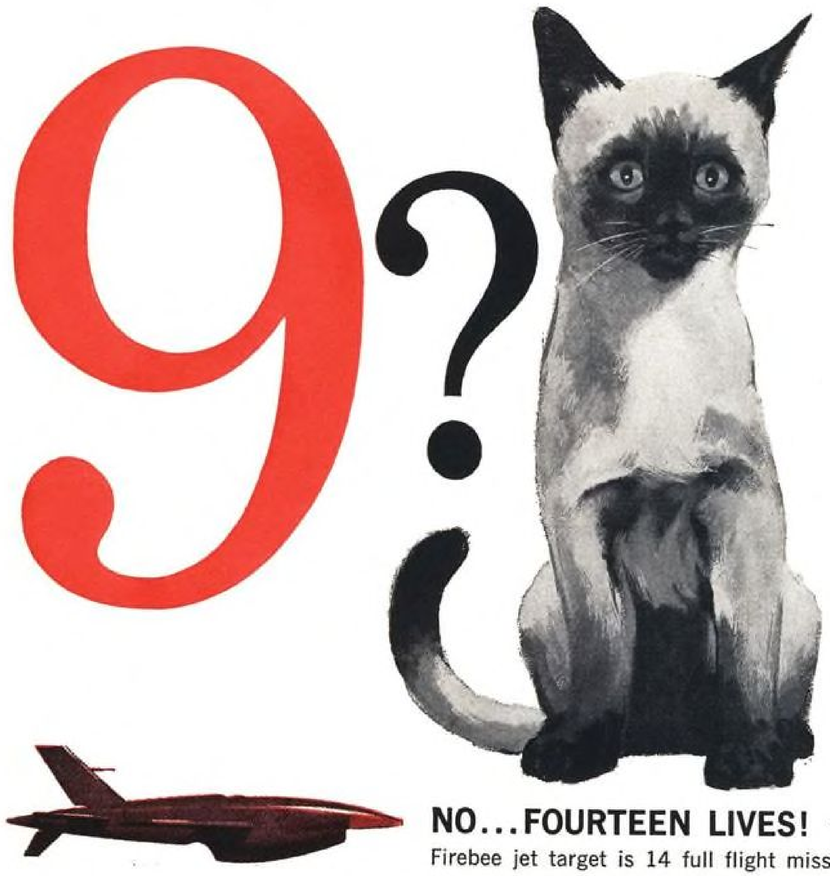
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**Based on Q-2C operations at Air Force Missile Development Center*

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November 21, 1960

Aviation Week and Space Technology

Vol. 73, No. 21
Member ABP and ABC

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COVER: First flight-test USAF Minuteman, fitted with Avco Mk. 5 re-entry vehicle, is being readied for December launch from Cape Canaveral, Fla. Black mark on extreme left side of nose cone is a circular flush-mounted antenna window for tracking. Dot on right side is telemetry antenna window. Banded interstage between nose cone and third stage contains R&D test equipment and is longer than structure that will be on operational missiles. Triangular fin-like fairings at base of interstage house telemetry antennas. Fairing along left side of third-stage casing is instrumentation raceway.

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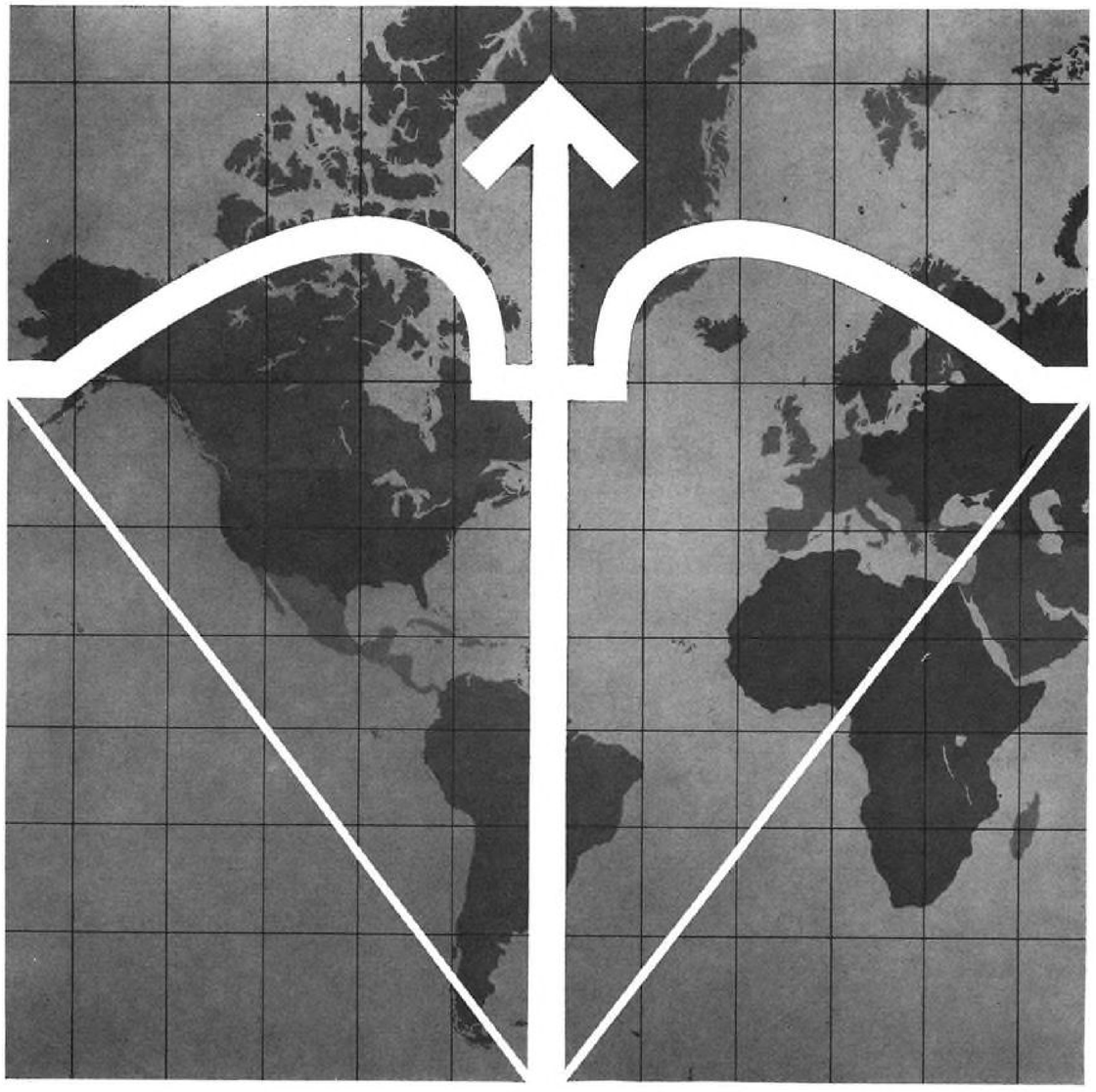
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EDITORIAL

The CAB Problem

One of the major problems that will be tackled by the administration of President-elect John F. Kennedy is a new look at the maze of federal regulatory agencies with a view toward speeding their actions and pointing their activity sharply at the current and future problems of the industries they serve. This would be in contrast to the backward-looking machinery that now makes their decisions ancient history by the time they are reached and contributes toward hobbling rather than helping either the industry involved or the public that uses it.

This problem has become particularly acute with the Civil Aeronautics Board which is dealing with an industry that changes so fast even its own management has trouble keeping abreast of technical progress and its economic impact. Former CAB Chairman James M. Landis, who has also had a distinguished career in other regulatory agencies of the government and a reputation for an incisive legal mind, has been working on this problem for the President-elect with a formal report due at the year's end. AVIATION WEEK's assistant transport editor David Hoffman, reporting from Miami Beach (see p. 37), details many of the salient points of the Landis recommendations for streamlining the federal regulatory agencies and we think there will be few who will disagree with these major proposals and some who will hope Mr. Landis may be recalled to apply them specifically to the CAB.

Lack of Experience Cited

One of the principal deficiencies of the agencies as they now operate, according to Mr. Landis, is the lack of experience by their board members in the fields which they regulate. This lack of expertise has certainly been a major handicap to effective functioning of the CAB. There have been few Board members in the past 15 years who have had any practical experience in the air transport field and in recent years this trend has grown even worse.

On the present Board only Alan Boyd has had flying experience, and it has been interesting to note his outstanding work even though he is one of the members of this august group. The CAB has become a convenient roosting place for political lame ducks, faithful party hacks awaiting another politically appointive sinecure on the federal bench or an occasional bright young lawyer on his way to better things.

Clearly the time is ripe to change the character of the Board by adding some members with some valid professional qualifications in air transport as the terms of incumbents expire. The first step should come with the appointment of an outstanding new chairman to fill the vacancy that will be left by the expiration of the term of John Bragdon, highway expert and West Point classmate of President Eisenhower, on Dec. 31. A knowledgeable and vigorous CAB chairman must be the key to any contributions this agency can make to an industry that is becoming increasingly entangled in the web of rising costs and falling load factors; over-competition and vastly increased seat capacity; and an increasingly complex pattern of jet trunklines, interlaced with feeder operations and helicopter shuttles.

These problems are already acute (for details see AVIATION WEEK transport editor L. L. Doty's report on page 35). Nor will they be solved by a simple rising level of the general economy even if this prospect was in sight. These problems are basic to the pattern of air transport as it is emerging in the jet age. They can only be solved by some fundamental reappraisal of the airline picture, not as it once existed in the DC-3 era and bolstered by precedents of the past, but as it is realistically operating today, bolstered by the trends that the present already indicates for the future. These problems involve not only the domestic route pattern but also the international scene where the combination of jet equipment and sharpening appetites of foreign airlines are changing the pattern that developed in the first postwar decade.

Regional Concept Obsolete

The speed and capacity of jet equipment have also rendered obsolete the regional concept of air transportation and the approach to regulatory and service problems based on that concept. Any change in a regional pattern with jet equipment now produces tremors that are felt globally. Among other things the CAB needs a broadgage approach to the whole problem of the jet age economic pattern as a substitute for the traditional segmented regional approach.

Naturally its procedures must be streamlined and speeded to permit handling of tomorrow's problems today rather than yesterday's problems tomorrow as the present pace dictates.

The domestic and international air transport pattern in the jet age is not only the swiftest reacting barometer to the fluctuations of the general economy today but is also a vital thread in this economic fabric. As such it deserves a regulatory agency staffed with sufficient expertise to understand and act on its problems and those of the public it serves and operating under procedures that will function with sufficient speed to be effective. Anything less than this will produce economic chaos and will increase the burden of federal subsidy in the jet age.

—Robert Hotz



ENEMY
LACK OF RECONNAISSANCE
"PROTECTS" THE ALLIES AT
GALLIPOLI

Gallipoli was a test for reconnaissance.

In 1915 the Allies struck at Gallipoli, intending to pierce the vital Dardenelles passage, capture Constantinople, remove Turkey as an effective fighting force and buoy the flagging spirits of their Russian allies. But the Gallipoli landings ran afoul of entrenched masses of determined Turkish troops. The stalemate continued from April through December, 1915. Finally, the Allied high command decided to evacuate . . . quite a trick when opposing trenches were often only ten feet apart! If the Turkish army should have an inkling of the evacuation before completion—if one effective reconnaissance flight were to examine the Allies' disappearing strength, it would mean disaster . . . perhaps the loss of more than 80,000 Allied troops.

But, while Turkish pre-war planning carefully built a large army, the generals ignored the value of reconnaissance capability, thereby allowing an entire army to escape intact. Allied planes, such as the Sopwith Baby, scanned the skies for Turkish and German recon planes. But none flew out to watch the exodus. For five days troops and supplies were discreetly taken off until only 1500 Allied soldiers manned the lines against the entire Turkish army. And finally everyone had gone. Casualties: 2 wounded.

The spirit and fierce resistance of the Turkish army had been manacled by lack of reconnaissance, a costly oversight.

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WHO'S WHERE

In the Front Office

Alfred L. McCarthy, Miami attorney, a director of National Airlines, Inc., filling the vacancy left by the resignation of **R. P. Foreman,** the corporate secretary.

Beech Aircraft Corp., Wichita, Kan., has elected the following vice presidents as directors: **Leddy L. Greever,** domestic sales; **Wyman L. Henry,** marketing; **James N. Lew,** engineering. Also elected a director: **A. R. Bell,** vice president-general manager, Beech Acceptance Corp.

William C. Whitehead, a director, Networks Electronic Corp., Van Nuys, Calif. Mr. Whitehead is president of Aerol Associates, Inc.

Leonard C. Marsac, president and director, Diehl Manufacturing Co., Somerville, N. J., a subsidiary of The Singer Manufacturing Co., succeeding **W. O. Langille,** now board chairman.

Alvin B. Beck, president, Air Express International Corp., New York, N. Y., succeeding **Chester M. Mayer,** who continues as board chairman and chief executive officer.

Henry C. Jones, president and a director, The Electrada Corp., Beverly Hills, Calif., succeeding **Homer H. Rhoads,** who continues as a director.

M. Lamar Muse, assistant vice president-planning, Finance and Planning Department, American Airlines, Inc.

Robert L. Wehrli, vice president and assistant to the president, Robertshaw-Fulton Controls Co., Richmond, Va. **Raymond H. Heller** succeeds Mr. Wehrli as general manager of the Aeronautical and Instrument Division, Anaheim, Calif., and **Charles H. Unruh** succeeds Mr. Heller as director of field engineering and sales.

J. Gilbert Nettleton, Jr., vice president-director of marketing, International Telephone and Telegraph Corp.'s Federal Division, Clifton, N. J., and ITT Laboratories, Nutley, N. J.

Charles B. Raybuck, vice president-contract management, Melpar, Inc., Falls Church, Va., and **William C. Purple, Jr.,** vice president-engineering and manufacturing. Also: **Dr. Paul E. Ritt,** director of research; **Robert S. Butts,** technical adviser to the executive vice president and general manager.

John D. Blitch, assistant to the executive vice president, Convair Division of General Dynamics Corp., San Diego, Calif.

Perry R. Roehm, executive vice president, The Barden Corp., Danbury, Conn.

Paul A. Pitt, vice president-engineering, Solar Aircraft Co., San Diego, Calif., a subsidiary of International Harvester Co. Also: **Sumner Alpert,** manager of a new division which includes Solar's aerospace, ground support and industrial products.

W. V. Warner, vice president-sales, Ford Instrument Co., Long Island City, N. Y., a division of Sperry Rand Corp.

William G. Sterns, vice president-engineering, Meridian Metalcraft, Inc., Whittier, Calif.

Russell E. Bowditch, vice president-marketing, Transval Electronics Corp., El Segundo, Calif.

(*Continued on page 132*)

INDUSTRY OBSERVER

► Requests for proposals on Tactical Air Command's STOL fighter have been delayed about 90 days. Proposals originally were due Nov. 4, with contract award scheduled for early January.

► **Lockheed has a small Air Force contract to investigate a maneuverable manned space station, or space ferry (AW Oct. 3, p. 54). Initially studied jointly with Hughes, the satellite rendezvous vehicle now is being investigated by the missile and spacecraft department of the preliminary design division at Lockheed's California Division. Company has made proposals based on its space ferry studies to Boeing for possible application to the Dyna-Soar program.**

► Ryan Aeronautical Corp. is developing a new version of the Firebee target drone, designated the Q-2D and designed to operate at altitudes up to 80,000 ft.

► **Bell Aerosystems Co. has designed a 5-9 passenger V/STOL aircraft in response to Air Force interest in a piggyback rescue system. Large aircraft, such as the C-130, would carry a VTOL aircraft or helicopter to the scene of an accident, extending the range of the vertical lift machine. USAF studies indicate the concept is feasible, but no formal design program has yet been launched. Bell V/STOL, now in partial mockup, would be powered by two rotatable ducted propellers mounted on wing tips and driven by twin turboshaft engines.**

► Douglas Skybolt air-launched ballistic missile test and evaluation program will be conducted from Air Proving Ground Center, Eglin AFB, Fla.

► **The three Project Apollo study contractors may be forced to assemble three completely different teams to accommodate National Aeronautics and Space Administration's desire for three distinct approaches to the problem. Convair, GE and Martin all have approached Aerojet-General about participating as propulsion unit subcontractor. Aerojet may be able to join two of the study teams by proposing a liquid rocket system for one, solid for the other.**

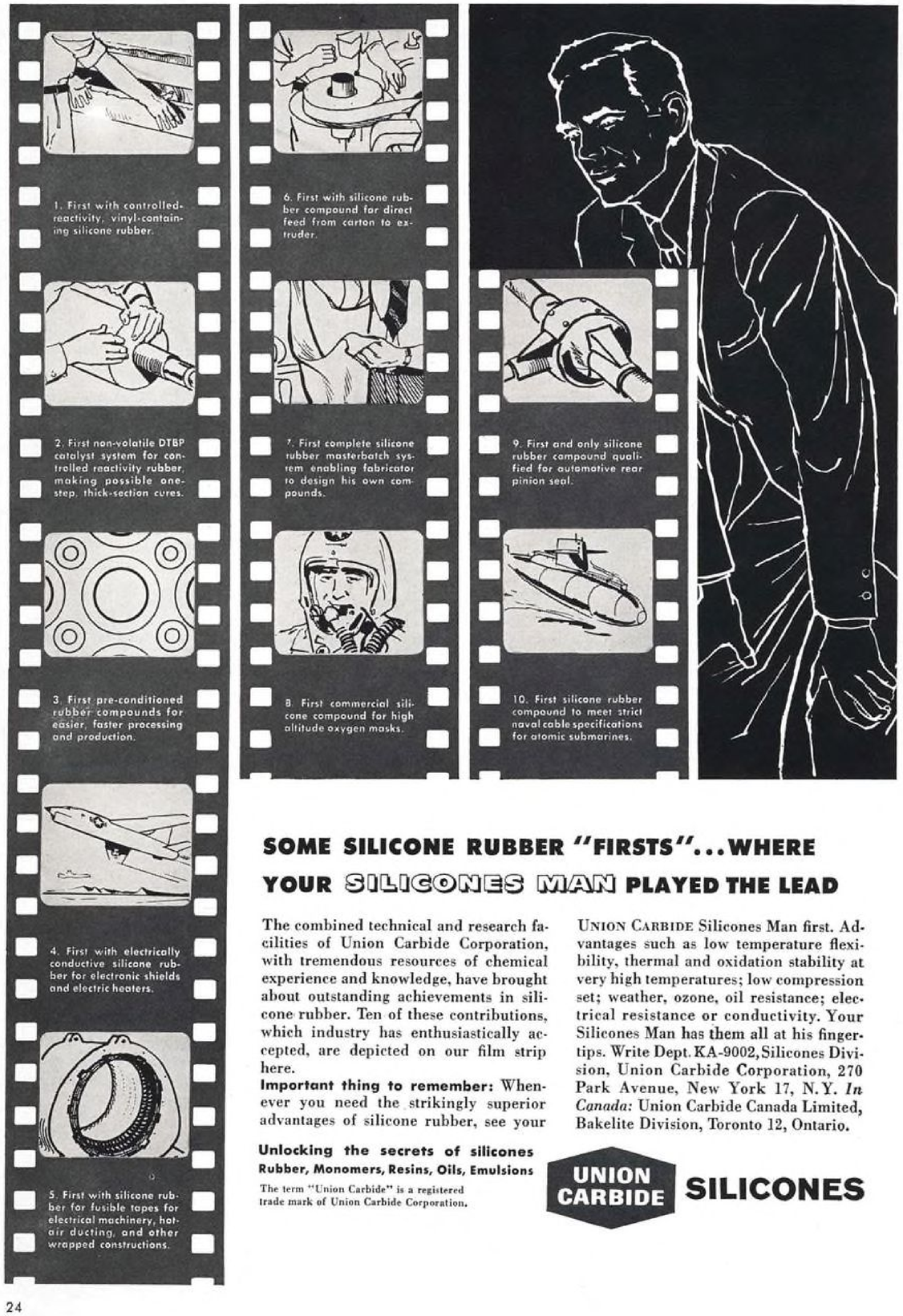
► Marine Corps now expects to reach a decision in its utility helicopter competition in January. Marines are evaluating the Sikorsky HR3S against Vertol's 107 Model II. Both are powered by General Electric T58-8 turbine engines.

► **Kaman K-16B amphibious VTOL aircraft currently is undergoing wind tunnel testing at NASA's Ames Research Center. Airframe is a Grumman Goose modified to a tilt-wing configuration, and the VTOL is powered by two GE T58-GE2A turbine engines (AW Jan. 11, p. 121). Tests will be completed next month.**

► North American XB-70 Mach 3 bomber will be fully dependent on a ground-powered hydraulic system to start its six General Electric J93 engines. Later, Y models will carry cartridge units for emergency starts independent of ground equipment.

► **Contracts for a 12-channel biological telemetry system, to be used on such vehicles as the X-15 and Dyna-Soar, will be awarded soon to one of nine bidders by Air Force Flight Test Center, Edwards AFB. System will have to be capable of transmitting a pilot's body temperature and galvanic skin responses, as well as electrocardiograms, phono-cardiograms and electroencephalograms.**

► New 24-in. diameter tire will be designed for the Convair B-58 in a competition Wright Air Development Division is conducting. Bigger tire will be designed to better withstand the takeoff and landing loads that have given the current 22-in. tire a short service life.



SOME SILICONE RUBBER "FIRSTS"...WHERE YOUR SILICONES MAN PLAYED THE LEAD

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UNION CARBIDE SILICONES

Washington Roundup

Soviet Export Drive

Soviet Russia continues to export fighter and transport aircraft and helicopters, making the sales an instrument of national policy by suiting the price to the customer's pocketbook—particularly if the customer is also interested in U.S. aircraft.

India and Russia now apparently have concluded an agreement under which Russia will furnish 8 to 12 Antonov An-12 four-engine turboprop transports, an advanced model of the An-10 Ukrania civil transport. The agreement also may include 10 Mil-4 helicopters. India has bought two Sikorsky S-62 turbine helicopters and has been considering the French Alouette III, but Russia may have beaten the U.S. and France on further sales. India wants the helicopters and transports for operations near the Communist Chinese frontier.

Morocco also has accepted an offer of Soviet military aid that includes jet aircraft. U.S. military aid in the form of trucks, Jeeps and communications equipment is arriving in Morocco now, and it is meeting strong opposition on the grounds that its acceptance may make the Moroccan government politically indebted to the West.

Russian propagandists are hammering hard at the British-U.S. agreement to base Polaris missile-firing submarines in Scotland. They are claiming that the U. S. is negotiating for similar servicing bases along the Arakan Coast on the Bay of Bengal and in the Baltic Sea.

Military Space Limits

Air Force is telling industry leaders in briefings that military space extends outward from earth to 10 earth diameters, or about 80,000 mi. Planning of weapons, defensive measures and related intelligence and logistic systems is based on this definition.

When Air Force adopted the term "aerospace" shortly after Sputnik I was launched, the implication was that it included everything from the ground up. With missiles going into underground silos and seaborne launching platforms under active Air Force consideration, a still more inclusive term may be needed.

The increasing emphasis on space has caused still another name change within the office of the Deputy Chief of Staff for Development. This office has been undergoing shuffles and title changes since Sputnik I. Its Directorate of System Development, headed by Maj. Gen. Marvin C. Demler, now has been renamed the Directorate of Aerospace Systems.

USAF has stopped referring to its proposed tactical range missile as TM-X and TBM, in another attempt to clarify terminology. It has adopted the term MRBM. The title of SOR 161 now reads "Specific Operational Requirement for a Mid-Range Ballistic Missile (MRBM) Weapon System."

The earth's only natural satellite caused a serious scare at the Ballistic Missile Early Warning System (BMEWS) station at Thule, Greenland recently. During initial operation of the station, radar signals suggested that the U. S. was under a mass ballistic missile attack. Shortly afterward, communications with Thule were suddenly cut off. But the radar signals turned out to be reflections from the rising moon, and the communications blackout turned out to be a purely coincidental break in a submarine cable, caused by a drifting iceberg. BMEWS computers now have been told what the rising moon looks like.

Progress on Zeus

Special Nike Zeus study group created recently by Richard S. Morse, Army director of research and development (AW Nov. 14, p. 27), has concluded its work and has produced a plan that would allow Army to begin a limited type of production before the Kwajalein test firings at Atlas targets are completed. The plan fully allows for cranking in technical changes as development progresses.

Optimism is the order of the day in the Rover nuclear rocket engine program. The promise of nuclear power for spaceflight, always considered great by those close to the project, now has rocket engine and airframe companies intensely interested and just as intensely competitive (see p. 33).

Martin, Thiokol and Westinghouse are the apparent winners of the latest contract award in the program—studies on the development of test and production facilities needed. Twelve companies bid for this, and more than half a dozen are expected to bid for development of the engine itself.

Success of the Kiwi-A3 test reactor caused National Aeronautics and Space Administration and Atomic Energy Commission to skip the preliminary engine studies, thereby gaining six months. Now, requests for proposals on engine development are expected to go before the end of this month, even earlier than NASA was predicting three weeks ago.

—Washington Staff

Europe Shuffles F-104G Production Plans

Final agreements may raise European licensed manufacture from previous high of 774 to 949.

By Cecil Brownlow

Geneva—A major reshuffling of West European production of the Lockheed F-104G, probably involving between 100 and 175 additional aircraft, is under way as Italy prepares to join West Germany, Belgium and Holland in the licensed manufacture of the all-weather supersonic interceptor.

Details of Italian participation in the program are still being threshed out in Rome, but final agreements between the principals involved could boost European licensed production figures from the previously planned 774 to a high of 949.

The Italian air force reportedly will fall heir to at least 100 of the additional aircraft. The West German air force, the initial and largest procurer in the European program, seems to be the best bet to absorb most of the remaining 75 if the 949 figure remains firm.

Lockheed Aircraft Corp. representatives were in Rome last week to complete their negotiations for the new arrangement. Italian officials expect representatives of General Electric Co.'s Flight Propulsion Division, manufacturer of the 15,000-lb.-thrust J79 turbojet engine which powers the F-104, to begin their presentations this week.

The over-all F-104 program may receive still another shot in the arm by an apparent U. S. decision to make it available to nations within Europe relying almost exclusively on mutual aid funds for major modernization of their air fleets.

Air Force Secretary Dudley C. Sharp recently announced during an Oslo visit that the U. S. will supply Norway with the F-104 to augment its present force of Republic F-84s and North American F-86 Sabrejets. Denmark also is expected to receive the Starfighter through the Mutual Aid Program. Other possible recipients that have been mentioned include Greece and Turkey.

Role for Fiat

In the West European production plan, Italy's entrance into the program will give a major role to Fiat in the manufacture of both the airframe and J79 components. It also is triggering a realignment in the groupings of participating firms (AW Aug. 15, p. 28).

Inclusion of Fiat and consequent shifting in the other alignments will boost the number of industry groups from two to three. Here is how the new alignment shapes up:

• **Belgian firms** of Societe Anonyme Belge de Constructions Aeronautiques (SABCA) and Avions Fairey are being pulled from the southern group which now becomes all-German in character, to join Fiat in the new partnership created by the realignment. SABCA, as prime Belgian contractor, had been scheduled to assemble 189 airframes—100 for the Belgian air force and 89 for Germany. SABCA's share in the program has now been trimmed slightly, to 182, matching the 182 assemblies assigned to its Italian partner. Of Fiat's total, 100 are expected to go to the Italian air force and most, if not all, of the rest to West Germany.

• **Southern group** of Messerschmitt, Heinkel, Dornier and Siebel will build 210 airframes under present plans as opposed to the 399 programed before the SABCA-Avions Fairey combine was withdrawn. Final assembly and flight test of the 210 aircraft remains the responsibility of Messerschmitt. All 210 are scheduled to go to the West German air force.

• **Northern group** composed of Holland's Fokker and Aviolanda and Germany's Focke-Wulf, Hamburger Flugzeugbau and Weserflug were scheduled to produce 375 airframes under original plans. There is a possibility that the number may be reduced. Of the 375—all to be assembled by Fokker—275 had been scheduled for Germany, 100 for the Dutch air force.

F-104G Test Force

West German, Canadian, Belgian and Netherlands air forces will team with USAF to form the F-104G joint test force for evaluating the F-104 weapon system. Col. William A. Kruge, AFFTC's director of fighter test forces, will become test director of the unit which will perform typical U. S. Air Force evaluation of the complete F-104G system.

Personnel named to the joint test staff are Maj. John R. Lyall, USAF, test force programing officer, Maj. Heinz Birkenbeil, West German air force member and test pilot, Sqdn. Leader John A. Tarzwell, Royal Canadian Air Force member, and Capt. James W. Wood, USAF, test force operations officer and test pilot. Belgium and the Netherlands are expected to appoint their members soon.

Turbojet Program

European licensed production of General Electric's J79 for the F-104 also is being shuffled to make room for Fiat.

Under original plans, J79 production was to have been split roughly along the lines of 60% for Germany's BMW Triebwerkbau GmbH. and 40% for the Belgian FN Works. Now the work will be divided evenly among BMW, Belgian National FN and Fiat.

BMW will have charge of the assembly of engines destined for aircraft of the West German air force, Belgian National FN for those going into Belgian aircraft and Fiat for those going to the Italian air force. Details as to just how the components' manufacture will be split among the three firms apparently has not yet been decided, although it is hoped that actual production can get under way sometime next year.

Italian participation in the F-104G program also should give a needed lift to much of that country's aviation industry since Fiat is expected to subcontract heavily to such firms as Piaggio, Industrie Meccanich Aeronautiche Meridionali Aerfer (Mechanical Aviation Industry of the South) in Naples and SIAI Marchetti of Milan.

As European production orders now stand, at least 574 aircraft are scheduled for Germany, 100 each for Belgium and the Netherlands and probably 100 for Italy.

When negotiations began, Italy announced that it could only fund production for 50 of the aircraft, a number obviously too low to make Italian production attractive. United States Mutual Aid officials offered to provide funds for an additional 25 if Italy would increase its own figure correspondingly. This plan providing 75 Italian-financed aircraft and 25 U. S.-funded F-104Gs is believed to have been agreed upon. A similar financing pact was recently concluded with Belgium (AW Oct. 10, p. 26).

If production orders for the northern or southern groups remain unchanged, the new arrangement seemingly provides a surplus of 75 aircraft that must be assimilated somewhere. These orders could be trimmed somewhat, with a cut in the northern group production most likely if there is a change.

An additional factor that could shave a few aircraft from European production is a recent West German decision to increase its order for F-104Gs to be manufactured by Lockheed in the U. S. in an effort to place a combat force in the field at the earliest possible date. Before the increase, Lockheed was to have produced 66 F-104Gs for the West Germans plus 39 two-seater trainer versions. Seventeen of the latter already have been delivered.

First German F-104G

Initial Lockheed-built F-104G for the German air force recently made its first flight (AW Nov. 14, p. 28), while the first European-produced aircraft is not expected to fly before December, 1961, and this date could easily slip.

While this decision could cut into the European production order, it is believed that the West German air force, rather than trimming, would like to further expand its orders and gain a more effective force.

One obstacle is the creeping increase in cost, from estimates earlier this year of approximately $1,175,000 per aircraft to the present figure of over $1.5 million.

Primary reasons behind the increases are the difficulties in bringing along and adapting advanced electronic systems designed to give the F-104 capability of all-weather interceptor and tactical bomber combined with the inherent problems of shifting the production effort from a single U. S. source to a number of European plants.

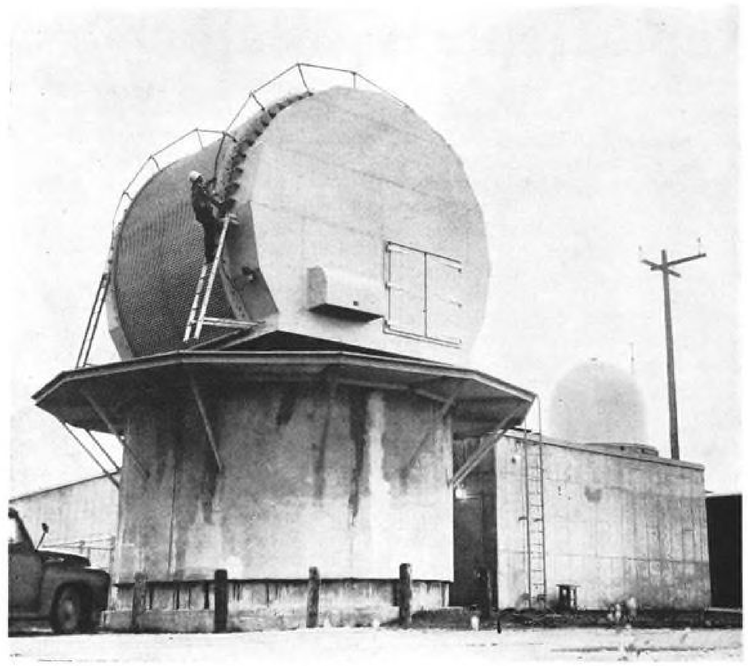
Norwegian F-104s

In announcing plans to supply the F-104 to Norway, USAF Secretary Sharp failed to mention the model number or just where they will be procured. Ostensibly, they could be supplied from surplus stocks of the U. S. Air Force day fighter version. However, to provide greater capability and maintain standardization with Europe, they are expected to be F-104Gs built by Lockheed in Burbank.

Norwegian defense officials say they expect initial deliveries of the F-104 in late 1962, which the European combine could hardly meet without giving Norway priority over participating countries, a highly unlikely possibility. Another factor is that the aircraft will be funded entirely by U. S. mutual aid funds and, as European aviation firms have regained their strength from the lows of the post World War II era, the policy of offshore procurement has gradually declined in purchases of hardware financed entirely by the United States.

No mention was made of the numbers of aircraft involved, but it is expected to be enough to equip at least one squadron.

A similar number may be delivered to Denmark on the same basis.



Third Atlas Radio Guidance Site Now Operational

Strategic Air Command's Atlas ICBM radio-command guidance facility at Offutt AFB, Omaha, Neb., has been completed by General Electric ahead of schedule. System's precision tracking radar follows Atlas and a rate-measuring system determines the missile's velocity and acceleration. Signals are sent from ground station to correct the missile's flight path. When proper velocity and trajectory are achieved, a signal is sent from the launch operations building to the ICBM to stop its engines for proper trajectory to target. Similar operational radio-command guidance facilities are at Vandenberg AFB, Calif., and Warren AFB, Cheyenne, Wyo. Photo shows precision tracking radar (left foreground) and white radome (right background) which houses antenna for rate-measuring subsystem. The radio-guidance system will be integrated with other parts of the Atlas weapon system.

U-2 May Monitor Mercury Flight

Washington—Defense Department is considering the Lockheed U-2 as chase aircraft to photograph the terminal phase of Redstone-boosted Project Mercury capsule flights.

The U-2 could photograph the entire operational sequence of the recovery parachute beginning at 42,000-ft., where it inflates after the capsule re-enters the atmosphere in a 200-mi. ballistic flight. Although no decision has been made on use of the high altitude aircraft in obtaining data on the Redstone-Mercury flight, two U-2s now are at Patrick AFB, near the Atlantic Missile Range. Defense Department is handling the search and recovery aspects of Project Mercury for the National Aeronautics and Space Administration.

U-2s Returned

In another U-2 development, Strategic Air Command is scheduled to return three of these aircraft to Laughlin AFB, Tex., next week from Australia after they have completed the first half of a two-part mission of sampling radioactivity at high altitude. The aircraft are stationed at the Royal Australian Air Force Base, East Sale, Victoria. They are sampling fallout between 40 and 50 deg. south latitude. The U-2 contingent is scheduled to return to East Sale in May to fly second part of the mission.

U-2 in Australia

Presence of U-2 aircraft in Australia has not been overlooked by the Soviet Union which has called their mission one of spying and a prelude to use of Australia as a rocket and atom bomb test site. Australian pacifist group, Victoria Peace Committee, demonstrated for removal of the U-2, but the Australian government denied allegations that they are spy planes and announced that findings will be published by the United Nations.

Rand Reports Weather Satellite Benefits

By Edward H. Kolcum

Washington—Economic potential in the use of satellite-produced weather data has been described by Rand Corp. in the first of a series of studies on the social impact of space research.

Rand reports that there is significant economic potential in the improved meteorological information and forecasting that would result from satellite observations. Most of this potential lies in savings which would come from better planning and reduced storm damage made possible by better weather information.

These preliminary findings, backed by more specific evidence produced as Rand continues its study for the National Aeronautics and Space Administration, will furnish ammunition for officials in the space agency, the Weather Bureau and other agencies in their effort to build a broad, integrated weather research and reporting program.

Initial Report

The Rand report is the first return from NASA's $400,000 investment in a broad program of studies to determine the impact in non-military fields of the rapidly expanding space research effort. These studies will produce the first significant non-technical data and opinion NASA will have available for its decisions on national space research goals, policies and levels of effort.

The degree of influence the social scientists will wield is going to depend on the policies of the new Kennedy Administration and on the recommendations the new President's NASA administrator makes to him. Reports will be available from all current studies by the time Sen. Kennedy moves into the White House as President late in January.

Fiscal 1962 Budget

NASA plans to continue the study program and is budgeting more than $500,000 for it in Fiscal 1962. Areas to be studied in the next phase will not be determined until the most comprehensive of the six current studies is completed next month. This is a survey by the Brookings Institution of the implications of peaceful space activity on human affairs, and it is expected to outline the areas of space research expected to be most fruitful from a social and economic standpoint.

Brookings study covers the effects of space research on economics, human behavior, domestic and international politics, national policy, potential by-products and the value of space research in the world as it is expected to be in the 1970s.

In addition to the Brookings survey and the Rand weather study, NASA is sponsoring these studies:

- **Government policy** on communications satellites and economic aspects of such satellites. United Research, Inc., is conducting a three-month study in this area, and the Rand Corp. has a contract for a longer range study.
- **Communications problems** between the scientific community and NASA are being studied by United Research.
- **Analysis of legal documents** relating to space and a proposal for control of space activities is being prepared by the American Bar Foundation.

Jack C. Oppenheimer, executive secretary of NASA's long range studies committee and monitor of its programs, said the communications reports will be received in January, and the Bar Foundation study is expected within the next several weeks.

Rand Studies

Rand is expanding its weather studies and is preparing a report on the economic effects of hurricanes. Rand also will report on the impact of improved weather information on air cargo operations.

While the Rand report predicts considerable economic potential in better weather forecasting techniques, it also warns that weather information will be valuable only if improvements are made in the means of communicating the best information quickly to those who need it to make decisions hinging on weather conditions.

In one case history, Rand cited a 100-day study of the Los Angeles area and concluded that full use of currently available weather information could cut economic losses caused by weather by a third, and improved forecasting could cut losses another 80% if the information were supplied efficiently.

In the study on weather information and its value to economic decisions, Rand does not consider technical aspects of satellite weather forecasting, but presumes that future forecasting will improve over present methods. The immediate conclusion is that better methods of forecasting and making known impending bad weather will mean fewer losses, for example, to airlines, in deciding flight routes and passenger loads; farmers, in crop choice, planting and harvest times; newspapers, in deciding whether to wrap papers in protective wax paper.

Rand has closely examined economic decisions pertaining to three specific industries to show that a framework can be established to investigate the value of accurate predictions. Detailed case histories were studied for:

- **Trucking**, specifically in decisions whether to protect a cargo at a cost of $200, or risk rain damage at a cost of $5,000. In an area having rain nine days out of 100, Rand has arrived at these weather cost figures: $200 per day to protect the cargo all the time; $220 per day if the cargo is never protected; $18 per day if the cargo is protected only when it rains.
- **Motion picture filming**, involving the decisions to film indoors or outdoors, with outdoor shooting having a $9,000 higher value than indoor work. In this industry, accurate forecasts can eliminate unnecessary costs of special lighting, cancellation of the day's work or early completion of outdoor filming.
- **Construction**, where direct value is not so pronounced because a contractor normally can cancel his crew with no payment if work has not begun because of bad weather. In the specific area studied by Rand, a roofing project, savings attributed to perfect forecasts would be small.

Rand has labeled the first report a pilot study to provide a basis for future policy, through analysis of improved forecasting and a rough estimate of its value.

The broad conclusion is that weather satellites will have value if they yield more or better information than existing systems for a given cost, or if they provide comparable information at a smaller cost.

NASA feels that weather satellites can furnish better information than present systems. Tiros I, the first experimental weather satellite, already has shown that individual storm types are identifiable from above by cloud vortex signatures, and a catalogue of these signatures could provide the basis for new forecasting techniques.

Dyna-Soar Communications Data Link

Los Angeles—Communications/data link subsystem of the Air Force's Dyna-Soar boost glider vehicle is expected to overcome one of the toughest environmental problems confronting communications with a space vehicle, namely the difficulty in transmitting through the plasma sheath which surrounds a re-entering vehicle.

The answer to this problem may hinge on the selection of a communication frequency band that lies within one of several possible "windows" in the spectrum. Communication equipment which transmits and receives on these frequencies may be able to penetrate the ionized layers created on re-entry.

For this reason USAF requested that companies which submitted bids on the communications/data link subsystem for Dyna-Soar direct equipment proposals to several frequency bands specified by the Air Force. Bidders were asked not to recommend selection of any one of these bands, presumably because selection would be made on the basis of Air Force-sponsored studies of the physics of re-entry communications.

About 50 companies attended the original bidders' briefing on the Dyna-Soar communications/data link subsystem but only 10 proposals were submitted for the $15-$25 million project (AW Nov. 14, p. 23). Several of the proposals represent team efforts. For example, one bid was filed for a team composed of the Airborne Systems and Surface Communications Divisions of RCA, Radiation, Inc., and Sprague Electric; another for Motorola and Cook Electric.

Airborne and ground equipment to be supplied may include the following:

- **Telemetry from glider to ground. This would probably provide monitoring of vehicle conditions as well as physiological responses of the pilot.**
- **Rescue and recovery. This would include a beacon and a transceiver so that the capsule and pilot could be found if landing occurs outside prescribed areas.**
- **Ground and airborne command transmitters and receivers for data and voice links.**
- **Airborne and ground signal generating, probably radar, tracking gear supported by large ground tracking antennas.**

Satellite Detection Shifted to Norad

Washington—Responsibility for military detection and tracking of satellites has been transferred from the Advanced Research Projects Agency to the North American Air Defense Command, indicating that operation of satellite kill mechanisms mightly eventually be assigned there also.

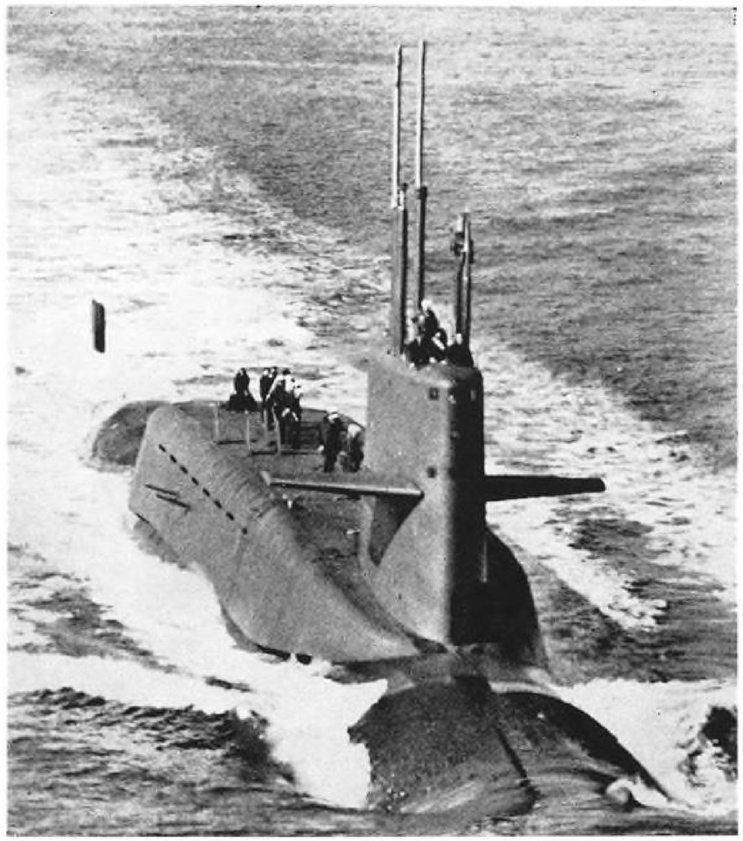
The detection system was considered far enough along in development of hardware techniques to be transferred to an operating command. The transfer also is expected to eliminate some of the differences between Navy and Air Force, which have operated separate parts of the system for ARPA.

Satellite detection and tracking will be integrated with NORAD's aircraft and missile detection and warning systems. Further improvements are expected to include greater range and wider coverage for the satellite tracking stations.

Main components of the current system are the Spasur (space surveillance) chain of detection stations stretching across the southern U. S. and operated by the Navy, with computing headquarters at Dahlgren, Va.; and Spacetrack, which includes military and civilian tracking stations reporting to Air Force, plus the USAF-operated National Space Surveillance Center at Cambridge, Mass., which receives, analyzes and catalogs space vehicle data from its own network and from Spasur.

Information formerly distributed to the world scientific community through the surveillance center now will be handled by National Aeronautics and Space Administration, under arrangements made by the Defense Department-NASA Aeronautics and Astronautics Coordination Board.

NORAD has responsibility for detection, identification and defense against aircraft. It also operates the Ballistic Missile Early Warning System and presumably will be given control of anti-missile missiles when they are developed. Transfer of the space detection mission to NORAD indicates that anti-satellite missiles and anti-satellite satellites—such as USAF intends to develop in the Saint and follow-on programs—would also be operated by this command in a continuing integration of the aerospace defense mission.



Polaris Sub Heads for Sea Duty

USS George Washington leaves Charleston, S. C., for sea duty, loaded with full complement of 16 Polaris A1 1,200 mi. range missiles, after completion of a series of underwater firing tests at Cape Canaveral, Fla. (AW Aug. 15, p. 19). Charleston is site for Polaris assembly and loading for nuclear-powered submarines. The George Washington later is expected to rendezvous with its tender, the Proteus, probably in January or February when a replacement crew will take over. Sister submarine, the USS Patrick Henry, will be deployed within a few weeks.

Target Plan Review

Washington—U. S. Defense Secretary Thomas S. Gates will review strategic target planning with Defense Department secretaries and members of the Joint Chiefs of Staff Dec. 1-2 at Offutt AFB, Neb. Targeting directorate was established by Gates last summer at the Quantico Secretaries Conference.

Minuteman May Get $1 Billion in Fiscal '62

Washington—Minuteman solid propellant intercontinental ballistic missile, which the Air Force now considers its optimum missile weapon system because of economy of production and operation, is scheduled to take a billion dollar bite out of the Fiscal 1962 USAF budget.

Projected spending was reflected in an Air Force announcement that the first Minuteman squadron would be in operation in July of 1962, a year ahead of schedule, at Malmstrom AFB near Great Falls, Mont. (AW Nov. 7, p. 71). The squadron will have 55 missiles in underground silos within a 115-mi. radius.

Minuteman packs less power in its warhead—in the low megaton range—than the Titan II, which is in the multi-megaton range. But its lower cost of $400,000 per launch compared with Titan II's $4 million, its lower support personnel requirement, and its availability in greater numbers will result in reduced over-all vulnerability and wider target selection.

Studies have revealed that development of missiles larger than the current ICBM size is not needed. Titan packs as big a punch as necessary and Minuteman missiles in large numbers can obliterate most targets, the studies indicated. Only large follow-on might be a solid propellant booster to carry a Titan II-sized warhead, making it a less complex weapon. Studies were conducted which contemplated capabilities of lifting warhead packages weighing as much as 30,000 lb.

In submitting its budget requests for Fiscal 1962, USAF indicated the importance it attached to the Minuteman program by asking $800 million in the lowest request it made—a budget totaling 5% less than USAF received in Fiscal 1961. If a budget of 5% or 10% more is approved, the figure USAF seeks will be $1.05 billion.

In view of the enthusiasm of President-elect John Kennedy and Congress for an accelerated missile program, Minuteman is almost certain to be earmarked for approximately $1 billion, no matter what figure is submitted to Congress originally by the Eisenhower Administration.

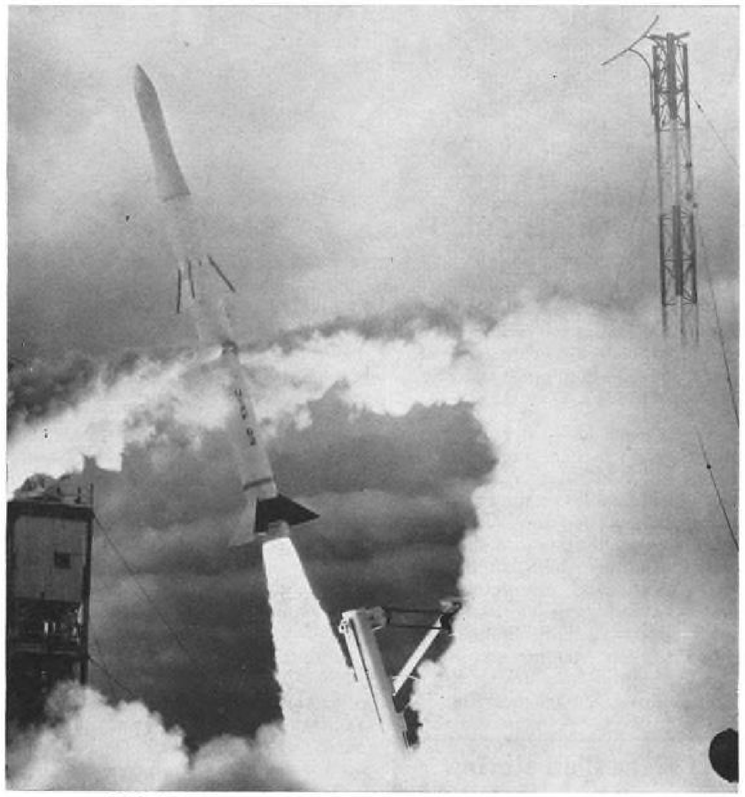
USAF's studies indicate that great numbers of enemy missiles would be required to knock out any significant portion of the ultimate Minuteman strength. Even firing by the enemy of several thousand highly accurate ICBMs of multi-megaton capability, with a high percentage of direct hits, would leave an estimated 5% of the Minuteman missiles ready to retaliate. This was considered to be the worst situation imaginable, and it did not take into account other U.S. retaliatory capabilities as aircraft, other missiles and sub-launched Polaris missiles.

Changing the degree of hardening of launching sites would materially affect the survival rate and force substantial changes in enemy plans regarding the number of missiles needed to deliver a severe blow. By having sites hardened to withstand overpressures of five pounds per square foot or less, numbers of hostile missiles in the low thousands would be required for a 95% attrition. However, if hardening goes into the hundreds of pounds per square foot, and a slightly greater error in accuracy is figured, the number of missiles required for a knockout blow goes to more than 10,000.

By advancing the operational date from 1963 to 1962, the period when Soviet missile numerical strength is expected to be at its greatest over U.S. strength, U.S. retaliatory power—including other missile and aircraft deterrent systems—still is expected to be capable of assuring a better-than-even exchange.

Present schedules for missile deployment call for operation of 13 Atlas squadrons with a total of 129 missiles and nine Polaris-firing submarines carrying 144 missiles by the end of 1962. This does not take into account the approximately level strength of the Strategic Air Command B-52, B-58 and B-47 bombers, and the attack aircraft aboard Navy carriers.

Economy in personnel is demonstrated by comparing the 500 men needed for a 55-missile Minuteman squadron—or a little more than nine men per missile—to the 600 men needed for a nine-missile Atlas squadron, which is about 66 men per missile.



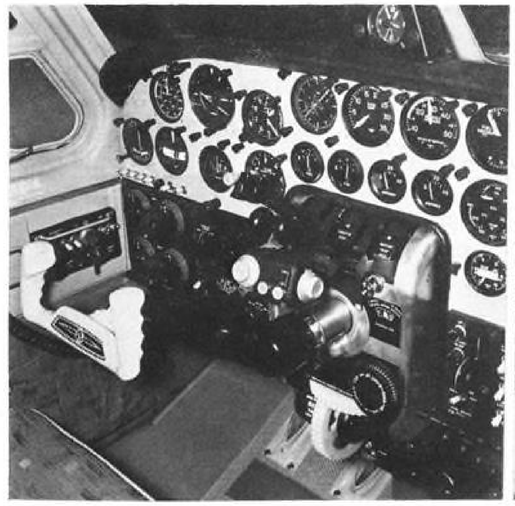
USAF Launches Second Blue Scout

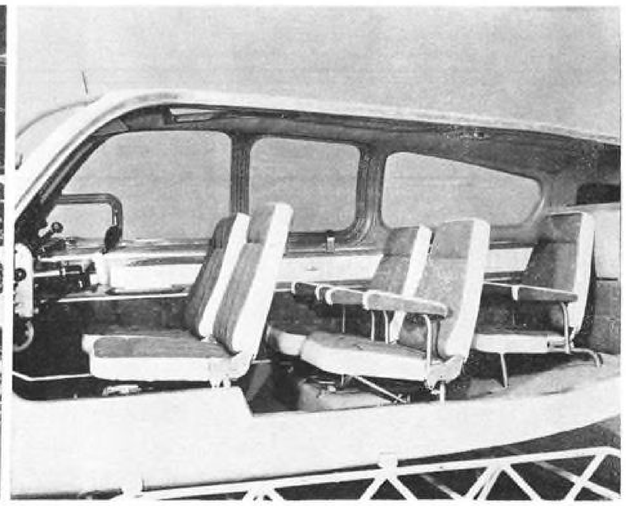
Air Force Blue Scout D-2 leaves its launch rail at Pad 18A, Cape Canaveral, Fla., in the second of 12 test flights planned for several variations of the Scout vehicle (AW Nov. 14, p. 38). Second stage premature cutoff halted the test after a 250-mi. flight. Note that hydrogen peroxide spin rockets have just ignited. Spin rockets stabilize unguided versions of Blue Scout at launch; fins stabilize vehicle when spin rockets burn out. First flight in September of a similar four-stage solid-propellant vehicle was not a complete success because fourth stage exhaust burned away some of the telemetry circuitry 8 sec. before burnout.



Swept tail distinguishes new Beech Model 55 Baron five-place, light-twin business plane, powered by two fuel injection, 260-hp. Continental IO-470-L engines. Baron has a top speed of 230 mph., gross weight of 4,880 lb., carries load of 1,920 lb. over 1,000 mi. range.

Beech Introduces Model 55 Light-Twin Baron

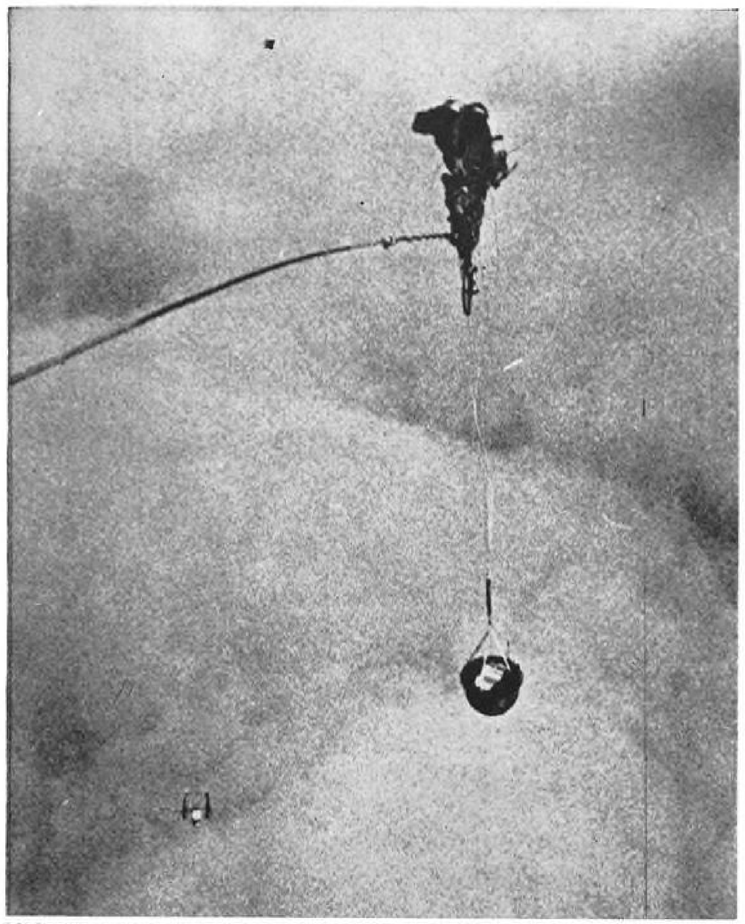




Instrument flight capability of Baron is indicated in panel provisions for IFR communications and navigation equipment. Center console groups engine and propeller controls. Control wheel is of the throw-over type. Cabin layout, at right, showing seating arrangement of 2-2-1 seats, is seen in mockup. Designed to handle load factors in excess of those required for utility aircraft, the Baron has an authorized penetration speed of 196 mph. in turbulence providing gusts of 45 fps. Large transparent areas in cabin (below) provide high degree of visibility. Like companion Travel Air, Baron's landing gear is patterned after that of Beech Bonanza.



Discoverer XVII May Yield Sunspot Data



DISCOVERER XVII CAPSULE trails behind Fairchild C-119 which retrieved it on second pass. The C-119 flying at lower altitude (below and left of capsule in top photo) would have attempted retrieval if the recovering aircraft had been unsuccessful. First pass by the C-119 was made at 11,000 ft., but was unsuccessful in snagging the capsule's parachute shroud lines in the C-119's trapeze-like gear, which is equipped with grappling hooks. Successful pass was made by same aircraft at 9,500 ft.



By Russell Hawkes

Sunnyvale, Calif.—Precise performance of the Agena B final stage of Discoverer XVII on its early orbits enabled USAF Satellite Test Center here to extend the duration of the test from 17 passes to 31 and gather more data in experiments called preludes to Samos and Midas.

Scientific experiments being publicized by USAF included:

• **Radiation counter** and an emulsion pack to explore radiation in the lower part of the Van Allen belts and perhaps learn the correlation between sunspots and the aurora borealis. The Discoverer XVII flight took place during a period of intense sunspot activity.

• **High-intensity light beacon** tracked optically by camera stations set up by the Smithsonian Astrophysical Observatory. Data are to be used as a check on the accuracy of Navy's Transit navigation satellite. Results of the experiment have already been called excellent.

• **Biological specimens** including artificially grown human cells, plant spores and bacteria. An industry official calls the biological experiments part of the direct preparation for a Discoverer flight in which a monkey will be aboard the recovery capsule.

Air recovery of the Discoverer XVII re-entry capsule was the second successful attempt and USAF officers are becoming more openly optimistic about the future of the technique. Atlantic Missile Range officials are reported to have once set the probability of successful air recovery at "one in 10, given Class A tracking and perfect vehicle performance."

Discoverer XVII was called the most successful operation in the Discoverer series by USAF officials. Vehicle performance was reported to be perfect and tracking excellent after the first pass during which radio transmissions from the orbiting Agena B final stage were weak and difficult to receive. Attitude control and retrorocket functioning during the re-entry sequence were obviously good, as the 300-lb. capsule fell within sight of four of the nine Fairchild C-119 recovery aircraft on station in the target area 500 mi. northeast of Honolulu 10 min. after ejection from the Agena B spacecraft.

The alternate aluminized and international orange gores of the re-entry capsule parachute were first visually spotted at an estimated altitude of 30,000 ft. Capt. Gene W. Jones, pilot of the successful recovery aircraft, made his first pass over the parachute at 11,000 ft., missed, executed a steep turn, and returned for the successful recovery at 9,500 ft.

The events of the Discoverer XVII flight were exactly the same as those programed for earlier Discoverers with Agena A spacecraft, aside from the new group of experiments and tests made possible by the larger payload of Agena B. Agena B has a dual-burn capability to permit considerable changes to the first orbit established, but there were never any plans to use it in Discoverer XVII. During Discoverer XVII flight, special attention was devoted to engineering tests of the Agena B attitude stabilization and control system because of trouble experienced with that system in the Agena A vehicle of Discoverer XV.

The successful launch of Discoverer XVII from Vandenberg AFB was made with a modified Douglas SM-73 Thor booster. The modified rocket is undesignated by USAF and is called DM-21 by Douglas. It is 10 ft. shorter than the Thor boosters used to launch Agena A Discoverers and other space vehicles because of the elimination of the guidance computer section. No guidance computer is needed in the Agena B Discoverers. The DM-21 has the improved Block I Rocketdyne engine used in late-model Thors and will burn RJ-1 fuel for the Agena B Discoverer series rather than kerosene.

General Electric phenolic nylon heat shield was used, the first time it has flown on Discoverer. This phenolic nylon type of ablation shield will be used on the forthcoming Discoverers which carry monkeys.

Micrometeorite Belt Detected

Pasadena, Calif.—A belt of micrometeorites the size of dust particles in orbit around the earth at altitudes between 100 mi. and several thousand miles has been detected by Explorer I, according to Dr. Albert Hibbs of California Institute of Technology Jet Propulsion Laboratory.

Dr. Hibbs said: "A close examination of the Explorer I data shows a strong change in micrometeorite counting rate as the satellite changes altitude. This effect could be caused only by a cloud of micrometeorites in closed orbits around the earth." Dr. Hibbs explained that the dust particles come in from outer space and are decelerated into highly elliptical orbits by the earth's gravitational field and the drag of its atmosphere. They remain in orbit for a few hundred or thousand passes before falling into the atmosphere and burning up. They are not expected to be a serious hazard to space flight.

House Group Asks Industry Help In Review of Rocket Programs

Washington—Industry has been asked to give the House Science and Astronautics Committee detailed help in preparing a review of current and projected rocket vehicle programs. The review is a part of the groundwork being laid for public hearings which the committee expects to hold early in the next Congress.

Companies are being asked to discuss 10 general areas of rocket development work. The committee is under considerable pressure to investigate certain specific contract awards made over the past two years by USAF and National Aeronautics and Space Administration or expected in the near future. In some cases, probing of the general subjects may form the basis for more detailed looks at specific contracts.

Senate Committee on Aeronautical and Space Sciences probably will be slower getting into hearings in the 87th Congress because it must be assigned a new chairman. Vice President-elect Lyndon Johnson has said he will not resign as Senate Democratic majority leader until shortly before he takes office on Jan. 20. Johnson was chairman of the Senate space committee in the last Congress, and its reorganization will be delayed if he does not resign until close to the 20th.

The Senate committee is expected, however, to release a report on space law before Jan. 1. The committee's staff also has completed a long technical report on the potentially controversial subject of policy planning for space telecommunications. Although the report contains no political implications in itself, the elections delayed its release because committee members did not have time to review it. A third report, which is a factual summary of the Saturn space booster program, also has been prepared. The committee hopes that these also can be released before Jan. 1.

The House study of rocket development will result first in a preliminary staff report. Its preparation includes visits to a number of rocket engine and airframe plants by Cmdr. Howard J. Silberstein, who is the service representative assigned to the committee for this year. Silberstein's previous assignment was in the Development Programs Office of the Office of Chief of Naval Operations.

Army, Navy, Air Force and National Aeronautics and Space Administration are assisting in the review. Companies have been asked to discuss these 10 areas of rocket work:

• **Value of liquid rockets** vs. that of solid rockets for use as large space boosters.

• **Application of atomic energy** to space boosters. This may go into the question of whether the Rover nuclear rocket engine now being developed by NASA and Atomic Energy Commission should be used as a first stage or only for upper stages. It also opens the way for questions on which company will develop and produce Rover. Rocketdyne Division of North American Aviation, Inc., now holds the contracts for all the large liquid rocket engine development being done for NASA and also has done considerable work on early Rover test engine components. Contractor for Rover will be selected within the next few months, and Rocketdyne's competitors can be expected to fight hard to keep Rocketdyne from getting this contract.

• **Hybrid rocket vehicles,** such as combinations of liquid, solid and atomic stages.

• **Whether proper boosters** are being developed to handle specific space payloads.

• **Significance of booster** simplicity and reliability in determining over-all project cost and project success.

• **Feasibility of recoverable,** reusable boosters for manned flights.

• **Need for development** of a family of space boosters not connected with intercontinental missile developments.

• **Need for an integrated,** well-defined launch vehicle development program for both military and civilian uses.

• **Availability of current** space vehicles to meet each company's program requirements.

• **Booster design** as it affects payload design from the standpoint of reliability, cost, environmental criteria and weight, vs. useful payload.

The House committee, which had 26 members this year, will have at least five new members next year. Reps. A. D. Baumhart, Jr. (R.-Ohio) and Erwin Mitchell (D.-Ga.) did not run for re-election. Reps. James Quigley (D.-Pa.), Leonard Wolf (D.-Iowa) and Edward Roush (D.-Ind.) were defeated for re-election. In addition, there may be some realignment due to the Republican gain in House seats.

The committee probably will make more use next year of subcommittees to explore specialized areas. It is expected to review the entire space program, paying particular attention to manned space flight and to duplication, overlap and conflict between civilian and military programs (AW Nov. 14, p. 25).

Defense to Operate Geodetic Satellites

Washington—Defense Department has assumed responsibility for the geodetic satellite program in a direct administrative transfer from the National Aeronautics and Space Administration.

NASA suspended all work on the project last August (AW Aug. 22, p. 32) pending a determination of whether it was to be a civilian or military program. Unmanned satellite committee of the Defense-NASA Aeronautics and Astronautics Coordinating Board, headed by NASA's Dr. Homer E. Newell, Jr., determined earlier this month that the military potential was the greater.

From a military standpoint, the satellite has the potential to fix with great precision the location of any possible target by triangulation of simultaneous pictures taken from ground stations of the high intensity lights which will flash from the satellite.

NASA said it could conduct the program only if the data obtained could be made available to the scientific community throughout the world. The agency had planned to launch the geodetic satellite to establish more accurately the shape of the earth, locate and map gravity changes, analyze moon mass and establish the gravitational center of the earth-moon system.

Defense has not assigned specific service responsibilities for the geodetic project, but the decision probably will be made to give payload responsibility to the Army—which handles mapping services for the Defense Department—and launching responsibility to USAF.

NASA Will Request Active Satellite Bids

Washington—National Aeronautics and Space Administration is developing an active-repeater communications satellite program which may go to industry as early as next month in the form of a request for test flight hardware design proposals.

Active-repeater communications system proposed by Hughes Aircraft Co. (AW Oct. 17, p. 26) already has been evaluated by NASA, but the agency says the project was entirely company-funded and a contractor for NASA's active satellite will be selected on the basis of future competitive bids.

Even if specifications are issued before January, it is not likely that NASA will commit money to the program until it is approved by Congress under a special emergency R&D funding category attached to the NASA appropriations bill for Fiscal 1961.

Special category includes $50 million to fund projects considered urgent. Before any of this money is obligated, however, NASA must justify the project, its cost and reasons for urgency to House and Senate space committees.

NASA Administrator Keith Glennan has said the space agency is planning an early flight to demonstrate feasibility of an active repeater, but the NASA program will not duplicate Defense Department Courier and Advent active satellites. Following Glennan's statement, Congress said it plans hearings to assure that duplication between NASA and Defense does not exist in communications, large booster and manned space flight projects.

X-15 Flies With New Engine

Edwards AFB, Calif.—North American Aviation X-15 powered by its new Reaction Motors XLR-99RM-1 engine (AW Oct. 24, p. 28), approached Mach 3 and reached an altitude of 80,000 ft. with speed brakes open and engine at idle power during its first successful test flight here.

Delays have plagued the testing of the new 57,000 lb. thrust engine on which design performance levels of the X-15 are based; successful flight was the sixth attempt. Afterward, North American test pilot Scott Crossfield said he believes the new engine will enable the X-15 to exceed design performance of Mach 6 speeds and altitudes over 250,000 ft. The next test may be scheduled within a week.

A North American spokesman said the XLR-99 engine was developing 28,500 lb. thrust at idle during the test and will reach a maximum power of 57,000 lb. thrust. The engine burns anhydrous ammonia and liquid oxygen. It is 6 ft. long, 40 in. in diameter, and weighs 910 lb. Crossfield reported that burnout came 137 sec. after ignition during the idle-power test. At full thrust, fuel consumption will go up to about 10,000 lb. per minute and burning time will be cut to 90 sec.

The drop of the X-15 from the Boeing B-52 mother ship was delayed about 10 min. by ice formed in a valve of the liquid nitrogen cabin cooling and pressurization system. Crossfield's pressure suit was inflated until he was able to direct a jet of hot air upon the frozen valve regulator to clear the line.

The X-15 which made the successful flight was the number two airplane, which previously had its back broken during an emergency landing due to an engine fire.

News Digest

Second flight of an Avco Mk. 4 Mod. 2 re-entry vehicle aboard a USAF-Convair Atlas was made over the Atlantic Missile Range last week. A data cassette, ejected from the nose cone during re-entry, was spotted by a JC-54 aircraft and recovered 1 hr. and 54 min. after launch by an Air Force Missile Test Center ocean range vessel, the Timber Hitch.

Convair-Ft. Worth was chosen last week to build the main wing box for the B-70 Mach 3 bomber under contract to North American Aviation.

Col. Nelson P. "Pete" Jackson (USAF ret.), Washington representative of the Joy Manufacturing Co. and president of the National Rocket Club, and Roger S. Bell, formerly with Litton Industries, Inc., were killed last week when a Navion flown by Jackson crashed into a mountain near Riverton, W. Va. Jackson, a West Pointer who was decorated 19 times as a flier in World War II, formerly was a legal and engineering consultant to General Electric Co.

Air France will order three more long-range Boeing 707-328s powered by Pratt & Whitney JT4 turbojet engines, bringing its total Boeing fleet to 20 aircraft. Delivery is scheduled for February-April, 1962. Air France also is buying six more Caravelles (AW Nov. 7, p. 43).

Army-Martin Pershing tactical range ballistic missile flew 160 mi. over the Atlantic Missile Range last week in the first fully successful test of both of its Thiokol solid propellant-powered stages. Launch was made from a prototype transporter-erector-launcher and the nose cone was separated but no attempt at recovery was made.

New Electronic Effect

New York—Discovery of a new electronic phenomenon which promises a major advance in molecular electronics and microminiaturization has been reported by General Electric. GE scientists have discovered that the tunneling phenomenon, which occurs in semiconductor materials, also takes place in two metal films separated by extremely thin insulator at near absolute zero temperatures. The discovery opens the way to an exremely low-cost electronic device which could perform a variety of different component functions, including switch, diode, triode, resistor and capacitor. New superconductive tunneling devices may prove as significant as the development of the transistor, a GE official says.

Lowest Trunk Earnings in Decade Forecast

Earnings may fall below $4 million level in 1960, following declining trend of first three quarters.

By L. L. Doty

Washington—Sharp dip in domestic trunkline net profits during the first nine months of 1960 coupled with a steady decline in the rate of traffic growth may depress year-end net earnings below the $4 million mark, the lowest level since 1949 when the industry turned its first postwar profit.

Earnings which will be reported by the 12 trunklines for the first three quarters of the year are estimated by AVIATION WEEK at $3.8 million, compared with a $51 million net profit registered during the same period last year. Since fourth quarter business in most years historically has produced only a slight profit if any, and since October traffic showed no marked improvement over the weak record of the past five months (AW Oct. 24, p. 52), the $3.8 million figure may stand as the 1960 industry profit.

Net earnings last year were $60 million. Highest profit level ever reached by the 12 trunklines was $63.1 million in 1955. First postwar annual profit was in 1949, when the scheduled domestic trunklines reported net earnings of $13.3 million.

Few bright spots appear in the over-all economic picture of the industry to create much cause for optimism this year. Revenue passenger miles for the first 10 months of the year climbed only 5.4%, contrasted with the 13-14% increase considered normal for the carriers as growth companies. Coach traffic, with its lower revenue yield, continued to play a dominant role in business volume although first class traffic inched slightly ahead of coach revenue passenger miles in October, the first month that this higher-revenue traffic has been in front since last June when coach traffic took the lead (AW July 18, p. 39).

Coach Growth Continues

Coach traffic continued to rise steadily in October, however, with a 24.8% increase in revenue passenger miles over October, 1959, compared with a 9.6% decline in first class revenue passenger miles. Load factor for coach traffic was 61% during the month, compared with 57% for first class, 59.1% for all traffic.

Seven of the 12 trunklines did show a net profit in the first nine months, although, with few exceptions, earnings were substantially below those reached last year. The net profit of $22.9 million estimated for these seven carriers will be all but erased by the heavy losses incurred by Capital, Eastern, National and Northeast.

Trans World Airlines will show an estimated loss of $493,000 on its domestic operations for the first nine months, but revenues from its international operations, particularly from economy services, will give the company a net profit of $6 million for the period. All but $4,000 of the airline's net was produced in the third quarter.

The industry's slight traffic increase generated increases in gross revenues, but the boost was not sufficient to offset the continuing upward trend in expense levels. In addition to normal cost increases, turbine transitional expenses have eaten deep into revenues.

For example, Delta Airlines operating expenses jumped 22% in the third quarter over the same period last year, compared with a 21% gain in gross revenues. Depreciation and amortization charges climbed 59% during the period.

Generally, the rising trend of unit costs does not appear abnormal in view of the over-all current economic situation. If any unit costs have moved usually high, they are in engine and aircraft maintenance, an understandable reaction to the switchover to turbine equipment, and in passenger service, an increase that may stem from stiffening competition within the industry. During the first six months of 1960, unit costs in these categories climbed 10% and 17% respectively over the same period last year.

Most airlines are faced with extraordinary increases in interest costs. American Airlines, which will report net earnings from operations of $6.9 million, reported an interest and miscellaneous expense increase from $685,000 during the first nine months of 1959 to $3.1 million in the same period this year.

American generated a 5.7% increase in revenue passenger miles during October to maintain a steadily rising trend in its traffic. Eastern, which reported a net loss for the nine months period of $5.7 million on all operations and a $3.6 million loss on domestic services only, will show a 13% drop in revenue passenger miles during October.

Eastern reported a drop in operating revenues of 1.9% during the first nine months of 1960, compared with the same period in 1959. The airline attributed an $8 million loss in gross revenues to a 12-day pilot strike. By cutting back jet available seat miles 7.5%, the airline was able to show a 3.1 point gain in load factors despite a 3.7% decrease in revenue passenger miles.

Eastern also apparently has suffered from a depressed off-season Florida market. Only airlines to report October load factors below the 50% level were the three which compete in this market along the East Coast—Eastern, National and Northeast.

First Class Increases

Northeast, however, was one of only three carriers to report an increase in first class revenue passenger miles during October. The airline recorded a 38% jump, compared with 13% for United and 19% for Delta. All other trunklines showed a drop in first class traffic volume.

On the other hand, Northeast and Northwest were the only two trunklines to show a decline in coach revenue passenger miles last month. All other carriers gained in this category. United led the group with a 63% increase.

United's greatly improved traffic performance this year is reflected in the carrier's report to its stockholders for the third quarter. Net profit of $7 million was the highest for any quarter in the carrier's history. Nine months net profit was $9.7 million, including revenues earned on the airline's Hawaiian route.

Western Air lines, which reported a total profit of $2.1 million, showed a decided climb in expenses and a revenue increase that fell short of early forecasts. Higher expense level was attributed to increased depreciation charges, additional costs related to the slowdown of the Lockheed Electra and transitional costs involved in the introduction of turbine-powered aircraft.

Depreciation and flying equipment



Swing-Tail Canadair CL-44 Makes First Flight

Canadair CL-44D4 swing-tail turboprop transport made its first flight last week at Montreal, Canada. The engineering test flight lasted 1 hr. 20 min. Fuselage fairings just forward of tail cover the swing-tail hinges (AW Sept. 5, p. 39). Payload is more than 66,000 lb. First swing-tail CL-44 is the ninth aircraft off the CL-44 line. The preceding eight are side-loading CL-44-6 aircraft for the Royal Canadian Air Force. Three U. S. cargo lines have ordered 17 CL-44-D4s.

rentals in the nine month period totaled $7.9 million, against $4 million in the 1959 period. Increase includes $1.5 million from accelerated depreciation of Western's Douglas DC-6B fleet.

During October, Western showed a 31% decline in first class revenue passenger miles and a 23% increase in coach traffic. The change is reflected in the carrier's 24% cut in the volume of first class available seat miles and a 23% increase in coach available seat miles.

Continental Air Lines reported the best nine month period in its history. Gross revenues of $45.7 million were 44% above revenues in the same period of 1959. Net operating profit was $4.9 million, an increase of 80% over the operating profit for the first nine months last year.

Continental's revenue passenger miles reached a total 46% higher than the volume produced in the first nine months last year. In October, however, Continental's revenue passenger miles dropped 13%, and system load factor fell from 57.6% in October last year to 54% this year. Coach revenue passenger miles jumped 27% in October, compared with a 5% dip in first class revenue passenger miles in the same period.

Braniff Boosts Coach

Braniff Airways put new emphasis on coach service with a 127% increase of coach available seat miles—to about ⅓ of total available seat miles, compared with roughly 1/7th last year—and generated a 152% increase in coach revenue passenger miles. First class available seat miles were cut 16% in October, and there was a 12% decline in first class revenue passenger miles. Braniff will report an estimated $812,000 net profit for the first three quarters of 1960.

Northwest will show a net profit for the nine month period, although the carrier has had a recent traffic decline. The airline's Douglas DC-8 turbojet transport fleet was grounded by labor trouble for about half of October, contributing to the traffic decline. Revenue passenger miles in October dropped 10%, and available seat miles were cut 6%.

For the first 10 months this year, first class revenue passenger miles for the 12 trunklines fell 4%, and coach revenue passenger miles rose 18%. First class available seat miles climbed 1%, coach available seat miles increased 19%. First class load factor for the first 10 months for the industry was 57%, compared with a 64% coach load factor.

In October, only five carriers out of the 12 had an increase in revenue passenger miles in all categories of passenger traffic. Six carriers reported an increase in available seat miles for the month, sufficiently offsetting cuts by the remaining six to produce an industry increase of 4.8% in available seat miles.

Braniff Sues Lockheed

Washington—Braniff Airways filed a $2.4 million damage suit last week against Lockheed Aircraft Corp. and the Allison Division of General Motors Corp. to cover the value of an Electra turboprop aircraft which crashed near Buffalo, Tex., on Sept. 29, 1959. Filed in U. S. District Court in Dallas, the suit contends that while the aircraft is safe to fly at currently reduced speeds, it can not be flown safely at the speeds for which it was designed. Both the airframe and the engine manufacturer have been given 20 days in which to reply to the Braniff charges of negligence in design and manufacturing. Last May, Lockheed announced that both the Braniff crash and the loss of a Northwest Airlines Electra at Tell City, Ind., on Mar. 17 were traced to wing failures resulting from a coupling of vibrations between the engine and the wing.

Pan American Reports Profit, Revenue Gains

New York—Pan American World Airways reported a net profit last week of $7.3 million for the first nine months of 1960 on total operating revenues of $310.6 million.

Net income after taxes in the first nine months of 1959 was $6.3 million, and revenues were $266.3 million.

Passenger revenues for the 1960 three-quarter period totaled $248 million, a 20% increase over the $206.8 million generated in the same period last year. Net income in the third quarter amounted to $5 million, compared with $5.6 million in the third quarter of 1959.

Landis Urges Speed-Up of CAB Case Flow

By David H. Hoffman

Miami Beach, Fla.—Faster procedures and barriers to White House pressure will accelerate the flow of cases through Civil Aeronautics Board if President-elect John F. Kennedy translates the recommendations of James M. Landis into action.

Landis, for nine years dean of the Harvard Law School and a former CAB chairman, has undertaken a study of federal regulatory agencies at the request of Sen. Kennedy. Well advanced last week, this study is scheduled for completion in mid-December. Landis, here for the Air Line Pilots Assn. convention, pinpointed some measures to make administrative agency proceedings less cumbersome and less costly. All, he said, could be applied to the CAB.

Landis recommended:

- **Tightening up the rules** of evidence that govern what can and what cannot be introduced at an agency hearing.
- **Delegating more power** to examiners, giving them clear-cut authority to rule irrelevant "evidence" out of order.
- **Requiring interested parties** to send "professional representation" to hearings, thus avoiding the sidetrack discussions that fill today's voluminous records.
- **Limiting the definition** of who may appear at a hearing as a so-called "interested party."

Landis' report to Kennedy probably will contain another recommendation aimed at restricting the right of appeal from decisions reached by an examiner. If this step is taken, Landis said, dissatisfied parties could not "duplicate automatically" examiner-level hearings before the full Board.

To hold down the number of inconsequential appeals, to free Board members' time for the consideration of more important questions, Landis suggested that the agencies be given certiorari power similar to that exercised by the U. S. Supreme Court. This, in effect, would allow CAB to reject some appeal petitions while accepting others.

Despite his guarded disavowals, Landis frequently is mentioned as a possible Kennedy appointment to the CAB. Asked whether the President-elect had offered him such a post in the new administration, Landis last week replied: "No, and I hope he doesn't." He said, "I don't want to go to Washington," but declined to answer whether he would go if summoned by Kennedy.

Should Landis return to CAB in place of J. S. Bragdon whose term expires on Dec. 31, he probably will view feederline applications to serve big population centers with considerable skepticism. Explaining this stand, the 61-year-old attorney told AVIATION WEEK that during his tenure as CAB chairman in 1946-47, trunkline and feederline fleets were composed of the same aircraft—largely Douglas DC-3s and DC-4s.

Today, however, the local service carriers still depend on twin-engine piston aircraft while the trunks can afford jets. If a feederline is allowed to link two major terminals not now served, their populations might be deprived of jet service, Landis said. Fifteen years ago the qualitative difference between the fleets of large and small airlines led to less important consequences.

Returning to administrative agencies, Landis suggested that the whole purpose for creating them be re-examined. To himself he posed the question, "do they possess expertise in their subject areas?" and answered it by criticizing the quality of appointments during the last 12 years.

In attracting outstanding administrators, shortness of agency tenure stands out as a major handicap, Landis said. Thus a talented young attorney named to the CAB would have to consider that a few years later he may be forced to rebuild his entire law practice.

Landis also recommended that the operational departments of the FAA, and especially the Air Safety Division of CAB, recruit more experts with commercial flying backgrounds.

In forming the regulatory agencies, Landis said, it was assumed that they could conduct business at a pace more rapid than that found in courts of law and at less cost to interested parties. This assumption is not borne out by the Southern Transcontinental Route Case and the General Passenger Fare Investigation, both before CAB for several years.

The Southern Transcontinental Case, Landis estimated, already has cost between $10 and $15 million, without including government expense in administering it. Even relatively simple proceedings can cost hundreds of thousands of dollars, Landis said, pointing out that when he steered New York Airways' application for a certificate through CAB, costs exceeded $175,000.

New barriers, Landis said, should be erected around the administrative agencies to shield them from indirect pressure emanating from the White House. In the airline field, carriers disappointed with CAB route case awards have unobstructed access to the presidential staff and often make use of it. If they succeed in generating pressure and this results in a reversal, White House judgment has been substituted for that of the so-called experts on the Board.

Only once, Landis added, did the President's office intervene while he was serving as CAB chairman. The Board then was weighing a decision to award Northwest Airlines several stops inside the Soviet Union on the assumption that a U.S.-USSR bilateral soon would be concluded. State Department, through President Truman, ruled that such a move would be unwise, and today Landis agrees.

To further ensure that qualified and able people receive administrative appointments, Landis would abolish the joint opinions used by the boards, agencies and commissions in deciding cases, so relative ability could be judged and tenure regulated accordingly, he said.

TWA Fund Talks Go On

Negotiations were continuing last week between Howard Hughes on one hand and the Bank of America and Henry Crown, former chairman of Materials Service Corp., on the other on an interim financing plan for Trans World Airlines.

Materials Service is now owned by General Dynamics Corp., from which Hughes has ordered 30 Convair 880s, but Crown heads the family interest in many other enterprises. He is a director of the Empire State Building in New York, chairman of which is Fred Glass, mentioned earlier as a candidate for the TWA presidency.

The interim financing would remove some immediate pressure from Hughes Tool Co., which owns most of TWA's jet fleet and leases it to the airline (AW Oct. 31, p. 35), but will not solve TWA's long term financing problems. Hughes assets other than the tool company are reported involved in the negotiations.

Aeroflot Still Using Obsolescent Li-2s

Moscow—Russia's Aeroflot is still using its obsolescent Li-2, Soviet version of the DC-3, extensively on trunk routes despite official predictions that almost all of these transports would be shunted to local lines by the end of 1960.

Standard 15-passenger and modified 28-passenger Li-2s, cruising at less than 150 mph., still fly from Moscow to such important Russian cities as Bryansk, Izhevsk, Kazen, Kostroma, Kursk, Lipetsk, Magnitogorsk, Orel, Saratov and Tambov.

Drop Foreseen in MATS Airlift Awards

Belleville, Ill.—Annual airlift contracts due to be awarded by Military Air Transport Service within the next two weeks probably will total about $32.7 million—a sum 17% less than the $39,566,137 parceled out last year and considerably less than the $45 to $60 million some airlines had expected.

Despite MATS' preference policy, which favors carriers allocating the largest number of turbine-powered aircraft to the Civil Reserve Air Fleet, most airline cargo experts agree that no single operator will emerge from the bidding competition with the bulk of the awards.

Distributed last month, MATS' Request for Proposals (RFP) invited 21 CRAF-eligible carriers to bid for business involving the airlift of 221,628 military passengers to and from the European, Far Eastern and Alaskan theatres. Deadline for proposals expired Nov. 7. Contracts will run through the 1961 calendar year, not from Oct. 1 to Sept. 30 as in years past.

Basis for Bids

To encourage industry purchase of modern transports that would be available to the military during "emergencies," MATS has said it will accord preference to bids based upon:

- **Turbine-powered cargo** or convertible aircraft.
- **Turbine-powered passenger** aircraft.
- **Pressurized piston cargo** or convertible aircraft.
- **Piston passenger aircraft** with range to overfly the Atlantic while carrying maximum payload or to cross the Pacific with not more than one stop.

Additional preference, according to MATS, will be given carriers with broad "expansion capability." Thus the bidding form issued to the airlines contains a new section in which carriers are asked to list the number and type of four-engine aircraft they would allocate to the Air Force during "periods of emergency which do not justify activating CRAF."

Specified Aircraft

Aircraft specified in this section would include those with which the carrier intended to perform the contract it sought in submitting the bid. The aircraft also must be modified to CRAF standards and allocated to CRAF through the Defense Air Transportation Administration by Jan. 1.

Effect of encouraging expansion in this way is to create a first-line CRAF and a second-line CRAF within a single framework. In the event of localized emergencies similar to last summer's Congo situation, MATS could press certain aircraft into service at agreed rates without mobilizing the entire Civil Reserve Air Fleet or requesting new bids from the industry.

If the carrier's volunteered expansion capability "has not been committed" elsewhere, the government would retain the right to use the offered aircraft whether or not an emergency was declared. Because some of its transports still were committed to the Congo airlift, MATS in September had to farm out $401,135.90 worth of contracts to cope with its regular overseas airlift. And the Congo uprising, technically, was not an emergency.

Bid Evaluation

If bids were evaluated only in terms of how many long-range, jet-powered aircraft were placed at MATS' disposal, one or perhaps two U. S. flag carriers could walk away with the entire $32.7 million currently available for 1961. This is because Civil Aeronautics Board's 2.9 cents per passenger mile floor—a rate well above those usually quoted for MATS' business—ensures that almost all bids on a given contract will be identical.

To avoid penalizing smaller carriers that depend on government contracts for their profit margin, MATS softened the impact of the jet preference scale. It did so primarily by subdividing the annual contract into 10 and then 11 items or packages—the same procedure it used in awarding fourth-quarter airlift contracts to the industry.

"No more than one item will be awarded to one carrier until each eligible carrier has received an award, or no further items remain," MATS said in connection with the $9,311,594.83 award for October, November and December.

This formula guaranteed that Pan American, despite its sizable jet fleet, probably could capture only as much MATS business as was represented by the largest package. When the awards were announced, this proved to be $1,916,336.24. TWA's award was $1,735,258.80. Of the 11 carriers winning fourth-quarter contracts, only these two are fulfilling them with turbine-powered equipment.

That small carriers again will capture a large slice of the 1961 awards is regarded as almost certain because of the RFP's structure. To illustrate, MATS' 1961 requirements have been subdivided as follows:

- **Item 1:** 14,400 passengers round trip from Travis AFB, Calif., to Yokota Air Base, Japan, via Honolulu. Its probable value based upon 13,502 stat. mi. at 2.9 cents per mile is $5,638,435.
- **Item 2:** 10,800 passengers from Travis AFB to Tachikawa or Yokota Air Bases in Japan via Honolulu and return. Probable value, $4,226,321.
- **Item 3:** 17,358 passengers round trip from McGuire AFB, N. J., to either Mildenhall Air Base, Great Britain, Orly Field, France, or Rhein Main Air Base, Germany, and return. Probable value based on an average distance of 7,430 stat. mi. is $3,740,099.
- **Item 4:** 7,800 passengers round trip from Travis AFB to Clark Air Base, Philippine Islands, via Honolulu. Probable value, $3,559,483.
- **Item 5:** 7,800 passengers from Travis to Kadena Air Base, Okinawa, via Honolulu and return. Probable value, $3,281,710.
- **Item 6:** 7,200 passengers from Travis to Kadena via Honolulu and return. Probable value, $3,029,270.
- **Item 7:** 12,174 passengers round trip from McGuire to Mildenhall, Orly or Rhein Main. Probable value on average mileage, $2,623,132.
- **Item 8:** 7,392 passengers round trip from McGuire to Rhein Main to Pisa, Italy, to Athens, Greece, to Ankara, Turkey. Probable value, $2,433,057.
- **Item 9:** 5,700 passengers from Travis to Agana NAS, Guam, via Honolulu and return. Probable value, $2,062,283.
- **Item 10:** 9,690 passengers round trip from Los Angeles International Airport to Hickam AFB, Hawaii. Probable value, $1,438,209.
- **Item 11:** 7,500 passengers round trip from McChord AFB, Washington, to Elmendorf AFB, Alaska, and 3,000 passengers from Elmendorf to Eielson AFB, Alaska. Probable value, $678,078.

All aircraft must be pressurized in order to qualify for a contract.

According to MATS, each airline can bid on as many items as it chooses but the awards will be spread among as many bidding airlines as possible, "supporting the program of broadening civilian air backup of MATS." In keeping with this approach, MATS twice amended its requirements for Items 3, 5 and 6, which in the original RFP could be flown with "turbine-powered aircraft only." This stipulation was first changed to read "turbine-powered aircraft preferred," and then deleted entirely.

In addition, through Amendment 4 to the basic RFP, MATS created an 11th item and reduced the volume of several of larger packages to gain a more equal distribution. Small carriers viewed the move with joy.

The service, on the other hand, would be no more specific in drafting the RFP than to state, ". . . any carrier receiving an award of one item, considering the interest of the government in establishing a broadened and modernized mobilization base, may (italics theirs) be dropped from consideration for subsequent items. Considering the interest of the government in establishing a broadened and modernized mobilization base, award of an item may be made, however, to a carrier which has (italics theirs) received an award on a previous item."

Because of the expansion capability procedure, however, award of a second item to a carrier would call for a second round of negotiation with MATS.

Soviet Air 'Lighters'

Moscow—Russia is experimenting with the use of helicopters to unload ships at ports where vessels must anchor in open roadsteads because of difficulties in approaching close to shore.

First tests of such operations are being made at Amur Bay in the Soviet Far East. "Great promise" is seen in employing helicopters as "aerial lighters" at ports in the Arctic, along the northern Siberian coast, and at Kamchatka, where ice floes and dangerous currents prevent docking.

Flying Tiger, Riddle Plan Drive For Commercial Atlantic Charters

By Glenn Garrison

New York—Two domestic all-cargo carriers hope to boost their revenues substantially next summer by going into the transatlantic commercial charter business in a big way.

Flying Tiger Line, which will be operating Lockheed 1049H Constellations in this type of charter service, is back, following a relative layoff for two years after a $4-million 1957 season on the Atlantic.

Riddle Airlines will put three of its newly acquired Douglas DC-7C passenger-cargo conversions into this charter work next season. It will mark Riddle's first large-scale venture into the market. Last summer the airline flew about 25 commercial charters in Douglas DC-4 equipment to gain experience on the route.

According to Robert Hewitt, president of Riddle, this experience formed the basis of the decision to go heavily into the field this year and to buy the DC-7Cs.

Riddle bought seven of the aircraft from General Aircraft Leasing Division of General Dynamics Corp. (AW Oct. 31, p. 90) for $10.4 million including spares. Three definitely are being modified by Douglas into the convertible configuration. Hewitt told AVIATION WEEK, and the other four probably will be modified depending on the outcome of negotiations for MATS contracts. First of the converted three is scheduled to be delivered next week.

Riddle's Plans

Hewitt said Riddle plans to sell about 180 round trips for next summer's transatlantic commercial charter business, with about $4 million in revenues. More flights will be made if the business is there.

In the commercial charter work, Riddle will put 104 seats in the DC-7Cs. Rates are on a sliding scale depending on destination and length of stay. For example, New York-London round-trip fares work out to about $212 per person for periods up to 15 days, $235 from 16-30 days, $261 from 31-70 days and $297 for more than 71 days. Hot meals and free drinks are provided.

Flying Tiger hopes next season to top 1957, its best year in this market. Fares, in Super H Constellations with up to 118 seats, run about $230 round trip from New York, Boston or Philadelphia to London or Paris. Hot meals and free drinks are provided in these operations. The airline largely withdrew from the market in 1959, when much of its fleet was busy with MATS contracts. Last summer it did some business, since it had no basic MATS contract, but some planes were idle at times. It now has an all-Super H fleet of 12 aircraft, and early next year will begin receiving Canadair CL-44 turboprop equipment—a total of 10.

This new equipment makes another strong effort in the transatlantic market logical for employment of some of the Super H aircraft.

Strong Competition

Both of these domestic cargo airlines face stiff competition in the transatlantic charter market not only from scheduled passenger airlines but from supplemental carriers. And the scheduled lines' jet transports, which went to work in a number of transatlantic charters last summer, are increasingly attractive to charter groups.

Riddle will put some DC-7C capacity into scheduled domestic cargo service, Hewitt said, but how much depends both on how much business is sold in this market and on how well the transatlantic effort turns out. The DC-7Cs will be used in both these areas and also in MATS contract work.

First of Riddle's AW 650 Argosy turboprop airfreighters will be delivered by Armstrong-Whitworth Aircraft by the end of this month, Hewitt said. Riddle ordered five of these planes and later picked up an option for two more. Training crews have already been checked out in England, Hewitt said, and ground school at Miami has been in operation for a couple of months. Under a Riddle contract with Logair which began last July, Argosies will begin phasing out C-46s next month. The contract started with 10 C-46s; by March these will have been replaced by five Argosies. This fleet takes care of the basic contract schedules; the other two can be used in extra sections or expansion capability service. None of these turboprops is likely to go into scheduled common carriage for at least three years.

Profits Anticipated

Riddle lost more than $1 million in the fiscal year ending June 30, when common carriage provided most of its revenues. This year, Hewitt said, he expects the airline will earn a million net. Scheduled freight carriage will make up only 25-30% of the total business. A growing field, Hewitt said, is commercial freight charters on Riddle's domestic routes. This business helps solve the time problem, with most big shippers wanting night departures for morning delivery.

By selling the charters in daylight hours at reduced rates, planes can be positioned for night schedules and not sit idle during the day or operate schedules at low load factors. As Riddle's scheduled fleet is modernized, C-46s will increasingly go into commercial cargo charter work. On the average, Hewitt said, one-way charters on Riddle's system are 25% cheaper than scheduled space, with the charter average 15 cents per ton-mile.

Hewitt is convinced that diversification is necessary to make money in his business, and diversification has been his chief aim since taking the Riddle presidency in 1959. Common carriage of cargo is still the "stepchild" of the industry, he feels. For one thing, rate structure is too low. Although it is true that lower rates would open new markets, such rates—as proposed by Flying Tiger—are lower than the industry can afford with present equipment. This equipment, according to the Riddle president, includes the Canadair CL-44 turboprop.

Another common carriage problem for Riddle is directional imbalance: its load factor to the south runs 85-100% from New York, Hewitt said, but northbound it is only about 59%.

Riddle's fleet currently includes 27 C-46s and a DC-4. Two DC-4s are on lease but will be relinquished when the DC-7Cs go into operation.



FINNAIR SUD CARAVELLE twin-jet transport lands at Le Bourget Airport near Paris. Carrier started Caravelle service last April.

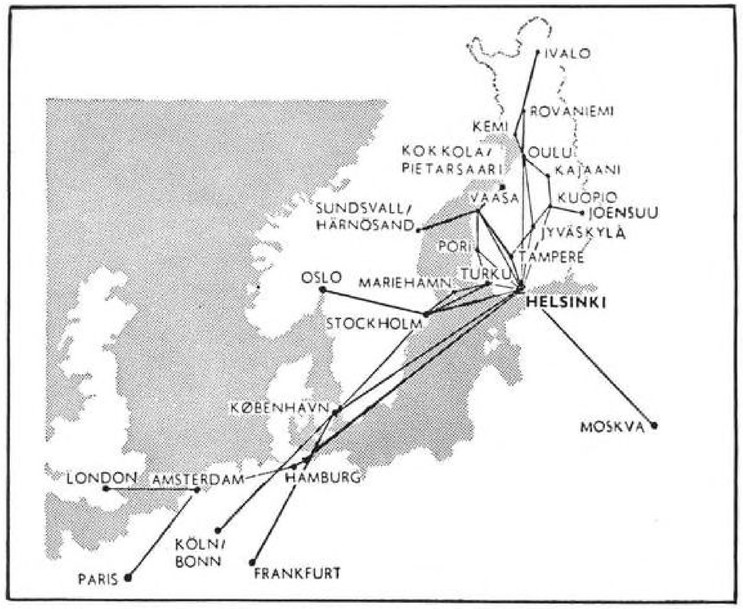
Caravelles Boost Finnair's International

By Edith Walford

Helsinki—Finnair-Aero O/Y, the Finnish carrier, reports a 35% growth in traffic on its international route network for the first half of this year, an increase marked by the introduction of its first three Caravelle jet transports on Apr. 1.

During the first 1½ months of operation, Finnair Caravelles carried 27,000 passengers or 70% of the company's total international traffic, a result which ranks among the best so far achieved by any medium-range jet transport operator. By the end of June this year, passengers transported by the three Caravelles totaled 78,000.

Convenient connections from Helsinki to most major European centers are attracting an increasing number of passengers, but the saving in Caravelle flying time compared with Finnair's fleet of piston-engine Convair 440 aircraft previously used on all the international routes is the chief contributing factor to the airline's good progress. Compared with the Convairs, Caravelle services from Helsinki to Hamburg, for example, cut flying time by 1 hr. 35 min., from Helsinki to London by 2 hr. 35 min.



DOMESTIC and international routes flown by the Finnish airline are detailed above.

Most important Caravelle round trip services are:

- **Helsinki-Copenhagen-Frankfurt** once a day.
- **Helsinki-Hamburg-Amsterdam** once daily.
- **Amsterdam-Paris** three times a week.
- **Amsterdam-London** four times weekly.

Longest route in Finnair's international network is from Helsinki to Paris or London, approximately 1,345 mi.

Flight schedule for the Caravelle services is as follows:

- **Takeoff from Helsinki** at 7:30 a.m. (one hour earlier according to Central European time), arrival Frankfurt at 10:15 a.m.
- **Departure from Helsinki** at 8 a.m., arrival Amsterdam at 10:35 a.m.
- **Aircraft leaves Helsinki** at 8 a.m., arriving in London at 11 a.m. or in Paris at 12 noon.

Finnair's fleet consists of nine DC-3s, six Convair 440 Metropolitans (three of these are Convair 340s purchased in 1953 and later converted to the Convair 440 configuration), and three Caravelles. The company has an option on one more Caravelle for possible international network extension by 1962, particularly to Zurich.

The strong competitive position of



SLEIGHS drawn by reindeer await skiers and other tourists deplaning from Douglas DC-3 at the Rovaniemi Airport in Lapland.

Traffic Growth

other carriers using Geneva Airport resulted in a very low load factor for Finnair. The comparatively small Finnish operator consequently had to discontinue its former Metropolitan winter-early spring flights via Geneva to Frankfurt-Cologne-Helsinki. It now hopes to obtain Caravelle landing rights in Zurich by next year. An additional Convair 440 is also to be put into service on its longer domestic routes shortly.

Present utilization rate of the airline's DC-3 fleet is 7½ hr. daily; initially it was 9 hr. per day. Prior to introduction of the three Caravelle services, the Convairs flew an average 8 hr. 20 min. daily. Present utilization rate has not yet been determined for the Convairs, but it is still fairly high.

To maintain such a good schedule as well as its accident-free record, Finnair has worked out a much improved maintenance and overhaul system. Two to three full-time mechanics are employed at all airports within the airline's route structure where stop-over time of its aircraft during the day or night is sufficient to allow a part of the servicing to be carried out.

Normally, two mechanics work on the DC-3s, up to three on the Convair 440s. Work is started immediately after the plane is parked and by the time it takes off again at least four or five items out of a total of about 50 per aircraft can be checked off the work sheet. This method has reduced Finnair's delays through servicing to an average of only 3 to 4%. This compares favorably with the normal prac-



ROLLS-ROYCE Avon turbojet engine is being checked at Helsinki Airport facility. Major overhaul and maintenance is performed at Rolls-Royce shop at Derby, England.



AEROFLOT Il-12 and Finnair Convair 440 are shown at Helsinki Airport, Finnair's home base. Finnair serves Moscow twice-weekly and Aeroflot flies to Helsinki four times weekly.



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tice of giving each aircraft a thorough check and overhaul after 100 flight hours, which can keep it out of service for anything up to five weeks.

On the basis of one flight hour, the DC-3s require 10 man hours of servicing, the Convair 440s 12. Calculations have not yet been made for the servicing of Finnair's Caravelles. General overhaul of the jets is done at the airline's own workshop at Helsinki Airport, but their Avon engines are maintained by the makers, Rolls-Royce, Ltd., at Derby, England. Ake Lundin, manager of Finnair's maintenance and overhaul at Helsinki, explained that it works out much cheaper to have the Caravelle powerplants serviced where they are made, compared with the cost of setting up a complete new jet engine overhaul workshop at Helsinki.

Lundin, who has been concerned with aviation since 1931 and was one of Finland's first glider pilots, has been in charge of the Finnish carrier's maintenance and overhaul since 1948. He is also responsible for pilot training. Finnair's maintenance staff, including engineers and mechanics, totals about 460, all of Finnish nationality. The workshop carries a constant supply of 60,000 different parts and spares representing in value about $3.25 million.

The DC-3 fleet, which Finnair bought from the Western Allies after World War II, serves domestic routes exclusively. The aircraft are now being phased out gradually and replaced by Convair 440s as longer runways at some of the smaller airports, particularly in the remote north of Finland, are completed.

There are a total of 19 airports in Finland of which three—Kauhava, which is also a Finnish air force training center, Kuorevesi and Lappeenranta—are used only by Kar-Air, the biggest of Finland's few charter companies.

The other 16 airfields covering a distance of 3,032 unduplicated miles, constitute Finnair's domestic route structure. The seven smallest of these, located mostly in the less populated lake and woodland areas of the country, are served by DC-3s on a once-a-day round trip basis. Ivalo in Lapland, situated about 155 mi. beyond the Arctic Circle and the most northerly airport of all, is served at least once daily from Rovaniemi during Finland's short summer period, although demand often warrants two additional DC-3 flights a week both ways. During the winter months, the service is four times weekly.

Both DC-3 and Convair 440 flights connect the remaining nine larger airports with Helsinki twice and in a few cases three times daily both ways. On Nov. 1 this year, Rovaniemi Airport inaugurated its first Convair 440 daily round trip service via Oulu, in the heart of Finland, and Kemi.



FINNAIR Douglas DC-3 and Convair 440 nightly newspaper freight services enable the population of Lapland to read the daily news at the same time as people in Helsinki.

By constantly improving existing facilities and gradually establishing additional airstrips, particularly in the thinly-populated northern regions of the country, Finnair is helping considerably in promoting tourist trade. The lumber industry, too, which is Finland's chief export commodity, is being boosted because foreign buyers like to take advantage of Finnair's well-placed airports and convenient flight schedules between the various industrial centers to conduct on-the-spot business. Later on, the airline hopes to establish a new service from Ivalo farther north to Kirkenes in Norway where a large pulp factory is being built.

On Nov. 2 this year, Finnair introduced a new round trip four times weekly Convair service via Stockholm to Oslo. Other international Convair services include Helsinki to Stockholm once daily and Stockholm via Copenhagen to Cologne three times a week both ways.

The Finnish carrier was the first Western airline to introduce a service to Moscow and establish a permanent office there in February, 1956. It serves the Russian capital with Convair 440 three-hour nonstop round trip flights twice a week. Aeroflot, the Russian airline, flies to Helsinki via Leningrad four times a week both ways, using either Il-12 or Il-14 aircraft.

At present, Finnair has a staff of about 1,450 including 100 pilots and 84 air hostesses, all Finns.

To qualify for service with Finnair, hostesses must speak at least four languages, but many of them are fluent in five: Finnish, Swedish, English, German and French.

Most of the airline's pilots come from aero clubs and the Finnish air force: a few are private pilots, but all possess their pilot's licence when they join Finnair. Instruction in the handling of civil transports takes about a year. The course is divided into separate groups for the three types of aircraft in service with Finnair. Caravelle flight crews and technical personnel receive additional instruction at Sud Aviation's training center in Toulouse, France. Pilots complete their jet training with 12 flight hours before they fully qualify to fly Finnair's Caravelles.

Finnair's vice president of operations, K. J. Temmes, told AVIATION WEEK that instead of three pilots, which is the normal practice with other airlines, his company's Caravelles are flown with only two. In his experience, he said, the two pilots remain far more alert and "on the job" than when there are more men in the cockpit apt to distract the chief pilot's attention.

Temmes believes that civil transports of the future will be capable of flying at around Mach 3. Apart from later versions of the Caravelle as a future addition or replacement in Finnair's fleet, Temmes said his company is studying the development of such types as the Boeing 727, British Aircraft Corporation's 107, de Havilland's 121 and the Convair 60.

On Nov. 1 this year, Finnair celebrated its 37th year of operation. It is 83% government-owned, 17% privately owned. It got off to a modest start in 1923 with a 4-seat Junkers F-13 aircraft purchased on credit and a staff of three. During the first year it carried a total of 269 passengers and flew 10,526 mi.

Although still a small carrier compared with most of its competitors, Finnair has shown a steady growth throughout the years. Passengers flown, for example, on the company's domestic routes in 1959 totaled 264,749. Passengers flown on the international network in 1959 numbered 137,062. Gross revenue increased 9% in 1959 compared with 1958 and the company paid its shareholders a 6% dividend.

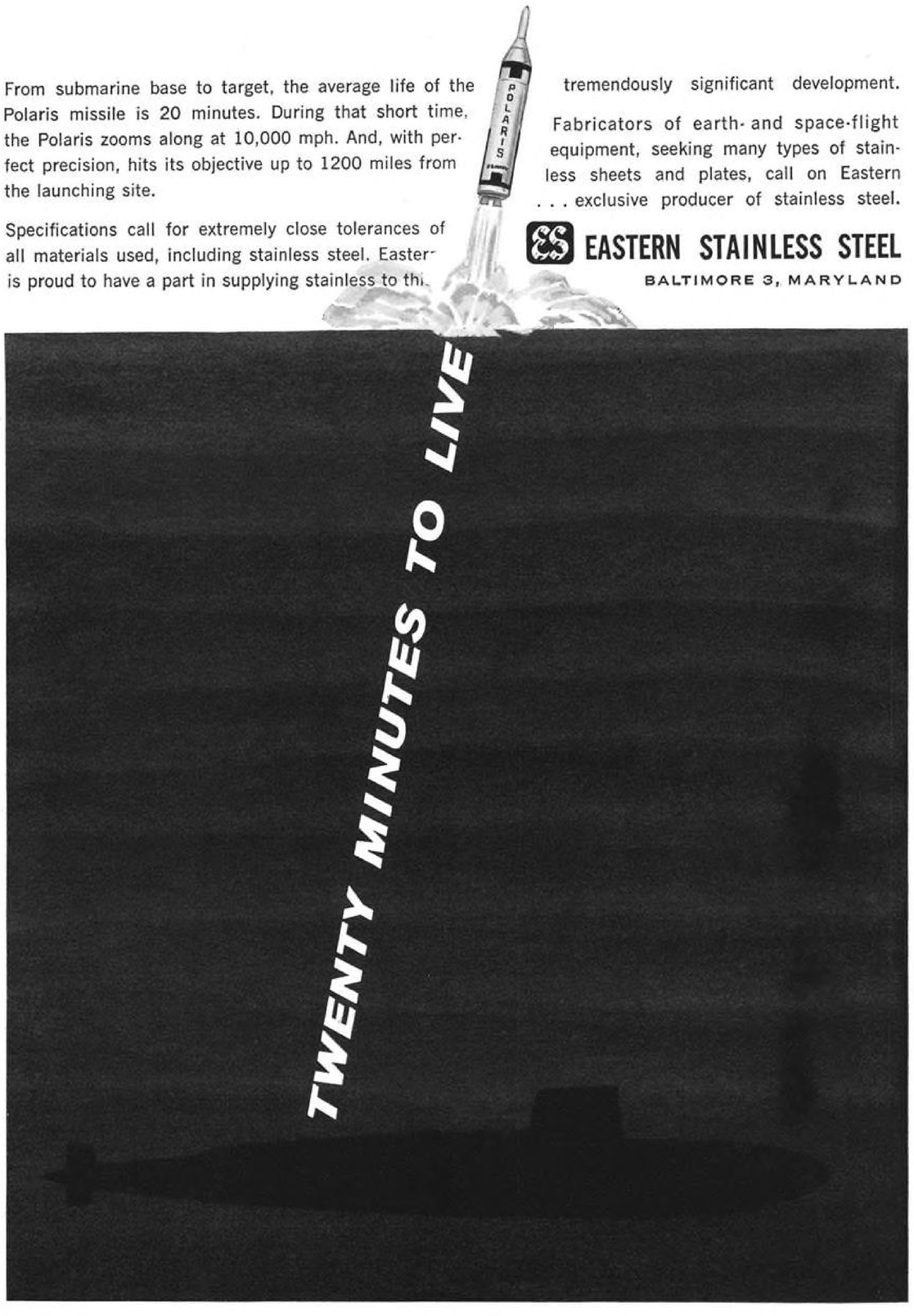
Based on the increase in Finnair's international traffic since it introduced its Caravelle jet services this spring, the company expects record over-all results for the current full year.

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Soviet Air Market Shifts With Growth

Moscow—Complexion of Aeroflot's business is changing materially along with the rapid growth in the Russian carrier's over-all traffic, with passenger traffic scoring the biggest gains.

Before and after World War II, the Soviet airline's business was predominantly mail, express and freight. But passenger traffic is now moving into a position of overwhelming predominance.

The Russian Seven-Year Plan (1959-1965) calls for passenger miles to increase to seven times the 1958 level and the number of passengers carried to increase six-fold. Cargo tonnage, including mail, is to rise 460% in the same period.

In 1958, passengers represented 58% of Aeroflot's traffic, and cargo was 42%. By 1965, passenger volume is to increase to 68% and cargo is expected to drop to 32%.

Proportion of total Soviet intercity passenger traffic carried by air is slated to jump from 3.1% in 1958 to 14.6% in 1965.

Air Taxi Operator Requests New Routes

Washington—TAG Airlines, an air taxi operator, asked the Civil Aeronautics Board last week to amend its application for a certificate as a scheduled air carrier to include additional routes.

TAG, a division of Miller Oil Co. of Detroit, has been operating as an air taxi operator on a scheduled basis flying from Detroit to Chicago and Detroit to Cleveland. Last February, the carrier asked the Board for a certificate to operate scheduled transportation of passengers, property and mail between the same three cities.

Last week, the airline filed with the CAB for the following routes: Chicago-Cleveland; Cleveland-Pittsburgh; Cleveland-Cincinnati; Cincinnati-Pittsburgh.

TAG operates a fleet of four de Havilland Doves carrying nine passengers each.

FAA Appoints Group For Medical Advice

Washington—The Federal Aviation Agency's Civil Air Surgeon Dr. James L. Goddard has established an 11-man Medical Advisory Council to advise the agency's Bureau of Aviation Medicine on policy matters.

The 11 men, all doctors prominent in aviation medicine, will meet twice a year in Washington to confer with and advise the civil air surgeon on matters of policy and exchange views with the FAA on medical problems of common interest. First meeting is scheduled for January, 1961, and Dr. Goddard will preside as chairman.

The council will later elect a chairman from its ranks.

The 11 doctors on the council are: Dr. W. F. Ashe, Jr., chairman of the Department of preventive medicine and professor of internal medicine, Ohio State University; Dr. C. I. Barron, medical director, California Division of Lockheed Aircraft Corp.; Dr. Neal Baxter, medical director, Westinghouse Corp., Bloomington, Ind.; Dr. R. H. Felix, director, National Institute of Mental Health; Dr. G. J. Kidera, medical director, United Air Lines; Dr. W. R. Lovelace, surgeon and director, Lovelace Foundation for Medical Education and Research; Dr. R. A. McFarland, professor of environmental health and safety, Harvard School of Public Health; Dr. L. C. McGee, attending chief of the department of medicine, Delaware Hospital, Wilmington; Dr. C. M. Starr, past president, Flying Physicians Assn., now in private practice; Dr. J. H. Tillisch, medical director, Northwest Airlines and consultant in internal medicine, Mayo Clinic; Dr. B. J. Wolpaw, Cleveland, ophthalmologist.

FAA Files Complaint In Airline Suspension

Washington—The Federal Aviation Agency filed a complaint with the Civil Aeronautics Board last week giving reasons for the emergency suspension of Arctic-Pacific Airlines' operating certificate following the recent crash of an Arctic-Pacific C-46 at Toledo, Ohio.

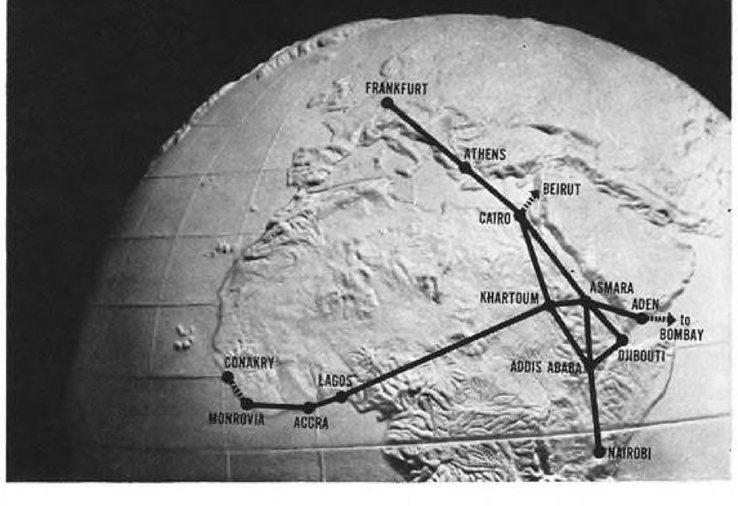
In its complaint, the FAA gave these reasons to the CAB, which is currently considering an appeal by Arctic-Pacific to override the agency's suspension order:

- **Aircraft exceeded** by 2,000 lb. the maximum takeoff weight of 46,850 lb.
- **The flight took off** despite information that weather conditions were below authorized minimums.
- **Arctic-Pacific** told the FAA it had discharged the pilot of the aircraft two days before the accident, pending an appeal of a license revocation because of previous Civil Air Regulations violations.
- **The aircraft was equipped** with a military surplus engine which was not modified and had not been properly inspected or maintained.
- **Arctic-Pacific** has falsified manifest reports, and discrepancies existed in the company's airman records and operations.

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Electra Testimony Points to Bird Ingestion

By Robert H. Cook

Washington—Probability that bird ingestion in the engines caused the crash of an Eastern Air Lines Electra in Boston Harbor was endorsed by a majority of government and industry witnesses last week before a House aviation subcommittee investigating the accident.

The bird theory got only partial support from Civil Aeronautics Board investigators, however. They called attention to the growing problem of birds around airport areas, but withheld any definite statement on the probable cause of the accident pending current Board studies of the Lockheed aircraft's control systems and of the duties of the Electra's crew during an emergency.

FEIA Stand

At the same time, the Flight Engineers International Assn. clashed with Eastern spokesmen over FEIA testimony that failure to recover from the bird impact may have been a direct result of the pilot's attempt to cope with a mechanical emergency as directed by Eastern's operating manual for the Electra. FEIA said that, in their present form, Eastern's manuals delegate many flight engineer duties to the pilot and are therefore not in conformance with the intent of Federal Aviation Agency certification of the aircraft or Lockheed's recommended crew duties.

The charges were emphatically denied by John H. Halliburton, Eastern vice president, who termed the FEIA stand part of a "continuing jurisdictional dispute" between engineers and pilots. Eastern supports the bird ingestion theory as the probable crash cause.

"We are shocked that an airline union would deliberately attempt to discredit an aircraft, an airline, a manufacturer, and the federal regulatory agencies, all in an apparent effort to achieve some slight leverage in a jurisdictional dispute with another union," he said. Halliburton promised that a detailed rebuttal to the FEIA charges will be available to the subcommittee.

Elwood R. Quesada, FAA administrator, who first advanced the bird theory, traced the early development, testing and certification of the Electra, along with current modifications now being conducted by Lockheed to correct structural defects which Lockheed said caused two Electra crashes.

Following his testimony that Electra airframes and engines have been designed to withstand the impact of four pound birds during FAA-conducted tests, Quesada pointed out that the accident at Boston "presented a new aspect of the bird problem not previously encountered . . . namely the ingestion of numerous small birds causing more than one engine to fail at the same time." He later said he was "sure it was a flock of birds" that caused the aircraft to crash.

Quesada said FAA is doing further research on the bird problem and has recommended several corrective measures to authorities at Boston's Logan Airport, since it is up to the airport operators to eliminate such hazards.

Melvin N. Gough, director of the CAB's Bureau of Safety, told the subcommittee that increasing bird incidents were indicative of a "new matter" being studied by the Board, which will hold public hearings on the Electra accident on Jan. 11-13. All data compiled by CAB on this problem will be presented at the hearing, he said.

Less than a month after the Eastern crash, Gough said, another of the airline's Electras had a non-fatal starling impact at Logan. The crew was assured that the runway had been inspected for birds and takeoff clearance was given. As it moved down the runway at a speed of 120 kt., according to Gough, the aircraft hit a "cloud" of starlings and was forced to abort the takeoff. No structural or engine damage was suffered by the transport, he said.

Also at Logan, Gough said that on Apr. 4 an American Airlines Electra struck birds after becoming airborne, was forced to feather No. 2 engine and returned to the field.

On Nov. 11, a Continental Airlines Boeing 707 struck a flock of pigeons after takeoff from Stapleton Field, Denver, Colo., suffering a power loss on No. 3 engine which forced it to return to the field, Gough said.

In another development late last week, an Eastern Air Lines Douglas DC-8 scheduled flight takeoff was aborted during initial roll when the transport ran into a flock of 150-250 starlings in low flight across the runway at Logan Airport. The pilot ordered the action as a precautionary measure, and the aircraft was returned to the ramp for inspection. First walk-around investigation revealed no damage, but the flight was canceled and the 99 passengers rescheduled.

Wreckage recovered from the Boston Electra crash showed that No. 1 engine had been shut down, and its cowling had a large dent that may have been caused by a seagull, the CAB spokesman said. The remaining powerplants showed evidence of being in normal operation at the time of impact, he said, but they could possibly have faltered seconds before the crash.

Gough answered with a flat "no" to a subcommittee query whether he would say that powerplant failure caused the accident, explaining that the Board is still investigating other phases of Electra operation, including "further study" of the aircraft's elevator boost system.

A problem in this system came to light recently on an Electra flight cruising near Atlanta, Ga., he said.

In addition, Gough cited the matter of cockpit management and posed the question of human reaction of a crew during such emergencies as the Electra accident. "What happens when the windshield is suddenly plastered with birds . . . where do all the hands go?", he asked. He added that there is no evidence to connect the Boston crash with earlier Electra crashes at Buffalo, Tex., and Tell City, Ind.

Lockheed Blames Birds

Robert E. Gross, board chairman of Lockheed Aircraft Corp., agreed that there was no connection between the Boston crash and the Braniff Airways and Northwest Airlines accidents, which the manufacturer said were caused by a vibration problem now being corrected.

On the basis of an "abundance" of testimony and evidence, including visual evidence of loss of power from two or more engines while in climb and a shaking and shuddering that could indicate a stall condition, Gross said he personally believed the bird theory. "It appears that the air intakes, scoops, and flap openings literally were smothered by the feathers and bodies of thousands of birds. Nothing tangible so far seems to support any other possible explanation," he said.

Lockheed engineers told subcommittee chairman Rep. John Bell Williams (D.-Miss.) that the remaining three engines in operation on the Electra may have been generating the equivalent of only 3,500 hp., or the takeoff power of one engine. Their estimate was based on a distance, time and altitude analysis of the aircraft and such a power loss may have been due to bird ingestion.

While the recovered powerplants appeared to have been developing normal power, the Lockheed engineers pointed out that they could have faltered, then surged back to normal power seconds before the crash.

Their opinion was supported by H. H. Dice of the Allison Division of General Motors Corp., manufacturer of the Electra's Allison 501-D engines. Dice noted that past tests showed bird ingestion could cause a power loss for 3 to 5 sec. that could account for as much as two-thirds of an engine's total power.

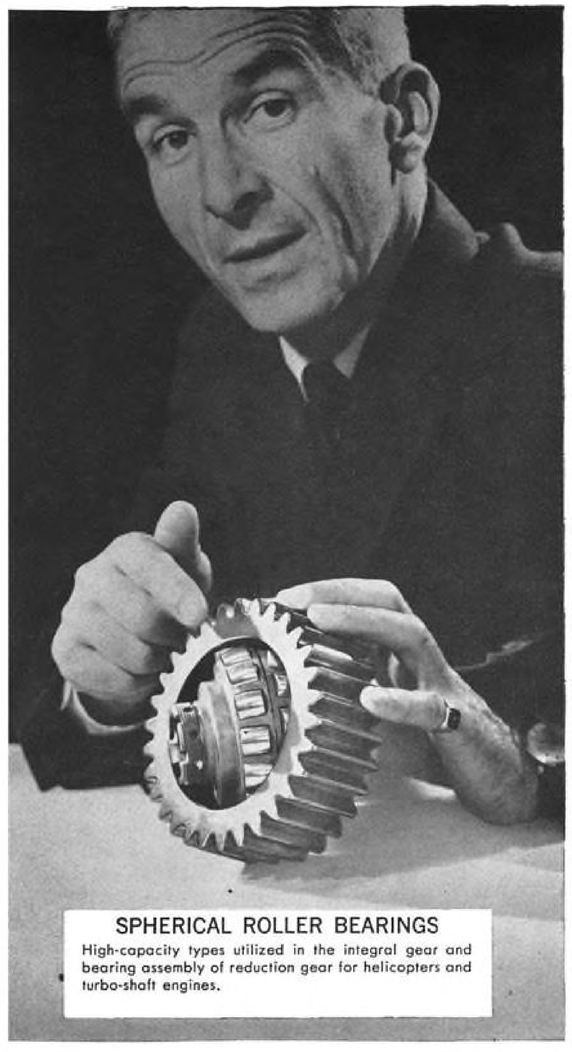
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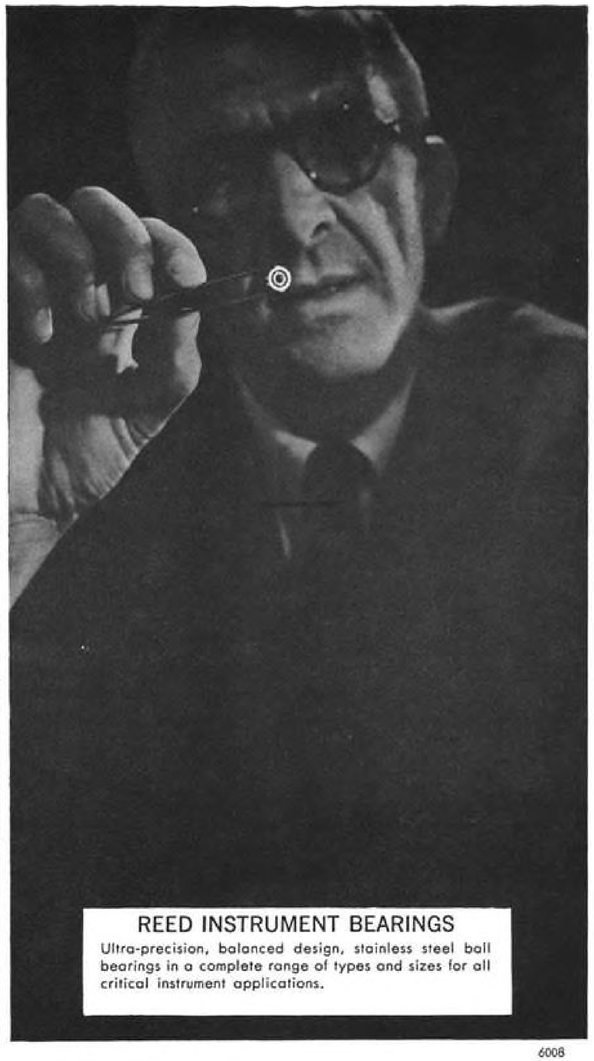
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AIRLINE OBSERVER

► **Self-contained hydraulic starting system for the Napier Eland 501 turboprop engine is being tested by Allegheny Airlines on one of its Eland-powered Convair 540s. The single-function hydraulic start system was developed by the Vickers, Inc. Division of Sperry Rand and uses a Solar T-62-T turbine APU to eliminate dependence on ground support equipment for engine starts.**

► Total Trans World Airlines bank balances offset against defaulted loans (AW Oct. 31, p. 39) amounted to approximately $19 million. Total bank loans in default were $27 million, but part of the $27 million TWA balances offset were federal income tax accruals, and the banks subsequently were persuaded to leave these funds alone.

► **Union of professional and administrative employes of the Air Line Pilots Assn., a union within a union composed of 24 full-time staff members who handle ALPA business affairs, has reached agreement over an unfair labor practices complaint against the pilots' union, placed before the National Labor Relations Board earlier this month. Agreement gives the staff members increased sick leave, Blue Cross-Blue Shield insurance paid by ALPA, paid vacations, formation of a grievance section and machinery. Contract to be signed will have an 18-month term retroactive to Nov. 15 and ALPA agrees to negotiate the pay issue 90 days more and submit the staff members' pay complaint to arbitration.**

► Complaints from passengers who are denied entry into scheduled airline private clubs have prompted an informal investigation by the Civil Aeronautics Board of such private clubs as American's Admirals Club, TWA's Ambassador Club and Pan American's Clipper Club. Findings of the current investigation will determine whether Board will launch a full-scale probe of the clubs to determine whether any discrimination in handling reservations or providing service is involved. All clubs operated by airlines are now under CAB scrutiny.

► **Russian commercial scheduled helicopter service in the Moscow area now connects all of the city's major airports with a heliport near the downtown area. Final link was closed with the inauguration earlier this month of 10-place, single-rotor Mi-4 taxi flights between Vnukovo southwest of the capital to Bykovo Airport in the southeastern suburbs. The new 34 mi. route is the longest on the Moscow helicopter system. Flying time is 25 min. Aeroflot began regular Mi-4 flights between the heliport at Central Airport near downtown Moscow and Vnukovo and from Vnukovo to Sheremetyevo Airport, northwest of the city, on Oct. 11. Initial service of this type started last July with flights between the downtown heliport and Sheremetyevo.**

► Trans World Airlines' time between major overhauls on its Boeing 707-331 and 707-131 turbojet transports has been increased by Federal Aviation Agency from 2,500 hr. to 4,000 hr. Time between overhauls on the Pratt & Whitney JT3C turbojet engines which power the 707-131 has been increased 200 hr. to a total of 1,400 hr.

► **State-owned Iraqi Airways will become an independent administration with its own board of directors attached to the Ministry of Communications on Apr. 1. Since 1958, the airline has been a department within the Directorate of Railways. Airline operations will be controlled by the board of directors which is appointed by the Minister of Communications.**

► Several airlines are seriously considering a name change for their Electras after they return from the Lockheed modification program at Burbank. Modifications are designed to eliminate high speed vibration problems responsible for two of the five fatal accidents with the transport (AW Oct. 24, p. 37). One Electra operator has a team of pilots and sales representatives discussing safety problems with corporate air travel accounts which have prohibited their employes from traveling on Electras.

SHORTLINES

► **Allegheny Airlines** has been denied authority by the Civil Aeronautics Board to operate nonstop service from Wheeling, W. Va., to New York. CAB said Allegheny should operate single plane, two stop service instead between any of three West Virginia cities—Wheeling, Huntington or Parkersburg—and New York via Pittsburgh and a city between Pittsburgh and New York.

► **Civil Aeronautics Board** has postponed action until Jan. 1, 1961 on amendment and five-year extension of Part 298 of the Economic Regulations, governing Air Taxi Operators, due to expire Nov. 30. CAB said the rules will have to be changed to allow for the fact that Alaskan Air Taxi Operators will come under the regulation of the State of Alaska Jan. 1 with respect to certain regulatory functions which formerly could be exercised by the Board.

► **Los Angeles Airways** has received Civil Aeronautics Board approval to offer express service between Los Angeles and Riverside and San Bernardino, Calif., using the first of its Sikorsky S-62 turbine-powered helicopters.

► **Northeast Airlines** has received CAB approval to temporarily suspend service at Providence, R. I., pending Board action on the carrier's application to permanently delete the city from its certificate.

► **Pan American World Airways** reports it carried 6,631,460 lb. of cargo westbound and 6,212,140 lb. eastbound on its transatlantic routes during the first nine months of 1960, a 45.9% gain over the 1959 period.

► **United Air Lines** has opened its new air freight terminal at San Francisco International Airport, a 22,000 sq. ft. building leased from the City of San Francisco.

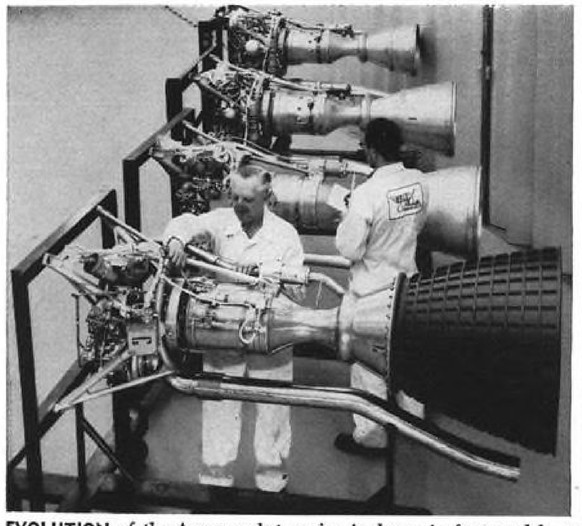
► **Varig Airlines of Brazil,** has begun direct Boeing 707 Intercontinental service from New York to Buenos Aires via Rio de Janeiro and Sao Paulo. The new 707 service will leave New York on Tuesday and Thursday evenings and Buenos Aires on Wednesday and Friday evenings. In addition, the Brazilian carrier also is operating a weekly round trip 707 service from New York to Brasilia and Rio de Janeiro, with connecting Sud Aviation Caravelle turbojet service to Sao Paulo, Porto Alegre, Montevideo, Buenos Aires and return.

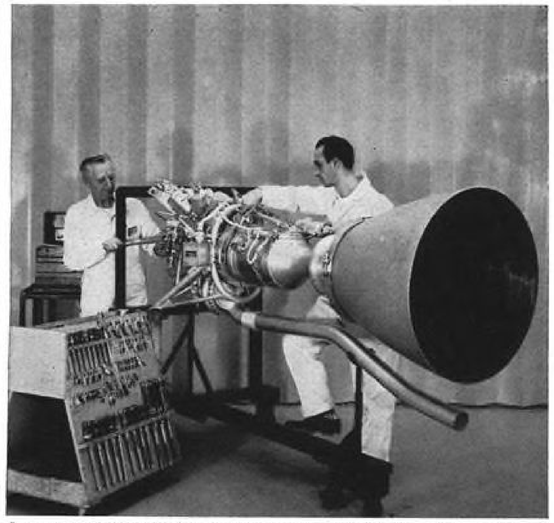


PERFORMANCE ON TRIAL Bendix achieves optimal man/machine interfaces in early system design through testing on its Computer Operated Electronic Display (COED). Designed to simulate the operator's station in the EAGLE Missile System, COED also permits real-time evaluation of energy management systems, logistic control, teaching methods, process analysis, and command control. Career positions are open involving use of this advanced technique for system design.

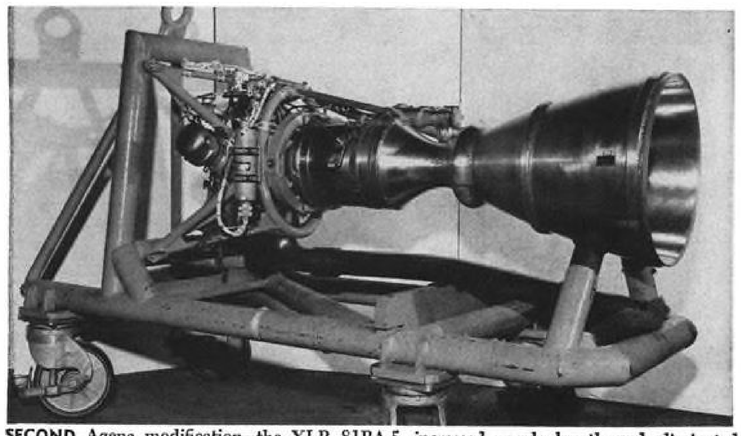
BENDIX SYSTEMS DIVISION
ANN ARBOR, MICHIGAN

THE Bendix CORPORATION

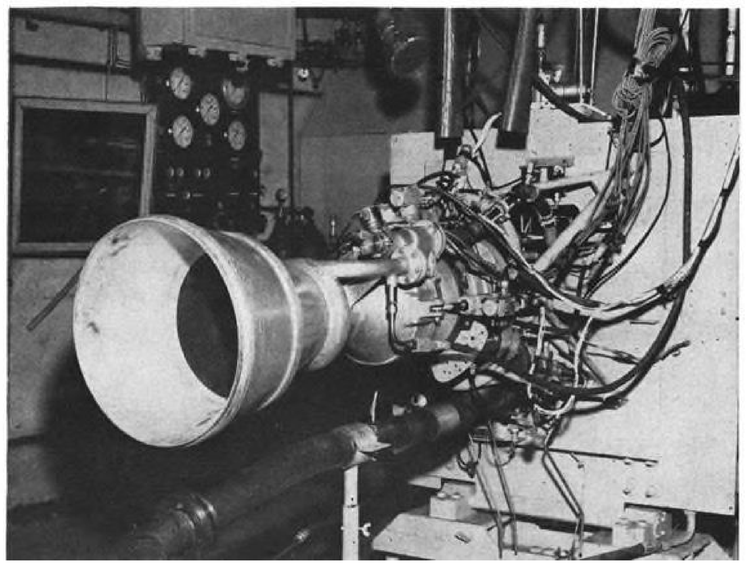




EVOLUTION of the Agena rocket engine is shown in four models, ending with XLR 81BA-9 in foreground at left. In early model of this engine, Bell Aerosystems engineers tried an uncooled graphite nozzle extension, which created manufacturing, handling problems.



SECOND Agena modification—the XLR 81BA-5—increased nozzle length and eliminated the liquid flow regulator. Below, fuel rich exhaust from turbine exhaust duct in static firing of XLR 81BA-3 was carried from test cell, ignited at end of a large 20-ft. pipe.



Bell Adapts

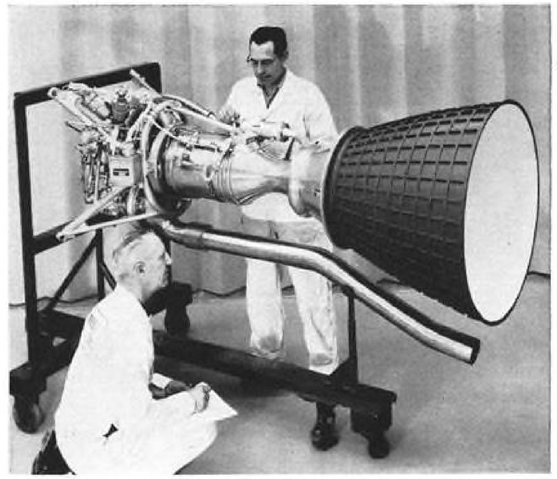
By Michael Yaffee

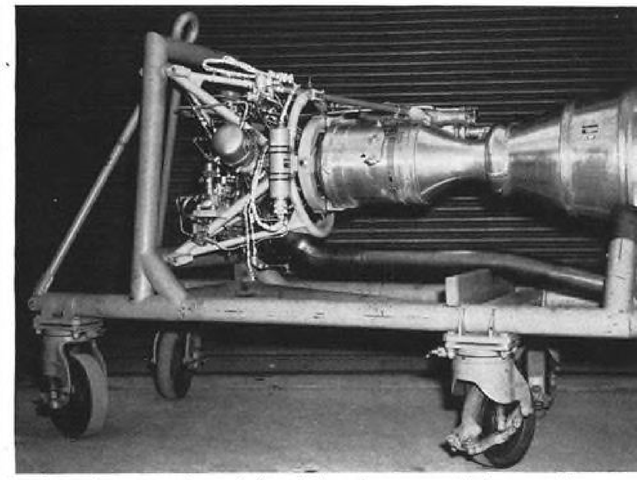
Buffalo, N. Y.—Bell Aerosystems Co. has just delivered the first XLR 81BA-9 rocket engine, the fourth and latest model in the Agena series, to Lockheed Aircraft Corp. The engine will probably be test flown in a Discoverer satellite shortly after the first of the year.

At the moment, the XLR 81BA-9 is the last Agena model for which Bell has a definite contract; it and the preceding XLR 81BA-7, third in the series, are the engines that will probably be used in most of the Lockheed Agena reconnaissance and early warning satellites and space probes. However, Bell has already submitted proposals to Lockheed for still further modifications of the engine in which a number of higher energy propellants are suggested for use in place of the present unsymmetrical dimethylhydrazine and red fuming nitric acid combination.

Use of higher energy storable propellants in the Agena, it is felt, would raise specific impulse at altitude from its current level just below 300 sec. to possibly 325 sec. and, Bell claims, would provide performance competitive with that of many high energy space systems.

Bell already has carried out static firings using high energy storable propellants such as nitrogen tetroxide, chlorine trifluoride and different hydrazine blends. The company has also conducted several firings with fluorine using major Agena components such as the thrust chamber and turbine pump





TO OVERCOME problems caused by graphite brittleness, a ceramic-lined titanium extension, reinforced by refractory metal hoops and stringers, was submitted in final configuration. First Agena modification, the XLR 81BA-3 is shown at right.

Hustler Rocket Engine for Varied Missions

assembly. These tests definitely indicate that the basic Agena engine will work with fluorine, says Bell, conceding that some modifications would have to be made in some components such as pump, seals and injector.

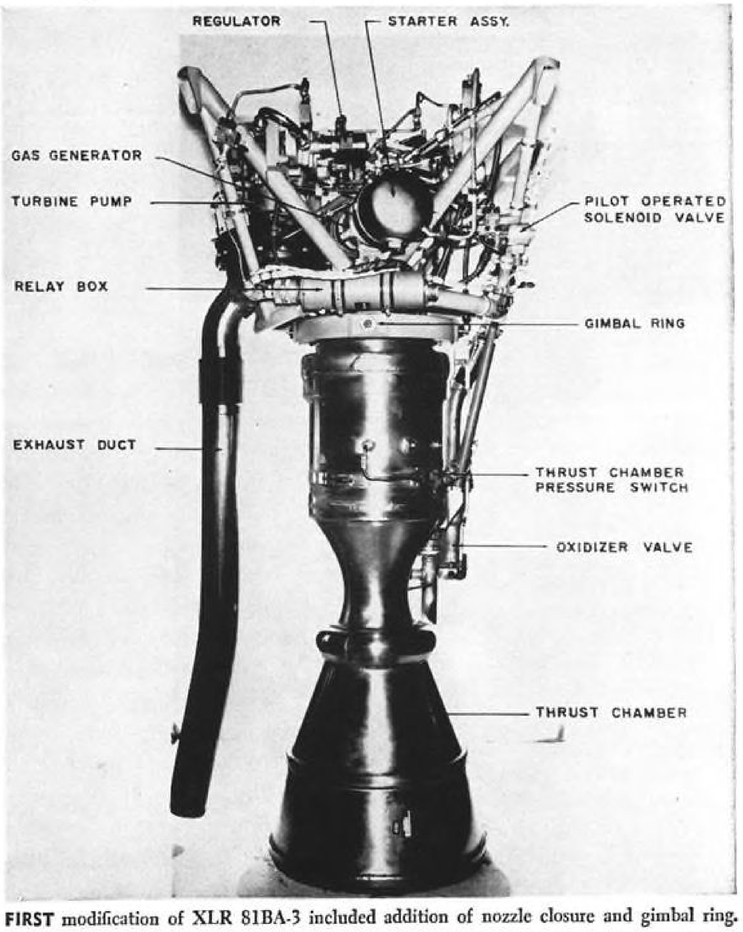
Originally developed to power the air-to-surface weapon pod on Convair's B-58 bomber, the Bell engine actually reached the preliminary flight rating stage, in May, 1957, and then passed into limbo when the powered weapon pod portion of the B-58 program was canceled. It was rescued in the fall of 1957 when Bell was awarded a contract by Lockheed for an off-the-shelf engine which, with minor modifications, was to be used in the Discoverer program.

Major Model Changes

In the past three years, the original Bell Hustler engine has passed through four major model changes and many significant modifications. The most important of these modifications, perhaps, has been the incorporation of a restart capability which enhances mission versatility and preciseness. But there have been several other important changes.

Here, briefly, is a rundown on the evolution of the Agena engine:

• **Gimbaling capability** was the principal additional requirement stipulated in the original Lockheed contract. By fall, 1958, Bell had delivered the first Hustler engine gimbaled for pitch and yaw control, the XLR 81BA-3, and this flew in the Discoverer I in February, 1959. Engine mount was redesigned



FIRST modification of XLR 81BA-3 included addition of nozzle closure and gimbal ring.

POINTS OF DEPARTURE

100% FASTER SPEEDS WITH THIN FILM STORAGE

Today's computers are fast, but they can move a lot faster. Currently, S-C scientists are investigating one of the most promising ways of helping computers live up to their ultimate capabilites. Underway is an extensive study of thin magnetic or dielectric films and their application to high-speed storage systems.

At present, operation of high-speed computers is deterred by the access time to stored information of conventional magnetic core storage systems. Magnetic films have the potential of providing an access time to stored information approximately 100 times greater.

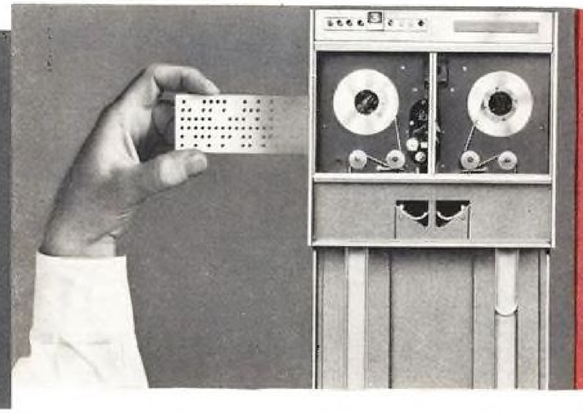
The application of solid-state devices, in conjunction with thin magnetic films, can permit an entirely solid-state storage system with such major advantages as lower cost per bit and increased storage density as well as reliable higher speed of access time.

Investigations will also be made of other promising devices such as cryotrons, tunnel diodes, and partial switching of ferrite cores. This program is only one of Stromberg-Carlson's numerous basic research projects now in progress in all areas of communications science and advanced electronics.

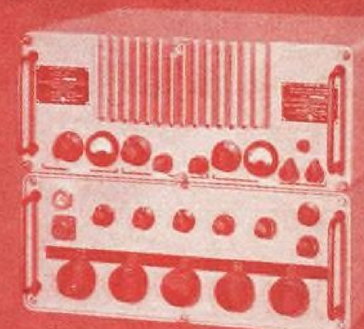
in SYSTEMS MANAGEMENT:



in COMMUNICATIONS RESEARCH:



in ELECTRONIC EQUIPMENT:



ONE-STOP SHOPPING FOR THE ON-SITE TITAN COMMAND CONTROL SYSTEM

A supermarket for systems—that's one way to characterize Stromberg-Carlson's systems capability. USAF officers found everything needed to develop the on-site Titan ICBM Command Control System under one roof at Stromberg-Carlson.

Name the components that must be integrated in such a system — computers, data transmission, processing and display, automatic test equipment, high-speed teleprinters. Stromberg-Carlson is engaged in state-of-the-art development and production of every one of them.

And there's another important fact that will get the Titan project off the pad fast. That's Stromberg-Carlson's unique brand of systems management. We call it Core Concept. We maintain a permanent staff of top scientists, engineers, technicians and management people — plus a group of prime capability sub-contractor companies — *in advance of systems proposals*. With our complete systems team permanently pre-assembled, we're able to move ahead at full speed once a systems contract is awarded.

And cost? Core Concept efficiency should reduce systems management costs significantly. If this sounds attractive, why not let one of our systems experts explain all the details to you.

SINGLE SIDEBAND TRIUMPH: 100 WATTS AND IT FITS IN A HATBOX

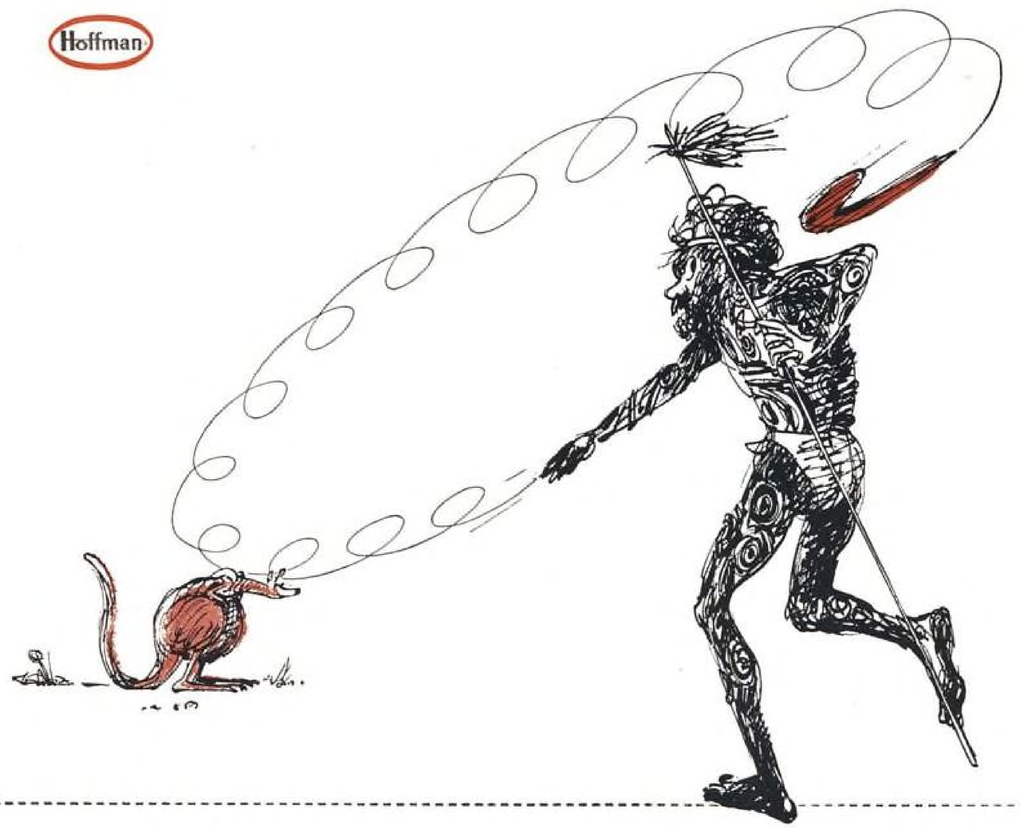
This compact transceiver, weighing just 60 pounds, is the Stromberg-Carlson Single Sideband S-C 901A. Total volume is 3650 cubic inches. It generates 28,000 frequencies from 2 to 30 megacycles.

But here's the real reason we think the unit is a feather in our cap. Along with lightness and compactness, it incorporates comparable improvements in economy, reliability and operating ease.

There's click-stop tuning that allows an operator to pick his frequency in no time at all. Frequencies have a stability of one part in 10^7 per week. The unit is highly transistorized. A unique heat-sink design eliminates forced-air cooling. With a peak envelope output of 100 watts, it draws less than half the power of comparable AM equipment.

At Stromberg-Carlson, we are currently developing equipment for BuShips to be used both as primary high frequency equipment and as standby equipment. And we're adapting features of our sets to air-borne units for the Air Force and the US Army Signal Corps. If you're interested in the S-C 901A transceiver or other advanced Single Sideband equipment, just write for the specifications.

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guidance problems?



Once a missile has left the launching pad, its success is dependent, in part, on the reliability of its guidance system—a system demanding an extremely high degree of precision. Hoffman's Electro-Mechanical Department employs the most advanced precision manufacturing techniques to produce gyroscopes, navigational computers, indicators, and other essential electro-mechanical instruments and components. Equipped with the tools and skills required for this highly exacting work, Hoffman's Electro-Mechanical Department stands ready to help solve your precision manufacturing problems.



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Agena Engine Program

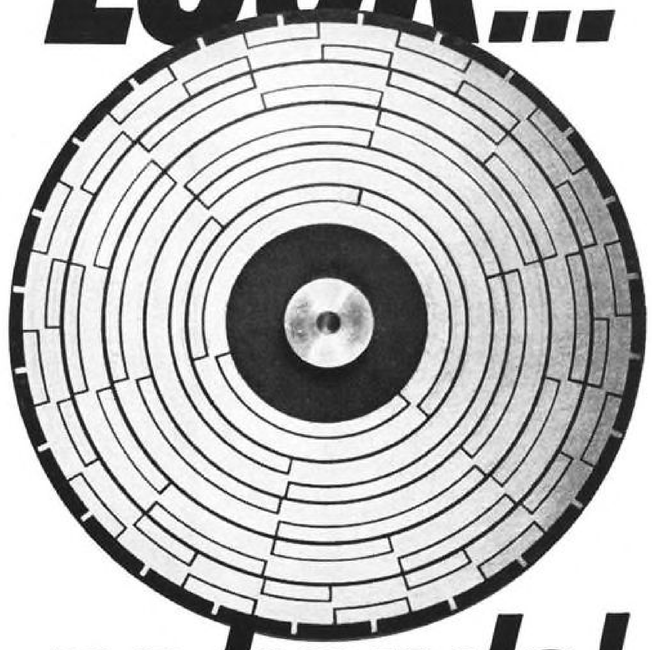
Through three years of continuing modifications, Bell Aerosystems Co. has succeeded in turning its Hustler missile rocket engine into the Agena satellite and space probe powerplant. Already established as the workhorse of the Air Force's Discoverer satellite program, the Agena with its modified Hustler propulsion systems is also scheduled for use in the following programs:

- Midas infrared early warning satellite. Agena will be used atop an Atlas booster in this program.
- Samos optical reconnaissance satellite will also use an Atlas-Agena combination.
- Ranger lunar exploration project. Present plans call for use of five Atlas Agena launch vehicles (AW Oct. 24, p. 31).
- Nimbus weather satellite program currently calls for use of four Thor Agena vehicles.
- Mariner planetary probes to Mars and Venus will use Atlas Agena vehicle combination.
- Rebound network of passive communications reflectors may be launched by Atlas Agena vehicles.
- Orbiting astronomical observatory will be put into orbit by Atlas Agena combination.
- Topside Sounder-satellite, a joint U. S.-Canadian venture to explore the ionosphere, is expected to use a Thor Agena launching vehicle (AW Oct. 17, p. 130).

and stiffened and over-all engine weight rose from about 250 to approximately 280 lb. Also, a nozzle closure was added to ensure ignition at altitude by retaining atmospheric pressure of 14.7 psi. in the thrust chamber.

- **In the spring of 1958,** Lockheed awarded Bell a second contract calling for an improvement in performance within the same engine envelope. Bell engineers substituted the hypergolic propellant combination of unsymmetrical dimethyl hydrazine and red fuming nitric acid for the non-hypergolic JP-4/RFNA mixture. This required redesign of the injector but provided an increase in specific impulse and eliminated the need for the UDMH igniter slug and the accessory ignition equipment. Further improvement in performance at altitude was obtained through a nozzle extension of approximately six inches, which increased the nozzle area ratio 30%.
- **Bell engineers at this time** took the opportunity to simplify the propellant flow control system by replacing the liquid flow regulators with cavitating venturis. Principal results of all these changes were a 10% increase in specific impulse and a moderate increase in thrust which translated into a 500-lb. increase in payload capability. The first

LOOK... no hands!



This printed circuit disc is the "face" of a clock that tells time in digital code

. . . or any code your computer, control system, or data processing device needs to keep it properly in touch with the world of real time.—A. W. Haydon is a company of infinite variation when it comes to such analog-to-digital converters, or "binary encoders". Time periods range from seconds to weeks. Sizes range from miniature to large. They come sealed, enclosed or open, with AC, DC, or pulse drive, and with an imposing variety of accessory equipment.—The model shown is for commerical use. It provides a discrete signal for each two-minute interval over a 28-day period. It is used, among other places, in an automatic parking lot ticket computing system.—This and several other time code generators are described in Technical Brochure SP9-2. It's yours for the asking. Similar solid-state devices can be supplied by our Culver City, Calif.,facility.



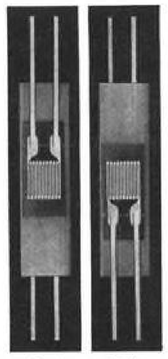
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Makes possible bending strain analyses even on surfaces formerly considered inaccessible.

Separates bending strains from direct (tensile, membrane, hoop) strains . . . accurately measures both.

*Patent Pending

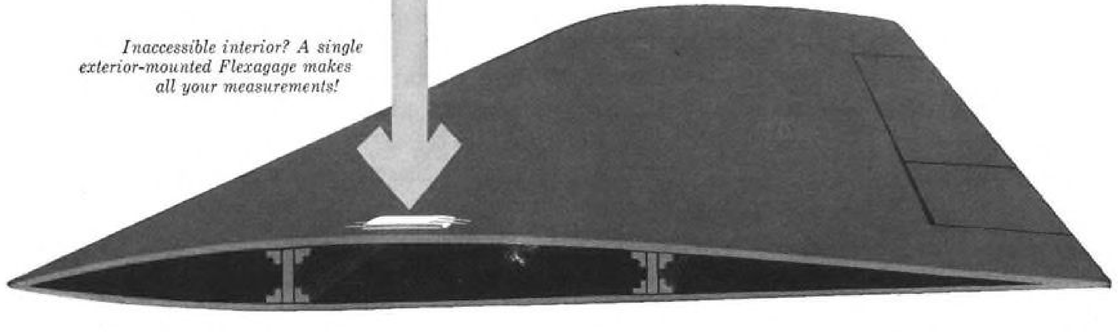
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- PhotoStress gages for unidirectional strain measurements, transducer applications, machine alignment and torque measurements.

of these new XLR 81BA-5 engines was delivered in the fall of 1958 and flew in the Discoverer II satellite in April, 1959.

• **Third contract from Lockheed,** awarded in the late spring of 1959, called for dual start capability and a 100% increase in burning time. Bell engineers added a second solid propellant starting charge and altered the starting sequence to provide an oxidizer lead which would take the place of the earlier nozzle closure in providing the initial combustion chamber pressure required for starting. At this time, Bell engineers also developed a fast shutdown system.

• **Requirement for a 100% increase** in burning created a serious cooling problem for Bell's aluminum-walled engine. To overcome this, Bell engineers varied the geometry of the cooling channels drilled longitudinally in the engine walls. The first of these XLR 81BA-7 engines was flown in Discoverer XVI on Oct. 26 (AW Nov. 7, p. 27).

• **Under the most recent contract** from Lockheed, awarded last fall, Bell engineers increased nozzle area ratio by more than 100% with an uncooled titanium nozzle extension and designed a more efficient injector. As a result, this fourth modification of the original Bell Hustler, the XLR 81BA-9, achieves a further increase in specific impulse at altitude of approximately 5%. Thrust has also been increased so that with the first thrust increment obtained in the dash 5 model, over-all thrust of the Agena has risen approximately 1,000 lb.

• **In the BA-9 engine,** Bell also added pump inducers to reduce tank suppression head requirements and redesigned the injector for greater efficiency. These pump inducers, small helixes on the shaft in line with the main pump, serve essentially as primary pumps and have reduced by 50% the amount of pressurization needed in the propellant tanks. The first XLR 81BA-9 was just recently delivered to Lockheed and has not yet flown.

Structural Details

As it now stands, the XLR 81BA-9 Agena engine, not including propellants or tankage, weighs about 290 lb., is 35 in. in diameter (measured across the mounting points) and is approximately 7 ft. long. The thrust chamber is fabricated mostly of aluminum except for a newly added titanium nozzle extension which is uncooled and coated on the inside with ceramic. Stringers and hoops fashioned from a refractory metal are used on the outside of the nozzle for greater structural integrity. The combustion chamber and aluminum portion of the nozzle are regeneratively cooled by oxidizer.

The engine operates at combustion

To increase safety at ***all altitudes . . .***

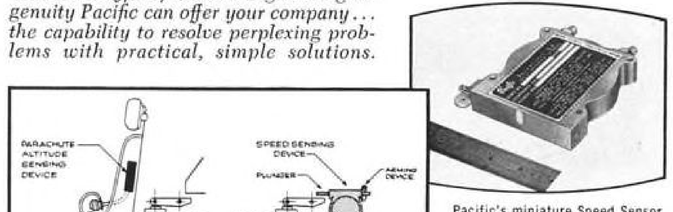


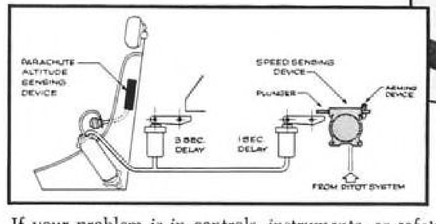
Pacific's
new EMERGENCY ESCAPE DEVICES
solve Automatic Sequencing Problem!

When a pilot ejects at high speeds, seat-man separation is delayed two seconds to prevent injury and parachute tearing. *However, this delay at low altitudes, where ejection is rarely made at extreme speed, may prevent full parachute opening before the pilot hits the ground!*

To reduce this delay and to increase pilot safety at low altitudes, Pacific Scientific has developed a *Speed Sensor* and a *Parachute Release Actuator* for the Air Force that cuts the two second delay to one second – and deploys the parachute in less than 1/10th second! In addition, these two devices permit a three second delay at high speeds – and high altitudes – thus providing the correct sequence of automatic seat separation and parachute deployment under any condition!

Both devices are unusually simple, rugged and dependable. And they are designed to permit easy installation on existing equipment at little cost! This is *the type of reliable engineering ingenuity Pacific can offer your company . . . the capability to resolve perplexing problems with practical, simple solutions.*





Pacific's miniature Speed Sensor (above) and Parachute Altitude Sensing Device (indicated in diagram) are the key elements in this new Emergency Escape System.

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CREATIVE MANUFACTURING AND DEVELOPMENT OF AIRBORNE CONTROLS.



Air Force's T-39 Sabreliner exceeds design specifications

The T-39 Sabreliner, Air Force's first twin-jet utility trainer, bettered its design speed and range by handsome margins in a non-stop test flight over the Western United States. Designed to cruise at 500 mph over a range of 1720 miles, the swept-wing T-39 averaged 540 mph during an 1820-mile flight. Then it loitered for an additional half hour and landed with ample fuel reserves.

The Air Force has ordered 94 of the multi-purpose aircraft for use as radar, navigation, and jet-proficiency trainers—as well as high-priority cargo transports. The T-39 is an aircraft of exceptional all-round utility and economy—a compact workhorse designed especially for jet-age needs. It is being produced by the Los Angeles Division of North American Aviation.

THE LOS ANGELES DIVISION OF **NORTH AMERICAN AVIATION, INC.**



BELL worker checks automatic welding equipment used to attach manifold to Agena rocket nozzle. Manifold connects cooling channels drilled in aluminum thrust chamber wall.

chamber pressure of approximately 500 psi. and produces a thrust of 16,000 lb.

Specific impulse at altitude is believed to be between 290 and 300 sec. Propellant tankage reportedly will accommodate about 13,500 lb. of propellant.

Agena Production

Of the four Agena models (Bell designations, in chronological order of modification, 8001, 8048, 8081 and 8096), it is believed that only the last two are now in production. Except for the Discoverer satellite program itself, which is expected to use the remaining XLR 81BA-5 engines as well as the dash 7 and dash 9 models, most of the other Agena-based vehicles will probably use either the 7 or 9 model with the 9 generally being used for the heavier payloads.

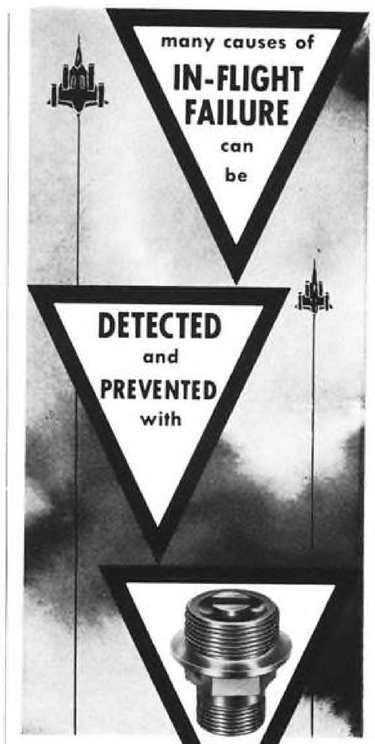
Briefly, this is how the latest Agena engine operates: When the programmer closes the "fire" switch, electrical energy from a 28-volt battery detonates a squib which ignites the solid propellant gas generator and at the same time activates the propellant pilot valve, causing it to close. Gas from the burning solid propellant starts the turbopumps.

Closing of the propellant pilot valve in effect redirects flow to the gas generator valve. When the actuating pressure provided by the turbopumps rises sufficiently, it forces the gas generator valve open; and turbopump operation, now fed by the engine's regular liquid propellants, becomes self-sustaining.

Discharge pressure from the oxidizer pump forces open a spring-loaded propellant valve that controls the flow of oxidizer to the thrust chamber. When the oxidizer flow is established at 90% of rated flow by an oxidizer manifold pressure switch, the switch is closed, completing an electrical circuit through which a fuel pilot valve is energized. The fuel pilot valve then allows pressure to build up in the fuel valve actuating cylinder which forces the fuel valve open, permitting fuel to flow into the thrust chamber. The purpose of this arrangement is to provide an oxidizer lead to the combustion chamber. This initial oxidizer flow vaporizes, building up pressure in the combustion chamber which "fools" the engine into thinking it is at a lower altitude where it can start.

Restart Capability

For restart capability, the engine is provided with a second starting can (that is, a second solid propellant gas generator) and an oxidizer valve fast shutdown system. When the restart requirement developed, Bell engineers found that the lag or hysteresis in the closing of the spring-loaded oxidizer check valve resulted in a heavy afterflow and loss of oxidizer. So Bell engineers developed a fast shutdown system in which stored nitrogen, upon initiation of shutdown, is fed to the back side of the oxidizer check valve to force it shut. A small hole in the valve fitting permits the nitrogen pressure to dissipate to the outside after three to five seconds, at which time the check valve can be reopened for the restart operation. ◆◆



LISLE *Magnetic* CHIP DETECTORS

Metal particles in an engine or accessory lubricant are a proven indicator of internal breakdown. Early detection of this condition is being accomplished today in both commercial and military aircraft with Lisle Magnetic Chip Detectors.

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Clarinda, Iowa



"Scratch the contact – it's a whale."

The false alarms which have continuously plagued antisubmarine warfare operations will be eliminated by a new sonobuoy under development by Chance Vought Electronics Division under the sponsorship of the Navy's Bureau of Weapons. This unique electronic device is being tested now against Navy surface ships and submarines at Key West, Florida.

Vought sees this sonobuoy as part of a family of new ASW systems which would converge from the sea, air and space to pin down enemy subs. Other links in this three-dimensional defense are also taking form at Chance Vought, where the combined resources of all divisions provide the broad capability required.

CHANCE VOUGHT ELECTRONICS DIVISION DALLAS, TEXAS

Early Space Test of Ion Rocket Urged

By Russell Hawkes

Monterey, Calif.—Requirement for an early flight test of an ion rocket in space was expressed at the American Rocket Society's Electrostatic Propulsion Conference held at the U. S. Naval Postgraduate School here by speakers who estimated that a small battery-powered motor could be delivered for flight test within a year or a year and a half.

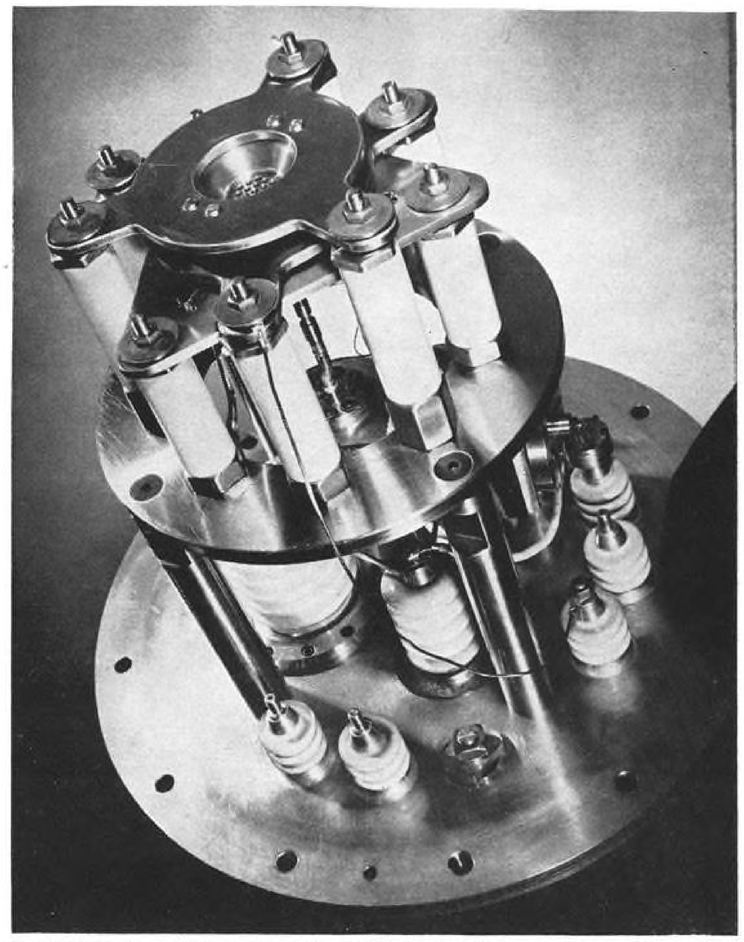
As yet, no firm date has been set for such a test, but guesses most frequently heard during the conference put it in 1963 at the earliest (AW Oct. 31, pp. 28, 73).

SNAP 8 nuclear power system for electric propulsion is supposed to begin testing in 1965. Many of the physicists and engineers at the conference suggested that methods of neutralizing the electrical charge of the exhaust should be proven before that date. Most scientists working on electrostatic propulsion apparently are convinced that little more can be done in earth-bound laboratories to prove the work of existing methods of neutralizing the electrical charge of the ion rocket exhaust. Despite careful efforts to eliminate the effect of walls and instrumentation, it is not certain that anyone has successfully duplicated the conditions of free space. If neutralization schemes should fail and the ionized exhaust should build a positive space charge behind the thrust chamber exit, the motor probably would stall within a few microseconds.

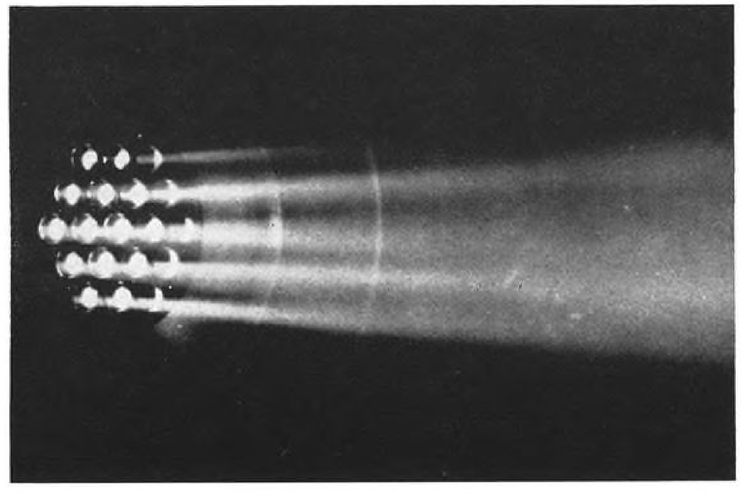
Space-Test Studies

David G. Elliott of California Institute of Technology Jet Propulsion Laboratory presented a study of trajectories and techniques for space testing of ion rockets. Elliott described a proposed ion rocket test vehicle to be launched by NASA Scout four-stage solid-propellant research rocket which is relatively inexpensive and immediately available. He said the necessary tests could be made either in high-altitude probe or orbital trajectories. Orbital tests offer the advantage of longer duration, but a high-altitude probe would keep the test within telemetry range at all times. Scout could launch a 10 mlb. (millipound) thrust ion motor with its power supply and telemetry system into a probe trajectory giving a test duration of about 1.4 hr. Battery life limits orbital test duration to a maximum of a few days. Longer durations must await solar or nuclear power developments and are unnecessary in early tests.

Elliott's proposals are for bare minimal tests to verify ion motor operation. He said the first space tests should be



PROTOTYPE ion motor developed by Electro-Optical Systems, Inc., produces several hundred micropounds of thrust during test (below) under simulated space conditions. Beam is produced from surface ionization source and projected by 19-holed electrodes.





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Novel Measuring Device

Ultra-low pressure measuring device, developed by Westinghouse Electric, uses ultraviolet beam focused on metal surface to produce electrons that subsequently produce ions instead of formerly-used heated filament, eliminating possibility of contamination of gas being measured. The device, known as a photomultiplier ion gage, reportedly is linear over range of 10^{-3} to 10^{-16} mm. mercury, equivalent to pressure of atmosphere at altitudes of 50 to 650 mi.

---

of motors with thrust levels in the range between 1 mlb. and 10 mlb. thrust. At levels below 1 mlb., the ratio of beam diameter to acceleration distance inside the motor may be small enough to yield thrust even without space charge neutralization, making results invalid for larger, more practical ion propulsion units. The 10 mlb. upper limit is set by the fact that no larger motors of the promising cesium contact ionization type are now under development.

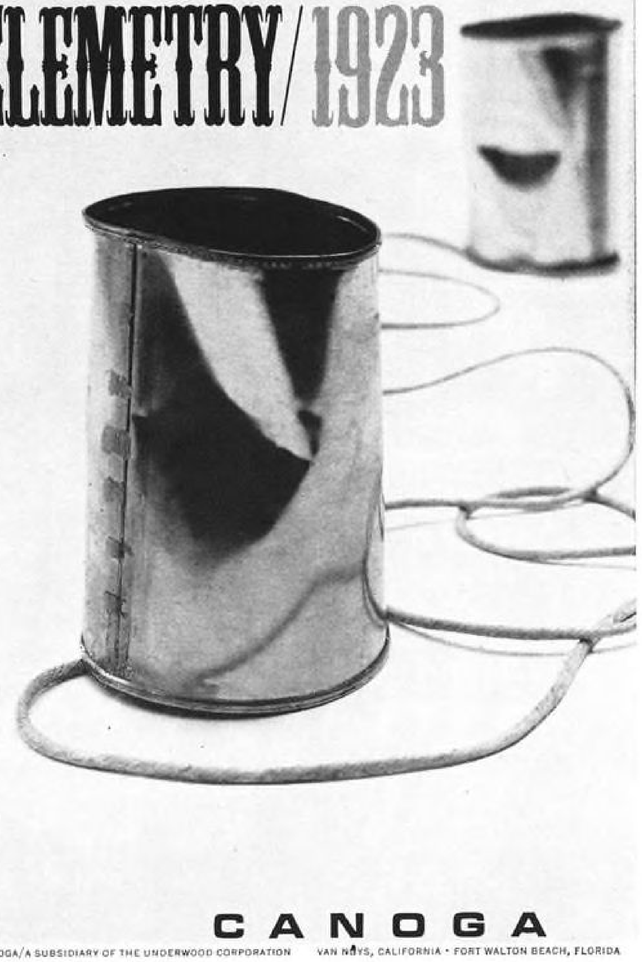
For thrusts and test durations contemplated, Elliott calculates that silver oxide-zinc batteries in magnesium or stainless steel cases will be the lightest power source. The key value to be measured is thrust. If neutralization fails, space charge accumulation will quickly bring thrust to zero, some scientists believe. Elliott indicated less certainty. He considered circumstances in which the net thrust would be the vectorial sum of the electrostatic forces between the exhaust, vehicle and jet reaction, thrust of the ion motor.

Elliott suggested four ways of measuring thrust of the space test ion motor:

- **Measurement of changing orbit** eccentricity of a spin-stabilized satellite test vehicle with the ion motor delivering a unidirectional acceleration, bringing the vehicle closer to earth on one side of its orbit and further from earth on the opposite side. No guidance system would have to be carried.
- **Measurement of changing orbit** altitude of an attitude-controlled satellite test vehicle with its ion motor deliver-

Two tin cans, a lengthy piece of taut string and two kids... many wondrous "bits" of information have been communicated by this process. As a matter of fact, the signals were oftentimes so conditioned that no adult decommutator existed that could decode them. Through experience such as this (plus quite a bit of an exorbitantly more technical nature), Canoga has developed a number of telemetry components...from the ground up (or vice versa, as the case may be). From transmitter, amplifier and airborne antenna to ground telemetry, tracking antenna and receiver... all at 2200 mc... Canoga ties both ends together.

TELEMETRY/1923



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Will The Mission Succeed?

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DATS

(Dynamic Accuracy Test System)

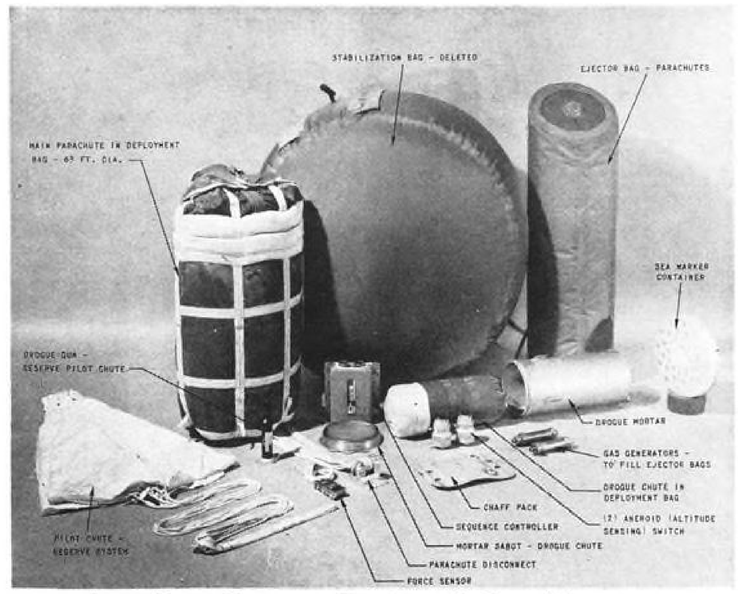


Flight-line checkout by DATS (Dynamic Accuracy Test System) tells the interceptor commander whether his aircraft and weapon control systems are completely ready for a successful mission. As a result of field evaluation tests, showing the effectiveness of DATS in improving weapon control performance, RCA has been awarded an Air Force production contract. Developed by RCA's Airborne Systems Division, Defense Electronic Products, Camden, New Jersey, DATS is a new approach to the evaluation of system readiness.

It makes certain that only aircraft with properly operating weapon control systems are sent on missions. Based on a building-block design employing the highest reliability factors, a mechanical programming device and self-test capability, DATS utilizes a series of synthesized attack runs typical of mission conditions. DATS could be made applicable to many interceptor types of aircraft.

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Landing System Designed for Mercury

Project Mercury landing system components were designed and packaged by Northrop's Radioplane Division (AW Oct. 10, p. 65). Stabilization bag has been replaced with a 4-ft. fabric skirt between the capsule and the heat shield, which separates from the capsule before landing. The air confined between capsule, shield and perforated skirt serves as a pneumatic cushion to attenuate landing shock. It also will serve as a sea anchor for a capsule floating after a sea landing.

ing thrust along lines tangent to the orbit.

• **Measurement of motion** relative to a reference object separated from the vehicle, but not necessarily outside of it. The motion of a ball released within a chamber of suitable size could easily be observed by photocells. Useful information could be gained from a short-duration altitude probe. A thrust measurement could be obtained in a minute or less.

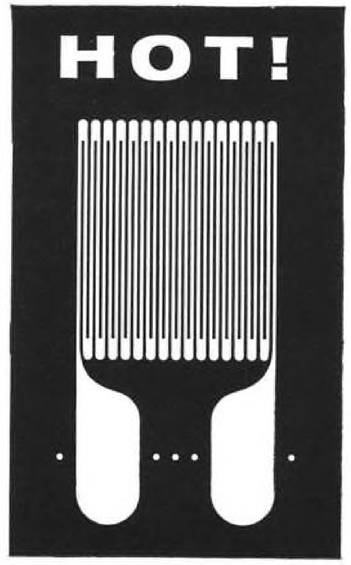
• **Measurement of rotational** acceleration produced by mounting the test motor a known distance to one side of the vehicle center of mass with the thrust line oriented so as to spin the vehicle. Rotational acceleration would then be a measure of net thrust and could be measured accurately as a frequency shift and easily telemetered to the ground. During a 1.4-hr. altitude probe test, this design, as proposed by Elliott, could cause a spin rate change of 235 rpm. if the motor produced the expected 10 mlb. thrust. Since the Scout fourth stage is spin-stabilized at 160 rpm., the test motor could be used to reduce that rate to 0 rpm. and then spin the vehicle up to 75 rpm. in the opposite direction. Spin rate can be sensed by an accelerometer, inertia switch or rate gyro inside the vehicle. Elliott favors the spin test.

Harold R. Kaufman of National Aeronautics and Space Administration's Lewis Research Center told AVIATION WEEK that scientists working in the field of electrostatic propulsion are giving too much attention to cesium-tungsten contact ionization. He said that between 80 and 90% of the laboratories working in the field have adopted this means of generating ions. Contact ionization is admittedly very promising, but Kaufman argues that it is too early in the development of the technology for so much of industry to abandon the search for better ways of creating the ion beam.

Kaufman and Paul D. Reader, also of Lewis, reported on their own work using electron bombardment ionization. They claim that the mechanical simplicity, reliability and efficiency of the two engines they have made upon this principle give them much promise in space propulsion. Only mercury has been used as a propellant in the Lewis Research Center experiments but Kaufman and Reader report that many other materials could be used.

Kaufman said that in experimental runs their motors have achieved 87% power efficiency (ratio of beam power to input power), 400 milliamps, at a specific impulse of 8,000 sec., corresponding to 15 mlb. thrust. This represents about 27% higher power efficiency than is claimed for any contact ionization motor.

The specific impulse is right in the



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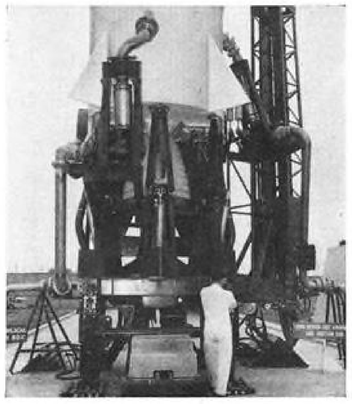
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3M Materials Memo

News of materials for the aerospace industry—selected from the 27,000 products of the 3M Company



■ Frigid But Not Rigid

When facing most crises, a stiff upper lip can be a real asset. Of course, if the lip in question happens to be a seal in a cryogenic fuel system, you'd probably give anything to keep stiffness out of the picture. One way to do just that with confidence is make these critical seals of "Kel-F" Brand Halofluorocarbon Plastic. This remarkable polymer has actually retained a good degree of flexibility at the liquid hydrogen temperature of —432°F — where ordinary seal materials become so rigid they shatter.

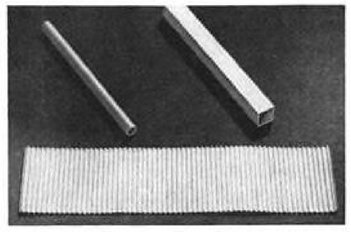
"Kel-F" Plastic has a number of welcome surprises bound up in its tough little chain. Not the least of these is its chemical inertness. This not only gives it resistance to corrosive chemicals and aggressive organic solvents, but in combination with its low temperature properties makes it a safe playmate for liquid oxygen. Other phases of its agreeable personality include good impact and compression strength and resistance to cold flow. What's more, it's a snap to polish or machine to required dimensions.

Why not get more information on this cool performer by contacting your CHEMICAL DIVISION representative or checking the box below.

■ For High Calorie Diets

Calories running rampant can scuttle a sylph-like figure in short order. In the form of heat, they can be pretty damaging to electrical insulation, too. Of course, if that insulation is our MICA INSULATOR DIVISION's "Isomica" 6-T, you're in for a pleasant surprise. You'll find that its voracious appetite for heat puts even the legend of the salamander's fiery diet to shame. It takes exposure to temperatures as high as 1900°F for short periods right in its stride. In environments running continuously at 1500°F, it literally thrives, without any degradation in electrical properties.

"Isomica" 6-T can boast a pretty exclusive ancestry. Its basis is a continuous 100% pure, crystalline mica sheet. This then is impregnated with an inorganic binder which gives it rigidity and strength — and incidentally, through chemical reaction, higher temperature resistance than



the original mica. The final product in tubular form of varying sizes (⅜" to 1⅛" O.D.) offers an extremely uniform high dielectric strength — approximately 650 volts/mill for 1/16" wall. Arc resistance is so high that the standard ASTM test goes off scale. It's also been approved for use where resistance to gamma radiation is required.

Experimental quantities of 6-T materials have also been made in rigid flat sheets and corrugated forms which can be flexed parallel to the corrugation.

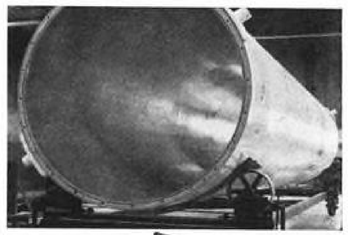
We think 6-T is a pretty hot number for coil forms, resistor and transformer cores, heating element spacers and scads of other uses. Check the coupon below for more information and see if you don't agree.

■ Bird Under Glass

A delicate delight for an epicure's palate? Well, hardly. The bird in this case is the Polaris IRBM — and the case, which is the whole point of our little dissertation, a tough *glass* reinforced plastic shipping container.

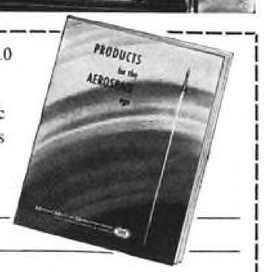
Built by our subsidiary, the ZENITH PLASTICS COMPANY, it's the largest one piece reinforced plastic cylinder ever fabricated. More than 25 feet long with a 57 inch I.D. and weighing less than 2400 lbs., it offered a significant weight reduction (with equivalent strength) over the metal case is replaced. In case you're wondering, ovality and straightness tolerance throughout the cylinder were less than ±.015". In addition the structure included an integral electric heating element for environmental control.

The Polaris case is an excellent example of the kind of structural magic that can be worked when the right materials and fabrication technology are combined in one facility. The raw materials, 3M's "Scotchply" unidirectional filament systems, assure top uniformity in composition and an excellent strength to weight ratio. Zenith, a fabricator (of many years standing) of large precision structures, is now even better equipped to provide quick, versatile and reliable service for you. Through expansion of their facilities and refinement of techniques, they're able to produce even larger such units — either as cylinders or complete rocket motor cases, and do so economically. Even if your requirement is a bit "offbeat," don't be afraid to discuss it with them. Chances are pretty good that they've already had worse. For current data on facilities and capabilities, check the box below.



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center of the range between 5,000 sec. and 10,000 sec. which is of most immediate interest to investigators. Since the prime source of energy in an ion motor is outside the thrust chamber, it is possible to have a specific impulse that is too high. Higher specific impulse calls for higher output from the power source and for a given mission the weight penalty will exceed the motor performance gain above a certain level of specific impulse. As the duration of space missions becomes greater, the importance of high specific impulse rises and power system weight becomes more tolerable. Because of this, the range of specific impulse interesting to ion motor designers can be expected to rise as the rest of space technology advances.

The mercury vapor injected in the Lewis Research Center engines is ionized by bombarding it with electrons emitted from a hot filament at energy levels between 20 and 100 electron volts. Below this range, efficient ion production is difficult and above it, the number of double-ionized atoms becomes so large as to complicate ion accelerator optics. A magnetic field is imposed on the ionizer chamber parallel to the axis of the motor to prevent high velocity electrons from reaching the chamber wall without first colliding with propellant atoms to be ionized. For a 10-centimeter diameter chamber a 20 gauss to 40 gauss field has been satisfactory and the upper limit seems to be about 100 gauss.

The ion accelerator system consists of a screen held at filament potential and the accelerator electrode just downstream of the screen held at a potential several thousand volts negative relative to the screen. This creates a field that tends to accelerate ions away from both screen and accelerator, thereby focusing them and creating an ion sheath at the open end of the ionizing chamber. The accelerator potential is negative enough to prevent electrons from backstreaming into the ion source.

Army Studies Devices To Detect Germ War

Douglas Aircraft Co. has received a $661,000 contract from the Department of the Army for the further research and evaluation of improved devices for the detection of biological contaminants in the air (AW Aug. 29, p. 23).

The system probably will be composed of sensitive detectors designed to indicate the presence of either large numbers of micro-organisms or the presence of unusual types of these organisms. This would only indicate that an attack had taken place and identification of the organisms would be undertaken as a separate step.

Propellant Briefs from Callery Chemical Company

NITRONIUM PERCHLORATE (NO_2ClO_4) New Solid Oxidizer is now available for testing purposes from Callery's laboratory scale production unit for use in propellant development. Large scale production is practical and efforts are under way to expedite rapid development of this capability.

Nitronium perchlorate if pure and properly handled is not shock sensitive. It is hygroscopic and must be handled accordingly. The bulk density of the production material is low, but can be increased by pressing to a density near that of the crystal density—2.22 g/cc. This will overcome some of the handling difficulties which may occur with the fine light material.

Callery has stored a sample of nitronium perchlorate for six years with very little reduction in purity.

Nitronium perchlorate is proving useful in solid and hybrid rocket systems and in explosives. It can be used as a nitrating agent and possibly as an intermediate in other chemical syntheses.

Write for Bulletin C-1200.

PENTABORANE (B_5H_9) Performance Data—Potential of pentaborane as a fuel is evident in its high heat of combustion—29,000 Btu/lb.— and its high specific impulse. Recent calculations yield the following shifting-equilibrium impulses for pentaborane:

Oxidizer	I_s 1000/14.7 psia	I_s 1000/.2 psia
OF_2	367	466
F_2	360	460
O_2	327	421
NF_3	326	413
H_2O_2	316	399
ClO_3F	306	391
N_2O_4	306	390
NO_2ClO_4	302	389

Pentaborane is compatible with all common metals, Saran, polycthylene, Kel-F, Viton A, asbestos, and graphite.

Write for Bulletin—Pentaborane C-1300.

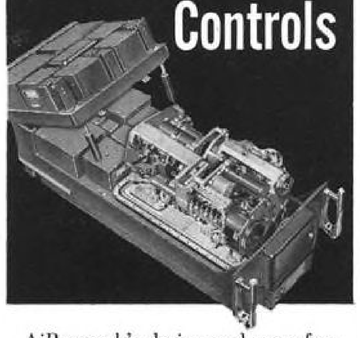
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Automatic Sequencing Controls



AiResearch's design and manufacturing capability covers many types of automatic sequencing controls such as those for missile ground checkout, controlling drone and missile flight profiles, and automatic elevation and leveling of radar antennas and missiles.

Above is an AiResearch sequence controller for cabin temperature of a jet airliner. It assimilates 25 sensor element inputs and supplies command signals to 18 amplifier channels. Consisting of servo-operated potentiometer cards, cam switch programmer and other electromechanical components, it is another example of AiResearch's over-all ability to design and produce intricate and complicated servo systems.

The most experienced company in the development and production of control systems for airborne and ground use, AiResearch is an industry leader in electromechanical systems and components of all types for aircraft, ground handling, ordnance and missile systems.

OTHER ELECTROMECHANICAL COMPONENTS AND SYSTEMS

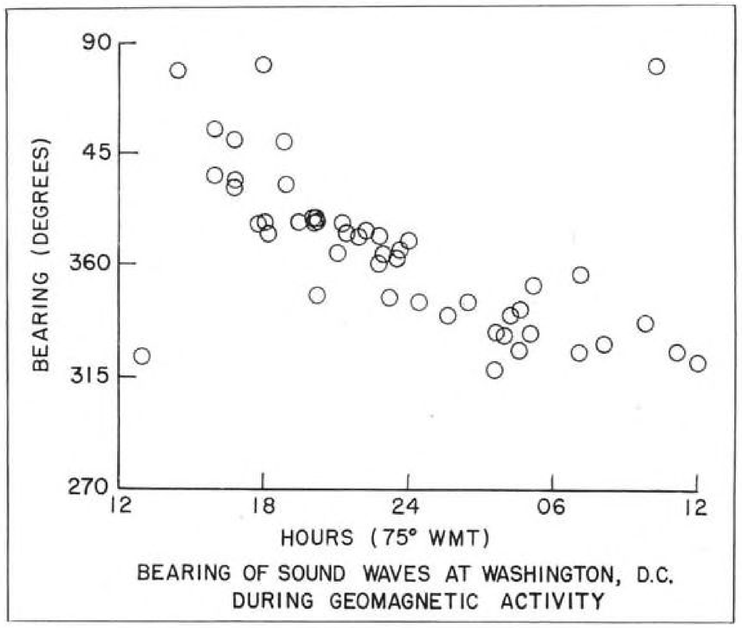
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THE GARRETT CORPORATION

AiResearch Manufacturing Division

Los Angeles 45, California



Infrasonic Wave Measurement

Low frequency sound waves produced by geomagnetic storms, measured by National Bureau of Standards as part of their infrasonic wave measurement program, undergo a shift in source direction with time of day, changing from northeast to northwest between noontime and becoming northerly at midnight. The geomagnetic infrasonic waves have a period greater than 20 sec. and travel across the surface of the earth at speed greater than velocity of sound, sometimes three times as great. Infrasonic waves also are produced by earthquakes and tornadoes but have different characteristics.



NBS infrasonic detection system in Washington consists of four microphones, each located in metal can shown above, separated by several miles, whose output signals are fed to central recording center. Noise-reducing pipe lines minimize effect of local turbulent wind conditions. Direction of approach of infrasonic wave and its velocity are determined by comparing instant of detection at each microphone. NBS plans to make similar infrasonic wave detection installation at Boulder, Colo.

Facility Inadequacy Hurts Re-entry Design

Washington—Lack of adequate laboratory tools is hindering design of lunar and planetary re-entry vehicles, according to Dr. Frederick R. Riddell of Avco Corp.

"First rate" design data, Riddell said, cannot be obtained because existing facilities do not provide equivalent gas energies at high velocities to simulate heat transfer, structures, and stability problems at extremely high velocities.

Riddell, technical assistant to the president of Avco Research and Advanced Development Division, said a facility is needed to duplicate velocities of 33,000-36,000 fps. The highest currently attainable is 24,800 fps.

Precise re-entry vehicle design requires higher velocities in arc jets in order to study heat transfer; in ballistic ranges, for study of stability and flow away from the body; and in shock tubes, for basic physical studies, he said.

Riddell discussed characteristics of these four re-entry bodies to illustrate the varying vehicle design requirements, basing computations on structures with one-foot nose radii:

• **ICBM, with a typical re-entry** angle of 20 deg. at a 23,000 fps. velocity. Dominating heat transfer mode is convection, although radiation effects are present. Maximum structural load is 40g.

• **Earth satellite,** in a shallow (two-degree) re-entry at 26,000 fps. velocity. In this situation, heat pulse is of a long duration, but of small value compared with the ICBM. Peak load also is smaller—about 8g. Heat transfer is almost entirely from convection.

• **Mars/Venus vehicle,** re-entering at a steep, near-vertical angle at 45,000 fps. velocity. Peak loads and heating are very short in duration, but of greater magnitude than the ICBM and satellite bodies, with radiation the dominant method of heat transfer at the stagnation, or hottest, point. Peak load of 500g is forecast for several seconds in steep angle re-entry.

• **Mars/Venus four-degree** re-entry, also at 45,000 fps. velocity. Shallow or grazing re-entry reduces peak g-load and heat transfer, but they have longer durations. Peak of 16g is expected, with heat transfer from convection.

Aerojet Studies Guide Mach 5 Vehicle Design

Aerojet-General's Spacecraft Division, Azusa, Calif, is conducting advanced design studies to establish techniques for guiding engineers in the design of swept wing aerospace vehicles flying at Mach 5-plus. The 18 month, $1 million research program is sponsored by ARDC's Wright Air Development Division.

Several 4-ft. wing span static and flutter models will be tested in the wind tunnels at Arnold Engineering Development Center, Tullahoma, Tenn. and subjected to simulated speeds from Mach .8 to Mach 8 at altitudes from sea level to 300 mi. The models, featuring a 70 deg. angle swept wing, will provide basic measurements in the orbital speed and altitude range. Static models will be fabricated from heat treated steel while flutter models will be made from a sandwich of plastic foam and magnesium sheet.

Explorer VIII Relays Ionospheric Data

Washington—Explorer VIII direct ionospheric measurement satellite is providing approximately 12 min. of data on each pass in an orbit which has elements very similar to those at injection.

Scientists were planning the first command to the electric field meter late last week to transmit data on the amount of accumulated charge on the vehicle skin. Other experiments were operating continuously and indications are that useful data will be transmitted for another two months (AW Nov. 7, p. 31). Passive lifetime is estimated at 2-3 years.

Field meter will be commanded to take measurements periodically, because the large power drain prohibits continuous operation.

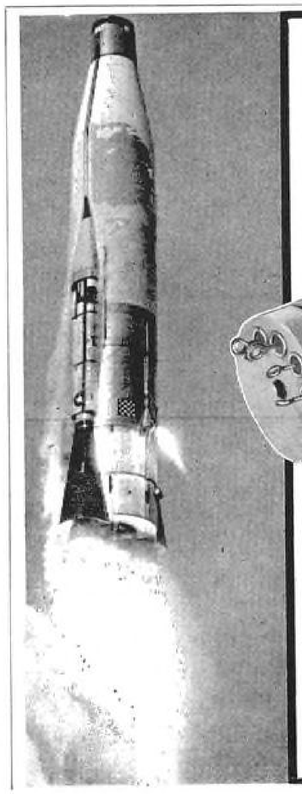
When Explorer VIII was injected into orbit, it had an apogee of 1,423 mi., perigee of 258 mi. and 112.75 min. period. After one week of flight, apogee was 1,423.4 mi. and perigee was 257.7 mi. with the same orbital period.

GE Re-entry Study Has ICBM Application

Washington—General Electric Missile and Space Vehicle Department has begun a study for the Army into physical phenomena of re-entry for application to anti-ICBM systems.

The study, costing about $500,000, calls for all government agencies doing re-entry physics studies to furnish data to GE for correlation. The object is to improve existing technical understanding of re-entry characteristics so parameters can be established on the probable missions of re-entry vehicles.

GE will assess work being done in theoretical gas dynamics, electromagnetic radiation, re-entry vehicle programs, shock tubes, gun ranges, plasma physics and radar and infrared-optical measurements.



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Convair 540 Conversion with Napier Jet-Prop Engines





Convair 540s undergoing modification with Napier Jet-Prop engines at AiResearch Aviation Service, the most experienced company in the modification of pressurized aircraft.

AiResearch Aviation Service converts Convair 340s and 440s into high performance airliners and executive aircraft with Napier Jet-Prop engines specifically designed for the Convair 540.

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An AiResearch auxiliary gas turbine installation (optional equipment) makes the Convair 540 self-sufficient on any landing strip. The on-board unit provides complete engine starting and all power for ground air conditioning and preflight checkout.

Installation of the 3500 eshp Napier "Eland 504" Jet-Prop engines with four-bladed propellers includes structural modification to engine nacelles, new instrumentation, and electronic and radio system modification in minimum down time.

Conversion of Convair 340s and 440s to Napier-powered Jet-Prop 540s is performed exclusively at AiResearch Aviation Service, the most experienced company in the modification of Convair 240s, 340s and 440s into executive aircraft and luxury airliners.

Employing more than 600 of the most highly trained and experienced engineers, technicians and craftsmen in the industry, AiResearch performs all design, engineering, fabrication and installation work in one location to meet the conversion, modification, maintenance and overhaul requirements of any aircraft.

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Increasing Conventions Come Under Fire

By Philip J. Klass

Washington—Mushrooming number of technical conventions, particularly in the electronic field, is forcing corporate managements to take a critical look at the drain on engineering man hours and travel funds.

The situation has reached the point today where an engineer could spend more than half the total working days in a year just attending conferences sponsored or cosponsored by the Institute of Radio Engineers and its many individual professional groups. Additionally there are conventions sponsored by other technical societies which are of interest to electronics engineers.

Conventions Grow

In the past few years, the number of technical conventions has nearly tripled and currently is multiplying at an even faster rate. For example, the calendar of coming conventions in the October, 1952, IRE proceedings listed 15 meetings for the next seven months, while the October, 1960, proceedings lists 36 conventions for the same period.

A list of all IRE-sponsored and cosponsored meetings issued in the fall of 1955 showed 31 conventions scheduled for the subsequent year, while a similar schedule just released by IRE shows 54 conferences for the subsequent 12-month period.

Criticism Increases

Engineers and scientists are increasingly outspoken in their criticism of the present situation. They complain of the general mediocrity of technical papers. They attribute this in large part to the fact that mushrooming numbers of conventions have created a demand for papers which far exceeds the supply of significant new work to report. This results in papers which largely duplicate previous papers and/or contribute little to the audience's fund of new knowledge.

One engineer summed up his feelings this way: "If I had to pay half of my own travel expenses myself, I'd skip 90% of the conventions I now attend."

Generally, engineers like the growing trend to conventions which deal with a single specialized subject, such as electric propulsion, energy conversion or semiconductor circuits. This enables them to attend only those meetings which deal with subjects of value in their work.

The across-the-board type conventions, which present a handful of papers on every subject from high fidelity to space vehicle guidance, are losing favor because engineers and scientists are becoming specialists. Increasingly, engineers and scientists are questioning the value of traveling hundreds of miles and spending three or four days to hear perhaps five papers in their field, only one of which may provide significant new ideas.

Another criticism is the scheduling of papers at across-the-board type conventions. Too often sessions dealing with a particular specialty are separated by one or more days, or they overlap with long intervals in which there are no sessions of interest to engineers specializing in a particular field.

There is growing criticism of the mad scramble among technical societies and among individual professional groups within the IRE to stake out claims to new technological areas by staging a new technical conference.

A good example is the field of communications satellites. Within a 60-day period, three different IRE professional groups sponsored four separate national conferences, all on the East Coast, which featured one or more technical sessions on communications satellites:

- **Aug. 1-3:** Global Communications Symposium, Washington, sponsored by IRE Professional Group on Communications Systems (PGCS).
- **Sept. 19-22:** National Symposium on Space Electronics & Telemetry, Washington, sponsored by IRE Professional Group on Space Electronics & Telemetry (PGSET).
- **Oct. 3-5:** National Communications Symposium, Utica, N. Y., sponsored by IRE Professional Group on Communications Systems (PGCS).
- **Oct. 24-26:** East Coast Conference on Aeronautical and Navigational Electronics, Baltimore, sponsored by IRE Professional Group on Aeronautical and Navigational Electronics (PGANE).

Several years ago when the IRE decided to permit formation of Professional Groups, each a miniature technical society within the IRE which deals with a specialized area of electronic technology, the lines of demarcation between such groups were well defined. Today there is sharp rivalry and overlap.

Examples of Rivalry

When the Professional Group on Aeronautical and Navigational Electronics was slow to officially stake out claim to space and change its name to reflect this claim, the Professional Group on Telemetry and Remote Control changed its name to Space Electronics and Telemetry, presumably seeking to claim responsibility where the atmosphere ends.

But the rivalry is not limited to these two groups. Because satellites and space vehicles figure prominently in military thinking, the IRE Professional Group on Military Electronics (PGMIL) concluded that it should not be denied a role in space. The numerous papers dealing with space technology at PGMIL's recent convention in Washington (June 27-29) reflect its intention to move into space.

Because satellites represent one of the most promising new techniques in the communications field, no one could rightfully deny the Professional Group on Communications Systems an inter-

The Explanation

To electronic engineers who have difficulty keeping up to date in their technical reading, figures recently disclosed by Institute of Radio Engineers will come as no surprise. Today the IRE proceedings, and the proceedings published by its 28 Professional Groups, total 17,968 pages in the course of a single year. This is a 3,000% increase over the total published only 20 years ago, and a 1,100% increase over the total only 10 years ago.

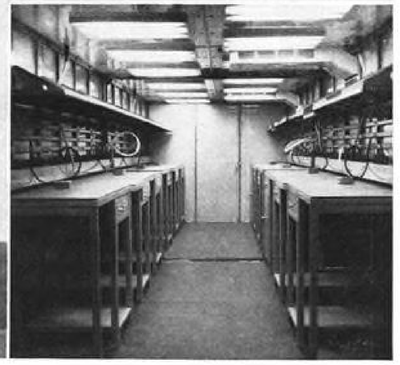
Wescon Survey

Survey of 405 persons who attended the 1960 Western Electronic Show and Convention (Wescon) indicates that 66% of them felt that "Wescon lectures and technical discussions serve to advance the art," while another 3% felt they did not. Remaining 31% answered "don't know." Questionnaire did not ask whether respondent's own knowledge had been increased by the technical lectures and discussions. Asked whether Wescon exhibits advance the electronic art, 73% said "yes," 11% said "no" and 16% replied "don't know."

Survey was conducted by Facts Consolidated, a market research firm, for Wescon management. The latter has pioneered many innovations intended to improve the usefulness of the convention to its attendees.

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Typical of Condec mobile shelters are these air-conditioned vans which can be joined in building-block fashion to provide any desired floor area. Transportable by land, sea and air, they provide comfortable working conditions from the Arctic to the tropics.

Fitted out as the electronic workshops shown here, they weigh less than 3,500 pounds. Equipment installed includes workbenches, instrument cabinets, outlets for 120/208-volt, 400-cycle AC and 28-volt DC, fluorescent lighting, emergency battery lighting, air-conditioning and heating.

The detachable, elevating undercarriage designed by Aircraft Equipment Division engineers adds a new connotation to the word "mobile." For loading in cargo planes, one crank elevates the body to platform height; four quarter-turn fasteners separate body from running gear, ready to be skidded aboard. When tow bar is released, brakes are automatically applied. Want to know how Condec can help you with your mobile shelter requirements? Call or write Mr. Jerome I. Davis, Vice President, Aircraft Equipment Division.

Condec Products for Missiles and Aircraft

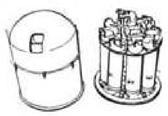
Special-purpose vehicles, like this runway sweeper, are key products at Consolidated Diesel. Other vehicles supply all power requirements for ground support of missiles and aircraft.



Test equipment covers entire range of systems to check hydraulic, pneumatic, electrical and mechanical operating parameters.



Special airborne devices include products like this radiosonde dispenser design that cuts weight 40%, space 16%, improved and simplified operating system.



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est in space. PGCS's recent convention papers indicate that it is not content to leave the subject to PGANE, PGSET and PGMIL.

Recognizing that antennas, computers, human factors, instrumentation and reliability are important elements of space vehicle design, some observers believe it may only be a question of time before the IRE Professional Groups on Antennas and Propagation (PGAP), Electronic Computers (PGEC), Human Factors in Electronics (PGHFE), Instrumentation (PGI), and Reliability & Quality Control (PGRQC) officially recognize the challenges of space and of other IRE professional groups.

Race for Space

When the IRE Professional Group on Space Electronics & Telemetry moved into an area that the Professional Group on Aeronautical and Navigational Electronics considered to be an extension of its own sphere of effort, PGANE stepped up its own emphasis on space and telemetry. At the PGANE convention in Dayton, May 2-4, more than half of the technical sessions were devoted largely or entirely to space technology, ranging from electric propulsion to interplanetary environment. There even was one session on telemetry itself. Three weeks later, five technical societies, including the IRE, sponsored the National Telemetering Conference in Santa Monica, devoted entirely to the subject of telemetry.

Four months later, IRE's Professional Group on Space Electronics & Telemetry held its own national convention. Only one of the 10 technical sessions was devoted to telemetry, the group's original area of interest, with the balance covering such diverse subjects as electric propulsion and space vehicle navigation.

Space navigation might appear to fall in the domain of the Professional Group on Aeronautical and Navigational Electronics, but PGSET thinks otherwise and recently held its own two-day symposium in Columbus, Ohio, devoted exclusively to space navigation.

The American Rocket Society is not sitting idly by while the IRE moves into the field of electric propulsion. The ARS held a two-day symposium in Monterey, Calif., devoted exclusively to electrostatic propulsion (see p. 63).

The ARS also is contesting with the IRE, and other technical societies, for a dominant role in energy conversion for space power use. It recently held a four-day conference in Santa Monica, Calif., Sept. 27-30, devoted to space power and energy conversion.

Even the Society of Automotive Engineers (SAE) sees an important role for itself in these fields. At its recent Aeronautic Meeting in Los Angeles, there were technical sessions on auxiliary power systems for space vehicles, plasma propulsion, space communications and guidance.

The American Institute of Electrical Engineers (AIEE), which has specialized largely in electric power generation and control, also sees the energy conversion field as an exotic addition to its area of interest. The AIEE and IRE's Professional Group on Electron Devices (PGED) are cosponsoring a symposium on energy conversion devices this month. The PGED, which is concerned with power tubes and semiconductor devices, bases its bid for a role in energy conversion and space power on the fact that thermionic converters employ power tube principles and solar cells are semiconductor devices.

In January a Symposium on Thermoelectric Energy Conversion will be held in Dallas, jointly sponsored by the following technical societies: Institute of Radio Engineers (IRE), American Institute of Electrical Engineers (AIEE), American Nuclear Society (ANS), American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), American Electrochemical Society (AES) and the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRE), plus the Defense Department.

The current situations prompt some observers to suggest that technical conferences, like organizations in general, are subject to "Parkinson's Law" which



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Programed relay tester, which operates from punched tape, automatically tests and records following information: coil resistance, contact resistance, pickup voltage/current, drop-out voltage/current, pickup bounce time, drop-out bounce time, pickup operate time and drop-out operate time. Tester will be built and marketed by General Electric, Specialty Control Dept., Waynesboro, Va.

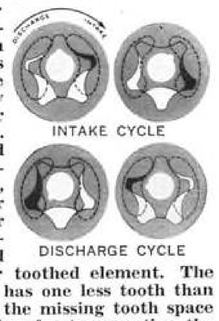


PUMP PRIMERS

ARTHUR A. NICHOLS

HIGH EFFICIENCY PUMPING AT HIGH ALTITUDES

► Engineers concerned with the pumping of various aviation fluids know well the difficulties of getting good performance at high altitudes where low inlet pressures are encountered. Pumps which work well at low altitudes frequently run into trouble when they encounter the rapid pressure changes, shock and turbulence which promote foaming and lowered efficiency at high altitudes.



► **Gerotor pumps are efficient at high altitudes and therefore are frequently specified for this service. A specialized form of internal gear pump, the Gerotor has an inner toothed element and meshing outer toothed element. The inner Gerotor has one less tooth than the outer and the missing tooth space forms a chamber for transporting the fluid from the inlet to the outlet port.**

► Slow opening of the chamber as it traverses the large inlet and discharge ports results in avoidance of the sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in foaming and lowered efficiency. Thus, Gerotor pumps offer exceptionally good performance at high altitude.

► **Low relative speed and closely held clearances between the two Gerotor elements mean high mechanical efficiency is maintained.**

► Low weight, high performance and unusual adaptability to space and geometry of housing structure make Gerotor pumps ideal for gearbox lube and scavenge service.

► **Engineers concerned with drives, auxiliary power sources, gear boxes and various transmission design problems involving pressure lubrication have found Gerotor type pumps extremely useful in their attempts to hold weight down and achieve maximum compactness with high service reliability.**

► Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

► *Technical data is available and your inquiry is invited. Write:*

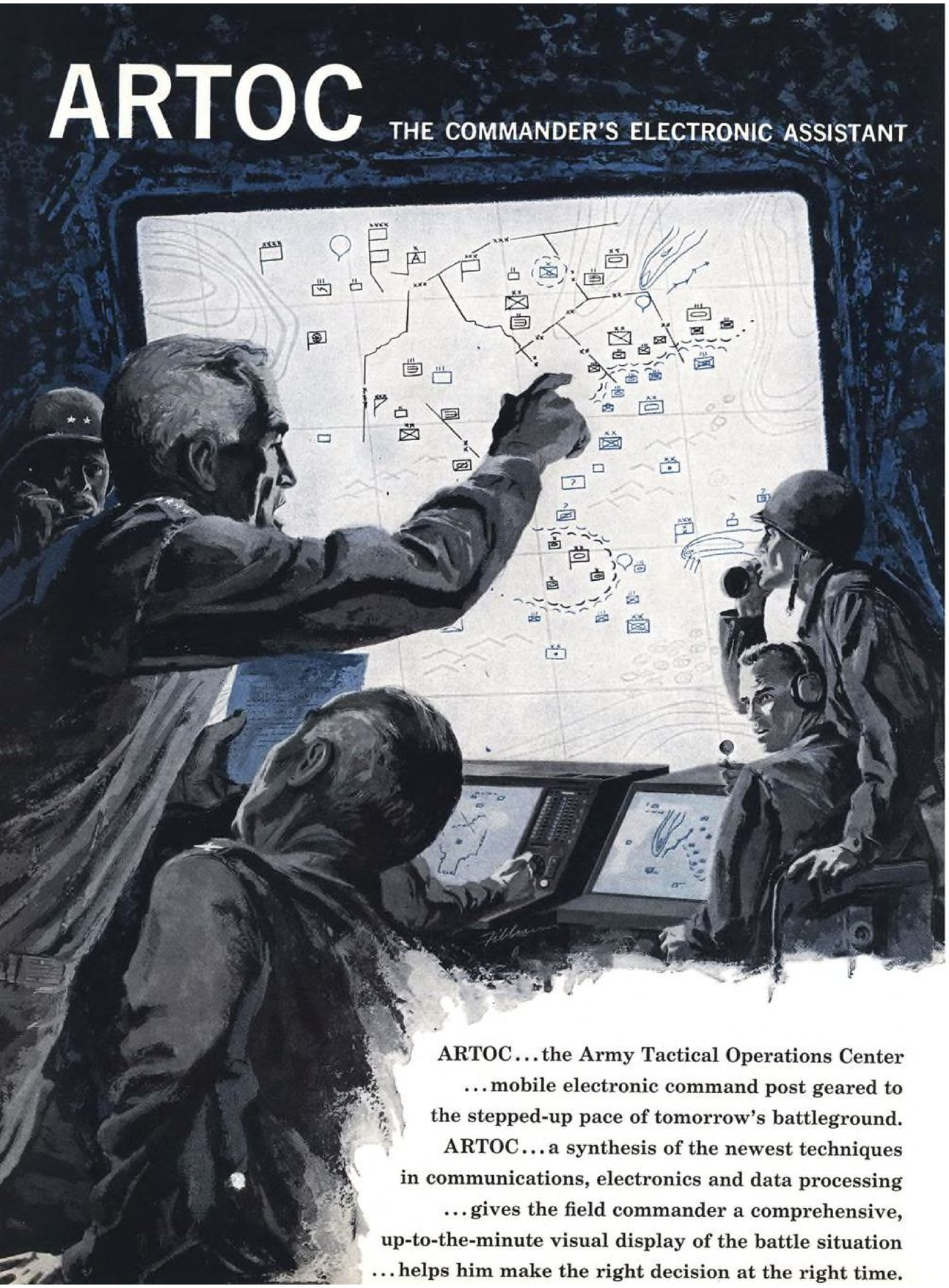
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Career opportunities are open for engineers and scientists

states that organizations increase in size about 6% every year, regardless of whether their workload is increasing, remaining constant or decreasing.

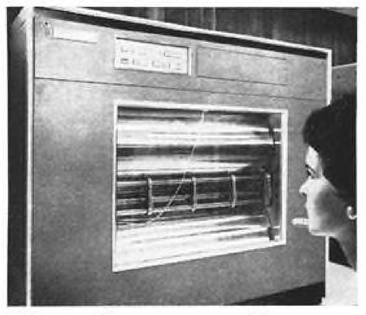
If the present trend continues, one observer makes the tongue-in-cheek prediction that "the time is coming when most of the nation's engineers and scientists will be devoting practically all of their time either to writing papers for technical conferences or listening to papers at technical conferences. This will result in an even more acute shortage of engineers and scientists, causing an astronomical rise in salaries. It may be a good thing for engineers and scientists but it could be disastrous for the nation."

One scientist sums up the situation in another way: "In most scientific effort, we place great emphasis on quality, not on quantity. The notable exception is our technical conferences where we appear to pride ourselves on the quantity of papers presented rather than on their quality."

Greater Selectivity Urged

What is sorely needed, this scientist believes, is far greater selectivity in the choice of authors and papers, with the primary goal of quality instead of quantity. This in turn means that conferences must be more selective in manning their committees to choose authors and papers for their convention. The latter should be both technical qualified and willing to spend the necessary time to assure that material selected for presentation is significant and new.

"Only in this way," this scientist concludes, "can we make our technical conventions representative of the best of U. S. science and technology, instead of typifying mediocrity." ◆◆



Giant Computer Memory

Giant computer memory, known as Univac Randex Storage, consists of two drums capable of storing 24 million digits and signs, with random access time of milliseconds. System, intended for use with Univac Solid-State and STEP computers, can be expanded to as many as 10 storage drums. Manufacturer: Remington Rand Division of Sperry Rand Corp.



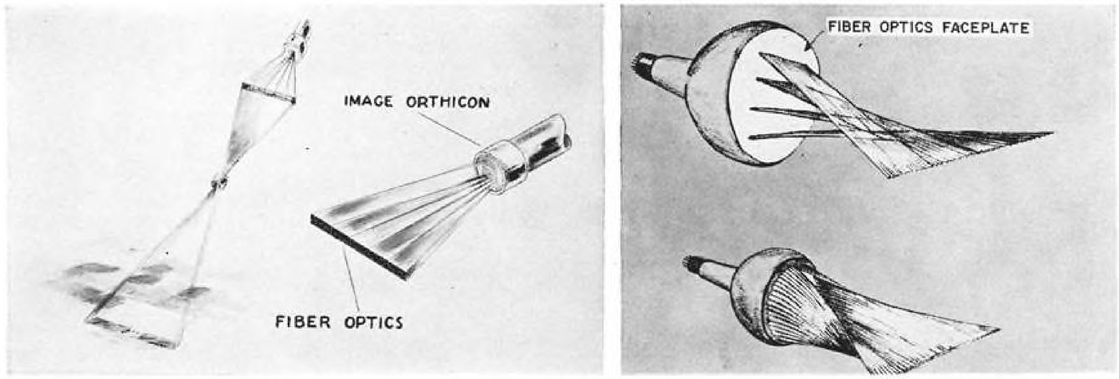
THEY RELIED ON
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TO TRANSMIT AND RECEIVE TIROS' WEATHER DATA

Now that the performance record is complete, it can be reported factually. All cloud cover pictures were telemetered to earth by two Radiation Model 3115 FM Telemetry Transmitters. Over 90% of the pictures from NASA's *Tiros I* were received on Radiation antennas. Both the transmitters and the antennas have proved their reliability in several major missile programs.

The two automatic tracking antennas which recovered the weather pictures are located at Ft. Monmouth, N. J., and Kaena Point, Hawaii. Radiation designed and built the Kaena Point antenna, converted the one at Ft. Monmouth to automatic tracking. During the 1600 orbits completed by *Tiros* in 3½ months, push-button antenna operation gave automatic satellite acquisition and tracking.

Transmitters and antennas . . . electronic data acquisition and processing systems . . . radar . . . instrumentation . . . all these are areas in which Radiation's capabilities have materially aided the defense program, industry and the advancement of electronic technology. For a closer look at the things we do . . . and can do . . . write for our "Capabilities Report". Radiation Incorporated, Dept. AW-11, Melbourne, Florida.

RADIATION
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HIGH-RESOLUTION fiber optics aerial TV system (left) would scan single line along earth, image it onto line-to-raster shape transducer butted up against fiber optics faceplate of camera tube. Typical shape transducers are raster-to-line converter (upper right) and circular line converter (lower right). Drawings represent developments of RCA Defense Electronics Products.

Fiber Optics Reconnaissance Explored

By Barry Miller

Los Angeles, Calif.—Potentially high-resolution airborne and satellite reconnaissance systems may ultimately emerge from early work now being conducted in an infant electro-optical technology based on fiber optics, an AVIATION WEEK survey of groups active in the field indicates.

Few scientists working with fiber optics—the transfer of constrained light from one end of a narrow glass or quartz fiber to the other—are willing to speculate about how extensive its applications in avionics/space technology may be or when practical fiber optics systems may be built. With a few exceptions, work in this field remains on the research and development level.

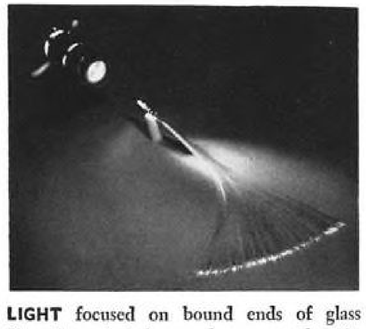
A number of companies prominent in aerial reconnaissance have been studying fiber optics for several years. After three years' research, Radio Corp. of America's Defense Electronic Products Division, in cooperation with the American Optical Co., has begun building a model of a fiber optics television reconnaissance system (AW June 27, p. 77) which may demonstrate a factor of 10 improvement over comparable reconnaissance systems.

Chicago Aerial Industries also has three years of studies in fiber optics, initially in collaboration with Armour Research Foundation. CAI expects fiber optics to play a role in image transmission systems, direct photographing from cathode ray tube faces, image intensifiers and in overcoming problems of field curvature in reconnaissance systems. Fairchild Camera and Instrument Corp. through the previous and continuing work of its recently acquired Allen B. Du Mont Laboratories Division also is active in this area.

A fiber optics scanner will be included by Fairchild in its proposal to the National Aeronautics and Space Administration's Jet Propulsion Laboratory for a high-resolution photographic system to be employed in mapping the moon's surface. Fairchild, RCA Astro Electronic Products and Eastman Kodak presently hold parallel feasibility contracts to study lunar mapping systems under Jet Propulsion Laboratory's VOIS (Visual Observation Instrumentation Subsystem) program (AW Oct. 17, p. 27.) When these feasibility studies are completed and if funds are made available, a competition will be held among the three to determine which system will be employed in an Atlas-Centaur boosted lunar orbiter.

Application Evaluation

Application of fiber optics to aerial combat surveillance systems is being evaluated at the Army Signal Research and Development Laboratory at Ft. Monmouth, N. J., Signal Corps representatives recently said at the Army's Electronic Proving Ground at Ft. Huachuca, Ariz. Under Signal Corps contract, Armour Research Foundation is examining the use of fiber optics in the reduction of data from side-looking radar and the coding and transmission of photographic data from aircraft. For Wright Air Development Division, Armour is investigating infrared transmitting fibers which could improve IR guidance, detection and recon.



LIGHT focused on bound ends of glass fibers is projected around curves and emitted from unbound ends.

Other avionic/optical organizations known to be working with fiber optics, either on electro-optical applications or as suppliers of the fine glass fibers required, include Bausch & Lomb, Inc., Mosaics, Inc., and Space Electronics Corp. In addition, scientists at Bell Telephone Laboratories are checking the use of fiber optics for focusing into small areas as part of an investigation of unconventional high-speed photography.

Bell's recent success with optical Masers (AW Oct. 24, p. 75) could extend its interest into possible waveguide properties of fiber optics.

Although interest in a myriad of potential applications for fiber optics is stimulated by the current availability of the glass fibers, the underlying principles of fiber optics are not new. A number of scientists over the years suggested the possibility of transmitting images through a bundle of flexible fibers.

Light impinging on the end of a transparent rod can effectively be piped through to the opposite end by a series of total internal reflections. As the diameter of the rod is reduced, the number of reflections within a given length increases, but the effect remains. Light enters and emerges from the rod at the same angle. If a large number of thin, flexible glass fibers (whose diameters are on the order of microns) are bunched together, their ends ce-

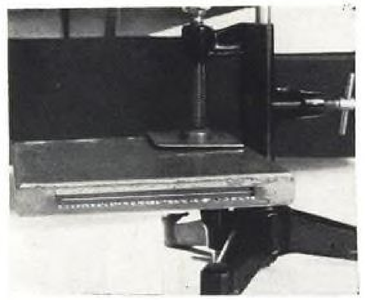
Behold the gated oscillator – genus electronics; natural habitat circuits, esp. digital volt-ohm meters ● Strange names abound in the work-world where physical, chemical and biological phenomena are converted into electrical signals. Uncommon names, in common use whenever there's need to present hitherto unknown or hard-to-come-by information ● An amino acid analyzer probes a protein for pharmaceutical research... an infrared spectrophotometer ferrets out the complex nature of an organic compound...a gas chromatograph analyzes and records the composition of a process stream... a data handling system monitors a nuclear reactor ● They're all of a lineage long distinguished for exemplary performance, even under most difficult conditions. And regardless of their sometimes numbing nomenclature, all uphold the family tradition – behaving perfectly in any scientific circumstance ● The family name is Beckman.



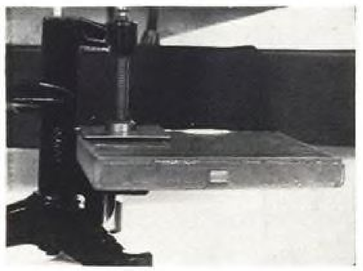
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RCA shape transducer's thousands of parallel glass fibers taper from 10-in. length (top) to 10 parallel lines of 1-in. length (bottom).

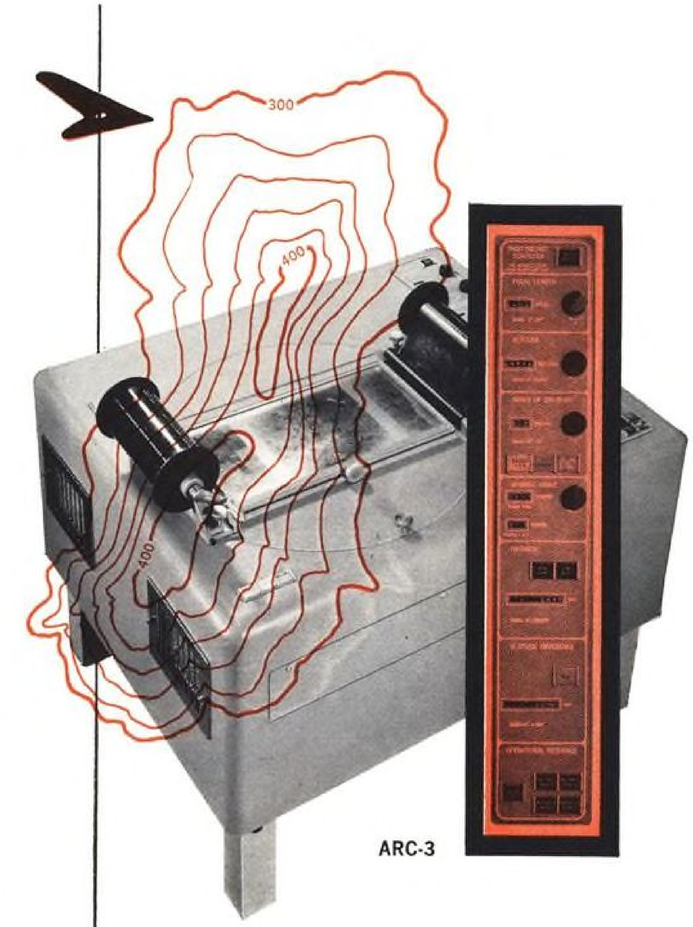


mented or fused, and substituted for the rod, the effect still remains. A complete image can be transferred by the fibers from one point to another with each fiber carrying a tiny portion of the image.

As long as the order of the fiber ends at the emerging end is the same as at the entering end, the center portions of the fiber bundle can hang loose, be twisted or bent without distorting the output image. This makes "seeing around the corners" possible and has stirred much interest among medical instrument researchers because fiber optic cystoscopes, prothoscopes and similar devices for probing human vitals now appear possible and practical.

Should fiber order be scrambled at one end of a bundle of many fibers, the emerging image would be unrecognizable. Scrambled images could be photographed and unscrambled by viewing from the origin or input end of the same or an identically scrambled bundle. Thus, coding and encoding are possible. A form of this is suggested by RCA for signature verification. Magnification by enlarging emerging fiber diameters, spiral and horizontal scanning are other fiber optic possibilities.

Smallest detectable detail through an individual fiber is variously reported as 1½ to 2 times the fiber's diameter because light incident on only a part of the fiber will emerge from the total diameter. On the basis of the latter figure, resolving power of a fiber bundle



computer/CAPABILITY

A major capability of The Aeroflex Corporation is to design, develop and produce specialized computers such as the ARC-3 that automatically measures co-ordinates, distances, areas and heights on panoramic, oblique or vertical photographs by solving complex trigonometric equations to perform the necessary computations—or the desk top ART-149 which provides visual analysis of factors relating to the operational performance of a reconnaissance system.

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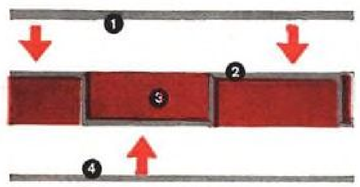


Johns-Manville Announces... **MIN-KLAD INTERLOK**

. . . a new structural system interlocking Min-K insulation and high-temperature reinforced plastic

Missile experience shows that in certain heat control situations no one material will perform as well as two (or more)—*an insulation with protective high-temperature facings.*

Problem is how to effectively combine these materials into a structurally strong unit? The answer is Min-Klad Interlok



1) Outer facing, 2) Interlocking web, 3) Core, any one of several Min-K formulations, and 4) Inner facing.



All the above components combine to provide a custom-made structural strong insulating system.

—a new structural system that interlocks Min-K insulation and reinforced plastic, metal or other high-temperature facings.

The result: one product that gives the missile designer every advantage of high-temperature plastic or metal foil—strength, toughness, rigidity! Erosion resistance! High heat capacity!

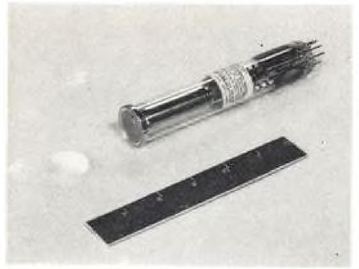
. . . plus the outstanding advantages of Min-K insulation—an insulating core that has the lowest thermal conductivity available for service temperatures up to 2000°F steady-state, and higher for transients. Min-K's thermal conductivity is actually lower than the molecular conductivity of still air.

Wide range of facings

For the hot face, the missile designer can specify Min-Klad Interlok in a wide variety of heat-resistant and/or ablating materials—asbestos-phenolic (ARP-40), and similar reinforced plastics, as well as stainless steel and other heat-resistant metal foils and meshes. For some requirements, the cool face can be made of a different material—for example, one that offers characteristics required for bonding or fastening to other surfaces and parts.

Like all J-M Aviation insulations, Min-Klad Interlok is factory-fabricated to your specifications into external skin panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JOHNS-MANVILLE JM PRODUCTS



VIDICON tube being developed by RCA has fiber optics faceplate.

with one mil diameter fibers would be about 500 photographic lines per inch, according to Leo J. Krolak of RCA. Limiting angle for trapping light incident on a fiber edge is the arc whose sine is the square root of the difference between the squares of the indices of refraction of the fiber and the jacket materials which surround and protect individual fibers. This limiting angle is referenced to the center line of the fiber.

Recon System

RCA is in the midst of making an aerial reconnaissance system which combines fiber optics with conventional television camera tubes. It would enable the system to cover a wide angle of view lateral to the vehicle travel and would contain many elements of resolution across the field of view, according to Krolak.

Such a system, Krolak observes, would offer the advantages of TV compared with photo reconnaissance, namely, the relatively high sensitivity of image orthicons and the absence of the need for film developing and scanning for generation of a transmittable video signal. It would offer an alternative to the choice between a TV system providing the ability to see small objects on the ground (yet with a tiny field of view) and the wide angle TV system with poor ground resolution.

Key to this system, Krolak explains, is a fiber optics shape transducer, or converter, which enables the system to realize a single long scanning line by assembly from many TV line scans. Such a transducer can be made by separating the edges of a single bundle of fiber optics into a multitude of narrower parallel edges. For example, a fiber optics bundle composed of 10 rows of fibers on one end of the bundle might be merged into a single long line at the opposite end, as shown in accompanying photographs.

If a camera tube is situated so that it will scan the 10 lines sequentially, it effectively scans the one line from one end to the other, Krolak says. Then, for 500 elements of resolution across

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each of the 10 scanning lines the single line contains a resolution of 5,000 elements, greater than that attainable with existing TV camera tubes, he adds. Up to 40 scanning lines, yielding as many as 20,000 resolution elements, appear capable of being assembled into a single line. This would be the highest resolution TV input presently known, Krolak says. Although it is a single scanning line, scanning in the direction lateral to the scanning line is achieved by aerial vehicle motion or by object motion should this be employed in facsimile.

Optical Contact

To scan the multiple rows of fiber optics, the photosensitive surface of the camera tube must effectively be in optical contact with the fiber optics. This is achieved by sealing circular disks, made of fiber optics, into the front of the image orthicon. In operation, the shape transducer would be butted up against the fiber optics faceplate of the camera tube. Use of TV camera tubes adds high sensitivity and high signal-to-noise ratios inherent in the storage of these tubes to a high-resolution single line scan fiber optics device. This also makes possible acquisition of intelligence at low light levels.

At the output or ground end a recording system must be capable of reproducing the high resolution input. In the recording camera the video information transmitted from the camera system is displayed as a multiple line image on a conventional kinescope. These many lines are reassembled using a fiber optics frame-to-line converter into a single high resolution line which reconstructs the input photograph image by such techniques as contact printing to photographic film. The kinescope would contain a fiber optics faceplate, as does the orthicon in the camera system, so that the kinescope phosphor makes optical contact with the fiber optics frame-to-line converter.

To date RCA has made the line-to-raster converter, the camera tube is being developed and the necessary electronic equipment for the system is being built.

Fiber bundles are made, typically, by extrusion of the glass from the molten material. A single fiber can be rolled onto a large spool, similar in form to a spool of thread. A section is then cut from this large coil and its ends bound to form the bundle.

Optics Goal

Fiber optics, like any other technology, especially an early one, has its problems. Obtaining and drawing fine quality fibers which have good transmission qualities is a continuously pursued goal. Properly laying fibers into bundles and then aligning fiber optics converters with camera or cathode ray tubes are among the thorny problems reported by scientists working in the field. Preventing light from escaping from one fiber to another and thus contributing to a blurred image at the output is, some scientists insist, only partially achieved by the present practice of jacketing fibers with low index of refraction glass.

Nature of some of the other activities in fiber optics are indicated by work at:

• **Armour Research Foundation.** Several years of effort by a group of seven persons headed by N. S. Katany, regarded as a leader and pioneer in fiber optics, has developed into 10 or 12 different fiber optics projects, five of them government supported. These projects range from fundamental studies, such as a study of waveguide effects in fibers for WADD, through prototype development. The group draws its own fibers, some of which are as narrow as



Collins Technicians Follow Audio-Visual Instructions

Production audio-visual technique, using combination slide projector and tape reproducer (above) to give assemblers step-by-step instructions, similar to Video-sonics pioneered by Hughes Aircraft (AW Jan. 4, p. 75), has reduced costs and improved operator quality and consistency at Collins Radio Co. plant in Cedar Rapids, Iowa, where it has undergone a three-month evaluation, company reports. Audio-visual units for factory and instructions for preparing tapes and slides are provided by Applied Communication Systems, Culver City, Calif. Collins also is evaluating a silent model in which assembly instructions appear over-printed on photo of the slide showing chassis at that stage of construction (below).





WHAT WAS SINGER DOING AT FORT BELVOIR? At this important Army Engineer Development Laboratory, tight 24-hour guard must be maintained. Here the SWAMI Motion Detector, developed by the Singer Military Products Division, is now undergoing rigorous tests and evaluation as a security device. No bigger than an attache case, SWAMI is designed to secure a critical area with ultra-sensitive radio energy. A division of The Singer Manufacturing Company, SMPD is composed of Singer-Bridgeport, Diehl Manufacturing Company and HRB-Singer.

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0.05 to 0.1 micron, and regularly uses 1 micron diameter fibers. It is investigating materials capable of transmitting infrared as well as visual images.

• **Chicago Aerial Industries.** All research and development in fiber optics at Chicago Aerial Industries over the past three years has been company-funded. Researchers are drawing their own fibers made from special glass formulas, making face plates and decoding systems. The company is considering a number of applications to conventional and perhaps color TV, image transmission systems, direct photography from cathode ray tube faces and image intensifiers.

• **Du Mont.** Company is conducting research in fiber optics and has included specific fiber optics devices as parts of its proposals on larger systems to government agencies.

Much of the interest in fiber optics today is spurred by the availability of fibers from companies such as American Optical and the applications, advice and assistance provided by this firm.

FILTER CENTER

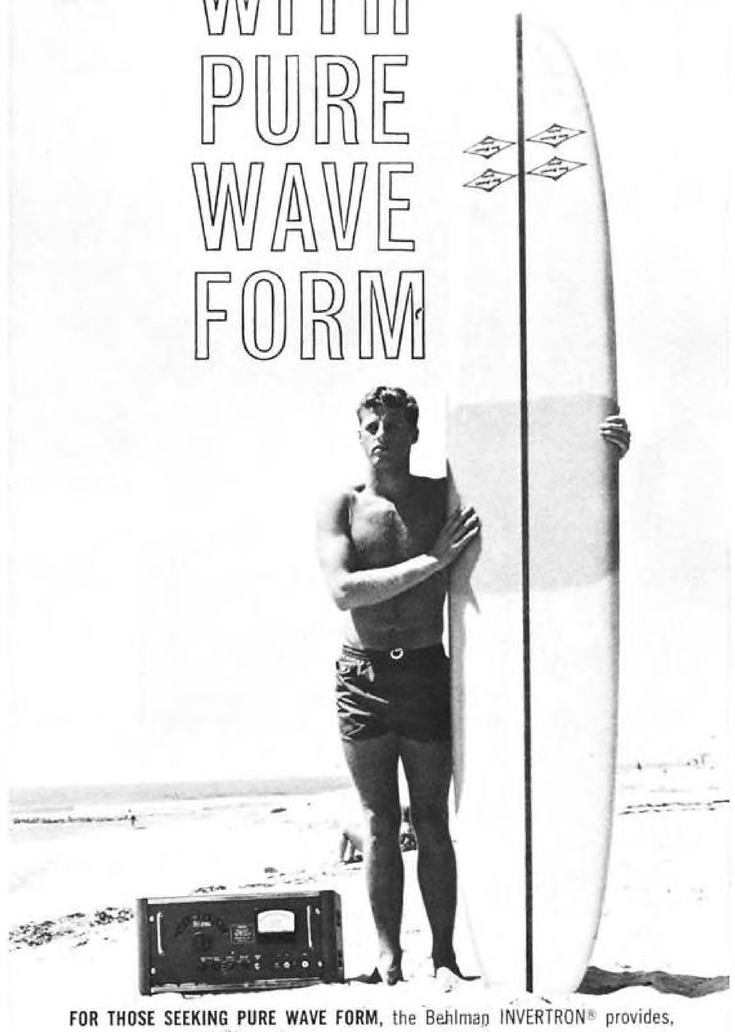
▶ **Soviets to Expand TV Production**—Measure of the size of the USSR's civil electronics industry production capacity can be gained from fact that Russia, which now has three million television sets in use, expects this number to increase to 15 million within five years. The U.S. produced 6.4 million sets in 1959, and the figure was set by sales rather than production capacity. United States has produced more than 70 million TV sets since end of the war.

▶ **EIA to Survey Electronics Engineers**—Electronic Industries Assn. will survey electronics manufacturers to determine the number of engineers and scientists now employed and the percentage engaged in defense programs. The survey is being undertaken at the suggestion of the Office of Secretary of Director of Defense Research and Engineering which hopes to use results in evaluating effect of military program changes on technical manpower reserve.

▶ **Miniaturization Award Competition Open**—Miniaturization Award, sponsored by Miniature Precision Bearings, Inc., which selects outstanding miniaturization achievements of the year, now is accepting nominations for 1960. Brochure which gives entry details can be obtained by writing to H. D. Gilbert, Box 604, Keene, N. H.

▶ **Advanced Radar Concept**—New radar employing spread spectrum techniques is being developed by Magnavox Research Laboratories at its recently

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FORM

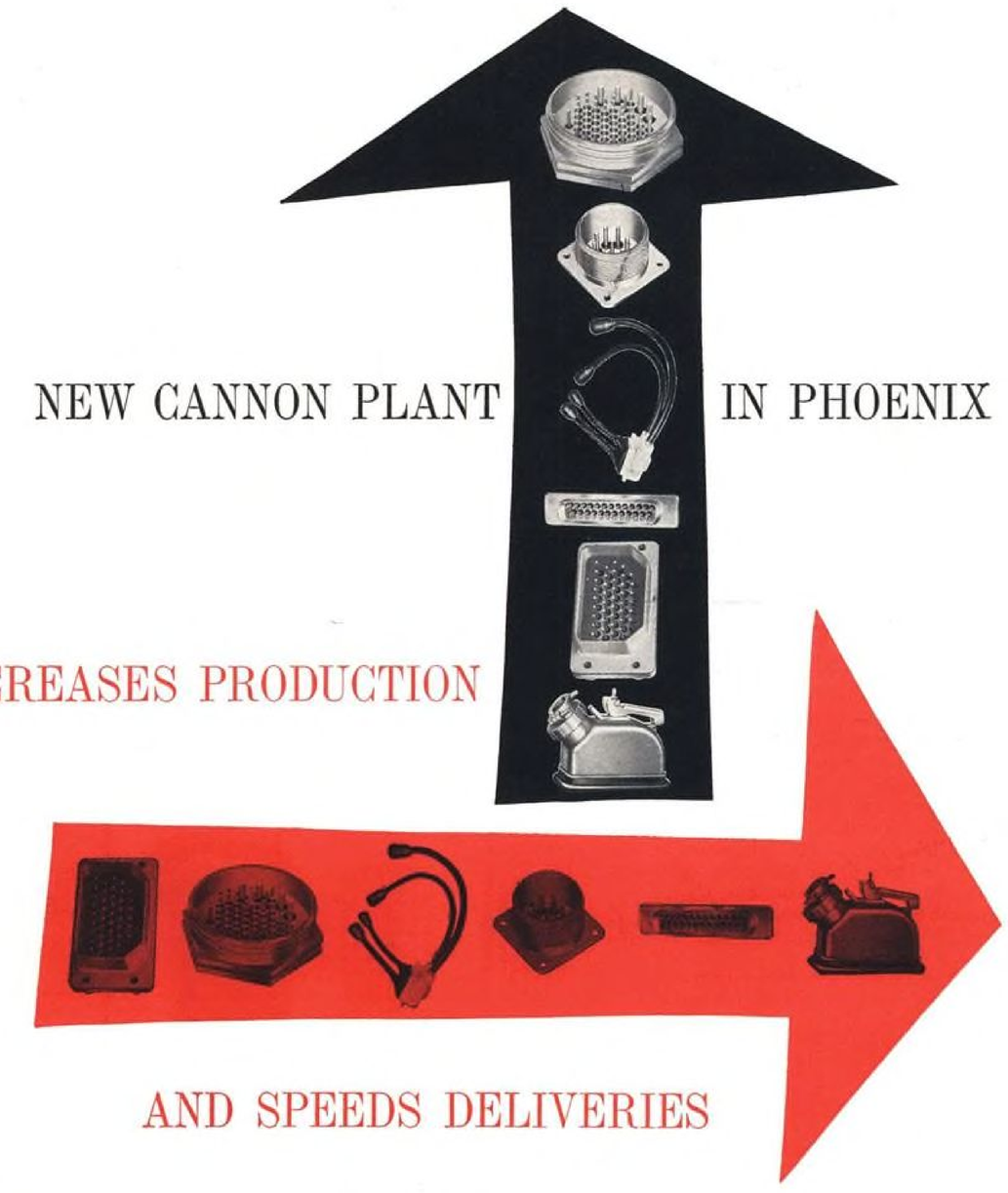


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opened facilities in Torrance, Calif. Work is partly company-funded, partly sponsored by the Army Signal Corps, according to a company spokesman.

▶ **Pinpointing Satellites** – Wideband satellite tracking system which can pick up, record and analyze satellite signals and determine nature of satellite telemetry system is being proposed to a number of government agencies including Advanced Research Projects Agency, Wright Air Development Division and the Pacific Missile Range. Estimated cost of the system developed by Astronautics, Inc., Melbourne, Fla., is about $5 million. Astronautics was formed by former personnel from the Atlantic Missile Range.

▶ **Ceramic Resistors Slated for Army Program**—Printed ceramic film resistors (AW Nov. 7, p. 97) ranging in value from 10 ohms to 1 megohm will be supplied to the Army-Radio Corp. of America Micromodule program by Microlectron, Inc., Santa Monica, Calif. To make the films, Microlectron prints a complex ceramic ink, fires it with a special technique, corrects values if necessary and then insulates the film with a hermetic seal. Four resistors, each with ⅛ watt rated power dissipation, are placed on a single Micromodule wafer.

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

• **General Dynamics Corp.,** General Atomic Division, $190,000 contract for development of high-temperature thermionic converter for use in nuclear auxiliary power system for space vehicle use. from Wright Air Development Division.

• **Sperry Gyroscope Co.,** $30 million award from Convair for additional production of bombing-navigation systems for the B-58 Hustler.

• **Ryan Electronics Division** of Ryan Aeronautical Co., San Diego, order for support equipment for AN/APN-97A doppler navigators which Britain has ordered for use in Westland Wessex helicopters.

• **Burroughs Corp.,** Detroit, Mich., $800,000 contract for development and fabrication of an ATC radar beacon video processing system for installation at Federal Aviation Agency's National Aviation Facilities Experimental Center (NAFEC).

• **International Telephone & Telegraph Corp.,** Federal Division, $1.5 million from Navy for company's Fort Wayne, Ind., facility to build fuzing mechanisms for Terrier missile.

• **Dorne & Margolin, Inc.,** Westbury, L. I., N. Y., $125,000 contract from

NEW EECO MAGNETIC CORE CIRCUITS



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In designing digital systems and equipment employing EECO T-Series Transistor Circuits, you now have an extra choice—EECO Magnetic Core Circuits that are both physically and electrically compatible with the EECO T-Series. This new family of compatible magnetic core circuits for the frequency range 0 to 250 kcs includes a large selection of shift registers (in single or dual units), pulse gates, and core drivers.

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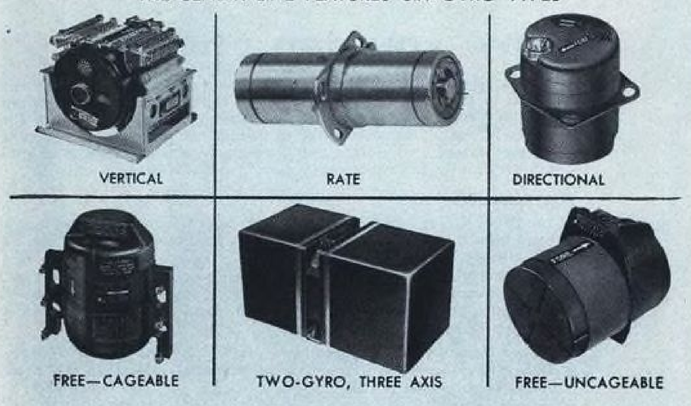
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REPORT
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Federal Aviation Agency for new type antenna for doppler-omnirange installations which will permit 100 antennas to be installed at one site instead of the present 50 antennas, producing an improved signal. New type antenna will be evaluated by FAA at NAFEC in Atlantic City, N. J.

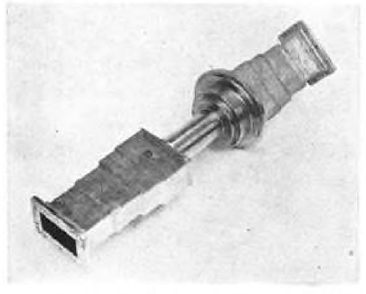
• **Electronic Communications, Inc.**, St. Petersburg, Fla., $2 million in additional orders for communications and data link equipment to be used on Convair F-106s and with the USAF's Airborne Long Range Input system for extending SAGE air defense system coverage.

• **North American's Autonetics division,** Downey, Calif., will design and build a stellar-inertial navigation system for use aboard a Pacific Missile Range instrumentation ship. System will provide accurate information on ship's position, velocity and vertical/heading reference for missile trackers.

• **Emerson Electric Mfg. Co.**, St. Louis, Mo., $1.3 million contract from USAF's Robins Air Materiel Area for components in support of the MD-7 fire control system which company produces.

NEW AVIONIC PRODUCTS

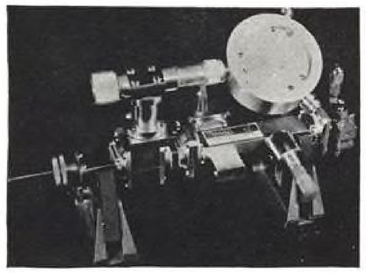
• **Microwave rotary joint,** Model RJSL-2A, incorporates transitions at each end to convert TE_{10} mode in waveguide to the TEM mode in a coaxial line. Non-contacting coaxial choke joints and ball bearings permit high speed rotation. Frequency range of



operation extends from 1.7 kmc. to 1.85 kmc., vswr is 1.1 and power handling capacity is 5 megawatts peak, 35 kilowatts average. The joints are $2,500 each and will be delivered 60 days from receipt of order, according to manufacturer, Canoga Corp., Van Nuys, Calif.

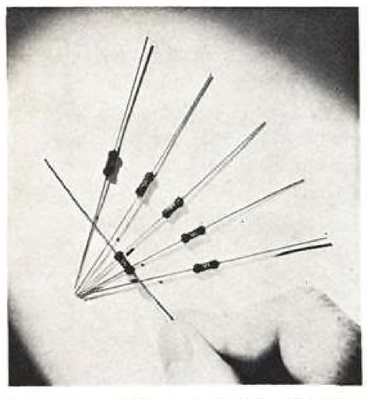
D.C. amplifier for either temperature or pressure control applications can operate from temperature, pressure or potentiometer pickup. Amplifier weighs 4 oz., measures 1½ cube, and requires 28 v. d.c. at 50 milliamps. Unit has 24 microvolts drift over 4 hr., a rise time of 100 microsec., and a frequency response from d.c. to 60 cps.—2%. It can also be used as a relay driver. Manufacturer: Vap-Air Division, Vapor Heating Corp., 6444 W. Howard St., Chicago 31, Ill.

• **Parametric amplifier,** S-band Model S1000, consists of a three-port ferrite circulator, a reflection-type diode amplifier, a klystron pump, a variable attenuator and a directional coupler monitor. Typical performance specifications:



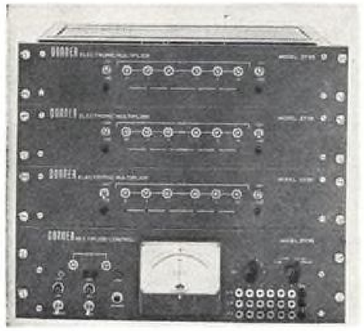
Tuning range of 100 mc., operating gain of 17 db., bandwidth of 20 mc. at 3 db. points and system noise figure of 2.5 —3.0 db. when operating into a mixer with a noise figure of 10 db. Application data is available from manufacturer: Micromega Corp., Venice, Calif.

• **Miniature precision resistor,** Type N-12, a ¼-watt precision film type, is available in resistance values of 100 to 133,000 ohms, in standard tolerance of 1% with temperature coefficient of 0.025% change per degree of centigrade



between —55C and 105C. Resistor measures 0.131 in. in diameter by 0.355 in. long. Voltage rating is 250 v. Unit meets performance requirements of MIL-R-10509B, according to manufacturer. Corning Glass Works, Corning, N. Y.

• **Dual multiplier,** Model 3735, provides single quadrant multiplication and squaring within an accuracy of 0.01% and four quadrant multiplication to 0.05%. Units, which do not require external amplifiers or power supplies to operate with analog computing equipment, are available in 2, 4 or 6 channel versions. Drift is less than 100 mv. over an 8 hr. period, noise is less than 100 mv. peak, and phase shift is less



than 1 deg. at 100 cps. Multiplier panel measures 3½ x 19 in. Delivery for multiplier and a control panel, Model 3735, can be completed in 90 days. Donner Scientific Co., 888 Galindo St., Concord, Calif.

• **Miniature power supplies** employ solid-state components to achieve compactness. Supplies measure 1⅝ in. square x 2⅜ in. in length. One series operates from 12 to 28 v.d.c. input and provides outputs from 400 to 2,000-v.d.c. at 20 microamps while the other series furnishes 28 or 12 v.d.c. outputs



at 100 milliamps from a 117 v.a.c. source. Regulation is 1% no load to full load and maximum voltage shift is ±1% from zero to 55C.

Prices of the units range from $90 to $145 with 30 day delivery. Manufacturer: Smith-Florence, Inc., 4228-23rd St., Seattle 99, Wash.

• **Switching transistor,** Type 2N1605A, an NPN germanium alloy device, housed in a TO-5 JEDEC case is available with 40 v. maximum collector-to base voltage for relatively high voltage circuits and 10 microamps maximum reverse leakage current at 40 v. Maximum power dissipation is 200 mw. at 25C. In quantities up to 99, transistors sell at $2.44 and between 100 and 999 at $1.63.

Sylvania Electric Products, 730 Third Ave., N. Y. 17, N. Y.

ENGINEERING
REPORT
ON OTHER BENDIX COMPONENT PACKAGES

CAM COMPENSATOR

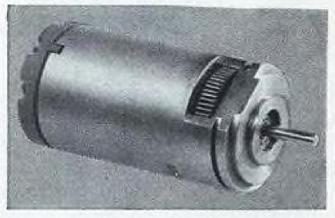
Efficient compensating device for servo system error.



The type CP-20-A1 is a simple, entirely mechanical means of correcting an output data shaft in relation to either servo loop errors, sensing errors, or known environmental factors affecting the system. Eliminates need for adjusting remotely placed or inaccessible units. Ask for full details.

CONTROL TRANSFORMER

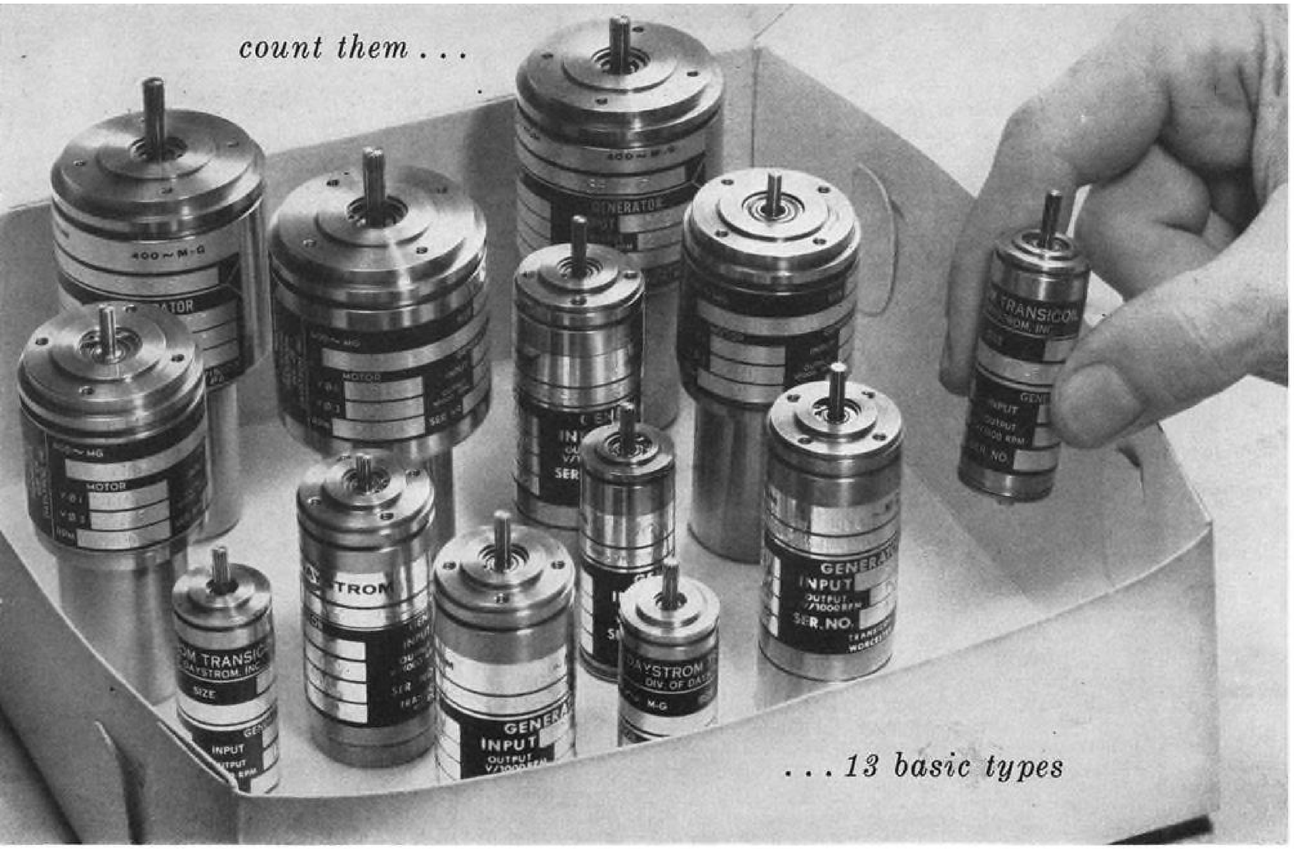
Changes mechanical differential inputs to electrical outputs.



Here is a corrosion-resistant unit that features a rotatable housing construction along with a standard synchro mounting. Because housing, as well as shaft, can be rotated, an additional output can be introduced into control system circuitry. Stator housing assembly is driven by a gear accessible through a slot in the housing, thus translating mechanical differential inputs into electrical outputs.

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

Eclipse-Pioneer Division
Teterboro, N. J.

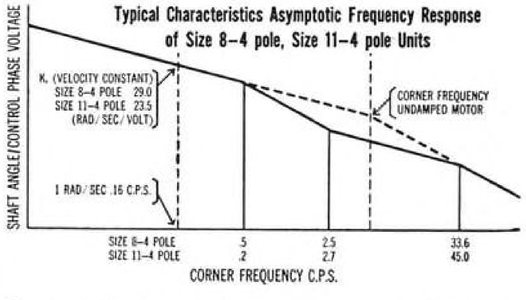


inertially damped servo motors

Thirteen lucky solutions to stability problems! Transicoil's complete new line of acceleration (inertially) damped servo motors matches every conceivable requirement with performance far in advance of previously available models. You can have size 8, 11, 15, or 18 . . . in 4, 6, or 8 poles . . . standard or high torque . . . corner frequencies cut to your special needs. And if necessary, an endless variety of special motor windings and shaft configurations. Highest 3rd corner frequency available in industry assures excellent system frequency response. Also, the large difference between the 2nd and 3rd corner frequencies simplifies amplifier stability requirements.

Using these new damped motors in a system you can operate at higher gain, with less position or velocity error, less backlash sensitivity, increased stability. They're far superior to damping generators in marginally unstable systems. And compared to viscous damping or rate feedback, permit high slewing speed, consume less power, generate less heat, require less wiring, and need no warm-up period.

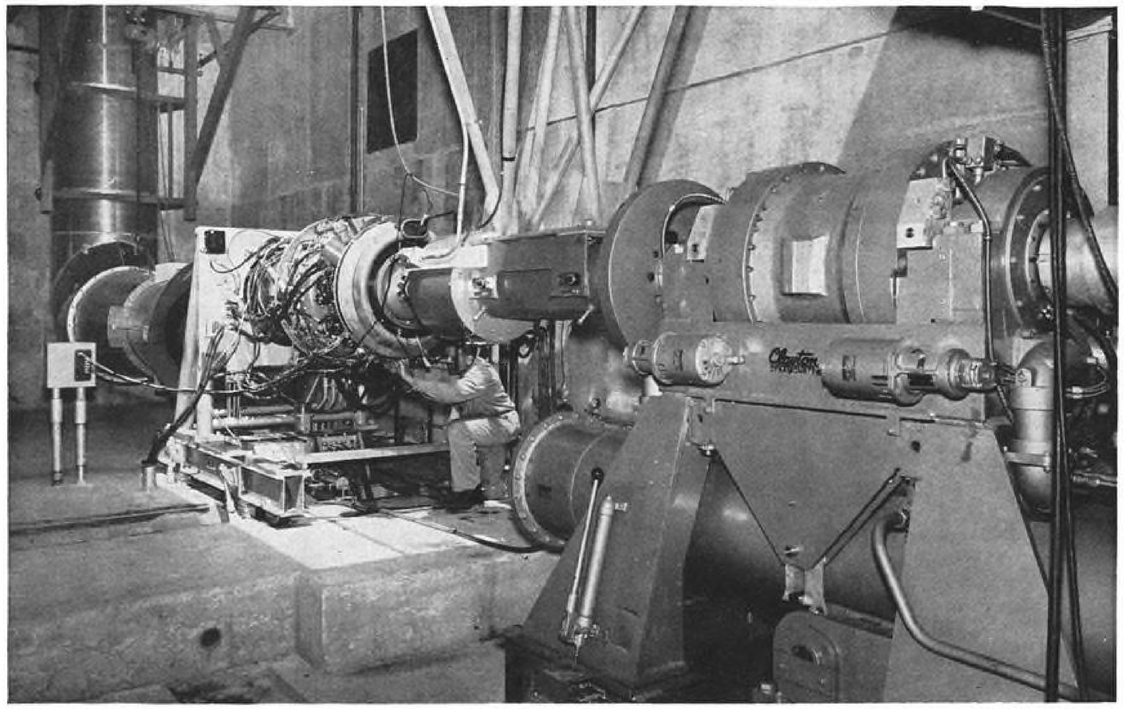
SPECIFICATION SHEETS on the complete line are available now on request. Or, just tell us your problems and we'll do our best to come up with a solution.



Foreign: Daystrom International Div., 100 Empire St., Newark 12, New Jersey. *In Canada:* Daystrom, Ltd., 840 Caledonia Rd., Toronto 19, Ontario.

DAYSTROM, INCORPORATED
TRANSICOIL DIVISION
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AERONAUTICAL ENGINEERING



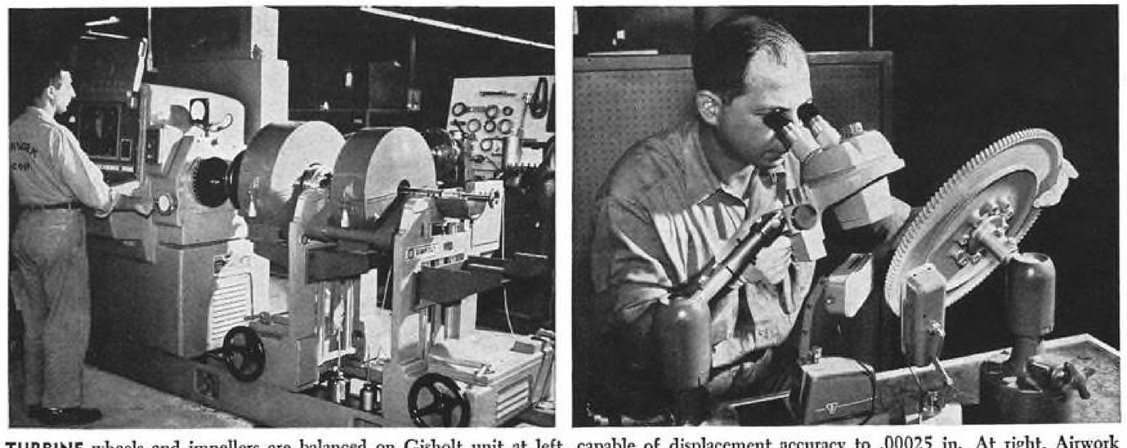
AIRWORK CORP. uses this Clayton dynamometer for Rolls-Royce Dart turboprop engine overhaul calibration at Millville, N. J.

Monitoring Increases Dart Overhaul Life

High overhaul life and turbine engine reliability can be achieved without part-time component changes but only through constant monitoring of development and operating failures and prompt remedial action, according to a statement made by a Rolls-Royce turboprop engine expert.

In a discussion of the service life of the Rolls-Royce Dart turboprop engine, Bernard Lang, chief service engineer for turboprop engines at Toronto, Can., pointed out that since 1953, the Dart's overhaul life has risen from 400 hr. to 3,000 hr., which was achieved last August. Average unscheduled removal rate has been about one engine every 5,900 hr.

Lang stressed that at this stage "by far the majority of service failures experienced are not of the in-flight variety, but can be detected during ground checks sufficiently in advance of the ultimate failure state." He cited the propeller feathering rate of one every 10,000 engine hours in 1959, "when service failure rate was at its



TURBINE wheels and impellers are balanced on Gisholt unit at left, capable of displacement accuracy to .00025 in. At right, Airwork employe uses a binocular microscope to inspect Dart disk and blades for cracks and flaws. Unit has a zoom lens for high accuracy.

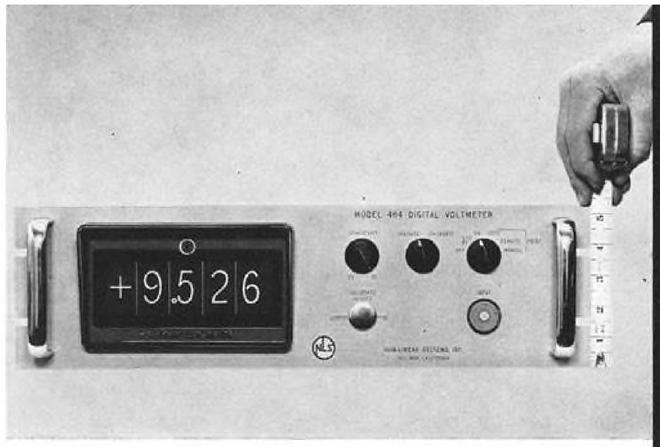
The Important Difference In Digital Voltmeters...

Check the design and construction features pictured here. These are the subtle marks of quality that exemplify the engineering leadership of NLS . . . the *important difference* between NLS digital voltmeters and those of other manufacturers. These are the engineering innovations that assure accuracy and rugged reliability . . . that minimize maintenance and downtime . . . that add to the long-term efficiency and usefulness of NLS instruments. Yes, there's more to a digital voltmeter than meets the eye . . . so look behind the front panel and beyond the specification sheet before you buy! Call on your NLS representative to demonstrate the instrument of your choice . . . to show what engineering leadership means to you in digital voltmeter performance and usefulness. Write today for the NLS catalog that describes the world's most complete line of digital voltmeters . . . by purpose, by price!

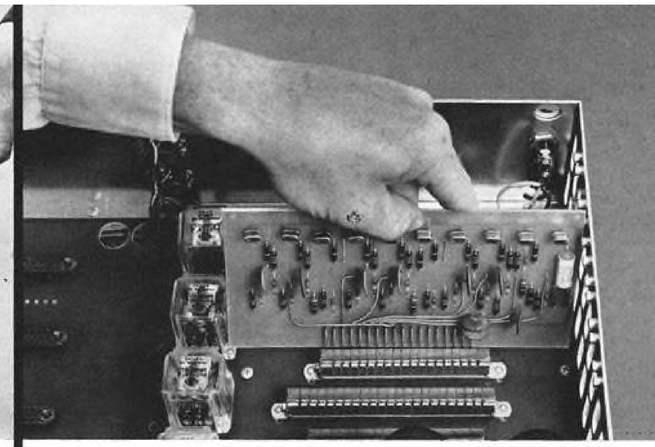
Originator of the Digital Voltmeter

non-linear systems, inc.

DEL MAR, CALIFORNIA



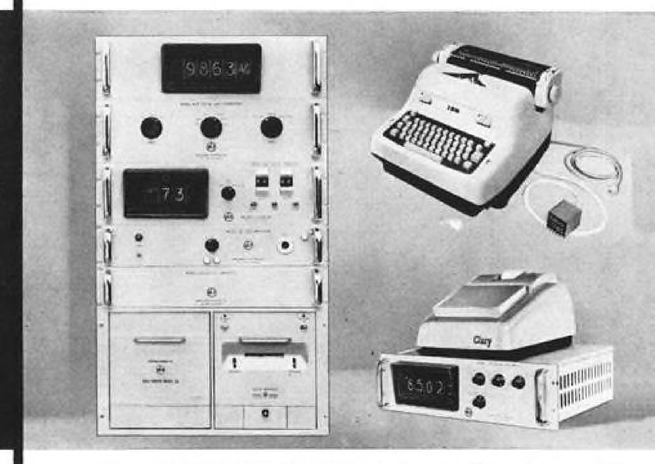
3 **COMPACT DESIGN** — *illustrated by the 5¼"-high NLS 484 DVM, complete with recording controls — is one of the more obvious clues to superior engineering. Even the lowest cost NLS instruments are more compact with fewer cables and connections. Result: greater reliability.*



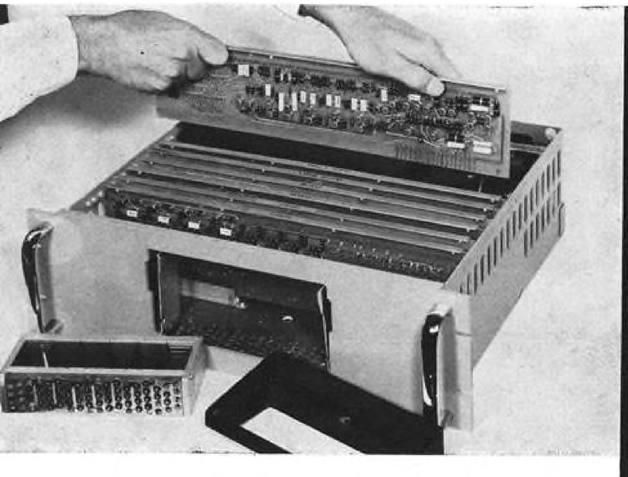
4 **"NO-NEEDLESS-NINES" LOGIC** *in Series 30 results from a new concept in transistor logic which eliminates unnecessary, time-consuming cycling of stepping switches through their 9's and 0's positions. This increases accuracy, speed, reliability and usefulness, particularly in systems applications.*



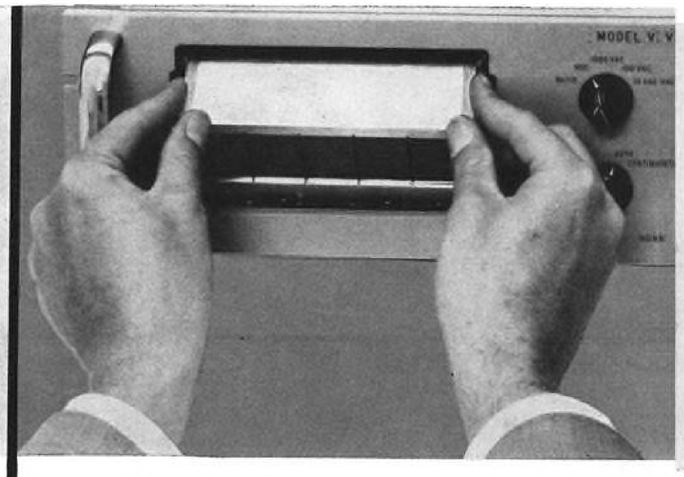
5 **FULLY AUTOMATIC OPERATION,** *pioneered by NLS, includes automatic selection and indication of range and polarity. Human error is virtually eliminated.*



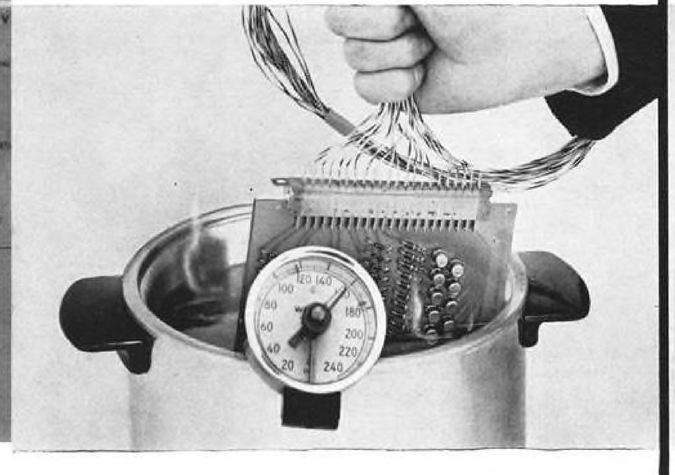
6 **PLUG-IN ACCESSORIES** *can be mated in minutes with an NLS digital voltmeter to form hundreds of combinations. These include AC/DC converters, preamplifiers, input scanners, and virtually every type of data recorder.*



1 **PLUG-IN MODULAR CONSTRUCTION** *simplifies servicing, drastically reduces maintenance costs, keeps instruments on the job. More than 99% of the components of the NLS V44, Series 20 and Series 30 instruments are mounted on plug-in modules.*



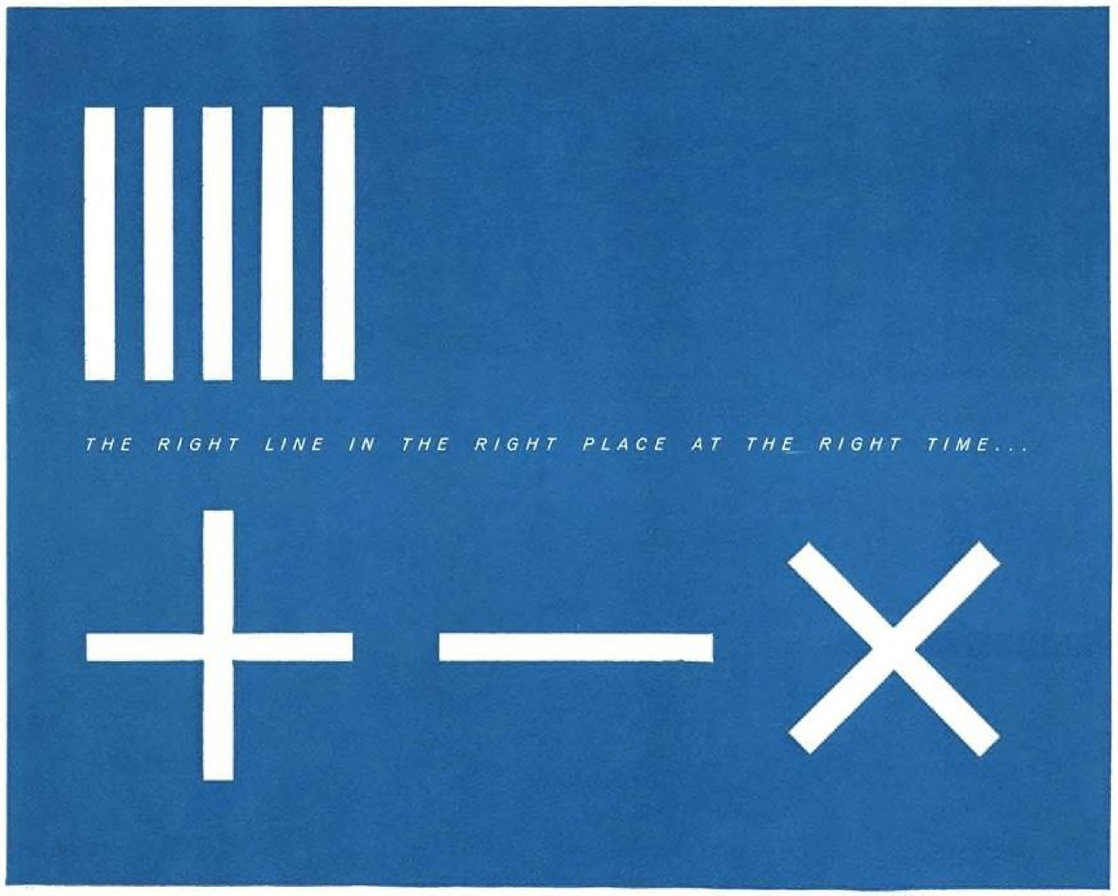
2 **SNAP-OUT READOUT,** *exclusive on all NLS digital instruments, permits 20-second bulb replacement through front panel without tools. Precisely engraved readout numerals can be read all day from close up or far away without eye fatigue.*



7 **"NO POTS AT ALL" STABILITY** *of the NLS V44 DVM is checked by the "boil in oil" test at 158°F. This feature eliminates all trimming of decade and amplifier circuits.*



8 **PLUG-IN OIL-BATH STEPPING SWITCHES** *in Series 30 instruments outlast dry switches by a factor of five . . . completely eliminate periodic disassembly for manual lubrication of switches.*



The Avnet System

creates a new Concept of Distribution

The Avnet System knows how to put the *right* line of electronic components in the *right* place at the *right* time. This little difference can make a big difference in your final result. If your requirements call for a certain type of component with, perhaps, highly individualized specifications, The Avnet System will put exactly what you need where you need it...at the time you designate.

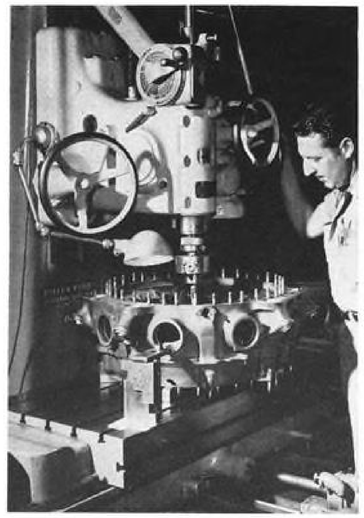
This Concept of "right" in selecting a line of electronic components is one of the many advantages in The Avnet System. *Avnet maintains a network of Sales Engineers traveling the U.S. Each engineer has his counterpart in a Service Center Expediter. Tremendous stocking facilities are maintained strategically throughout the country. Avnet maintains and operates complete assembly facilities for Connector Prototype requirements.* For the right line of electronic components, contact your nearest Service Center in The Avnet System.

AVNET

THE AVNET SYSTEM
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Avnet Service Centers and Stocking Facilities are located in Los Angeles, Cal.; Sunnyvale, Cal.; Chicago, Ill.; Dayton, Ohio; Westbury, L. I.; Burlington, Mass.

Avnet distributes from its stocking facilities: BENDIX SCINTILLA CONNECTORS, SPERRY SEMICONDUCTORS, RHEEM SEMICONDUCTORS, ELECTROSNAP AND HETHERINGTON SWITCHES, GREMAR CONNECTORS, CLARE RELAYS, ROBERTSON SPLICE & CONNECTOR CASES, BABCOCK RELAYS, KING SUBMINIATURE HI-TEMP CERAMIC CAPACITORS, TIC PRECISION TRIMMERS, VIBREX FASTENERS by GENERAL TIRE & RUBBER CO., U. S. SEMCOR SEMICONDUCTORS, SANGAMO CAPACITORS, SPRAGUE CAPACITORS



PRATT & WHITNEY jig borer is being used at Airwork to true a liner boss, at accuracies to .0005 in.

highest." The majority, he told the Airwork Corp. symposium at Millville, N. J., was due to instrumentation and only one every 25,000 hr. was due to an engine or accessory defect.

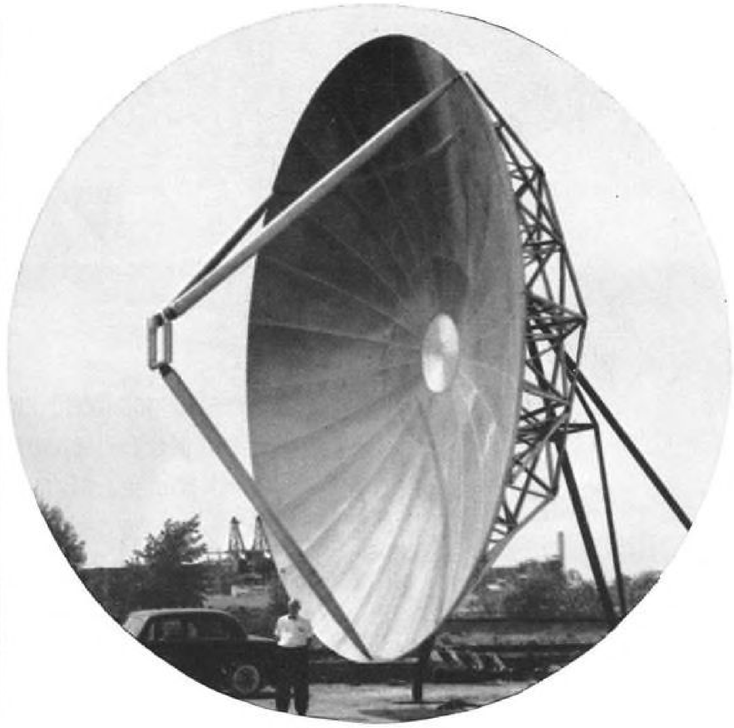
During Dart development Rolls-Royce encountered these problems:

• **Number of compressor** cupwasher and layshaft bearing failures, during the end of 1955 and early 1956. Modification was to change the cupwasher material from aluminum to steel. Bearing failures were due to excessive wear on retaining lips during descent with zero or negative torque. Instruction was issued to maintain positive torque during descents.

• **Failure of turbine blades** occurred in mid-1957 on the Dart 506 and 510 after introduction of increased cruise powers. Initial fix was a change in operating procedures and removal from inventory of certain batches of material found to be failure-prone at the higher rate. Meanwhile, turbine blade material was changed from Nimonic 80A to Nimonic 90; flight trials, however, showed that while Nimonic 90 was an improvement, it was insufficient for the envisaged blade life. Eventually, Nimonic 105 was developed to have a high creep resistance. Cruise power also was reduced and the failure rate became negligible.

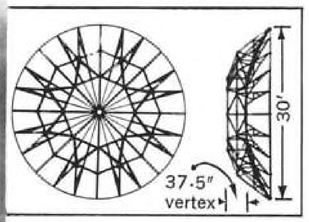
Lang noted that blade failures were a major problem since so many factors exert a powerful influence. But he pointed out that, in general, operators who have followed the recommended climb and cruise powers throughout the flight regime have not been plagued by blade failures.

Among other service problems was the failure of air casings, which Lang



This precision 30-foot antenna has a more accurate surface than any other production parabolic reflector of comparable size.





Antenna System's new solid surface, high precision 30-foot antenna (model 103) is designed to set a new standard for accuracy in the fields of radio astronomy, tropospheric scatter propagation, tracking radar, and experimental test installations. It features:

• High precision — The static surface tolerance of the first unit has been measured. The deviation from the ideal curve measured 0.033 inches RMS.

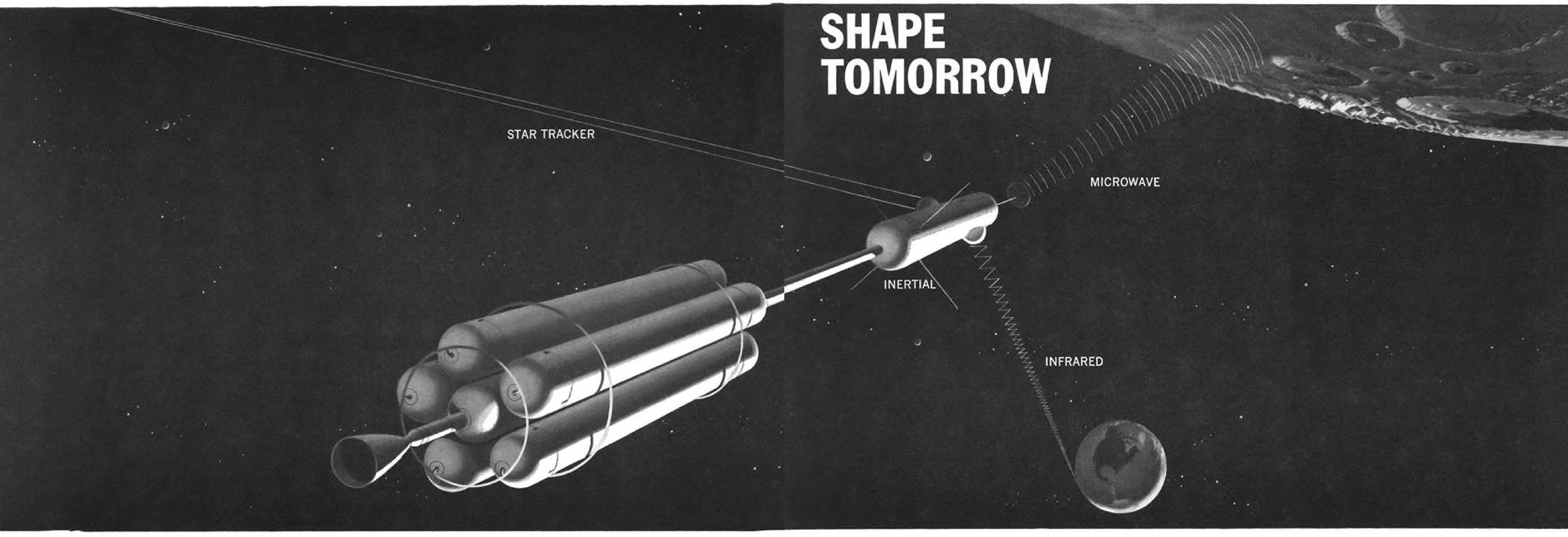
• Has an f/d ratio of 0.417 which readily adapts to a wide variety of feed systems.
• Fully machined sections are interchangeable and easy to assemble.
• Solid surface panels permit use at any frequency.
• Useable with a wide variety of feed support systems.
• Built to withstand 150 MPH wind with 4" ice.
• Can be mounted on either the top or side of a tower with azimuth and elevation adjustments, on el-az or equatorial pedestals, self-contained trailer tower mounts, or other types of mounts.

Write for specification sheet.

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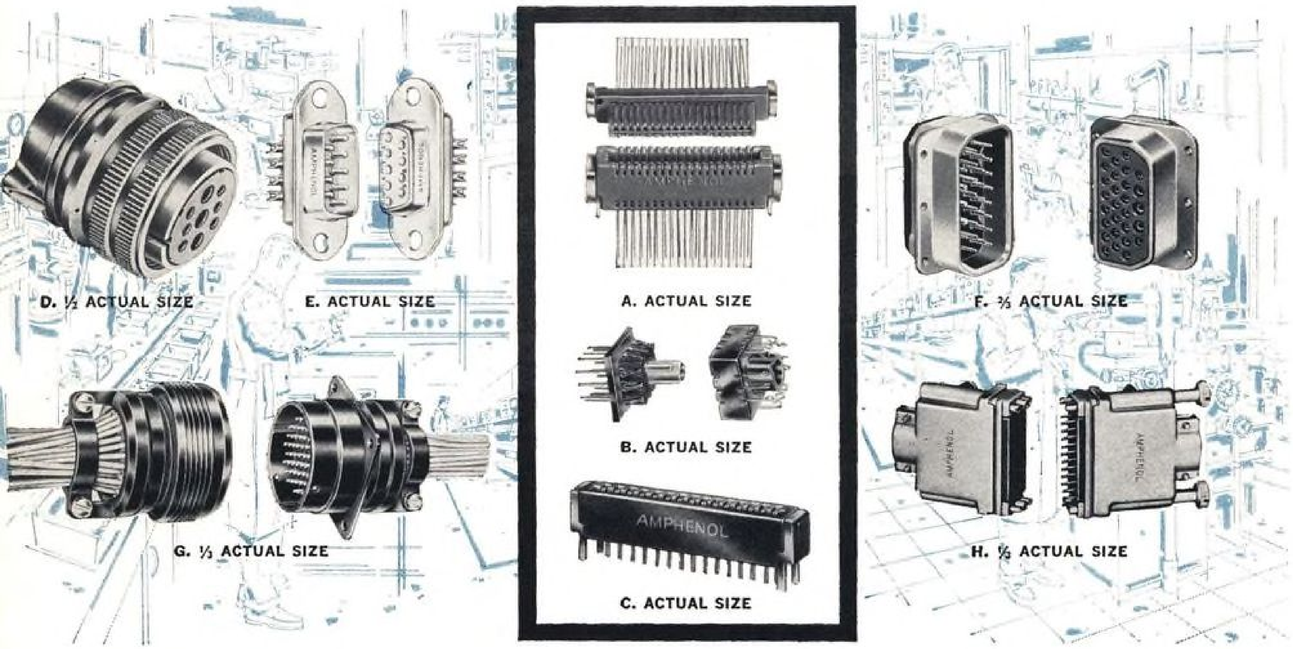
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NEW CONTRIBUTIONS TO RELIABILITY

Continuing AMPHENOL R & D is markedly increasing the reliability of interconnecting devices. In two areas this activity has produced particularly valuable results. In micro-miniaturization, revolutionary Micro Min, Micro Mod and Micro Edge (pat. pend.) have been developed to accommodate flat form, modular and printed circuit packaging. And in the AMPHENOL-developed concept of crimp Poke Home contacts (U.S. Patent 2,419,018), aircraft and other industries have an outstandingly reliable method of connector wiring. Contacts are uniformly crimped outside the connector body, then quickly inspected and inserted to complete the assembly.



MICRO MINIATURE

A Micro Min 19 contacts single side or 38 contacts double side, on .050" centers. Pair weigh .008 pound.

B Micro Mod WESCON design award winning module/stick connectors. 12 contacts on .075" centers. Pair weigh 0.73 grams.

C Micro Edge Newest edge-board or printed wiring receptacle. 15 contacts on .075" center. Connector is 1.292" long.

POKE HOME CONTACTS

D 69 Series "Poke R" Upgraded MIL-C-5015 "R" construction with the decided advantage of crimp Poke Home contacts. 3 shell styles, sizes 10SL through 36.

E Min Rac 17 Space- and weight-saving miniature rack & panels, 9 to 50 Poke Home contacts.

F 94 Series Up to 63 Poke Home contacts in these rectangular rack & panel connectors developed for airborne equipment.

G Mil-C-26500 Sophisticated aircraft and missile connectors. Performance unaffected by 1000 hours at 200°C. 3 shell styles, 4 to 55 Poke Home contacts.

H 93 Series 34, 42 and 50 Poke Home contacts. Rack & panel connectors originally developed for missile applications.

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described as important in view of the fire hazard. Failure was due to vibration caused by out-of-balance conditions resulting from blade failure or faulty construction. Modification was a strengthened casing, now a feature on production engines.

Bearing track fatigue failures were confined to bearings which had been salvaged by chrome-plating the outside diameter to restore the bearing fit in the housing; chrome was found to have a deleterious effect on bearing strength, so the method was discontinued and suspect bearings removed from service. In the case (1957) of fatigue failure of high speed pinion and interstage compressor bearing tracks, the fix was to install an increased capacity bearing.

As overhaul life grew in mid-1958, Rolls-Royce found that rubber sealing rings in the lubrication system were proving inadequate for top efficiency, resulting in high oil consumption. These were changed to a silicone mix rubber sealing ring, installed at overhaul in the compressor and turbine sections.

Fuel Contamination

In the component area, engineers found that slipper pads in the fuel pump were showing excessive wear and surmised that the major contributory cause was fuel contamination, plus use of JP-4 with lubricating qualities lower than JP-1. Pad material was changed from phosphor-bronze to beryllium-copper, a harder-wearing alloy.

Notch effect of the internal spline, Lang continued, caused isolated cases of reduction gear layshaft cracking of the front bearing journal. Modification was to change the geometry of the bearing journal. However, he explained, this resulted in reduced mating area between the splines and restrictor shaft and, since the drive for major accessories is taken off this shaft, a new wear problem was encountered. Rolls-Royce now is removing these shafts and replacing them with layshafts having longer internal splines to restore the mating area to the satisfactory original.

Flame tube defects of the front cooling ring, downstream of the burner, were due in part to disturbance of gas flow by buildup of carbon deposits and slight cracking and buckling of the tube wall. Improvements now being introduced include:

- **Fuel-washed burners** to prevent carbon buildup.
- **Thickening** of the inner flare rim to reduce erosion effect.
- **Riveting**, instead of resistance welding of the front cooling ring to the flame wall tube wall, to reduce effects of differential expansion and consequent cracking and buckling.
- **Staggering** the front cooling ring to make cutouts for the interconnectors unnecessary; these cutouts weaken the cooling ring and often, Lang said, are the origin for breakaway.

Investigation of turbine disk rim cracking on the Dart 520 series, Lang said, showed that cracking was extremely fine and had a slow rate of propagation. By blending out cracks and increasing the radii in the fir tree roots, the problem was greatly reduced. As a long term fix, he noted, the disk fir tree roots are undergoing a "small redesign" to reduce the local stress.

Cracks in the first stage rotor hub, which showed up during development cyclic tests, were caused by fatigue and were a function of cyclic hoop stresses and thus depend on the number of takeoffs. Initial reaction was to life-limit the component. Later a rotor was developed with an increased hub spline radius which reduced local stresses.

Lang emphasized that since overhaul lives of the order of 3,000 hr., or one year's airline operation, are now being achieved, it takes at least that year to prove out a new component. He added:

"This situation is particularly true of turbine blade lives since it has been learned from the past that even with the latest methods at our disposal it is almost impossible to predict an economical life and that it needs service experience to establish lives."

Microfilm Catalog Files Product Data

New system, a microfilm catalog designated VSMF, has been installed at Convair/Pomona, Convair Division of General Dynamics Corp. to reduce the amount of time spent by engineers in searching for product information and specifications data now estimated to take 15% of the working day.

More than 50,000 pages of product information from approximately 1,500 suppliers are recorded on 27 reels of microfilm.

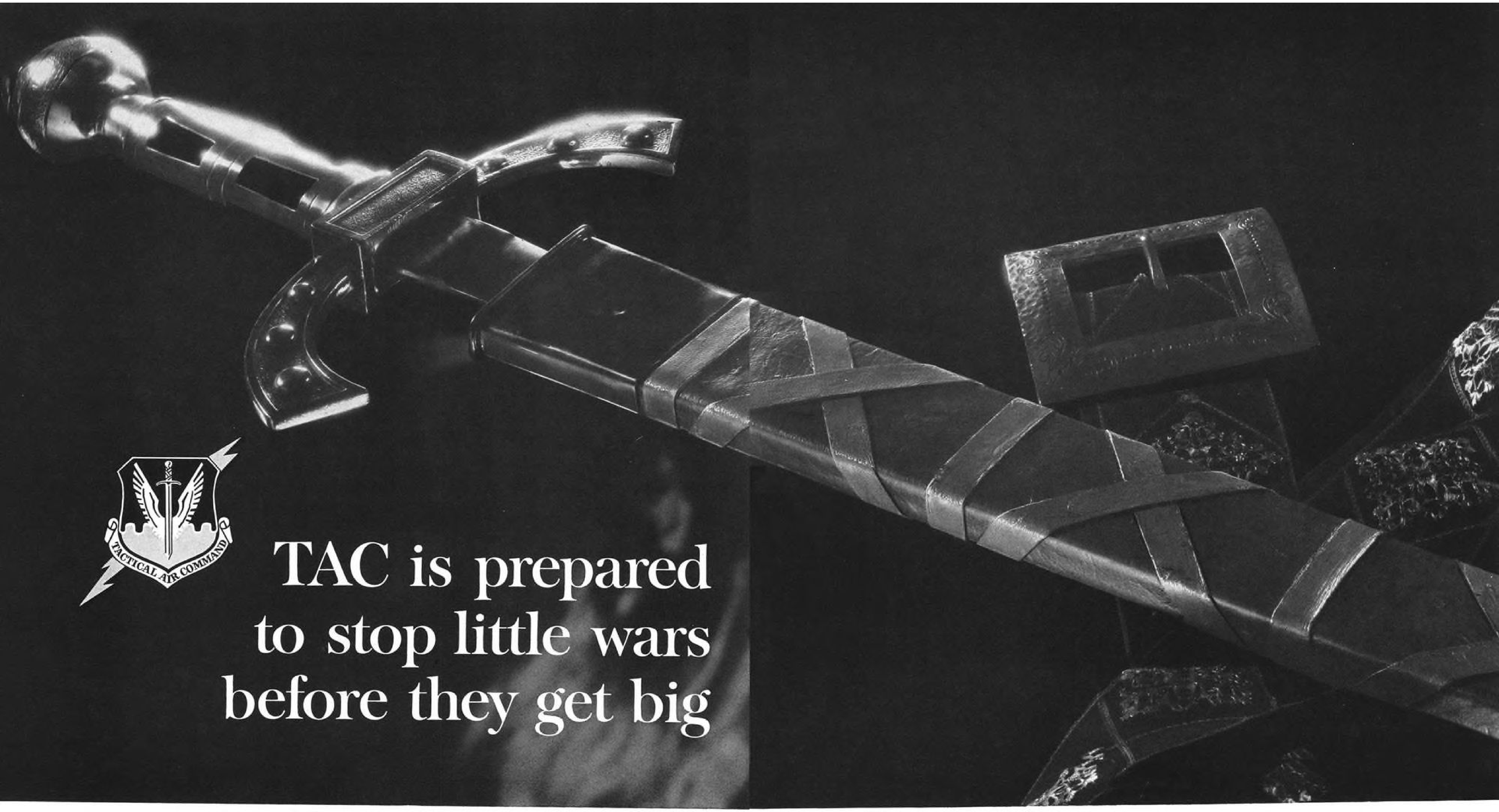
Engineers now may refer to a product index which refers to the magazine reel on which the information is contained. The reel is then placed in a special "reader" and in a matter of seconds, the item appears on a 13 x 13 in. screen. A photocopy device on top of the reader will make a black and white copy of the image on the screen for further study.

Information is updated and the entire system refilmed at least every four months.



FAA Completing JetStar Engineering Evaluation

Federal Aviation Agency team (above) is completing engineering evaluation of the Lockheed JetStar four-turbojet transport (AW Nov. 14, p. 33). Nose cone is rolled forward on this production model and engine cowlings have been opened for visual access. Avionics gear in nose cone includes VHF transmitters, two VOR navaids, an ILS system and a weather radar unit.



TAC is prepared to stop little wars before they get big

When trouble starts brewing, the Tactical Air Command can clamp the lid on localized aggression before it boils over and spreads to the rest of the world. TAC helps keep the peace in two main ways: (1) with its now famed CASF force which deploys quickly to any world trouble spot to work with local governments and provide air cover and attack strength as might be needed; (2) by establishing and maintaining a strong tactical airlift for Army strike forces, supplies, and support equipment.

The Lockheed/Georgia C-130 Hercules has served with TAC for more than 3 years—and has proved it meets all requirements for true airlift operation: straight-in end loading; truck-bed height cargo floor; air-conditioned pressurized cargo compartment; and ability to lift, land, or airdrop heavy, bulky pieces of freight. And the C-130 can get closer to the action—operating to and from strips much too rough and short for most cargo airplanes.
Lockheed Georgia Division, Marietta, Georgia.



LOCKHEED GEORGIA

WORLD HEADQUARTERS FOR AIRLIFTERS AND CARGOLOADERS



RESEMBLANCE to the famed Piper Tri-Pacer can be seen in this flight view of the two-place Colt, which uses many Pacer components.

Aviation Week Pilot Report:

Piper Aims Colt at Sports, Club Pilots



COLT lightplane is parked at Grand Bahama Club airport. In background is Bahamas Airways Douglas DC-3. Mackey Airlines also operates into the single-strip airport.

By Herbert J. Coleman

Grand Bahama Island—Piper Aircraft Corp., has aimed its new high-wing, two-place Colt at a high degree of general aviation utility, and a low cost to the buyer, student and rental operator.

The Colt (AW Nov. 14, p. 128) resembles the Tri-Pacer, and Piper executives say that many of the Pacer components will be used in Colt production. The two prototypes were not hand-built but went down the Lock Haven, Pa., production line like any other airplane.

Resemblance to the Tri-Pacer (which has been discontinued) is however, mostly confined to general configuration. The plane is lighter and more responsive to control pressures and its two-seat layout returns the plane to the sport category for which it is intended.

The plane is restricted from aerobatics but the flight regimes are wide, it was learned in a flight here. Rate of climb is excellent and the Colt's flight characteristics bring the pilot to the basic need for coordination—needle, ball and airspeed type of flying.

Piper had been losing volume with its Tri-Pacer sales and has moved into the four-place, low-wing Cherokee class to rebuild it. The Colt is aimed at the market first developed by the Cub. William T. Piper, company president, has high hopes that the Colt will rejuvenate this field. He noted:

"Aviation has been clamoring for a low-cost airplane which can be used for sport and vacation flying, for the salesman who has a large territory to cover, for the flying clubs which are springing up in large numbers and for the flying service operator."

Manufacture of the Colt puts Piper in a competitive position with the two-place, high-wing, all-metal Cessna 150 which costs $7,495 in the standard version (AW Oct. 31, p. 31) with a 100-hp. Continental O-200-A powerplant.

The price is pegged at $4,995 for the Colt Custom, which can be bought for $995 down and $29.68 a week. The Colt Super Custom is more heavily instrumented and will cost $5,995. Both have dual controls.

Flight Check

Flight was made at a single-strip airport owned by the Grand Bahama Club, on a 75F day with gusty winds at 20-25 mph. from the northwest. After a cockpit check, the plane's 108-hp. Lycoming O-235 four-cylinder dual-ignition engine, turning a Sensenich propeller, was started without priming.

Taxiing is simple; the nose wheel is connected to the rudder pedals and turn radius is quite tight. Visibility is excellent; the center wing is cut back overhead about 7 in. to give good upper visibility and side windows are large.

After a magneto and power check, full throttle was applied and the plane was off the ground at 55 mph. after a ground run of a few hundred yards. Best climb is at 60 mph. and the Colt soon reached cloud base, which was about 2,900 ft. on this particular morning.

At 2,250 rpm. the Colt indicated about 95 mph.; at 2,500 rpm., indicated airspeed was 115 mph. In both power settings cockpit noise level is low and conversation can be carried on normally.

Like the Tri-Pacer, the Colt is difficult to stall. Slow flight can be accomplished indefinitely at 55 mph., pulling about 2,000 rpm. and carrying the nose at about a 20 deg. angle. Colt stalls reluctantly with a shudder and



AERIAL view of the Grand Bahama Club airport on the west end of Grand Bahama Island, shows large number of Piper airplanes flown here for annual distributor meeting.

Piper Colt 108 Specifications

Engine	Lycoming O-235-C1B
Horsepower	108 to 2,600 rpm.
Gross weight	1,650 lb.
Empty weight (Standard)	940 lb.
Empty weight (Super Custom)	985 lb.
Useful load (Standard)	710 lb.
Useful load (Super Custom)	665 lb.
Wing span	30 ft.
Wing area	147 sq. ft.
Length	20 ft.
Height	6.25 ft.
Propeller diameter (maximum)	74 in.
Power loading	15.3 lb.
Wing loading	11.2 lb.
Baggage capacity	100 lb.
Fuel capacity (Standard)	18 gal.
Fuel capacity (Optional)	36 gal.

Performance*

Top speed	120 mph.
Cruising speed (75% power, sea level)	108 mph.
Optimum cruising speed (75% power, 7,000 ft.)	115 ft.
Stalling speed	54 mph.
Takeoff run	950 ft.
Takeoff over 50 ft. barrier	1,500 ft.
Landing roll	500 ft.
Landing distance (over 50 ft. barrier)	1,250 ft.
Best rate of climb speed	75 ft.
Rate of climb	610 fpm.
Best angle of climb speed	60 mph.
Service ceiling	12,000 ft.
Absolute ceiling	14,400 ft.
Fuel consumption (75% power, leaned)	6 gph.
Cruising range (standard fuel, 75% power, sea level)	3 hr., 324 mi.
Cruising range (opt. fuel, 75% power)	6 hr., 648 mi.
Cruising range (opt. fuel, 75% power, 7,000 ft.)	6 hr., 690 mi.

* Performance rated at full gross (1,650 lb.) which consists of a Super Custom Model, 2 persons, 36 gal. of fuel, 72 lb. of luggage. Flown normally at 1,500 lb. gross, all performance data would be bettered.

Custom Colt 108 Business Flying Costs

For Business Purposes						
Depreciation:						
16% per year with a 20% residual at end of five years			$959.20			
Annual hours flown	300	400	500	600	800	1,000
Miles flown	33,000	44,000	55,000	66,000	88,000	110,000
Direct hourly cost	$3.80	$3.80	$3.80	$3.80	$3.80	$3.80
Indirect hourly cost	3.16	2.37	1.90	1.58	1.18	.95
Total hourly operating cost	$6.96	$6.17	$5.70	$5.38	$4.98	$4.75
Operating cost per mile at 110 mph. (Block to Block)	$.063	$.056	$.052	$.049	$.045	$.043
For business purposes:						
Depreciation per mile (16% per year . . . 20% residual after 5 years)	.029	.022	.017	.015	.011	.009
Total cost per mile	$.092	$.078	$.069	$.064	$.056	$.052

slight fall-through on the nose.

Power-off stall occurred at a bit under 50 mph. with a similar reaction and there was no tendency to fall off on a wing. During flight maneuvers, one must watch a tendency to over-control; in a steep turn, the tendency to use too much back pressure on the control wheel is an initial reaction.

This aircraft was equipped with the standard 18-gal. fuel tank in the left wing, although another 18-gal. tank is optional, giving the Colt a 6 hr. range. The engine has a mixture control.

Trim Uneffected

Carrying fuel in the left wing has no appreciable effect on trim, either on takeoff or when fuel has burned down.

For landing, the Colt was slowed to about 85 mph. in the downwind leg and final was made at about 70 mph., probably faster than necessary but needed on this landing due to a gusty crosswind. Plane was held in a crab until just before touchdown, kicked straight and landed. Landing roll was short and a running takeoff was made for another landing before returning to the ramp.

Instrumentation included a tachometer, airspeed indicator, needle-and-ball, altimeter, oil pressure and temperature gages, ammeter and fuel gage. Hand brake is located at center cockpit, hung from the panel. Radio gear was a Narco-VHT-3 Superhomer. The Colt also has a circuit breaker panel for generator, fuel, lights, ignition and radio.

Operational group on the lower center panel includes the carburetor heat, ignition (starter is on the key), throttle, mixture control and primer. Two tubular bars are angled from the fuselage top at the rear of the front windshield for strengthening, but these have little adverse effect on visibility.

Baggage can be carried in a roomy area behind the seats, placarded for 100 lb., but, as one distributor put it, "I'll bet the jury-rigged jump seats show up fast."

Super Custom

The higher-priced Super Custom Colt instrumentation includes an engine-driven vacuum pump, artificial horizon, directional gyro, clock, manifold pressure gage, air temperature gage, rate of climb and turn and bank indicators. Also included is Piper's new Autonav low frequency homer, plus Narco Superhomer for VHF communication and omni navigation.

Wheel pants can be purchased for $132 and the extra 18-gal. fuel tank costs $200. Strut-cuffs and tie-down rings are sold for $30.

Thomas F. Piper, vice president-operations, said that Colt development started with the Tri-Pacer by pulling the rear seat and shelves, eliminating the top fuselage hump to give rear-seat headroom, eliminating flaps and retaining the instrument panel.

By reducing the empty weight and restricting the Colt to a two-place airplane, Piper then could return to the Lycoming O-235-C1B engine which has now been put back into production. The plane has a high degree of Tri-Pacer part interchangeability, Piper noted, since both use the same landing gear, motor mounts, windshield, door, tail surfaces, struts, seats and instrumental panel.

Custom Colt 108 Costs

Hourly Direct Costs	
Gas & Oil: 6 gal. per hour at $.38 and oil including 50 hr. oil change	$2.35
Inspection & Maintenance: Includes 100 hr. inspection, parts and normal maintenance	.80
Reserve for engine & propeller overhaul: Engine overhaul based on hours	.65
Direct hourly operating costs	$3.80
Annual Indirect Costs	
Hangar rent at $30 per month:	$360.00
Insurance:	
Hull . . . all risk . . . ground & flight $250 deductible	
6.5% Rate	389.68
Single limit liability . . . $250	198.00
Total annual indirect cost	$947.68



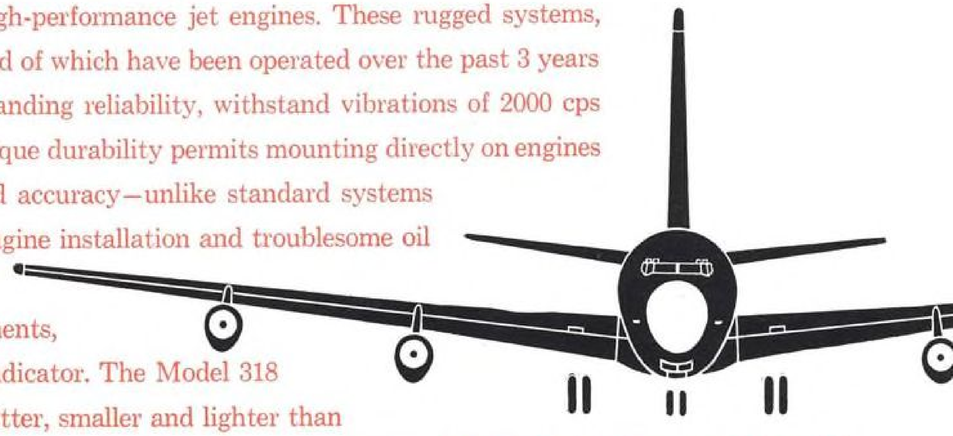
L. B. Smith Designs Gulfstream Interior

Grumman Gulfstream turboprop transport owned by National Gypsum Corp., Buffalo, N. Y., has 10-passenger configuration designed by L. B. Smith Aircraft stylist Nicholas Auriemma. View above shows aft seating; chairs use Fiberglas and metal to reduce weight.

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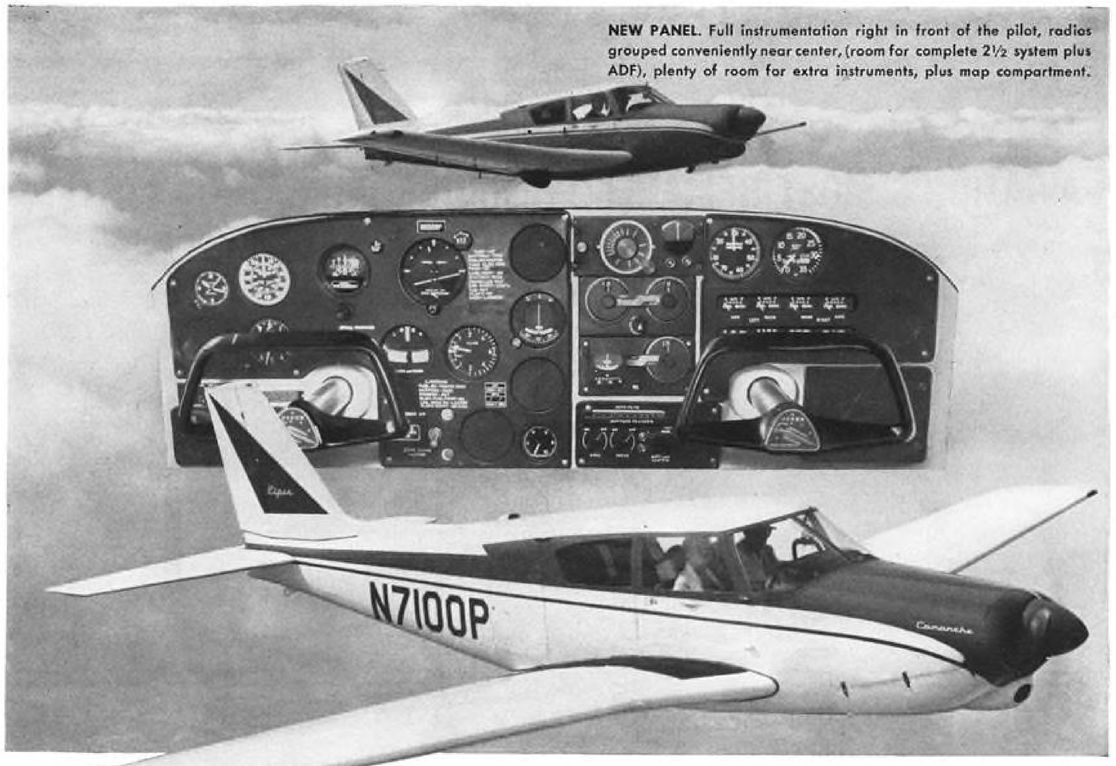




Standard hermetically sealed indicator, available in 1½" and 2". Model 296, a 2" indicator, is integrally lighted: in daylight, numerals and pointer are white and at night red. When power is off, pointer will move off-scale below zero.

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ATTRACTIVE LEASE/FINANCE PLANS



CESSNA Skyhawk, de luxe version of the Model 172, has shortened landing gear and raised engine for propeller clearance.

Cessna Tailors Line for Wider Market

By Erwin J. Bulban

Wichita, Kan.—Twelve models, ranging from the two-place 150 up through the light-twin 310F and a four-seat rotary wing aircraft, compose Cessna Aircraft Co.'s 1961 line of business airplanes.

Wide line characterizes the company's intention to continue exploitation of what it believes to be a vast untapped market potential by studying all areas and determining where new penetrations can be achieved, bearing in mind that a new model tailored toward a particular customer may be required.

New Models

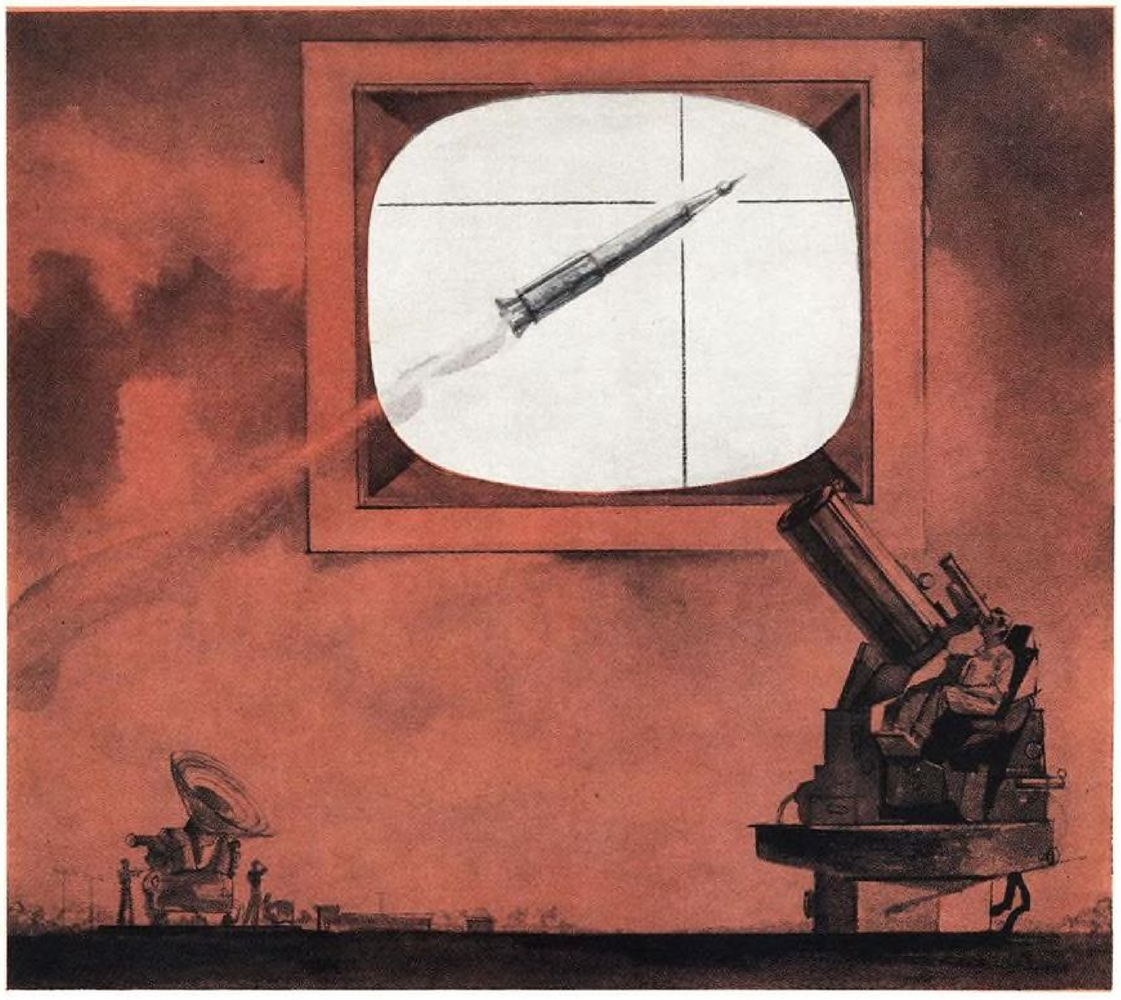
Success of this philosophy thus far is indicated by looking over the record of recent years as new models have been added. The Model 150, for example, introduced two years ago because the company's studies indicated that there was a desire for an equivalent to the compact car for training, short distance business trips, a second airplane and utility work, already has gone over the 1,000 mark in unit sales. The Model 175 and companion Skylark, introduced in 1958 to fill the gap between the light 172 and "heavy" single-engine 182, have scored approximately 2,000 unit sales. The light 172 four-placer, brought on the market in 1955, has sold over 4,800 units and introduction of the high-performance Model 210 single-engine airplane provided some 575 unit sales since its introduction last year.

Three additional aircraft have been added to the line for 1961; future plans (AW Nov. 14, p. 32) show that con-



MODEL 150 two-seater (above) has landing gear relocated to improve ground handling. Model 210 (below) has extra window on each side of rear cabin; cabin roof was raised.





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• • •

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tinued build-up is in mind. Model lineup for 1961 covers these airplanes:

• **Model 150** two-place compact, which Piper this year is challenging with its two-seated Colt, shows effects of interior restyling. All three models of this airplane feature a revised instrument panel layout with flight and navigation equipment grouped directly in front of the pilot and standard powerplant instrumentation and fuel gages on the right. Panel can be flooded with rheostat-controlled red light for night operation. A magnetic fuel level indicator has been installed to give faster response to fuel level changes.

Cabin heater control, electrical and master switches are on the top edge of the panel and remaining switches are in a vertical row at the right of the two centerline radio positions.

Airplane's center of gravity has been shifted forward by relocating the main landing gear two inches aft to improve loading ease and ground handling characteristics. Acrylic plastic molded control wheel, lighter and warmer than the former magnesium wheel, is fitted. Transparent area has been increased some 15% by increasing size of rear windows. Added as optional equipment are adjustable seats providing 14 combinations of tilt and length adjustment. Airplane cabin door locks have been modified to provide flush inside door handles and semi-flush automotive-type window latches.

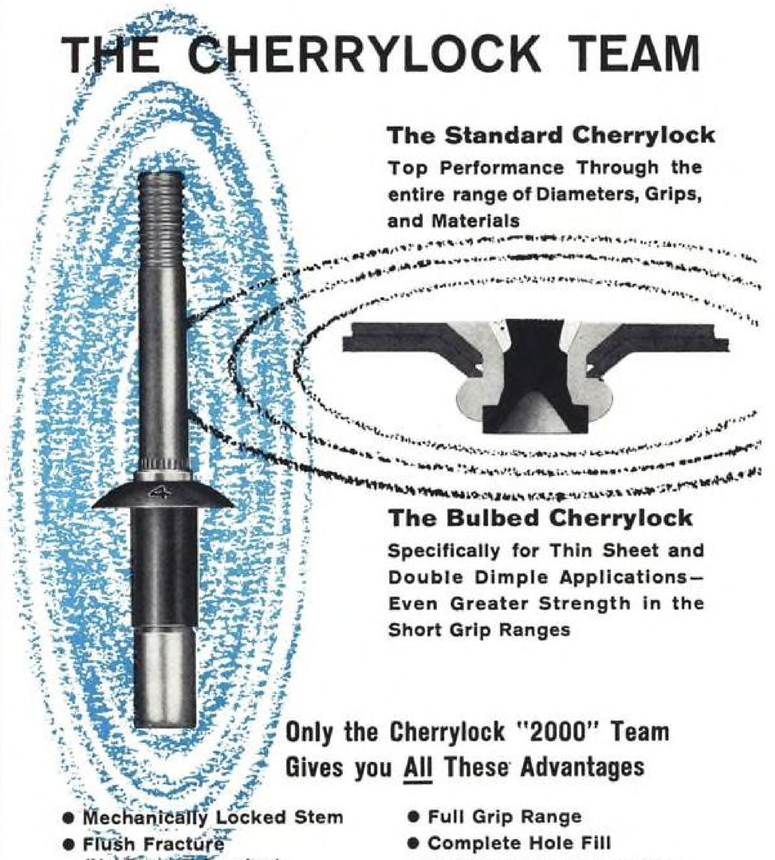
Factory Prices

Flyaway factory prices for the 150 are $7,495 for the standard version, $8,400 for the trainer and $8,995 for the inter-city commuter. Patroller-type wings, providing 38-gal. fuel capacity, compared with the standard 26-gal., cost $175 additional on a factory-exchange basis. Patroller doors, with extra transparent area in the lower portion, cost $165 extra and a message chute is currently available for $22 extra.

• **Model 172** this year has a new forward fuselage section as a result of raising the propeller line to provide ground clearance required from lowering the landing gear some three inches to improve ground handling. An outside baggage door has been added for easier access to the 120-lb. luggage compartment and engine starting is made more convenient by installation of an electric pushbutton system. The new 172 has the 145-hp. Continental O-300-D engine, similar to the "C" model except for crankcase modifications to provide for the electric pushbutton starter and vacuum pump drive.

For 1961 Cessna has added a de luxe counterpart of the 172, called the Skyhawk, which carries as factory-installed equipment the items previously designated as optional for the 172. Price of

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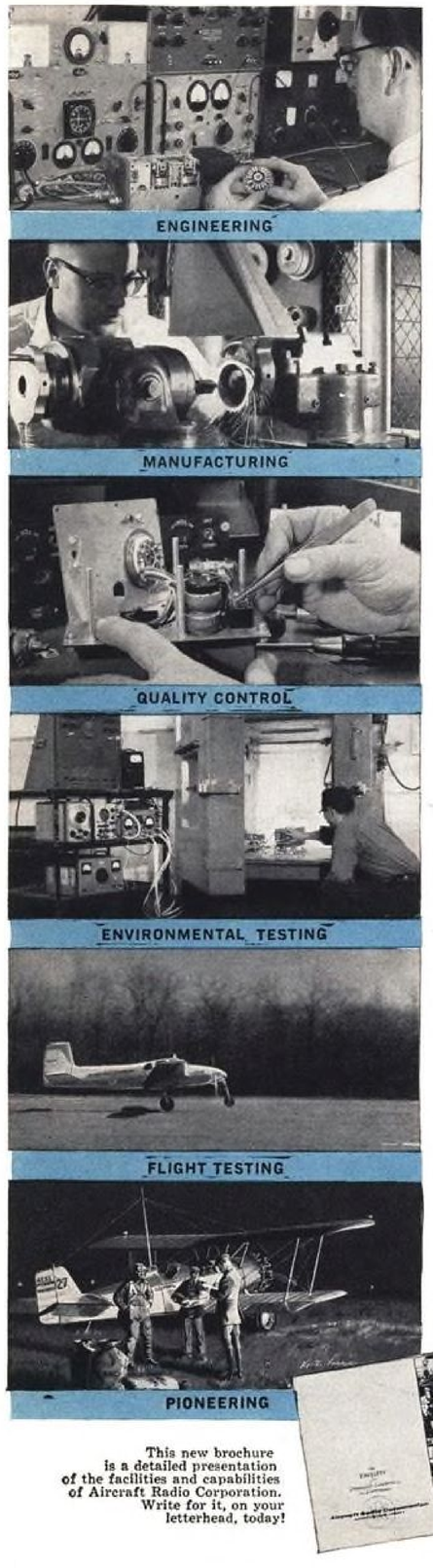
Higher joint strength allowables, close blind side clearance, and the widest grip range available—only with the Cherrylock Team—result in better fastening at lower cost. The Cherrylock Team provides the strongest mechanical lock—flush fracture rivet available. Positive visual inspection after installation—with grip length marked on the rivet head—is offered only by the Cherrylock Team.

* * *

For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

*Patent No. 2931532

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COMPLETE line of Cessna's 1961 models was viewed by dealers and distributors in display area in Wichita auditorium. Below is record flyaway involving $4 million worth of airplanes which left the factory at conclusion of the company's annual dealer meeting.

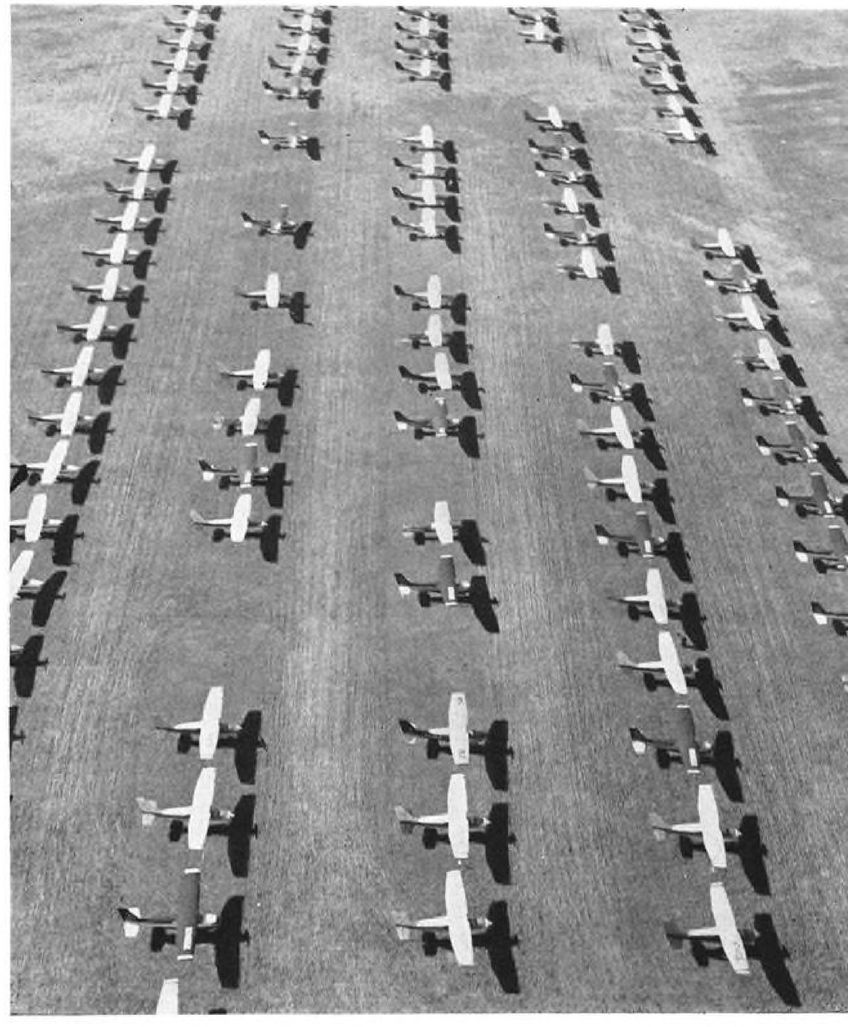
the model is $9,795 and for the Skyhawk $11,475.

• **Model 175** and its companion de luxe model, the Skylark, have revised instrument panels for more convenient reading of gages and the magnetic fuel level gages are also provided. Standard Model 175 has simplified starter activation through re-routing of the starter control. The Skylark incorporates electric pushbutton starting on its Continental-geared 175-hp. GO-300-D engine. The 1961 standard 175 is priced at $11,995 and the de luxe Skylark at $13,775.

• **Model 180** utility airplane in 1961 shows effects of pushing with new interiors available in choice of two colors, plus a special utility interior for more rugged operations. Instrument panel is revised and has a modified eyebrow overhang. Radio selector switch console is added to the upper right center portion of the panel, with switches provided for two transmitters, two receivers, automatic direction finder and marker beacon receiver. Three-position hinged back seats are optional for the front position. Model 180 this year is priced at $15,275.

• **Model 185** is the company's new, heavy duty utility airplane available for the first time in 1961 (AW Oct. 31, p. 31). Skywagon, as it is named, meets requests for a 180-type airplane having considerably greater load-carrying ability —the airplane can carry six adults and 270 lb. of baggage with full fuel compared with the Model 180's four-seat, 120-lb. baggage capacity. Powered by a fuel injection 260-hp. Continental IO-470-F, the 185 is designed to take off at full gross weight and clear a 50-ft. obstacle in 1,510 ft. and land in 1,265 ft.

Skywagon will be available in five



interior configurations—utility version containing only a pilot's seat, a similar version, with two seats up front, seating for pilot and copilot plus two two-place rear seats, a standard four-seat layout, and a four-place de luxe interior.

Edo floats are available as optional equipment and permit carrying a useful load of 1,401 lb. Additional fuel capacity, increasing normal range from 885 mi. to 1,160 mi., will be optional. First deliveries of the new Model 185 Skywagon are expected to be made in March. The airplane will sell for $18,950 in its standard version.

• **Model 210,** to be shown publicly in January, this year will feature larger cabin windows and two additional rear panes, resulting in an increase of some 10% in transparent area over last year's version.

An important feature of this "heavy" single-engine type is a revised fuselage in the cabin area, providing additional headroom through raising the height of the roof. Wing fillets provide cleaner mating of wing and top of cabin. Baggage door is redesigned to ensure more rigidity in the fuselage area toward the tail cone and easier loading. The instrument panel features the switching console provided for all Cessna airplanes which have two or more radios installed, arranged so that the pilot can select the transmitter he wishes to use and receive only on one receiver while all the others are in "On" position. Also on a panel is a new fuel flow indicator which shows fuel consumption in gallons per hour, replacing a gage which had measured fuel flow in pounds per square inch, which should make computation simpler.

Airplane now has a new elevator down-spring connected through a cable system providing a down force on the elevator resulting in increased stability throughout the center of gravity, particularly emphasizing the aft gross weight condition. Price of the standard Model 210 is $23,450.

• **Model 310F** five-place light-twin primarily is restyled, rather than incorporating major design changes. Nose cap is more pointed and trailing edges of the wintip tanks are modified, while the propeller spinners also have a more pointed shape. Two windows have been added to the rear of the cabin to increase rear seat visibility.

Faster, more positive Scintilla engine starting system is provided to simplify this procedure. The new magneto eliminates the mechanical impulse coupling used on previous designs to provide the retarded spark for starting. A retard breaker in conjunction with a battery-operated vibrator is used, the vibrator providing rapidly interrupted current to the primary of the magneto, which in turn induces a high voltage to the secondary, producing literally a shower of sparks at the spark plug. When the switch is released to running position, the retard breaker and vibrator become inoperative and the main breaker assumes spark control.

Model 310F also incorporates an improved engine induction air box, permitting removal of the filter without having to take off the engine cowling. Price of the standard 310F is $62,500.

• **Model 182** has its main and nose gear lowered some four inches to improve ground handling. A new nosewheel fork, similar to that on the 210, is incorporated to provide a more durable installation. Engine cowling has been redesigned to incorporate Camloc fasteners for heavier reinforcing while at the same time speeding cowl removal. Price for the 1961 Model 182 is $15,490 and for its companion de luxe version, the Skylane, price is $17,950.

• **Skyhook** rotary wing aircraft (AW Oct. 17, p. 131) is being introduced formally this year because of studies indicating that a decided upsurge in business use of the helicopter is probably due in the next few years. One study made by Cessna indicates that there are over 12,000 qualified prospects for rotary wing aircraft in the U. S. today and that its Skyhook four-seater fills some 85% of the potential requirement.

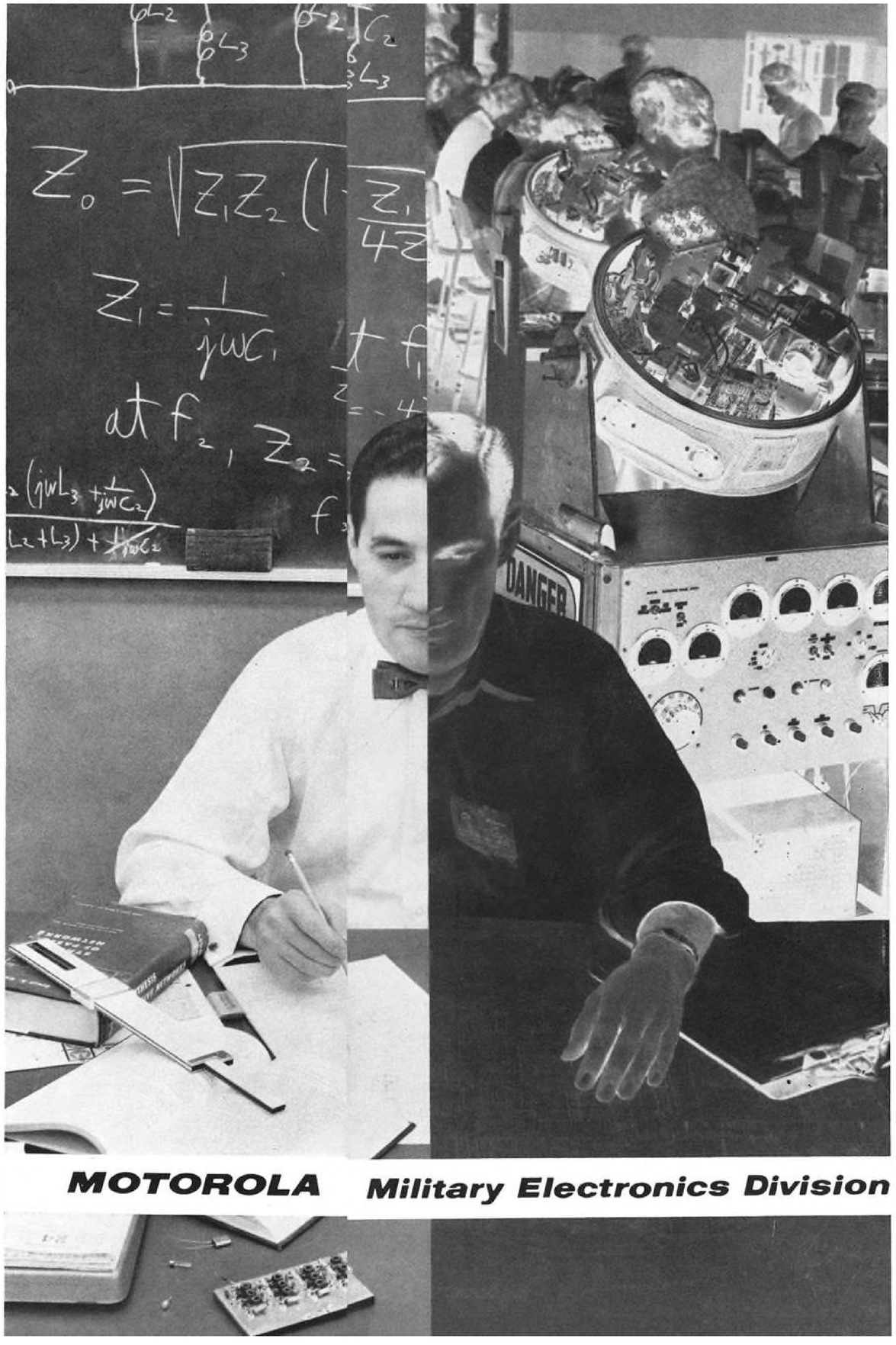
Certificated both for visual and instrument flight rule operation by Federal Aviation Agency, the Skyhook is being offered initially in the VFR configuration, priced at $79,960. Plan is to provide sales and service through Cessna's large dealer network, although initially, because of its cost, demonstration programs will be handled through the factory.

Cessna's commercial aircraft sales for the fiscal year ended Sept. 30 were about $56 million, a 20% increase over last year's record high of $46,623,000. Total sales were more than $103 million, second highest in company's history.

PRIVATE LINES

Shipments of business and utility aircraft by eight U. S. manufacturers in September totaled 368 units valued at $9,682,000 in factory billing prices. Figure brings year's deliveries to 5,658 airplanes with billing value of $114,676,000. Total compares with 5,615 units valued at $97,532,000 for a similar period a year ago.

Collins Radio Co. is supplying lightweight navigation and communication systems for Navy Piper Aztec twins under $183,958 contract from Piper. Navy has ordered 20 Aztecs.



MOTOROLA Military Electronics Division

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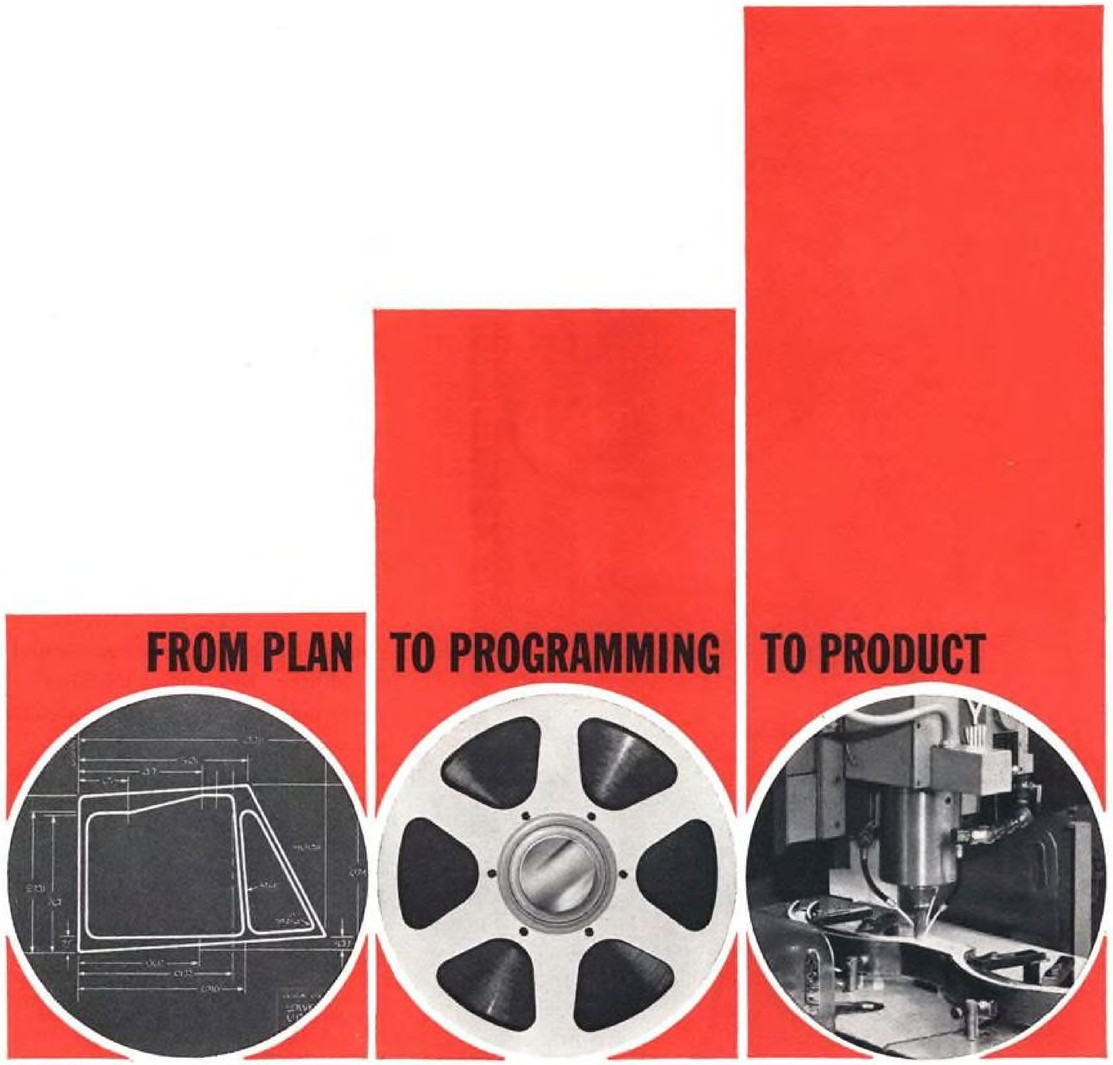
That's why Motorola has performed key roles in research, development and production for such sophisticated military electronics as:

- Military Communication Systems & Equipment
- Data Transmission, Processing & Display Programs
- Missile Systems, Electronics & Instrumentation
- Electronic Warfare & Countermeasures Programs
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- Applied Research & Development in Microelectronics
- Advanced Radar & Sensor Developments
- Solid State Developments in Materials & Devices
- Navigation Systems & Equipment
- Surveillance Systems

For more detailed information, a comprehensive brochure will be mailed on request.

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COMPLETE NUMERICAL CONTROL SERVICE FROM ROHR. Rohr Aircraft Corporation has established a complete, ***in-plant*** Numerical Control Department, offering a full range of services that can be tailored to any requirement. If you use numerically controlled machine tools, or recognize the method's superiority, this new service will interest you.

Rohr can provide complete service—tool planning, tool manufacture, part programming, computer processing, tape or card preparation, final part machining—or any part of the service separately.

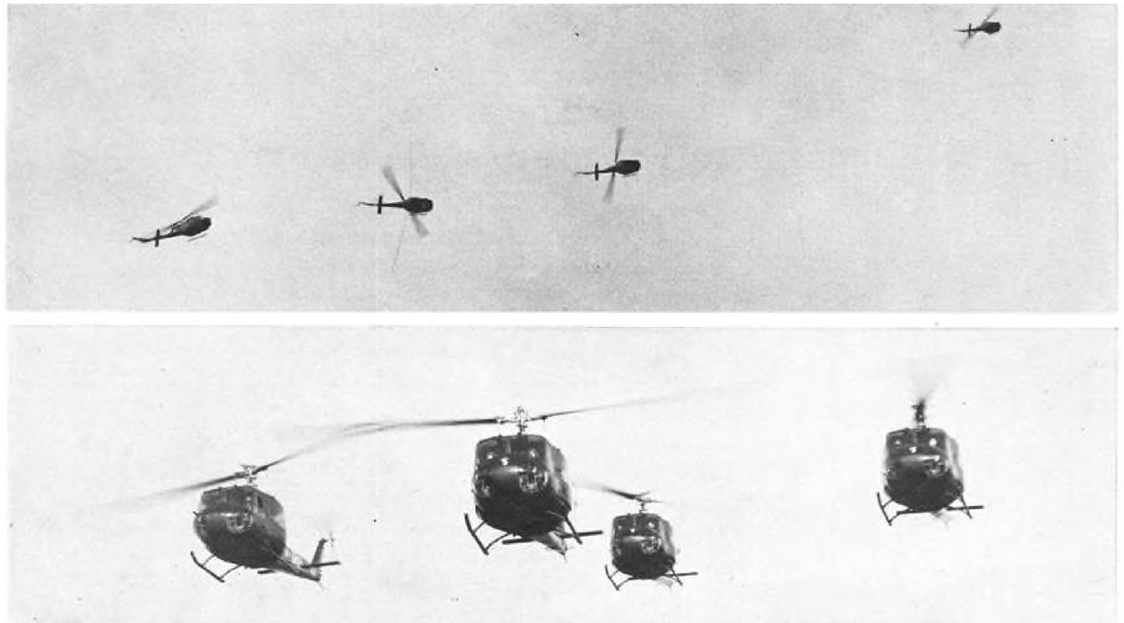
If you own a machine, for example, Rohr will produce tape or card media from your plans. Or you may need to employ only computer or director service. Whatever your numerical control needs, this fully flexible service can meet them.

Rohr's recognized leadership in the use of numerically controlled machine tools and in programming stems from an early realization of the method's potential in production of uniform, close-tolerance parts. Studies began more than a decade ago —years before the first machines were built. Today, Rohr's complete facilities, practical experience, and highly trained staff combine to provide an unparalleled capability in numerical control.

A new brochure describes Rohr's numerical control services in detail. Write Mr. A. R. Campbell, Sales Manager, Dept. 8, Rohr Aircraft Corporation, Chula Vista, California.

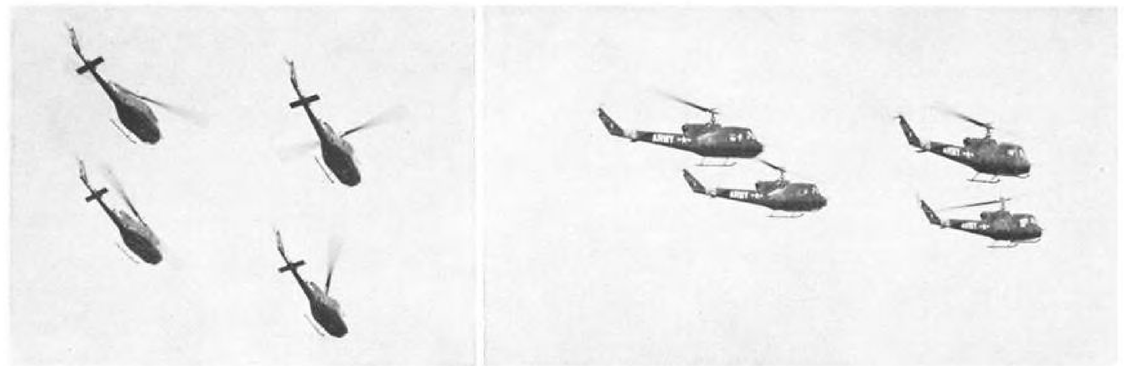
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Iroquois Chieftains of the U. S. Army's 101st Airborne Division perform precision maneuvers in Bell HU-1A turbine-powered helicopters.

Army Organizes Bell HU-1A Precision Flight Team



Precision team's repertoire includes bomb burst, tight turns and backward flight, all performed in tight formation. Army chose the Bell HU-1A, powered by a Lycoming T53 shaft turbine engine, as its new instrument trainer and bought 14 Iroquois last month for delivery to Army Aviation School, Ft. Rucker, Ala. HU-1A has considerable tactical versatility, can carry six Nord SS-11 wire-guided missiles. Iroquois version equipped with HU-1A engine and HU-1B rotor blades recently broke seven world records (AW Aug. 15, p. 31).

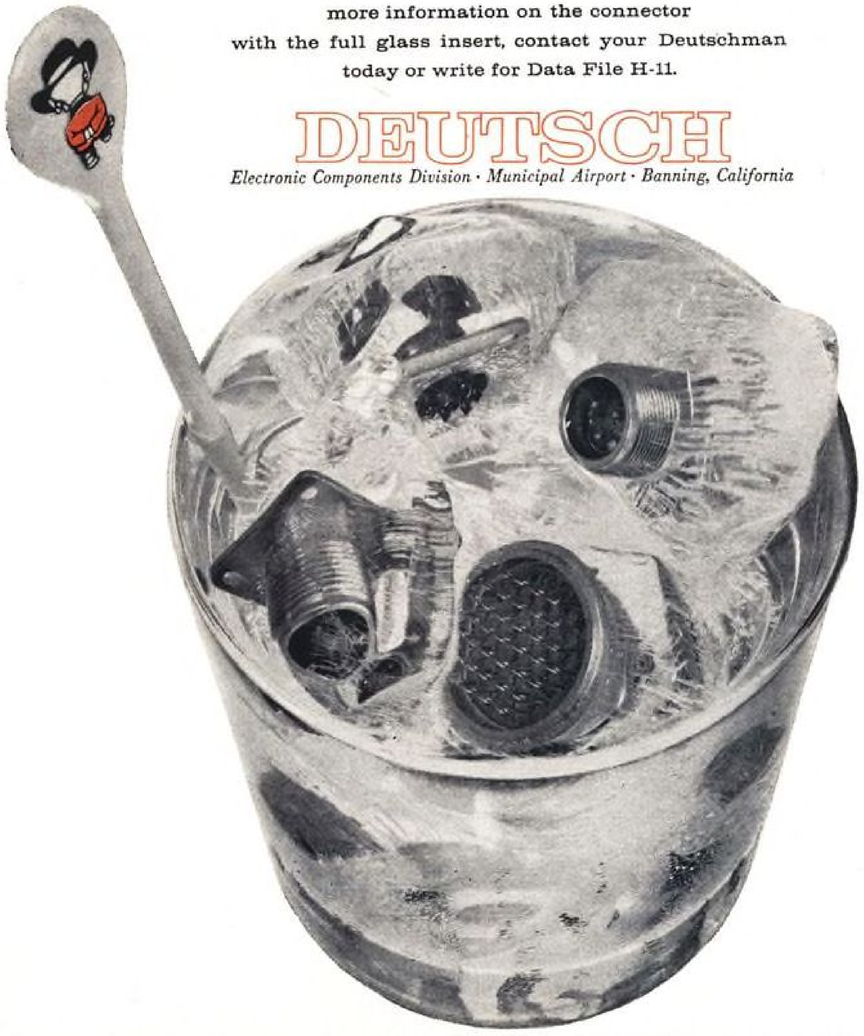


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The Deutsch hermetic receptacle
has withstood every kind of trial and tribulation
we could think of, and will soon be
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against extreme environmental conditions. The
secret of this leak-proof performance
is the unique compression glass insert molded into
the connector shell as one solid piece
with contacts fused right in. And we can
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more information on the connector
with the full glass insert, contact your Deutschman
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ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS

PRODUCTION BRIEFING

Production contract in the amount of $1,775,000 for 500 KD2R-5 target drones has been awarded by Navy to Northrop Corp.'s Radioplane Division. Deliveries are scheduled to start this month. The KD2R-5, a development of the PQ-19, has been used extensively as a training target for surface-to-air missiles and anti-aircraft artillery.

Douglas Aircraft Co. has received a $139,248 study contract from Wright Air Development Division for Project Slomar (Space Logistics Maintenance and Rescue). The one-year contract was one of six Slomar awards made in September (AW Oct. 24, p. 23).

United States Steel's National Tube Division is producing high-pressure helium and nitrogen storage vessels for Titan missile complexes. Vessels will be placed in upright positions 80 ft. below ground in launching silos.

Lockheed Aircraft Service will perform turnaround maintenance on Alitalia's Douglas DC-8s, and will maintain Rolls-Royce Conway turbojet engines stored by the Italian airline at Lockheed Aircraft Service's Idlewild, N. Y., facility.

West German government placed an additional order with Sud Aviation for 75 Alouette II helicopters. New order brings total German Alouette order to 205 and Sud Aviation's Alouette backlog to 704.

Talley Industries, Cheshire, Conn., and Phoenix, Ariz., has received three contracts totaling $525,000. They are from Boeing-Seattle for production of Minuteman silo-door ballistic actuators, from Boeing-Wichita for B-52 emergency escape rotary ballistic actuators and from Convair for B-58 escape capsule gas generators.

First Atlas airframe to be built at Convair's downtown San Diego facilities has been delivered to the main plant at Kearny Mesa. The 129,000-sq.-ft. building was formerly used for production of F-106s.

Gulton Industries. Metuchen, N. J., has developed a new nickel-cadmium battery which it says has a proprietary ceramic-to-metal molecularly bonded seal, a modified nylon sheet separator and improved electrical characteristics.

Butler Manufacturing Co., Kansas City, Mo., will produce fuel transporters for the Jupiter IRBM under $1 million Army contract. The 6,000-gal. aluminum semi-trailers can dispense fuel at 1,000 gpm.



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Since they fed the first bird 22 years ago, Grove pressure regulators have set the pace. It is fact that original Grove designs are still the basis for every pressure regulator used in ground support systems today. Specify Grove regulators for dependable pressure control.



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SMR*



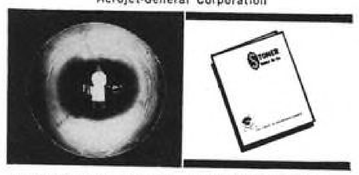
Stoner's SMR has broken through the thermal sealant barrier that has faced the missile and rocket industry for many years.

The varied shapes and forms that this versatile material has taken includes: chamber sealants; liners; insulation for head closures; high temperature insulation; prefabricated proofed sleeves and bladders, as well as other critical applications for rocket components.

SMR is also being used to advantage in plastic molding compounds and pre-preged laminates.

*SMR is a special Silicone Modified Rubber produced by Stoner Rubber Company, Inc.

Photo of Rocket Chamber courtesy of Aerojet-General Corporation



SMR PROVIDES A TOUGH THERMAL LINER AND RELIABLE SEALANT FOR MISSILE AND ROCKET CHAMBERS. This unique rubber has exceptional high bond strength at elevated temperatures.

FREE IDEA CATALOG. Technical information on SMR and other Stoner products in this 24 page catalog will help you solve your rubber problems.

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WHAT'S NEW

Publications Received:

Sky Guide—Sky Guide, 2091 San Vicente, Long Beach 15, Calif.; $1.90; 220 pp. Includes Civil Air Regulations, communication procedures, weather information, night flying, plus flight log, signals and diagrams.

Dynamitron—Radiation Dynamics, Inc., Westbury, Long Island, N. Y. Drs. Marshall R. Cleland and Kennard H. Morganstern describe characteristics and operation of the Dynamitron accelerator.

Community Planning for Air Transportation—National Association of State Aviation Officials, Suite 403, 1101 Vermont Ave., N.W., Washington 5, D. C. $2.00; 90 pp. Civil Aeronautics Board cases involving new or continued airline service are described in detail along with a brief history of federal and state regulation of air transportation.

The Physics of Fluids—American Institute of Physics, 335 E. 45 St., N. Y. 17, N. Y. This journal reporting on the results of research on the structure, statistical mechanics and general physics of gases, liquids, plasmas and other fluids will be published monthly beginning with Vol. IV in 1961 instead of bi-monthly.

Technical Translations—Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Subscription: $12.00 a year ($4.00 additional for foreign mailing). New material available from translations of Soviet articles and books in most scientific and technical fields is listed in Technical Translations, which is published twice a month.



FEATHERWEIGHT PRESSURE INDICATOR

This B.F.Goodrich Pressure Indicator incorporates an Omega-design bellows, which closes a contact when pressure reaches a preset value in the range of 250 to 500 p.s.i. Device is less than 1 inch long, weighs under half an ounce. Now used in primary missile batteries and torpedo batteries; special design can be built to meet your needs. Write for complete information.

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Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.:

An Exploratory Study of Prolonged Intermittent Photic Stimulation—Capt. H. S. Alexander, USAF, and W. D. Chiles, Aerospace Medical Laboratory, WADD, U. S. Air Force. Nov., 1959. $.50; 11 pp. (PB161504).

Transistorized Four-Segment Commutator for a Direct-Current Machine—F. L. Schwartz, Massachusetts Institute of Technology, for WADD, U. S. Air Force. Feb., 1960. $1.25; 47 pp. (PB161721).

Rocket Propellants—Armed Services Technical Information Agency. March, 1960. $1.50; 59 pp. (PB161654).

The Effects of Radiation on Oxygen Designed for Human Consumption—J. F. Kircher and others, Battelle Memorial Institute for Air Research and Development Command, U. S. Air Force. Dec., 1959. $1.00; 37 pp. (PB161551).

Design Study of High Pressure Oxygen Vessels—D. A. Keating, Aerospace Medical laboratory, Air Research and Development Command, USAF. February, 1960. $.75; 28 pp. (PB161666).

A Simplified Electronic Tracking Apparatus (SETA)—P. Gain and P. M. Fitts, Ohio State University and OSU Research Foundation, for Wright Air Development Center, U. S. Air Force. Nov., 1959. $.50; 17 pp. (PB161550).

The Soviet Training Program for Automation and Computer Specialists—Prepared by an agency of the federal government. $.50; 8 pp. (60-21187).

Role of Structural Damping in Acoustical Fatigue—W. J. Trapp, Materials Laboratory, and B. J. Lazan, University of Minnesota for WADD, U. S. Air Force. Jan., 1960. $1.00; 31 pp. (PB-161742).

FINANCIAL

Earnings Reflect Chance Vought Change

New York—Success of Chance Vought Aircraft's formula for reorganizing its resources and diversifying its military and space age markets will be tested during the coming year, according to Chance Vought President F. O. Detweiler, speaking before the New York Society of Security Analysts here last month.

Consolidated sales for the nine months ending Sept. 30, 1960, totaled $169,753,012, compared with $191,686,384 for the same period in 1959. Net income amounted to $2,727,340, or $2.29 a share, compared with net income of $4,297,437, equal to $3.61 per share for the corresponding three quarters in 1959.

Unfilled government orders increased to $211,000,000 as of Sept. 30, 1960, from $184,000,000 as of June 30, 1960. Although the U. S. Navy still purchases the bulk of the company's hardware production, Detweiler said, "nearly three-fourths of our current backlog of research and development contracts was received from the Air Force and NASA."

A recent letter to Chance Vought shareholders proposed a change in the company's name to Chance Vought Corp. to better represent the company's diversified interests and to avoid the limiting connotation of "aircraft."

Detweiler referred to 1960 as "the year of transition" marked by progress in improving the company's new form of organization, in digesting new acquisitions and reorienting its research and sales objectives. Current activities of the corporation's various divisions include:

• **Vought Aeronautics Division**—Continued production of the F8U Crusader series carrier-based fighter aircraft. First F8U-2N aircraft—the latest version of the Crusader—were delivered to the Navy last month. Aircraft have all-weather capability and improved armament, fire control and navigation equipment. Navy recently placed a $68-million order with the division for production of the F8U-2N beyond 1962, bringing to $162.6 million the total contract amount on the aircraft. "It appears likely that additional follow-on quantities will be ordered by the Navy next year for production of the F8U-2N through Calendar 1963," Detweiler said.

The division also has been engaged in engineering and development work on Project SLAM, a nuclear-powered supersonic low altitude missile; Project ADAM, a VTOL aircraft concept which makes use of deflected and vectored thrust from a jet engine power source; detection and communications systems components in the field of ASW. The division also expects to participate in North American's B-70 project and was among several companies who received contracts last week from North American Aviation to supply honeycomb panels for the B-70.

• **Vought Astronautics Division**—Organized 15 months ago, the division's principal hardware project is the solid-fuel Scout rocket research vehicle for National Aeronautics and Space Administration. Last month the division was appointed prime vehicle contractor for Scout under an additional $6 million NASA contract, making it responsible for both final assembly and launching of the vehicle. The division is a key contractor for USAF's TS-609A Blue Scout Junior research rocket, which made its first flight Sept. 21.

• **Vought Electronics Division**—Important part of the division's production consists of flight controls and ground support equipment for the Crusader aircraft, and the Minuteman and Titan missiles. Work is being conducted on a novel guidance-navigation system for low level missiles and aircraft currently applicable to many SAC missions and later to the SLAM vehicle. A high performance sonobuoy is being developed under Navy contract. The division has developed a multi-polarized antenna for installation on USNS Range Tracker, assigned to the Pacific Missile Range (AW Nov. 7, p. 110).

Non-military products of the division include a coupling device for the Federal Aviation Agency that permits utilization of four times as many transmitters and receivers as are presently used without increasing the number of antennas. According to Detweiler, the device also improves the quality of voice transmission and provides a means for detecting transmitter and receiver failures. Under another FAA contract the division is designing and developing a compact, low-power, low cost transmitter to be used with the coupling system. A new off-site facility containing 80,000 sq. ft. of floor space is under construction and will be occupied by the division about Feb. 1, 1961.

• **Vought Range Systems Division**—Primarily engaged in engineering, technical and administrative contract serv-



Gliders Proposed for Moving Rocket Stages

Transport gliders with 110,000 lb. payload capacity and an internal cargo volume measuring 96 x 24 ft. are being proposed by advanced design scientists of Lockheed's Missile and Space Division as a means of moving large rocket stages from factory to launch site. Gliders would have a wingspan of 211 ft., a cruise speed of 190 kt. and a gross weight of 153,000 lb. Main advantage would be a saving in time over barge delivery of the rocket stages, which takes 5-20 days. Size limitations make the movement of assembled rockets by either rail or highway impractical and the gliders could be built at a cost comparing favorably with that of barges. Lockheed engineers claim that such a fleet of towed gliders could operate from most existing airfields.

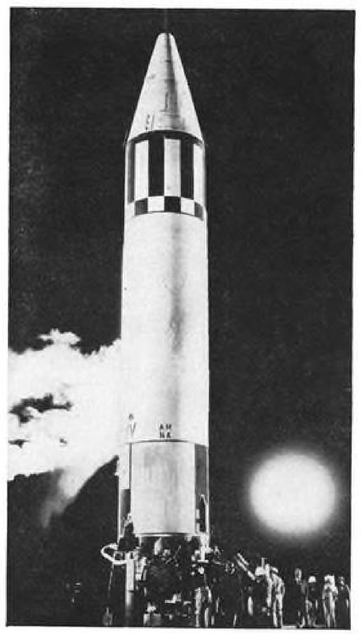


INERTIAL SYSTEM TEST

Can you measure a movement several thousand times slower than the hour hand of your watch? With the skills of an expert organization behind you, could you design and develop your own test methods, equipments, and procedures? These would be for the evaluation of servo, gyro, and accelerometer performance and early prototype inertial systems, and would include precision voltage analog measurements. Write to Mr. S. L. Hirsch.

LITTON SYSTEMS, INC. Electronic Equipments Division
Beverly Hills, California

SILICONE NEWS from Dow Corning



By Jupiter... it's reliable!

Reliable . . . that one word sums up the record established by the Army's Jupiter and the performance of Silastic®, the Dow Corning silicone rubber is part of that record.

Rubber ducts must not crack even though frozen hard and brittle by liquid nitrogen. Access door seals must remain a rubbery seal despite high skin temperatures. Rubber parts must be "ready-to-go" even after long storage without signs of aging cracks. Chrysler Missile Division engineers specified Silastic to help keep the Jupiter ready . . . Silastic, flexible from —130 to 500 F and ageless in storage.

Photo courtesy Chrysler Missiles Division

Write to Dept. 1011a for information

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MIDLAND, MICHIGAN

ices with the military services, the division also operates target drones for the Bomarc missile on the Eglin Gulf Test Range and supports the Navy's Barking Sands missile operations and NASA's range tracking activities at Kokee Park, both on Kauai, Hawaii. The division is instrumenting one of the Pacific Missile Range ships and is performing a variety of telemetry and instrumentation services.

• **Chance Vought Research Center**—The organization is conducting basic and applied research in the fields of life sciences, electronics, energy sources and materials.

• **Vought Industries, Inc.**—A consolidation of three companies and 14 plants, the mobile homes division registered about $60 million in sales during 1959, while 1960 sales are currently running about 20% below nine-month sales for last year. In addition to mobile homes and travel trailers the division is planning to develop industrial units for construction crew housing, portable housing units, motel units and prefabricated housing. A subsidiary of Vought Industries—Crusader Finance Corp.—was organized six months ago to support wholesale and retail sales of the division's mobile homes and currently holds more than $5 million worth of loans, 60% of them retail.

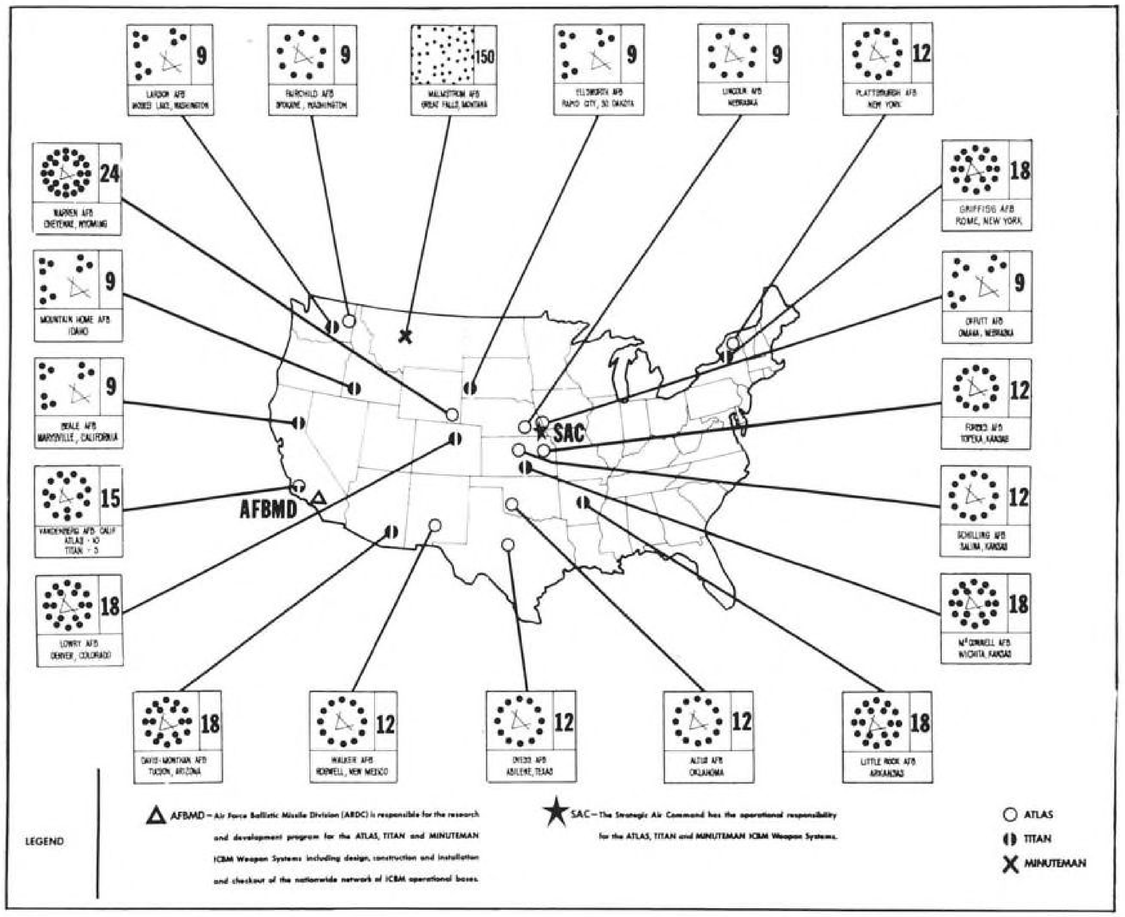
• **Information Systems, Inc.**—An 80% owned subsidiary, ISI is engaged in design, production and installation of annunciator, alarm and instrumentation systems and more recently computerized control systems for a wide range of processing industries and for the electric power industry and other utilities. A division of ISI will be moved from Chicago to Los Angeles to be integrated with Chance Vought's former Genesys Corp. Detweiler anticipates better profits from ISI than from military business.

• **National Data Processing Corp.**—Engaged in the business data processing field, Chance Vought acquired a 51% interest in the Dallas corporation late in 1959. Under a Federal Reserve Bank contract, NDP had undertaken the development of a full range of automatic check-handling equipment in 1959 and will make a major installation in the Federal Reserve Bank of San Francisco early in 1961. National Data Processing also is engaged in the development of optical scanning systems, the first of which are scheduled for installation late this year. Systems include optical reading machines, credit card imprinters and other point-of-sale recording devices. Pointing to the high development costs incurred this year in preparing its products for commercial application, Detweiler said that 1961 appears to be the year when National Data Processing must prove its equipment in actual field use.

Projected fourth-quarter earnings should approximate third-quarter earnings subject to year-end adjustments, Detweiler said. Earnings from aircraft deliveries in 1961 will decline, assuming no schedule changes, but Detweiler said that this reduction will be compensated for partly by estimated earnings of the Astronautics, Electronics and Range Systems Divisions; Mobile home sales by Vought Industries should at least equal 1960 sales, Detweiler said, and should be more profitable as a result of improvements effected. Operations of ISI are expected to be profitable and should show an increase in sales, he added.

Sales in 1961 are expected to be about 10% lower than this year, Detweiler said, but earnings—which should total about $6.6 million this year against $7.36 million in 1959—are expected to continue at a high level.

In another report to stockholders, President Mundy I. Peale of Republic Aviation Corp. reported consolidated net income for the first nine months of 1960 of $1,572,548, or $1.10 a share, compared with $2,640,254, or $1.79 a share for the corresponding period in 1959. Income was based on nine-month sales of $115,264,645, compared with $152,952,050 for the similar 1959 period. Peale noted a backlog of orders amounting to $738 million representing a 45% increase over the $511-million backlog at the beginning of the year. Peale told stockholders that he anticipated a further increase during the final quarter that would bring sales and earnings for 1960 above last year.



USAF ICBM Operational Sites

USAF missile bases, some with two or more squadrons, reveal varying configurations. Radio-command Atlases and Titans are in 3 x 3 layouts, with three launchers at each of three guidance stations. All-inertial liquid ICBMs are emplaced singly in widely dispersed 1 x 9 or 1 x 12 silos. Minuteman, with 150 missiles per base, will also be positioned in individual silos.

Financial Briefs

Rohr Aircraft Corp. reported sales of $193,249,182 for the year ended July 31, compared with sales of $191,703,998 for the year previous, and net loss of $2,604,375, compared with earnings of $2,586,300 for 1959. Losses were attributed to write-off of costs incurred in development and initial production of components for the Boeing 707, Convair 880 and the Douglas DC-8.

Burnell & Co., Inc., Pelham Manor, N. Y., manufacturer of electronic filters and delay lines, reported earnings of $80,678 on sales of $1,805,610 for the six months ended Sept. 30. This compares with earnings of $57,016 on sales of $1,459,675 last year.

Airwork Corp., Millville, N. J., earnings on sales of $12,446,946 for the year ended July 31 were $420,688, compared with earnings of $293,479 on sales of $9,319,141 for previous year.

Radiation, Inc., Melbourne, Fla., earnings for the fiscal year ended Aug. 26 were $184,787 on sales of $23,155,845 compared with $588,993 on sales of $14,005,734 for the previous year.

PROBLEMATICAL RECREATIONS 41



Jack speaks the truth twice out of five times, John three times out of seven, and Jim once out of nine times. Jack questions Jim regarding Jill's truthfulness. Then John says that Jack has affirmed that Jim denies that Jill is a liar. Investigate Jill's regard for truth.

—Pepys' Diary

The Electron Tube Division of Litton Industries wants to inform you that they have made significant breakthroughs in attaining broad band width and peak powers in L-Band Klystrons.

ANSWER TO LAST WEEK'S PROBLEM: Seven-year-olds don't have wives in Philadelphia, fathers rarely confuse their children's names ... this kind of logic plus a little digging reveals that Mr. White is the president, Mr. Brown is the professor, Mr. Black is the instructor and Mr. Green is the Janitor.

LITTON INDUSTRIES
Beverly Hills, California

ATTRACT AND HOLD TECHNICAL PERSONNEL

DAYTONA BEACH METROPOLITAN AREA
ORMOND BEACH
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STRATEGIC LOCATION FOR GROWTH INDUSTRIES

Daytona Beach, the east-to-west terminal on the north-to-south route of the projected Federal Limited Access Freeway System, gives industry a plus for the future.

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Write for 101 page Brochure
R. H. MILES, Mgr.
INDUSTRIAL DEPT.
CHAMBER OF COMMERCE
DAYTONA BEACH, FLORIDA

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:

Industrial Components Division, Raytheon Co., Newton, Mass., Raytheon spectrum analyzer, model MRFR 30-3, 1 ea., and data, contract AF 33-(600)42182, $43,367.

Wilding, Inc., Chicago, Ill., production of 35 mm. black and white motion picture entitled, "Over Your Signature," TF 1-5346, contract AF 33-(600)42203, 1 ea., $26,060.

Roland Reed Productions, Inc., Hollywood, Calif., production of 35 mm. black and white motion picture entitled, "Communist Political Indoctrination Techniques," SFP 1021, contract AF 33-(600)42204, 1 ea., $33,370.

Borg Equipment Division, Amphenol-Borg Electronics Corp., Janesville, Wis., indicators, course, ID-250A/ARN, Aerno 81,3364, supplement agreement No. 4 to contract AF 33-(600)40962, 451 ea., $64,006.

Schulz Tool and Manufacturing Co., San Gabriel, Calif., nozzle, flight pressure refueling, type MA2, Aerno 45-7602, and data for F-105D aircraft, contract AF 33-(600) 42053, 440 ea., $43,180.

AiResearch Manufacturing Co. of Arizona Division, the Garrett Corp., Phoenix, Ariz., starters, pneumatic, aircraft engine, USAF type STU-1/A, Aerno 42-9409, contractor's P/N 350690, and data, contract AF 33-(600)42110, 112 ea., $179,424.

Defense Electronic Products Division, Radio Corporation of America, Camden, N. J., engineering services for time division data link, amendment No. 1 to letter contract AF 33-(600), $100,000.

The Mitre Corp., Lexington, Mass., facilities in support of the Air Defense Missions System, contract AF 33-(600)41229, $55,-000.

Lockheed Aircraft Corp., Marietta, Ga., additional quantities of C-130B and SC-130B airplanes, amendment No. 1 to letter contract AF 33-(600)40997) $1,700,000.

FAA Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Materiel Contracts Branch, Federal Aviation Agency:

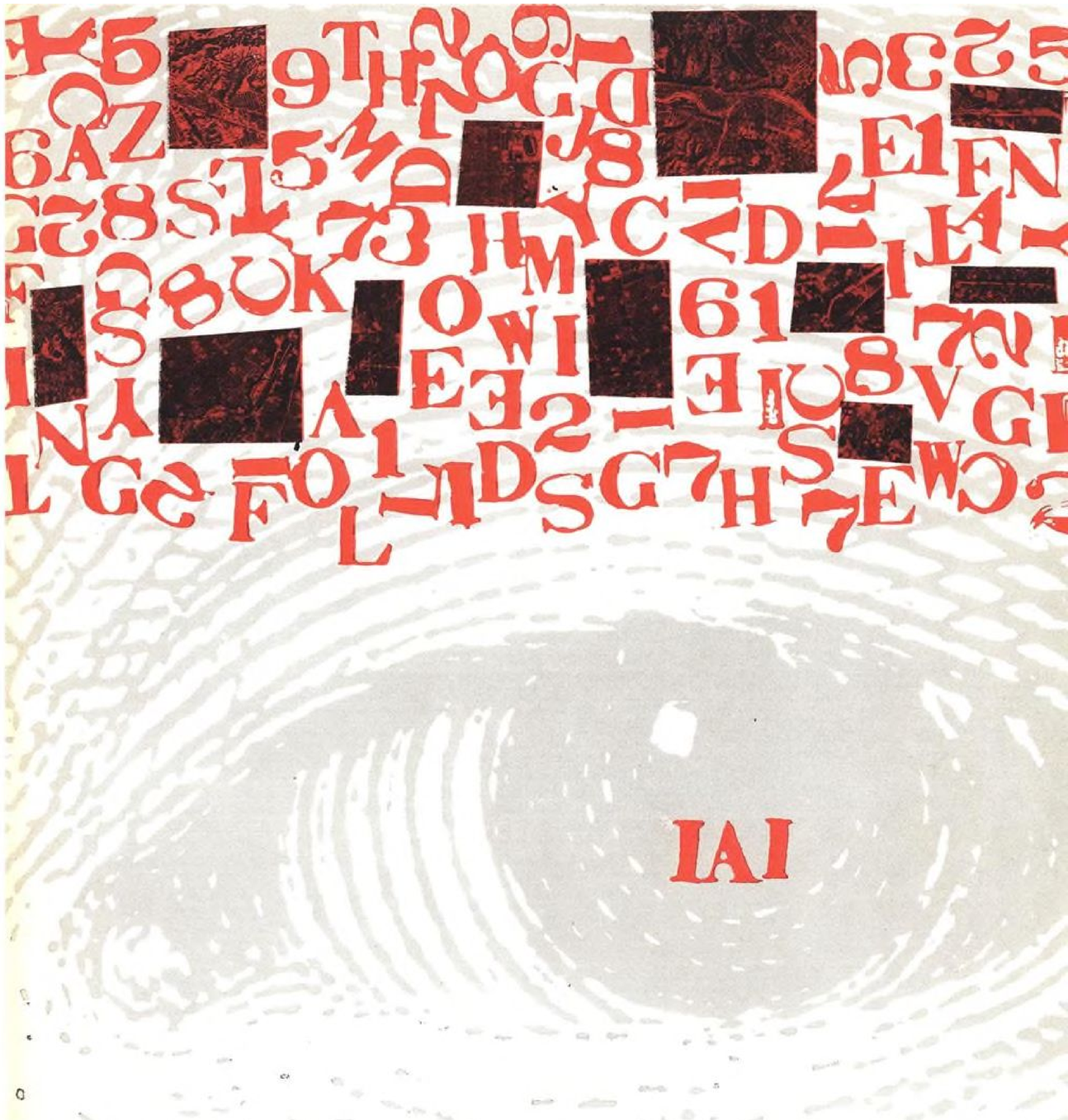
Universal Moulded Products Corp., Bristol, Va., contract FA-1039(1-3089), shelter, antenna, reinforced plastic, ARSR-1(radome), 55' diameter, complete including repair kit and maintenance equipment, in accordance with specification FAA-1298, 5 ea., spare parts as listed in contract, one lot, item identifications, 50 ea. in accordance with specification FAA-G-1210a, $103,-616.

Plastoid Corp., Hamburg, N. J., contract FA-1043(1-3016), cable, coaxial, RG-8A/U and RG-13A/U in accordance with specification MIL-C-17c, in continuous lengths (no splices) of 2,000 ft. per reel, 410.0 MFT, returnable reels, 205 ea., $36,007.

Superior Cable Corp., Hickory, N. C., contract FA-1044(3016) cable, coaxial, RG-17A/N in accordance with specification MIL-C-17c, continuous lengths (no splices) of 1,000 ft. per reel, 175.0 MFT, $46,350.

L. G. DeFelice and Son, Inc., North Haven, Conn., contract FA-1051(3111) services, furnishing all labor, equipment and materials to perform all work for grading, drainage, structures and paving for approximately 5.5 mi. of four-lane divided highway, all in connection with development of the Dulles International Airport, Va., estimated sum, $4,335,118.

Polarad Electronics Corp., Long Island City, N. Y., contract FA-1046(1-1091), synchroscope, spectrum analyzer, "L" band in accordance with contract, 23 ea., instruction books, identical to and in addition to those furnished under item 1, 10 ea., open channel instrument dolly, for mounting of item 1, 23 ea., prepare and furnish replaceable parts list for items 1 and 3, 1 list, item identifications for replaceable parts in items 1 and 3, estimated quantity, 100 ea., estimated cost, $110,184.



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CAB Accident Investigation Report:

Weather May Have Caused B-26 Crash

A Martin B-26C, N 1502, owned and operated by the Continental Can Company, Inc., crashed near Marion, Ohio, July 1, 1959, about 1752. All occupants, company pilots John R. Dunham and Donald Martin and eight company executives, were killed.

The purpose of this flight was to transport the executives from Midway Airport, Chicago, Ill., to Baltimore, Md. Departure from Midway was at 1645.

When the flight was near Marion, Ohio, and shortly after it had traversed an area of pronounced thunderstorm activity, it dived violently and nearly vertically to the ground. Destruction was of such extent that it could not be determined if a structural failure occurred in flight and consequently the probable cause of this accident could not be established.

INVESTIGATION

Pilot Dunham filed an IFR flight plan for the proposed flight as follows: "Midway Airport to Baltimore via Peotone, V 144, V 44, estimated departure time 1630[1], requesting 9,000 ft., proposing 225 kt. TAS, with 2:30 hr. ETE, and 5:30 hr. of fuel on board.

Personnel of the Weather Bureau office at Midway Airport were busy during the afternoon of July 1 and cannot state definitely that they briefed the crew of this particular flight prior to departure. However, knowing the normal practices of Continental Can Company crews, they believe that a weather briefing was supplied to this crew. All eastbound briefings that afternoon called attention to the extensiveness and frequency of severe thunderstorm activity expected. Attention was drawn to all pertinent forecasts and flash advisories available. The B-26C aircraft used on this flight was equipped with weather radar, which was operable as far as can be determined.

N 1502 departed Midway Airport, Chicago, Ill., at 1644. Taxi, takeoff, and climbout, as recalled by tower operators on duty, were routine in all respects. N 1502 was issued a clearance from Midway to the Baltimore Airport via Peotone, V 144, V 44, to maintain 5,000 ft.

Normal radar hand-off was effected between Midway Tower and Chicago Center. The center radar controller subsequently cleared N 1502 to climb to and maintain 9,000 ft. A position report was made over Peotone at 1655, estimating Ft. Wayne at 1725. At this time the flight was cleared from the Chicago departure control frequency to the Goshen peripheral frequency. N 1502 reported over Ft. Wayne at 1724 at 9,000 ft. and estimated arrival time at Findlay at 1740 and was advised to contact Cleveland Center on 125.8 mc.

[1] All times herein are Eastern Daylight, unless otherwise indicated, and based on the 24-hr. clock.

Upon contacting Cleveland Center at 1733, N 1502 gave its position as over Ft. Wayne at 1724, at 9,000 ft., estimating Findlay omni at 1740, with Appleton omni as the next checkpoint. The controller gave the Findlay altimeter setting as 29.87. The center's records indicate that the flight reported over Findlay omni at 1739, at 9,000 ft., estimating Appleton omni at 1754, with Zanesville omni as the next checkpoint. At this time N 1502 was advised to contact Indianapolis Center on 125.4 mc.

At approximately 1740, N 1502 contacted Indianapolis Center and gave the following position report: "1502 checked Findlay at 39, at nine thousand, estimating Appleton at 56, Zanesville, go ahead." Indianapolis Center acknowledged the position report and gave the Columbus altimeter at 29.92. N 1502 acknowledged; this was its last transmission; none of the radio contacts suggested any difficulty.

At 1752, N 1502 was observed by people on the ground to enter a near-vertical dive and crash at a point about three miles south-southeast of the Marion, Ohio, Airport. The crash site is about 15 mi. to one side of the flight's planned course and the crash occurred a few minutes after the aircraft should have traversed the area.

An estimated 80 persons were contacted regarding their reported observations of N 1502 prior to the crash and 19 supplied witness statements to investigators. In consensus, these statements indicate the following:

N 1502 was first observed flying over the Marion Municipal Airport on a south-southeast heading at about 4,000 ft. altitude. (How and why the aircraft descended from 9,000 ft. is not known.) It was next seen over the U. S. Army Engineer Depot, Marion, Ohio, still on a south-southeast heading. The next positive observance of the aircraft was when it was turning from an easterly heading to the north. At this time the aircraft was observed to make a "short" climb and then continue the turn to a northerly heading. The aircraft maintained this northerly heading and was shortly seen to enter a dive, described as vertical. At the start of the dive the aircraft was at an altitude of approximately 4,000 ft.

Witness descriptions of the sound created by the powerplants indicate that the maximum or near maximum power was being developed by both engines throughout that portion of the flight when the aircraft altered heading from the south-southeast to the north. N 1502, gaining altitude throughout the turn, continued to climb after reaching the northerly heading. At this point power noise became less and the aircraft was observed to enter the reported vertical dive with power again applied, at or near maximum, continuing until impact.

According to local persons the weather at the time of the accident was substantially as follows:

A thunderstorm had passed through the Marion, Ohio, area an estimated 30 min. prior to the crash. Light rain was falling at the time with light winds reported. The ceiling was estimated as 1,500 ft. to 4,500 ft. There were no reports of lightning or thunder in the area at the time of the crash.

Radar observations made by the Weather Bureau at Columbus, Ohio, and Canton-Akron, Ohio, at 1700 showed a 10-mi. wide belt of thunderstorms running generally from northeast to southwest just west of Marion, Ohio. Findlay, Ohio, about 35 mi. northwest of Marion, had thunderstorms and rain shower activity at this time. A surface barometric pressure jump of .05 in. occurred at Findlay at 1318 during the passage of a thunderstorm.

Severe Weather Warning

A severe weather warning was issued at 1140 July 1 by the Weather Bureau's Severe Local Storm office at Kansas City. The text of this warning was as follows:

"Line thunderstorms at 1200E from northeastern Indiana southward to western Kentucky and western Tennessee expected to move eastward about 25 kt. intensifying during afternoon. Northern portion line more active with a few severe thunderstorms with ½ to ¾ isolated one inch hail aloft isolated extreme turbulence and surface wind gusts to 50 kt. isolated 60 kt. expected in area 60 mi. either side of a line from 30 mi. northwest of Dayton, Ohio, to 25 mi. north Bradford, Pa. Valid 1300E to 2100E. Isolated heavy thunderstorms expected southward along line through southern Ohio central Kentucky and western and central Tennessee as this line moves eastward during afternoon and early evening . . ."

An amendment to this warning was issued at 1225 and read as follows:

"Revise severe limits to read ½ to ¾ isolated one inch hail surface and aloft isolated extreme turbulence and surface wind gusts to 55 kt. isolated 65 kt. valid 1330E and 2100E. Pub Fcst Issued. . . ."

The aviation area forecast issued by the Weather Bureau at Chicago at 1252 read in part as follows:

"Deepening surface low over northern Lake Michigan with cold front southward across extreme western lower Michigan—Goshen, Ind., with front continuing eastward at 20 kt. for next 12 hr. A squall line NNE-SSW across extreme northeastern Indiana with occasional ceiling 1,500 ft., sky obscured, visibility two miles, thunderstorm, rainshowers, gusts to 50 kt. moving out of northeastern Indiana by 1400C to 1600C."

The Weather Bureau forecast office at Cincinnati issued the following flash advisory at 1542:

"Cold front at 1700E, 50 mi. SE of Ft. Wayne to near Paducah moving eastward 15-20 kt. with series of squall lines east of front through southern and central Ohio, northern Kentucky, northwest West Virginia. Locally precipitation ceiling 500 ft. sky obscured, visibility ½ mi. thunderstorm heavy rain shower in front and squall lines with severe turbulence and hail. Valid until 2100E."

FAA procedures, at the time, did not require transmission of the above severe weather information to the flight on ground initiative. However, any or all of it could and would have been given to the flight on request. No such request was made.

The aircraft hit almost vertically on a heading of about 013 deg. There was some evidence of a very brief flash fire after impact. The speed at impact was extremely high, as evidenced by the heavy portions of the aircraft imbedding themselves some eight feet in hard clay. The resulting destruction was so explosive-like that a high degree of disintegration occurred with widespread destruction of the airframe and of the powerplants. All major components of the aircraft were found at the crash site indicating that there had been no inflight loss or separation of parts. There was no physical evidence of structural failure in flight nor of control failure nor of powerplant failure, although investigation for these possibilities was thorough.

Examination of the maintenance history and records of this aircraft indicated that maintenance had been satisfactory and in full conformance with Civil Air Regulations; no significant entries were found.

Aircraft History

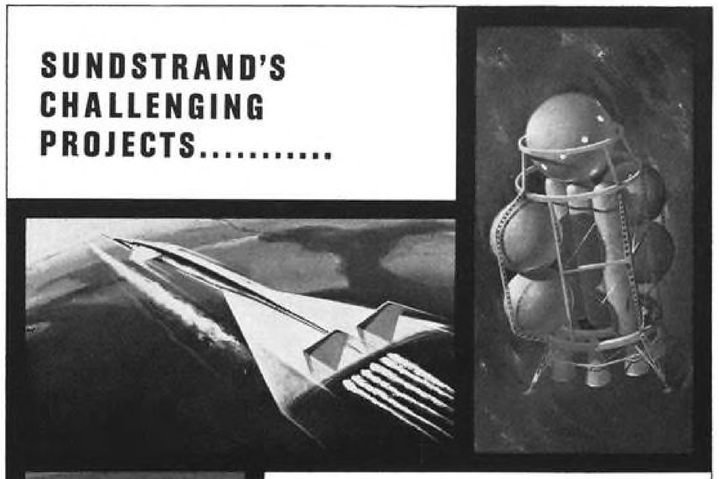
N 1502, a Martin B-26C, was manufactured on Dec. 23, 1943, and delivered to the U. S. Navy on Jan. 6, 1944. The airplane was bought from surplus by a private individual in Honduras, Central America, and sold to the Honduran Government. It was subsequently purchased from the Honduran government by Continental Can Company and delivered to Air Research Manufacturing Co. of Los Angeles, Calif., for modification and conversion to an executive-type transport. The airplane was granted a type certificate and licensed under the provisions of a waiver of Part 9 of the Civil Air Regulations, adopted by the Civil Aeronautics Board on June 17, 1953, as Order No. S-574.

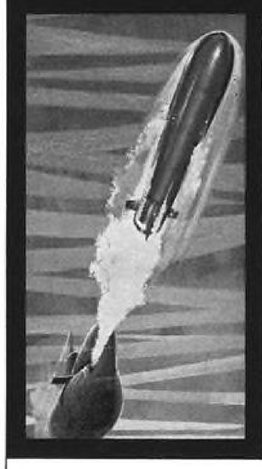
At the time of delivery of the airplane to Air Research for conversion it had accumulated a total of 371:15 flying hours. At the time of the accident it had accumulated a total of 2,967:15 flying hours, and a time since overhaul of 2,596:00 flying hours. The flying time since the last regular (quarterly) inspection was 76 hr. and 50 min.

The engines were Pratt & Whitney Model R-2800-CB16. All prescribed periodic maintenance had been complied with. The left engine had a total of 1,706 hr., with 645 hr. since overhaul; the right had a total of 1,579 hr., with 534 hr. since overhaul. Propellers were Hamilton Standard Model 43E60 with 6895-A-8 blades. Their maintenance was current and overhaul of all blades had been within prescribed limits.

Capt. John R. Dunham, age 41, had

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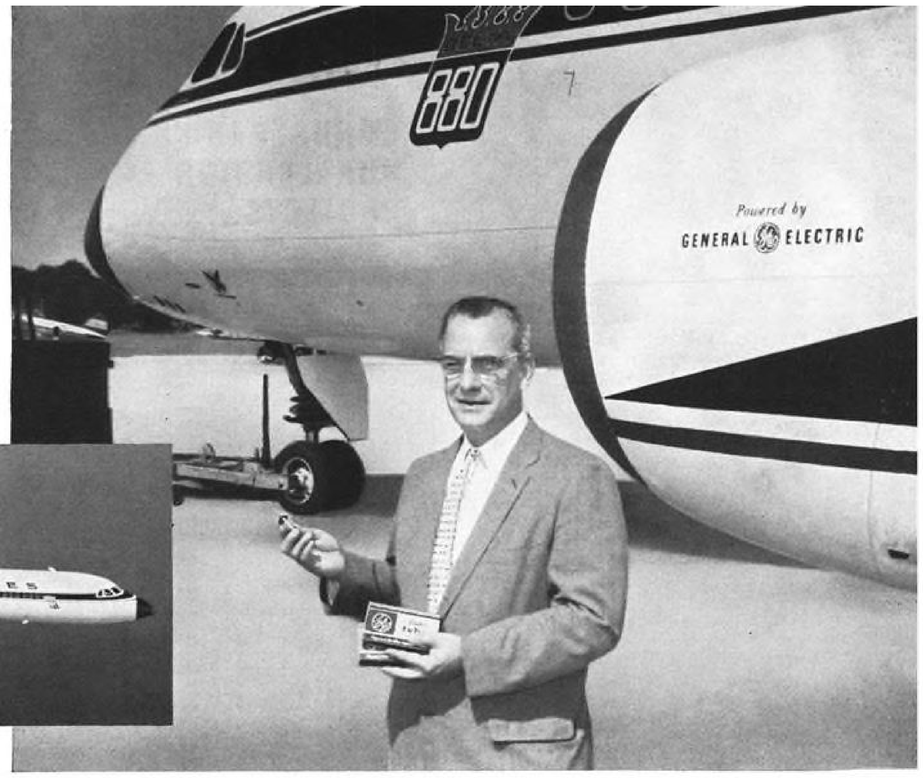
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a total flying time of 10,577 hr., of which 805 hr. had been in B-26s. He had flown 51 hr. during the 30 days preceding the accident and had had a rest period of 19 hr. and 45 min. before the final takeoff. Mr. Dunham had been employed by Continental Can Company since January 1952 and held all FAA certificates appropriate for the flight.

Copilot Donald Martin, age 40, had a total flying time of 3,766 hr., of which 1,728 hr. had been in B-26s. He had flown 55 hr. during the 30 days preceding the accident and his rest period before the final flight was 19 hr. and 45 min. Mr. Martin had been employed by Continental Can since July 1950, and held all FAA certification for the flight.

ANALYSIS AND CONCLUSIONS

It is apparent that there must have been control difficulty of an undetermined nature. This may have been the breakage of a structural member or possibly a deformation or bending of a part, precipitating the dive. It also seems logical that this had its inception while the flight was in severe turbulence only a few minutes earlier. It is not possible to do more than surmise as to the genesis of the trouble, because a considerable number of initial malfunctionings could have resulted in the aircraft's turn and final plunge. The physical evidence recovered did not reveal the nature of the trouble. The nature of the aircraft's maneuvers prior to the final dive, and their proximity to the Marion Airport, may suggest an intent to land there; there is no tangible evidence of this.

It appears probable that the aircraft's speed was reduced during the thunderstorm activity; this would account for the time of the crash being a few minutes after the aircraft should have passed the vicinity. Being some 15 mi. to one side of the planned course may well have been an attempt to avoid the worst of the weather as indicated by airborne radar. There is no explanation as to why this much deviation from the airway was not reported; possibly it was because of stress.

Pilot competence, as indicated by company and other records, appears to have been of high quality. Both pilots were well experienced generally and specifically on this particular model aircraft.

This and other seemingly similar air disasters have led the Board to initiate a series of conferences with other government agencies and with industry to better both the currency and accuracy of flash advisories (weather) and to impress their importance on the flying public. These conferences are now in the exploratory stage and are aimed at the development of new procedures designed to assure the reception of severe weather bulletins by those flights which could come within influence of the severe weather. By the CAB.

PROBABLE CAUSE

The Board is unable to determine the probable cause of this accident. However, circumstances suggest control difficulty of an undetermined nature during passage through an active developing line of thunderstorms.

Whitney Gillilland
Chairman

Chan Gurney
Vice Chairman

G. Joseph Minetti
Member

Alan S. Boyd
Member

J. S. Bragdon
Member

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident very shortly after occurrence. Board investigators were immediately dispatched to the crash site. Thereafter, an investigation was initiated and conducted in accordance with the provisions of Title VII of the Federal Aviation Act of 1958. In connection with the Board's investigation of the accident depositions were taken at Morristown, N. J., on July 27, 1959, at Chicago, Ill., on Aug. 6, 1959, and at Marion, Ohio, on Aug. 7, 1959.

Continental Can Company, Inc., is a New York corporation with headquarters at 100 East 42nd Street, New York, N. Y. At the time of this accident it owned and operated six aircraft, including N 1502, and employed 13 pilots, copilots, and flight engineers.

CAB Resumes Search For DC-7B Wreckage

Washington — Civil Aeronautics Board has resumed its search for wreckage of a National Airlines DC-7B which crashed in the Gulf of Mexico last year, using new electronic underwater search devices.

Previous efforts to locate the transport have been unsuccessful, although the general location of the wreckage is known. The Board said its Bureau of Safety could not continue to search for the cause of the National aircraft crash with the meager amounts of floating debris found and that it needs to recover more wreckage for examination.

The Board has signed an agreement with Marine Geophysical Services, Inc., of Houston and Alpine Geophysical Associates, Inc., of Norwood, N. J., who have special equipment and knowledge of underwater search and recovery techniques. The expedition is using a 145 ft. converted minesweeper and is accompanied by Texas A.&M. scientists.

The search will be guided by a remote navigational system, Raydist, which is accurate within 20 ft. on 10 mi. search runs and within 200 ft. on 50 mi. runs. Also being used are: a continuous strategication profiler, which shows depth of water, sea-bed profile and layers of sediment on the bottom; a precision depth recorder and a survey echo finder. A magnetic gradiometer, which detects metal within 50 to 100 ft., will be used to locate the aircraft parts. Identification of any contacts made at the bottom will be made with an underwater camera.



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WHO'S WHERE

(Continued from page 23)

Honors and Elections

Col. Carroll H. Dunn, Corps of Engineers Ballistic Missile Construction Office, Air Force missile complex, Inglewood, Calif., has been awarded the Air Force Commendation Medal for "his distinguished work in constructing a Ballistic Missile Early Warning Site at Thule, Greenland."

H. W. Haynes, vice president for finance and controller of Boeing Airplane Co., has been elected 1961 chairman of the Procurement and Finance Committee of the Aerospace Industries Assn. Elected vice chairmen of the committee: **D. P. Murray** vice president for contract administration of McDonnell Aircraft Corp.; **Robert V. Faragher**, counsel for Radio Corporation of America.

Changes

B. A. Erickson has been promoted to special assignment in the office of the assistant manager for operations, Convair-Ft. Worth Division of General Dynamics Corp., Ft. Worth, Tex. **Richard Johnson** succeeds Mr. Erickson as manager of the flight department.

John F. Cooney, manager of central services, Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., succeeding **Arthur C. Haines**, now manager of design, fabrication and field service, Aeronutronic's Space Systems Operations. Also: **Robert B. Katkov**, manager of tactical missile systems, Aeronutronic's Weapon Systems Operations.

Benjamin G. Walker, manager of the newly established Space Systems Operation (Santa Barbara, Calif.) of General Electric Co.'s Defense Systems Department.

Lewis C. Bohn, an authority on international control of armaments, has joined the Systems Research Center of Lockheed Electronics Co., Plainfield, N. J.

Robert H. Hadfield, director of marketing, Raymond Atchley, Inc., Los Angeles, Calif., a division of American Brake Shoe Co.

John P. Butterfield, executive engineer on the corporate staff of The Martin Co., Baltimore, Md.

J. L. Bromberg, director of programs-defense programs, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Friedrich L. von Doblhoff, corporate director of engineering-Europe, Boeing Airplane Co., with offices in Bad Godesberg, Germany.

Douglas Haynes, production manager, Clarostat Mfg. Co., Inc., Dover, N. H.

Robert H. Packard, chief engineer, Power Sources, Inc., Burlington, Mass.

R. V. D. Campbell, director of research, Burroughs Corp., Detroit, Mich. Also: **Dr. Charles Register**, general manager of Burroughs' research laboratories, Paoli, Pa. **Russell A. Lampman** succeeds Dr. Register as manager, of the ALRI (airborne long range input) Division.

Louis J. Newby, manager-field sales, Jack & Heintz, Inc., Cleveland, Ohio.

John Wright, Jr., merchandise manager-special products, Kaylock Division, Kaynar Mfg. Co., Los Angeles, Calif.

Dr. C. M. Wolfe, head of transducer engineering, Borg-Warner Controls, Santa Ana, Calif.

Dr. Ernest Mayer, has joined the senior staff of National Engineering Science Co., Pasadena, Calif.

Marion Maxfield, manager of commercial programs, Vertol Division of Boeing Airplane Co., Morton, Pa., succeeding **Kenneth Hemberger**, now appointed to the License Administration Department.

Charles L. Spencer, special engineering adviser for systems evaluation, Developmental Engineering Corp., Washington, D. C.

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PUBLISHED BY THE FLIGHT PROPULSION DIVISION OF GENERAL ELECTRIC IN CINCINNATI, OHIO / **NOVEMBER, 1960**

FPD NEWS offers latest information on openings throughout the Division to interested engineers and scientists. Technical information and news relating to current projects will also appear from time to time in this column.

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LETTERS

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.

Airline Bright Spot

With reference to your editorial "Pity the Poor Passenger" in the Oct. 3 AVIATION WEEK, the ticket counter bottleneck you describe sounds all too familiar to anyone who travels by air. However, there are a few bright spots showing through the clouds, such as Pacific Southwest Airlines.

PSA has been quietly going about the business of providing quick, frequent, and economical scheduled flights between San Diego, Los Angeles, and San Francisco with but scant, if any, recognition in AVIATION WEEK. I never see them mentioned in your tabulation of Airline Income & Expenses, or in your Airline Observer column. Yet, it has been my experience and the experience of many others, who have occasion to travel up and down the West Coast, that we get better treatment and more efficient service on PSA than we have come to expect from the major airlines.

D. K. WARNER
Pacific Palisades, Calif.

(AVIATION WEEK *refers Mr. Warner to its Air Transport story in the Nov. 30, 1959, issue, p. 38.—Ed.*)

Aerial Cameras

Re: "Aerial Cameras" letter, AW Sept. 19, p. 182.

It is unfortunate that this discussion with Mr. Dunn has to be prolonged but in his two letters he has apparently wandered off the track and attempted to create false impressions. The following are the facts of the case.

Fact #1: Although a small quantity of KA-30s has been produced, the point is that this new camera, only now becoming operational, has inferior shutter performance to the Fairchild KA-2 which has been in service since 1954. The confusion here, which Mr. Dunn makes no attempt to clarify, is caused by the difference in the manner of specifying shutter speeds. The figures given in the KA-30 specification are Effective Speeds, whereas those given in the KA-2 specification are Total Open Times. The Effective Speeds of the Fairchild shutters in the KA-2 are about double the figures in the specification.

To get them both on a comparable basis then, the Effective Speeds of the 6" focal length KA-2 camera that photographed the dam (see original article AVIATION WEEK June 13, p. 54) is about 1/850 second. The Effective Speed of the 6" KA-30 is stated as 1/400 second. The true motion stopping performance (total open times) will be very nearly in the same ratio as these effective speeds; better than two to one in favor of the KA-2. And to cover the same area, two KA-30s would be needed, giving four times the number of photos to be handled, processed, viewed, printed, etc. with correspondingly more facilities and time involved. If the 3" focal length KA-30 is used, the speeds are somewhat better (1/800) though still inferior to the KA-2 and, in addition, the photos require enlarging to produce the same scale—a process that invariably loses some resolution and also requires additional time.

Fact #2: "IMC (image motion compensation) is of little value in high oblique photography." Mr. Dunn's illustration is selected to favor the advantages of IMC. Actually the 12 in. KA-2 is used at a depression angle of 15°, not 30°, in the RF-101.

One must, however, also consider cases such as the 6" camera with 9" x 9" format set at depression angle of 30° that took the photo of the dam (the photo that started this discussion). Here the variation of image motion from top to bottom of the photo, assuming a top useful angle of 5° below the horizon, is 12 to 1. The writer does not agree that upper portions of oblique photos are valueless—a look at the photo (AW June 13) shows that the 20° below horizon level suggested by Mr. Dunn includes very little more than the upper edge of the dam itself. However, with these modifications, Mr. Dunn's analysis serves to prove the point very well—IMC is indeed of little value. Perhaps he would like it better rephrased (so as not to create any false impression) as: IMC is of some value—but is not a cure-all.

Fact #3: Regarding Mr. Dunn's original inference that the speed of the aircraft was limited by the reconnaissance equipment (AW July 4, p. 102) he apparently either did not read the original article by Mr. Anderton or chose to ignore it, as it clearly states (AW June 13, p. 59) that the pilot flew throttled down because of the turbulence. The cycling rate of the oblique KA-2 was not the limiting factor. The best thing to minimize image blur due to turbulence is again high shutter speed. Here IMC is of no value.

Fact #4: Faster lenses are definitely a virtue in an aerial camera and newer cameras certainly should have them. They are an advantage in minimizing image blur, however, only because they permit the use of higher shutter speeds. The fact is the higher lens speeds do not produce sharper pictures if the camera doesn't have the necessary shutter speeds. And the KA-30 doesn't have them.

Lastly, a brief comment on Mr. Dunn's last paragraph. He apparently tries to give the impression that Fairchild believes that the KA-2 is the camera for all time. A progressive organization such as Fairchild doesn't think that way. In time the KA-2 will be replaced by a better camera, a camera superior and not inferior in performance, just as the RF-101 will also inevitably be replaced in time by a better airplane.

A. G. NASH
Defense Products Division
Systems Management & Engineering Dept.
Fairchild Camera & Instrument Corp.
Syosset, N. Y.

Technical Coverage

This is the second time recently that I have had the pleasure of wanting to write a letter expressing appreciation of a very excellent editorial job by your staff.

The article by Barry Miller appearing in the Oct. 17 issue of AVIATION WEEK (p. 54), entitled "Lockheed Develops Titanium Components," is a real tribute to Barry's technical writing capability and has done a lot to improve our ego after reading it in print.

Over the last 15 years, I have never ceased to be impressed by the very high level of technical information contained in your magazine. Here at Lockheed Missiles and Space Division, AVIATION WEEK is considered the top source of information of this type.

Mr. W. D. Fuller, who is the manager of the Research Department in which this work has been done, and his immediate superior, Mr. W. F. Main, as well as Dr. J. P. Nash, director of research, join me in expressing our appreciation of this excellent article. Pete Staver also expressed his appreciation. Would you please pass these comments on to Mr. Barry Miller when you have the opportunity.

FRANK MANSUR, Manager
Research & Equipment Sales
Lockheed Aircraft Corp.
Missiles and Space Division
Sunnyvale, Calif.

Industry Competition?

Well, I see now that the Californians are trying to push us all another step farther into socialism—and they are doing it under the guise of supporting free competition.

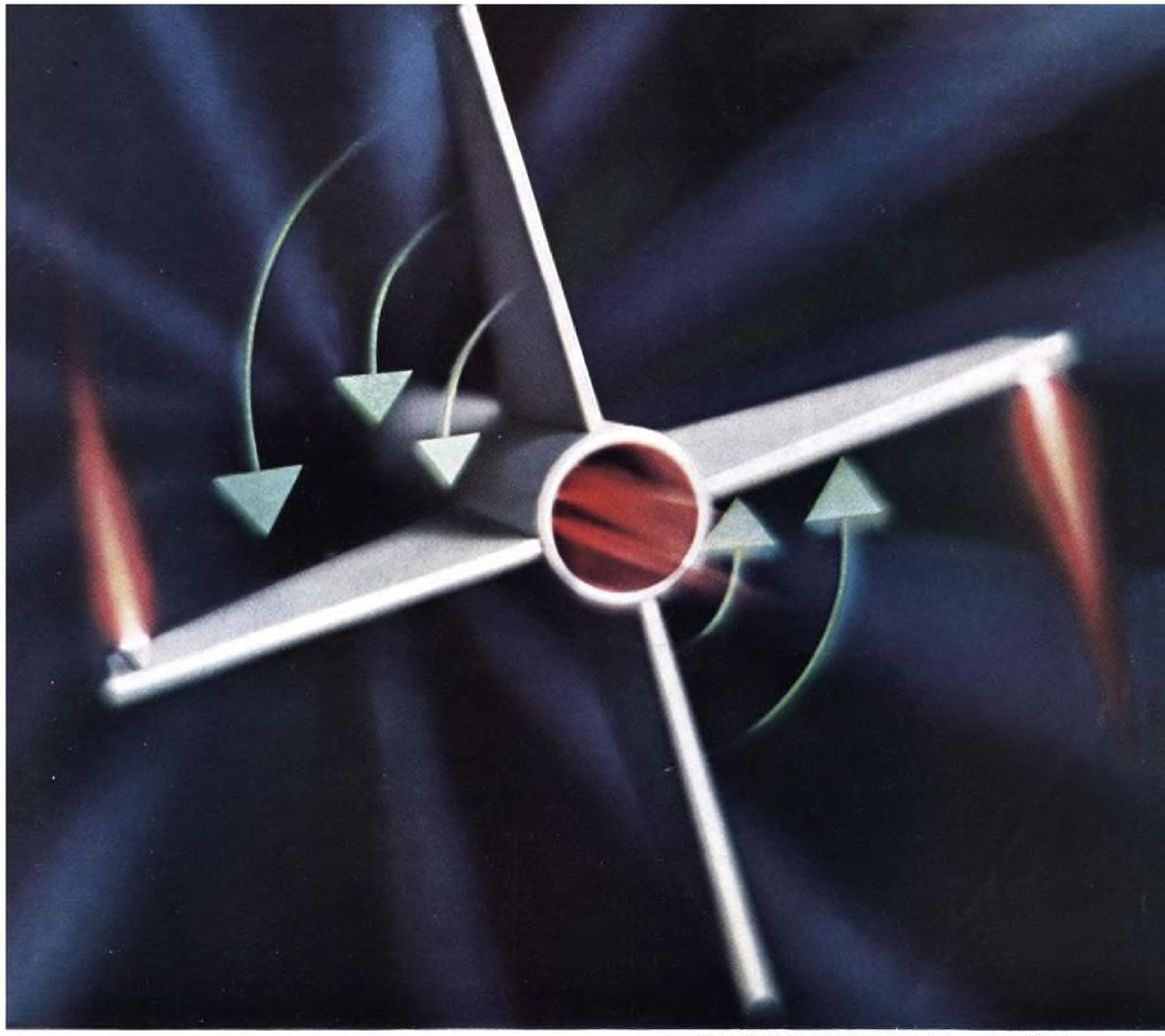
The "Washington Roundup," (AW Oct. 3, p. 25) points up current pressure on the White House and others to throw military jet transport ". . . business to Douglas-Long Beach in order to maintain industry competition . . . Boeing and Lockheed already have substantial military transport business and Douglas-Long Beach and its 18,000 employes should also be kept busy."

How ridiculous can our reasoning get? What sort of "industrial competition" is it that requires the government to shore up the lagging members? Is a hard luck story and the showing of red figures on the balance sheet the most effective way of getting orders for military airplanes—or any other government-purchased commodity?

We can't really blame the Californians for this current effort. They are merely following a pattern that has been previously set all too often. As a taxpayer I am interested in seeing my government's purchasing dollars spent where they will buy the most, not spent where some supplier needs them the most.

If one company can out-perform the others in providing the necessary military jet transports, let's buy from that company—but on the basis of performance, not because they "should also be kept busy."

JOSEPH H. ANDREWS
Omaha, Neb.



Reaction controls at work in space — symbolized.

STEERING GEAR FOR ASTRONAUTS

Conventional aircraft control surfaces will not guide space ships and capsules. Rudders, ailerons and elevators find no resistance and hence produce no reaction to their movements where there is no atmosphere. Even at altitudes only half way up, they are sluggishly ineffective.

The accepted answer to a dependable steering mechanism for astronauts is a system of jet reaction controls developed and produced by Bell Aerosystems Company. First used on Bell's own supersonic X-1B several years ago, the system has been greatly improved and adopted for the X-15, the Mercury man-in-space project and other space vehicles.

Through strategically located, low and high thrust (1 to 1500 pound) rocket engines, Bell's reaction controls not only position and guide the ship by controlling the roll, pitch and yaw, but they also provide for orbit changes and retro-thrust. Some of the jets are throttleable while others can be operated in combination to provide the astronaut positive and flexible control.

This revolutionary steering gear for space, available using monopropellants or high energy bipropellants, is just one of many advanced projects which are currently engaging the diversified talents of Bell Aerosystems Company in the fields of rocketry, avionics and space techniques. Engineers and scientists seeking challenging, long-range career opportunities can find them at Bell.

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