Aviation Week & Space Technology

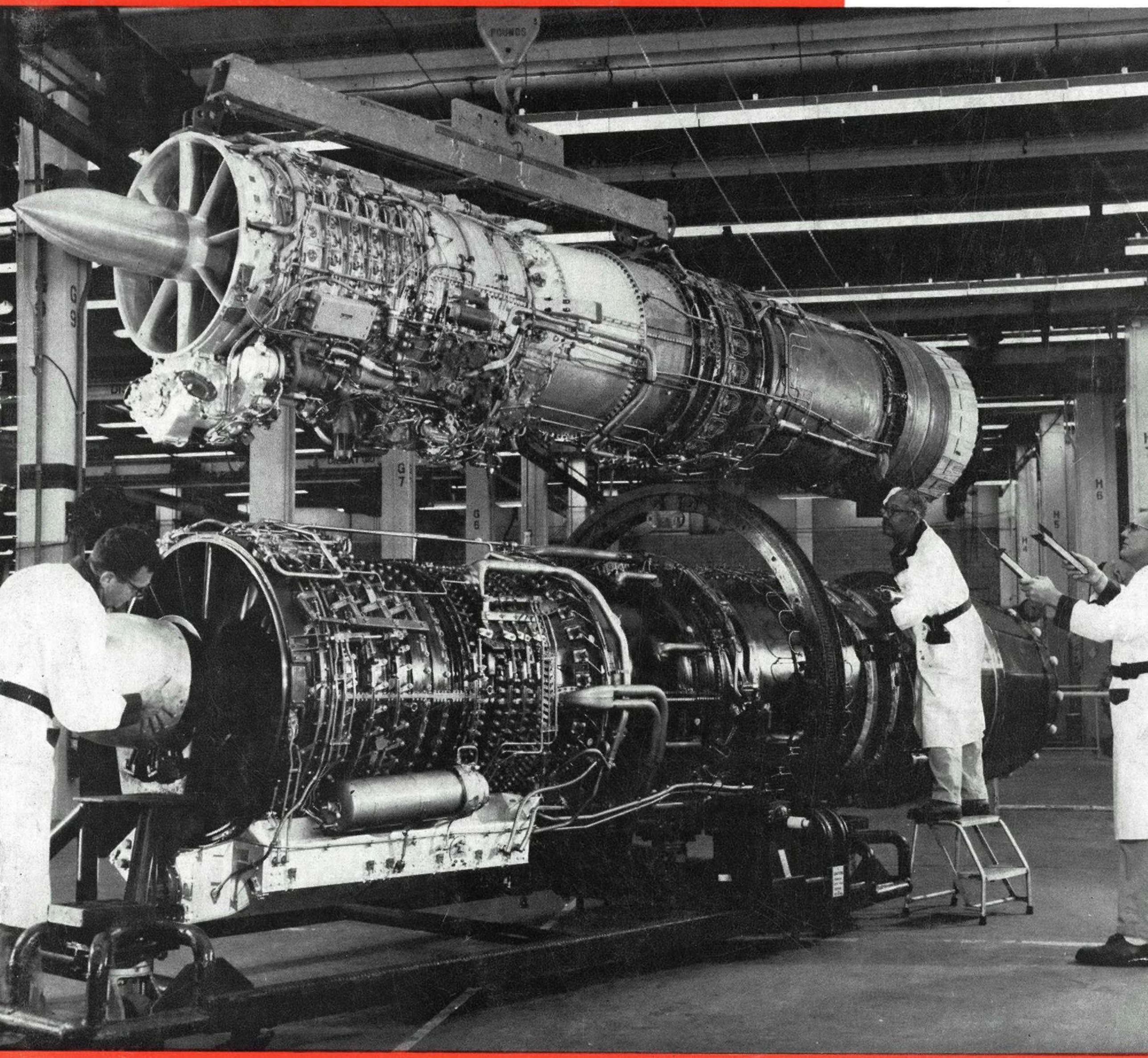
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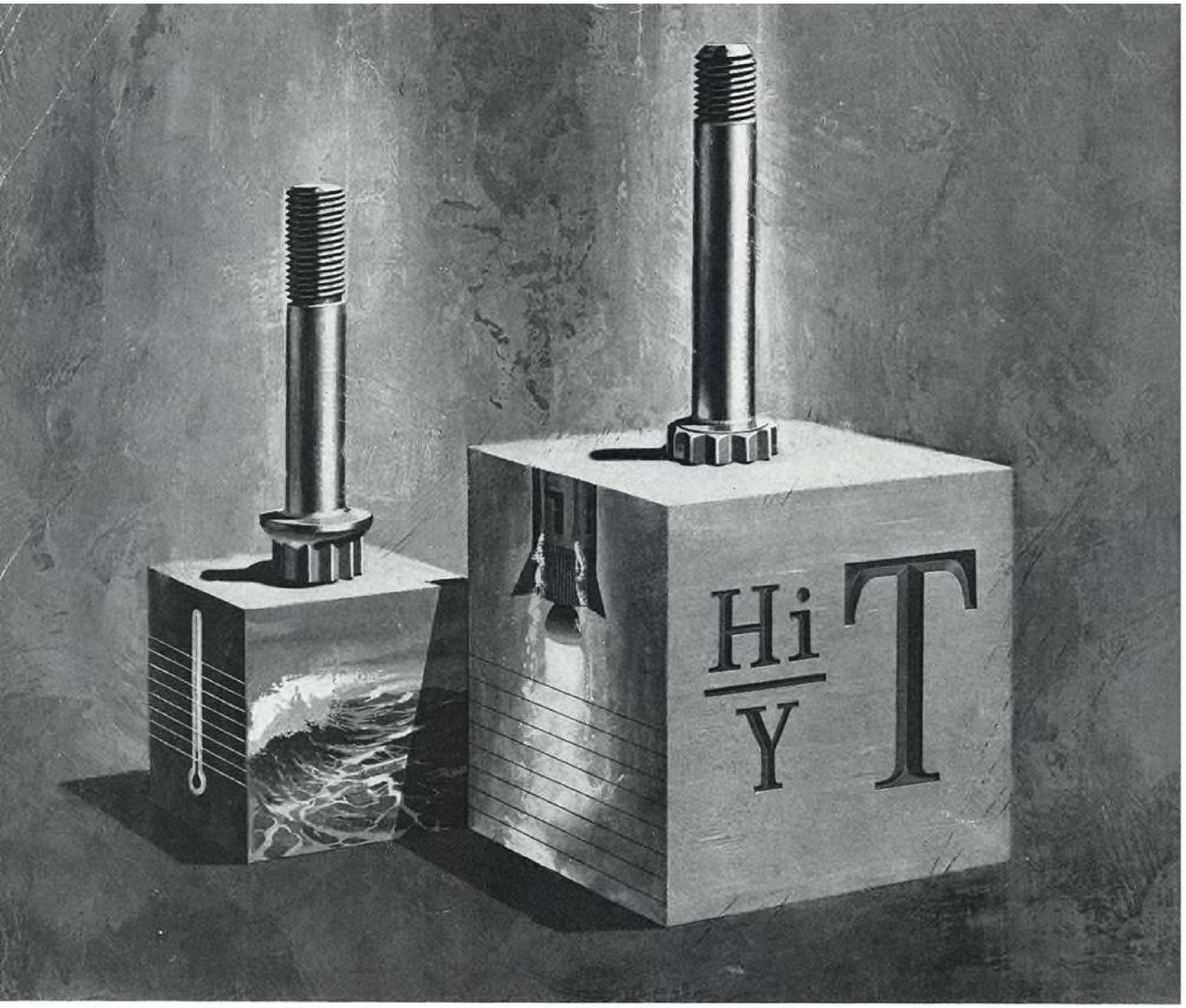
September 23, 1963

Afterburner Applied to Rocket System

GE's J79, J93 Turbojet Engines



Tighter Semiconductor Competition Looms



"Tensilized®" Bolts by Voi-Shan
160,000 PSI through 260,000 PSI

A-286—Waspaloy
Inconel 718—Udimet 700

The Voi-Shan Tensilized bolt family is the latest concept in aerospace bolt design. Super alloys, as listed above, undergo Voi-Shan's Tensilizing process to obtain the maximum ultimate tensile strength from each of them. An added advantage of these alloys is their $\frac{Hi}{Y}$ properties (significantly higher than the typical 80% yield-tensile ratio). The Tensilized family offers nut-bolt combinations in all conventional configurations through the 260 KSI uts level. Prime features of these bolts are their abilities to operate in the **CRYOGENIC** temperature range as well as the **HIGH** temperature range with maximum **CORROSION RESISTANCE.** The following table lists specifics for each of these materials:

ALLOY	TEMPERATURE RANGE	ROOM TEMPERATURE STRENGTH LEVEL (uts)
A-286	—423°F thru +1200°F	200,000 psi (Min.)
Udimet 700	—423°F thru +1600°F	240,000 psi (Min.)
Inconel 718	—423°F thru +1600°F	260,000 psi (Min.)
Waspaloy	—423°F thru +1600°F	260,000 psi (Min.)

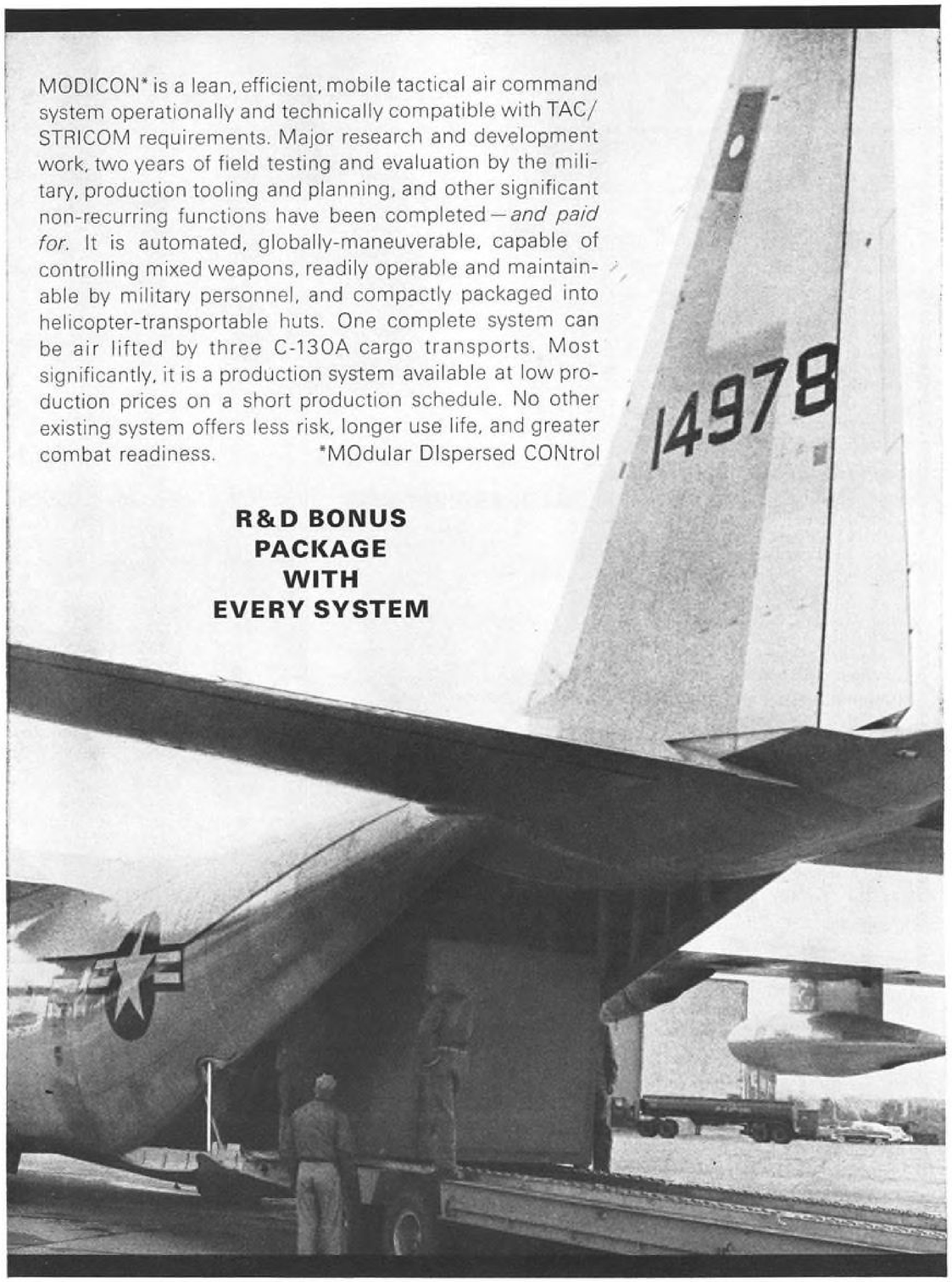
Detailed technical information on Voi-Shan's Tensilized bolt series and a wide variety of other aerospace fastening devices is readily available. Write on your company letterhead to:

VOI-SHAN MANUFACTURING COMPANY
A DIVISION OF VSI CORPORATION, **8463 Higuera Street, Culver City, California**

VSI

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LITTON INDUSTRIES DATA SYSTEMS DIVISION

POT-POURRI

(pō'poo-rē', pot-poor'i), **n.** [Fr.; a pot + *pourri*, pp. *pourrir;* transl. of Sp. *olla podrida*].

Published monthly by Giannini Controls Corporation: 1. In self-recognition of unusual Measurement & Control capabilities for Aerospace & Industry. 2. For painless, incremental reading. 3. To advance the theory that truth need not be dull.

GOOD OLD PRODUCT!



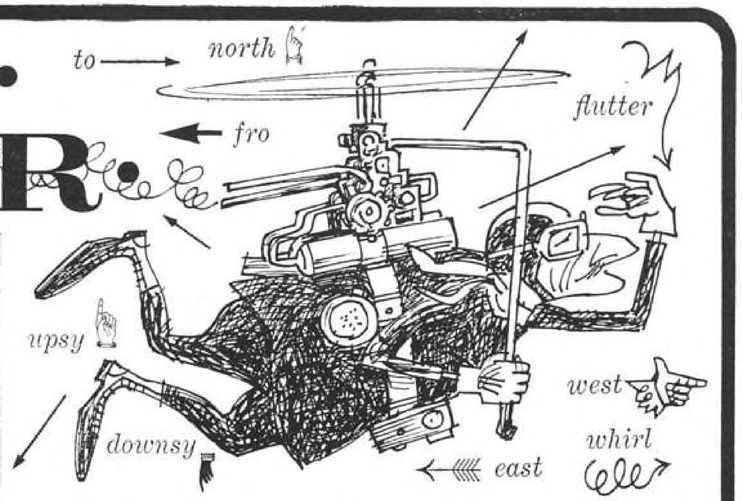
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Model 8620 precision rectilinear potentiometer has ball joint connection between 360° rotating shaft and wiper carrier to prevent alignment problems and eliminate critical assemblies. Stroke ranges to six inches are standard with resistance ranges from 2,000 to 40,000 ohms/inch of stroke. Meets NAS 710 and MIL-E-5272C environments. For complete specs, just tell us to whom and where.



(DON'T SAY YOU READ IT HERE)

Talk about secrets! We've been working on a project so secret, even the editors of Aviation Week don't know about it. And you should see the stuff we've come up with . . . it's a real technical tour de force. Too bad we can't share it with you; it's the sort of data you can really get involved with. Especially if you're interested in missile arming and fuzing techniques (OOPS).



GCC BUGS MOON MAN

Our friends at Ham.-Standard tell us each LEM "moonsuit" will be equipped with two GCC Model 451218 miniature pressure transducers. One of these 1" by 1" by 1" by 1-ounce sensors will be used for telemetering suit pressure data. The other, a switch output device, automatically warns the moon man to bug out when his suit pressure approaches the danger level. These "cubic inch" transducers have been thoroughly field tested as in-flight, surface mounted pressure pickups ...in missile and space vehicle telemetering...on re-entry vehicles... and wherever small, light, accurate pressure data sensors are required. For a spec sheet on the 451218, send us your name and company address.



BIG GCC DENVER SCORE PROMISED BY MARTINEZ

This is our year in Denver. According to our local Manager, Dick Martinez, last year's loss in the semi-finals will not be repeated. We think this is a swell idea for both GCC and Dick since we're traditionally an outfit that hates to lose. So, if you're a betting man, put your bucks on the GCC sponsored Denver Little Leaguers and hope that two-thirds of the team doesn't leave for camp *en masse* in a repeat of last year's performance.

True Air *Zig Zag Tack Twirl Skitter Crab & Skew* Speed

Nice thing about aircraft, from a TAS designer's point of view, is that they're generally unidirectional and relatively unconcerned with speeds below 100 MPH. Helicopters are birds of a different feather.

Our New Jersey Division has recently put a pile of effort into developing operational true air speed hardware to tell helicopter pilots how fast they're going. And since how fast they're going can be in any direction of the compass, irrespective of fuselage attitude, the design problem is a compound one.

The GCC answer to this dilemma gives readings for forward, reverse, port and starboard speeds (or any combination thereof). It's accurate right down to a few miles per hour. Modesty forbids further hyperbole. And budget forbids complete description here. But the following may whet your appetite: The GCC system is based on mounting pressure sensors in the rotor tips (where else on a helicopter can you get an accurate reading on free air stream conditions?) As you can no doubt appreciate, having the sensing end of a TAS system scribing full 360° circles several thousand times per minute on the end of a thin, hinged, pitch-controlled blade that gets wet-spaghettiish under flight loadings, can create some rather exotic compensation problems for an air data computer. It's the sort of problem you automatically send to GCC.

For complete details on our typically practical working hardware-type solution to helicopter true air speed measurement, send us your name, company and address.

Giannini Controls Corporation

1600 South Mountain Avenue, Duarte, California

AEROSPACE CALENDAR

Sept. 30-Oct. 1—Manned Interplanetary Exploration Meeting, American Institute of Aeronautics and Astronautics, Cabana Motor Hotel, Palo Alto, Calif.

Sept. 30-Oct. 2—Canadian Electronics Conference, Inst. of Electrical and Electronics Engrs., Exhibition Park, Toronto.

Oct. 1-2—Project Mercury Summary Conference, NASA Manned Spacecraft Center, Houston, Tex. (By invitation.)

Oct. 1-2—Defense Dept. Conference on the Use of PERT Costing Techniques, Rock Island, Ill.

Oct. 1-3—Eighth National Symposium on Space Electronics, Institute of Electrical and Electronics Engineers, Fontainbleu Hotel, Miami Beach, Fla.

Oct. 1-3—National Aerospace Nuclear Safety Topical Meeting, American Nuclear Society, Albuquerque, N. M. Co-sponsors: Los Alamos Scientific Laboratory; AEC Albuquerque Operations Office; AF Special Weapons Center; AF Directorate of Nuclear Safety; Sandia Corp.; University of New Mexico.

Oct. 1-3—Symposium on Physics and Nondestructive Testing (unclassified), San Antonio, Tex. Sponsored by Southwest Research Institute.

Oct. 1-4—First National Aerospace Nuclear Safety Topical Meeting, American Nuclear Society, Albuquerque, N. M.

Oct. 2-4—National Assn. of Air Traffic Specialists, Sheraton-Oklahoma Hotel, Oklahoma City, Okla.

(*Continued on page 7*)

AVIATION WEEK & Space Technology

September 23, 1963

Vol. 79, No. 13

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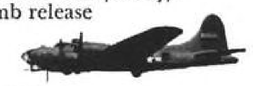
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1931 introduction of night airmail from New York to Chicago—birth of AGASTAT principle for airfield landing-light control.



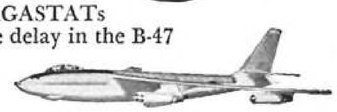
1942 B-17s and B-24s used AGASTAT time/delay/relays for control of the bomb release signal system.



1949 P-80, the first production jet fighter, relied on AGASTATs in the jet ignition system.



1954 hermetically-sealed AGASTATs provided a fixed time delay in the B-47 armament system.



1955 B-52 jet bombers employed AGASTAT time/delay/relays for controlling bomb bay door closure.



1957 Atlas ushered in the ICBM age with AGASTAT time/delay/relays both in the bird and ground control system.





TODAY'S solid state AGASTAT represents another important step forward in relay technology. This miniature time/delay/relay offers the reliability and accuracy essential for critical missile and computer use. 18-32 vdc; —55 to 125c. Delays from milliseconds to hours, on pull-in or drop-out. Base size —1⅛" sq.

ESNA pioneered the electrically-actuated pneumatically-timed relay in 1931, and today offers a full line of time/delay/relays—your guarantee of objective application engineering assistance. Write for information on these high-reliability units, or for a quotation on your specific requirements. Dept. S4-19.

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Thin coat tapes... *like having a quarter reel bonus in recording time!*

25% more tape to the reel! That explains how "SCOTCH" BRAND Thin Coat Heavy Duty Instrumentation Tapes extend recording time, conserve data storage space, permit more compact equipment for high frequency recording.

An .18-mil oxide coating (60% thinner than standard) reduces tape thickness, while polyester backings of normal thickness assure no loss in strength or change in physical properties. And the thinner coating, of high potency oxides provides closer head-to-tape conformity and improved high frequency resolution in the bargain.



Heavy duty oxide-binder formulation shrugs off heat as high as 225°F, minimizes rub-off to assure 15 times the life of ordinary tapes. Conductivity is 1000 times that of ordinary coatings, drains off dust-attracting static. Silicone lubrication protects against head wear, extends tape life. Choice of 7 thin coat heavy duty tapes meets all high frequency and short wavelength requirements.

TECHNICAL TALK Bulletin No. 1 provides helpful information on handling and storing instrumentation tapes. It discusses splicing, ways of minimizing dropout errors, precautions in handling and storing, and how to avoid tape distortion, accidental erasure, etc. Free. Write 3M Magnetic Products Division, Dept. MCJ-93, St. Paul 19, Minn.

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Magnetic Products Division 3M COMPANY

AEROSPACE CALENDAR

(*Continued from page 5*)

Oct. 3-4—Second National Symposium, Society for Information Display, Barbizon Plaza Hotel, New York, N. Y.

Oct. 5-20—10th International Aircraft Display, Genoa International Fair, Genoa, Italy.

Oct. 7—Second Annual USAF Contract Aerospace Services Symposium, Dayton Biltmore Hotel, Dayton, Ohio. Sponsor: National AeroSpace Services Assn.

Oct. 7-9—Ninth National Communications Symposium, Institute of Electrical and Electronics Engineers, Hotel Utica, Utica.

Oct. 7-11—International Air Transport Assn. 19th Annual General Meeting, Rome, Italy.

Oct. 7-14—William Tell 1963, USAF Interceptor Weapons Meet, Tyndall AFB, Fla. Host: Air Defense Command.

Oct. 8-10—10th Annual Air Force Science and Engineering Symposium, Air Force Academy, Colo. Sponsors: Office of Aerospace Research; AFSC.

Oct. 8-10—National Airport Conference, Norman, Okla. Sponsors: American Assn. of Airport Executives & University of Oklahoma with the cooperation of FAA.

Oct. 8-11—International Conference on Electromagnetic Relays, Tohoku University, Sendai, Japan.

Oct. 9-11—21st Annual Aerospace Electrical/Electronics Conference, Aerospace Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 10-11—National Engineering Conference, Lafayette Hotel, Long Beach, Calif. Sponsor: Professional Engineers in Industry.

Oct. 12-21—1963 General Conference, Federation Aeronautique Internationale, Mexico City.

Oct. 13-17—16th Annual Meeting and Conference, Airport Operators Council, Roosevelt Hotel, New Orleans, La.

Oct. 14-16—Eighth Annual Exposition and Symposium, Air Traffic Control Assn., Statler Hilton Hotel, Dallas, Tex.

Oct. 15-18—Eighth Symposium on Ballistic Missile and Space Technology, Naval Training Center, San Diego, Calif. Sponsors: AF Space Systems Div.; AF Ballistic Systems Div.; Aerospace Corp.

Oct. 16—Second Annual Technical Colloquium, Society of American Value Engineers, Airport Marina Hotel, Los Angeles.

Oct. 16-18—Tenth National Vacuum Symposium, American Vacuum Society, Statler Hilton Hotel, Boston, Mass.

Oct. 17—Fourth Annual One Day Technical Symposium on Information Processing in the Nation's Capital, University of Maryland, College Park, Md.

Oct. 17-18; Oct. 21-22—Ninth Anglo-American Conference, American Institute of Aeronautics and Astronautics-Canadian Aeronautics and Space Institute-Royal Aeronautical Society. Massachusetts Institute of Technology, Cambridge, Mass. (Oct. 17-18). Queen Elizabeth Hotel, Montreal, Canada (Oct. 21-22).

Oct. 21-23—Tenth Annual East Coast Conference on Aerospace and Navigational Electronics, Institute of Electrical and Electronics Engineers, Emerson Hotel, Baltimore, Md.

(*Continued on page 9*)

WHICH OSCILLOSCOPE?

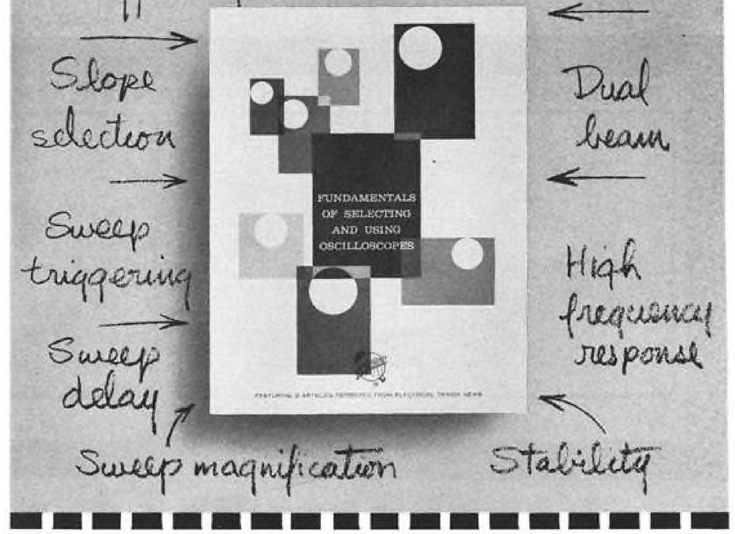
Choosing the *right* oscilloscope to help solve a measurement problem is sometimes confusing. The choice seems so large. For example, Tektronix offers over fifty different types.

The choice of an oscilloscope narrows considerably, however, once the application is known. Determining the *type* which best suits the application then becomes a matter of understanding the various features of the oscilloscope.

To help you better understand oscilloscope features, Tektronix offers you a free booklet. The booklet, FUNDAMENTALS OF SELECTING AND USING OSCILLOSCOPES, can be an invaluable aid in furthering your knowledge of oscilloscopes and in learning more about how these precision tools might help you in your studies of changing phenomena. Also, in addition to explaining oscilloscope features, this informative 16-page booklet designates differences in oscilloscope types and describes factors affecting validity of waveform displays.

For your copy of the booklet, please write to Tektronix or use the coupon below.

SOME OSCILLOSCOPE TERMS AND TECHNIQUES EXPLAINED IN THIS FREE BOOKLET



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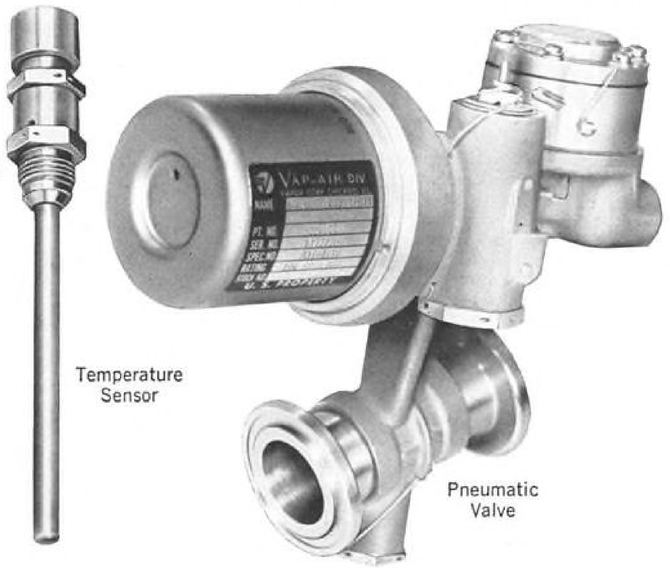
VĀP-AIR PNEUMATIC TEMPERATURE CONTROL SYSTEM

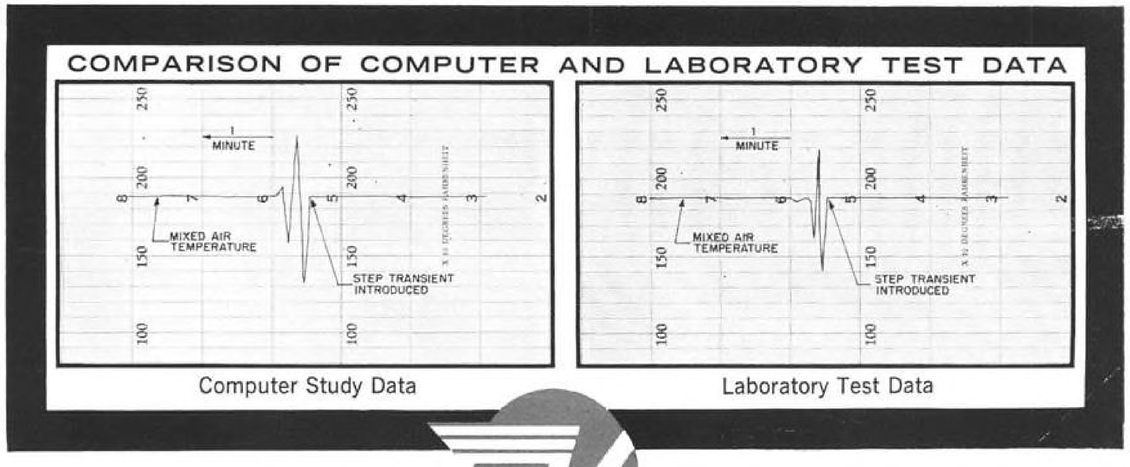
for high performance aircraft

Vap-Air's completely pneumatic temperature control system for high performance aircraft offers many advantages over electro-mechanical systems for controlling air flow in such applications as primary heat exchangers, windshield de-fogging, canopy de-fogging, rain removal, anti-icing and others.

Advantages include:

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- Lower cost
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COMPLETE ENVIRONMENTAL FACILITIES

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*(500 PSIG and 1200 F°)

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VĀP-AIR®

Division

VAPOR CORPORATION

80 East Jackson Blvd.

Chicago 4, Illinois

AEROSPACE CALENDAR

(*Continued from page 7*)

Oct. 21-23—Annual Meeting, Assn. of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 21-25—23rd National Convention, Society for Nondestructive Testing, Pick-Carter Hotel, Cleveland, Ohio.

Oct. 28-29—13th Annual Aerospace Fluid Power Conference, Pick-Fort Shelby Hotel, Detroit, Mich. Sponsor: Aerospace Div. of Vickers, Inc.

Oct. 28-29—Fall Meeting, Western States Section/The Combustion Institute, University of Southern California, Los Angeles, Calif.

Oct. 28-30—National Electronics Conference, McCormick Place, Chicago, Ill.

Oct. 29-31—International Symposium on Plasma Phenomena and Measurements, Institute of Electrical and Electronics Engineers, El Cortez Hotel, San Diego.

Oct. 30-Nov. 1—Annual Convention, Southeastern Airport Managers Assn., Roanoke Hotel, Roanoke, Va.

Oct. 31-Nov. 1—1963 Electron Devices Meeting, Institute of Electrical and Electronics Engineers, Sheraton-Park Hotel, Washington, D. C.

Oct. 31-Nov. 1—Fall Quarterly Regional Meeting, Assn. of Local Transport Airlines, Royal Hawaiian Hotel, Honolulu.

Nov. 3-8—International Air Safety Seminar, Flight Safety Foundation, Athens, Greece. For FSF members and by invitation.

Nov. 4-6—Vehicle Design and Propulsion Meeting, American Institute of Aeronautics and Astronautics/Air Force Systems Command, Wright-Patterson AFB, Dayton, Ohio. (Classified.)

Nov. 4-6—Northeast Electronics Research and Engineering Meeting (NEREM), Institute of Electrical and Electronics Engineers, Commonwealth Armory/Somerset Hotel, Boston, Mass.

Nov. 6-7—Western Regional Meeting, Institute of Navigation, Airport Marina Hotel, Los Angeles, Calif.

Nov. 12-14—Symposium on Supersonic Airliners, London, England. Sponsors: British, French and U.S. Air Line Pilot Associations.

Nov. 13-14—Seminar on Automatic Checkout Equipment and Techniques, Columbus, Ohio. Co-sponsors: NASA's George C. Marshall Space Flight Center; Battelle Memorial Institute.

Nov. 18-20—Sixth National Symposium, Society of Aerospace Material and Process Engineers, Olympic Hotel, Seattle, Wash.

Nov. 19-21—Conference on Stratosphere-Mesosphere Structure, El Paso, Tex. Sponsors: Texas Western College; American Meteorological Society; AIAA.

Nov. 19-21—42nd Annual Meeting, Aviation Distributors and Manufacturers Assn., Shamrock Hilton, Houston, Tex.

Dec. 3-5—Joint Annual Meeting and Convention, National Pilots Assn. and National Aviation Trades Assn. including the National Air Taxi Conference, Fontainebleau Hotel, Miami Beach, Fla.

Dec. 6—Fourth Annual Seminar on the Reliability of Space Vehicles, Institute of Electrical and Electronics Engineers, Airport Marina Hotel, Los Angeles.

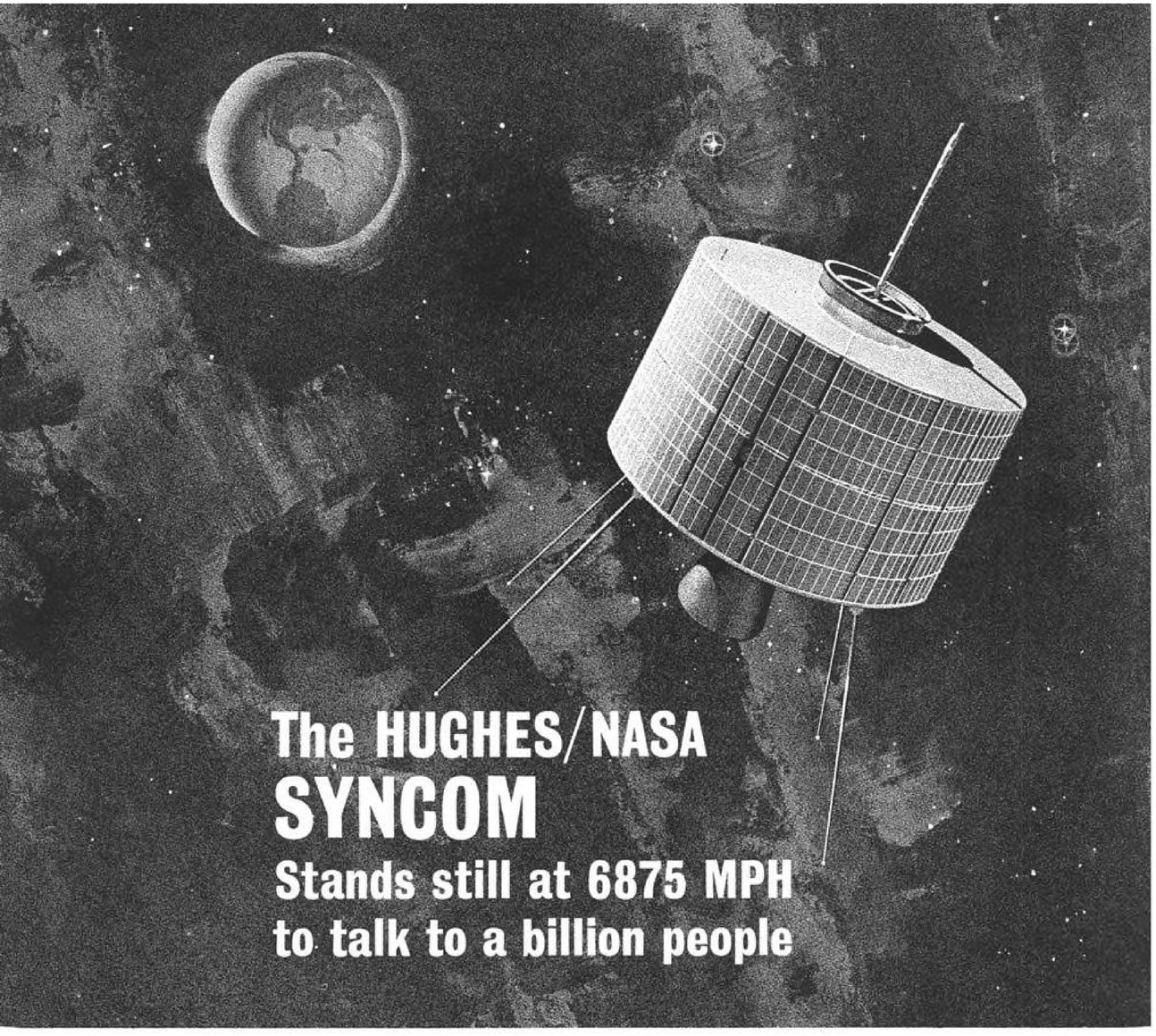


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With valuable savings in both weight and space, the air mixing valve shown above maintains maximum comfort in the cabins of helicopters while also providing a means of windshield defrosting. The valve mixes hot bleed air from the engine with outside air, utilizing a bi-metal thermostat to adjust the bleed air stream to the desired control temperature. In case of malfunction the bleed air receives maximum dilution. This simple mixing principal and other equally sound ideas can be applied to your helicopter heating projects—when you put Janitrol's years of experience to work for you. Write: Janitrol Aero Division, Midland-Ross Corporation, 4200 Surface Road, Columbus 4, Ohio. Ask for JA-223.

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The HUGHES/NASA SYNCOM

Stands still at 6875 MPH to talk to a billion people

Syncom is an entirely new kind of communications satellite. It is the first synchronous satellite — the first to "stand still" in space.

Actually it is traveling 6,875 mph. But at its altitude of 22,300 miles, Syncom's speed matches the earth's rotation. Result: It is "parked" over the earth.

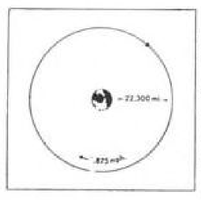
From this vantage, above the mouth of the Amazon River, Syncom can "see" 40% of the earth. Thus it can beam signals to over one billion people in North and South America, Western Europe and Africa.

Further, since Syncom remains in a controlled position, it can be used 24 hours a day for uninterrupted communications to this entire area.

In fact, in Syncom's first month of operation, it logged more operating time than all other communications satellites had up to that time.

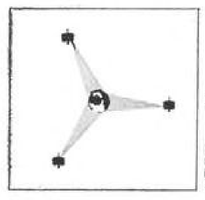
Little wonder NASA has called Syncom a major breakthrough in the peaceful use of outer space.

Hughes Aircraft Company, under contract to NASA, is proud to have conceived, designed and built Syncom.



◀ *Syncom differs* from other satellites in that it is precisely controlled in a high-altitude orbit. Here it can be permanently "parked," while other types of satellites are in random, low-altitude orbits.

Future Syncom system in development at Hughes requires just three operating satellites to extend telephone, telegraph, TV and wire photo service to all the populated areas of the world. ▶



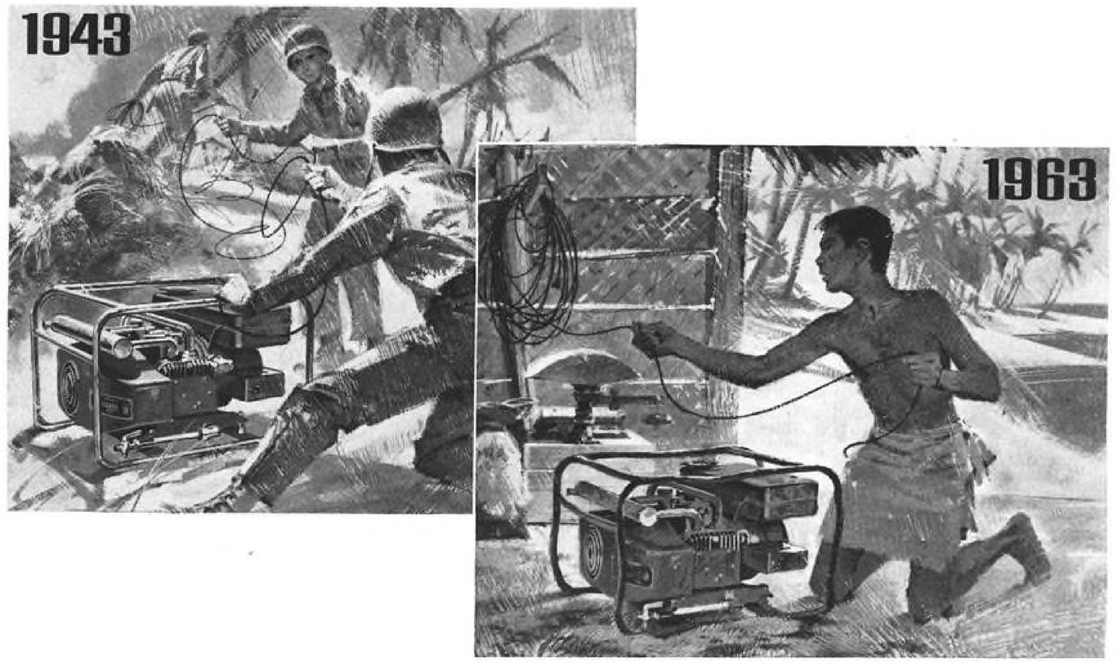
Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY

After 20 years of the toughest service . . .

These World War II Onan Generators are STILL GOING STRONG



Isn't this the kind of service you want when you specify electric plants?

Our Parts and Service Department regularly receives orders for parts for Onan Plants manufactured for WW II use. It is obvious that many of the hundreds of thousands of military gen sets we built in the early '40's are still being used all over the world.

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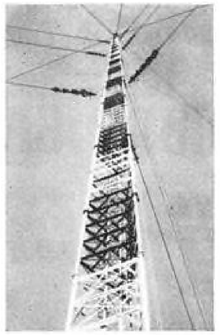
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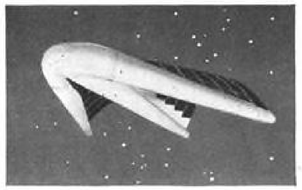
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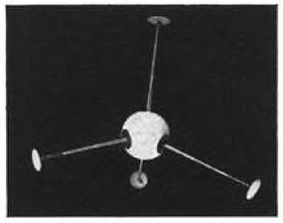
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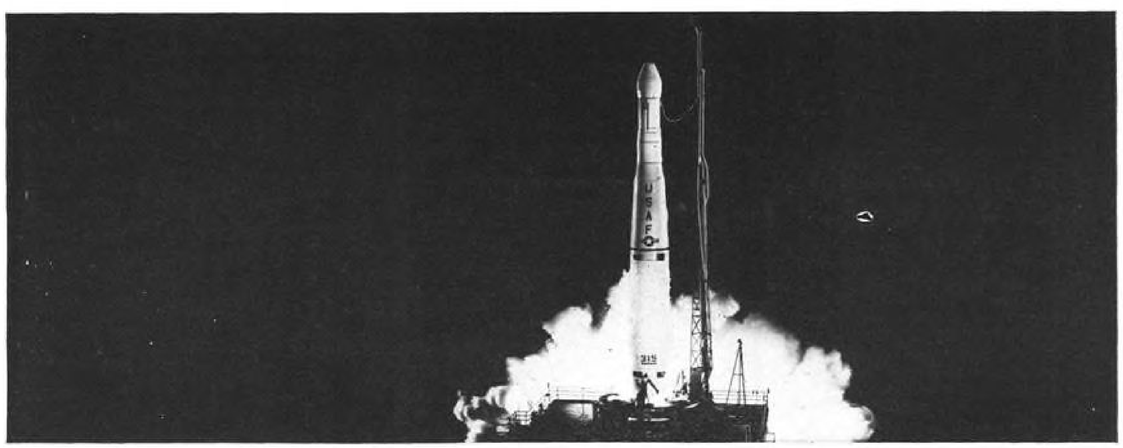
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USAF F-106 Interceptor

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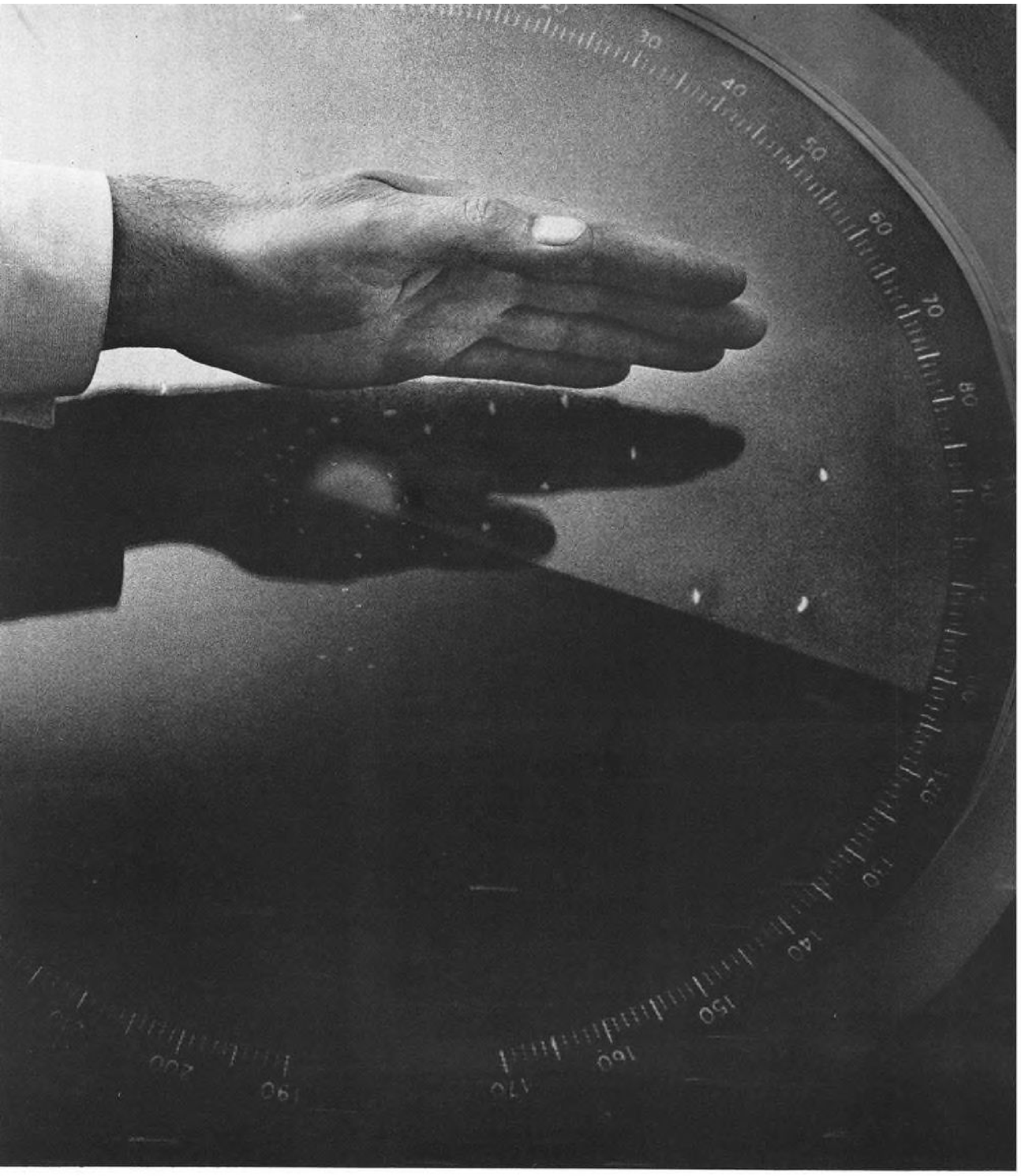
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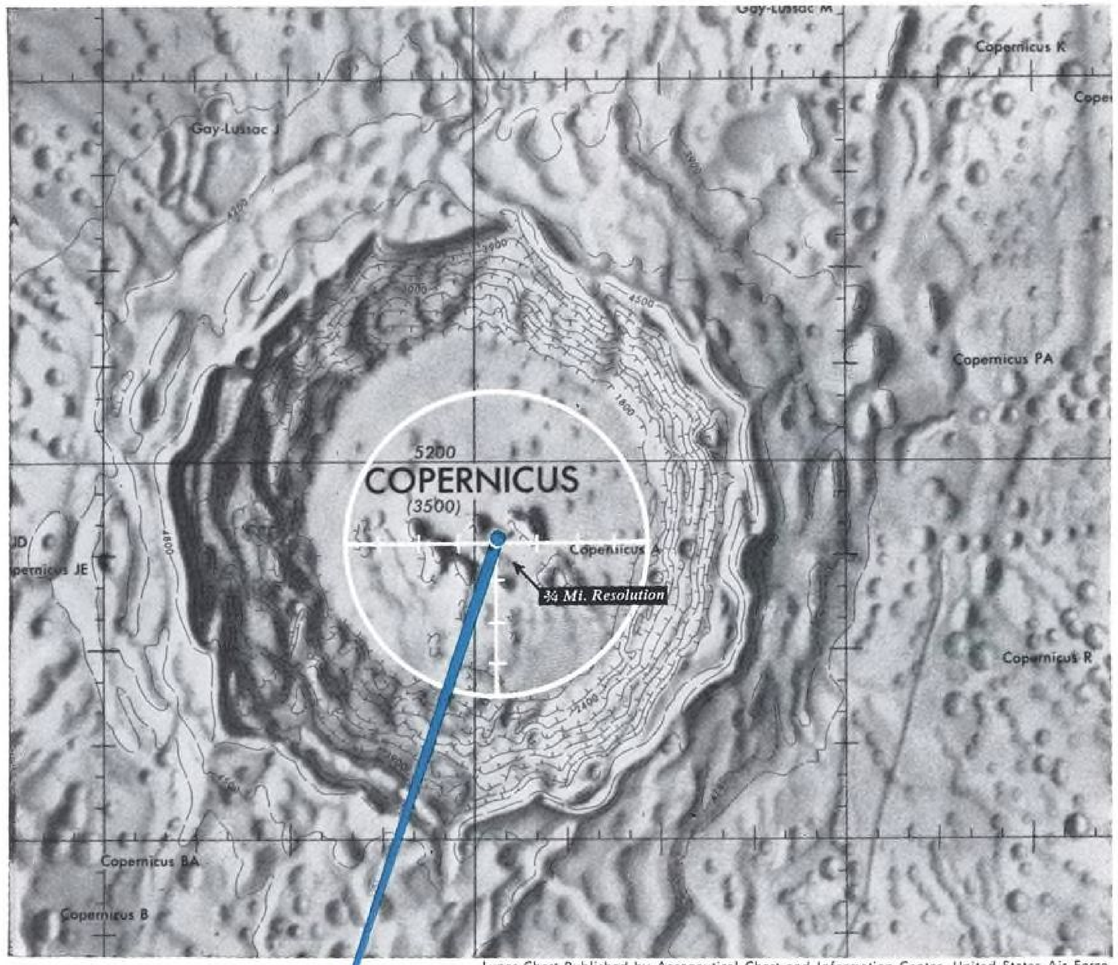
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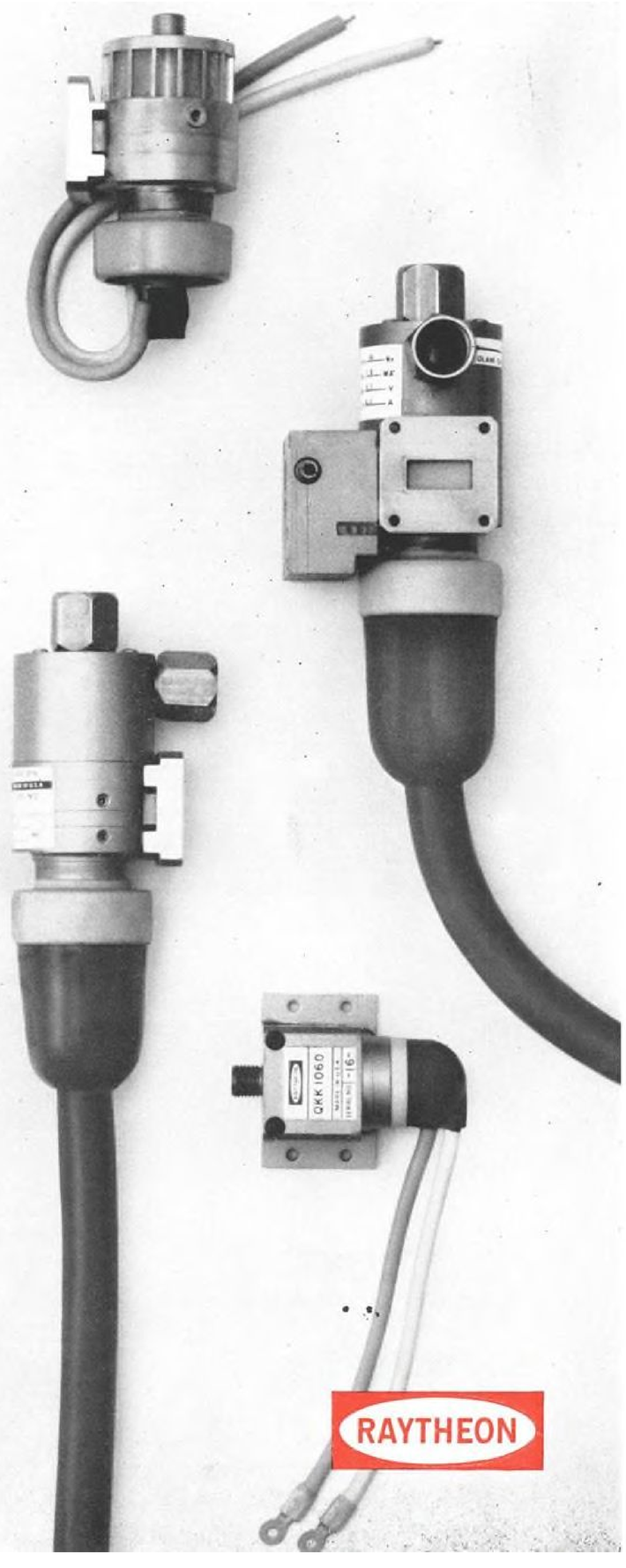
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Aviation Week & Space Technology

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Number 13

September 23, 1963

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EDITORIAL

Nuclear Delivery: Theory vs. Practice... 21

COVER: General Electric's J93 turbojet engine (bottom, cover photo) is shown beneath the company's J79 powerplant. The 30,000-lb.-thrust J93 (AW Sept. 16, p. 32) will power the USAF/North American B-70 Mach 3 bomber. The J79, which weighs approximately 1,500 lb. less than J93, is used on the McDonnell F-4B and F-4C, Lockheed F-104, General Dynamics B-58 and North American A-5A.

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Nuclear Delivery: Theory vs. Practice

Gen. Thomas S. Power has had more practical experience in the delivery of bombs on strategic targets than any other military commander in the world today and currently has dual responsibility for the U.S. nuclear delivery capability as chief of Strategic Air Command and chairman of the Joint Strategic Targeting Group. His views on the theory vs. practice of weapon delivery on target were presented at the recent Air Force Assn. Annual Convention in Washington, D. C. *(See pp. 38, 39 for Gen. Power's comments on other subjects).**—Ed.*

There have been an awful lot of so-called experts who said that the manned bomber is doomed and cannot deliver the weapons. Unfortunately the so-called experts cannot speak from experience. They are speaking from theory.

I will give you a few facts. In the last war we flew 1,550,000 heavy-bomber sorties at a loss rate within 1.8%. We lost 9,500 bombers. Those are the facts. I have been in the bombing business since the spring of '29 and yet every other expert in the bombers said we would be shot down. The British said we could not do daylight bombing. Everyone predicted utter failure for the bombing mission. And yet an American bombing mission has never been turned back from its target.

Improved Defenses

The defenses have improved. In the last war we did not target them. In the last war we lost 1.8%, but they are targeted today and they are way up on our target list and we would like everybody in the world to know that.

We will take the best penetration device ever invented by man, the hydrogen bomb, and we will destroy them and will deliver those bombs, no question about it. We know what the defenses can do. We do not exploit their strength, but their weaknesses.

You have a choice of tactics and timing. There is no question about it. There is absolutely no question about our ability to destroy any target on that target list today. . . I told you we have this position because of action we took in the past. If you do not do anything now, no, you will not have that position [in the 1970s]. This is not a static position. Some people say this is an arms race. If it is an arms race, let us win it. And we are winning it. . . .

I guess this is the first time in the history of the United States Air Force, formerly the Army Air Corps, that we have not had some type of bomber in production. The B-52 and the B-58—well, we only have a handful of the B-58s, so we cannot consider them as providing a substantial part. There is a rule of thumb in that a new weapon system becomes obsolescent in seven years and obsolete in ten years.

So when you introduce a new weapon system, putting it in the hands of combat troops, you should then start planning the replacement for it. When I had the Air Research and Development Command in 1955 we laid down the B-70 to replace the B-52. We have been talking about it for eight years. I suggest you will never have one if you do not stop talking and build one.

Acceptable Weapon Systems

What do we want? I am in a position that I will take anything, because it is better than nothing. There is a whole family of weapon systems that are acceptable to me. I have made my requirements known to the Chiefs of Staff and made them known in the order of their priority, but it covers the whole spectrum. . . .

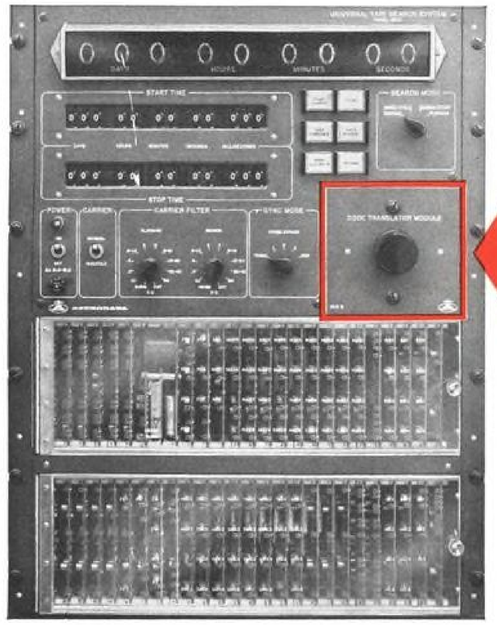
Now, if you want to go to new aircraft, General Schriever mentioned some of the ones he had under consideration—the so-called long endurance aircraft, low-altitude manned penetrator and high-performance, high-altitude aircraft.

General Schriever has these under consideration. What we would like at the Strategic Air Command is to have them stop considering them and light on one and let's build it. . . .

I say that we must be prepared to cover the entire spectrum of tactics that are necessary to fight a war . . . I say you have to have some weapon systems that are not bombers, some systems that fly high and some that fly low. I choose the tactics when I am delivering the bomb. As I said before, they cannot last for 100 years. So we have to plan to replace them.

Now in replacing them, somebody might theoretically get the superman system, to be all things to all men. We have never achieved that possibility or capability. And I suggest a real practical way of making sure is to have all of those systems. . . .

When a new time code is introduced...

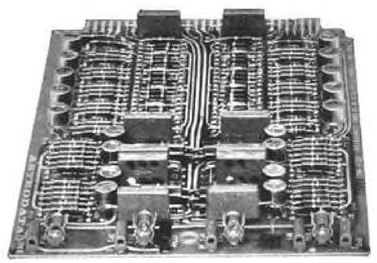


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All solid-state construction, using exceptionally conservative design criteria, gives you maximum protection against downtime. More than 40 systems have been installed to date. All customers report excellent operation...names on request.

Considerable savings accrue to users because of Astrodata's years of experience in the design and manufacture of time code generation, translation, telemetry and tape search systems combined with a modular approach that permits many engineering and production economies.

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WHO'S WHERE

In the Front Office

Dr. Ronald Smelt, vice president and chief scientist of Lockheed Aircraft Corp., a newly created post, reporting to **M. Carl Haddon** (AW Sept. 16, p. 23).

Paul S. Collins, president, Arnoux Corp., Culver City, Calif., a subsidiary of The Electrada Corp.

Bernhard B. Bundesman, formerly JetStar commercial sales manager of Lockheed-Georgia Co., now president of Hawker Siddeley International, Inc., LaGuardia Airport, New York, N.Y., succeeding **Ian Fossett**, who is returning to England in a new executive position with Hawker Siddeley.

Dr. Richard H. Woodward, vice president-senior scientist, Pickard & Burns Electronics Div. of Gorham Corp., Waltham, Mass.

Arthur J. Kjontvedt, vice president-marketing, Houston Fearless Corp., Los Angeles, Calif.

Dr. E. M. Pritchard, chief scientist, Lockheed Electronics Co., Plainfield, N.J., and a member of the Lockheed Aircraft Corporate Research Council. **S. J. Jatras** succeeds Dr. Pritchard as general manager of the Military Systems Div. Both continue as company vice presidents. Also: **Gerard L. Seelig**, company vice president and general manager of the Avionics and Industrial Products Div., Los Angeles, Calif., succeeds Mr. Jatras. **Paul F. Pearce** succeeds Mr. Jatras as general manager of the Industrial Technology Div., Metuchen, N.J.

Harold V. Wallace, a vice president, Edgerton, Germeshausen & Grier, Inc., Boston, Mass.; he will continue to direct the company's product operations.

Arnold Pollack, a vice president, Aerotest Laboratories, Inc., Deer Park, N.Y.

Air Commodore V. C. Otter, director of RAF aircraft development, England.

Joseph P. Villo, assistant vice president for customer relations, Standard Pressed Steel Co., Jenkintown, Pa. **John M. Sherman** succeeds Mr. Villo as general manager, aerospace fastener sales.

Honors and Elections

C. L. Johnson, Lockheed's vice president for advanced development projects, has received the Air Force Assn.'s Theodore von Karman Award (formerly designated the AFA Science Trophy) for "designing and directing development of the U-2 aircraft . . ."

Rulon Nagely, vice president-material of North American Aviation, has been awarded the Small Business Administration's first Public Service Award for outstanding contributions to the small business community.

Lt. Col. Edmund A. Wright, Jr. has received the Air Force Commendation Medal for his role in developing and testing the Bomarc missile for the Air Defense Command. Col. Wright is now head of the Targets Div., Detachment 4, Aeronautical Systems Div., Eglin AFB, Fla.

Marilyn C. Link, executive secretary of the Link Foundation, has received the 1963 University Aviation Assn. Award in recognition of her outstanding contributions to aviation education.

(*Continued on page 132*)

INDUSTRY OBSERVER

► USAF's concept of a multipurpose, long-endurance aircraft, called Maple (AW May 6, p. 33), envisions about 12 missions, ranging from missile launching and airborne command post functions through emergency communications and anti-submarine warfare. One goal is to keep the aircraft airborne for 48-64 hr. The plane would be capable of subsonic cruise and Mach 3 dash at tree-top level. As a launch platform, the aircraft might carry 10 missiles weighing 10,000 lb. each.

► **Guidance development for the mobile medium-range ballistic missile (MMRBM) is sufficiently advanced that, if and when the MMRBM development project is approved, several guidance system options are available. These would include all-inertial, stellar-inertial with one-star tracking, and stellar-inertial with two-star tracking. The two-star system has been virtually ruled out, however, because current nuclear warhead yields are so high that the accuracy available with a two-star guidance system is not required. Biggest problem still unsolved is precise determination of the launching point.**

► Air Force has spelled out its requirements for the CX-4 transport which would replace the Douglas C-133 Cargomaster in hauling such outsize items as missiles and space boosters. The CX-4 (AW June 24, p. 52) would gross about 600,000 lb., carry a 150,000- to 200,000-lb. payload, have a range of 4,000 naut. mi., be powered by four to six turbofan engines, fly at 400-500 mph., and have a cargo floor 16-19 ft. wide.

► **Cape Canaveral sources believe that the Project Stabilization Agreement signed in August, 1962, between the Patrick AFB Contractors Assn. and the local Building Trades Council may not be renewed next March, when the pact is scheduled to terminate. The agreement, which was intended to preclude unauthorized work stoppages by building trades unions, has been violated 16 times this year.**

► Military services and Defense Dept.'s Advanced Research Projects Agency are seeking practical applications in detection of some of the 32 "strange particles" that result from atomic fission in addition to X-rays, the gamma spectrum, electrons and neutrons. DOD and some leading scientists are exploring the possibility of detecting the particles as a means of locating and tracking nuclear reactors in space and the air, on the surface of the land or sea and underground or below the surface of the sea.

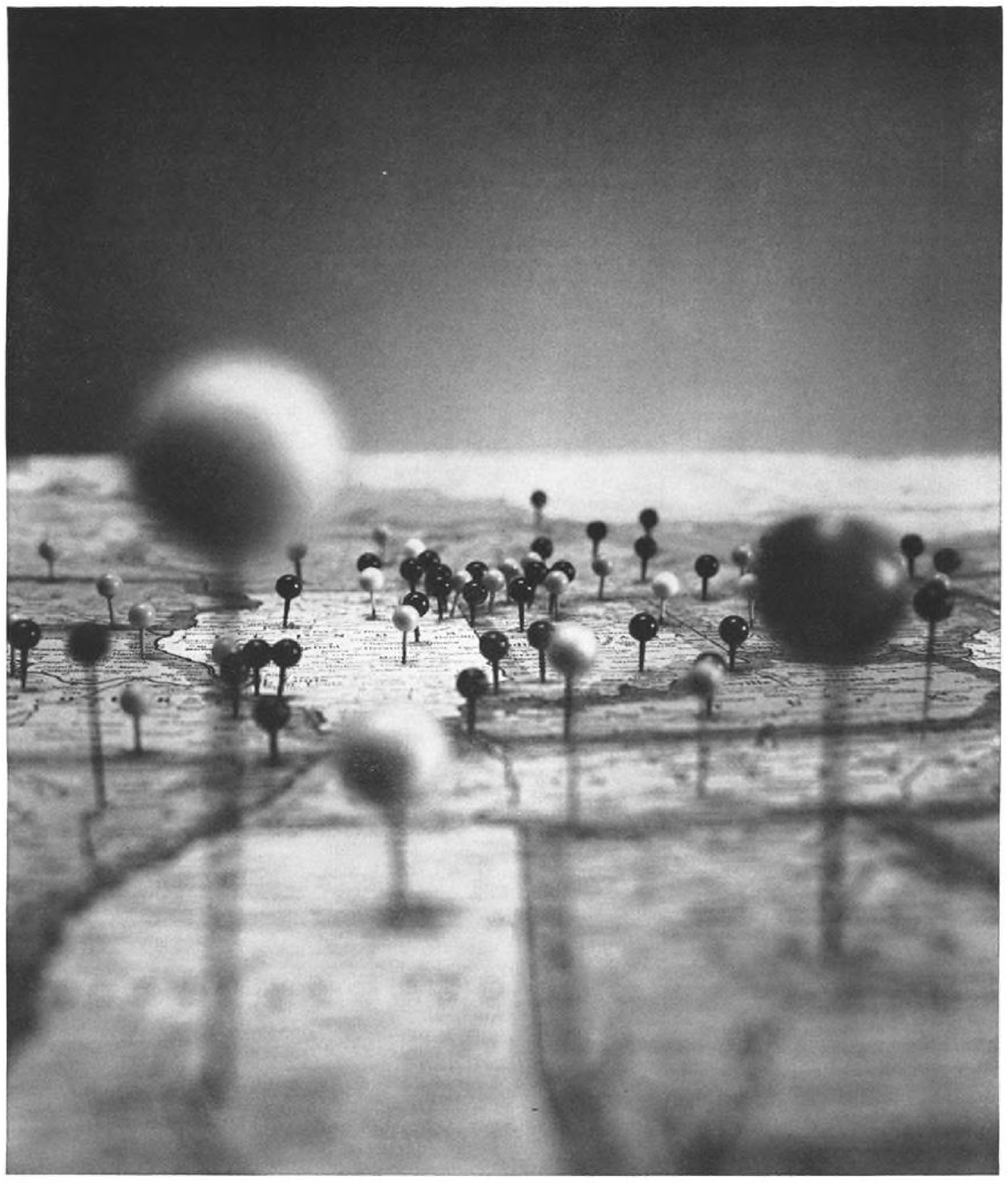
► **Rollout of the first Chrysler-built Saturn booster (AW Sept. 16, p. 54) will take place Dec. 12 at the Michoud, La., manufacturing facility.**

► Aerospace Pilot Research School has outlined to USAF Systems Command a requirement for an advanced two-place training aircraft capable of reaching 50-mi. altitude (AW July 22, p. 259). Second seat would be used for student indoctrination and possibly for training scientists prior to deploying them aboard an orbiting space station.

► **Aerospace industry has been challenged to do more work on high-pressure presses. Dr. Willard Libby, former Atomic Energy Commission chief and professor of chemistry at the University of California, told an Air Force Office of Aerospace Research meeting that a press capable of producing pressures to one million earth atmospheres is needed for materials research.**

► Czechoslovakian aircraft industry has produced and flown a prototype agricultural plane called the Cmelak XZ-37 (Big Bee) at its main production plant at Kunovice. The monoplane has a low aspect ratio cranked wing and is powered by a Soviet-built Ivchenko reciprocating engine. The XZ-37 has a gross weight of 3,748 lb. and will go into limited production pending a sales campaign in Communist countries and the West by Omnipol, Czechoslovakia's state export organization.

► **Langley Research Center will begin checkout of its lunar landing research facility within a few weeks. The facility, designed to study lunar landing piloting problems, consists of a 250-ft. high by 400-ft. long gantry structure with a 10,000-lb. tethered piloted vehicle. A crane will support $\frac{5}{6}$th of the vehicle's weight.**



Task Force. Under Sperry systems management, 337 companies, including 18 major subcontractors, share responsibility for the navigation of every Polaris-firing submarine. It was Navy's precept that the nation's best talents be teamed for the job.□Because the system must continuously and precisely provide exact position information for launching the Polaris, our long experience in navigation and inertial technology made Sperry a logical management choice.□Among new technologies contributed to the program by Sperry were ultra-low drift gyroscopics, the SINS inertial system, the advanced NAVDAC computer, and new processing techniques for a sea of technical and management data. Vital to U.S. defenses, Polaris will serve other free world forces as well. *SPERRY POLARIS, Sperry Gyroscope Co., Great Neck, New York.*

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Washington Roundup

NASA Budget Crisis

National Aeronautics and Space Administration is seriously considering asking Congress for more Fiscal 1964 money at the very moment several members of the House Appropriations Committee are demanding that the space agency's Fiscal 1964 budget be cut by almost $1 billion.

Rising costs—primarily in manned space flight—on the one hand, and more budget cuts on the other may put the space agency in the tightest financial squeeze since its expanded program got under way in 1961.

Right now NASA's Fiscal 1964 budget is in the hands of a House appropriations subcommittee. Some budget cutters there suggest reducing NASA's request for $5.7 billion all the way down to $4.9 billion, an $800 million slash. Authorization legislation already enacted sets the ceiling on the appropriation at $5.35 billion.

Key lawmakers in the current budget decision are Reps. Clarence Cannon and Albert Thomas. Rep. Cannon is the economy-minded chairman of the House Appropriations Committee, who believes much of the space effort is a sheer waste of money. Rep. Thomas is chairman of the NASA budget subcommittee and is a beneficiary of NASA's decision to put the $120-million Manned Spacecraft Center in Houston, Tex., adjoining his congressional district. But Rep. Thomas must walk the line drawn by his own chairman, Rep. Cannon.

Just what figure emerges from the House Appropriations Committee will be determined within the next few days. The Senate is always more generous than the House toward space money requests. It restored over $300 million of the cuts the House made in the NASA authorization bill.

Any NASA request for supplemental funds will come after Congress passes the space agency's Fiscal 1964 appropriations bill. Last year NASA Administrator James Webb elected to increase the size of the Fiscal 1964 budget rather than submit a request for more Fiscal 1963 funds, a decision heavily criticized by several space leaders in Congress and the agency itself.

NASA's Fiscal 1964 budget troubles may be compounded when it submits its Fiscal 1965 request to the Budget Bureau. President Kennedy is demanding economy moves within his Administration. NASA's tentative Fiscal 1965 estimate is $5.6 billion.

TFX Field Work

Senate TFX investigators spent several days in Ft. Worth, Tex., in an attempt to build up their conflict-of-interest case against Navy Secretary Fred Korth. They traced the relationships between the Continental National Bank, which Korth headed, and General Dynamics, which won the TFX contract.

McClellan subcommittee plans to hit hard at the conflict-of-interest possibilities surrounding both Korth and Deputy Defense Secretary Roswell L. Gilpatric during the TFX competition (AW Sept. 9, p. 27). Hearings are expected to resume late in October. A Republican senator not involved in the TFX investigation is primed to make a floor speech on the conflict-of-interest issue just before the hearings re-open.

Decision is imminent on whether General Electric or Philco will develop the military's medium-altitude communications satellite system (AW Sept. 2, p. 40). Air Force last week briefed civilian chiefs on its preference, but final decision may have to await White House clearance.

France is expected to propose a ban on broadcasting from satellites directly into home radio or television sets. This proposal, slated for consideration at the International Telecommunications Union meeting opening in Geneva Oct. 7 on space communication frequency allocations, will be hotly contested by the U.S.

Astronaut Enterprises

Sixteen new astronauts assigned to NASA's Gemini and Apollo programs knowingly let themselves in for charges of commercialism and signed a contract with Life magazine and Field Enterprises Educational Corp. last week for their personal stories.

The contract could bring the astronauts a total of $2 million by the time the U. S. lands a man on the moon. The contract is for four years and can be extended an additional four. Life will pay each astronaut $6,250 annually for magazine rights while Field will pay each of them $10,000 for book and newspaper syndication rights. The 10 to 15 additional astronauts NASA will select this fall will be offered the same terms.

The new contract was signed amidst continuing protests in Congress and within NASA that the astronauts are reluctant to fill speaking engagements that are not personally profitable but would help build public support for the space program.

Public Be Dimmed

Although NASA once awarded—and then took back—$400,000 to Columbia University to find ways to increase public understanding of the national space program, the agency has closed to the public a symposium at Goddard Space Flight Center Oct. 28-30 on the physics of solar flares.

Kansas City Athletics are looking to science to help them out of the second division. The team recently asked NASA something Whitey Ford has known about for years: how temperature and humidity affect the flight of a baseball.

—Washington Staff.

NASA Favors Two SCAT Configurations

Agency may seek parallel industry effort on radically different designs for civil supersonic transport.

By Edward H. Kolcum

Washington—National Aeronautics and Space Administration may propose parallel development of two radically different supersonic commercial air transport (SCAT) configurations that have emerged as the most promising designs in industry studies now nearing completion.

The agency in the past has said it favors a supersonic transport development program in which two competing types would be developed through prototype construction (AW Aug. 5, p. 58). The configurations that the studies show have the most potential are SCAT 16 and SCAT 17. The first is a variable sweep wing design with three engines. SCAT 17 is a canard delta with fixed wings and four engines. It closely resembles the North American RS-70.

Announcement that these two aircraft concepts appear most promising came Sept. 19 at Langley Research Center at the conclusion of a three-day technical meeting for government, industry and airline representatives on the status of supersonic transport research in the U. S.

The broad conclusions represent the findings of eight-month analytical studies by Boeing and Lockheed, which concentrated on four SCAT configurations that survived nearly eight years of in-house NASA research (AW Apr. 1, p. 59).

Data developed from both NASA and industry studies will be available to both airframe and engine manufacturers who are now preparing proposals for the Federal Aviation Agency's Phase 1 supersonic transport competition. Bids for this phase—essentially a conceptual design—are due Jan. 14 (AW Aug. 19, p. 37).

FAA is over-all manager of the supersonic transport development program, and NASA acts as technical consultant. N. E. Halaby, FAA administrator, has expressed a hope that a single configuration can be defined before the start of Phase 2, or detailed design, which is now scheduled to begin next May with the award of contracts.

Langley, which managed the Boeing and Lockheed configuration studies, provided design guidelines compatible with those of FAA, except that the NASA studies reflect a strong position that the aircraft be capable of Mach 3 flight. FAA is more conservative in requiring only "faster than Mach 2.2." These are other study guidelines:

- **Payload of 26,125 lb.**, which is equivalent to 125 passengers and baggage.
- **Range of 1,150 to 3,700** mi. at supersonic speeds, and 230 to 1,150 mi. at subsonic speeds.
- **Operation on 9,500 ft.** of runway for takeoff, and 7,000 ft. to land.
- **Useful lifetime** of 15 years, comparable to 30,000-50,000 hr.
- **Operating characteristics** that will produce no more than 2 psf. sonic boom overpressure during acceleration, and no more than 1.5 psf. during cruise.

Boeing and Lockheed concluded that the sonic boom overpressure will be a controlling factor in the gross weight, and that extensive structural use of titanium will significantly reduce weight. However, they said additional understanding is needed on use of titanium for structures.

NASA had specified use of either stainless steel or titanium, but the studies indicate that stainless steel cannot meet guideline requirements in weight. Civilian leaders in the Defense Dept. said Boeing's intended use of titanium for structural members in the F-111 (TFX) was one of the major technical drawbacks in the firm's proposal (AW Aug. 26, p. 34), because, they contend, the metal is unproven and its use is an additional risk.

Fundamentally, Boeing and Lockheed evaluated the over-all feasibility of the four SCAT configurations, matched the configurations with four paper engines, and established data on tradeoffs. At the Langley conference, the companies defined several areas where additional research is required. Prime among them are general aerodynamic efficiency, low-speed stability and control, airworthiness and advanced aircraft design criteria.

The aircraft manufacturing industry has been reticent in committing itself to the supersonic transport program, and a number of companies have said they will not participate in the FAA Phase 1 competition (AW Sept. 16, p. 46). As of late last week, only Boeing, Lockheed and North American said they will submit airframe designs.

Three engine manufacturers, Curtiss-Wright, General Electric and Pratt & Whitney, also announced they will participate in the competition. GE said its J93 turbojet engine could be adapted for the supersonic transport by adding a zero-stage compressor, increasing air flow or adding an aft fan (AW Sept. 16, p. 32). The J93 (see cover) has a thrust of 30,000 lb., and the supersonic transport powerplant will be required to provide about 40,000 lb. thrust.

Airline industry likewise is cautious regarding SSTs (see p. 49), and would like to delay their introduction until the service lives of subsonic jet transports are further down the road. However, the spur of foreign competition has made an earlier-than-wanted introduction more probable. Pan American has indicated it will purchase six British-French Concorde supersonic transports, and Continental intends to buy three.

SCAT Design Features

Distinguishing features of the two supersonic commercial air transport (SCAT) configurations judged through industry study to be the most promising for U. S. development include:

- SCAT 16—incorporates a variable sweep arrow wing which is twisted and cambered. Two engines are slung under the wing, and the third engine is stacked on the fuselage. Concept for this design was developed at Langley Research Center. Aspect ratio varies from 1.4 to 9.3, depending on degree of wing sweep.
- SCAT 17—canard delta configuration developed by Ames Research Center, the forward canard surface of which is movable. Tail surface is deflected upward for trim in subsonic flight and downward for directional stability in supersonic.

SST Meeting Lineup

Airframe manufacturers invited to the supersonic transport conference held last week at Langley Research Center were Boeing, Douglas, General Dynamics, Grumman, Ling-Temco-Vought, Lockheed, McDonnell, North American, Northrop and Republic.

Airlines invited were American, Braniff, Continental, Delta, Eastern, Northwest, Pan American, TWA and United.

Curtiss-Wright, General Electric and Pratt & Whitney represented the engine industry.

Government agencies attending, in addition to the host National Aeronautics and Space Administration, were Federal Aviation Agency, Defense Dept., National Aeronautics and Space Council, President's Office of Science and Technology and the Civil Aeronautics Board.

Soviet Space Station Lead Cited

Edwards AFB—Russia may be able, several years ahead of the U. S., to erect a manned space station and gain a significant advantage in development of space weapons, according to Dr. Arthur Kantrowitz, director of Avco-Everett Research Laboratory.

Kantrowitz told a symposium on space rendezvous, rescue and recovery here that the Russian ability to launch manned vehicles on schedule and into orbits suitable for rendezvous also has helped master some of the requirements for manned space station operation. Deployment of a U. S. station is not seen likely before 1967 or 1968.

Capabilities already partially demonstrated by the Soviets, or which they logically could be assumed to have acquired were listed by Kantrowitz as:

- **Rendezvous potential demonstrated on the first dual Vostok flight during which rendezvous might have been made if additional propulsion had been aboard.**
- **Ability to fund payload development. Reliance on a primary booster for both ICBM and space programs is expected to have reduced the cost per pound of payload in orbit to the point where the cost of other programs could be assumed. Relaxing packaging restrictions on payloads by merely launching another relatively inexpensive booster could effect further cost savings, resulting in an over-all development cost smaller than that required for a U. S. program.**
- **Booster production. Although there exists no evidence, it is reasonable to expect that by using production boosters, they could produce the 25 to 50 required each year for a permanent manned space station.**

Objectives Slowed But Unchanged By French Civil Space Budget Cut

Paris—Government economy decision cutting the French civil space budget by one-third will slow down French efforts both in national and international programs (AW Aug. 12, p. 52) but won't change the main objectives in France's ambitions.

The 1964 budget for the Centre National d'Etudes Spatiales (CNES), France's coordinating agency for civil space programs, finally has been fixed at $48 million. This is more than this year's budget of $32 million, but is considerably lower than the 1964 proposed budget of nearly $70 million requested by CNES.

Satellites Curtailed

As a result of the budget cut, CNES has been forced to drop several planned satellite launchings, reduce government and industry space technology studies, slow-down hiring of personnel and scale-down space-biological experiments.

Gen. Robert Aubiniere, CNES managing director, while regretting the cutbacks, insists that France's main space objectives nonetheless will be maintained. French aerospace industry sources generally express a more pessimistic reaction to the government's slash in the nation's civil space budget.

The government presently is attempting to cut down inflationary pressures in France with a series of measures which include reduced government spending. Even before the government's anti-inflation drive, however, the CNES budget request seemed certain to be cut.

President de Gaulle, despite his interest in French civil space programs, had to sacrifice this portion of the budget in order to continue underwriting his military nuclear program. Portions of this program, such as military missile projects, contribute heavily to France's over-all space effort.

According to CNES, major items in its reduced budget are as follows:

Its largest, $16 million, is earmarked for France's 1964 participation in European-wide space projects. CNES had requested $20 million for the work. The reduction reflects some government feeling that European-wide groupings like European Space Research Organization (ESRO) and the European Launcher Development Organization (ELDO) won't be moving as fast as had earlier been thought, so funds won't be needed as quickly. Other French officials, as well as a fair number of French aerospace companies, think higher priority should be given to France's national space effort, at least initially. CNES sources, however, say France intends to stick to its financial commitments to ESRO and ELDO (AW Aug. 12, p. 52), even if it requires supplementary budget requests during 1964.

A budget item of $3.3 million represents the CNES 1964 share of the Diamant launcher development (AW June 17, p. 26), the bulk of the cost being borne by French military.

Diamant's initial launching in the Sahara of a French satellite—the FR.2A early in 1965—remains on schedule although only two tracking stations will be completed in time instead of the four planned.

CNES, however, will thereafter launch only two satellites in 1965-66 using Diamant vehicles. CNES originally had planned to launch four satellites in the same period.

Gen. Aubiniere admitted it was now impossible for France to meet its original plan of having four tracking stations in Africa completed by late 1964. It is now expected that only two stations will be ready when the Diamant-FR.2 flight is made in 1965 at Hammaguir, in the Algerian Sahara.

First government contract for equipping these two tracking stations has been awarded to two electronic companies, Compagnie Generale de Telegraphie sans Fil (CSF) and Thompson-Houston. Electronic division of SNECMA, state-owned engine company, also is involved. CNES' 1964 budget contains $4 million for tracking stations.

Actual locations of the four tracking stations have not been disclosed, although all four will be situated in Africa within 30 deg. lat. north and 30 deg. lat. south.

Grants by CNES for research, both by government and industrial groups, also were cut. CNES' contributions to government and university space studies will total $5.5 million. This cut now will rule out certain projects, such as a proposal by the Centre d'Enseignment et de Recherches de Medecine Aeronautique (CERMA) to launch in 1964 a monkey along a ballistic trajectory in the nose cone of a Vesta rocket (AW Aug. 12, p. 55).

Research grants to industry will total $2.4 million. Here again, the 1964 grant is higher than the same grant in 1963 but much lower than CNES requested. Some French aerospace observers now say industry will lose a year's research effort due to the cut.

Other Budget Items

Other CNES 1964 budget items include $7.6 million for satellite development and $4 million for funding of rocket probes.

CNES officials say the lower budget now means they will be expanding at slower rate. CNES presently employs about 100 people, including 52 scientists and 43 technicians. Total number of CNES personnel is expected to go to 400, but not as quickly as had been planned.

CNES officials say no changes are being made in plans to launch FR-1A, France's first satellite, in October next year using a NASA Scout booster. It will be launched at the U. S. Pacific Missile Range in California. The system will be checked out earlier in several test firings at NASA's Wallops Island facility using Aerobee rockets.

Nord Aviation this week is delivering the first FR-1 structure to CNES.

Russell Scores Abandonment of Bombers

By George C. Wilson

Washington—Chairman Richard B. Russell (D.-Ga.) deplored the abandonment of the manned bomber as his Senate Defense Appropriations Subcommittee sent to the floor a bill to appropriate $47,371,407,000 for most of the activities of the Defense Dept. for Fiscal 1964, an amount $1,642,830,000 less than President Kennedy requested but $289,398,000 more than the House voted.

Senate Appropriations Committee last week approved its subcommittee bill after rejecting several amendments, including two to deepen the cuts in the budget. Sen. Russell, in assessing the strategy represented in the money bill, termed it a "serious mistake" to forsake manned aircraft and rely instead on missiles which are largely unproven and have far less psychological value in the eyes of the world.

He said the United States seems to have a "Narcissus complex where we want to look pretty all around the world" by not displaying our armed might. Sen. Russell said there is no psychological comparison between talking about missiles standing in holes in the ground back in the U.S. and landing an aircraft in a field "where tribesmen and their children" can see it.

Sen. Russell, who is the most influential member of Congress on defense policy because of his dual jobs as chairman of the armed services and military appropriations committees, strongly endorses the build-up of airlift capability. He said an aircraft that could take troops from the U.S. to Germany in 8 hr. decreases the need for keeping U.S. forces in parts of West Europe where it would take them 8 hr. to reach the front by truck. He said the new airlift capability might justify reducing U.S. forces in Europe by one division per year over the next five years, thus helping the unfavorable balance of payments. This argument helped win Senate committee restoration of the $25 million House cut in USAF-Lockheed C-141 procurement funds.

Sen. Russell said he would like to see "a little more imagination" in military space activities. He said, "I can't see any reason for not launching flying platforms" for military experiments as part of the national space program (see p. 38).

Risks inherent in the nuclear test ban treaty reinforced his subcommittee's determination, Sen. Russell said, to keep military forces in a high state of readiness. The subcommittee acceded to many of Defense Secretary Robert S. McNamara's reclama requests in restoring House cuts (AW July 29, p. 20), but refused to change one House bill's language restricting $125 million in Air Force research funds for the Boeing Dyna-Soar and Mach 3 aircraft. McNamara wanted to add the term "space vehicle." Sen. Russell said "space vehicle" is "about as broad a term as you can get," in explaining the subcommittee's refusal.

The Senate committee approved an amendment proposed by Sen. Karl E. Mundt (R.-S.D.) to limit indirect expenses of research grants to 20% of the direct costs. The House-passed bill allows 25%. These and other differences in the House and Senate measure will be resolved in a conference to be held shortly after the Senate passes its bill.

The final bill will determine how much money the Defense Dept. will receive for personnel, operation and maintenance, procurement, research and development. Military foreign aid and construction funds are handled in separate legislation. Several senators are planning to offer amendments on the floor to reduce the Defense Dept. appropriations even further, but the committee's version of the bill is expected to pass pretty much intact. Sen. Russell will manage the bill on the floor.

President Kennedy requested a total of $16,724,800,000 for procurement. House voted $15,666,472,000 and the Senate committee voted $15,795,447,000. The President asked $7,262,000,000 for research and development, with the House voting $6,889,000,000 and the Senate committee $6,984,230,000.

The Senate Appropriations Committee report gave these reasons for restoring House cuts:

• **USAF-Lockheed C-141.** House cut $10 million from spare parts procurement and $15 million to ensure that Air Force made Lockheed share development costs commensurate with ultimate commercial profits from the aircraft. Senate argued the reduction would disrupt the three-year schedule set up to produce 127 C-141s, and said the government's interests regarding cost-sharing were adequately protected.

• **USAF-McDonnell RF-4C.** Senate said it would be "unwise" to delay the procurement by imposing the additional $25 million reduction made by the House Appropriations Committee. Previously, the authorization bill, already passed by the House and Senate, reduced the budget request by $35 million, or 14 aircraft. Senate Appropriations Committee restored $25 million of that total $60 million cut. The $25 million restoration represents seven aircraft. The Senate report said reconnaissance capability is the limiting factor in tactical support for the ground forces.

• **USAF-Lockheed HC-130E.** Authorization bill reduced the request by $32.4 million, or 11 aircraft, and the House, in its appropriations bill, made an additional $16,175,000 cut, or four more aircraft. Senate Appropriations Committee noted the "heavy demands" the military and civilian space programs are putting on search and rescue aircraft. The committee restored the $16,175,000.

• **USAF mobile medium-range ballistic missile.** House reduced Defense Dept.'s research money request from $143.1 million to $43.1 million. Senate Appropriations Committee voted $103.1 million—an increase of $60 million over the House figure. Sen. Russell said he agreed that development should be started, but said this did not mean he would favor procurement.

• **Navy-Grumman EA-6A.** Senate committee restored half of the $59 million cut by the House "to meet the needs of the Marine Corps electronic reconnaissance missions."

• **North American T-2B.** Senate committee restored all of the $11.7 million cut by the House so the Navy Board of Inspection and Review could complete its testing program before the first operational buy.

• **Navy-Grumman TC-4B Gulfstream** navigational trainer. Authorization bill cut the request from $17.2 million to $10.2 million and the House, in its appropriations bill, wiped out the remaining $10.2 million. In restoring $10.2 million, the Senate committee said: "These aircraft are for an existing training mission and are not to be considered as mission support aircraft."

• **Army instrument trainer helicopters.** Senate, in restoring the $3.9 million House cut, said procurement of these aircraft "will result in substantial savings in initial costs and in operation and maintenance costs inasmuch as tactical helicopters are now being used for this purpose."

• **Army/Ling-Temco-Vought Lance** (Missile B). In restoring the $5 million House cut, the Senate committee said the reduction would result in a costly stretch-out of the program.

• **Communications satellite.** House appropriations bill reduced the total request from $135.6 million to $73,720,000. Senate committee voted to increase that amount to $96,720,000 by allowing Defense Dept. to use some of its unspent Fiscal 1963 Advent funds. This is how that amount would be allocated: Army $19,594,000; Air Force $50,731,000; Defense Dept. agencies $3,395,000, for a total new obligational authority of $73,720,000. The additional $23 million would come from unused Fiscal 1963 funds for the Advent program.

House appropriation cuts which the Senate committee did not restore included:

• **Aircraft procurement.** USAF-Bell UH-1F and unchosen fixed-wing light aircraft for support of missile sites, $3 million; Navy-Grumman E-2A, $17 million; Navy-North American A-5C, $5 million; Navy-McDonnell RF-4B, $7.7 million; Navy-Grumman S-2E, $1 million; Navy-Beech U-8F, $4.6 million; Army-Bell UH-1 helicopter, $3,197,350.

The already enacted authorization legislation has made these additional cuts in aircraft procurement: USAF-McDonnell F-4C and RF-4C, $35 million from each of the two separate requests; USAF-Northrop T-38A, $8 million; USAF-Lockheed HC-130E, $32.4 million; Navy-McDonnell F-4B, $13 million; Navy-Grumman TC-4B, $7 million; Army observation helicopter, $1.9 million; Army instrument trainer, $600,000; Army primary helicopter trainer, $300,000; Army-Grumman OV-1C, $9.4 million; de Havilland CV-7A transport, $6.3 million.

• **Missile procurement.** Navy-Bendix Typhon, $1,290,000; Army-General Dynamics Mauler, $96.3 million.

NATO Transport Talks

London—Hawker Siddeley Aviation and Dornier design teams are discussing the feasibility of pooling technology of the de Havilland DH-129 and Dornier DO-31 for a new joint design of a NATO tactical assault transport.

Teams have reached agreement in principle and the next move will be to start contract negotiations leading to the joint effort.

De Havilland, a division of Hawker Siddeley, developed the DH-129 under the NMBR-4 specification. Its design calls for two Rolls-Royce Speys mounted on the aft fuselage, with Rolls Dart RB.162 pure lift engines mounted sideways on the wings and employing thrust deflection.

The DO-31 design included two Bristol Siddeley deflected-thrust Pegasus engines, plus RB.162s packaged on the wings. Pegasus is now funded to a 15,500 lb. thrust. Hawker Siddeley is being pressed by Dornier and Northrop Corp., U.S. licensee for the Hawker P.1127, for an 18,000 lb. thrust engine.

Symington Cites Weapons Control In Backing Ban on Nuclear Tests

By Katherine Johnsen

Washington—Air Force's first Secretary—Sen. Stuart Symington (D.-Mo.)—took the Senate floor last week to support the nuclear test ban treaty with the prospect that it "might point the way toward bringing nuclear weapons under some form of satisfactory control."

Symington was the only senator to participate in the two Senate reports on the treaty: The Senate Foreign Relation Committee's report strongly urging ratification, and the Preparedness Investigating Subcommittee's report stressing the military risks for the U.S. that would result from the ban (AW Sept. 16, p. 30, p. 93).

Symington unqualifiedly endorsed the Foreign Relations report. He supported the facts presented in the Preparedness subcommittee report, but dissented from its "overly pessimistic" conclusions on the security threat.

The Senate will vote on ratification of the treaty at 11 a.m. Sept. 24. It has the support of the Republican, as well as the Democratic, leadership. Approval by a comfortable margin over and above the required two-thirds—67 votes—is expected.

The measure banning atmospheric, underwater, and space testing, negotiated by the U.S., U.K., and the USSR, has the concurrence of approximately 90 nations.

No Amendments

There will be no Senate amendments to the treaty requiring renegotiation with the U.K. and the USSR. The deadline passed last week without any amendments being offered.

A condition for presidential implementation of the treaty, reviving the Cuba controversy, will probably be voted on Sept. 23 and defeated. Sponsored by Sen. Barry Goldwater (R.-Ariz.), a major general in the Air Force Reserve, it would require the removal of all Soviet nuclear weapons, weapons capable of carrying nuclear warheads, and all Soviet military and military-technical personnel from Cuba before President Kennedy could bind the U.S. to the treaty.

Symington called the treaty "the most important action during our time. Unless there can be some understanding among the growing number of nations that will have the weapon, a nuclear holocaust is only a question of time."

Weighing the risks of restricting testing against the risks of unlimited international testing, Symington commented that "it is clear—and all witnesses have so testified—that this test ban treaty will inhibit certain aspects of U.S. weapons development and weapons effect knowledge. . . . But we must weigh such disadvantages to the U.S. against comparable, if not similar, disadvantages to the Soviet Union."

The greatest risk, Symington said, is that the U.S. will be prevented from obtaining through atmospheric testing vital information on the survivability of the sites and control centers of its missile offense. Present knowledge is based on extrapolations of small tests of less than a megaton yield.

"I would much prefer that we learn more, that we reduce the uncertainties regarding our missile site vulnerabilities," he said. "But the evidence is that the Soviets know no more than we do about such vulnerabilities. The evidence is that they have not conducted any large-yield tests of this kind."

Teller Contention

Symington discounted the contention of Dr. Edward Teller that the Soviet Union during its 1961-62 series of intensive testing developed information which will permit the development and deployment of an anti-intercontinental ballistic missile system (ABM).

Without naming Teller, Symington observed:

"Some of the able, experienced, and completely honorable scientists who testified against the treaty made mistakes in fact, apparently because in the reasonably recent past they had not been cleared for all classified information. Specifically, apprehensions in the ABM field were not borne out . . . in the highly classified intelligence briefings we received. . . .

"The evidence . . . is that the Soviets have not yet solved their ABM problems; therefore . . . if the treaty inhibits our ABM development, it will likewise inhibit theirs."

Symington expressed disbelief that an ABM system would ever be developed which would protect a nation against lethal harm.

Symington also challenged the Air Force on the requirement for the big bomb—up to the 100-megaton yield within the capability of the USSR. He noted that the Joint Chiefs of Staff, as a whole, "place no emphasis on having yields in excess of those which can be achieved under the treaty." This would be up to 60 megatons for transport by B-52 or up to 35 megatons for delivery by missile.



SIOUX SCOUT design demonstrated by Bell Helicopter is an extensively modified Model 47 aimed at tactical warfare applications.

Bell Demonstrates New Design for Tactical Helicopter

By Erwin J. Bulban

Ft. Worth—New helicopter configuration, aimed at advancing the state-of-the-art in armed rotary wing aircraft design and tactical use, was demonstrated here for the first time to high-ranking military officials by Bell Helicopter Co.

Flight demonstration of the Bell Sioux Scout was a feature attraction of a two-day research and development symposium sponsored by the company here last week for military and National Aeronautics and Space Administration personnel.

The Sioux Scout attracted major interest because of its wide implications. An extensively modified Model 47 helicopter, it is a configuration concept, or flying mockup, of an attack-class helicopter embodying the latest thinking of Bell engineers and ideas the company has been able to obtain from military personnel. As such, its prime features include:

- **Aerodynamic refinement for** minimum drag, including tandem seating of two-man crew of pilot and gunner.
- **Stub wings** to increase climb rate and maneuverability and also provide platform for additional armament.
- **Nose-mounted turret** to provide maximum firepower flexibility. The significance of Bell management's decision to privately fund the Sioux Scout is the controversy that appearance of the vehicle is expected to provide in view of current status of so-called "Warrior" helicopter program. Considered one of the bright hopes for the helicopter industry in opening up a completely new market for a tactical machine as a production item separate from the conventional utility helicopters, the basic program has been slowed nearly to a standstill because of disagreement within the industry and the military as to what the configuration should be and even as to whether such a machine would provide enough of an improvement over armed conventional helicopters to be worthwhile.

Indications are that Bell management decided that there was a critical need for three-dimensional flying hardware in order to spur thinking and get the program off dead-center. Unofficially, Bell personnel expect controversy, but at least they feel that demonstrations and availability for critical examination, will speed settling some basic policy decisions. At the same time, the Sioux Scout could provide a useful educational tool in developing actual requirements, and determining configuration, performance, mission capability and tactics.

Time, cost and reliability were the criteria in developing the particular machine now flying. The aircraft uses the basic Bell OH-13s rotor dynamic system and powerplant and a center section and tail boom from the commercial Model 47J-2. Skid landing gear is also a modified Model 47J-2 component. Forward fuselage section, housing the crew, is largely built of reinforced plastic skinning, a speedy method of fabrication and one lending itself to rapid modification.

The company anticipates that the Sioux Scout will be subjected to considerable analysis and initiate many recommendations and suggestions as a result of being viewed and flown. Therefore, although there was feeling within some quarters of the company, that only an aerodynamic prototype was necessary, the decision was finally made to provide as complete a piece of hardware as possible, including installation of a working turret and fire control system, so that all aspects of the system could be demonstrated.

Bell, in turn, will utilize the vehicle in testing products and equipment applicable to the mission.

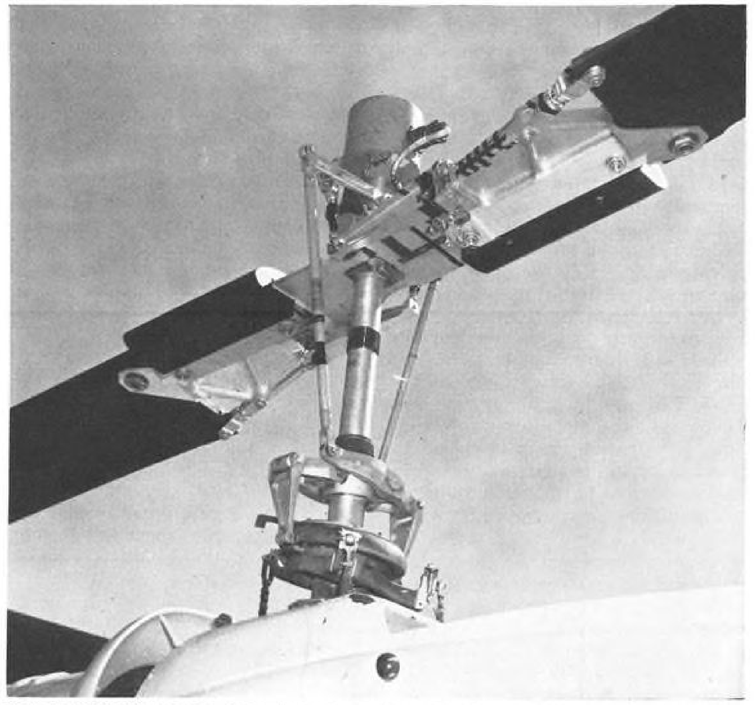
Powerplant is the 260-hp. Lycoming turbo-supercharged TVO-435-A1A used in the Bell OH-13s. Testing thus far has not extended into the high-speed portion of the performance envelope, but Bell anticipates that the Sioux Scout will show a marked improvement over the standard OH-13s because of its lower drag. An operational attack helicopter of the new class would be turbine-powered.

Cockpit arrangement places the gunner in the nose, ahead of the pilot, whose seat has been raised to provide maximum forward visibility. Armament system, as installed on the Sioux Scout, is a considerably modified version of the M-60 turret installed on the UH-1B, and like the airframe is the result of a privately-funded program by Emerson Electric Manufacturing Co., St. Louis.

Fire control system is like that on the UH-1B, but instead of being hung from the roof, is floor-mounted. Firing controls are on either side of the sight



TANDEM SEATING is a design feature of Bell's configuration concept of an attack-class helicopter. Note stub wings, gun turret.



"DOOR HINGE" ROTOR SYSTEM is designed to provide a combination of greater simplicity, improved performance and lower maintenance, as well as marked improvement in vibration characteristics and loads on the rotor at high speeds. New rotor system is now being flight tested by Bell Helicopter. Its Teflon bearings require no lubrication, Bell says.

head. The two .30-cal. guns respond rapidly to movement of the sight as it tracks the target. The turret swivels 200 deg. in azimuth, 15 deg. above the horizon and 45 deg. below the horizon. Should the gunner be disabled, a "dead man's" switch automatically returns the guns to neutral fixed forward position and the pilot can continue using them, aiming them by maneuvering the aircraft.

The aircraft is fitted with dual flight controls, the pilot having a conventional system and the gunner being provided with sidearm-type controls on arm-rest style pedestals on either side of his seat. Both gunner's and pilot's controls are active at all times, but due to longer leverage of the pilot's set, he has the mechanical advantage in over-riding the gunner when desired.

Stub wings are designed to carry auxiliary fuel, in addition to providing lift. The wings directly contribute to the aircraft's climb capability, and provide a definite advantage in steep turns, while maintaining higher speed, before objectionable vibration appears.

In addition to the new Sioux Scout, Bell briefed its visitors on these other aspects of its project list:

• **"Door-hinge" rotor system,** designed to provide greater simplicity, lower maintenance and improved performance is being flight tested by Bell. Tests have shown marked improvement in vibration and loads on the rotor system at high speeds. Vice president-director of development Joseph Mashman told AVIATION WEEK & SPACE TECHNOLOGY that this latter factor is very noticeable. Pulling a constant 2g in turns during a check of the system, he noticed that he could get to much higher speeds before objectionable vibration set in than with standard system.

The simpler, cleaner rotor hub that the door-hinge rotor system permits, provides a drag reduction estimated to save approximately 50 hp. when flying at 140 kt.

Conventionally, the Bell system has utilized a roller-type feathering bearing for attaching the rotor blades to the hub. The new door-hinge type has Teflon bearings, requiring no lubrication, is stiffer in the rotor plane to maintain blade symmetry and yet flexible as a beam to absorb rotor blade vibration, thus doing a much improved job of isolating rotor system-to-fuselage vibration. The design also permits all-steel construction of rotor head components, since vibration performance is more predictable than before, resulting in the simplification of fabrication procedures.

The basic idea is applicable to all Bell semi-rigid or hingeless rotors of two or more blades. Company declines to indicate when it will be a production article, saying it is in advanced development. It has been flying six months on a Model 204.

• **Spacecraft rotor recovery** system the company has developed and is currently building under a contract from NASA Ames Research Center was also displayed. A 25-ft.-dia. three-blade test rotor and actuation system will be delivered by November, 1963, for trials in Ames' 40-ft. x 80-ft. wind tunnel. Details are not yet available, but the program is aimed at developing recovery systems for spacecraft beyond Apollo.

• **Hepcat,** an acronym for helicopter pilot control and training equipment, is a small and inexpensive controller, derived from the company's microwave remote area instrument landing system program, which has been found applicable in reducing the time required to train helicopter pilots in the solo stage. The equipment basically comprises three items—the instructor's controller, a miniature stick, an electronic amplifier and mixing box to adjust the gain between controls and display, and a cross-pointer type display.

Hepcat provides a system by which the instructor can level out the helicopter, then introduce a maneuver on the display being closely monitored by the student, without changing the ship's attitude, and have the student perform the actual maneuver by working the controls to bring the cross-pointer back into neutral.

Gilruth Supports Gemini as Vital; Elimination of Some Flights Seen

Washington—Despite its development and funding problems, the Gemini program was strongly defended by Robert R. Gilruth last week as a critical preliminary to the Apollo manned lunar landing.

Gilruth, director of National Aeronautics and Space Administration's Manned Spacecraft Center, said that the data from Gemini experiments—particularly in developing rendezvous and docking techniques—will not be too late to be applied to Apollo. He indicated that if scheduling problems become more acute, some experiments planned to be run separately may be done concurrently. This could mean elimination of some of the 15 Gemini flights now being planned.

Concern has been expressed that because of delays, Gemini will be of no use for Apollo if the goal of a manned lunar landing before 1970 is to be met. Gemini piloted missions originally were scheduled before the end of this year. First manned flight is now scheduled for December, 1964.

On other subjects discussed at a National Rocket Club meeting here, Gilruth said:

• **Exchange of hardware** with Soviet Russia for a joint lunar landing program would be difficult from an integration standpoint. He said data exchange with Russia on manned space flight has been one-sided, and that he would welcome the opportunity to look at the USSR program.

• **U. S. ability to conduct** the Apollo mission was in doubt until Dr. John Houbolt, formerly of Langley Research Center, conceived the lunar orbit rendezvous technique. Gilruth said until this concept, "I did not believe we could make the lunar landing.

• **NASA would welcome** a larger Air Force role in Gemini. However, future USAF participation "depends on what other people do."

• **Third group of astronauts** is now being selected and will be announced this fall. Gilruth also said, "we would not turn our backs" on the Air Force Dyna-Soar pilots, "if something happens to Dyna-Soar."

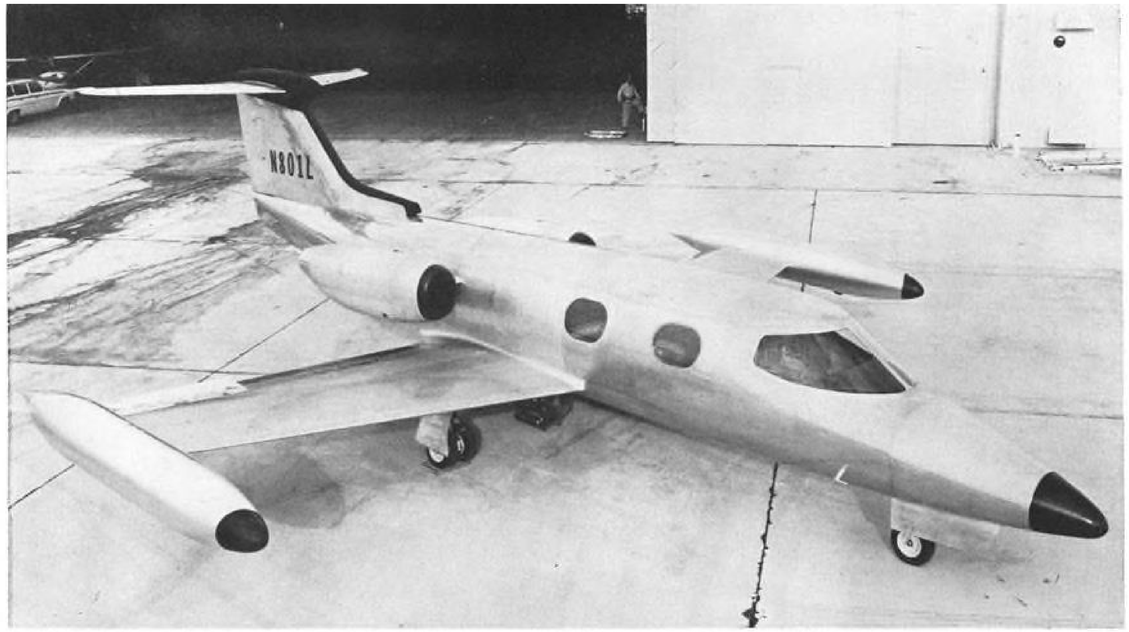
Gilruth added that he believes Russia hurt its space program by flying a woman—Valentina Tereshkova in Vostok 6—because the flight was a "diversion." He said it would be a diversion to have U. S. women in space.

• **Whether space station** or lunar landing should be the next major goal "has given us many worries. Only history will give us the answer."

Gilruth announced that the final report to the nation on Project Mercury will be made at Houston on Oct. 3-4. He said the two most difficult periods in the Mercury program occurred just before the first suborbital flight made by Cdr. Alan B. Shepard and before the flight of Lt. Col. John H. Glenn.

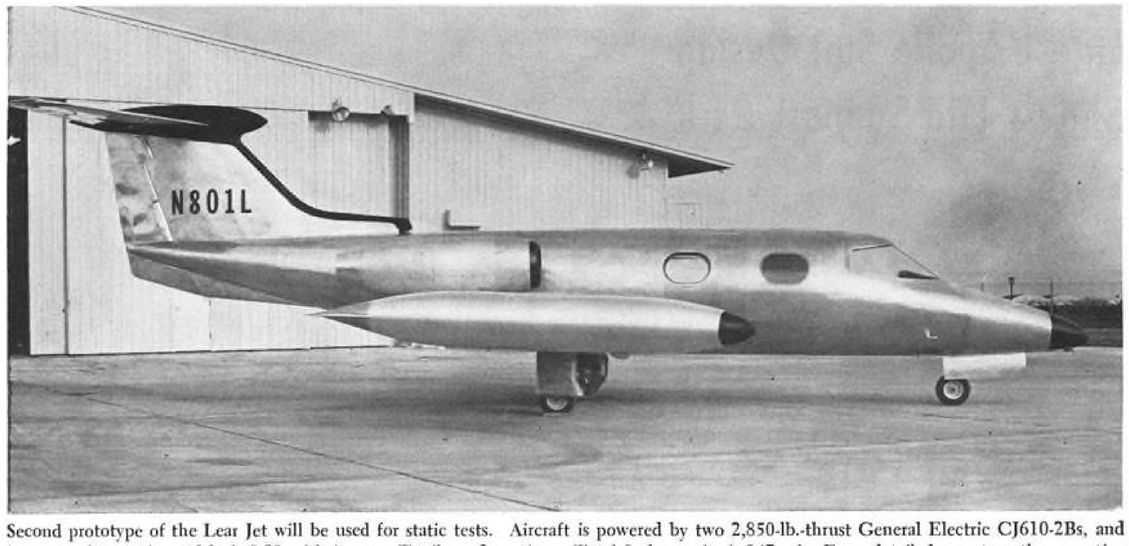
Before the Shepard flight, "crucial [test] operations were under way at Wallops Island and Cape Canaveral, and we were being investigated by scientists and doctors to see if the concept was any good," he said. At the same time, he added, the Mercury team was searching its soul regarding the basic concept.

Gilruth said the complete Mercury program cost about $380 million, divided this way: 37% for 20 spacecraft, 33% for the tracking and communications network, 24% for launch vehicles, 4% for operations, including Defense Dept. charges, and 2% for supporting development in such categories as wind tunnel tests and pressure suit work. He said an average of 300 government people directly managed the program, and two million people had some part in it.

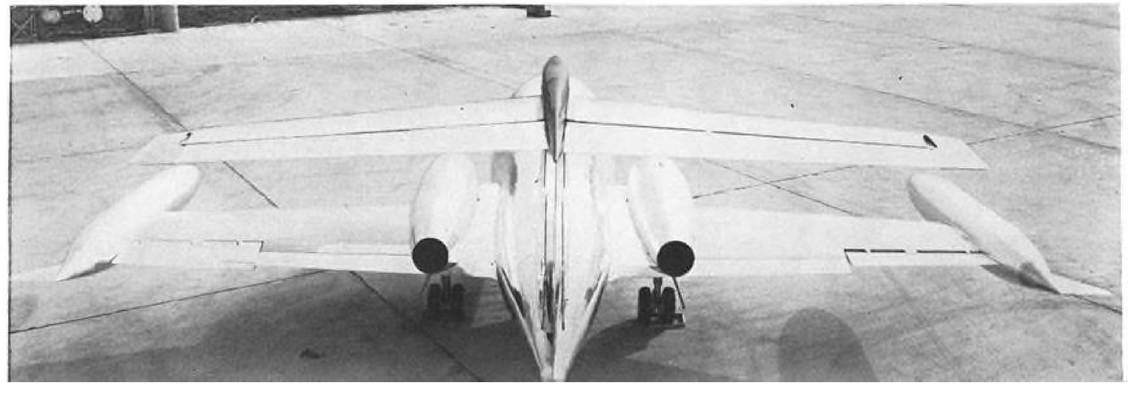


Lear Jet executive transport prototype was rolled out last week at company's Wichita, Kan., facility. Factory personnel have gone on a three-shift basis to prepare for flight tests in October. First flight is scheduled for Oct. 1-3, according to William P. Lear, president.

Lear Jet Rollout Intensifies Flight Preparations



Second prototype of the Lear Jet will be used for static tests. Aircraft is powered by two 2,850-lb.-thrust General Electric CJ610-2Bs, and is expected to cruise at Mach 0.82 with its new T-tail configuration. Total fuel capacity is 847 gal. For a detailed report on the executive turbojet and turboprop sales markets, see p. 102.







Latest Apollo space suit has portable life support system for up to 4 hr. on the lunar surface. Strap-on system provides oxygen and communications. Power supply also operates fans to circulate air. System can be recharged within the lunar excursion module for additional 4-hr. periods. Silvery suit, above left, slips over pressurized suit and support system to protect against heat and cold. International Latex Corp. is making the suit for National Aeronautics and Space Administration.

Latest Apollo Suit Design Shows Life Support Pack







This is an incandescent ball of gases, plasmas, magnetic fields, thermonuclear reactions and mysteries.

But NASA has started to throw some light on it.

After all, the sun does sustain life on earth. It disrupts our communications, pours deadly radiation into space and makes our weather do tricks.

So we need to learn the how and why and when of the sun's phenomena. And in the process pick up some basic facts about the whole universe.

So far the trouble has been that our atmosphere acts as a barrier. It makes optical and photographic and spectrographic images shimmer and scatter. In fact it completely *stops* most of the sun's radiation spectrum.

Now . . . if we could only put our instruments *outside* the earth's atmosphere . . . in a new and extremely sophisticated satellite . . . pointed precisely at the sun . . . .

Today, development work for that satellite—the Advanced Orbiting Solar Observatory—is being performed at Republic, under a prime contract to NASA/Goddard.

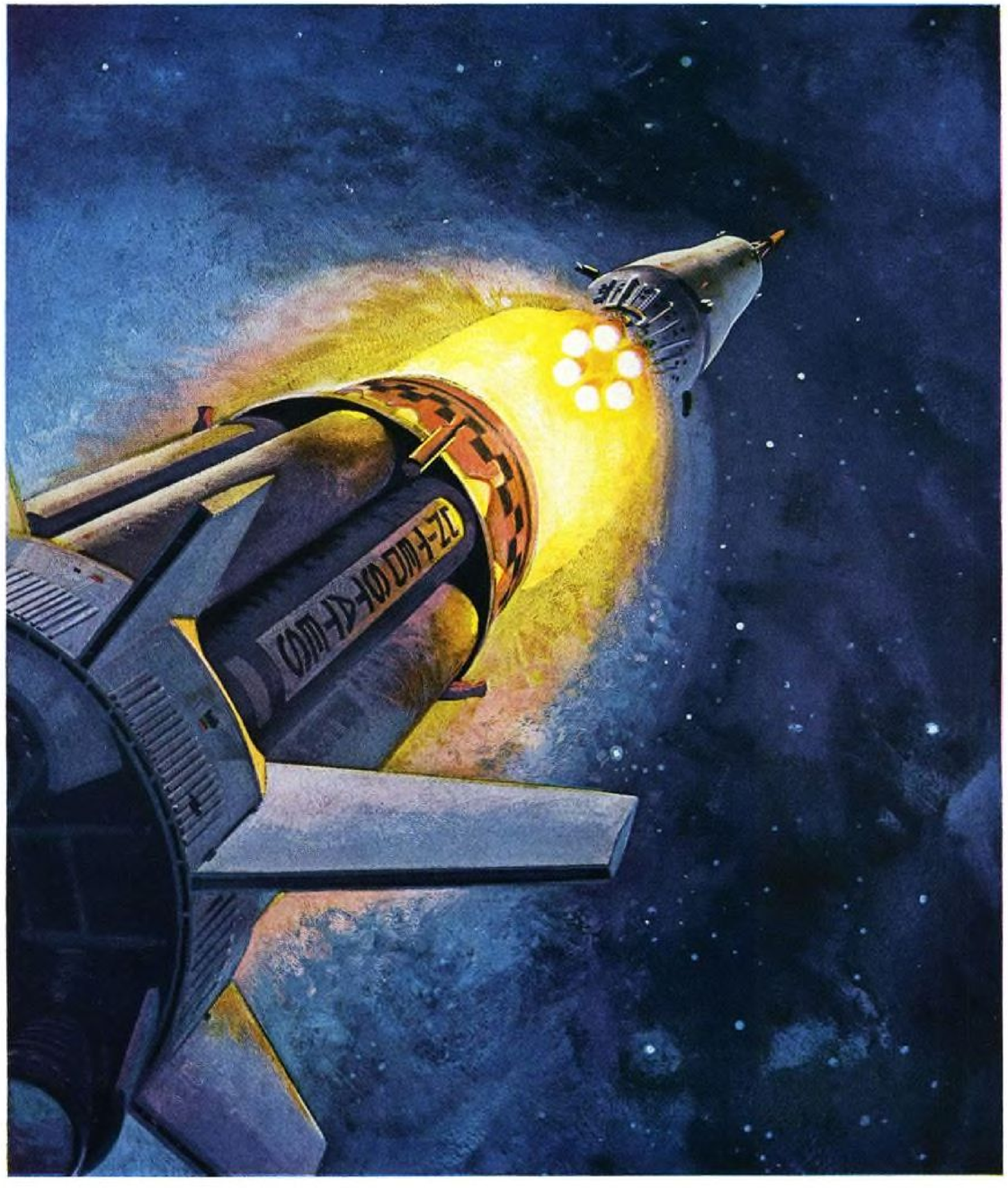
The AOSO will orbit 300 miles above the earth. In sunlight uninterrupted for months on end. Carrying about 250 pounds of instruments to collect, store and transmit data on the sun's gamma-ray, x-ray and ultraviolet activity.

It will be aimed at the sun with an accuracy of five seconds of arc. That's like shooting at a dime one-half mile away. And hitting it.

NASA's Advanced Orbiting Solar Observatory will look something like the model below. Nobody expects it to find *all* the answers that solar physicists and astronomers have sought for 350 years. But after it has studied that incandescent ball for a while, we'll be a lot less in the dark.



REPUBLIC
AVIATION CORPORATION
FARMINGDALE, LONG ISLAND, NEW YORK



New power for space will come from America's first liquid-hydrogen engine, the RL-10. This upper-stage powerplant is being developed by Pratt & Whitney Aircraft for NASA's Marshall Space Flight Center. The RL-10 is designed to stop and start in deep space, with advanced models offering throttle control of power. Pratt & Whitney Aircraft provides design and manufacturing leadership in power for many applications, in and out of this world.

Pratt & Whitney Aircraft
U
DIVISION OF UNITED AIRCRAFT CORP.
A
EAST HARTFORD, CONN.

Glider Lost After ASSET Shot Succeeds

By George Alexander

Cape Canaveral—Air Force lost its first ASSET experimental re-entry glider in the ocean last week after the vehicle made a successful 1,000-naut. mi. ballistic flight down the Atlantic Missile Range.

USAF was certain only that the parachute of the recovery system had deployed properly. A downrange vessel criss-crossed the predicted impact area, but reported back that it had not picked up any signals from the recovery locator beacon carried aboard the glider. USAF was preparing to send out aircraft during the night to see if the crews could sight the high-intensity strobe light also carried by ASSET as a recovery aid.

The ASSET (aerothermodynamic-aerothermoelastic structural systems environmental test) glider, first of six McDonnell Aircraft Corp.-built vehicles scheduled to be flown from here (AW Mar. 18, p. 34), was launched by a Thor intermediate-range ballistic missile at 4:40 a.m., EST, Sept. 18.

The Douglas Aircraft Co.-built Thor—the first of the missiles to be used since their return and refurbishment from service with the Royal Air Force in Great Britain—performed normally, reaching a peak altitude of 203,000 ft. before nosing over and diving to 195,000 ft. to impart a velocity of 16,000 fps. to the glider.

Thor burned out at, and the ASSET vehicle separated at, 195,000 ft. ASSET then flew a shallow glide trajectory back to earth at an angle of attack of 38 deg. above a local horizontal.

The glider transmitted data gathered by 59 thermocouples, 35 pressure transducers, six deflection sensors and four accelerometers mounted on different parts of the structure over 140 telemetry links. Quality of the returned data received by at least one downrange tracking station and one ship was described by a source as "excellent."

ASSET carried an X-band telemetry transmitter in addition to a conventional VHF set and an on-board tape recorder. The X-band system, developed by Avien, Inc., was expected to pierce the sheath of ionized gases flowing over the glider during re-entry and was to have been used about 4 min. of the approximately 10-min. duration of the sheath.

The system had been flown aboard a Scout vehicle previously, but had never had the opportunity to operate, since the Scout failed.

One of the molybdenum panels on the forward end and one of the columbium panels on the aft end of the glider's underbody were coated with a Boeing Co.-developed disilicide material under consideration for the X-20 (Dyna-Soar) spacecraft.



FIRST ASSET GLIDER is shown atop Douglas Thor booster before launch last week.

Like ASSET, Dyna-Soar's airframe will consist largely of molybdenum and columbium, refractory metals which oxidize readily and which must be protected with a coating until the vehicle is beyond the corrosive earth atmosphere. Molybdenum and columbium panels were 0.029-in. and 0.020-in., respectively, and were backed by beryllium heat sinks. Neither metal was used for load-bearing members.

Detailed analysis of the data gathered by the six gliders in the program is expected to provide a better understanding of the physical phenomena surrounding a lifting body during re-entry. Such elements as heat flux distributions, airflow patterns, pressure gradients, structural integrity and performance of refractory metals under actual re-entry conditions, glider design stability and control characteristics, flutter and vibration, are all expected to be explored with the ASSET gliders. The findings are expected to have application to such future vehicles as Dyna-Soar, hypersonic aircraft, aerospace planes, and advanced re-entry systems.

Both the leading edge configuration and the 70-deg. sweep of ASSET's short, 14-sq. ft. stub wings are nearly identical to those of Dyna-Soar. One engineer said that the data gathered by this first ASSET—an aerothermodynamic model—on airflow patterns over the wings would be checked closely for correlation with wind tunnel data taken on Dyna-Soar models.

Hottest spot on the 68.7-in.-long, 58.9-in.-wingspan, 1,060-lb. glider was expected to be the nose cap, with a temperature of about 4,000F. The cap consists of a series of 1.5-in.-long, 0.5-in.-dia. zirconia pins in a zirconia cement. Cap resembled a honeycomb structure.

USAF Stresses Manned Aircraft Needs

By Larry Booda

Washington—Demands for manned aircraft that can fly faster and higher, loiter for long periods of time, penetrate enemy territory at low altitudes, intercept enemy aircraft by flying Mach 3 and carry outsized cargo overseas were voiced here recently by the commanders of the major Air Force commands. They marked a major change in Air Force emphasis away from missiles and space.

The demands were answered by Gen. Bernard A. Schriever, commander of the Air Force Systems Command, who said: "From a technological standpoint, as I look into the 1970s, I haven't heard a single requirement here that we can't fulfill."

The exchanges took place at a panel discussion on manned aircraft requirements for the 1970s during the recent Air Force Assn. convention here. The technical requirements were voiced by Gen. Thomas S. Power, head of the Strategic Air Command, Lt. Gen. Herbert B. Thatcher, commander of the Air Defense Command; Tactical Air Command Chief Gen. Walter B. Sweeney and Military Air Transport Service Commander Gen. Joe W. Kelly. In supporting these commanders, Gen. Schriever said:

- **Application of shock cancellation** techniques may enable aircraft that are of basically subsonic design to cruise at speeds in excess of Mach 1.
- **Use of laminar flow control (LFC)** on aircraft lifting surfaces will make possible increases in the subsonic speed range and endurance of large aircraft.
- **Advances of engine inlet design** and the technology of combustion, coupled with the use of hydrogen as a fuel, could lead to design of aircraft that are much faster than present supersonic aircraft—speeds on the order of Mach 6 to Mach 8.
- **Technical progress** in the configuration of aircraft, development of high-temperature structural materials and propulsion systems will make feasible the development of a wide variety of aircraft ranging from conventional designs to vertical-takeoff-and-landing (VTOL) aircraft.

In addition, Gen. Schriever noted that by the late 1970s, the U. S. may have some manned systems that combine many of the characteristics of aircraft and space vehicles. In the aerospace plane concept, he said, the vehicle would take off like an aircraft from a standard runway, perform a mission in space and then return for a routine airfield landing (AW Sept. 16, p. 29).

Gen. Power made the strongest demands. He said that the Boeing B-52 fleet can do a good job at present, but in order to maintain a variety of strategic nuclear delivery systems, one or more manned aircraft systems are needed to replace them in the near future.

Gen. Thatcher stated that if a potential enemy were to develop a Mach 2.5 bomber, a Mach 3 interceptor would be necessary to catch it. He supported his view by saying that Russia has announced its intention of developing a Mach 2.5 transport, and that conversion of such an aircraft to a bomber configuration is relatively easy.

Gen. Kelly noted that MATS strategic airlift aircraft needs are now being met with the Lockheed C-130 series and the Lockheed C-141. However, the Douglas C-133 Cargomaster, a four-turboprop aircraft designed to carry outsized cargo such as missiles, was produced in limited quantity and must be replaced. He strongly supported the CX-4 transport program (see p. 23).

Gen. Sweeney said the General Dynamics F-111 (TFX) tactical fighter answered his needs for the near future, but that greater emphasis on VTOL aircraft would be desirable for the 1970s.

Among the proposals now being studied, Gen. Schriever said, are several strategic systems. These include a high-altitude, extremely high-speed strike-reconnaissance aircraft, an aircraft designed to make low-altitude penetrations to targets, and a multipurpose, long-endurance aircraft capable of several types of missions.

The low altitude manned penetrator (LAMP) is a relatively new study, while the multi-purpose, long endurance (MAPLE) has been under consideration since last year (AW May 6, p. 33, Sept. 16, p. 26).

Panel members defended two aircraft that have been criticized in the past. Regarding the F-111, Gen. Sweeney said "there isn't any question in my mind that the airplane we are getting will do a job that is badly needed. It will do an extremely fine job."

Gen. Schriever added, "The airplane has much greater performance capabilities than anything we have in the inventory today or anything that is going into the inventory. This is performance in the way of runway requirement, or performance in the way of low-altitude and high-altitude speed, range and bomb-carrying capacity."

Gen. Power defended the General Dynamics B-58, the only supersonic bomber in the SAC inventory. "We went through a long, hard period in trying to get that airplane so it flies," he said. "It will fly in the development criteria and make speed records, but when you put a combat requirement on it in order to fly 24 hours a day, either you can do it or you cannot. . . .

"We finally have the bugs out of it, and I consider it one of the finest systems in the world today. It has a very fine low-altitude capability and of course it has a Mach 2 capability at high altitudes. It has an extraordinary piece of bombing equipment in it," the SAC commander said.

The panel took note of Army needs in counter-insurgency and limited war situations and in support of strategic airlift and close support firepower. Although there was general agreement that VTOL would be desirable in aircraft to fill all of the mission categories, there was no optimism that significant technical breakthroughs in this area would be forthcoming soon to meet the counter-insurgency requirement.

In summarizing the requirements, Gen. Schriever said, "The fact that they are possible does not guarantee their actual development. The crucial factor in acquiring a new system is often not technology. Rather it is the problem of translating technology into operational systems on a timely basis. No matter how extensive our research may be, it has not served its purpose until a decision has been made to actually build something."

He also said that advances could be made without pushing the state-of-the-art. They are "right before us in the area of materials and the area of propulsion," he continued. "I am talking about old-fashioned jet propulsion. We can achieve much higher thrust-to-weight ratios. We can achieve much better fuel consumption," Gen. Schriever told the panel.

Schriever Outlines Forecast Goals

Washington—Air Force has tried to identify areas of technology that will pay off the most in future weapon systems, without attempting to foresee what breakthroughs might occur, in its Project Forecast which began last spring (AW Apr. 8, p. 25).

In the first public comment on the project, Gen. Bernard A. Schriever, commander of the Air Force Systems Command and project director, said recently, "We have been looking at this from several points of view. First from a national policy objective, then the best estimate of the situation as we can forecast it for the time period we have under consideration [1965-1975]."

Areas of technology that look as though they will pay off will be exploited at accelerated rates, he said. Participants in Project Forecast were technical and operational Air Force personnel, Army and Navy representatives on panels where missions overlap, Aerospace Corp., Mitre Corp. and Rand Corp., he said. A contract was also let to the National Academy of Sciences for work in some technical areas, he added. The Air Force Scientific Advisory Board was used on a consultant basis.

The project consisted of 13 technical panels and five capability panels (AW Sept. 9, p. 28).

The formal study period is drawing to a close, Gen. Schriever said, and a series of reports are being prepared. No formal report of the entire proceedings will be made to high level authority. Rather, the material will be placed into regular Air Force planning channels where it will be refined for future submission for approval, he said.

Gen. Schriever took care to explain that not only technical knowledge and intelligence were used in the project, but that political, economic and other considerations for both the U. S. and a potential enemy were included.

The project tried to fit its studies into the climate of any political administration, he said, including policy objectives such as survivability; controlled response, negotiating thresholds and crisis control.

"Where we have the big problem is the transition of technology into a decision to go ahead with the system. Now that's where you commit your big money and that's where you need to be sure that you've spelled out your requirements in the way of specifications that are satisfactory to the user, as well as being satisfied that technology is sufficiently advanced that you're not taking too great a risk in making the decision to go ahead."

U.S. 90% Confident of Capability To Destroy Vital Enemy Targets

Washington—U. S. has a confidence factor of better than 90% that important enemy targets will be destroyed by strategic retaliatory weapons, according to Gen. Thomas S. Power, commander of the Strategic Air Command.

During a panel discussion on manned aircraft requirements in the 1970s at the recent Air Force Assn. Convention here, Gen. Power said:

"We try a realistic war game, a sortie through a defense environment, and then we . . . give it a downgrade through malfunctions of the equipment, through weather, through crew error, and through enemy attrition. You have to take each sortie through a normal defense environment.

Confidence Factor

"Now we arrive at a confidence factor of whether that particular sortie will deliver its weapons. And with the weapons we deal with in SAC it takes only one weapon to destroy anything that is in its target area, if it is delivered accurately. So, therefore, we just have to add on weapons until we reach the desired structure.

"For example, in one weapon system, say a B-52 out of New Mexico going against the Soviet Union, if your realistic war games are thorough, you have a 50% confidence factor for destroying that target with a given weapon. If you are satisfied with a 50% confidence that that target would be destroyed, you would send one weapon against it. If you want a higher confidence factor you send two.

"But you don't get 100% confidence; you get 75% confidence with a given weapon system. If you want more confidence you send three. Now you are in the high 80s. If you want to be still more confident you send four or five, and eventually up to six or seven. Each added weapon system buys you a very small fraction of a percentage of increase so there is a level you can't go beyond.

"But let's say you have a 90% confidence factor. That means that there is a 10% chance you don't destroy your target at all. You might send four or five weapons against it, but you don't necessarily send four or five of the same weapons. This is where a diversified inventory helps you in a war plan. You send one type, and then another type, maybe from a different location—mixing airplanes and missiles together to make sure that you get that target.

"Now the difference between regular war plans and most of the things people get involved in, you are down to stark reality here, and now you are dealing with facts, you can't be wrong. And all I will tell you is that we have a better than 90% confidence factor that what we call the hard targets, important targets, will be destroyed."

Asked why there was a modernization program under way on the B-52 bombers, he explained his views on weapon reliability like this: "We do not update aircraft simply to get increased performance, but to get better reliability. There have been some modifications which increased performance. But the real requirement is reliability and flying safety. . . .

"The most useless thing in this world is a weapon system that cannot fight—and I mean 24 hours a day. We have a lot of systems that are of questionable value. The only ones I can put into action are the ones that have known reliability factors. And this is why I stress the word reliability.

Weapons Reliability

"We never can achieve the same reliability in missiles [as in aircraft]. That is something that is unknown. . . . One of the things that worries me is you know you will not have a high degree of reliability if you do not test realistically. You can realistically test aircraft under combat conditions and you could do the same with missiles if you wanted to.

"But the trend today is not to test them realistically from their actual operating locations. And this means you take a weapon from inventory, put it in the hands of a combat unit and take it out and detonate it just to see if it goes off.

"We know from hard experience that until you do that, you are never sure. . . . We have some interesting things in the field of firing bombs that were lying in storage. We went to drop them and they just would not go off."

MILA Proposals

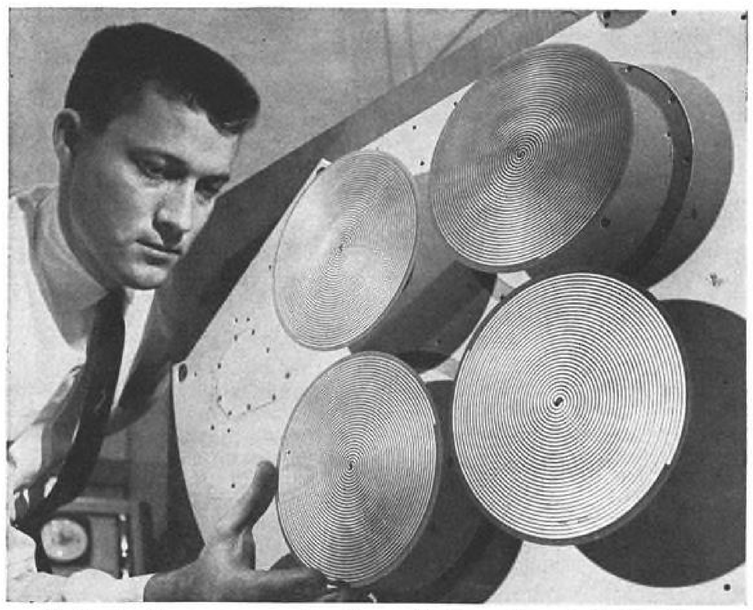
Cape Canaveral—National Aeronautics and Space Administration has mailed proposal requests to 197 firms—including a news service—interested in its housekeeping support functions at the Merritt Island Launch Area (MILA).

The contract, for administrative and management services (AW Sept. 9, p. 23), is one of four for housekeeping at MILA. NASA said there was extreme interest shown in it, although a number of the firms seeking the bid requests apparently were hoping to act as subcontractors to large prime contractors.

In addition to the expected interest from such large aerospace firms as Boeing and General Electric, NASA said the list included Trans World Airlines, Riddle Airlines, Page Airways, the Fruehauf Trailer Co. and Hearst Metrotone News.

The contract is in four main sections—technical information, photographic operations, field printing plant operations and automatic data processing.

NASA is expected to announce soon its choice of a firm to handle all communications for the area except normal administrative telephone services (AW Aug. 12, p. 30).



Spiral Antennas Designed for Gemini Radar

Transmitting and receiving antennas for the Gemini radar are examined by engineer at Westinghouse Electric Corp., contractor for rendezvous radar and transponder equipment. Use of the spiral antenna, which will be located on the front of the spacecraft, allows a reduction in weight, compared with a dish-type antenna. In addition, spiral antenna needs only to be rotated, not pointed at target like a dish antenna, Westinghouse says.

Fastener Firms and Officials Fined

Los Angeles—Six corporate and three individual defendants indicted for violating the Sherman Anti-Trust Act by fixing the prices on self-locking nuts sold to aerospace firms were found guilty and fined $500 each in a U. S. district court here last week.

Each defendant entered a "no contest" plea, which was accepted by Judge Thurmond Clarke. Maximum punishments in the criminal proceeding could have been a year in prison and a $50,000 fine for the individuals and a $50,000 fine for corporate defendants.

A "no contest" plea, which is neither a "guilty" nor a "not guilty" plea, is often used as a means of expeditiously disposing of legal proceedings to avoid a long trial. Judge Clarke said after the arraignment he felt the $500 fine was all that was justified on the facts presented (AW Sept. 9, p. 37).

Those fined:

- **Elastic Stop Nut Corp.** of America, Union, N. J., and the Collins-Powell Co., Beverly Hills, Calif., acquired by ESNA in 1959 and operated as a subsidiary.
- **Kaynar Mfg. Co., Inc.,** Fullerton, Calif.
- **Standard Pressed Steel Co.,** Jenkintown, Pa.
- **Townsend Co., Norwalk, Conn.,** which last November was merged into Textron Industries, Inc., Providence, R. I. and Boots Enterprises, Norwalk, which was acquired by Townsend in Nov. 1960.
- **W. F. McGuinness,** president of ESNA., Frank A. Klaus, president of Kaynar, and H. Thomas Hallowell, Jr., president of Standard Pressed Steel.

A federal civil complaint also alleging price-fixing was filed with the U. S. District Court here at the same time that the criminal indictment was returned.

The civil suit, still pending, names four firms, including three named in the criminal indictment. The four are ESNA, Kaynar, Standard Pressed Steel and Textron. The court was asked to halt the alleged price-fixing and to order the companies to issue new price-lists.

A Kaynar legal spokesman said that neither the company nor Mr. Klaus would comment regarding the "no contest" plea, since the civil suit is still outstanding. He added, however, that it was considered the most expeditious way to handle the matter "in view of all the circumstances."

According to the indictment, companies named accounted for 93% of the $19.6 million in U. S. sales of all self-locking nuts qualified under National Air Standards and military standards.

News Digest

Air Force Space Systems Div. issued proposal requests Sept. 18 to 45 companies to bid on national orbiting space station (NOSS) studies (AW Sept. 16, p. 26). Bids are due Oct. 18 and three parallel awards will be made early next year. The companies will share about $1 million for the studies.

Rolls-Royce Medway bypass engine derivative has been selected to power the Whitworth Gloster AW-681 V/STOL transport for the Royal Air Force (AW Apr. 1, p. 57), capping a long behind-the-scenes-battle between Rolls and its main British competitor, Bristol Siddeley Engines, Ltd., builders of the Pegasus family of deflected thrust engines. Decision favoring Rolls will be announced soon by the Air Ministry and Ministry of Aviation.

General Electric's Missile & Space Vehicle Dept. is expected to be picked soon by USAF's Ballistic Systems Div. to conduct a program definition phase study of the advanced Minuteman ICBM re-entry system, known as Mark 12 (AW July 29, p. 24). An award would culminate almost a year of delays in the procurement.

Air Force's Space Systems Div. will brief industry Tuesday, Sept. 24 on its requirements for a standardized space guidance system (AW Sept. 16, p. 39). Industry proposals are due on Oct. 14. Proposal requests were distributed to 22 companies on Sept. 13.

Hercules Powder Co. will furnish the propulsion system for HIBEX (AW Sept. 9, p. 37), a high-acceleration rocket motor designed to generate information for advanced anti-ballistic missile systems. The contract was awarded by Boeing for an undisclosed amount.

Doman Helicopter board of directors has voted to recommend stockholder approval of a proposal made by Waltham Precision Instrument Co. whereby Waltham would be entitled to acquire an interest of approximately 80% in Doman in return for financial and managerial support. Doman would operate as a subsidiary of Waltham under the proposal and would resume its postponed program for the manufacture and sale of an eight-place commercial helicopter, Model D-10B.

John H. Rubel, former assistant secretary of defense for research and engineering, has been named vice president and director of technical planning for Litton Industries.

Local Service Subsidy Cut Irks Congress

Legislators surprised, angered by CAB's plan to reduce payments by one-third over five-year period.

By Robert H. Cook

Washington—Civil Aeronautics Board's detailed plan to slash local service airline subsidy payments by at least one third over the next five years has triggered protests from perplexed congressional supporters of the industry (AW Aug. 19, p. 38).

Behind this reaction is the unspoken suspicion that the White House is attempting a bold invasion of territory historically controlled by Congress. What it has been unable to accomplish through appeals to Congress in the past two years may now come about through a direct executive order to the CAB, many industry leaders fear. Only the most intense congressional pressure can avert adoption of the plan, they feel.

It appears that Congress has been caught off guard by the unaccustomed intensity of CAB's interest in subsidy reduction. The local service subsidy bill always has run an annual gauntlet of Administration, congressional and industry scrutiny, but always has survived intact on the principle that the value of the grass-roots service far outweighed its cost to the taxpayer. Against this background, the Administration's directive that CAB prepare a detailed plan of actual subsidy reduction was generally regarded as just another exercise which would never be put to actual use.

Reduction Schedule

Unless Congress can marshal its defenses quickly, the entire plan may become a *fait accompli*. CAB has already announced that it intends to implement the reduction schedule by Jan. 1 unless it is blocked by the lawmakers, and Board sources report that the Fiscal 1965 budget being prepared for the Budget Bureau is tailored to the subsidy reduction proposal.

In addition to the Board's alacrity in promoting the plan, Congress also must contend with possible early approval of the plan by a special committee headed by Commerce Secretary Luther Hodges. The Budget Bureau is represented on this committee, along with the Federal Aviation Agency, which has been cooperating closely with the CAB's program of establishing regional airports as a local service economy measure, and the Council of Economic Advisers, whose members are more likely to think in terms of the local service industry's role in over-all national transportation, rather than its immediate problems. The White House insistence on the plan, and its delivery to the special committee, has also caused some industry observers to speculate that it may be the first step in the Administration's long-cherished hope for a unified, national transportation system.

The sole point of unanimity with the local service industry is that the idea is exceedingly premature. In addition to those who see the plan as a "trial balloon" for a national transportation system, others are more suspicious of the underlying motives, charging that the idea is a direct result of trunk carrier pressure to reduce and block competition from the smaller airlines. Supporting this theory, they emphasize that key parts of their plans for future growth—such as a DC-3 replacement and entry into heavier traffic areas—have been flatly rejected in the report.

Small Minority

Still another group takes the position that the local service industry suffers the natural disadvantage of being a small minority of the entire U. S. transportation system, domestic and international, at a time when the Administration is concentrating upon essentially large issues. As an example, they cite the apparent ease with which the Federal Maritime Administration enjoys both Administration and congressional support for the merchant marine subsidy bill, which exceeded $300 million in Fiscal 1963. The purpose is to assure that the U. S. fleet operators can compete successfully against foreign competition, and to this end FMA is paid a heavy operations subsidy, plus 55% of the cost of new ships and generous trade-in allowances for old vessels.

While the local service subsidy bill of about $60 million is only a fraction of the merchant marine subsidy, the subsidized airlines are not in the more glamorous area of foreign competition, which only a few years ago required heavy subsidy payments for both Trans World Airlines and Pan American World Airways. In short, many local service operators feel that the Administration has concentrated so heavily on the "big picture" issues that it has failed to realize the importance of the smaller carriers to the domestic airline transportation system.

The subsidy reduction program, authored by a former Commerce Dept. employe, David W. Bluestone, has been drawn in large measure from an earlier Bluestone project entitled "Goals of the CAB." In this study, Bluestone concluded that local service subsidy should be "compared to the national output, and to other transport and non-transport subsidies. Then a year-by-year dollar value should be established and requested as a series of congressional appropriations."

Later, he added that the class mail rate formula could be used to control subsidized services and that reduction of the total subsidy bill to a much lower level than the present, without eliminating it within a specific span of years, would be among several alternate goals.

Present Form

In its present form, the reduction plan leans heavily on the class mail rate as a subsidy slashing tool. Compared with the present formula which pays subsidy for eight round trips a day, the reduction plan will lower this to a maximum of only four trips a day within three years. Net subsidy reduction for the locals would start at $3.5 million for the first year and reach $18.7 million during the fifth and final year.

A key part of the proposal is a requirement for minimum of two round trips a day for an estimated 42 smaller communities. Higher subsidy rates will be paid for these services, and the hope is that they will generate sufficient traffic to avert being dropped from the airlines' routes under the Board's "use-it-or-lose-it" policy.

Bluestone contends that this provision alone carries out the "will of Congress" to promote adequate airline service for smaller communities. He adds that among the smaller communities now receiving only one trip a day, 88%

have failed to generate enough traffic and have become subject to deletion from the local service routes. In contrast, he points out, the deletion rate is only 33% for communities with two trips a day.

Local service spokesmen take bitter exception to the "two trip a day" theory, claiming that it will not only cost more than the estimated $1.8 million in subsidy but will fail to generate the anticipated traffic, resulting in eventual deletion of these points and an almost complete abandonment of service to grass-roots communities.

In a clear enunciation of congressional understanding of the local service airlines' problems Sen. Warren G. Magnuson (D.-Wash.), chairman of the Senate Commerce Committee, said this:

"Each year as certain as the ground hog, the Civil Aeronautics Board is urged to expand service to smaller communities on the one hand and reduce subsidies to the local service carriers on the other. I think we should recognize once and for all that the Board cannot do the impossible. They have done an admirable job of minimizing subsidies consistent with the mandate of Congress to provide such service. At this stage of the art it is economically infeasible under even the most severe management restraints to provide this service at a profit. Consequently the need for subsidy arises . . . and it will continue until the need for such air service ceases or until research develops more economical equipment."

Rep. Albert Thomas (D.-Tex.), chairman of a House Appropriations subcommittee on independent offices, customarily places CAB's subsidy budget request under a withering scrutiny, but has never suggested any large-scale reduction, industry observers contend. Most of the congressman's probing questions have been directed at assuring the subcommittee that CAB keeps an accurate watch on what it is getting for each subsidy dollar, rather than any intimation that the industry in general is collecting too much, they point out.

Sen. A. S. "Mike" Monroney (D.-Okla.), chairman of a Senate aviation subcommittee, took particular issue with the Board's contention that it is carrying out the "will of Congress."

"It is hardly our will to support any move which will strike a severe blow at the small and medium-sized communities of America and jeopardize the future of the local service airlines," he replied.

He charged the backbone of the subsidy reduction plan is based upon "wild assumptions" of lower operational costs and higher traffic volumes, and promised to oppose any move to implement the plan.

"This is a serious problem," he said, "coming at a time when it's tough for these airlines to survive. And it is also ironic that, while the White House seems to feel the country cannot afford two or three million dollars a year for local service, it has no compunctions about subsidizing nearly one billion for a supersonic transport program useful primarily in foreign travel."

Sen. E. L. Bartlett (D.-Alaska), a member of both the Senate Commerce Committee and the aviation subcommittee, hit the CAB study as a "meat axe approach" that would create "absolute chaos" in Alaska because of that state's dependence on aviation for internal transportation.

Sen. Ernest Gruening (D.-Alaska) said bluntly that he was "outraged at the stupidity of the CAB," and would take the proposal up with the President if it appears the plan may be adopted.

Pressures Mount on CAB Over Northeast

By L. L. Doty

Washington—Political pressure on the Civil Aeronautics Board to reverse the decision that removed Northeast Airlines from the New York-Florida route (AW Aug. 26, p. 38) attained new heights last week with a direct attempt at intervention by the Kennedy Administration.

The move, a petition by the Justice Dept. to participate in the case, was promptly rebuffed by the Board, but there were no signs as of late last week that top-level governmental pressure on the CAB had slackened. Regional congressional activities in behalf of Northeast have gained such momentum that the New England delegation, which is leading the attack on the Board under Sen. E. M. Kennedy (D.-Mass.), began to draw criticism from its colleagues in Congress.

Pressure Cited

Most outspoken was Rep. William L. Springer (R.-Ill.), who last week told the House that "I have never seen this kind of pressure exerted since I came to Congress 13 years ago." At the same time, a top Board official told AVIATION WEEK & SPACE TECHNOLOGY that he had never before experienced such pressure as that brought to bear on the Board by the Northeast decision.

Meanwhile CAB Chairman Alan S. Boyd refused to yield in his determination to follow proper Board procedures to the letter in the case. Last week, he locked horns with the Justice Dept. by publicly criticizing the petition for intervention, an episode that is widely interpreted here as a blow to any political aspirations Boyd may have under the Administration.

On a Westinghouse Broadcasting Co. radio program, Boyd last week said that the Justice Dept. is entitled to an opinion on the number of airlines servicing the New York-Florida route, and then added:

"In fact, the Justice Dept. was entitled to take this position in June of 1961 when the case was started. The major issue in the case was whether or not there should be three carriers. I must confess I'm surprised that the Justice Dept. just found out about the case."

In its petition, Justice Dept. gave these reasons as grounds for intervention:

- **U. S. has a "direct interest,** in its sovereign capacity and as a user, in the preservation of competition to the extent necessary to assure the sound development of an air transportation system" for commerce, mail and the national defense.
- **Board decision** that there is no need for a third carrier on the Florida-East Coast route "raises substantial questions affecting the public interest, and the public convenience and necessity."

Later in the week, the CAB, by a 3-2 vote, denied the move to intervene, noting that "nothing in the department's petition for intervention shows good cause for untimely filing. Moreover, the petition . . . discloses that the department wishes to address itself to matters which have been in issue since the inception of the proceeding and have been fully litigated by the parties to the proceeding."

Vice Chairman Robert T. Murphy and Member G. Joseph Minetti, dissenters in the original decision dissented against the denial.

Chief Target

Although Boyd is backed by Members Chan Gurney and Whitney Gillilland in the formal decisions that have reduced Northeast from a trunk status to a regional operator, he alone has been the chief target of the mounting pressure against the Board which, so far, has included the Justice Dept. petition, a request by New England senators for a Justice Dept. investigation of the case, two congressional investigations and new legislation designed to over-ride the CAB decision.

Boyd has not wavered in his position nor has he gone to Congress for support in his stand, although it is now apparent that he has a strong reservoir of backing in both the Senate and House despite forces the Kennedy group has brought into play. In his broadcast, Boyd gave this explanation of the Board's position in the Northeast case:

. . . "We are not playing favorites in this case. This is a very irresponsible charge that is often leveled by people who don't like something that happens. The plain fact of the matter is that the Board, as is true of all other agencies of government, has to make decisions. And when we make a decision, normally somebody is happy and somebody is unhappy. The unhappy people tend to become very irresponsible. And that's exactly what happened in this case."

The issues at stake are now broader than the argument over whether Northeast's certificate should or should not be renewed. Main thrust is the issue of how far can regional interests go in barring the CAB, or any regulatory agency, from acting freely in reaching a decision in the public interest.

Congress can question decisions, and applicants in any case have the right of appeal and the right to file for reconsideration, all devices designed to prevent unfair practices. But the prime purpose of the regulatory system is to provide regulation of an industry in the public interest without any political considerations (AW Sept. 9, p. 41).

Meanwhile, there are other signs that the scope of the Board's authority is gradually being narrowed by the transfer of some of its functions to other departments.

Commerce Dept., for example, is showing signs of wanting more authority in the air transport field, has already been successful in drawing the local service guaranteed loan program under its jurisdiction. State Dept. has strengthened its hand in the international air transport field by upgrading its aviation division, and was directly responsible for the U. S. decision to disapprove the Chandler fares (AW May 20, p. 39).

The Kennedy Administration has asked the CAB to play little part in other areas affecting air transportation. The development of the White House policy (AW Apr. 29, p. 34) was achieved with only minor CAB participation, and the White House chose W. Averill Harriman, whose career never brought him close to aviation affairs, as chairman of the Interagency Committee on International Aviation Policy.

It has ignored the CAB on a number of issues as it did when it named J. Kenneth Galbraith as mediator in the Canadian-U. S. bilateral dispute (AW Aug. 19, p. 25) or George Ball to resolve the Pakistani bilateral air transport agreement with Red China (AW Sept. 9, p. 39).

Flight Engineers Prepare New Moves in Dispute With Eastern

Washington—Flight Engineers International Assn. attorneys are preparing a new legal assault against Eastern Air Lines as a final move designed to settle the union's 15-month-old strike against the airline.

Dual goal of the union's strategy is to force a Civil Aeronautics Board hearing on the Eastern strike and win a permanent injunction that would prohibit alleged bargaining between the airline and the Air Line Pilots Assn. over FEIA contract issues.

The union has already filed an appeal with the U. S. Court of Appeals, District of Columbia, asking that CAB be directed to set aside a recent order dismissing FEIA's request for a hearing. Rejecting the recommendations of its own Bureau of Enforcement, which found "reasonable grounds" to believe that Eastern had been violating labor provisions of the Federal Aviation Act, the Board ruled that a hearing would serve "solely to provide a forum for the adjustment of private grievances."

CAB pointed out that FEIA could find "adequate remedy" in the courts, and added that the continuing jurisdictional dispute between ALPA and FEIA over representation of Eastern's flight engineers raises "considerable doubt" that FEIA will continue as the certified bargaining agent for Eastern's engineers.

FEIA Plans

Pending court action on the appeal, FEIA is making final plans to file for a permanent injunction against Eastern in the U. S. District Court, Southern District of New York. The union was refused an earlier request for a temporary injunction by the same court, but feels the new litigation may be more successful on the basis of new and more detailed evidence. Part of this evidence, FEIA claims, includes copies of actual agreements signed during the strike between ALPA and the airline. Terms of these agreements, which the union cites as "illegal collusion," delete the requirement for an A and P license in the flight engineers' contracts, add a new requirement for pilot training and require that all newly hired flight engineers be qualified pilots.

Since it resumed operations more than a year ago, Eastern has been flying with three-man, pilot-qualified crews, and FEIA contends that the main purpose of these contract changes is to provide ALPA with a logical basis on which to submit a future application with the National Mediation Board for a representative election that could result in ALPA's being named bargaining agent for the flight engineers at Eastern.

A key part of both cases is the subject of "super-seniority" as a matter of illegal discrimination against strikers. In the case of Eastern, the union contends, the airline invoked super-seniority as a back-to-work enticement by issuing an ultimatum that only strikers returning to work before a July 24, 1962, deadline would be permitted to bid for assignments to turbojet aircraft. Net effect of the order is that ALPA members now serving on Eastern jet flights would have permanent "super-seniority" over FEIA members, even though the engineers might consider returning.

Legal Precedent

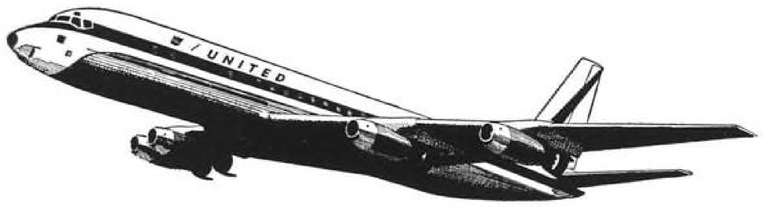
As a legal precedent that it feels should carry great weight in its battle with Eastern, the union cites a recent opinion written by U. S. Supreme Court Justice Byron White, in the case of the National Labor Relations Board vs. the Erie Resistor Corp. Remanding this case back to an appeals court, Justice White held that a legitimate business purpose does not always qualify as a defense in an unfair labor practice charge. During a three-month strike of Erie employes, the company announced to both the strikers and replacements that it would not lay off replacements at the end of the strike and would accord them some form of super-seniority.

"In the light of this analysis," Justice White wrote, "super-seniority by its very terms operates to discriminate between strikers and non-strikers both during and after a strike, and its destructive impact upon the strike and union activity cannot be doubted."

CAB's own findings of super-seniority discrimination in an order directing Southern Airways to resume bargaining with the Air Line Pilots Assn., after a 28-month strike, should also apply equally as well to the FEIA problem at Eastern, the union contends. Here the Board cited as support portions of the same Erie Resistor case as appealed by the National Labor Relations Board. In ordering a resumption of negotiations at the airline, CAB refused a Southern proposal for super-seniority for replacement pilots retained after the strike.

In particular, the union takes issue with the Board's insistence that FEIA may lose its bargaining representation at Eastern. Both the Feinsinger Commission findings and the National Mediation Board have guaranteed this right, the union contends, but "the CAB in effect relies on ALPA and EAL conduct in asserting that the NMB did not mean what it said."

United Air Lines sets new world air traffic record



Almost One Billion miles flown by 1,348,000 passengers in August

Long the leader in world passenger transportation, United Air Lines set a new all-time traffic record for a single month—when it carried 1,348,000 passengers 974,000,000 miles during August—far exceeding the traffic carried by any other air line in the U.S. or throughout the free world.

For each day in August, United averaged more than 43,000 passengers on its coast-to-coast system. United is the only air line linking the principal cities of the East and Midwest with both California and the Pacific Northwest, and Hawaii.

United is most appreciative of the opportunity to have served the 1,348,000 passengers who traveled with us last month. And we acknowledge with pride the performance of our employees who rendered Extra Care service to them.

We will continue to increase our efforts to provide fine, courteous, dependable service . . . with such improvements as our popular and rapidly expanding One-Class service; the world's largest jet fleet, soon to be expanded by forty new Boeing 727 tri-jet aircraft; and above all Extra Care—for people.

UNITED

THE EXTRA CARE AIR LINE

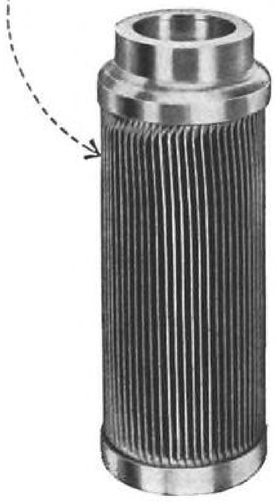
Airline Revenues, Expenses—First Six Months, 1963

(IN THOUSANDS OF DOLLARS)	OPERATING REVENUES						Total Operating Expense	PROFIT (or LOSS)	
	Passenger	Cargo	Other Non-Mail	U.S. & For. Mail	Subsidy	Total		Operating	Net
DOMESTIC TRUNKS									
American	203,116	19,016	1,128	5,154	.....	228,414	215,440	12,974	4,109
Braniff	38,438	2,509	427	1,163	.....	42,537	40,485	2,052	627
Continental	33,881	1,901	433	726	.....	36,941	34,040	2,901	1,437
Delta	94,868	5,804	624	2,010	.....	103,306	89,067	14,239	6,271
Eastern	144,586	7,563	1,352	2,694	.....	156,195	159,388	(3,193)	(6,418)
National	50,965	3,456	339	930	.....	55,690	47,627	8,063	2,762
Northeast	24,559	1,001	520	251	.....	26,331	27,914	(1,583)	(2,284)
Northwest	47,555	3,724	277	1,362	.....	52,918	49,675	3,243	1,322
Trans World	145,297	9,833	1,616	3,856	.....	160,602	161,756	(1,154)	(6,540)
United	247,765	18,563	4,543	8,671	.....	279,542	274,553	4,989	552
Western	39,278	1,439	485	590	.....	41,792	33,955	7,837	3,247
Domestic Trunk Total	1,070,308	74,809	11,744	27,407	.....	1,184,268	1,133,900	50,368	5,085
INTERNATIONAL									
American	3,935	342	171	45	.....	4,493	3,047	1,446	696
Braniff	4,322	669	19	275	.....	5,285	6,413	(1,128)	(596)
Caribair	2,780	189	48	45	.....	3,062	2,855	207	101
Delta	1,381	132	3	4	.....	1,520	1,866	(346)	(180)
Eastern	18,600	1,057	1	460	.....	20,118	19,050	1,068	585
Mackey	875	37	203	.....	.....	1,115	1,142	(27)	(47)
Northwest	15,872	2,565	1,346	5,305	.....	25,088	20,038	5,050	2,160
Panagra	7,121	1,663	769	740	.....	10,293	10,274	19	(100)
Pan American	187,482	28,155	20,070	22,364	.....	258,071	242,490	15,581	4,775
South Pacific	270	2	.....	3	.....	275	573	(298)	(369)
Trans-Caribbean	4,057	427	1,730	2	.....	6,216	5,987	229	129
Trans World	42,242	5,105	1,311	7,182	.....	55,840	51,824	4,016	1,685
United	13,791	557	247	699	.....	15,294	10,498	4,796	2,481
Western	3,879	93	33	41	.....	4,046	2,658	1,388	633
International Total	306,607	40,993	25,951	37,165	.....	410,716	378,715	32,001	11,953
LOCAL SERVICE									
Allegheny	8,075	571	164	159	3,090	12,059	11,745	314	103
Bonanza	4,508	123	56	27	1,545	6,259	5,144	1,115	431
Central	2,632	176	72	101	2,192	5,173	5,059	114	38
Frontier	4,677	298	103	101	4,059	9,238	8,323	915	403
Lake Central	3,123	199	92	73	1,934	5,421	5,488	(67)	(141)
Mohawk	9,767	441	270	144	2,379	13,001	12,577	434	94
North Central	8,435	549	182	222	3,957	13,345	13,139	206	4
Ozark	5,485	361	44	117	2,474	8,481	8,256	225	(14)
Pacific	3,603	130	62	106	1,871	5,772	5,646	126	(27)
Piedmont	7,019	318	225	138	2,781	10,481	9,959	522	222
Southern	4,128	211	139	137	2,959	7,574	7,321	253	141
Trans-Texas	3,326	221	67	106	2,328	6,048	5,922	126	49
West Coast	3,225	120	55	55	2,522	5,977	5,767	210	329
Local Service Total	68,003	3,718	1,531	1,486	34,091	108,829	104,346	4,483	1,632
ALASKA & HAWAIIAN									
Alaska Airlines[1]	1,576	282	2,217	359	976	5,410	5,339	71	69
Alaska Coastal	671	116	70	87	656	1,600	1,664	(64)	(82)
Aloha	2,435	39	(24)	14	114	2,578	2,672	(94)	(228)
Cordova	114	63	143	39	264	623	666	(43)	(52)
Hawaiian	3,336	536	7	25	.....	3,904	4,110	(206)	(317)
Kodiak	91	15	23	5	32	166	262	(96)	(101)
No. Consolidated	472	217	85	463	681	1,918	1,682	236	73
Pacific Northern	4,160	867	102	645	464	6,238	7,158	(920)	(576)
Reeve Aleutian	629	189	349	334	.....	1,501	1,422	79	108
Western Alaska	36	9	15	11	88	159	162	(3)	(6)
Wien Alaska	578	251	882	529	1,086	3,326	3,414	(88)	(81)
Alaska & Hawaiian Total	14,098	2,584	3,869	2,511	4,361	27,423	28,551	(1,128)	(1,193)
HELICOPTERS									
Chicago	150	2	7	5	584	748	792	(44)	(11)
Los Angeles	476	102	5	76	894	1,553	1,479	74	21
New York	991	31	67	17	1,001	2,107	2,224	(117)	(193)
Helicopter Total	1,617	135	79	98	2,479	4,408	4,495	(87)	(183)
CARGO & OTHER									
Aerovias[2]	.....	314	720	.....	.....	1,034	1,165	(131)	(131)
Avalon	133	4	70	7	.....	214	242	(28)	(13)
Flying Tiger	.....	5,004	14,132	97	.....	19,233	20,022	(789)	(834)
Riddle	.....	2,035	4 417	80	.....	6,532	7,362	(830)	1,367
Seaboard	.....	5,486	5,285	2,103	.....	12,874	11,654	1,220	(2,082)
Slick	.....	1,586	6,933	12	.....	8,531	9,064	(533)	(216)
Cargo & Other Total	133	14,429	31,557	2,299	.....	48,418	49,509	(1,091)	(1,909)
Industry Total	1,460,766	136,668	74,731	70,966	40,931	1,784,062	1,699,516	84,546	15,385

[1] Preliminary Report [2] Six Months Ending Dec. 31, 1962

Prepared By Ray & Ray

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IT'S A PUROLATOR PRESSURE LOCK FILTER ELEMENT AND LOOK WHAT IT DOES:

- Gives you a filter that's absolutely free of built-in contamination
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- Cuts 43% off the weight of an identical filter assembled by conventional bonding methods
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Pressure Lock is an exclusive Purolator process of assembling a wire-mesh filter medium without welding, brazing or cementing, and without the contamination that any of these methods produce. Pressure Lock embeds the filter medium in the end caps in an absolute bond that contains no material other than the metal of the cap and filter medium. As a result, the only limitation on the performance of a Pressure Lock filter – temperature, pressure, vibration, filtration or weight – is the physical properties of the construction metals.

Present ratings are for a nominal 10 micron (absolute maximum particle size of 25 microns) and for a nominal 5 micron (absolute maximum particle size of 15 microns); in capacities of ½, 3, 6, 12, and 24 GPM.

The Pressure Lock process provides, literally, a new standard for filter applications in aircraft and missiles, industrial hydraulics, pneumatics and chemical process industries. Write for specification sheet IC-801.

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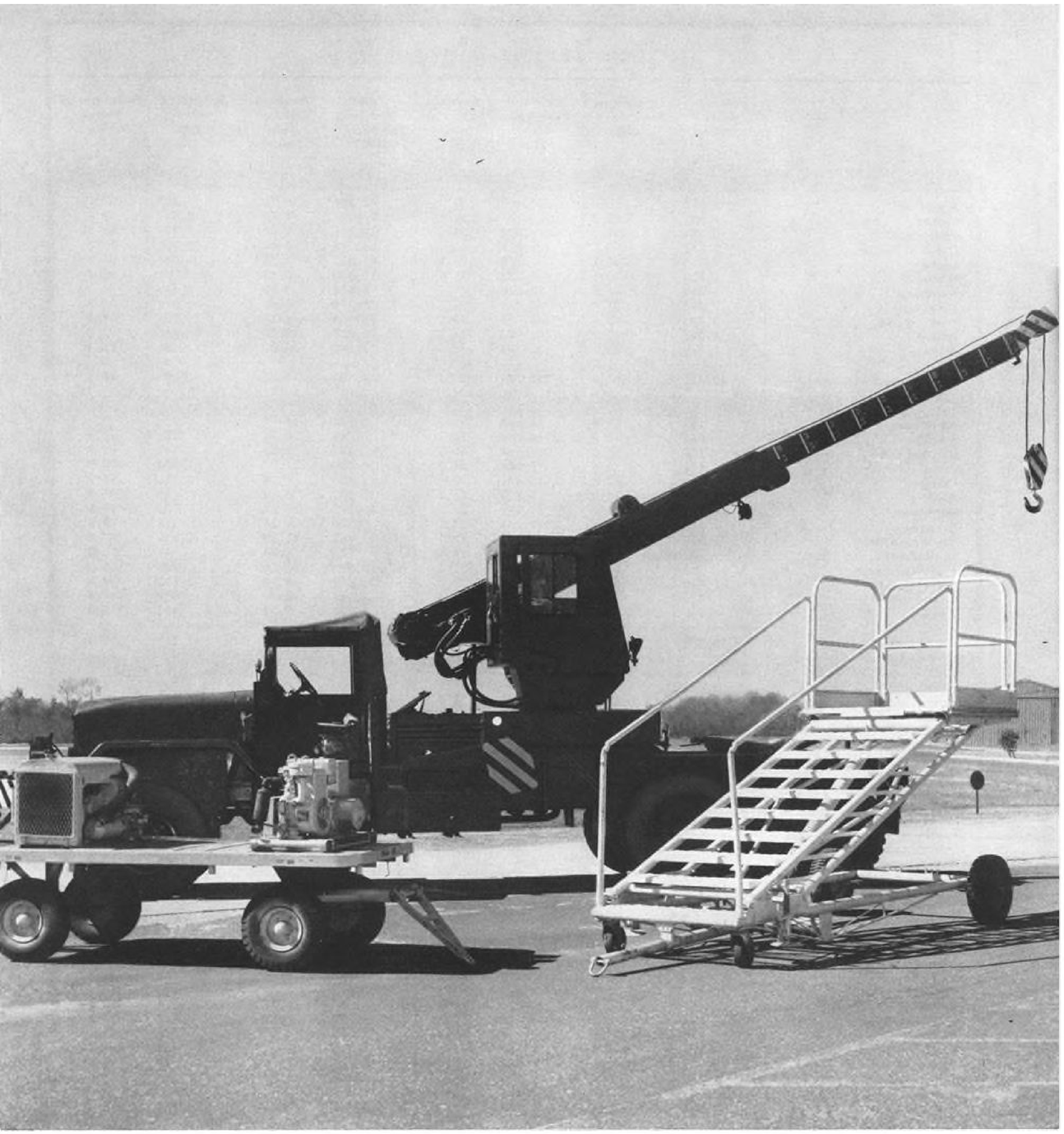
PRODUCTS, INC.

RAHWAY, NEW JERSEY, AND VAN NUYS, CALIFORNIA

Airline Traffic—July 1963

	Revenue Miles (000)	Originating Passengers (000)	Revenue Passenger Miles (000)	Revenue Passenger L/F (%)	Total Revenue Ton Miles (000)	Average Over-all Load (Tons)	Scheduled Miles (000)	Performance Factor (%)
DOMESTIC TRUNKS								
American	11,616	720.6	647,112	60.0	78,266	6.74	11,597	99.1
Braniff	2,652	208.0	104,141	52.4	11,671	4.40	2,640	99.4
Continental	2,374	154.3	114,890	54.5	12,615	5.31	2,399	98.5
Delta	5,157	401.7	251,917	60.0	28,077	5.44	5,201	98.3
Eastern	9,013	768.2	381,778	48.9	41,325	4.58	9,061	97.7
National	2,733	170.0	142,228	51.3	15,540	5.69	2,770	98.4
Northeast	1,465	124.9	53,528	49.9	5,413	3.69	1,546	94.0
Northwest	2,935	205.4	140,078	53.3	15,776	5.38	2,948	99.2
Trans World	8,786	486.9	492,725	55.5	55,936	6.37	8,767	99.6
United	16,395	1,062.9	788,990	54.9	90,850	5.54	16,556	97.2
Western	2,349	240.1	133,384	55.5	13,670	5.82	2,369	98.8
Domestic Trunk Total	**65,475**	**4,543.0**	**3,250,771**	**55.1**	**369,139**	**5.64**	**65,854**	**98.3**
INTERNATIONAL								
American	162	9.8	9,636	53.8	1,242	7.65	156	100.0
Braniff	283	10.9	14,265	53.2	1,763	6.24	283	100.0
Caribair	187	65.6	5,154	60.5	533	2.85	183	95.9
Delta	112	3.6	6,086	64.0	680	6.07	112	100.0
Eastern	1,165	74.7	110,451	70.0	10,653	9.14	1,116	98.3
Mackey	182	15.0	5,825	42.4	572	3.14	83	98.7
Northwest	1,163	26.4	79,199	59.4	11,219	9.65	920	98.3
Panagra	335	12.8	21,154	64.1	3,120	9.31	328	99.3
Pan American	10,929	459.9	849,961	62.3	111,462	10.20	10,420	97.2
South Pacific	22	0.4	983	54.9	100	4.56	22	100.0
Trans-Caribbean	563	35.9	76,045	82.6	6,813	12.10	353	100.0
Trans World	2,740	67.2	203,153	57.0	26,612	9.71	2,638	99.3
United	941	28.9	72,230	64.8	8,036	8.54	954	97.6
Western	189	8.5	13,055	68.5	1,396	7.38	189	100.0
International Total	**18,973**	**819.6**	**1,467,197**	**62.6**	**184,201**	**9.71**	**17,757**	**97.9**
LOCAL SERVICE								
Allegheny	993	91.1	17,959	39.5	1,936	1.95	985	98.9
Bonanza	517	45.3	11,550	58.8	1,144	2.21	517	99.4
Central	618	35.0	7,077	41.5	746	1.21	620	99.3
Frontier	1,042	47.7	13,645	40.1	1,460	1.40	1,048	97.3
Lake Central	545	37.4	5,996	39.0	645	1.18	548	98.7
Mohawk	1,060	97.5	21,026	46.1	2,154	2.03	1,069	97.8
North Central	1,333	102.1	19,490	43.3	2,087	1.57	1,320	99.5
Ozark	865	64.4	12,367	48.5	1,302	1.50	867	99.7
Pacific	467	48.3	10,415	53.1	1,033	2.21	468	99.5
Piedmont	942	70.2	16,353	44.9	1,696	1.80	939	99.5
Southern	799	50.2	9,482	36.9	1,001	1.25	796	99.5
Trans-Texas	648	34.6	8,201	39.7	874	1.35	650	99.6
West Coast	611	35.3	8,811	44.0	887	1.45	618	97.6
Local Service Total	**10,440**	**759.1**	**162,372**	**43.9**	**16,965**	**1.62**	**10,445**	**98.9**
ALASKA & HAWAIIAN								
Alaska Airlines	226	9.8	8,530	55.3	1,451	6.42	170	97.9
Alaska Coastal	199	13.0	1,064	61.0	127	0.64	130	97.7
Aloha	251	48.8	7,521	68.9	609	2.43	232	95.8
Cordova	133	3.6	418	47.1	144	1.09	69	93.8
Hawaiian	352	56.5	8,660	61.3	890	2.52	317	91.9
Kodiak	81	1.9	158	42.8	17	0.21	24	100.0
No. Consolidated	194	4.1	1,288	51.6	362	1.87	132	98.3
Pacific Northern	418	18.8	17,274	45.8	2,643	6.32	393	99.4
Reeve Aleutian	148	1.9	1,769	46.3	540	3.64	86	88.7
Western Alaska	38	1.4	72	77.4	9	0.23	17	96.5
Wien Alaska	444	7.8	2,973	50.6	649	1.46	214	97.3
Alaska & Hawaiian Total	**2,484**	**167.6**	**49,727**	**53.2**	**7,441**	**3.00**	**1,784**	**96.3**
HELICOPTERS								
Chicago	18	4.3	88	48.1	9	0.47	18	99.2
Los Angeles	67	16.0	627	51.2	66	0.99	76	86.8
New York	45	27.3	531	50.8	53	1.18	44	86.7
Helicopter Total	**130**	**47.6**	**1,246**	**50.8**	**128**	**0.98**	**138**	**88.5**
CARGO & OTHER								
Aerovias	Not Available							
Avalon	Not Available							
Flying Tiger	1,543	10.6	36,744	85.9	23,605	15.30	326	100.0
Riddle	1,154	6.7	22,054	95.1	10,142	8.79	194	90.7
Seaboard	695	11.9	45,128	99.4	11,708	16.84	350	88.9
Slick	655	0.9	4,267	70.4	9,334	14.25	175	97.4
Cargo & Other Total	**4,047**	**30.1**	**108,193**	**92.2**	**54,789**	**13.54**	**1,045**	**94.1**
Industry Total	**101,549**	**6,367.0**	**5,039,506**	**57.1**	**632,663**	**6.23**	**97,023**	**98.2**

Prepared by Ray & Ray



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For instance... No need to unload cargo or dismantle the interior for access to inspection points—the designers, understanding the problems of field maintenance, avoided locating any systems under the floor or behind insulating blankets. Creative engineering, forward-thinking weapons system program management and the vast resources of the Boeing Company have made the Chinook possible.



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ALPA Adopts 'Diplomatic' Bargaining

By James R. Ashlock

New York—Air Line Pilots Assn. is adopting a "friendly, diplomatic" approach in its contract negotiations with airlines, the union says, and is de-emphasizing wage increases in favor of wider fringe benefits.

The pilot union feels that the technique will help cut down the time required for contract negotiations, while at the same time achieving terms acceptable to both management and the union.

Standard negotiation practice is to sit down with company representatives in preliminary informal discussions before formal contract talks begin. In these sessions, the union says, many problems can be outlined and perhaps solved before they are presented in the stiffer atmosphere of the bargaining table.

On the wage front, ALPA feels that income tax requirements are eroding increases in pay. Pilots benefit more, union spokesmen say, from added fringe benefits, such as larger company contributions to insurance and pension plans, which are now viewed as more desirable than pay boosts.

ALPA has used the new practice in talks with North Central Airlines, with results the union feels were highly satisfactory. But Charles Ruby, president of ALPA, said North Central didn't represent a conclusive test case since company-pilot relations there have always been exceptionally good.

"We're following the practice now in talks with TWA and Pan American," Ruby said. "Results there will tell us whether it is a good procedure."

Ruby added that he wasn't implying any poorer relations at either TWA or Pan American, but that negotiation becomes tougher with large carriers.

There is evidence that the preliminary discussions are having a favorable effect at Pan American. Ruby said the airline had already agreed to work toward changing its approach to divisional seniority among Pan American pilots, keeping this issue out of contract talks.

Under the divisional seniority procedure, Pan American crews are generally restricted to the geographic divisions where the airline operates—the Pacific, Atlantic, Latin America and Alaska. This situation is a holdover from the days when Pan American operated each of these divisions as separate entities.

Pilots presently are promoted within the division where they fly, and this has caused some inequity of qualification throughout the airline. A pilot may be flying copilot on a piston aircraft in one area, yet have the flight time and seniority to be a jet captain in another division. ALPA says Pan American has agreed to untangle the situation, even though it may cost $500,000 to do so.

Pan American's pilots may also request some reduction in their monthly flight time requirement, although Ruby said a poll of the pilots indicated this isn't a primary goal, since there was no major dissatisfaction with the current time scale.

Wages may become a contract issue at Northwest Airlines. ALPA officials said that the engineer-pilot on Northwest receives less pay than his counterpart on other carriers, and the union will seek an increase.

Trans World Airlines' pilots will seek a flight time reduction comparable to that recently granted pilots at American Airlines (AW Sept. 9, p. 47). But the key issue of the TWA talks will probably center on the crew-complement question, involving a merger of the pilot and flight engineer unions. Both parties are agreeable to a merger, but the flight engineers must be satisfied as to job security and their pay relationship to that of the pilots.

Ruby expressed little worry over a movement within Pan American's pilot ranks to break away from ALPA in favor of another union patterned after the Allied Pilots Assn., which was organized by American crews. Ruby said a poll of Pan American pilots showed a wide majority in favor of retaining ALPA as the bargaining agent.

He also discounted recent rumors that ALPA is in financial difficulty, mainly because of membership refusal to pay special assessments for strike support. The union treasury was heavily tapped for strike benefits in the Eastern Air Lines and Southern Airways shutdowns.

"There was a time there when it looked like we might have financial trouble," Ruby said. "But we're on firm ground again and haven't had to touch our $2-million reserve fund."

ALPA paid off a $1-million bank loan in February, and has completed its obligations in the Southern strike. Ruby said that about $50,000 in excess assessments were collected for that dispute, and ALPA plans to reimburse members according to their individual shares of this surplus.

The only delinquent assessments on the Eastern strike are charged to American pilots, Ruby said. And although American has 1,600 pilots, the majority of whom no longer hold ALPA membership, only 462 did not pay the Eastern assessment, he added. Payments ranged from $16 to $100, according to pay scale.

Allied Pilots Upheld

New York—U. S. Circuit Court of Appeals here last week upheld the right of Allied Pilots Assn. to represent American Airlines' 1,600 pilots. The decision supported an earlier district court ruling which was appealed by the Air Line Pilots Assn. (AW Aug. 19, p. 41).

Allied Pilots Assn. still faces a district court injunction in Washington that blocks a National Mediation Board election which would provide Allied with formal recognition. The injunction was granted on ALPA's plea that the mediation board did not determine conclusively whether any coercion or misrepresentation by Allied Pilots was involved in the American pilots' split with ALPA.

The appeals court decision here, however, said that no misconduct by Allied Pilots was revealed in testimony presented, and it questioned whether the Washington court should maintain its injunction.

Dempsey Hits SST

New York—Airline industry today is in more need of a passenger boom than a sonic boom, J. F. Dempsey, general manager of Irish International Airlines and president of the International Air Transport Assn., said here last week.

Dempsey said that business, not politics or prestige, should dictate the time and place of supersonic aircraft operations. By rushing prematurely into the supersonic age, he said airlines will merely expose themselves again to the problems they encountered with the introduction of the first jets.

Emphasis on supersonics comes at a time when the airlines could better devote more time and money toward filling existing aircraft, he said. He referred to the North Atlantic routes, where growing capacity dropped the industry load factor to 42% in the first quarter this year, compared with 48% in the same period a year ago.

Rather than a supersonic transport that would cater to the relatively few long range travelers, Dempsey said, it would make more sense socially and economically to concentrate on economic short-to-medium range aircraft that "would open up air transport to the multitudes waiting to avail it."

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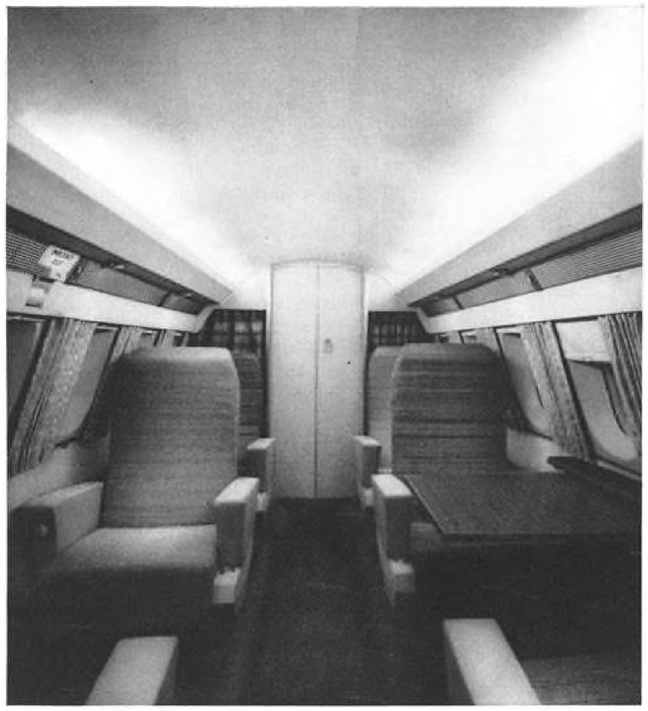
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See the Hawker Siddeley DH 125 full-scale mock-up at the NBAA Convention Exhibit Hall, Shamrock Hilton, Houston, September 24-26th.

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Above: DH 125's, shown here on the ramp at Hatfield, England, are backed by de Havilland's more than twenty years' experience in building jet aircraft.

Right: Designed and built by the de Havilland Division of Hawker Siddeley Aviation, the DH 125 is powered by twin Bristol Siddeley Viper 521 jet engines of 3,100 pound thrust each.

Left: The DH 125 carries six to eight passengers in luxury. The cabin, which includes a completely separate lavatory of airliner dimensions, is almost twenty feet long.

HAWKER SIDDELEY INTERNATIONAL, INC.
La Guardia Airport, New York



AIRLINE OBSERVER

► U. S. domestic trunklines showed a net profit of $9.4 million for the first seven months of 1963 compared with a net loss of $7.1 million in the same period last year. Net profit for July was $5.8 million. During the seven-month period, operating revenues were $1,391,618,000 and operating expenses were $1,330,132,000, for an operating profit of $61,486,000.

► **U. S. endorsement of IATA rate-making machinery at the Ottawa conference of governments last summer (AW July 29, p. 28) was tempered last week by N. E. Halaby, Federal Aviation Agency administrator. He said: "While it must be recognized that government pressure can be only one factor in bringing down fares, we in the government are not, as the President has said, going to 'abdicate our responsibility to protect the traveler and the shipper' if the international private organization that now determines rates—IATA—does not itself show a strong sense of responsibility."**

► Watch for Russia's Aeroflot to make a major effort to reduce the high operating costs of its large fleet of twin-jet Tu-104s by refitting them with turbofan engines designed to cut fuel consumption 20-30% and to reduce noise. Modification could increase payload or boost range.

► **Sharp cutback in U. S. financing of foreign airport construction would follow any extensive reduction of the Agency for International Development budget by Congress. AID spokesmen note that most aviation loans and grants have been used for this purpose and estimate that airport projects planned for Fiscal 1965 may be cut in half.**

► Stockholders of two private French airlines, Transports Aeriens Intercontinentaux (TAI) and Union Aeromaritime de Transport (UAT) have formally approved a merger of the two lines. Actually, merger was approved in principle nearly two years ago and the two carriers have been involved in merging their operation ever since. Merged carrier, ranking 22nd in IATA, will be called Union de Transports (UTA) serving five continents.

► **British Air Transport Licensing Board last week turned down applications by British Overseas Airways Corp. and British European Airways to enter into troop-carrying contracts now handled by independent airlines (AW July 22, p. 33). The board said the two state-owned airlines were "imprecise," in that applications lacked details of actual fares and baggage allowances.**

► Cunard Eagle Airways name has been changed to British Eagle International Airlines. Its fleet by next year will be composed of 10 Bristol Britannia 312 turboprop transports, some purchased from BOAC surplus. The airline, under the direction of Harold Bamberg, will apply for standby internal services in direct competition with BEA.

► **Civil Aeronautics Board will give priority to the following trunkline cases during the balance of the year: Pacific-Northwest-Alaska Case, United States-South American Route Case, Transatlantic Route Renewal Case, Dallas-Ft. Worth Regional Airport Case and Pan American-Grace-Panagra Anti-Trust Case. Applications for permanent authority by supplemental carriers will be given priority treatment, and staff emphasis will be given to local service use-it-or-lose-it program, local service route realignments and suspension of trunklines at points also served by local service airlines.**

► Two Allegheny flights and one special FAA flight were diverted by weather last Monday at Atlantic City airport because of an inoperable ILS unit and repairs on the ILS runway. Flights carried a number of delegates to a symposium at FAA's Atlantic City National Aeronautical Facilities Experimental Center. Symposium subject: an all-weather landing system.

► **FAA plans an official inspection tour of its Latin American field offices in November. A planeload of agency officials will spend several weeks visiting Miami, Panama, Lima, Buenos Aires and Rio. The group will examine foreign carriers operations vs. U. S. flag airlines, general aviation facilities and FAA's certification program for mechanics and airmen. Under the agency's present organization chart, operational responsibility for Latin America has been added to the southern region, which has headquarters in Atlanta.**

SHORTLINES

► **British Overseas Airways'** flight crew training on Seaboard World Airways CL-44 freighters is progressing on schedule toward an Oct. 1 inauguration of a joint transatlantic cargo service. Three BOAC pilots already have been certificated by FAA to fly a CL-44 leased from Seaboard, and 14 other pilots and engineers, plus six navigators, are completing simulator and flight training on the aircraft.

► **British West Indian Airways** recorded an average 93% load factor during the first three months of operation of its Jamaica Sunset Excursion fare service between Miami and the island. Inaugurated on May 23, the new Viscount service offers a $49 round-trip fare for 17-day excursions.

► **Continental Air Lines** has asked the Civil Aeronautics Board to approve extension of its route system from Los Angeles, Denver, Kansas City and Chicago to Toronto and Montreal. Nonstop rights are being sought between these points.

► **Delta Air Lines** will complete a 6,000-sq.-ft. addition to its present air freight terminal at Atlanta Airport by Nov. 1.

► **International Air Transport Assn.** plans an intensive campaign to promote the Universal Air Travel Plan from Nov. 18 through 24. IATA figures indicate there are now more than 1.1 million UATP card holders, each of whom averages 30 trips by air annually.

► **Northwest Airlines** has started a series of travel agent seminars in 14 cities to promote its Pacific services. Objective of the program is to build advance traffic to Japan and the 1964 Olympic Games in Tokyo.

► **Pan American Grace Airways** air cargo operations accounted for 13.5% of the company's available ton miles flown during the first half of this year. The figure is the highest registered in international cargo operations by any of the scheduled U. S. airlines in the period.

► **United Air Lines** is adding the family fare plan to its one-class service. Under a new filing with the CAB, the head of the family will pay the one-class fare while other members travel at a 50% discount. United claims the combination, effective Oct. 27, will provide the lowest family fare plan in the scheduled airline industry.



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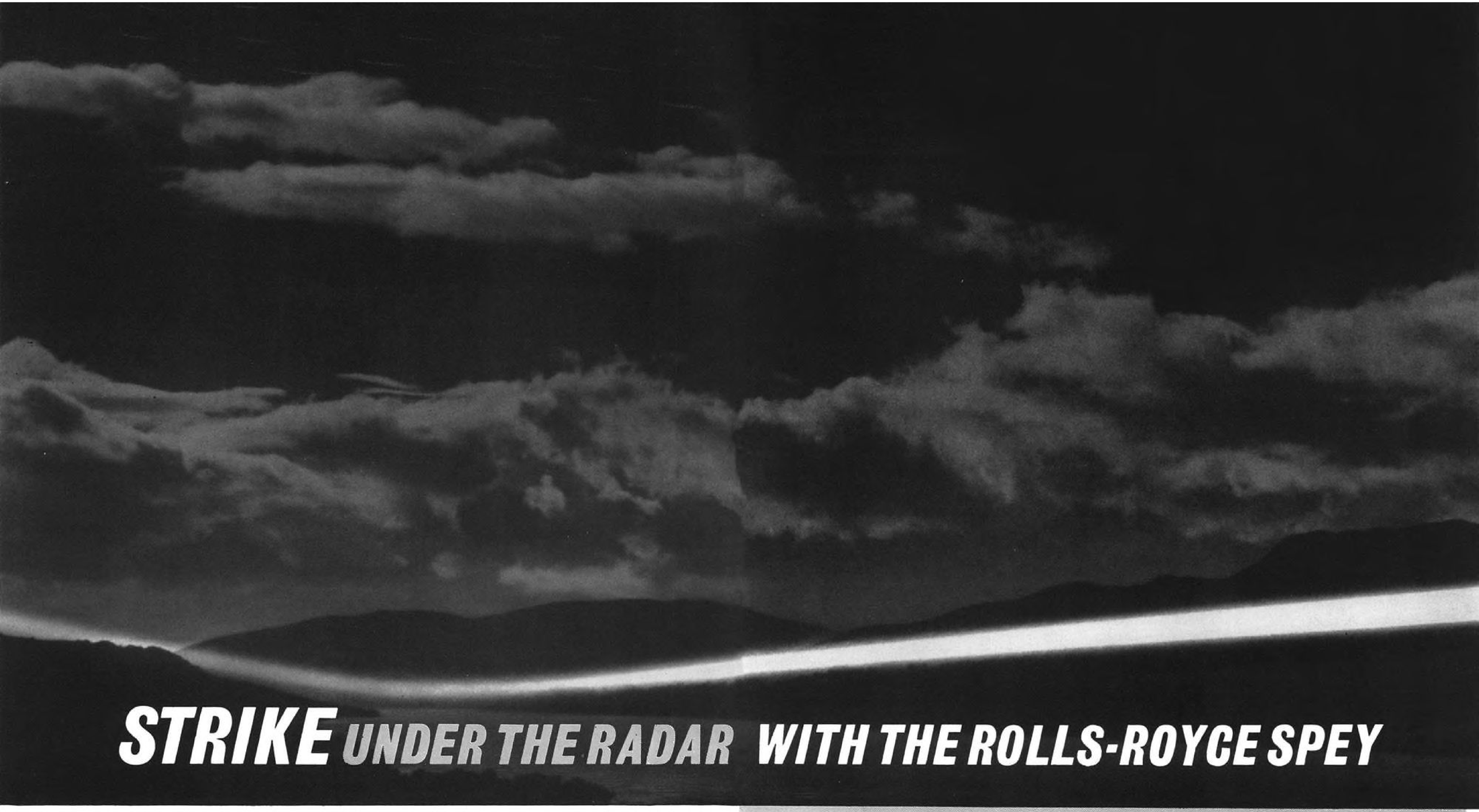
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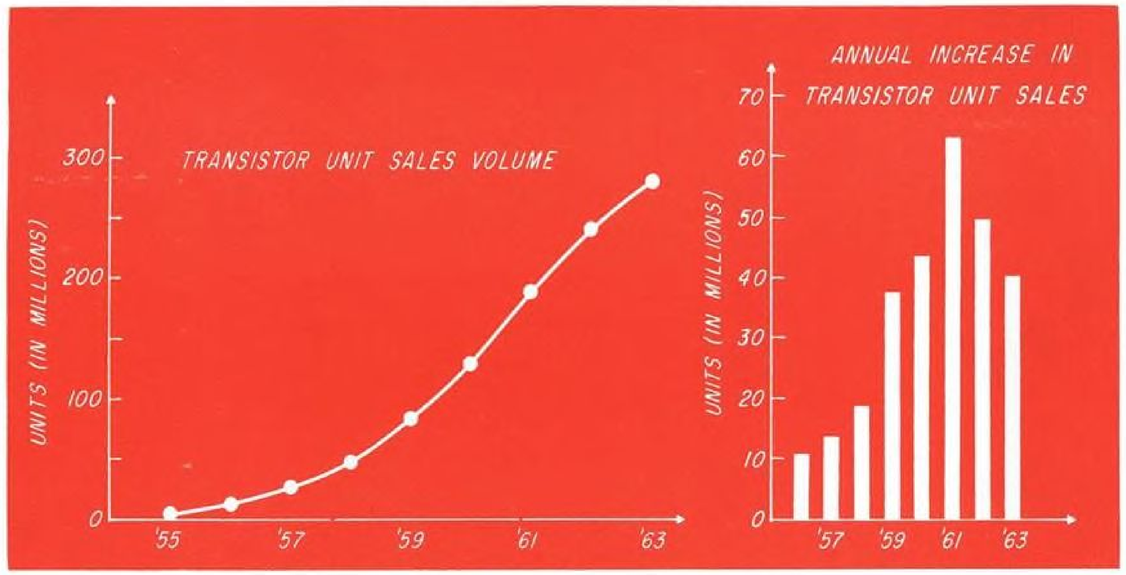
STRIKE UNDER THE RADAR WITH THE ROLLS-ROYCE SPEY

The Spey is the most advanced military engine now flying. It has been under military development since 1961. And in the Blackburn Buccaneer S.2 it is demonstrating its outstanding characteristics: a high performance at very low altitudes; a cruise performance so economical that it makes possible a wide operational range; and the inherent reliability of an engine building up impressive flying hours in the civil Trident, and now also in the civil BAC One-Eleven. The Spey offers the advantages of a modern by-pass jet for strike and reconnaissance aircraft, for military transports and for VTOL applications. It joins that unique group of Rolls-Royce engines which today power more than 30 types of military aircraft in 36 armed forces.

1. Flight testing of the Spey-powered Buccaneer S.2 is now proceeding.
2. Development testing of the military Spey with re-heat is under way, and very high thrust boosts have been achieved.
3. Already 7 airlines in 5 countries have ordered Spey-powered One-Eleven and Trident airliners, and two governments have ordered the Buccaneer S.2.

A NEW PHASE BEGINS WITH ROLLS-ROYCE POWER

ROLLS-ROYCE OF CANADA LIMITED, 6265 COTE DE LIESSE ROAD, MONTREAL P.Q.



ANNUAL UNIT SALES of transistors have shown a steady increase over the past ten years (left) but the annual rate of increase, and the actual yearly increment in units, appear to be declining (right). This suggests that the transistor unit volume sales curve may be approaching a limit. Unit sales figures for 1963 are what is believed to be an optimistic projection of figures compiled by the Electronic Industries Association for the first six months of 1963.

Competition to Tighten in Semiconductors

By Barry Miller

Another stiffly competitive period confronts semiconductor manufacturers, and with it the likelihood of a tighter squeeze on profits for many companies and a further winnowing of those in the field.

Following the chaotic price war which shook semiconductor makers during the past three years (AW June 12, 1961, p. 73), producers now are enjoying a hiatus. Many company leaders and financial people, surveyed in recent weeks by AVIATION WEEK & SPACE TECHNOLOGY think the respite will be short lived.

While the fierce price cutting, the dumping of large inventories on the market and the panicky and unreasoned selling of products below cost have now largely vanished, the basic difficulties remain. These are largely problems created by continued overinvestment in the field, resulting in an overabundance of competing companies, an actual overcapacity in certain product areas, and potential overcapacity in others.

Expansion Rate

Moreover, the market for semiconductor devices is no longer expanding at as high a rate as it once did. The annual increase in sales of transistors, in units as well as in percentage, has been slipping for two years. This suggests that the market for transistors, as one example only, may be approaching a limit.

Growth of sales dollar volume has remained relatively static for three years, rising by an estimated $50 million, or about 10% after years of greater increases, reflecting the unabated decline in prices in most product lines.

Although price declines, perhaps not so precipitous, are characteristic of maturing business, they stir concern among some observers about continuing heavy investment in the field and what these observers view as overly optimistic predictions about dollar sales volume during the next decade.

Until two years ago, it was customary for transistor market leaders to predict, without contradiction, and to predicate much of their expansion on a semiconductor device market of $.75 to $1 billion or more by 1965. This enthusiasm has dampened only slightly in the past two years. Predictions of a market this size and larger (AW Dec. 10, p. 95) are still proffered, with the target date now retarded from two to seven years.

Continued optimism is based on the introduction of semiconductor-based microcircuits and their growth partially through the capture of new markets, as yet untapped by semiconductor devices, but also partially at the expense of future transistor and diode markets.

Yet a primary attraction of microcircuits, the one which will enable them to exploit new markets, is their potential low cost, compared with comparable circuits made of individual components. Whether the combined dollar sales volume of microcircuits and discrete semiconductor devices will mount fast enough to justify these predictions and the investments they encourage remains conjectural. At least a few people in the field are skeptical.

High Profits

It is the hope or faith in eventual high profits from a large microcircuitry market more than any other factor which has postponed a wholesale shakeout of semiconductor companies. Many companies which have suffered financial losses over sustained periods in the semiconductor business have displayed what they regard as remarkable tenaciousness in surviving. The lure of microcircuitry is believed to be keeping disappointed backers and managements of parent companies doling out support for their semiconductor organizations, despite the fact that microcircuitry requires a higher investment than discrete semiconductor devices.

Much of the semiconductor market's difficulties in the past couple of years retrospectively is believed to stem from anticipation of a market based on conservative manufacturing yields. When yields—the ratio of the useful output to input—rose, at least in product areas where there was much competition, manufacturers were confronted by overcapacity in these lines. Similarly, it is felt, the same situation now looms for microcircuitry. Demand outstrips current capacity, based on low manufacturing yields. More money is being invested in expanding capacity and more companies are entering the field even as leading microcircuit manufacturers are predicting appreciable rises in yields within the next couple of years. Many leaders say the demand will not be great enough to long absorb a sudden jump in capacity.

During the past two years, the semiconductor field has been experiencing a subtle form of shakeout, which was not entirely unexpected (AW June 12, 1961, p. 73). The shakeout is along product lines primarily, rather than in the classical form of company after company closing its doors. In addition, weaker managements have floundered and disappeared and a sprinkling of corporate changes have occurred.

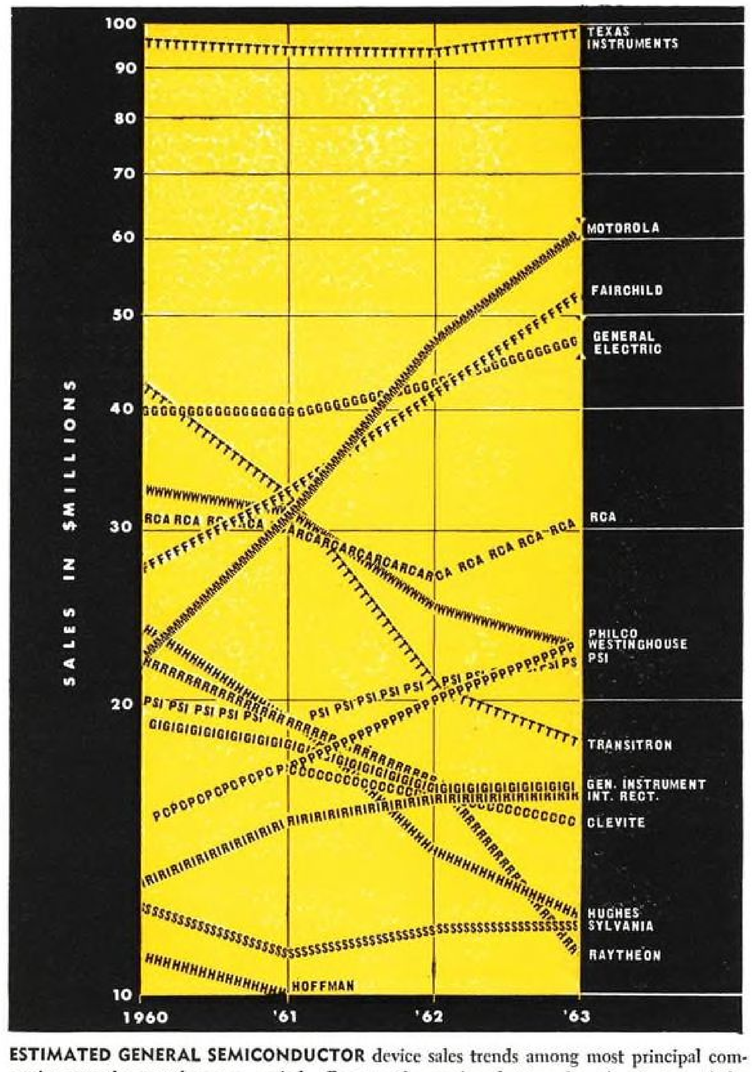
More and more companies are dropping out of product lines which have not been profitable, are too competitive or are becoming obsolete. This tendency was in evidence at the recent Western Electronic Show and Convention (Wescon) in San Francisco. For example, Tung-Sol indicated it had discontinued its germanium transistor lines, retaining silicon rectifiers as its only semiconductor products.

Hughes has dropped a number of diode lines, most of which, it says, it plans to update. For the time being, Hughes has discontinued silicon planar diodes, some alloy Zener diodes, alloy general purpose silicon diodes and silicon voltage variable capacitors. This decline in the number of companies in given product lines is witnessing the dropping of germanium and some older silicon devices by Raytheon, germanium mesa devices by General Electric, germanium alloy by Sylvania, etc.

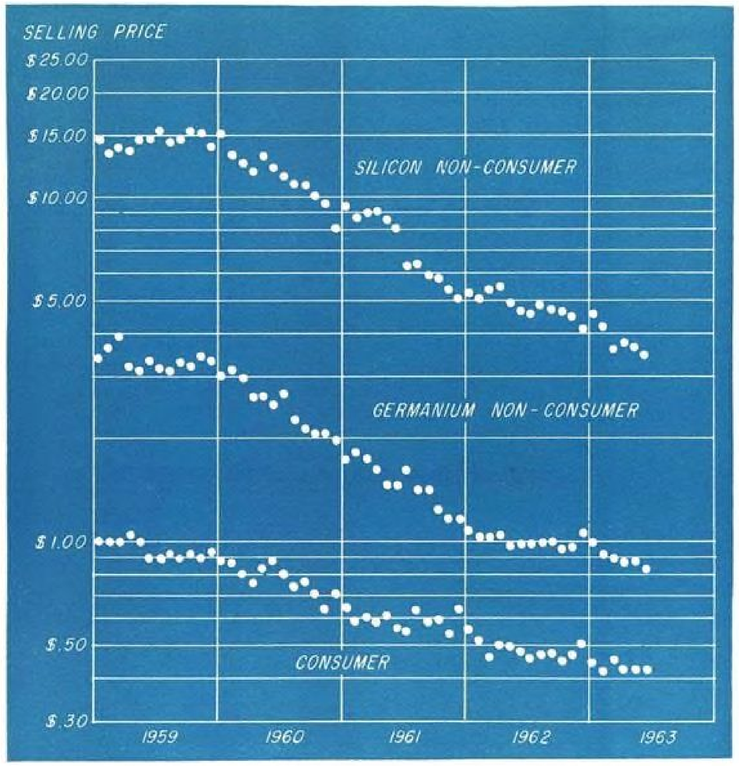
Consequently, in most device areas, there are today only a handful of primary competitors, a factor which is partially responsible for the tenuous stability that now exists. In fact, the disappearance of companies from a few product areas has resulted in temporary price rises.

With the shakeout along product lines, the following are considered by industry sources to be among the leading producers in 13 device areas:

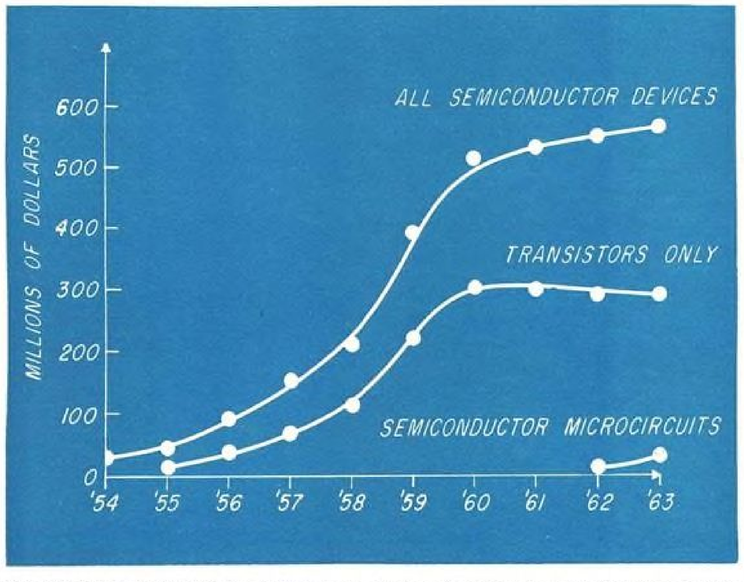
- **Silicon grown junction transistors**—Texas Instruments and General Electric.
- **Silicon alloy transistors**—National Semiconductor, Raytheon and Sperry Semiconductor.
- **Silicon power transistors**—Texas Instruments, Westinghouse, Silicon Transistor (all in the low frequency end); Motorola, Pacific Semiconductors, and Clark Semiconductor, high frequency end.
- **Germanium consumer transistors**—Radio Corp. of America and Texas Instruments.
- **Germanium alloy transistors (non-consumer)**—Radio Corp. of America, Texas Instruments, General Electric, Motorola and General Instrument.
- **Germanium mesa (diffused) transistors**—Delco, Motorola, Bendix Semiconductor and Texas Instruments.
- **Silicon mesa, planar and epitaxial transistors**—Fairchild Semiconductor, Texas Instruments, Motorola, General Electric, Raytheon and about two dozen other companies. About 90% of these products are sold to the military. This is the category most seriously threatened by semiconductor microcircuits.
- **Silicon reference diodes**—Motorola, Hoffman Electronics (in the power area), and Continental Devices (in the small signal portion).
- **Silicon computer diodes**—Fairchild, Texas Instruments, Continental De-



ESTIMATED GENERAL SEMICONDUCTOR device sales trends among most principal companies over the past four-year period. Because the semiconductor sales of only two of the indicated companies can be deduced directly from their public financial reports, these estimates are derived from industry estimates, clues provided in company statements and direct disclosures to Aviation Week & Space Technology.



DECLINE IN TRANSISTOR PRICES in various categories is shown in these plots of monthly average prices of silicon transistors and germanium transistors for non-consumer applications and in combination of silicon and germanium devices for consumer use. None of the three price curves appears to have bottomed.



TEN YEAR SALES CURVE for semiconductor devices shows leveling over last several years due to price declines and drop in rate of penetration into new technical markets. Curve for transistor sales volume has been flat since 1960 (within accuracy of estimates) and is expected to decline significantly with continued price deterioration and the expected growth in the semiconductor microcircuit market. Based on an estimated $555 million in semiconductor sales during 1963, dollar volume will have climbed by less than $50 million in three years, well below optimistic industry projections.

vices, General Electric and Pacific Semiconductors.

• **General purpose silicon diodes**—Continental Devices, Sylvania, Texas Instruments, General Instrument, Transitron Electronic and Pacific Semiconductors.

• **Germanium computer diodes**—Clevite, Transitron and Sylvania.

• **Controlled and high current rectifiers**—General Electric, Westinghouse and International Rectifier. These lines are now experiencing the fierce competition they escaped two years ago when others were hard hit.

A relatively small number of companies, about 18 by AVIATION WEEK & SPACE TECHNOLOGY count, and certainly far smaller than the number predicted by industry leaders over the past years, have dropped out of the semiconductor business, been acquired or absorbed by other companies, have failed to go far beyond the initial announcement of their formation or have gone bankrupt.

Western Transistor is one of the few to shut its doors and sell its equipment at public auction. In the other categories are the Rheem and CBS Electronics semiconductor operations (absorbed by Raytheon), Clark (acquired by National Semiconductor), Standard Rectifier (acquired by American Micro Devices), North American Electronics (acquired by International Resistance) and Molecular Science (which failed to get started), to mention several.

In line with the dominant trend to shake out along product lines, rather than along corporate lines, the industry is now tending to polarize roughly into large, broad capability houses and those trying to compete in this manner and, on the other hand, more narrowly-based companies which concentrate on restricted product lines with either relatively narrow or broad groups of products. Smaller companies are forced to assume the latter role because they lack the money to expand, especially into microcircuitry, which larger companies insist requires a multimillion dollar effort.

Since most semiconductor companies are divisions or subsidiaries of larger organizations, which combine earnings reports of their member groups into consolidated financial statements, it is difficult to quantitatively assess how each company is doing. These earnings reports nowadays frequently express gloomy comments about the discrete semiconductor component business or in the recent past have reported inventory write-downs, which add to the qualitative picture.

From general statements made by various companies, a number of clues provided by the companies themselves, the status of industry sales and price trends, turnover in leading personnel, and the rate of formation of new companies, it is possible to piece together a picture of the industry which is informative and appears consistent with the fragmentary facts.

This would suggest that while there is a general squeeze on earnings, those companies which were able to invest in research and development and have followed an aggressive policy of introducing new products have fared better than those which did not. By staying technologically ahead, the companies emphasizing new developments were able at least partially to maintain their margins by shifting to new and better products by the time capacity in going lines built up. Others have usually not done as well.

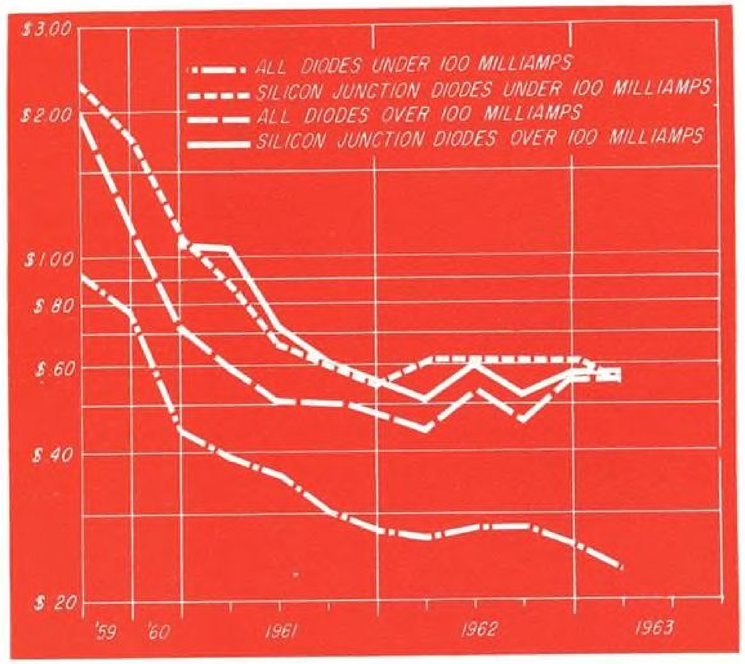
The four companies with the largest semiconductor sales—Texas Instruments, Motorola, General Electric and Fairchild—all claim to be operating profitably on an annual basis, claims which few in the industry dispute. During the past several years, two of these companies, Motorola and Fairchild, made appreciable sales gains while many other major companies lost ground or remained relatively constant. Motorola rose from $10.5 million in 1959 sales to what may be between $60 and $63 million in 1963; Fairchild similarly rose to what is expected to be in excess of $50 million in sales for the year.

Partially because of its success in winning microcircuitry business, Texas Instruments appears to be picking up momentum and its semiconductor sales are expected to rise this year.

Within the generally unfavorable climate of the past several years, a number of smaller, specialty companies have proved that through concentration on specific devices, operation with close process control and low overheads and/or by exploiting specific technical know-how, a small company can make money in the semiconductor industry.

One of these is Dickson Electronics Corp., a privately-owned firm employing 250 people and founded in 1960. This year it expects to gross about $3.5 million in sales (compared with $1.7 million in 1962, $0.6 million in 1961), concentrating in Zener diodes and to a lesser degree in high voltage rectifiers and tantalum capacitors. The company is operating profitably, doing better than 10% before taxes, according to its founder, Don Dickson. The company holds about 5% of the Zener market.

Another small specialty company in this category is Silicon Transistor Corp., also founded in 1960, concentrating primarily on power transistors for military applications. It anticipates $7.5 million in sales this year, following records for the two previous years of $2.7 million and $1.7 million, respectively.



GENERAL DOWNTREND in diode prices since 1959 is reflected in average prices for periods indicated. Average prices of low-current diodes appear to be dropping, higher current lines show more firmness. Part of apparent recent firmness in average prices may be due to discontinuation and poorer market showing of lower priced, obsolete types and introduction of new products which traditionally enter at higher prices.

Continental Devices, founded in 1958 and now employing 1,000 people, probably will do in excess of $10 million for the calendar year. Specializing in diodes, it claims to be the largest producer of silicon glass diodes in the country. It has been operating profitably every year since its Fiscal 1960 period, a recent stock prospectus indicates.

Besides the industry shakeout, other factors contributing to the semiconductor market's stability, or expected to influence it in the future, include:

• **Mature management**—No single cause for the chaotic conditions that existed in the semiconductor industry in the recent past is cited more often within the industry than the inexperience and faulty judgment of the young technical managements who ran semiconductor companies. Many young men in their twenties and thirties found themselves thrust into the leadership of new companies during the flowering of the semiconductor industry when technical and scientific knowledge were the main ingredients of success. But, as the technological know-how spread and the business suddenly became competitive, new skills—those traditionally associated with management of competitive industries—were required. Those who failed to learn and made too many mistakes disappeared from positions of responsibility, while those whose judgment proved equal to the need weathered the rough days. Management in the industry is now a good bit more experienced, older and perhaps wiser than it was two or three years ago and a repetition of buying into business without regard to costs seems much less likely.

• **Profit heyday gone**—With the collapse of prices and narrowing of profit margins, buying into business in the hope of making money on future volume is considerably less attractive.

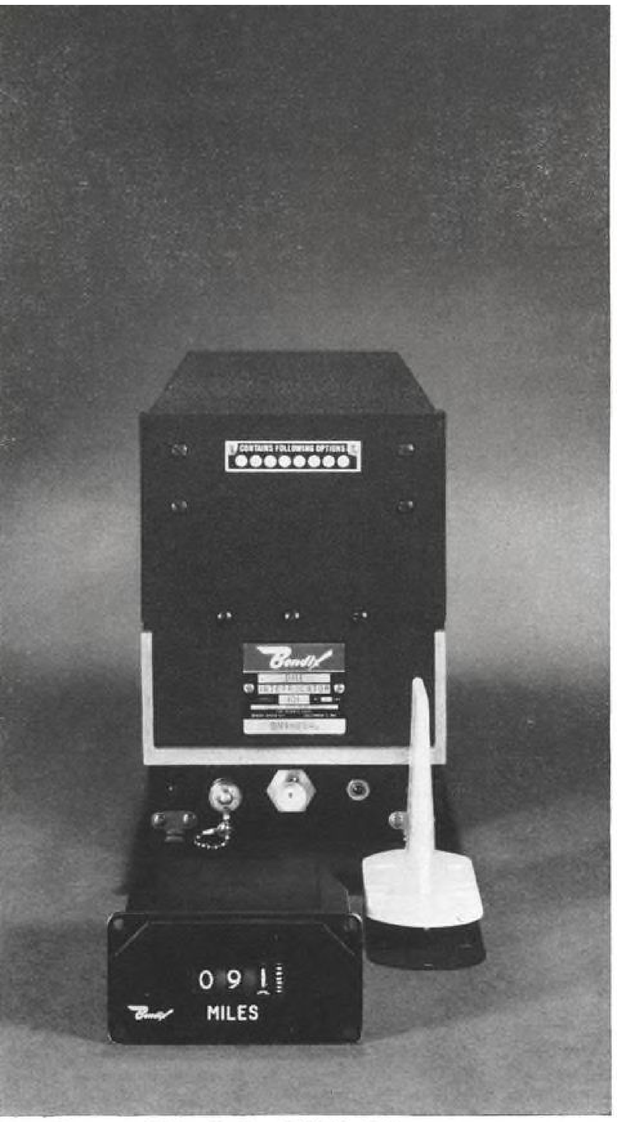
• **Capacity lag**—Increasing demand and the dissipation of capacity in some competitive lines has narrowed the gap between available supply and demand for

International Rectifier

International Rectifier Corp., a producer of semiconductor rectifiers, Zener diodes and solar cells among other products, has reported earnings after taxes of $484,865 on sales of $17,289,098 for the fiscal year ending June 30, 1963. Earnings for the comparable period last year were $1,207,282 on sales of $17,882,213.

During Fiscal 1963, the company says it produced 20% more semiconductor devices than in the previous year, but the market sales value for the total produced was only about equal to that of the preceding year, due to price declines.

The company's net income, as a percent of its sales, for Fiscal 1963 was 2.8%, as compared to 6.8% last year, 7.4% in 1961 and 9.5% in 1960.



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these devices. Over the past couple of years a number of products became obsolete, inventories dwindled and many companies were more cautious about jumping into newer lines than they had been in the immediate past. This situation will only be a transient one, many industry leaders say, lasting until semiconductor microcircuit yield problems are resolved, exposing the vast potential capacity now being accumulated.

• **Military and space business**—The need for extremely high reliability components, such as those developed under the Minuteman ICBM program, is tending to promote higher prices for these parts. The costs of producing them are higher, based on the need for elaborate reliability and test equipment in the component manufacturer's plant.

The ability of a vendor to win a large-volume military contract or to be specified to the equipment supplier by the government agency assures the vendor at times of profitable volume business and damps out unevenness and uncertainties in his manufacturing plans. Minuteman, for example, has had beneficial side effects for all its successful semiconductor suppliers. It has imposed tough demands on reliability, which was achieved by tighter process control. This in turn led to lower costs and better products for these companies.

The Minuteman reliability program is credited with significantly assisting such companies as Fairchild, General Electric, Motorola and Pacific Semiconductors. Competition for follow-on Minuteman business has been vigorous, as this business constitutes over-all the largest single chunk of semiconductor military business. The possibility of a delay in the program, and a consequent lapse in parts procurement late next year, because of difficulties in microcircuit development for improved Minuteman, could adversely affect a number of companies.

Program Position

This need to gain military agency approval and get program position will become more crucial with microcircuits and may favor entrenched companies.

• **Falloff in new companies**—The high rate of formation of new companies, characteristic of the semiconductor field and a contributor to overcapacity, is now slowing. Not many years ago a young scientist who indicated a desire to form a new company could have money thrust on him from a number of quarters. Then, the semiconductor market was a magnet for risk capital. Today, the situation is quite different. Venture capital people want no part of the semiconductor business, according to financial authorities. The semiconductor business has become far too competitive and a much larger purse is needed now than when the name companies of today rose to success.

Semiconductor companies are still being set up. But usually, in the past two years, they have been started by established companies, generally those interested in maintaining a position in the systems business by plunging into microcircuitry, rather than by venture capital. A new company established to produce diodes or transistors is rare, if not unheard of today.

The monetary rewards to the founders are much more modest now than in the past. For principals to share 50% or more of the venture was common years ago. The eight scientists who founded Fairchild Semiconductor six years ago had such an arrangement and divided $3 million among themselves when Fairchild Camera & Instrument exercised its options to purchase the company.

Today, principals who can get financing and wind up with a fifth of the concern are regarded as fortunate. For example, the total share set aside for all founders and future optionees of Signetics Corp., one of the more recent semiconductor companies (founded in August, 1961) is 20%.

The Signetics case is instructive for other reasons. Signetics was one of the last groups with the avowed aim of becoming a major company, rather than a specialty house, to get non-corporate financial backing. Its initial financing, arranged and headed by Lehman Bros., materialized at the height of the pricing chaos two years ago. It was one of the first new semiconductor companies with the announced intention of focusing on microcircuits only, to the exclusion of transistors and diodes. The company quickly gained and retains recognition with customers and at least grudging respect from competitors.

When its initial round of financing expired on Oct. 1, 1962, the company had a choice between additional funding through Lehman Bros. and an offer from Corning Glass Works, which wanted a controlling interest in Signetics, thereby securing for itself a semiconductor facility to complement its thin film and component capabilities. The Signetics principals elected to accept the Corning offer because of a realization then of the large financial investment necessary for developing microcircuits and the long-term nature of the business. Without the Corning backing, the company now concedes, it could not hope to be a success.

Although the monetary incentive may be shrinking, there is no diminution in the number of individuals or groups of individuals seeking backing for new semiconductor ventures. Their difficulty in obtaining necessary support tends to reflect what financial and industry executives are saying about the choking off of venture capital support for semiconductor companies. For another thing, potential backers now insist that principals have a proven record of success in the semiconductor industry, a requirement that might have excluded many of their predecessors.

Positive Step

The large investment now necessary to make a semiconductor company go and its more limited chances of success may further discourage outside backing for new ventures and continue to reduce the rate of formation of new companies. This is widely viewed in the field itself as a positive step in reducing excessive competition.

Coincidentally, the program booklet of this year's Wescon listed 69 semiconductor exhibitors, of which no more than 32 might legitimately be described as semiconductor manufacturers. Last year's Wescon booklet listed 78 semiconductor exhibitors with a slightly higher ratio of actual manufacturers. A spot check back through program booklets for several previous Wescon meetings indicates that this is the first year in which the number of semiconductor exhibitors declined. While

Philco Re-Orientation

Major product re-orientation at Philco Corp.'s Lansdale Div. will result in phasing out of mass production for the open market of certain unprofitable types of electrochemical and silicon planar transistors in favor of concentration on development, experimental production and sale of microelectronics, integrated circuits and related transistors.

Advanced development work and microelectronics activity had been increasing even before the decision to phase out the mass production types and is cited as one reason for the change. The re-orientation will permit the division to favor growing market areas, discontinuing production and marketing efforts which it says are frankly no longer profitable because of competitive production or pricing action.

Philco licensees, including Sprague Electric Co. and General Instrument Corp., will probably be relatively unaffected by the change, and should be able to continue any line now being produced under existing agreements. The competitive position of licensees may actually be improved as Philco discontinues its own production of transistor types also produced under license.

Timetable and schedule by specific types for the phasing out will depend on reports from representatives Philco is now sending to all primary customers and distributors to determine a "reasonable and proper" schedule based on customer needs and availability of substitute inventories.

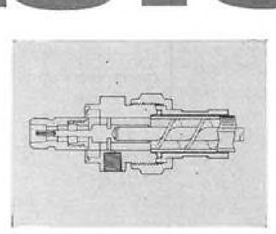
MATCHING PERFORMANCE STANDARDS
OF PHELPS DODGE COAXIAL CABLE

COAXIAL CONNECTORS

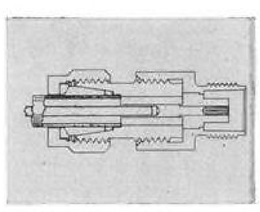
■ The high performance characteristics offered by five types of Phelps Dodge Electronics air dielectric, semi-flexible coaxial cable are protected by use of off-the-shelf connectors designed specifically for these cables. Matching and reactance compensating techniques are used to minimize electrical reflections capable of creating serious VSWR problems.

If your feed network demands the unusual, consider Phelps Dodge Electronics capability. Typical of several R & D programs now underway, high voltage cable-connector combinations are being developed. Gas pressurized 1⅝" diameter Styroflex® coaxial cable fitted with type LCF high-voltage connectors has been successfully tested with continual application of 50 KV DC.

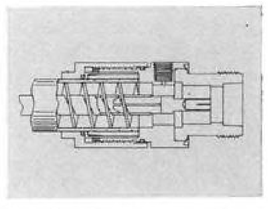
Pure-bred components as well as subsystem and system capability in sophisticated feed networks can be utilized for challenging assignments. When systems communications is the key to your project . . . see Phelps Dodge Electronics.



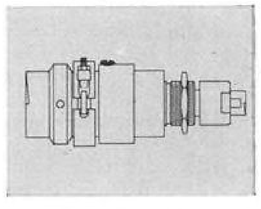
Design features include an uninterrupted wave surface path. Wirelok Connector shown is for Foamflex, Styroflex® and Spirafil cable in ⅜" to 3⅛" size.



Outer conductor joints are pressure butt type with electrical contact made on the inside diameter of the butt. This connector is for .180" and ¼" Foamflex.



High pressure spring fingers assure an encircling contact around the center conductor of the cable. Diagram is typical connector for Helical Membrane coaxial cable.



Resonant effects due to electrical contact within the center conductor typical in "basket" or "indented" designs are eliminated. Many special connectors are in stock.

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there is no necessary correlation, this may suggest the beginnings of an overall decline in the number of semiconductor manufacturers.

• **Rebranding**—The rebranding of semiconductor devices by one manufacturer with the labels of others at their request is becoming a more widespread practice in the semiconductor business today and might expand into an important future stabilizing influence. Most sources among those questioned, who professed to have any knowledge of it, contend that rebranding occurs on an insignificant scale today. But there are indications that the volume of rebranded products may increase. The number of companies engaged in this practice as either buyers or sellers is believed to be upwards of eight.

Rebranding tended to have a stabilizing effect on prices in the vacuum tube field, and may similarly affect the semiconductor business if only to a more limited degree.

The buyers' interest in rebranded products could be severalfold. If he has an established distributor setup and wishes to keep his people stocked with lines he does not or cannot make, he can do so by purchasing products bearing his own label from a competitor. This also might enable him to get the reputation for having a product line he lacks. Or it may permit a manufacturer who has not yet developed the product line to get a jump on its own products or keep a company in the product line until price rises make it economically feasible for the buyer to make his own.

Conceivably, this practice could be of value to a component company which wants broad product lines even though it does not plan to manufacture all of them. It would buy the devices at volume prices and make its margin by reselling them at small-quantity prices. At best the buyer could turn around and match the price of the rebrander on the item, but could not undersell him except at a loss.

For his part, the rebrander is selling to just another customer. His customer may have access to business he might otherwise never get or even be aware of. But he also faces something of a dilemma: If he turns the business away, he may be passing it along to another competitor. If he accepts it, he may be helping to keep a competitor (the buyer) in business.

Perhaps one of the most pervasive technical problems in the semiconductor field today is the effort by microcircuit companies—and this group embraces most of the larger semiconductor companies—to increase the production yield of microcircuits. This essentially is a mechanical problem requiring close production and process control.

Although microcircuits are made by the same processes that transistors and diodes are, the product yields are substantially lower. The reason is that microcircuit wafers are larger than those of a transistor, significantly compounding process control difficulties. The chances of cracks or holes occurring in the larger wafer are statistically greater than in a smaller one. The possibility of

Motorola Microcircuits

Motorola has begun assembling microcircuits in a new two-story 360,000-sq.-ft., $5-million plant in Phoenix, which is expected to be in full operation later this year. The new facility raises to over 1 million sq. ft. the area the company is devoting to production and storage of semiconductor products. This is more than double the space the company two years ago anticipated would be necessary for it by 1964.

Late this year, or early next year, Texas Instruments will move its microcircuit manufacture into a new 300,000-sq.-ft. facility which the company's Semiconductor-Components and Apparatus divisions will share.

Texas Instruments devotes slightly less than 700,000 sq. ft. to making semiconductor devices, resistors and capacitors.

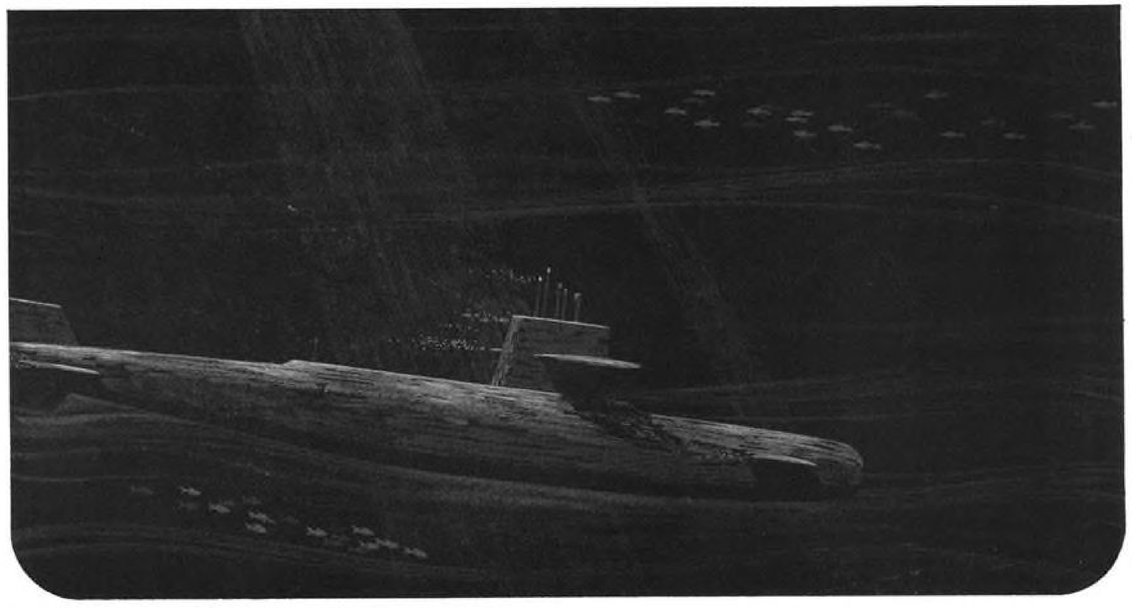


DALMO VICTOR'S "MAD" SYSTEM SPOTS UNDERSEA SUBS *In the vast, almost unexplored regions of inner space, potentially hostile subs may roam. Quick detection of such activity is a key factor in the Navy's undersea warfare capabilities.* ☐ *Such a project is Dalmo Victor's "MAD" System... Magnetic Airborne Detection. This antisubmarine warfare system is an advanced product of DV's oceanographic section. The "MAD" vehicle, towed here by a Bell helicopter, carries a head sensitive to the earth's magnetic field. Sudden change in the known magnetic field indicates the presence of a submerged submarine. Surveillance can be continued indefinitely.* ☐ *This ASW system is another example of Dalmo Victor's integrated systems capability. DV is in the vanguard of new developments in our major product areas.* ***If you are interested*** *in becoming part of these challenging programs, Dalmo Victor currently is accepting applications from qualified scientists and engineers. For further information contact: Director, Scientific and Engineering Personnel.*

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DV A textron COMPANY



surface contamination is greater, with more exposed surface area. Mask alignment is more difficult, breakage, general control and handling are all acute. Combined, these factors make the microcircuit more sensitive than the transistor to process error.

In addition, there are 14 basic steps in making a transistor, but 22 for a microcircuit, according to one company. If a 95% yield for each step were obtained, then transistor yield would be 50%, microcircuit yield 25%.

The additional steps and increased handling boosts manufacturing costs, contributing along with lower yields to a higher price tag, by perhaps a factor of 10, over a quality transistor. Average microcircuit price today is from $35 to $40.

To reduce its costs, the industry today is working to reduce the size of the microcircuit to improve yields and get more units per input effort. Motorola has found that lowering the linear dimensions of a square microcircuit wafer from 100 to 50 mils results in better yields by a factor in excess of the expected figure of four, because defective areas tend to be grouped into non-random patterns.

The longer the difficulties in yield and process control remain, the more acute may be the overcapacity problem later. For with microcircuit production limited, more semiconductor companies, and others, will enter the field in pursuit of the relatively high priced microcircuit.

Among the general trends in the

Transitron Reports Loss

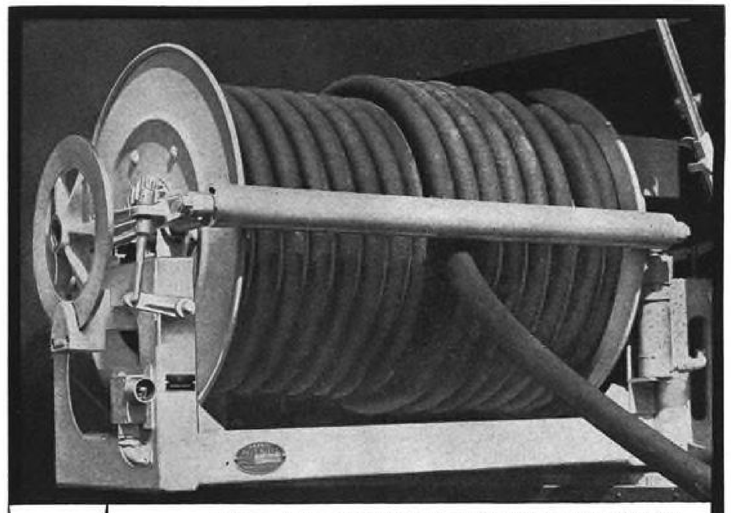
Transitron Electronic Corp. and subsidiaries reported net sales of $22,925,523 and a net loss, after federal income tax carryback, of $2,806,776 for its fiscal year ending June 29, 1963.

For the preceding annual period, Transitron's net sales were $28,831,539 and it recorded a loss of $763,755 after carryback but before a special renegotiation credit of $265,000.

In 1960, Transitron's net sales reached $47,753,064, the second highest semiconductor sales figure for that period. Its net income after taxes for that year was $8,110,641. Sales in 1961 declined to $37,059,966 for a loss after taxes of $1,451,792.

Dr. David Bakalar, president, claims Transitron "has continued as a major factor in the industry and remains today in a strong position, both financially and competitively."

"Although price competition and other adverse factors will probably continue throughout the year," Bakalar says, "management believes that there will be a marked improvement in operating results."



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PROBLEMATICAL RECREATIONS 189

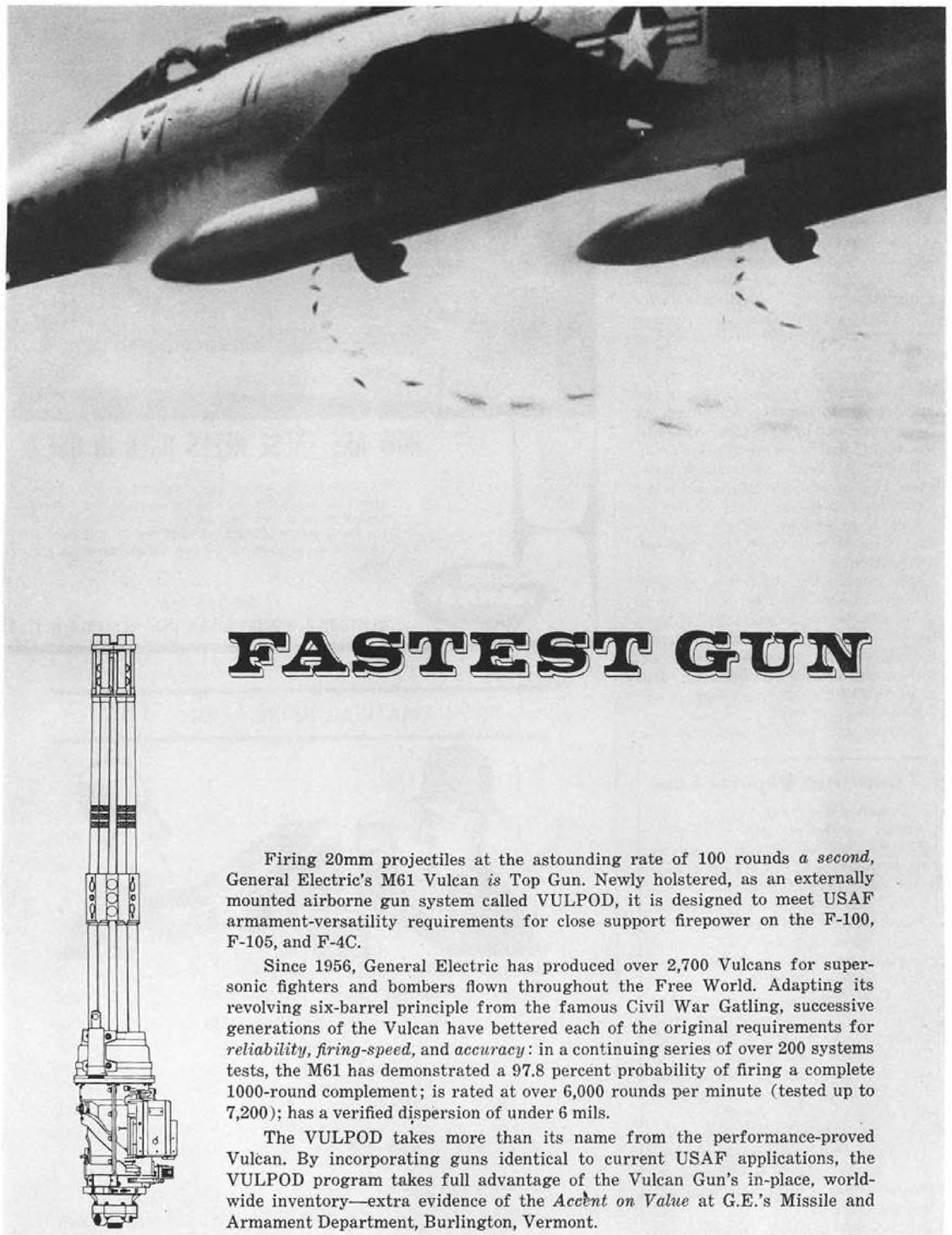


What is the largest amount of money you can have in coins, and still not be able to give change for a dollar? —*Contributed*

Ever since their formation, the Encoder Division of Litton Precision Products has been in a state of perpetual motion. We could barely catch the manager recently for a progress report on their product line. "Both contact and non-contact analog-to-digital shaft encoders," he hurriedly told us, but we could get nary a word on their many new devices and developments. We're sure you can. Write: 7942 Woodley Ave., Van Nuys, California.

ANSWER TO LAST WEEK'S PROBLEM: We have $\frac{x^2}{a^2}+\frac{y^2}{4a^2}=1$ as the equation of the ellipse, where 2 a is the height of the arch. From the data, $x = 3$, $y = 12$, so that $a = 3\sqrt{5}$. The truck will therefore be able to go under an arch $6\sqrt{5}$ or approximately 13 ft. 5 in. high.

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FASTEST GUN

Firing 20mm projectiles at the astounding rate of 100 rounds *a second*, General Electric's M61 Vulcan *is* Top Gun. Newly holstered, as an externally mounted airborne gun system called VULPOD, it is designed to meet USAF armament-versatility requirements for close support firepower on the F-100, F-105, and F-4C.

Since 1956, General Electric has produced over 2,700 Vulcans for supersonic fighters and bombers flown throughout the Free World. Adapting its revolving six-barrel principle from the famous Civil War Gatling, successive generations of the Vulcan have bettered each of the original requirements for *reliability, firing-speed,* and *accuracy*: in a continuing series of over 200 systems tests, the M61 has demonstrated a 97.8 percent probability of firing a complete 1000-round complement; is rated at over 6,000 rounds per minute (tested up to 7,200); has a verified dispersion of under 6 mils.

The VULPOD takes more than its name from the performance-proved Vulcan. By incorporating guns identical to current USAF applications, the VULPOD program takes full advantage of the Vulcan Gun's in-place, worldwide inventory—extra evidence of the *Accent on Value* at G.E.'s Missile and Armament Department, Burlington, Vermont.

AEROSPACE AND DEFENSE GROUP **GENERAL ELECTRIC**

semiconductor field foreseen by industry leaders are:

• **Further profit squeeze** – Continued erosion of many semiconductor companies by further price declines, especially those companies unable to vigorously support necessary research and development to update product lines. This might prod weaker companies to concentrate in microcircuitry, to the exclusion of unprofitable discrete component lines, in the belief its last chances rest there.

• **Exploit new products**–Eager for new business, many companies are expected to seize and exploit any new technical innovations quickly. No technical innovations in conventional semiconductor technology, with the possible exception of packaging techniques, are expected to have the impact or market-creating ability which other semiconductor devices had in the early days of the industry. The field effect transistor is a current example of a product with an attractive but modest and specialized future, many transistor specialists point out.

While the market for it may be promising, when divided among the six to 12 or more companies developing the devices it is not appreciable.

• **Small company prospects**–The small company which has capability in restricted areas, is willing to be satisfied with limited markets for products peculiar to it, and does not attempt to overexpand, may continue to enjoy a modest future, many say. As long as the small producer keeps technologically ahead of the big organization, it may expect to sell reasonable quantities at high prices. Others argue that the pressure of competition from companies seeking to boost volume and profits by expansion into new arenas will increase, making the future of small semiconductor companies tougher.

• **Microcircuit success chances tougher**–As time passes, the likelihood of success for a company first entering the semiconductor microcircuit field diminishes, considering the necessary large capital investment, the time required to fully develop all the associated technologies, the appreciable competition already in the field, the need for production capability and customer preference. Estimates of how large an investment is necessary to win a competitive position vary anywhere from $1.5 to over $5 million. Time required is variously estimated from two to five years with the company already possessing the semiconductor capability enjoying a head start.

Not many new companies starting from a standing position are expected to be able to afford a loss position for that period of time. Fairchild says it has invested over $5 million in microcircuitry, has been at work in the field for



"Don't tell me
how sophisticated it is...
Will the damn thing work?"

(From an imaginary but realistic exchange between a Source Selection Board and Tapco.)

Source Selection Board (cont.): I can see this subsystem is highly designed . . . but will we need some PhD standing by to maintain it?

TAPCO: You'll be able to plug it in and forget it.

SSB: You sound pretty confident. What's your basis?

TAPCO: There's no Buck Rogers in it. Actually, there's nothing really new about the concept.

SSB: You mean to say there's been no R&D?

TAPCO: On the contrary. There's been plenty. I meant there's nothing new to *us* about the concept. Pound for pound, we spend as much or more money than anybody coming up with new stuff.

SSB: What are you driving at?

TAPCO: Our guys have rung up plenty of "firsts"—more than our share, maybe. But the point is—we're *hardware oriented.*

SSB: Which means . . . ?

TAPCO: It means the men who put this system together are hard-nosed. They've got four questions they use for a "go-no-go gauge" on every element in the system. Will it perform in service? Is it man-rated? Can it be produced on schedule? Will the reliability and confidence level be maintained? We get those answered and we think we've *really* got a sophisticated design.

SSB: You sell real well. Can you back it up?

TAPCO: Absolutely. Example: An aircraft alternator drive we designed and produced by the thousands. Spec life was 500 hours. We suggested some minor modifications. Customer accepted. Today that drive is operating 1250 hours TBO. Some field men say it'll go 3000 hours.

SSB: Do I get this approach on my project?

TAPCO: *You bet!*

If you'd like to continue this conversation in terms of your specific requirements, write R. A. Paetz, Director, Requirements and Contracts, Tapco, TRW, 23555 Euclid Ave., Cleveland, O. 44117.

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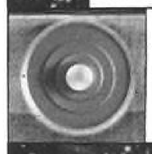


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Subjected to 8 weeks and million cycle test immersed in JP-4 fuel. Tested for 100,000 cycles at 28 vDC, 3 amps inductive at 80,000 feet.



Part No. 6107
MS27993

STANDARD HERMETICALLY SEALED SWITCH . . .
Operating force 22 oz. maximum movement differential .0005 to .005. Electrical ratings, 5 amps resistive, 3 amps inductive, 28 VDC/115 VAC.

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over 3½ years, has been selling devices for about two years and still has not recovered its investment. And this company is believed to be responsible for over half the reported semiconductor microcircuit sales in 1962 and at least a sizable portion this year.

Today, there are no fewer than 26 companies with a claimed semiconductor microcircuit capability, 20 of these being semiconductor organizations. At least 15 of the total are known to have actively sought a program position in one or another military or space project. To this number must be added several newer companies, plus a large number of systems companies with expanding in-house capability which have not committed themselves as out-of-house market suppliers.

There are indications of an increasing awareness of the importance of time and money in microcircuit success. Electronic Engineering Co. and Baldwin Piano, joint backers of Siliconix, a recent semiconductor and microcircuit company (founded March, 1962), have discovered that it takes longer than they had anticipated to develop the technology and to cultivate customer preference for microcircuits.

This requires additional capital for which the two companies are seeking a third partner. The two started Siliconix to satisfy internal microcircuit needs and to diversify. They are reluctant to sell the operation now that it shows "great signs of success," according to Electronic Engineering. In order to get the additional capital, the two companies may be forced to offer a potential third partner a long-term option to buy Siliconix.

Success in microcircuitry will require a mixture of things from the technologies to the people who know how to spend the money. Silicon planar technology is regarded as the cornerstone and with this go furnaces, measuring equipment, laboratories for oxide coatings and diffusion chambers, plus manufacturing people who can control processes to desirable yields. To this must also be added research and development capability and effective marketing of the product.

• **Make or buy resolution**—The question of whether or not systems manufacturers will make or buy microcircuits, the outcome of which will have a crucial bearing on the future health of the semiconductor industry (AW Mar. 19, 1962, p. 55), shows signs of resolving in favor of the semiconductor manufacturers.

While many systems companies have built internal semiconductor capabilities, few have shown any appetite to manufacture quantities for their own or external use, with the exception of International Business Machines and the systems companies already in the semiconductor business. The more time that elapses the more able the semiconductor industry will be to satisfy customer needs, thus eliminating one reason for users resorting to internal manufacture. And, for the reasons cited earlier, the ability to be successful in the business is getting tougher day by day.

Several avionics systems manufacturers which are pioneering users of microcircuits and are known to have been troubled by tardy deliveries and/or unsatisfactory supplier performance were questioned recently. They express no more inclination to enter the business than they did nearly two years ago (AW Mar. 19, 1962, p. 55).

Typical of these is Litton Systems, which is designing microcircuits into several airborne avionic systems (AW Sept. 2, p. 87; Mar. 11, p. 237). Litton considers delivery difficulties it experienced as no more of a danger sign than similar experiences with other new parts. The central point, the company says, is that it finds it cheaper to design its own circuits and then seek suppliers to fabricate them.

Litton is, however, developing an in-house capability which it describes as of sufficient stature to produce modest development quantities of microcircuits. This gives the company a chance to evaluate the circuits in microcircuit form before releasing them to vendors.

Its first group, consisting of 40 people working on thin film and semiconductor microcircuits, will be followed by two others, each in a different division of the company. They will function in parallel with circuit design groups and will resolve with company design engineers any difficulties in meeting requirements in microcircuit form.

Litton is believed to have carried the internal microcircuit fabrication capability scheme further than most systems manufacturers planning to follow the same or a variation of this course.

The reaction of semiconductor suppliers to this approach is mixed. One voiced strong support, expressing the belief that systems users would develop from it a better understanding of the problems, limitations and advantages of microcircuits. From this they could design better circuits, more suitable to microcircuit techniques.

Raising a contradictory opinion, another industry source contends that in-house development capability will lull the user into believing that a microcircuit realized in the laboratory can as easily be duplicated as a production item, an unjustifiable deduction.

Even without any appreciable number of systems makers or component companies entering the microcircuit business, the consensus of leaders in this field predicts an excess of microcircuit capability and companies.



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LEFT, BOEING MINUTEMAN (GROUND SUPPORT) ABOVE, SIKORSKY S-64 SKYCRANE



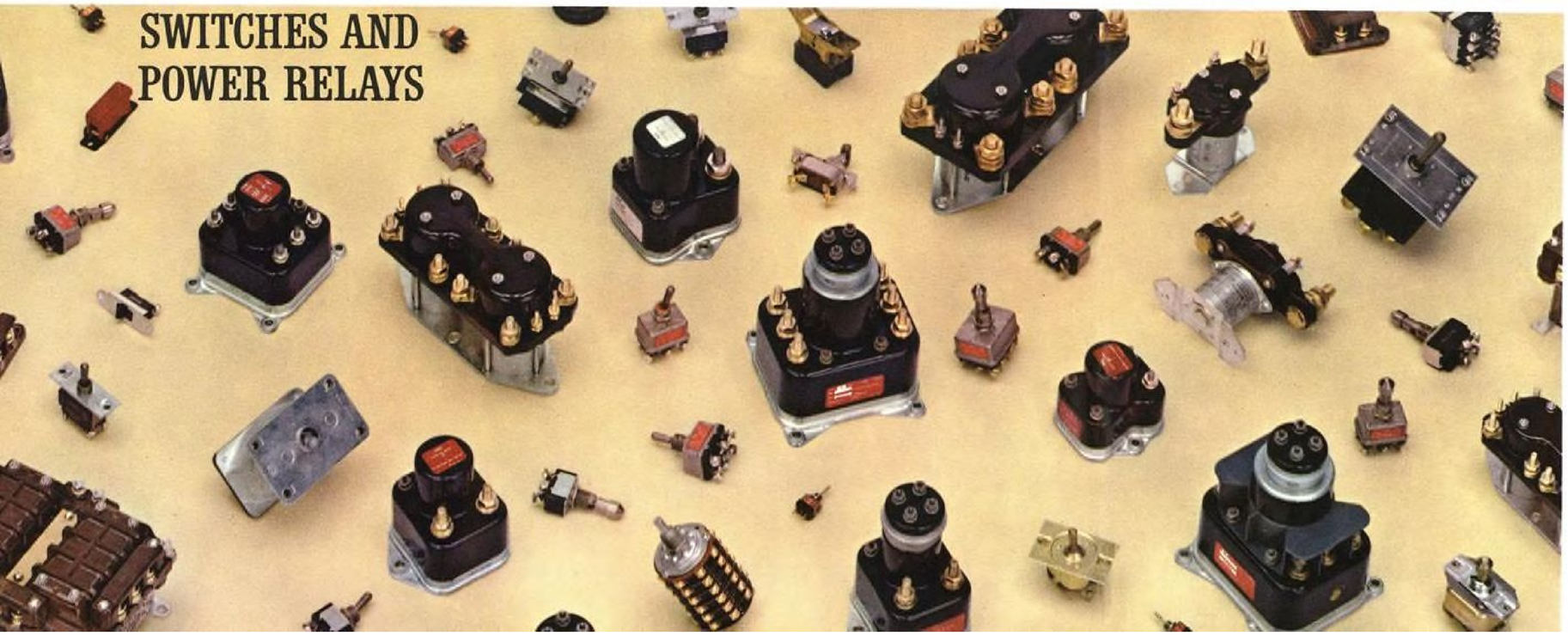
ABOVE, GRUMMAN SA-16B ALBATROSS BELOW, REPUBLIC F-105 THUNDERCHIEF





ABOVE, NORTHROP T-38 BELOW, CESSNA 310G





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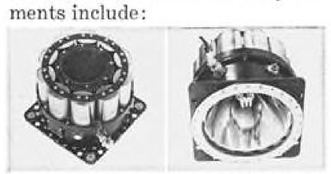
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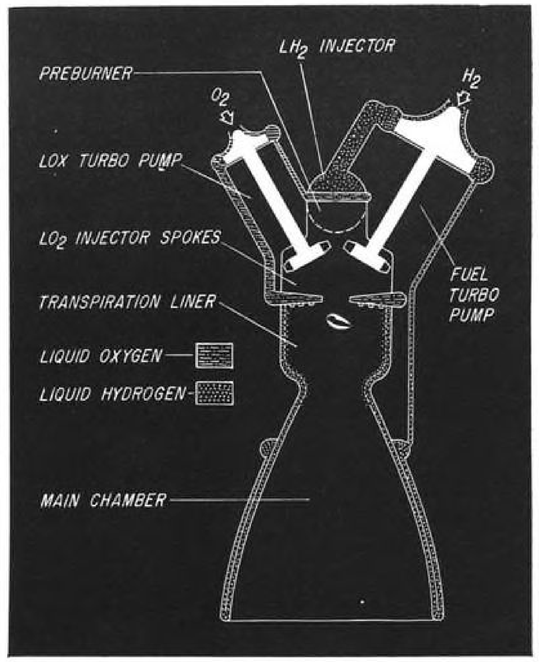
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PRATT & WHITNEY'S RL20P-3 advanced engine is shown in mockup form (left) and in schematic (right). P&W says operational version could deliver 265,000 lb. thrust in vacuum. In background of left photo, engineers work on RL10 engines.

P&W Studies Small, High-Thrust Engines

By George Alexander

West Palm Beach, Fla.—Application of the turbojet afterburner technique to a rocket engine is being developed here by Pratt & Whitney Aircraft in its research on small-size, high-thrust propulsion systems for future launch vehicles.

Pratt & Whitney, a division of United Aircraft Corp., displayed a mockup of such an engine to the recent Air Force Association meeting in Washington, D. C. An operational version of the mockup, the company said, could deliver 250,000 lb. thrust at sea level and 265,000 lb. in vacuum. Notably devoid of myriad plumbing lines, the engine would burn liquid hydrogen and oxygen and operate at pressure and temperature levels considerably higher than today's powerplants.

Principal Components

The engine, principal components of which have been tested successfully by Pratt & Whitney at its Research and Development Center here (AW Sept. 9, p. 30), consists of a two-stage liquid hydrogen and single-stage liquid oxygen pump, separate fuel and oxidizer injectors, two-part transpiration-cooled combustion chamber, and regeneratively-cooled nozzle skirt extension.

Centrifugal pumps mounted 180 deg. apart on the top of the combustion chamber are canted inward at about 35 deg. angles off the engine centerline. That gives the engine a slight "Y" appearance. Drive turbines of both pumps extend down into the upper half of the two-part combustion chamber, where they are driven by the fuel-rich gas flowing in the region.

The combustion chamber is divided into two segments of nearly equal volume by a series of radial liquid oxygen injector-spokes extending from the walls of the chamber toward a center point. Spokes are similar in effect and purpose to the flameholder ring in a turbojet afterburner.

The main chamber, in the lower half of the combustion container, is cooled by transpiration. It was the successful demonstration of this technique with scaled-down chambers, Pratt & Whitney said, which made feasible the concept of engines operating at pressures of 3,000 psia. and temperatures between 5,500 and 6,000F.

This method bleeds fuel or some other liquid through pores in the chamber walls to form a thin insulating gas layer along the inner wall surface. In the past the technique has not been overly successful because of the difficulty in achieving controlled porosity throughout the basic wall material. This is essential if the fluid is to be distributed along a gradient commensurate with the temperature gradient inside the chamber. Greatest heat flux occurs at the base and throat area of a combustion chamber.

Porous Liner

Pratt & Whitney's approach is to leave intact the nickel-alloy chamber walls and instead insert a porous liner inside the chamber. For proprietary reasons, Pratt & Whitney declined to give any details on the liner other than to say it is fabricated of metal and is machined to obtain the desired porosity.

It extends from just under the oxidizer injector-spokes to a point just below the nozzle throat. There it joins with the regenerative coolant tubes which make up the nozzle skirt extension. Liquid hydrogen fluid tapped off the pump comes up the tubes, passes into the liner and then seeps through the pores into the chamber. Seepage, or transpiration, is greatest in the base-throat area.

Hydrogen fuel and liquid oxygen oxidizer each has its own separate injector. The hydrogen dome is of flat-plate design but is positioned against the wall

of the upper half of the combustion chamber, with its face in a vertical plane.

Oxidizer injectors are tapered spokes with orifices on the underside (facing the nozzle). There is a 3-in. dia. pass-through gap off the ends of the spokes, in addition to the wedge-shaped passages between spokes, through which the gas exhaust flows from the upper to the lower half of the combustion chamber.

Starting sequence would be similar to that of Pratt & Whitney's RL-10, in which expansion of the cryogenic fluids passing through the feed lines is sufficient to turn the pumps.

Pump Outputs

About 90% of the hydrogen pump's output, and about 15% of the oxidizer pump's output, would be fed into the flat-plate injector on the side of the upper part of the combustion chamber. The oxidizer would contain a small amount of hypergolic fluid—most likely fluorine—to initiate combustion.

Combustion takes place in the upper half of the chamber, called the pre-burner. The pre-burner can is shaped like an inverted foot. Combustion occurs in the foot and is turned 90 deg. to flow down the shank over the turbine blades of the pumps and then into the main chamber. Temperature of the fuel-rich gas mixture would be about 1,500F.

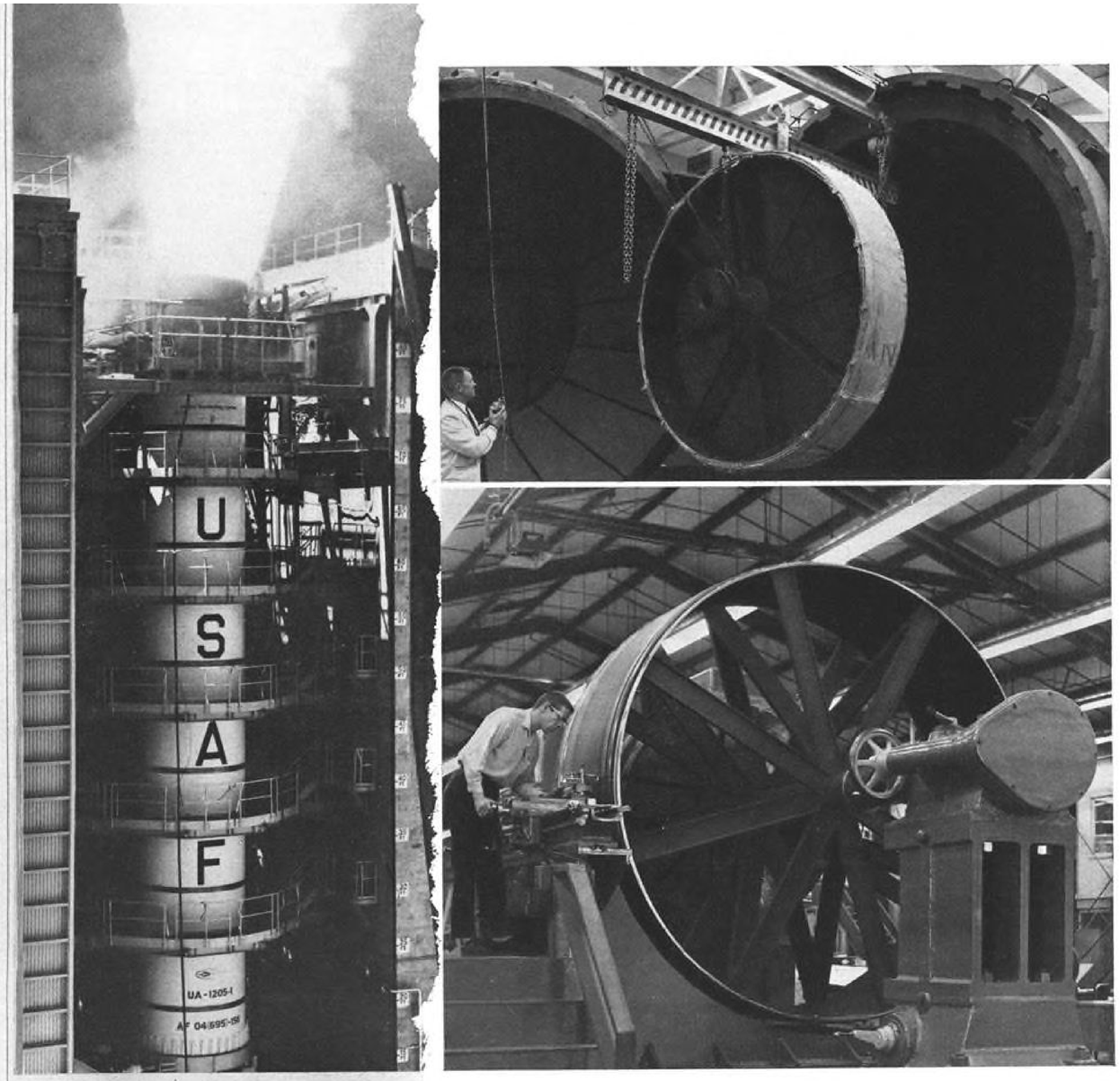
Passing over the oxidizer injector-spokes, the fuel-rich gas essentially would be heated hydrogen (the amount of oxygen in the pre-burner would be negligible). Contacting the oxygen, the fuel would ignite and temperatures would jump to 5,500-6,000F.

High Pressure

At a mixture ratio between 6.5 and 7-to-1 (lb. of oxygen to lb. of hydrogen) and at pressure levels initially imparted to the propellants by the pumps, there would be a considerable quantity of gas molecules in a fairly small chamber. Pressure would be extremely high—Pratt & Whitney said it started with a design requirement of 3,000 psia. in the chamber—and so would the characteristic velocity. As a result, both specific impulse and thrust would be high. Specific impulse is said to be around 430 lb.-sec./lb.

Over-all, this method of combustion is similar to that of a turbojet afterburner, in which fuel is dumped into the exhaust flowing from the main chamber to combine with unburned oxygen.

The 10% of the hydrogen pump's output not fed into the fuel injector would be ducted to a point about one-third down the length of the nozzle skirt and led into a circular manifold



Mightiest solid-propellant rocket tested by United Technology Center

Exhaust flames leap 200 feet from the nozzle of a 250-ton solid-propellant rocket motor in a static test at the Coyote, Calif. test site of United Technology Center. The motor, the largest solid-propellant rocket ever fired, produced a peak thrust of 1 million pounds. Two of the 75-foot tall rockets will make up the first stage of the Air Force Titan III-C space booster. Mission: To meet requirements in the 5,000-25,000 pound payload category for relatively low altitude orbits, ranging from 20,000 pounds in a 100 nautical miles orbit to 13,000 pounds at 1,000 nautical miles.

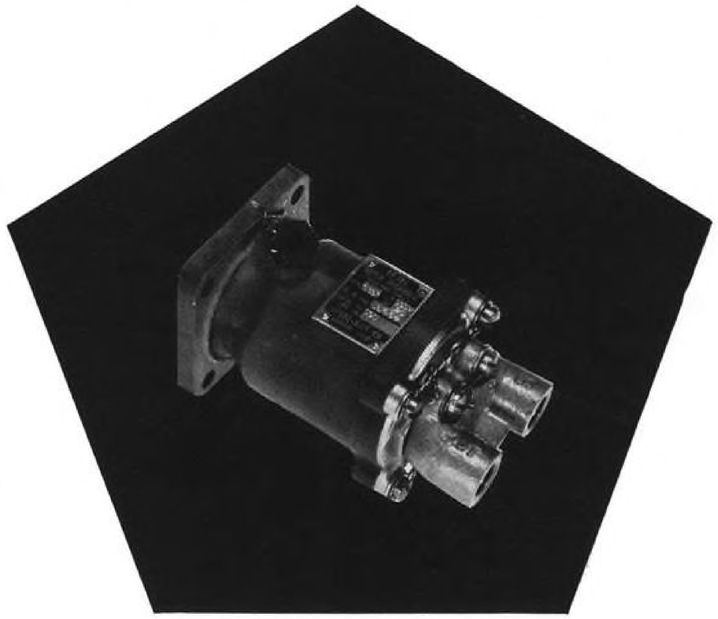
Titan III-C booster liners built by Rohr

On these massive, motor-driven mandrels, Rohr is fabricating the large insulating liners for first-stage boosters of the Air Force Titan III-C for United Technology Center. Built up through precise application of many plies of uncured, calendered rubber, the entire unit is encased in nylon and cotton shrink tapes and cured in 15-foot diameter Rohr autoclaves. Very subtle tapers and convolutions are achieved in the components to accept the configuration of the engine case. Production of these critical booster liners provides another demonstration of constantly expanding capabilities in many new product areas at Rohr. For information concerning specific Rohr engineering and production know-how, please write: Marketing Mgr., Dept. 19, Rohr Corp., Chula Vista, Calif.

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ROHR CORPORATION

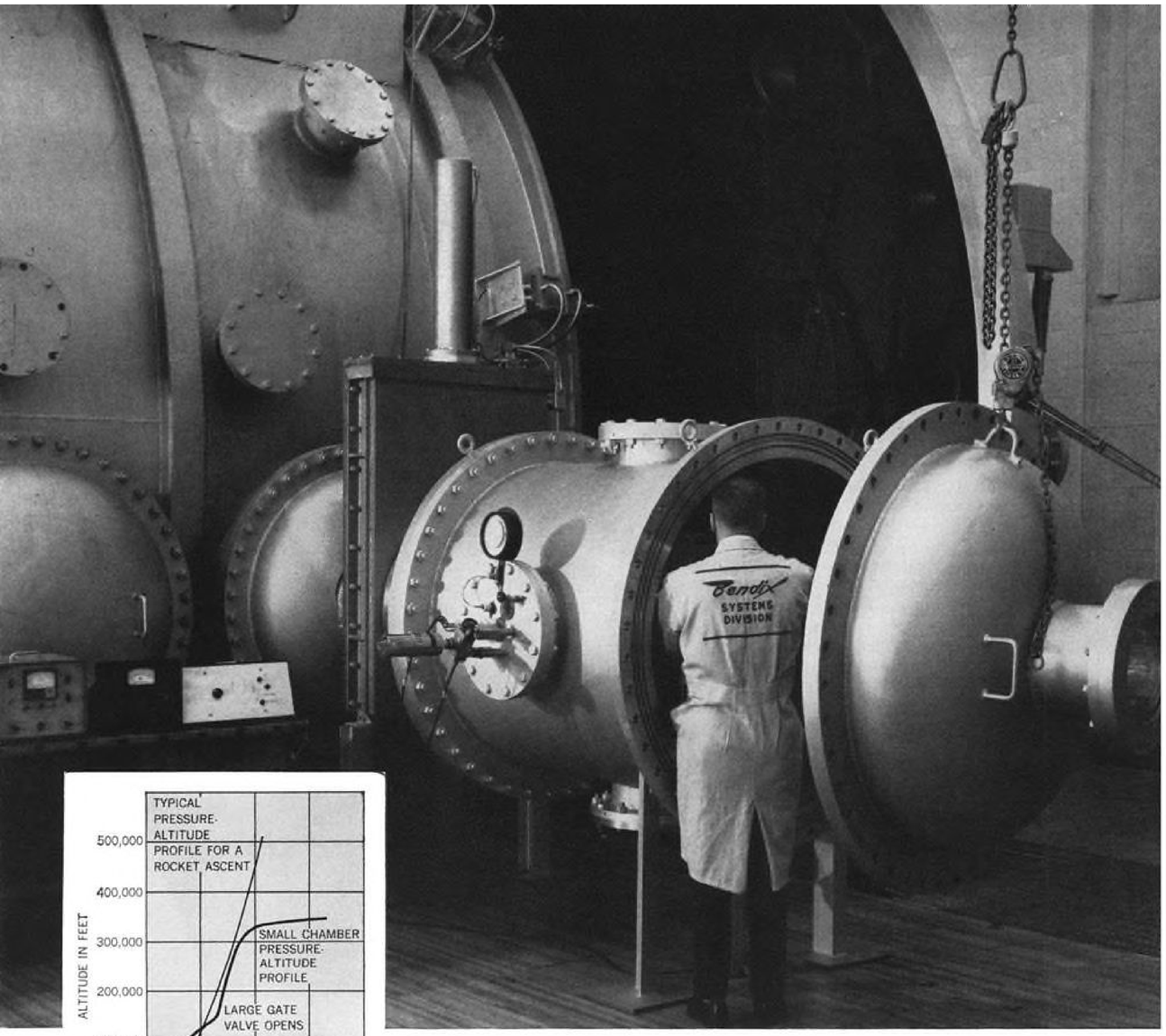
Hydraulic motor: greater starting torque with peak running efficiency. Interchangeable parts. Straight line design. Longer life. Increased shaft rigidity.

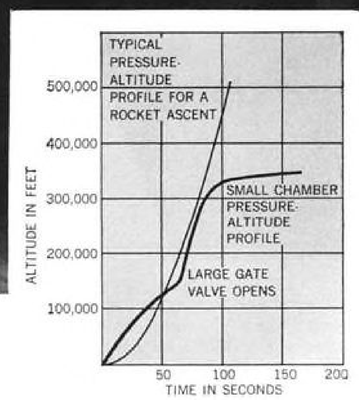


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RISE-TO-ALTITUDE TEST FACILITY. The small 4 x 4 foot chamber attached to the large 20 x 27 foot chamber has been designed and developed to duplicate the pressure history experienced by a rocket-borne payload as it climbs to altitude. The large chamber acts as a vacuum reservoir, isolated from the small chamber by an air-operated gate valve. The test sequency first evacuates the small chamber to a pre-determined level, then opens the valve to the large chamber which can be evacuated to 5 x 10^{-8} torr. The insert shows the resulting approximation to the actual vehicle pressure history.

INSTANT SPACE SIMULATION (JUST ADD VACUUM). The rise-to-altitude chamber, to simulate pressure changes encountered by rocket-borne payloads, is a new addition to the Bendix environmental laboratories where engineers design, fabricate and test space vehicles. Engineers experienced in integration, assembly and test will find new careers at the Bendix Systems Division, Ann Arbor, Michigan. Write or call our Personnel Director.—An equal opportunity employer.

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Mississippi Support

Cape Canaveral—General Electric and National Aeronautics and Space Administration have signed a one-year, $2.4-million contract for support services to be provided by GE at the space agency's Mississippi Test Operations (MTO) facility.

GE, selected in February, 1962, as the Apollo integration, reliability and checkout contractor, also was chosen for the Mississippi test role earlier this year (AW Apr. 22, p. 28).

GE's support will be broken out into two major areas:

- Plant support, including utilities, motor pool, security, fire protection, employe medical, plant maintenance, reproduction and graphic arts.
- Command and control systems, including data acquisition and processing, engineering services, component servicing and shop services.

The company is expected to distribute almost all of the functions in the package to subcontractors and retain those tasks in the second grouping for itself. Both NASA and GE estimate that the company will have between 1,200 and 1,500 personnel at the site by 1966.

embracing the bell. Fluid would flow down one set of tubes and up alternate ones, to cool the skirt before passing into the transpiration liner within the combustion chamber.

Pratt & Whitney said a variety of skirt extensions could be added to the basic chamber for best engine performance in either sea-level or high-altitude applications. The engine also would be throttleable over a 10-to-1 range, according to the company. Throttle controls, which could be as simple as straight mechanical linkage, also would regulate the amount of fluid coolant introduced into the transpiration liner.

In a booster stage application of the engine, the propulsion system could be checked out by starting and idling at the lowest level, such as, 10%—much the same way a pilot runs up his engine before taking off.

The engine is designated the RL20P-3 by Pratt & Whitney, and the Space Transport Engine by company engineers. The company foresees several possible applications for the engine, including both military and civilian space agency projects, but the most prominent one would be in a re-usable booster.

It is for that reason that engineers have applied the "transport" label to the engine. Pratt & Whitney has studied several RL20P-3s in a plug nozzle configuration and contends that it could be used in an economical re-supply vehicle for orbital space stations.

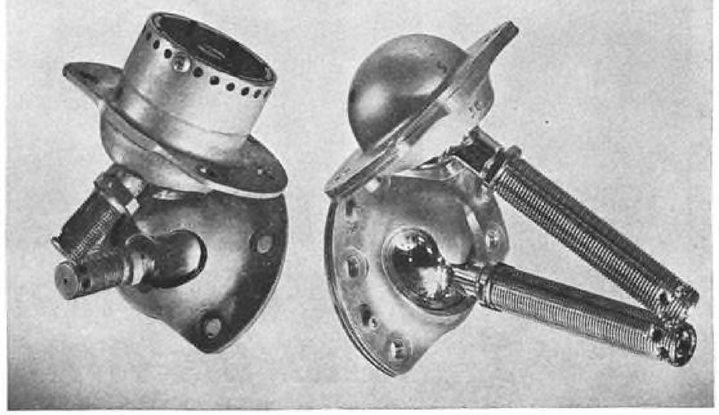
The engine displayed at the Air Force Association stood slightly more than 6 ft. tall. It appeared to have a throat dia. of about 6-8 in. and a nozzle exit dia. of about 36 in., which would give it an area expansion ratio of about 20-to-1.

It also appeared to weigh about 2,000 lb., which—in an operational unit delivering 250,000 lb. of thrust—would give it a thrust-to-weight (engine) ratio of about 125-to-1.

The Rocketdyne F-1 engine, which produces about 1.5 million lb. thrust, reportedly weighs close to 20,000 lb. for ratio of 75-to-1. Rocketdyne's J-2 engine, which delivers 200,000 lb. of thrust, has a ratio of about 100-to-1 but is considerably bigger in linear dimensions than the Pratt & Whitney powerplant.

When designed for high re-use rates—and assuming no damage to the system during recovery operations—the engine could be operated for 10 hr. between overhauls, the company claims. Taking 6 min. as the average duty cycle time of a conventional first stage booster or about 60 min. for a single stage-to-orbit vehicle, the engine could be re-used between 10 and 100 times if Pratt & Whitney could achieve the estimated overhaul rate.

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Space Vehicle Log

(As of Sept. 5, 1963)

1963 OBJECTS IN ORBIT Designation/Name	Source	Launch Date	Inclination (deg.)	Period (min.)	Apogee (mi.)	Perigee (mi.)	Transmitting Freq.[1] (mc.)
1963- 3 Thor Agena D	USAF	Jan. 16	81.88	94.6	324.0	293.3	.....
1963- 4 Syncom	NASA	Feb. 14	33.51	1,426.4	22,948.7	21,192.8	(Silent)
1963- 5 Blue Scout	USAF	Feb. 19	100.48	97.8	492.8	315.1	.....
1963-8B Lunik 4[2]	USSR	Apr. 2	.....	.....	.....	.....	(Silent)
1963- 9 Explorer 17	NASA	Apr. 3	57.60	96.0	537.5	165.9	(Silent)
1963-13 Telstar 2	NASA	May 7	42.76	225.2	6,600.9	603.4	136.050
1963-14 Atlas Agena[3]	USAF	May 9	87.34	166.5	2,283.6	2,245.1	.....
1963-17 Cosmos 17	USSR	May 22	48.88	94.5	461.0	155.4	20.005
1963-22 Blue Scout[4]	USAF/USN	June 16	90.01	99.8	469.1	456.1	150; 400
1963-24 Tiros 7	NASA	June 19	58.21	97.4	408.9	381.6	136.234; 136.922
1963-25B Electron Sensor[5]	USAF	June 27	82.11	132.6	2,554.8	213.8	.....
1963-26 Geophysics Research	USAF/NASA	June 28	49.72	102.1	807.5	261.6	.....
1963-27 Thor Agena	USAF	June 29	82.31	94.8	329.3	300.2	.....
1963-30 Thor Agena[6]	USAF	July 18	88.38	167.9	2,319.5	2,255.6	136.890
1963-31 Syncom 2	NASA	July 26	33.09	1,436.0	22,221.6	22,183.6	136.980; 136.468 1814.069; 1815.794; 1820.177
1963-33 Cosmos 19	USSR	Aug. 6	48.97	92.0	299.5	170.3	90.02
1963-34 Thor Agena	USAF	Aug. 24	75.00	90.5	261.0	108.1	.....
1963-35 Thor Agena	USAF	Aug. 29	81.81	90.8	210.7	176.5	.....

PRE-1963 SATELLITES STILL TRANSMITTING

			Source	Launch Date	Inclination (deg.)	Period (min.)	Apogee (mi.)	Perigee (mi.)	Transmitting Freq.[1] (mc.)
1958	Beta 2	Vanguard 1	USN	Mar. 17, 1958	34.17	133.9	2,444.1	409.5	108.017
1961	Omicron 1	Transit 4A	USN	June 29, 1961	66.80	103.8	621.3	546.2	150; 400
1962	Omicron 1	Ariel	NASA/UK	Apr. 26, 1962	53.84	100.6	736.2	246.7	136.406
1962	Alpha Alpha 1	Tiros 5	NASA	June 19, 1962	58.10	100.5	593.4	377.2	136.233; 136.923
1962	Alpha Psi 1	Tiros 6	NASA	Sept. 18, 1962	58.29	98.7	443.1	425.1	136.233; 136.922
1962	Beta Alpha 1	Alouette	Canada	Sept. 29, 1962	80.47	105.5	641.5	621.5	136.978; 136.592; 136.077
1962	Beta Gamma 1	Explorer 14	NASA	Oct. 2, 1962	40.00	2,184.9	60,172.8	1,093.9	136.440
1962	Beta Mu 1	Anna 1B	USN	Oct. 31, 1962	50.15	107.8	733.5	672.0	162; 324
1962	Beta Tau 2	Injun 3	USN	Dec. 13, 1962	70.36	114.9	1,650.2	151.6	136.871
1962	Beta Upsilon 1	Relay 1	NASA	Dec. 13, 1962	47.51	185.0	4,626.0	815.5	136.140; 136.620
1962	Beta Chi 1	Explorer 16	NASA	Dec. 16, 1962	52.00	104.3	741.2	458.6	136.861; 136.200

1963 DECAYED OBJECTS

Designation/Name	Source	Launch Date	Decay Date
1963- 1 Lunik	USSR	Jan. 4	Jan. 5
1963- 2 Thor Agena D	USAF	Jan. 7	Jan. 24
1963- 6 Cosmos 13	USSR	Mar. 21	Mar. 29
1963- 7 Blue Scout	USAF	Apr. 1	Apr. 26
1963- 8A Lunik Carrier	USSR	Apr. 2	Apr. 3
1963-10 Cosmos 14	USSR	Apr. 13	Aug. 29
1963-11 Cosmos 15	USSR	Apr. 22	Apr. 27
1963-12 Cosmos 16	USSR	Apr. 28	May 8
1963-15 Faith 7[7]	NASA	May 15	May 16
1963-16 Thor Agena	USAF	May 18	May 27
1963-18 Cosmos 18	USSR	May 24	June 2
1963-19 Thor Agena	USAF	June 12	July 12
1963-20 Vostok 5[7]	USSR	June 14	June 19
1963-21 Thor Agena	USAF	June 15	Aug. 7
1963-23 Vostok 6[7]	USSR	June 16	June 19
1963-25A Thor Agena	USAF	June 27	July 26
1963-28 Atlas Agena	USAF	July 12	July 18
1963-29 Atlas Agena	USAF	July 18	Aug. 13
1963-32 Thor Agena	USAF	July 30	Aug. 11

PRE-1963 OBJECTS DECAYED[8]

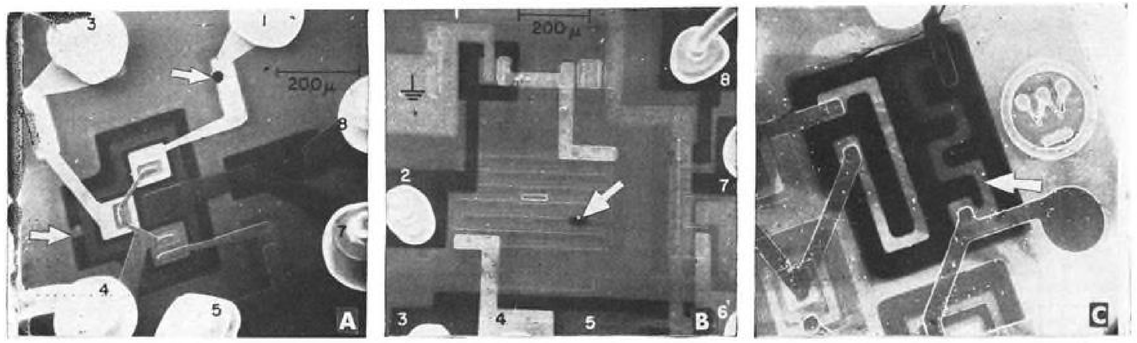
1962 Alpha Xi 1	Cosmos 8	USSR	Aug. 18, 1962	Aug. 17, 1963
1962 Iota 1	Cosmos 2	USSR	Apr. 6, 1962	Aug. 20, 1963

Notes: (1) Defense Dept. does not normally release transmitting frequencies; (2) In highly elliptical earth orbit; (3) Probably carried two tetrahedral research satellite (TRS) payloads ejected from the main package; (4) Transit payload; (5) Piggyback payload with Discoverer-type package; (6) Carried unspecified piggyback; (7) Recovered with human pilot; (8) Objects decayed since last report published (AW June 17, p. 72).

Sources: Aviation Week & Space Technology, National Aeronautics and Space Administration, North American Air Defense Command, United Nations Registry, U. S. Air Force and Smithsonian Astrophysical Observatory.

SUMMARY

Year	Launched	In Orbit	Year	Launched	In Orbit
1957—US	2	0	1961—US	35	12
1958—US	5	2	—USSR	5	1
—USSR	1	0			
1959—US	11	4	1962—US	54	27
—USSR	3	1	—USSR	19	2
1960—US	17	10			
—USSR	3	0	1963—US	26	15
			—USSR	10	3



SCANNING ELECTRON BEAM microscope provides photos permitting detailed analysis of the electrical topography of semiconductor microcircuits, revealing faults which might otherwise go undetected or unexplained. Typical faults revealed include: (A) Structural damage in base resistor lead, (top arrow) and flaw in isolation junction (lower arrow); (B) small dust particle which is accumulating charge (arrow). Properly formed semiconductor resistor is shown in (C) by uniform change in voltage potential from dark to bright ends.

Electron Beam Technique Makes, Inspects

By Philip J. Klass

Pittsburgh—Technique which can provide a heretofore unavailable picture of the electrical topography of semiconductor devices, as well as a new method for fabricating such devices with greatly increased component density and performance, has been developed by Westinghouse Central Research Laboratories.

The technique uses the non-thermal properties of a high-resolution scanning electron beam both for non-destructive fine-grained inspection of semiconductor devices and to fabricate such devices with active area dimensions as small as a few millionths of an inch, according to company scientists.

This opens the way to semiconductor microcircuits in which hundreds or thousands of circuit functions can be fabricated on a single 1-in.-dia. silicon wafer. The wafer can then be inspected to determine which individual circuits are satisfactory after which the same basic technique can be used to interconnect these into a complex supercircuit.

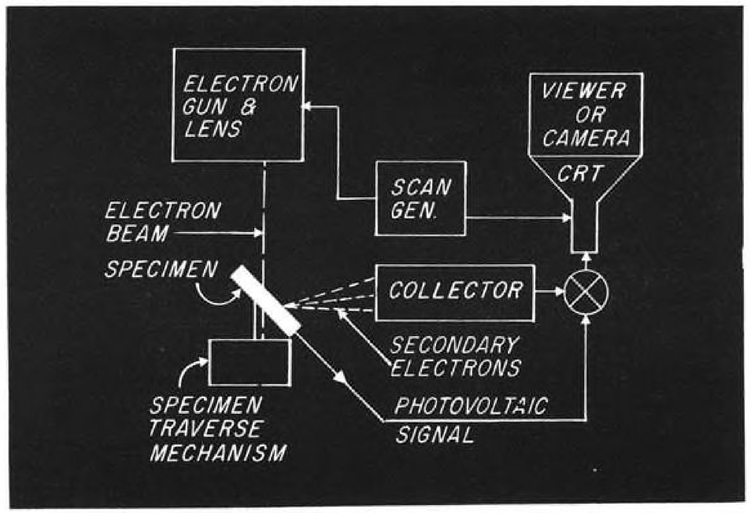
The work here has been partially supported by the USAF's Electronic Technology Div., Wright-Patterson AFB, with the balance funded by Westinghouse. Although the investigation has been under way for several years, the most promising results have been achieved only recently.

Westinghouse credits Prof. C. W Oatley and Dr. T. E. Everhart of Cambridge University in England with the first reported use of scanning electron beam microscopy to view the biased junction of a semiconductor in 1957. However, the company believes it is the first to intensively apply the technique to microcircuitry and to use it for fabrication as well as inspection, according to Dr. S. J. Angello, project leader at the laboratories here. Dr. Everhart, who later joined the laboratories here, then moved to the University of California at Berkeley, will soon return.

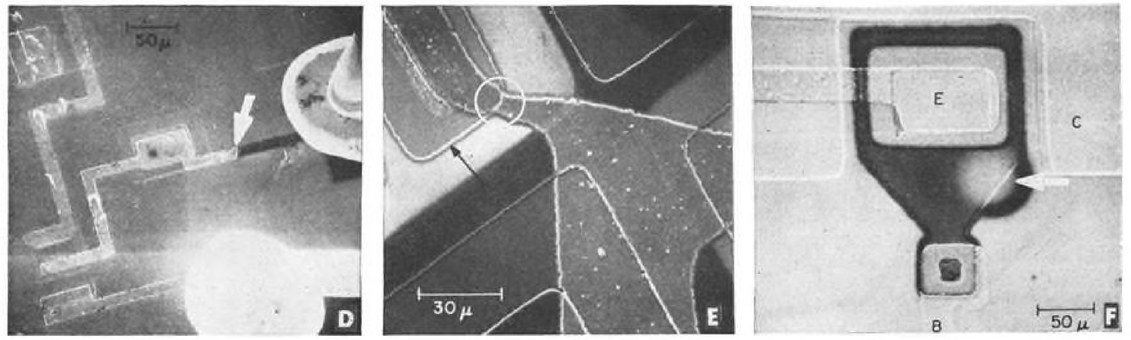
First Report

A group of Westinghouse scientists will make the first public report on their efforts next week at the Electrochemical Society meeting in New York City. Dr. Ian Mackintosh, manager of the information devices department in the Central Research Laboratories, who will deliver the lead-off paper, emphasizes that the technique still is in its "infancy." But he adds that progress in recent months "suggests that a major new technology may be emerging from this work. The potential advantage of this new technique is at least important and at most revolutionary." These are strong adjectives coming from a usually conservative scientific researcher.

Mackintosh emphasizes that the new technique should not be confused with the use of electron beams to produce intense spot heating or to generate X-rays. The latter, a useful technique for determining the composition of semiconductor materials, currently is under investigation by North American Aviation's Autonetics Div. (see box, p. 88). Westinghouse uses an electron beam accelerated by voltages in the 5-50 kv. range which does not produce significant heating of the material.



SIMPLIFIED SCHEMATIC shows how semiconductor specimen is illuminated by low-energy electron beam, causing it to emit secondary electrons received by collector. Its output signal is used to modulate intensity of cathode ray tube whose beam is scanning in synchronism with main beam. When reverse bias is applied to specimen, producing difference in potential across junctions, change in secondary emission received by collector results, causing CRT to create picture showing electrical topography of semiconductor microcircuit.



TYPICAL MICROCIRCUIT FABRICATION faults revealed by electron beam micrographs include: (D) Break in aluminum conductor is shown by sharp contrast (arrow) when voltage is applied to conductor. (E) Undesirable lateral diffusion of emitter dopant underneath oxide window (arrow) and insufficient thickness in evaporated aluminum lead as it passes over sharp oxide edge (circle). (F) Flaw in collector-isolation junction is visible as bright charged circular area, with magnification of 280:1.

Semiconductor Microcircuits

The scanning electron microscope which Westinghouse has built contains an electron gun and magnetic lenses which focus the beam to a diameter of about 0.1 micron at the focal point where the semiconductor specimen is placed. The narrow beam can be caused to scan over a suitable area of the specimen by means of electromagnetic scanning coils.

When the electron beam strikes the specimen, the material emits secondary electrons, some of which impinge on a combination scintillator-photomultiplier, referred to as a collector.

The number of secondary electrons emitted by the specimen depends upon the particular material, its surface topography and the angle of incidence which the electron beam makes with its surface. The number of secondary electrons which reach the collector depends upon these same factors and also on the voltage (potential) difference between the specimen and the collector.

Secondary Electrons

If the specimen is a semiconductor material which contains a junction, and a small reverse-bias voltage is applied across this junction, when the electron beam is directed first at one side of the junction and then at the other, equal numbers of secondary electrons will be emitted. But because of the different voltage potentials on either side of the junction with respect to the collector, more of the electrons will impinge on the collector when the beam is aimed at one side of the junction than when aimed at the other side. Thus the output from the collector will be greater when the electron beam is directed at one side of the semiconductor junction than when aimed at the other.

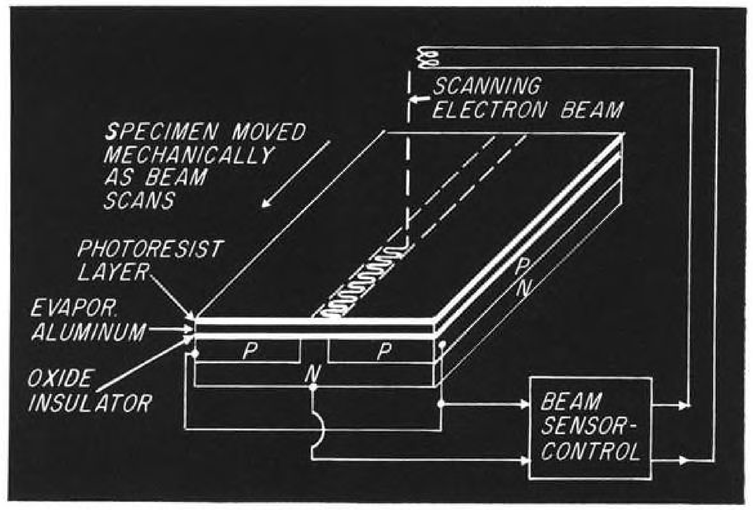
When the output signal from the collector is applied to a cathode ray tube (CRT) and used to modulate its intensity, and the CRT beam is scanned in synchronism with the electron beam moving over the surface of the semiconductor, the resulting image formed on the face of the CRT will clearly display the electrical outlines of the semiconductor junction, including any irregularities in its outline (see photos, above). By reducing the specimen area scanned, magnifications as high as 1,000:1 can be obtained.

One side of the junction will appear darker than the other. Whether this is the more positive or more negative region will depend upon the voltages used, the relative position of the specimen, final lens and the collector.

The junction topography of the semiconductor surface is clearly visible even when it is covered with a protective layer of silicon oxide, Westinghouse found. By analyzing a photograph made from the CRT image, it is possible to discover minuscule undercuttings of junctions with respect to the oxide windows used to produce them. This can reveal, for example, that impurities intended only to diffuse downward into the silicon crystal also have diffused laterally, causing degraded performance or potential failure.

Because the percentage of secondary electrons emitted by the specimen which reach the collector depends upon the relative potential between the two, it is possible to achieve optimum contrast for viewing any particular portion of a crystal by varying the reverse bias voltage level.

This same property provides a convenient method for checking the



AUTOMATIC CONTROL of scanning beam to achieve high-resolution gate electrode in an insulated-gate field-effect transistor to prevent stray coupling due to electrode overhang, uses photovoltaic signal developed in semiconductor when illuminated by electron beam. Signal becomes a maximum when beam is aimed directly at P-N junction, causing control to reverse beam scan until other junction is reached.

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A new performance record for the books has been credited to a new DC-8F jet freighter, recently delivered to Trans-International Airlines.

In its first eight days of contract operations by T.I.A. for the Military Air Transport Service, the big Douglas cargo-jet delivered a total of 234,637 pounds of freight to Southeast Asia from California. Distance logged on the three round trips was more than 50,000 miles.

On one of these trips it airlifted the heaviest payload ever carried operationally by any transport—87,028 pounds—from Travis Air Force Base near San Francisco 8900 miles across the Pacific to Saigon, South Vietnam. Stops were made at Honolulu and Guam.

This record-breaking jet freighter has a ferry range of more than 7,000 miles and a cruising speed above 575 mph.

In addition to T.I.A., other airlines which have DC-8Fs in operation or on order include Capitol Airways, KLM Royal Dutch Air Lines, Trans-Canada Air Lines, Trans Caribbean Airways, and United Air Lines.

DOUGLAS AIRCRAFT DIVISION

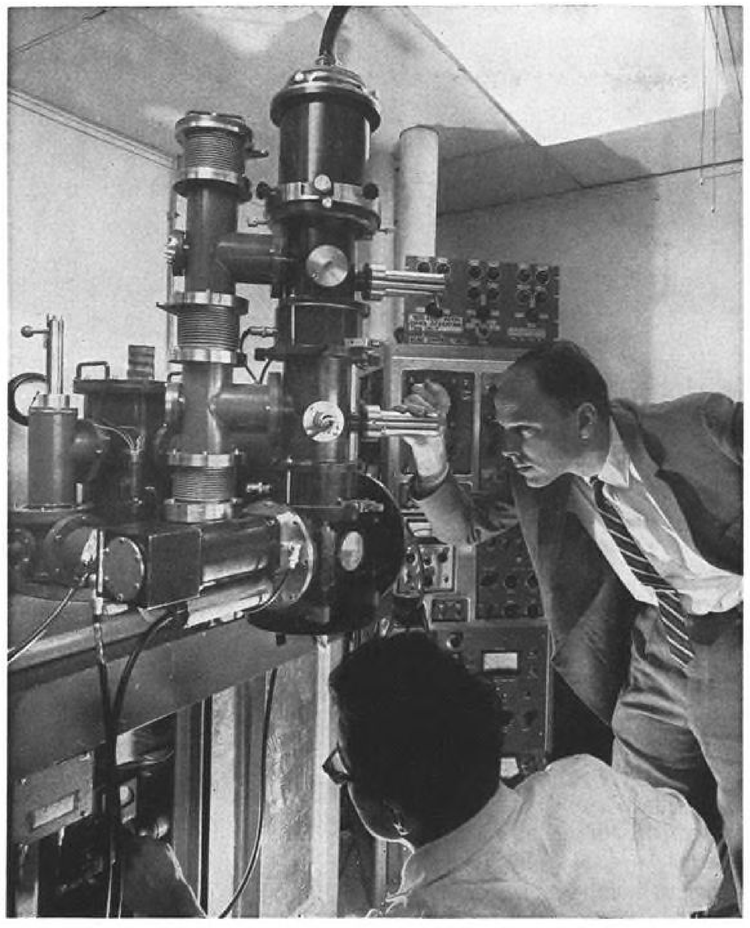
DOUGLAS BUILDS GREAT TRANSPORTS



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SCANNING ELECTRON MICROSCOPE built by Westinghouse contains an electron gun and magnetic lenses which focus the beam to a diameter of about 0.1 micron at the focal point where the semiconductor specimen is placed. Electromagnetic scanning coils cause the narrow beam to scan over a suitable area.

continuity and uniformity of semiconductor resistors fabricated on the microcircuit crystal. With a small voltage applied across the resistor, its shape will be clearly outlined. If it has been properly fabricated, the illumination will vary uniformly from dark at one end to extremely light at the other end (see Fig. C, p. 80).

Tiny particles of dust on the semiconductor crystal, often too small or obscure to be visible with a conventional light microscope, show up clearly as intense spots of light on the photographs made from the CRT tube, called "scanning electron micrographs." But the technique also reveals whether such particles, or surface scratches, adversely affect the electrical characteristics of the device or microcircuit so that needless rejection is avoided.

The ability to, in effect, "see" the electrical action of the device is one of the greatest benefits from the new technique. For example, in one special device fabricated by Westinghouse scientists as a control sample, with oxide surface passivation, it was apparent from a scanning electron beam micrograph that pinholes in the oxide layer had allowed a boron dopant to diffuse through into the N-type wafer. This dopant had then diffused laterally through the crystal and provided a low-resistance connection between two areas which were supposed to be isolated electrically. This could have been detected by means of conventional electrical tests, but the reason for the fault would not be known.

Evaporated aluminum conductors used to interconnect components on a microcircuit crystal also emit secondary electrons when illuminated by the electron beam. This makes it possible frequently to see imperfections or structural damage which would not be visible by other means.

Where the evaporated aluminum conductor crosses an abrupt "step" of silicon oxide passivation, the technique



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► **These pumps are positive displacement types inherently simple, valveless, balanced and quiet. In severe environments they prove exceptionally reliable.**

► The Gerotor is a form of internal gear pump consisting of only two moving parts: an inner toothed element and an outer, meshing toothed element. The inner element has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet port to the outlet. (See Figure 1). Pump capacity is measured by the volume of the "missing tooth" multiplied by the number of driver teeth and RPM.



FIG. 1

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

► 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.

► **Engineers find the Gerotor pump most attractive because there are several convenient variables that can be adjusted to meet the application requirements: Gerotor** *diameter* **which governs the area of the pumping chamber, Gerotor** *thickness,* **which, taken with area, determines** *unit volume* **per revolution and** *R.P.M.* **Thus, it is possible to vary the diameter, length and speed of the pump elements to secure wanted capacity. In addition, the porting of this type of pump is completely flexible in location, making for ease of fitting, adaptability to the available space and geometry of the engine structure.**

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

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STATE-OF-THE-ART REPORT ON SOLID PROPELLANT ROCKET MOTOR DEVELOPMENT AT UTC

Dramatic refinements in solid rocket motor technology during the past few years have greatly increased their usefulness. High-performance solid propellants, segmented motors, extended duration nozzles, thrust vector control, lightweight fiberglass casings, and simultaneous ignition of solid propellant clusters have all been successfully demonstrated — in the past 18 months — at United Technology Center. Current rocket motor programs at UTC apply the simplicity and reliability of these improved motors to such uses as giant boosters, upper-stage components, retro- and sounding rockets, and "hi-G" assignments for anti-missile weaponry.

■ UTC pioneered the concept of large segmented solid propellant booster motors, and is prime contractor for the first stage of USAF Titan III C, the Standardized Space Launch Vehicle. Together, the two 120-inch segmented solid propellant motors which make up this booster stage will generate lift-off thrust of over 2 million pounds — more than 80% of the vehicle's total thrust. Identical motors, fired in larger clusters, could achieve the very large lift-off capability required for any space mission now planned for this decade.

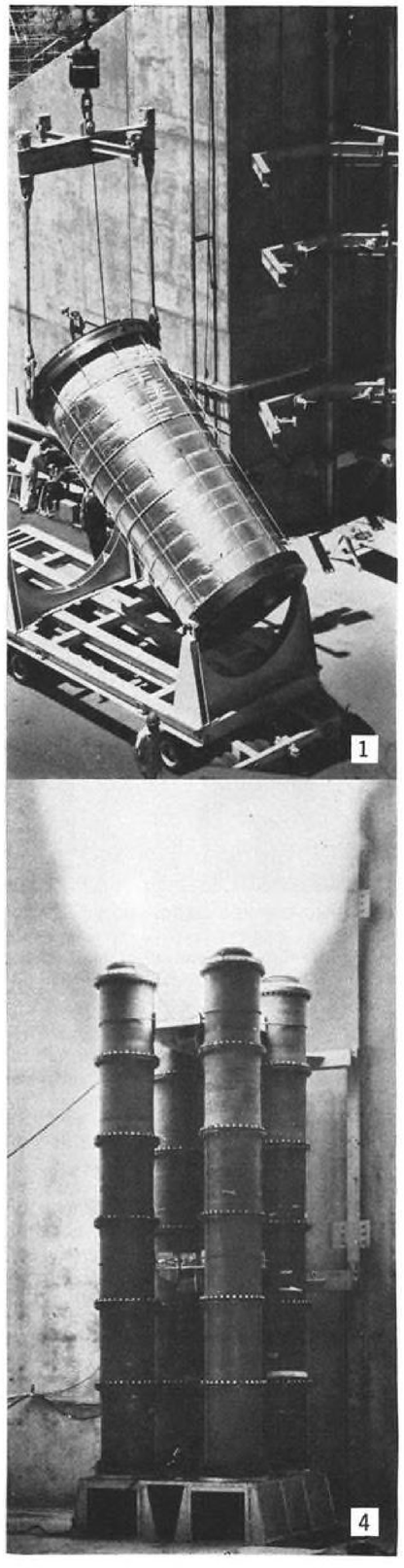
■ Research and development programs at UTC — company funded and contractual — cover a broad spectrum of propulsion: solid and storable liquid propellant rockets, and hybrids.

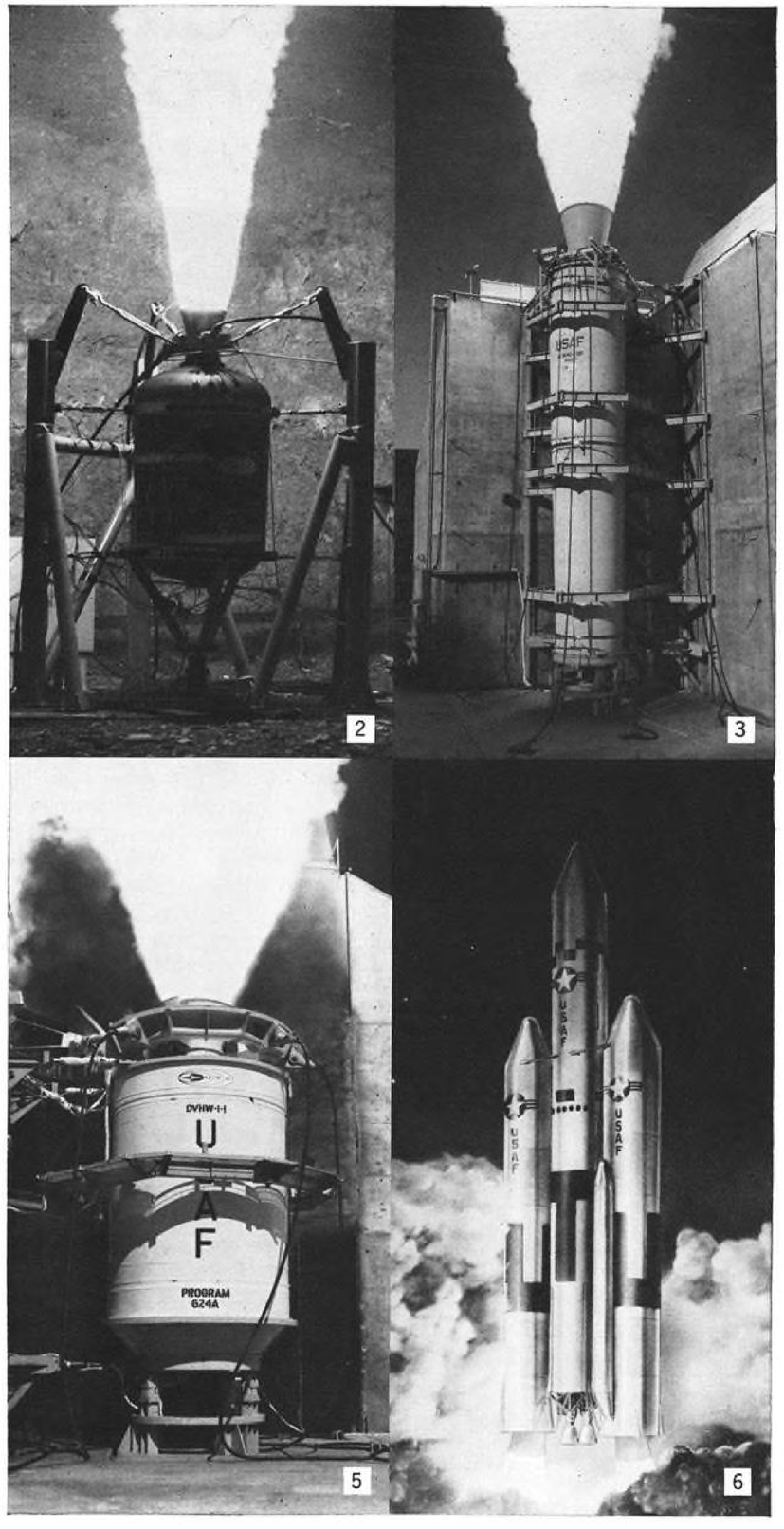
The company's facilities, production capacity, organizational experience, and backup by United Aircraft Corporation equip United Technology Center to handle a variety of advanced propulsion assignments.

UNITED TECHNOLOGY CENTER

UTC

DIVISION OF UNITED AIRCRAFT CORPORATION





1. Segmented solid rocket motor. The concept of large, segmented, solid propellant boosters, first advanced by UTC in 1958, has been brought to reality at the company's Coyote development center. Here, giant test bays have capacities up to 4,000,000 pounds of thrust.

2. Early feasibility test firings demonstrated the efficiency of UTC's unique clevis joint, key to the development of reliable segmented solid propellant rockets. Subsequent tests included the nation's first practical segmented fiberglass cased motors.

3. Company Funded R & D overcame intitial problems of large segmented solid propellant boosters: core design, exit nozzles, and thrust vector control. Test of USAF 35-ton motor verified UTC's preliminary results.

4. Clustered Solid Propellant Motors fired by UTC demonstrated simultaneity of ignition far exceeding manned launch specifications. Clusters of large solids can provide tens of millions of pounds thrust.

5. First 120-Inch Motor fired under USAF Program 624A produced peak thrust of 250,000 pounds during two-minute firing. Single-segmented test is first step in UTC's Titan III C development program.

6. USAF Titan III C. The first stage of this Standardized Space Launch Vehicle, consisting of two five-segment solid propellant rocket motors, 120 inches in diameter, will give this vehicle more than 2 million pounds of thrust at lift-off. It will orbit multi-ton payloads to low and medium altitudes.

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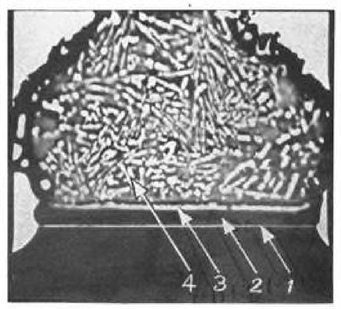
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Microprobe Reported

Use of an electron Microprobe analyzer to determine the chemical composition of semiconductor materials by the X-rays resulting from electron bombardment will be reported this week by a North American Autonetics Div. scientist at the Symposium on the Physics of Failure in Electronics, in Chicago.

Dr. Paul Pietrokowsky will describe Autonetics' use of the Microprobe to determine the location of atoms within a semiconductor crystal by means of the characteristic frequency of the X-rays generated. The machine, made by Applied Research Laboratories, Glendale, Calif., uses an electron beam in the 5-50-kv. energy range, the same as that used by Westinghouse (see story). Another similarity is the use of a cathode ray tube for display and the fact that the technique is non-destructive.

However, despite these similarities the Microprobe analyzer function is basically different from the capabilities of the new Westinghouse technique which uses a scanning electron beam to display electrical topography of semiconductor microcircuits and to fabricate such devices.

Microprobe X-ray photo above shows an alloyed silicon diode at 200:1 magnification with base area at bottom, followed by thin junction (1), black regrown region (2), bright areas of aluminum-rich region (3) and the maze-like aluminum cutectic (4).

may reveal that the aluminum is not thick enough to assure long-life across the sharp edge, or reduced cross-sectional area of the conductor at some point may result in over-heating and subsequent failure (see Fig. E, p. 81).

When the aluminum conductor is thickly deposited, it tends to partially obscure junction areas directly underneath, but the photovoltaic characteristic of semiconductor junctions enables Westinghouse to get around this limitation.

When a P-N junction is illuminated directly, or through a thin aluminum conductor, by the electron beam, a voltage is developed across the junction. As the electron beam moves from the P-region to the junction and beyond into the N-region, this generated voltage will increase, reaching a maximum when the beam is directly over the junction, then decreasing beyond it.

By combining this photovoltaic voltage from the specimen with the output from the collector (due to secondary electron emission), the edges of the junction are much more clearly defined in the micrograph even when covered by aluminum conductors.

Beam Fabrication

Optical-masking is the cornerstone of the technique now widely used in fabricating transistors and semiconductor microcircuits. Typically, the silicon wafer is first oxidized with a layer several thousand angstroms thick which is coated with a few-micron thick layer of photoresist material. A precision mask then is aligned with the crystal wafer and exposed to ultraviolet light which polymerizes those portions of the photoresist not blanked out by dark portions of the mask. After developing, un-polymerized portions of the photoresist are washed away and acid is used to etch away the oxide layer underneath these portions. This provides exposed areas on the silicon crystal, or "windows," through which the dopant material can be diffused.

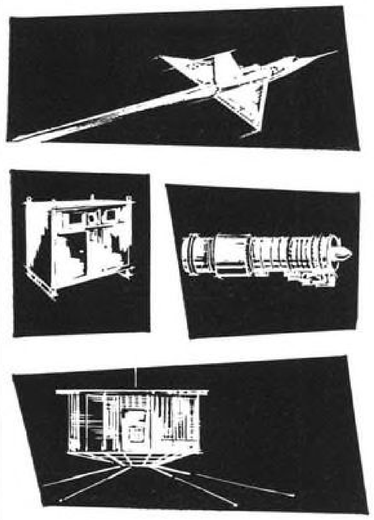
Instead of using optical masks and ultraviolet light, Westinghouse proposes to polymerize the desired windows in the photoresist by means of the scanning electron beam. There are several possible ways to control the beam scanning to produce the required pattern on the photoresist surface.

One would be to use a second CRT tube whose face contacts a photomultiplier with a mask of the desired window configuration sandwiched between the two. The beam of this pattern-generation CRT would scan in synchronism with that of the main beam used for polymerization of the photoresist. When the beam of the pattern-generation CRT is momentarily blocked by an opaque area in its mask, the beam of the main electron gun also would be blacked out. Rather than shut off this beam, it appears more feasible to deflect it off the semiconductor crystal swiftly by a special pulse-deflection coil, too quickly to cause polymerization as the beam sweeps off the crystal.

Because the mask used by the pattern-generation CRT is many times larger than the contact type now used, mask preparation will be less critical and less costly.

But more important, the use of an electron beam which can be focused to give an image as small as 0.05 micron in diameter is expected to provide at least a 10-fold improvement in resolution over the best that might be achieved using conventional optical-

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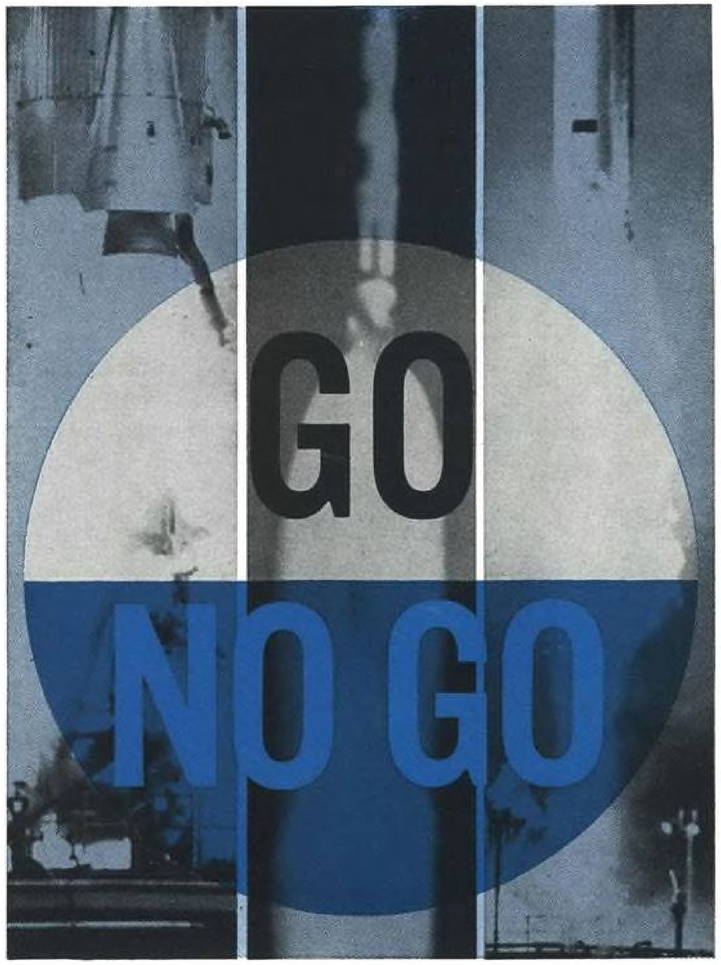
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masking techniques, according to Dr. Mackintosh. The limiting item turns out to be internal scattering of photons within the photoresist material.

Using currently available photoresist materials in thicknesses of about 0.2 micron and available electron beam technology, Westinghouse scientists expect to achieve resolutions in the order of 0.1-0.2 micron.

To date, scientists at Westinghouse have achieved fabricated areas in widths as small as 1 micron.

This promises at least an order of magnitude increase in the number of circuits which can be fabricated on a silicon wafer. Using conventional techniques, the active element usually occupies an area about 15-30 microns square.

Using scanning electron beam fabrication, this may be reduced to as little as 3 microns square.

Higher Frequencies

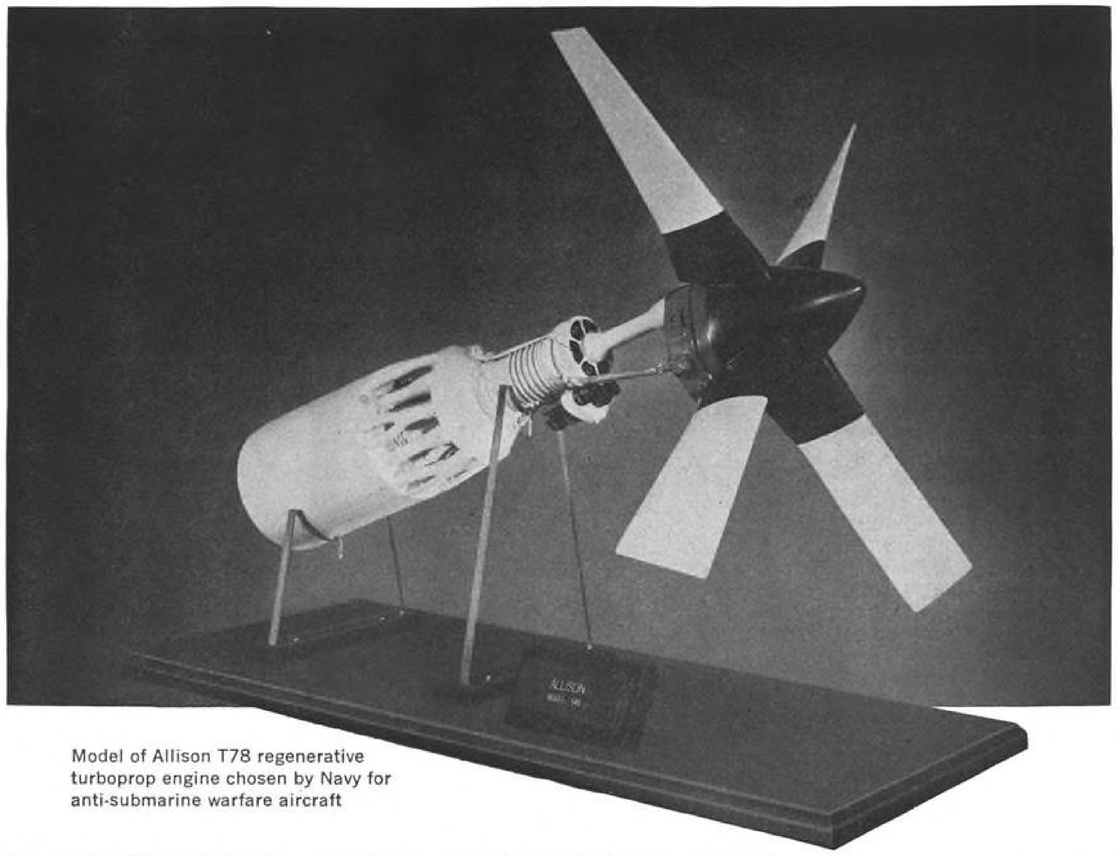
This size reduction also is important in the fabrication of separate transistor devices since their maximum operating frequency normally is limited by the size of device structure; i.e., the smaller the device, the higher the operating frequency.

Westinghouse expects the new technique also will be invaluable in fabricating more exotic types of amplifying devices such as the insulated-gate field-effect transistor. These are attractive for use in mass arrays on a microcircuit crystal but require extremely close dimensional control for good performance at high frequencies. Westinghouse calls its device by the acronym of SCOUT (surface-controlled oxide unipolar transistor) while Radio Corp. of America uses MOS—for metal oxide semiconductor transistor.

Silicon Substrate

The Westinghouse SCOUT consists of a silicon N-type substrate into which two P-type regions have been diffused, called "source" and "drain." For high-frequency operation, the channel of N-type material between source and drain should be extremely thin. Current flow from source to drain is modulated by a signal applied to a metal electrode, called a "gate," deposited along the N-type channel but insulated from it by an oxide layer (see sketch, p. 81).

To prevent degraded performance due to stray capacitive coupling, it is important that the gate electrode does not overhang the source or drain, according to Westinghouse scientists. If the N-type channel had a width measured in tens of microns, this would pose no difficulty. But the several-micron wide channel which can be obtained by scanning electron beam fabrication techniques requires extremely precise con-



Model of Allison T78 regenerative turboprop engine chosen by Navy for anti-submarine warfare aircraft

POWERPLANT ENGINEERS: Opportunity is at Allison in Turbine Engine Advancement

Allison—long-famous leader in development and production of aircraft engines—is pacing state of the art advancement in the turboprop area.

Contract for design and development of a regenerative turboprop engine—embodying concepts further advanced than in any known turboprop in the world today—was recently awarded by the U. S. Navy to Allison . . . the Energy Conversion Division of General Motors.

Featuring a regenerative cycle which transfers heat from exhaust gas to compressor discharge air, Allison's T78 will extend long-range and on station capabilities of anti-submarine warfare aircraft through greatly improved fuel economy. Allison's newly developed hollow, air-cooled turbine blades will permit higher inlet temperatures for a major improvement in engine performance. Greater reliability and simpler maintenance will be achieved with a unique, unitized propeller-reduction gear box.

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Mechanical Design Engineers
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Aero-Thermo Engineers
Aerodynamic design, analysis and development of axial and centrifugal compressor turbines and diffusers. Requires comprehensive understanding of the fluid dynamics of rotating machinery.

Senior Project Engineers (Controls)
Design of transistorized and/or magnetic amplifier servo-amplifiers. System and circuit design. Preparation of realistic and sound design and test specifications. Must be strong in servo-system theory.

Project Engineers (Controls)
Turbine engine control system analysis. Assist in project planning and direct analysis of new control systems and methods. Need strong math background and familiarity with digital and analog computers.

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Inland Gearless Torquers give 2-axis precision to Reeves Radar Pedestals

Precision Radar Pedestals . . . manufactured by Reeves Instrument Corporation, Subsidiary of Dynamics Corporation of America . . . play vital roles in major satellite and missile programs. Designed to accommodate reflectors up to 30-feet in diameter, they feature 5-second angular accuracy, azimuth load bearing ratings at 250,000 pounds and tracking rates from zero to 10 rpm in azimuth and from zero to 1/2 radian/second in elevation.

Accurate 2-axis servo-positioning of these Reeves Pedestals is effected by Inland Gearless Torquers ranging in torque output from 500 to 3,000 pound-feet.

Fast, high-resolution response to servo-position error signals is a major reason why Inland Gearless Torquers win so many missile and space-vehicle assignments. The superior performance of these direct-drive d-c torque motors comes from torque-to-inertia ratios 10 times higher than equivalent gear-train servo motors. Moreover, their compact pancake configuration meets space and weight restrictions.

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trol of the dimensions of the gate electrode to prevent overhang.

An automatic servo control system for accomplishing this can be obtained by using the photovoltaic properties of a P-N junction previously described. The voltage generated within the semiconductor across the P-type source/drain and N-type base will be a maximum when the scanning electron beam is directly over the P-N junction. This voltage can be used to control the scanning action of the beam to cause it to reverse direction until it encounters the adjacent P-N junction at which time it will again reverse (see sketch, p. 81).

Controlled Dimensions

Based on results of preliminary experiments, Westinghouse scientists expect to be able to control the dimensions of the gate electrode to within 0.1 micron, according to Dr. Mackintosh.

Westinghouse scientists here have ideas for applying more advanced automation to the control of the scanning electron beam which may ultimately lead to automatic fabrication of transistors and semiconductor microcircuits, but they are not yet ready to discuss these ideas in detail for competitive reasons.

They do suggest the possibility of automated inspection-test of microcircuits by means of two identical scanning electron beam microscopes. One would contain a "perfect" microcircuit which would serve as a master reference while the other machine would contain a newly-fabricated microcircuit to be inspected. The two machines would be synchronized in their scanning so that the two beams would be viewing corresponding portions of the master and specimen microcircuit simultaneously while the outputs of their respective collectors would be compared for similarity or discrepancy.

Second Microscope

Westinghouse currently is building a second scanning electron beam microscope to expand its research capacity with the new technique. The machine is expected to cost nearly $100,000, including associated equipment.

For successful application, extreme rigidity is required between the final electron beam lens and the specimen under scrutiny. Additionally, the machine's power supply must be very well regulated since the slightest ripple in its output will produce a corresponding ripple in the position of the beam.

The several papers describing the Westinghouse work to be given next week at the Electrochemical Society meeting will be authored by the following researchers from the laboratory here: Dr. Stephen J. Angello, Dr. Thomas E. Everhart, Dr. Oliver C. Wells and R. K. Matta, in addition to Dr. Mackintosh.

FILTER CENTER

►**Preparing for TFX Reconnaissance Aircraft**—In anticipation of a possible Air Force requirement for a reconnaissance version of the F-111 (AW Sept. 2, p. 15), General Dynamics/Fort Worth is asking avionics companies to submit proposals this week for reconnaissance gear and navigation and radar aids for the contemplated RF-111. Then the company will prepare a master plan of the proposed aircraft's avionics equipment from the industry proposals. Reconnaissance gear likely to be aboard such an aircraft would include infrared, side-looking radar, cameras and associated controls, electronic countermeasures (Elint), equipment for transferring reconnaissance data to film and an onboard data processor to tie together outputs from the recon sensors. The aircraft's radar and navigation equipment may differ from that now slated for the F-111. Among the many companies attending an RF-111 briefing in Fort Worth two weeks ago were A. C. Spark Plug, Airborne Instruments Laboratory, Autonetics, Conductron, Electronic Specialty Co., Goodyear, HRB Singer,



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► **Active Penaids Tests From Green River**—Initial flights in Air Force's active countermeasures flight test program, aimed at exploring feasibility of incorporating active ECM gear in Air Force ballistic missiles to jam and confuse enemy defenses (AW Oct. 15, p. 30), probably will be aboard Athena rockets launched from Green River, Utah, into White Sands Missile Range in southern New Mexico (AW Sept. 2, p. 26; Dec. 17, p. 23). Other tests are expected aboard ballistic missile test fired from Cape Canaveral. The active ECM program is conducted by Avco and Sperry Rand, sponsored by USAF's Ballistic Systems Div.

► **Missile Plume Radiation Suppression**—An experimental flight test program to evaluate techniques for reducing the characteristic short wavelength (infrared and ultraviolet) radiation emitted by a ballistic missile during its launch phase is planned by Air Force's Space Systems Div. Infrared radiation from missile exhaust plumes was the basis for Air Force's Midas missile alarm system and a number of other proposed warning and intercept systems. For several years the industry, under military sponsorship (AW Apr. 2, 1962, p. 63) has been seeking means of suppressing distinctive missile radiation, presumably to reduce vulnerability of U. S. missiles to launch detection and to prevent deception of Midas type systems.

► **Dual Mode Radar Seeker Makes Sidewinder More Versatile**—The dual mode radar seeker on Navy's Sidewinder 1C air-to-air missile enables the missile to home either on the echo of a radar pulse transmitted by the firing aircraft or on radar jamming signals from the target. The radar head extends the missile's usefulness into foul weather conditions and permits frontal assault not possible with earlier infrared homing guidance versions of Sidewinder. The 1C does have an updated infrared homing head for which the radar seeker serves as an interchangeable, supplemental guidance system.

► **Cubic Proposes Low-Cost Launch System**—A four-stage solid-propellant boost vehicle, called Forester, intended for placing 25- to 100-lb. scientific payloads in low altitude earth orbits has been proposed to Japanese, European and American research organizations by Cubic Corp. The company would develop the vehicle, using Thiokol solid-propellant rockets, and provide an integrated avionic system for range safety, guidance, tracking and telemetry. Two types of vehicles differing only in their first stages are suggested. Forester 1 with a single motor first stage would be capable of placing a 25-lb. scientific payload in a 315-mi.-apogee polar orbit. Forester 2, having a double rocket first stage, would be capable of putting a 75-lb. payload in a 1,460-mi. orbit. The second through fourth stages would each be single solid rockets.

► **Compound Semiconductor Microcircuits**—Research into semiconductor microcircuits using semiconductor compounds rather than silicon is under way at Texas Instruments in a program supported by USAF's Aeronautical Systems Div.

► **Litton Acquires Communications Company**—Litton Industries, Inc., plans to acquire Adler Electronics, Inc., New Rochelle, N. Y., a manufacturer of telecommunications equipment, including air transportable gear suitable for use in tactical, command and control situations. The company's sales were about $24 million during the past fiscal year.

► **Shocking Laser**—Aeronutronic Div. of Philco is working on a concept of chemically pumping a laser based on shock phenomena, under a $150,000 Office of Naval Research contract. The company is exploring conversion of shock energy created by pyrotechnic decomposition in a gas to high energy radiation emittance from solid state lasers, primarily ruby devices. Low molecular weight gases are being used to make high-speed, high-energy shocks possible.

► **STL Becomes TRW Division**—Space Technology Laboratories will become a division of Thompson Ramo Wooldridge, effective Oct. 1. Prior to this, including the period during which the laboratories were providing systems management to the Air Force's ballistic missile programs, STL was a wholly-owned subsidiary of TRW.

► **Laser Communications Test Plan**—NASA test plans for a spacecraft-to-ground laser communications link (AW Aug. 26, p. 87) call for three graduated test steps: Ground station to ground station, flyby aircraft to ground station and orbiting spacecraft to ground station. Should the laser equipment be completed before a suitable spacecraft is available, simulation tests will be substituted for the spacecraft step.

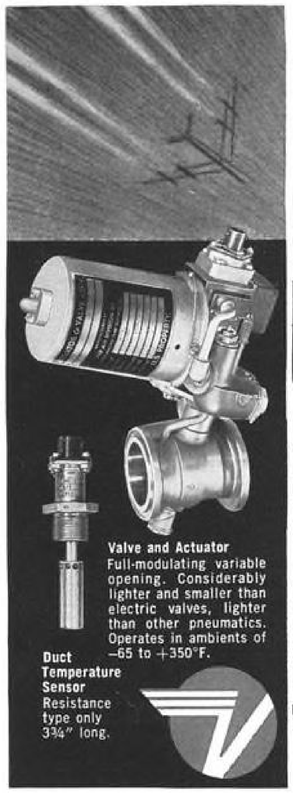
► **Precision Missile Tracking System**—A precision missile tracking system, known as OPDAR (optical direction and ranging), which employs a continuous wave gas laser to obtain trajectory data dur-



TRANSPONDERS

PROVEN RELIABILITY IN ACTUAL USE makes Motorola radar transponders the logical choice for critical tracking, data and control missions. Case in point... AN/DPN-66 (Motorola SST-102A) illustrated above, **USED ON SATURN, PERSHING** and over 15 other current aerospace programs. A precision C-band unit, weighs 10.8 lbs., occupies 200 cu. in., it is just one of a complete line of transponders ready for fast, off-the-shelf delivery. Others include: **USED ON SCOUT, ATHENA** and at **WSMR**  SST-131, this transponder is an extremely rugged microminiature superheterodyne unit, weighs only 3 lbs. and occupies just 40 cu. in., qualified for high-thrust, solid propellant boosters. Power: 400 watts. Sensitivity: —65 dbm. **USED AT AFMTC**  AN/DPN-71, a high-power, superheterodyne unit for deep-space tracking assignments. Power: 20 kw. Sensitivity: —75 dbm. **USED ON SATURN,** and **PERSHING**  AN/DRN-11, UDOP (UHF Doppler) transponder provides extreme range and position accuracy for ballistic vehicles. Power: 3 watts (15-watt power amplifier optional). Sensitivity: 5 microvolts. **USED ON NAVY AIRCRAFT**  AN/APN-132, an X-band transponder with 5 channel decoder. Power: 100 watts. Sensitivity: —65 dbm. For full performance specifications, or modification data to meet other parameters, write our Instrumentation Products Group.

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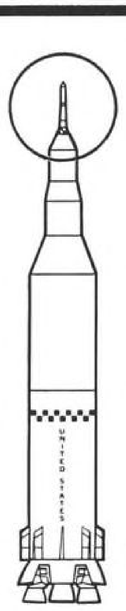
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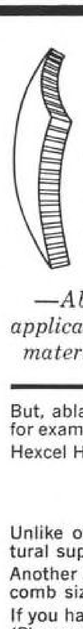
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ing the early powered phases of a missile's flight, is being investigated by Perkin Elmer Corp. under contract from the Air Force's Rome Air Development Center. The work is an outgrowth of an earlier study, called precision infrared tracking (PIRT), conducted by Perkin Elmer for Patrick Air Force Base (AW Apr. 22, p. 61).

► **Satellite Attitude Determination**—A technique for determining the attitude of a space vehicle by a ground reference radio system independent of attitude sensing devices on the vehicle is under study at Cubic Corp. The program, sponsored by USAF's Electronic Systems Div., is called ODVAR (orbit determination and vehicle attitude reference). It can be used to correct vehicle borne attitude references. Accuracies claimed for it are from 2 to 3 min. of arc down to 20 sec., and in special cases as low as a few seconds of arc. The ODVAR approach is centered about the use of phase comparison angle measuring techniques, which the company has employed in a number of systems.

► **Army Shifting on Microcircuitry**—Despite Army's heavy public commitment and investment in the Micro Modules, rapid progress in semiconductor and thin-film microcircuitry suggests these techniques will figure more prominently in future Army electronic hardware. During recent Military Electronics Convention (Mil-E-Con) in Washington, Dr. Jere W. Hohmann, Army Electronics Research and Development Laboratory, acknowledged as much and said it has "necessitated some revision in the plans for future military equipments." He said the Army is concentrating on developing a silicon microcircuit intermediate frequency amplifier for use in small portable radios. Another Mil-E-Con report by R. A. Gerhold and D. S. Elders, of the same Army facility, described recently developed "Enhanced Micro Module" designed to accommodate microcircuit functions on each of the several ceramic wafers that make up the module. New design provides 36 conductors instead of the 12 available for wafer interconnections on the conventional Micro Module.

► **"Flip-Chip" Interconnections**—Novel technique for packaging and interconnecting group of semiconductor microcircuit chips, in which 30 to 40 individual circuit function chips are interconnected and housed in flat container measuring 1 x 1 x ⅛ in., has been developed by General Electric's Light Military Electronics Dept., Utica, N.Y. Technique, called "Flip-Chip," uses a ceramic substrate on which has been deposited the required thin-film interconnection conductors. Semiconductor chips, with special pad areas for outgoing connections, are placed face down on the thin-film interconnections and bonded to the substrate, eliminating need for flying leads and thermo-compression bonds which are potential sources of failure. The technique was reported at recent Mil-E-Con by GE's Thomas A. Telfer.

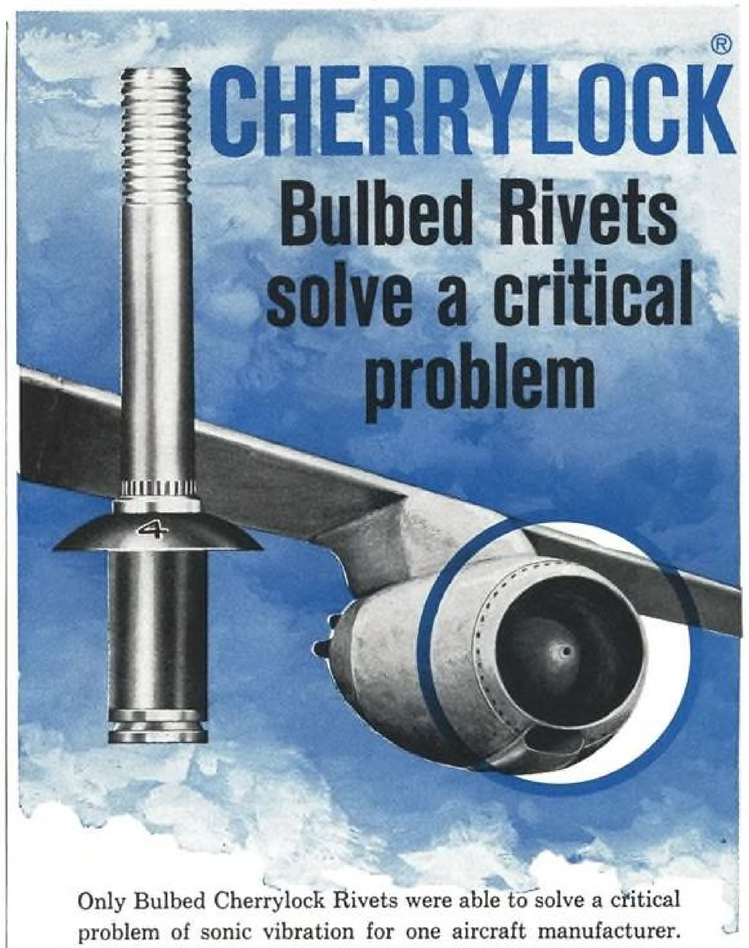
► **New Family of Devices Proposed**—Program to apply available microwave tube techniques to the design of a new family of devices such as a frequency stepping switch, high-power electronic phase shifter, microwave time delay device and broadband delay lines is under way at Raytheon's Spencer Laboratory. The research and development effort, known by the acronym of SPEED (signal processing in evacuated electron devices), already has demonstrated the feasibility of a high-power phase shifter, for possible use in phased-array radar, which can handle peak powers of hundreds of kilowatts and shift phase through 360 deg. rapidly, Raytheon's Dr. Howard Scharfman reported at Mil-E-Con. The device, which consists of a slow-wave structure with an electron beam passing through the capacitive region of the structure, is controlled by grid which varies the beam current, Scharfman said.

► **New Type Maser Reported**—Traveling wave maser using chromium-doped rutile coupled to a meander line slow-wave circuit, providing a 50% tunable bandwidth from 1.9-3.1 gc. (kmc.), has been successfully operated by Radio Corp. of America scientists. The device exhibited gains in excess of 23 db. over the entire band and the noise temperature for the complete maser, including second stage, was measured at 10K, according to a report presented at Mil-E-Con by L. C. Morris, D. J. Miller and H. B. Yin of RCA.

► **Laser For Turbulence Detection?**—Possibility of using a laser radar to detect clear-air turbulence, not detectable by aircraft weather radar, has been proposed by Martin-Orlando scientists. The shear, or discontinuity, in the atmosphere which causes clear-air turbulence might provide sufficient reflection of laser energy, they speculate.

► **Signed on the Dotted Line**—Major avionic contracts recently announced include the following:

• **Automatic Electric Co.**, Northlake, Ill., $16.8-million contract from AF Electronic Systems Div. for production of high-speed switching centers to interconnect world-wide defense communications system for Defense Communi-



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Santa Ana, Calif.

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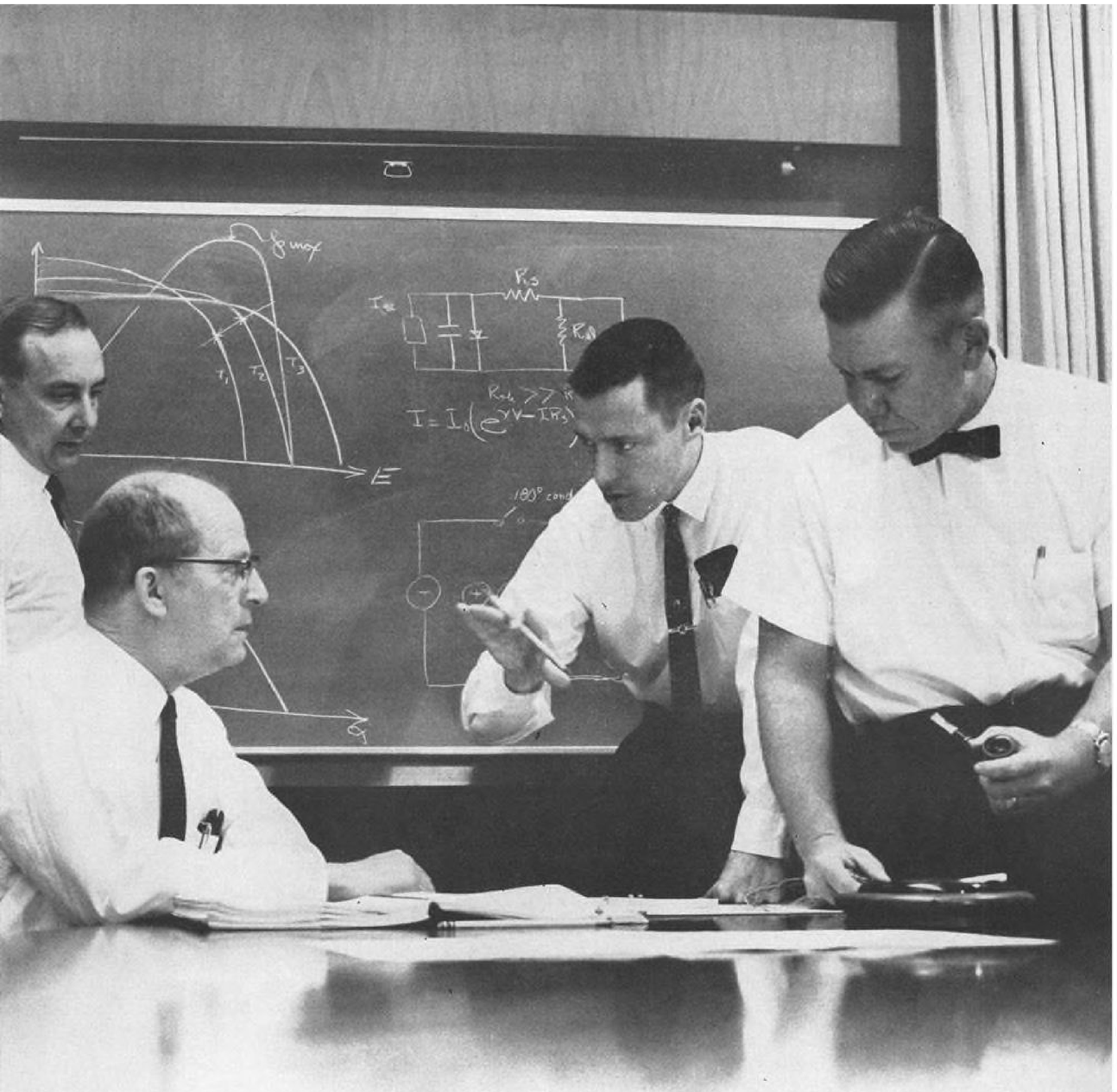
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In Canada: Parmenter & Bulloch, Gananoque, Ontario

What every young lunar engineer should know

The engineers who will design the vehicles and equipment needed to occupy the moon will have to throw out most of the basic concepts of terrestrial design. They'll have to think in moon terms instead of earth terms. ■ To help them, Lockheed has undertaken the tremendously complex task of collating all the known facts about the moon. This organized engineering data will enable Lockheed's engineers to design more efficiently for lunar conditions as we know them, without having to calculate each value for themselves. ■ In space, as in so many new fields of human knowledge, you can continue to Look to Lockheed for Leadership. **Lockheed**

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☐☐ Among the top members of ITT's technical staff, shown here debating a fine point on the mating of solar panels to inverters, are *(left to right):* Siegfried Lindena, Director of Research on Power Conversion for the ITT Space Power Group; Frederic E. Fuller, Director of the Power Sources Laboratory; Robert L. Hansen, Senior Member of the Technical Staff; and Robert B. Beltz, Manager of the Space Power Group.

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cations Agency. Project is designated 490-L.

• **Bell Aerosystems Co.,** Buffalo, will develop a miniature electrostatic accelerometer for National Aeronautics and Space Administration to be used in measuring ion propulsion powered spacecraft acceleration, under $199,446 contract.

• **Collins Radio Co.,** Dallas, will build four satellite tracking stations for Goddard Space Flight Center under $5.8 million contract. Two of the stations will be installed at Fairbanks, Alaska, and Rosman, N. C.

• **Hoffman Electronics Corp.,** will build 151 RT471/ARN-65V Tacan navigation sets for Air Force's Aeronautical Systems Div. under $1.1-million contract.

NEW AVIONIC PRODUCTS

• **Miniature solid-state one-year clock,** designed to automatically shut off a satellite tracking beacon, has no moving parts, measures 3x3x1 in. Using magnetic counting techniques, the device requires only 15 microamperes at 10 volts. It operates over temperature range of −20C to 85C and has an accuracy quoted at 5%, or higher on special order. Clock can be operated on accelerated time to check out a one-year cycle in only four minutes. Manufacturer: C & K Components, Inc., 103 Morse St., Newton 58, Mass.

• **Static frequency converters,** rated from 1-30 kw., can change 400 cps. power to 60 cps., or vice versa, without intermediate conversion to direct current. The 5-kw. unit weighs 125 lb., the 30-kw. unit weighs 315 lb. Converters are protected against short circuits. Publication SCW-1297 gives full application data. Manufacturer: General Electric Specialty Control Dept., Waynesboro, Va.

• **Microchopper,** Model 5, a solid-state chopper which can be operated from d.c. to 100 kc., switching voltages from a fraction of a millivolt to 10 volts, is housed in a TO-5 transistor package. Device, weighing 1 gram, is electrostatically shielded. Manufacturer: Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif.

• **50-Megawatt giant pulse laser,** Model K-1Q, using Kerr cell control, has minimum peak power output of 50 megawatts at room temperature. Pulse energy is one joule, rise time is 3 nanosec. and pulse width is 5-20 nanosec. with beam width of seven milliradians. Manufacturer: Korad Corp., 2520 Colorado Ave., Santa Monica, Calif.



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Chemical beads are the heart of the Binks air dryer . . . a completely new unit that gives you surgically-clean, moisture- and oil-free compressed air for spray painting systems and pneumatic tools.

How dry is the air coming out of this unit? As low as —20°F. dewpoint . . . and this meets the most stringent requirements for dry compressed air.

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The new Binks air dryer is available in 33 models. Capacities range from 13 cfm to 11,000 cfm at 100 psi. Pressure drop is less than 1 psi. Operating cost is amazingly low, too . . . just one cent per 15,000 cfm of dried air under normal conditions.

Send today for complete information on this highly efficient air dryer. Ask for Bulletin A37-2R.

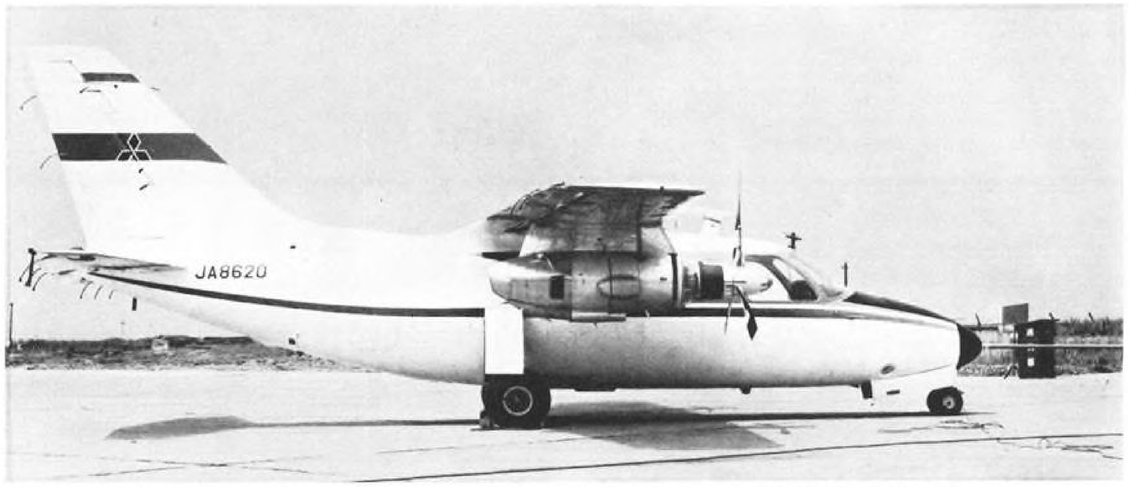




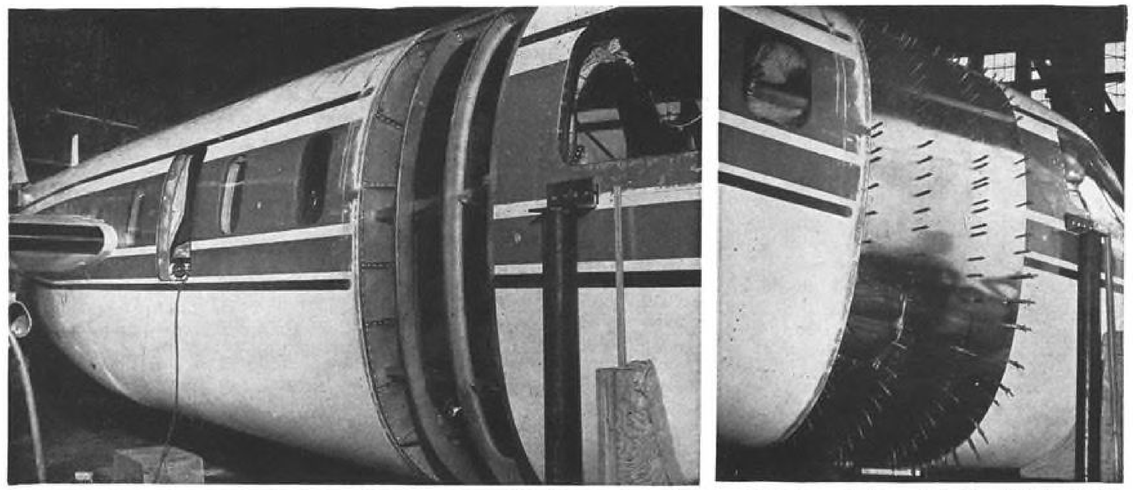
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REPRESENTATIVES IN MAJOR CANADIAN AND U. S. CITIES... AND AROUND THE WORLD



MOONEY-MITSUBISHI MU-2 turboprop, to be built in the United States, will compete with the Beech King Air.



EXTRA 30 IN. fuselage section has been added to prototype Jet Commander. Structure (left) is ready for metal skin, (right) riveting.

Corporate Turbojet and Turboprop Sales Plans Aim at Future Executive Markets



PRODUCTION OF 10 ADDITIONAL Lockheed JetStar executive aircraft is under way at Marietta, Ga. Lockheed reports six are sold.

By David A. Brown

Majority of the companies bringing new turbojet and turboprop executive aircraft on the market are aiming at the same customer, tending to increase competition for the sales dollar.

Replacement of the estimated 750 aging corporate aircraft of more than 12,500-lb. gross weight is being looked upon by the manufacturers as the core of the market and a necessary stepping-stone to further sales.

As the number of aircraft aiming at this market increases, the first notes of caution are beginning to appear in the statements of manufacturers and sales representatives about achieving dominance in the field.

While a general mood of optimism still prevails, fostered by the belief that the industry will undergo a turbine revolution in the next 5-10 years that will open vast markets for new aircraft, talk now is of selling a given number of aircraft per year, rather than of achieving a large percentage of the market.

This trend, with but a few exceptions, was revealed in a survey of turbine-powered aircraft manufacturers and sales outlets by AVIATION WEEK & SPACE TECHNOLOGY.

Market Estimates Vary

Even the potential market itself varies widely in estimates by different companies. For example, estimates by manufacturers and sales representatives of smaller turbojets range from a market high of 3,500 aircraft to a low of 300 aircraft over the next 10 years.

The survey revealed these opinions to be prevalent:

• **Division of the market** into large and small airplane categories is generally expected by manufacturers, whether they are producing turboprop or turbojet aircraft.

• **Further division of the large** aircraft market into turbojet and turboprop areas is expected.

• **Only manufacturers of smaller turboprop** aircraft feel that a turbojet/turboprop division will take place in the small aircraft field. Manufacturers and sales representatives of smaller turbojets feel that the turboprop will not succeed in penetrating the market to any significant degree.

• **Most of the manufacturers** consider their aircraft as a replacement for present corporate aircraft of the Lodestar/Learstar – DC-3 – Convair – B-26 class. This common point tends to place in competition companies which otherwise feel their respective aircraft would not be competitive with each other. Most manufacturers plan to make replacement of the current corporate fleet of aircraft of more than 12,500-lb. gross weight the basis of the market for their aircraft and to move up or down from that base.

Four aircraft generally are considered in competition for the small turbojet market—Aero Commander's Jet Commander; Dassault's Mystere 20, which will be marketed by Pan American World Airways under the trade name of Baby Jet; Lear Jet Corp.'s Lear Jet, which rolled out last week and is due to make its first flight in about two weeks, and Hawker Siddeley's DH-125. The DH-125 will be marketed in the U.S. by Atlantic Aviation and AiResearch Aviation Service Co., and in Canada by Timmins Aviation, Ltd.

Lockheed's JetStar, the only entrant in the large jet category, could have a competitor if Grumman continues plans for a swept-wing, fan jet-powered version of the turboprop Gulfstream.

In between the large and small jet categories, and competing in both to some degree, is North American Aviation's Sabreliner.

Aircraft Needs Differ

Among the most optimistic of the small jet builders, Aero Commander sees itself winning 45-50% of a 1,300 aircraft market in the next 10 years. Tom Harris, vice president and general manager of Commander, believes there also will be some military requirements for its jet, although Commander is not now planning for military production of the aircraft.

The aircraft, Harris said, was designed for the American market. He did not expect either the Jet Commander to sell well in Europe or European-designed aircraft to be successful in the United States.

There are different requirements for the two areas, Commander believes. European firms travel mainly between major airline terminals, with little requirement for aircraft with short-field capability. American users, on the other hand, use their aircraft primarily for off-airways travel and operate primarily from fields which do not meet airline requirements.

For this reason, Harris said, the ability to operate at slow speeds, and from

CP Motor capability



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3-phase/208 v./ 400-cycle; AC brake; 4-pole; 10,800 rpm. 10.1 lb.; 2.500" dia.; 6⅝" h.

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U.S. Business & Utility Plane Shipments

(July 1963)

Make & Model	No. of Units	Net Billings
Aero Commander 500A, B	3	
560F	3	
680F	1	$1,003,000
680FP	1	
Grand Commander	2	
Beech 23 Musketeer	32	
33 Debonair	11	
35 Bonanza	20	
50 Twin-Bonanza	1	$2,870,000
55 Baron	11	
80 Queen Air	6	
95 Travel Air	5	
Cessna 150	35	
172, Skyhawk	68	
P172	4	
180	11	
182, Skylane	50	
185 Skywagon	19	$4,384,000
205	24	
210	10	
310	18	
320 Skyknight	3	
336 Skymaster	11	
Champion 7FC Tri-Traveler	3	
7GCB Challenger	5	$147,000
7HC DX'er	1	
402 Lancer	4	
Lake LA-4	2	$53,000
Mooney Mk. 20C	41	$620,000
Mk. 20D	2	
Piper PA-18 Super PA-18-150 Super Cub	10	
PA-22-108 Colt	10	
PA-23-235 Apache	1	
PA-23-250 Aztec	15	
PA-24-180 Comanche	1	
PA-24-250 Comanche	16	
PA-25-235 Pawnee	22	$2,269,000
PA-28-150 Cherokee	6	
PA-28-160 Cherokee	8	
PA-28-180 Cherokee	48	
PA-30-160 Twin Comanche	5	
Totals	549	$11,346,000

Note: Above brings total 1963 shipments through July to 4,354 aircraft having a total factory net billing value of $84,485,000, an increase of 384 airplanes and $2,428,000 in billings over the same period last year. July 1963 shipments alone represent an increase of 104 units and $1,423,000 in billings over the same month last year.

3,000-ft. runways will count for more in the domestic purchaser's mind than an extra 65 mph. cruise speed. European aircraft, designed originally for European requirements, will not penetrate the market in the U. S., Harris believes.

Even so, Harris expects orders for the second hundred Jet Commanders to "come a lot harder than the first hundred." As of last week, the company had received 67 orders with deposits for the airplane. Increased competition from other capital goods is expected. Companies which are considering the Jet Commander as a business investment also are being forced to balance its value against such things as data processing equipment and machine tools, Harris reported.

DH-125 Prospects

Sales prospects for the Hawker Siddeley DH-125 in the U.S. market are based largely on the production available rather than on the prospective market.

The initial batch of 60 DH-125 aircraft has been committed to production in England. About a third of the early production aircraft are going to the Royal Air Force.

One U.S. sales official, whose company also will be handling turboprop aircraft, feels there will be a market both for turbojets and turboprops, mainly because of price differential. He noted that the DH-125 is priced almost midway between the smaller turboprops and the larger turbojet and turboprop executive aircraft.

Added Space

Price differential also is counted on to aid the DH-125 in fighting competition from other executive jets of the same class, as is the cabin size of the aircraft. De Havilland's opinion is that executives will want additional space in their aircraft and will lean toward the aircraft that has a larger cabin.

Although the original Mystere 20 was designed for the European market, Pan American has had it modified to meet American requirements. These modifications included installation of the General Electric CF-700 turbofan engine, a lengthened fuselage, more wing area and increased range.

Like others in the category, the Mys-



Artwork by Glenn Dodenhoff—courtesy Northrop Corporation

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Northrop's highly versatile F-5 MAP supersonic fighter is powered by two General Electric J85 afterburning jet engines equipped with fuel pumps engineered and precision-produced by Chandler Evans.

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tere 20 is aimed at present owners of corporate aircraft, from the Beech 18-Aero Commander class up through the larger corporate airplanes.

Pan American is scheduled to receive its first aircraft in February, 1965, but feels this will not be a handicap. It considers the delivery date estimates of its competitors, which run as much as 10 months earlier, unduly optimistic.

A total market of about 50 aircraft per year in 1965-66, gradually increasing to 100 per year in 1970-71, is forecast by Pan American. Of this total, Pan American looks for the Mystere 20 to capture about half, at least at the beginning. This would account for all of the 25 Mystere 20s the airline will receive each year.

Pan American will show a full-scale mockup of the aircraft this week at the National Business Aircraft Assn. convention in Houston. Its nacelles will be modified to the configuration that will be used for the CF-700.

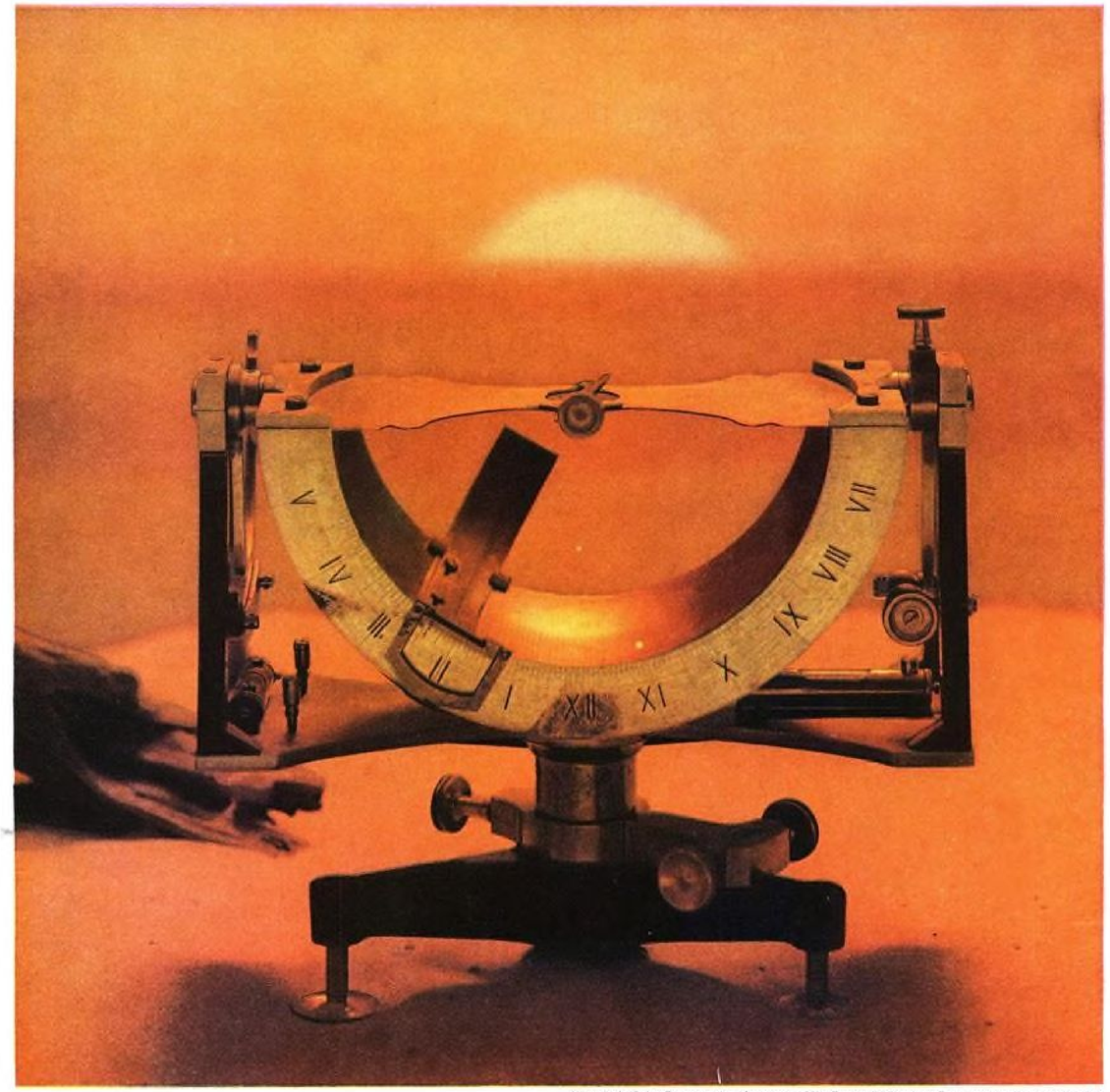
French orders for the Mystere 20, the only ones received other than Pan American's, have been altered to specify the CF-700 engine.

Smallest of the American-built turbojets, the Lear Jet is aimed at replacing aircraft of the Beech 18-Lodestar category, but not larger aircraft such as the Convair.

William P. Lear, president of the



DASSAULT'S MYSTERE 20, only fan jet currently being developed, will be marketed in the U. S. by Pan American under the name of Baby Jet.



Wheeler's Solar Chronometer (American—19th Century)—Courtesy Cranbrook Institute of Science

from solar chronometer to space booster guidance

The Wheeler Solar Chronometer was designed to indicate true sun time and longitude, with corrections for the seasons and the earth's position. Highly accurate though it was, the instrument had the basic fault of all sun dials: it was utterly worthless when the sun went down.

To avoid the possibility of being in the earth's shadow, space launch vehicles require guidance systems capable of determining positional fixes without solar observation. This requires advanced navigational systems of unparalleled accuracy—AC accuracy.

AC is presently modifying its Titan II inertial guidance system for application in the Titan III. And AC has recently been selected to produce the navigation guidance system for NASA's Apollo command module. Added to these current programs, AC's outstanding performance on the Thor, Mace, Regulus and Polaris missile programs and its work in providing navigation equipment for manned aircraft have established AC as a leader in the field of navigation and guidance.

AC's ability to design, develop and produce highly accurate guidance and navigation systems at low cost is unique. Put it to work for you. Contact Director of Sales, AC Spark Plug Division, General Motors, Milwaukee 1, Wisconsin.

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WAVEGUIDE SEAL
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STAT-O-SEAL®
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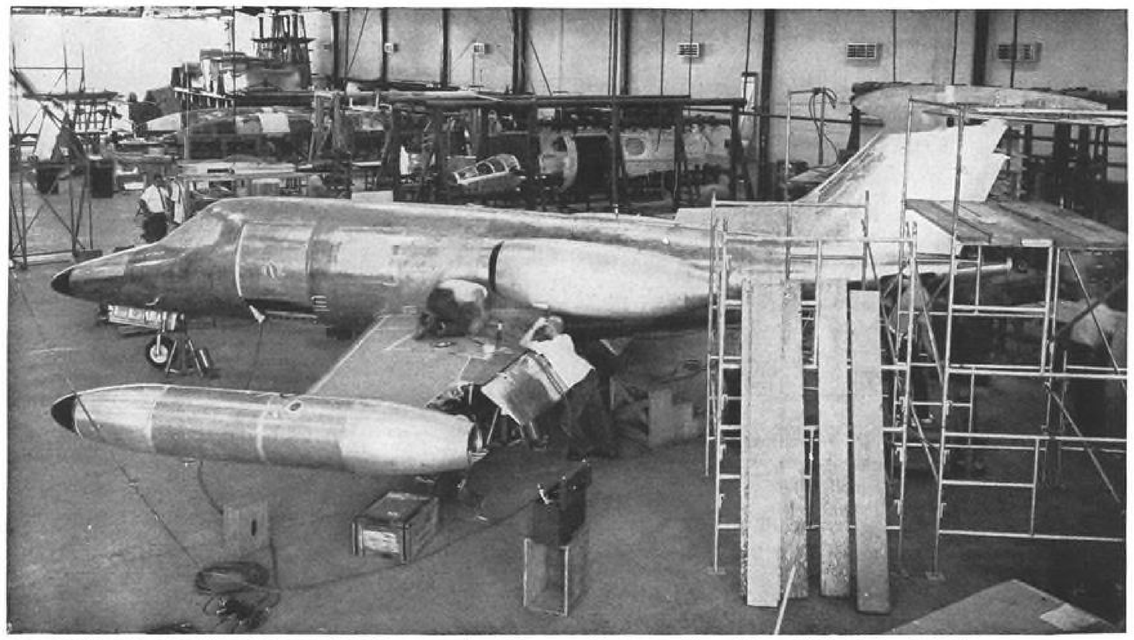
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FIRST LEAR JET, SHOWN BEFORE ROLLOUT, was produced from production tooling. Note additional aircraft in jigs at rear.

company, says that the Lear Jet is designed for corporations netting from $200,000 to $1 million per year. He believes there will be a market for a minimum of 3,500 aircraft in this category in the next 10 years.

Lear expects to sell about 100-125 Lear Jets per year during that period.

Lear's philosophy that short-field capability is the key to sales in the domestic market closely corresponds to that of Aero Commander. The Lear Jet, according to Lear, will have the capability of using 4,000-ft. runways with non-professional pilots.

'Status Symbol'

Major competition, Lear feels, will come from companies that want what he terms "status space" and are willing to pay for it without gaining corresponding performance.

For this reason, Lear believes the Mystere 20 will be the most competitive aircraft and that 10-20% of the companies that would have purchased the Lear Jet will swing to the Mystere because of the additional size.

He feels that other capital equipment, mentioned by Commander as a competitor for the sales dollar, will not prove a serious factor. Lack of high-quality personnel, Lear feels, will force companies to purchase turbojets in order to spread their top executives around.

North American's Sabreliner, which is currently in production at the rate of one per month, also is aimed at replacing the DC-3-Convair class of piston-powered executive aircraft, as well as the larger turboprops such as the Grumman Gulfstream and the Fairchild F-27.

The Sabreliner is designed for companies that need to move six or more persons on the average trip, according to North American's manager of commercial marketing, J. F. (Skeets) Coleman.

Coleman expects there will be a commercial market of about 300 aircraft during the next 8-10 years for jets of this class and that for the next two years the Sabreliner and Lockheed's JetStar will have the field to themselves.

Competition so far, Coleman said, has come mainly from available aircraft like the JetStar and the Gulfstream. Non-aviation capital goods have been competitive in a cyclic manner. They represent more of a threat when business is in decline such as the oil and steel industries have experienced in recent times.

Lockheed, whose JetStar was the first domestic turbojet to reach the market, is aiming for sales among the top 50 or 100 corporations and therefore has a smaller potential market than most other turbojet manufacturers.

The company estimates there will be 30-40 corporate turbojets in the $1-million-plus category sold each year for at least five years and possibly for 10, depending on technical developments. Lockheed hopes to capture 25 to 35%, or about 10 to 15 aircraft per year.

The commercial market, however, remains secondary in Lockheed's marketing plans. Its first consideration is to the military mission support aircraft market. Lockheed estimates that 400-500 aircraft of the JetStar class will be ordered by the military and sees a fair chance of getting 25 to 50% of this number.

Four other turbojets, all of European design, were announced for the U.S. market, but one of these is officially dead and another has slipped badly in its schedule.

Only the Hamburger Flugzeugbau HFB.320 is holding fairly close to its original schedule. Rollout is set for December and the first flight for sometime around the first of the year.

Canceled Project

The Macchi MB.330 project—which never progressed beyond the design stage—has been canceled due to lack of support by the Italian government.

The Piaggio-Douglas PD.808, which was to have flown in time for this year's Paris Air Show, now is not scheduled to fly before next February.

The four-seat Saab 105 is flying, but primary emphasis seems to be on the military versions of the aircraft. If the airplane meets design specifications, the Swedish air force has promised to buy at least 130. No orders for executive versions have been received, Saab reports.

Hamburger Flugzeugbau is expected to announce, at the NBAA meeting in Houston, arrangements with several U.S. firms for sales, servicing and overhaul of the HFB.320. Four orders have been received and the company hopes to be able to announce five more orders at Houston. Negotiations for these last are still pending.

Price of the aircraft with factory interior and VFR instrumentation will be $575,000 in the United States.

A mockup to be shown at Houston will incorporate the only major change in the aircraft, a 1½ in. increase in cabin headroom. The company is confident that it can match Dassault's delivery date of February, 1965, because it has undertaken an extensive program of wind tunnel testing.

Turboprop manufacturers are in a slightly different position, with two small aircraft—the Beech King Air and the Mooney-Mitsubishi MU-2—competing in one area and two larger aircraft—the Grumman Gulfstream and the Potez 840—competing in another.

Of these, the Gulfstream is the only aircraft now on the market and is considered prime competition not only by the Potez 840, but also by a number of turbojet manufacturers. As of last week, 118 Gulfstreams had been ordered.

Gulfstream Future

Although Grumman feels that it will be able to continue selling Gulfstreams despite the advent of the smaller jets, most of the smaller turbojet manufacturers believe that they will be able to replace some of the Gulfstreams in corporate fleets. They cite the increased flexibility of two turbojet aircraft, as opposed to one turboprop, for relatively the same money.

Larger jets, Grumman feels, are competitive in size but also are complementary to a degree. In any event, Grumman may enter both fields. A fan-jet version of the Gulfstream has been in design stages for some time and talks with Cornell Aeronautical Laboratories have been held regarding wind tunnel testing.

The Potez 840, marketed in the United States by Turbo-Flight, Inc., of Chicago, has been demonstrated in the United States for more than a year but is not scheduled to receive final Federal Aviation Agency certification until January, 1964, with deliveries to start the next month.

Don Payton, president of Turbo-Flight, said he believes the aircraft will replace most of the Lodestars and B-26s and some of the DC-3s and Convairs (see p. 138).

Payton foresees about 25% of today's 1,000 Lodestar-class airplanes being replaced by the Potez. He also feels that another 200 will be needed by local service airlines.

Small jets, Payton feels, will be competition only insofar as they siphon off jet-oriented customers who would have gone to turboprop aircraft by default.

Aircraft which have a backlog of time in the air will have a sales advantage, Payton says. He feels that the time on the Potez demonstrators will be sufficient to enable the aircraft to claim this advantage.

Mooney was the only manufacturer to note that it expected some competition from piston-powered aircraft. While the Japanese-designed MU-2 will be competing primarily with the Beech King Air, it also will have some competition from pressurized reciprocating aircraft, such as the Aero Commander 680FP.

Mooney plans to concentrate its sales efforts almost solely on companies now operating aircraft and will make no effort to pioneer new areas, according to Ralph Harmon, engineering vice president. Company expects to sell 30 aircraft in 1965 and 50 per year through 1968 by convincing owners of Queen Air/Aero Commander-class aircraft to upgrade to the turbine vehicle. At the same time, an effort will be made to have current operators of aircraft as large as DC-3s and Convairs increase the size and flexibility of their fleets by purchasing two MU-2s for each aircraft now operated.

Harmon noted the low initial cost of the MU-2—between $275,000 and $325,000—and said this should make the aircraft competitive both with the smaller turbojets and with non-aviation equipment.

Deliveries on U.S.-produced aircraft are expected in the first quarter of 1965.

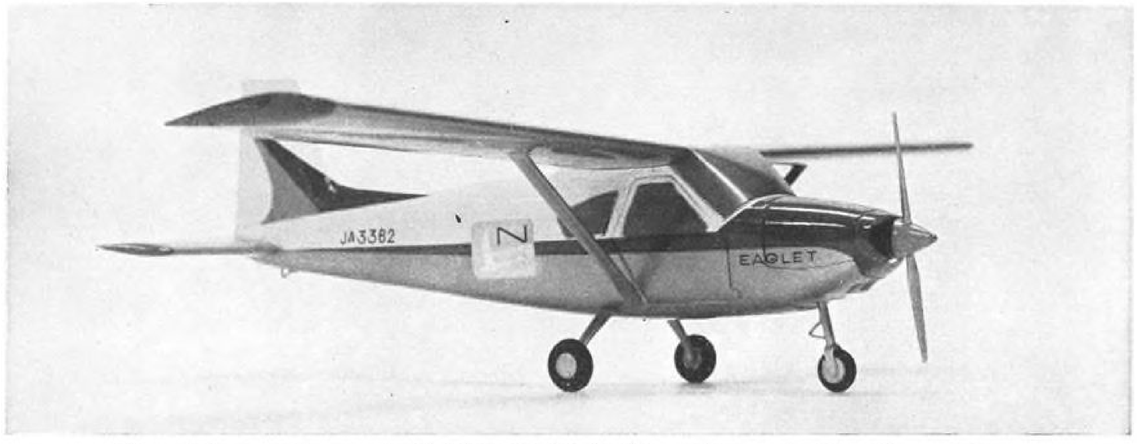
Overlapping Market

Beech, like Aero Commander and Lear Jet, felt short-field performance was the key to sales to the corporate market. The turboprop King Air, according to the company's market analysis, should be able to compete effectively not only with other turboprops but with turbojets because of its short-field ability.

Beech believes that more than half of the total turboprop market—both large and small—will go to the King Air. It feels the aircraft should make a good showing in what is acknowledged to be a "real fight" between turboprop and turbojet aircraft for an overlapping market.

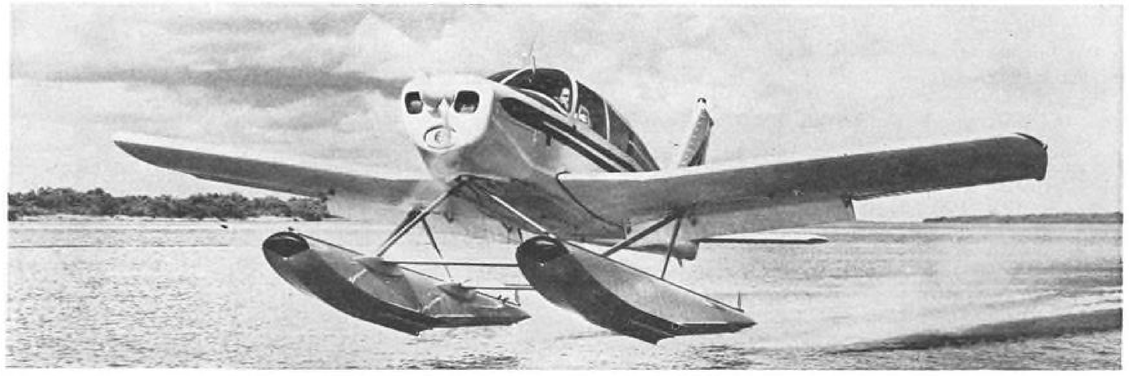
Most of the market for King Airs, Beech foresees, will be in replacing the current Lodestar/Convair fleet. It also hopes to get a number of Queen Air and Aero Commander owners to upgrade to the more powerful aircraft.

A third source of sales, the company



First Photo Shows Itoh N62-160 Utility Aircraft Configuration

Model of the C. Itoh Aircraft Maintenance and Engineering Co. N62-160 utility aircraft shows high-wing, tricycle landing gear design. Airplane is scheduled to make its first flight in November (AW Sept. 16, p. 33). Aircraft was designed to have STOL characteristics, with wing flaps allowing take off in 820 ft. and a landing distance of 840 ft. The N62-160 was developed in collaboration with a research group from Nihon University. Japanese government subsidy was provided.



Cherokee Floatplane Offers Rapid Conversion

Piper is offering Cherokee 160 and 180 aircraft on floats designed for rapid conversion from sea to landplane status. Edo Corp. floats attach to the three landing gear mounting points. The company says the aircraft may be converted from one configuration to the other in approximately 3-4 hr. Gross weight of the 180 Cherokee floatplane is 2,222 lb., and cruise speed is 122, the company says. Cherokee 160 gross weight is 2,140 lb., and cruise speed is 117 mph.

believes, will be among current owners of larger turboprops if they can be convinced that two smaller aircraft are a better investment than one larger one.

Beech apparently has researched the expected market impact of the smaller turbojets thoroughly and has come to the conclusion that lower cost, lesser pilot requirements and short field ability, coupled with its widespread dealer-service organization, give the King Air a good chance of becoming a profitable program.

Turbojet manufacturers, on the other hand, feel that the turboprop will not make a significant showing in the sales competition because they consider it only a substitution for a slow aircraft. One manufacturer called the King Air project "a nibble instead of a bite."

But all turbojet manufacturers believe that the jets will create at least as great a revolution in the corporate transportation field as they did in the airline industry. Several noted the fate of the Lockheed Electra turboprops once the turbojet airliners were on the market.

Lear's studies show that the effective use of corporate aircraft was limited not by the range of the aircraft but by the time executives are generally willing to sit in the aircraft. This is about 2½ hr., according to Lear. Thus, while a turboprop would give an executive a range of about 600-700 mi., a turbojet would extend this to 1,100 to 1,200 mi.

Beech counters this by saying that the main difference between the airlines and the corporate fleet is that the latter will have to operate from short, non-airline fields. It is confident that only a turboprop will be able to do this consistently.

Turboprop manufacturers are fairly uniform in believing that the corporate jets will grow to be "big airport" airplanes. Several cited the recent increase in gross weight of the Jet Commander as a case in point. The Jet Commander, originally a 14,000-lb. airplane, recently had its gross weight increased to 16,000-lb.

Size was a point on which no two manufacturers agreed, except to say that it was costly.

Most manufacturers are sure that executives want additional room in their aircraft, but few believe that enough are willing to pay the cost of this space to make larger aircraft profitable.

Lockheed says the JetStar is "just barely big enough." On the other hand, Lear, which has the smallest aircraft, says that extra space is merely for prestige and companies will have to pay $200,000 to $250,000 for it. Lear admits that the lure of additional room in corporate aircraft can't be contended with "if price is no object."

Size of the aircraft has been found by some companies to be a drawback. A number of manufacturers have reported that executives feel embarrassed to have a large plane deliver them to the terminal alone. Lear and North American believe that executives prefer smaller aircraft.

Lear says that corporate officers and boards of directors are under increasing stockholder pressure to economize. A smaller airplane will avoid the appearance of ostentatiousness, they feel. North American believes that many executives tend to be masochistic to the degree that they would rather ride in a smaller, less comfortable airplane than in a larger one that might appear frivolous.

Most manufacturers concede the necessity of a professional crew in sales planning. Beech says there is a market for aircraft crewed by professionals and non-professionals with a grey area in between. Its King Air, however, was designed for operation by professionals.

The Lear Jet was designed for the professional pilot, but consideration was made that some companies may want to have an executive double as co-pilot or to fly without a co-pilot.

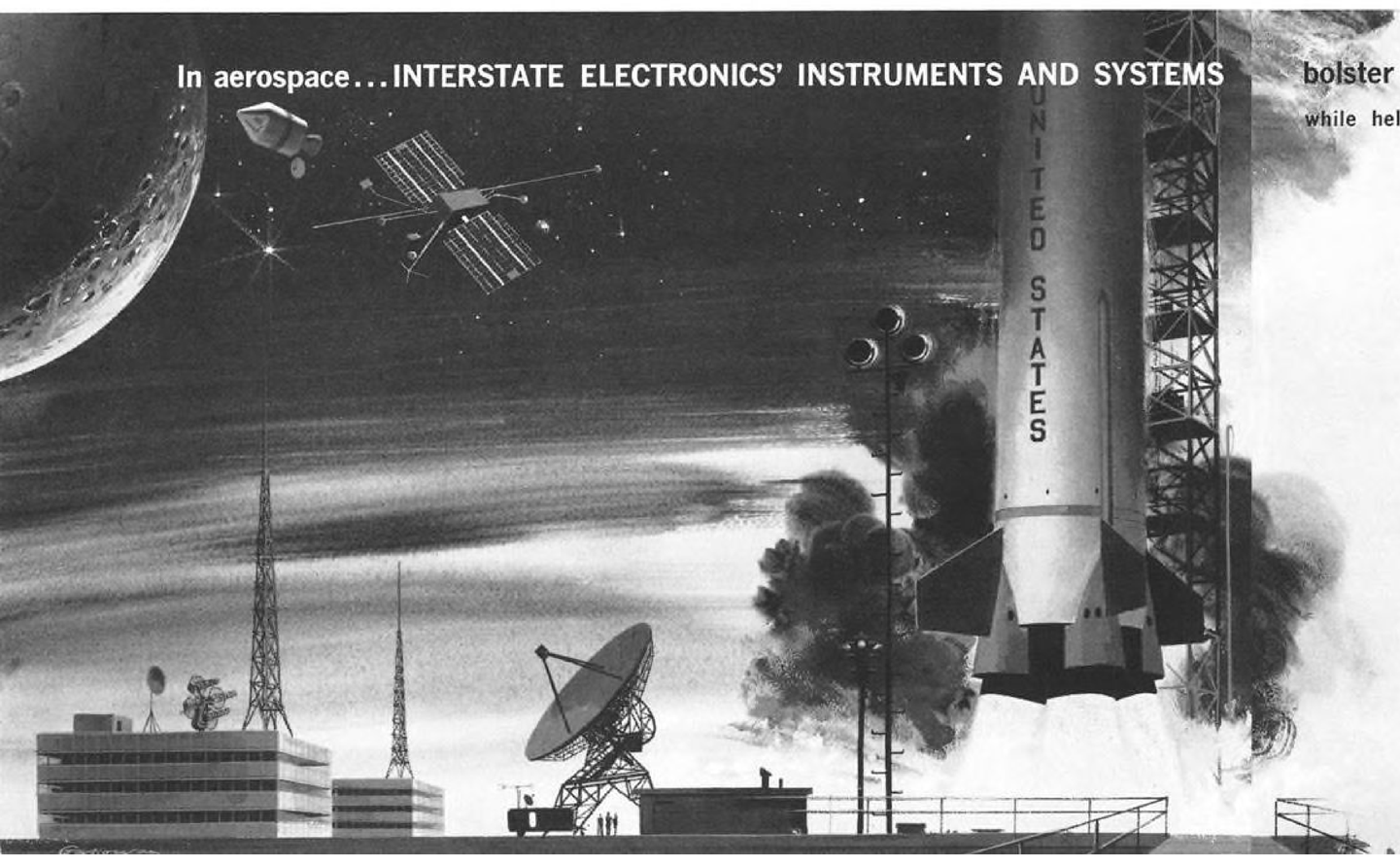
The Jet Commander was designed to be operated by a professional crew, but Commander designers believe that corporate pilots closely correspond to senior airline pilots in their outlook and do not want a "hot" airplane.

Commander accordingly has emphasized slow-speed characteristics during approach and landing in its sales plan.

Lear Jet Representatives

First area sales representatives signed under contract by Lear Jet Corp. to market the company's new twin-jet business aircraft are Patecell Enterprises, La Guardia Marine Terminal, N. Y., and Cavalier Aviation, Inc., Los Angeles. The former is assigned the New England states, New York and New Jersey, the latter the state of California.

Additional sales representatives are expected to be assigned following the National Business Aircraft Assn.'s annual convention in Houston this week. Lear Jet expects to discuss contract arrangements there with approximately a dozen prospects. Arrangement with factory representatives does not require that they maintain a demonstrator.



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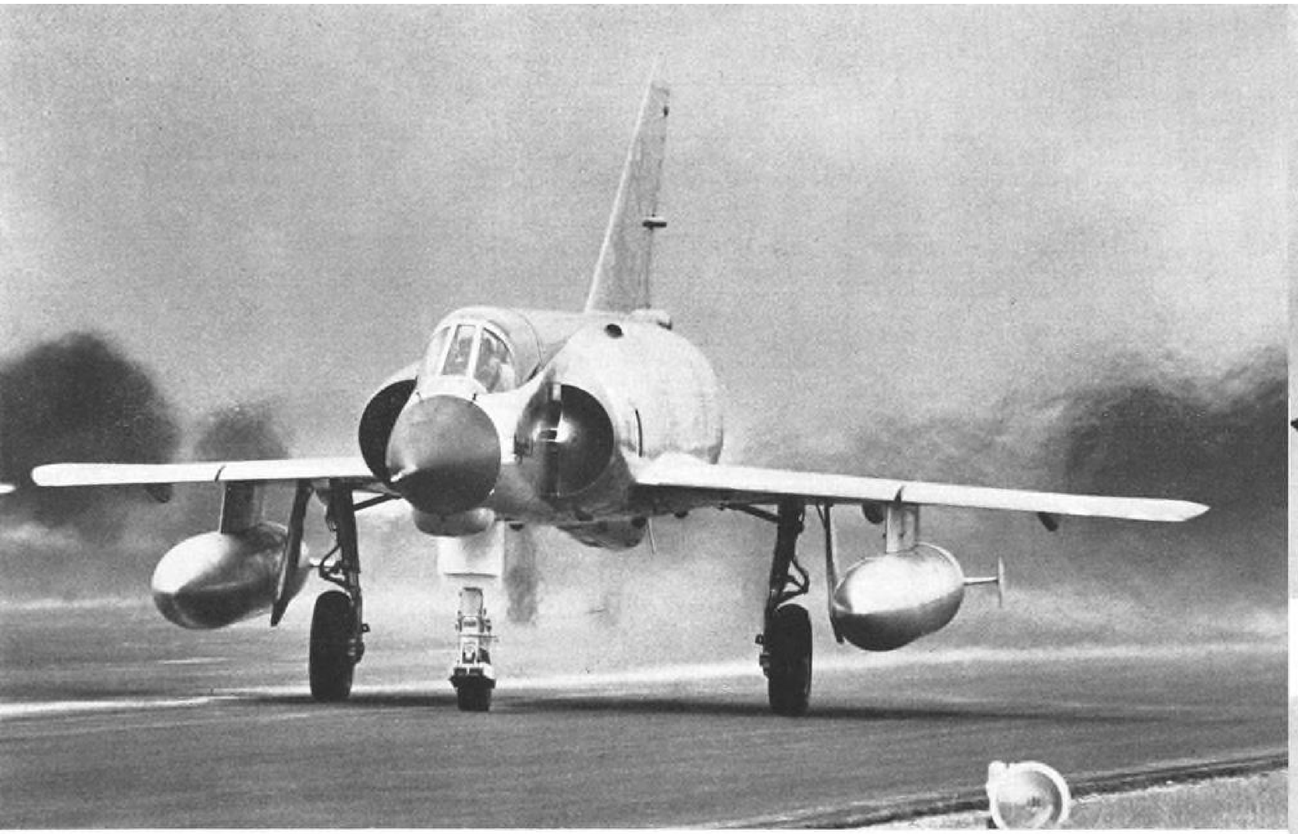
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Dassault Mirage 3E, one of four versions of the Mirage 3 in production or under development for the French air force, generates heat waves in the background as the afterburner is lighted for takeoff. The 3E, shown with underwing fuel tanks, is a long-range intruder. Cyrano 2 fire control radar is mounted in the nose and Marconi Doppler radar on the belly under the cockpit.

All Four Versions of Mirage 3 Demonstrated

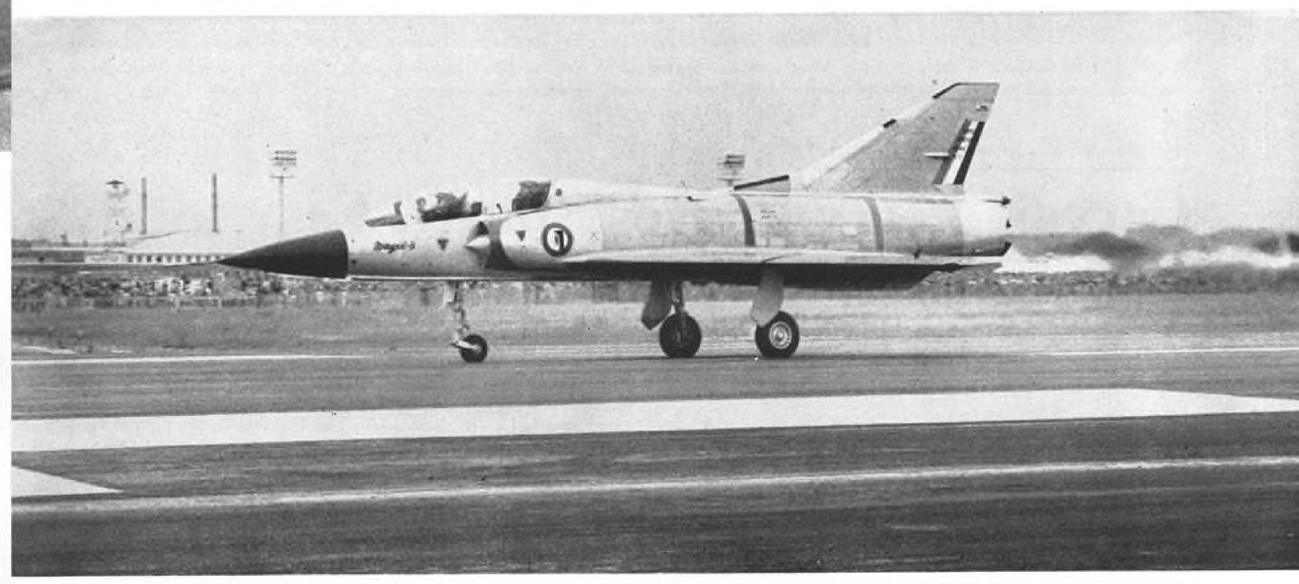




Modified nose for camera installation and camouflage paint distinguish the Mirage 3R reconnaissance version. All versions are powered by the Snecma Atar 9 turbojet and have installations in the tail for an SEPR auxiliary rocket engine.



Varied stores carried by the Mirage 3C production fighter (above) include (left to right) belly-mounted Nord AS.20 air-to-surface missile, two belly-mounted bombs, a belly-fitted Nord AS.30 scaled-up version of the AS.20, and a belly-mounted AS.20 with wingtip-carried Sidewinder missiles. All aircraft also carry stores on their wing pylons.



Two-seat Mirage 3B (above), although primarily a trainer, also can perform strike missions. Australia and Switzerland are building versions of the 3E (below). The 3E includes a 1-ft. lengthening of the fuselage that places the pilot farther ahead of the intakes. All versions were flown at the Paris Air Show last summer, where the photographs on these two pages were taken.





SEVEN ATL-98 CARVAIR car ferries are being operated by European airlines. The aircraft, built in England, is delivered with zero-time engine and airframe. British United plans to put 10 of the aircraft in service this summer.

Aviation Week Pilot Report:

Carvair Ferry Proves Sturdy, Easy to Fly

By Herbert J. Coleman

London—Aviation Traders' Carvair ATL-98 car ferry, a Douglas DC-4 conversion that is as sturdy and easy to fly as the original, is gaining acceptance in Europe as a means of expanding a new tourist market without a large capital investment.

Pioneering the concept of car-passenger service to the Continent is British United Air Ferries, a division of British United Airways, the largest British independent airline. F. A. Laker, BUA managing director, proposed the Carvair idea (AW Sept. 4, 1961, p. 46).

Aer Lingus also uses the Carvair as an inducement in promoting car-passenger traffic between Britain and Ireland.

Interocean Airways S. A., of Luxembourg, uses two Carvairs for charter and long haul to Africa. The newest operator, Alisud of Naples, has one Carvair on a four-month lease for the Naples-Palermo route, with an option to buy.

British United plans to put 10 Carvairs in service by next summer to replace the aging Bristol Freighter piston transports absorbed into the fleet when the airline took over Silver City Airways. Emphasis will be on deep penetrations into Europe, along with the short haul routes to Holland and France. The airline has asked for Air Transport Licensing Board permission to expand its network accordingly.

Aviation Traders, Ltd., the manufacturer and another British United division, also is mounting a new sales program to push the Carvair in other world markets ranging from South America and Africa to Alaska and Hawaii. Carvair was a strong contender in Hawaii until the state's board of transport supported surface transport, instead of air, for inter-island passenger and cargo haulage.

On a long-range basis, Aviation Traders is designing a swing-tail Carvair, using airframes and engines of Douglas DC-6 or DC-7 series aircraft, and is sounding out operators for potential interest. That design, however, is considered as a Carvair replacement, just as the Carvair now is considered the Bristol Freighter replacement.

Generally speaking, Aviation Traders converts a DC-4 to zero time on the airframe and engines before delivery to an operator.

It will convert a DC-4 to a nose-loading Carvair without zero time if it is satisfied that a potential operator's history of maintenance and safety warrants it. One South American airline currently is negotiating for three Carvairs on that basis.

Conversion costs about $290,000. The completed airplane, delivered without furnishings and radios but with tanks re-sealed and airframe and engines at zero time, is priced at about $520,000.

In converting a DC-4 to the Carvair configuration, the airframe is stripped and existing nose section discarded for the bulbous design which includes a hydraulic-powered entry door. A new nose is constructed in upper and lower halves and mated in jigs at Aviation Traders' hangar at Southend-on-Sea airport.

Trailer trucks then transport the humped noses to Stansted Airport, in Essex, where Aviation Traders has established the main production line. Tail vertical fins are extended at Stansted to cope with airflow changes caused by the larger nose section.



CARVAIR NOSE DOOR can be operated by one crewman. Automobiles are loaded in main cargo section, with passenger seats at the rear.

To review flight characteristics of the DC-4 conversion, this AVIATION WEEK & SPACE TECHNOLOGY pilot flew the Carvair at Stansted Airport. The flight was terminated at Southend-on-Sea, the main Carvair base for flights to Basle and Geneva.

The airplane flown, registered G-ASKG, had just received final clearance for delivery to Alisud. Aircraft commander was Aviation Traders' chief test pilot, D. B. Cartlidge, who had been assigned to set up British United crew requirements for the Naples-Palermo tourist route as part of the short-term lease deal. Cartlidge tested the airplane for certification both by Air Registration Board and Federal Aviation Agency.

From a pilot's standpoint, the bulbous nose is the major factor in airplane familiarization and checkout, since the cockpit is on a second deck level, high above the taxi strip and runway. About 8 in. wider than in the DC-4, the new cockpit has been well laid out for panel instrumentation and radio and navaid accessibility.

With Capt. Cartlidge in the right seat, the four Pratt & Whitney R-2000-7M2 powerplants were started. No flight engineer is needed and engines are handled by the pilots. Switch panels are fitted in the cockpit roof.

The main electrical junction box and circuit breaker panels on the Carvair are located behind the pilot's seat and the radio rack is positioned back of the junction box.

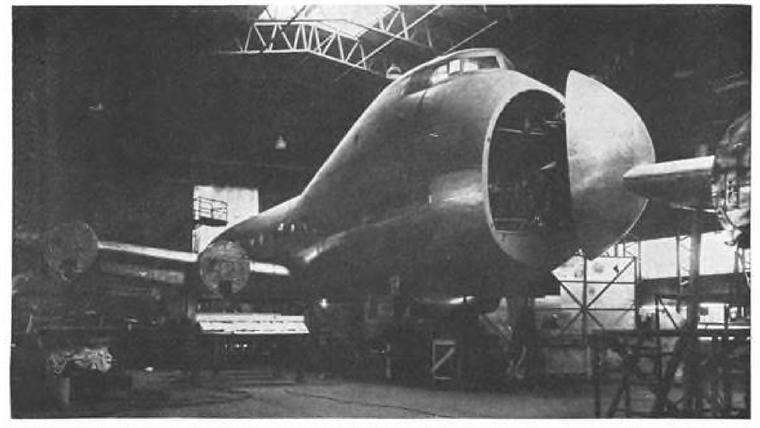
The crew compartment is elevated above the freight-passenger compartment, to provide easy access for freight and vehicles through the powered nose door. Floor length is 80 ft. 2 in. and capacity is 4,500 cu. ft.

Once the new pilot is accustomed to the height, taxiing is a simple process, with nose wheel steering provided on the left bulkhead. Weather for the flight was good, with 7/10th cloud cover at 5,000 ft. and wind from the north at 20 kt., providing a slight crosswind for takeoffs and three landings at Stansted.

With flaps set at takeoff position, engines were run to full power and brakes held on. When brakes were released, directional control was maintained by nose wheel steering until about 60 mph. Rotation was accomplished, using considerable up elevator, at about 80 mph. and climb was established at 130 mph. to 1,200 ft., staying in the Stansted pattern for practice landings before proceeding on the flight plan route to the destination, Southend.

In pattern flying, the aileron control loads were heavy but not uncomfortable. Carvair pilots are asked to compute a target threshold speed, based on gross weight—in this case about 59,000 lb.—giving a threshold speed of 103 mph.

A final approach speed of about 15 mph. above the threshold speed is rec-



PRODUCTION LINE for conversion of DC-4s to car ferries has been established at Stansted Airport as part of British United Airways' program to promote tourist trade to the Continent. BUA has ordered 10 of the aircraft.



The Defense Dollar:
Who spends it? Who gets it?

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ommended by the plane's manufacturer.

The downwind leg was flown at 150 mph. with gear and flaps up. At the far end, flaps were lowered to the takeoff position of 15 deg., and gear was lowered turning into the base leg. Speed there was 140 mph.

On final, the flaps were lowered to 30 deg. and approach speed was stabilized at 125 mph. Full flaps were lowered shortly before crossing the threshold. Carvair procedure is to carry about 12 in. Hg. power down to touchdown of the main gear.

Nose gear is lowered as quickly as possible to aid in braking.

Reaction of a new pilot to the Carvair landing is predictable—because of cockpit positioning, the instinctive reaction is to overcompensate and flare out too high. But a single landing, followed in this case by a running takeoff, establishes the profile and the subsequent landings were accomplished easily.

In this period of varied throttle changes of power settings, it was noted that trim changes were slight. An increase in power at low speed, as on the final approach, results only in a slight nose-up change. Lifting flaps after takeoff, however, results in a fairly marked nose-up trim change.

However, this poses no problem because speed of flap movement is relatively slow.

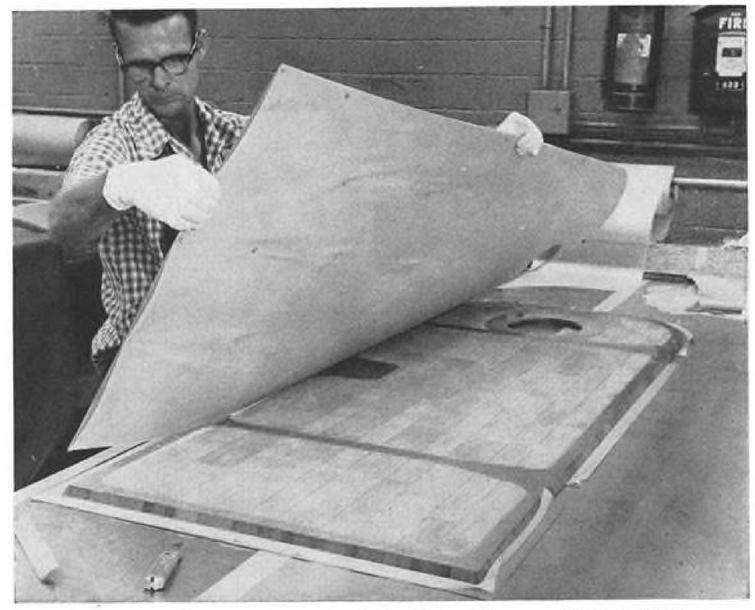
Straight and level flight in the Carvair is much like DC-4 characteristics, except in steep turns when considerable trim is needed to keep nose level.

During a series of stalls conducted at 7,000 ft. over the English Channel, in both gear-down and clean configurations, the Carvair showed no dangerous habits, although there is little natural stall warning.

In both clean and dirty configuration, a slight buffeting precedes the stall and the nose drops sharply straight ahead. Recovery is accomplished by pushing the control column forward. A slight tendency toward roll in the stall, mostly toward the left, is controlled by a moderate aileron movement.

In case of engine failure, most critical loss would be that of the No. 1 engine (outer left). Directional control calls for considerable rudder movement, counteracted by trim. Climb can be maintained at 140 mph. if the propeller is feathered.

Because of the long-range features of the Carvair, British United Air Ferries is pushing for a number of new routes, all comparatively deep penetrations, aimed at the 1964 tourist season. It has asked permission to fly to Strasbourgh, Nimes, Liege and Bordeaux, in addition to Basle and Geneva, and applications are now being considered by the British Air Transport Licensing Board.



Balsa-Metal Sandwich Used on XC-142A

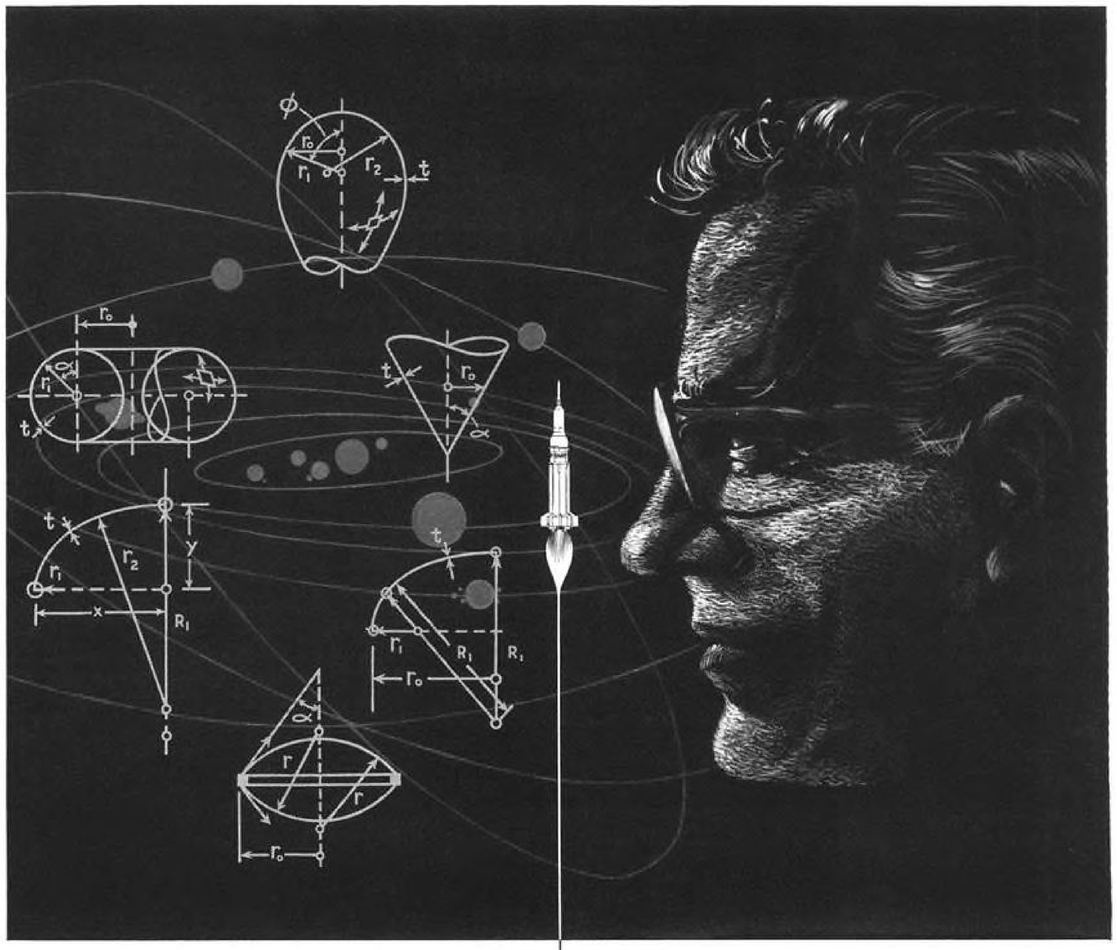
Lightweight door for the Vought XC-142A V/STOL transport is fabricated of balsa-wood blocks bonded to aluminum sheets. It is shown in final assembly, with the outer skin being placed over the wood. Dark areas are mahogany inserts to provide strength in areas of stress. After alignment, the assembly is placed in an autoclave for 2½ hr. at 300F for bonding of metal to wood. Stresses of 35,000 psi. and compressive stresses of 80,000 psi. are possible with this construction, the company says.

We hereby announce a new color film for instrumentation.

Officially it is rated at ASA 64—half the speed of KODAK EKTACHROME ER Film—but it stands up far better to forced processing for unanticipated underexposure. (It can take 4 stops of underexposure, 2 of overexposure.) It is much finer grained. It can be run head-to-tail in processing machines with ER. It comes in 16mm, 35mm, and 70mm. Arrangements to get it into your hands without delay can be worked out by Eastman Kodak Company, Photorecording Methods Division, Rochester 4, N.Y. (Phone 716-562-6000, Ext. 3257)

It is to be known as KODAK EKTACHROME MS Film

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SPACE DIVISION CHRYSLER CORPORATION

PRODUCTION BRIEFING

Ryan Aeronautical Co., San Diego, Calif., has been awarded a Navy Bureau of Ships contract for service test radar altimeters for Navy's new hydrofoil ship. The altimeter will provide precise information on how high the vessel's hull is above the surface when it is up on its hydrofoils. The altimeter will read in inches.

J. A. Jones Construction Corp., New Orleans, has received a $6.3-million contract for continuation of work on an engineering building at the NASA Michoud operations plant.

Bell Aerosystems Co. has been awarded a $1-million contract for production of reaction control systems for the Centaur liquid hydrogen rocket. The firm has developed and delivered to NASA prototype systems, which consist of 10 small hydrogen peroxide thrust chambers which produce thrusts ranging from 0.5 lb. to 50 lb.

Warrior Constructors, Inc., Houston, has received a $3.4-million contract to build a three-story headquarters office building at the NASA Mississippi Test Operations facility.

Air Force Logistics Command's incentive awards program for employe ideas has saved the Air Force more than $455.2 million in its 20-year history, Logistics Command says. During the period, Air Force has paid nearly $12.2 million in awards to employes. The sum was paid for a total of 129,850 adopted ideas and 39,691 special acts and sustained superior performance awards.

Fairchild Stratos Corp., Bay Shore, N. Y., has a North American Aviation Space and Information Systems Div. contract with an initial value of $115,000 for development of components for the Apollo spacecraft waste management system. Components will include a bacteria control unit and a liquid disposal lock.

Murray J. Shiff and Co., Tucson, Ariz., has a $2.5-million Army contract for construction of Apollo Test Complex 2 at White Sands Missile Range, N. M.

First of three Lockheed F-104N aircraft ordered by NASA's Flight Research Center, Edwards AFB, Calif., has been delivered. The aircraft will be used in high-speed research and as an X-15 training plane, with gear and flaps extended to simulate X-15 glide characteristics.



In a way,
this actuator takes up no space

When a missile engineer came to us for a suggested solution to an actuating problem, he seemed to think our little Size 2 solenoid would do the job. He was right.

Trouble was, the solenoid and a small cable had to occupy the same space.

Our solution?

We built the solenoid around the cable.

Chances are you don't need an actuator with a hole through it. But whatever your actuating job, simple or complex, our people will get a lot of pleasure out of helping you solve it.

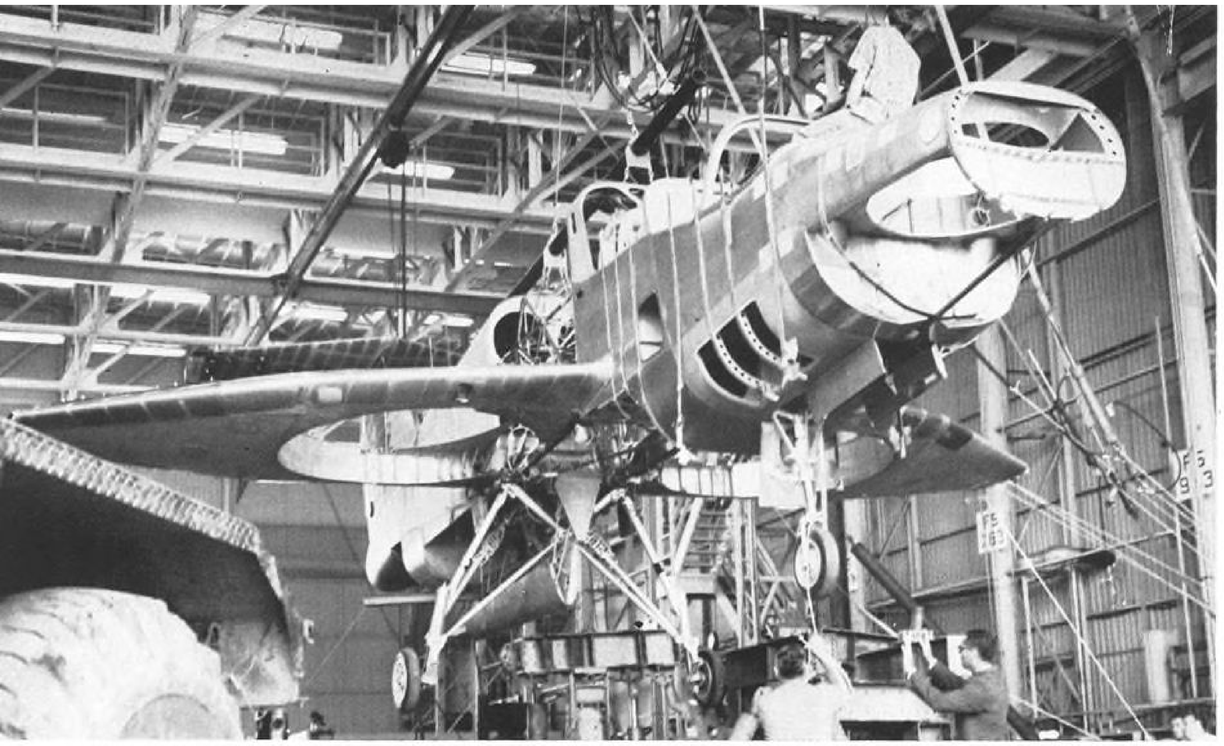
There are other engineers here at Ledex who are experts in switch circuitry and step-servo motors. They're ready to design a new unit, or work out ways to make our standard products help you put out more work in less space.

If you have an immediate actuating problem, phone 513-224-9891. Or for more information on solenoids that pack more work into less space, write for "Solenoids," Ledex Inc., Dayton 1, Ohio.

Thanks,

Robert J. O'Brien
Chief Engineer

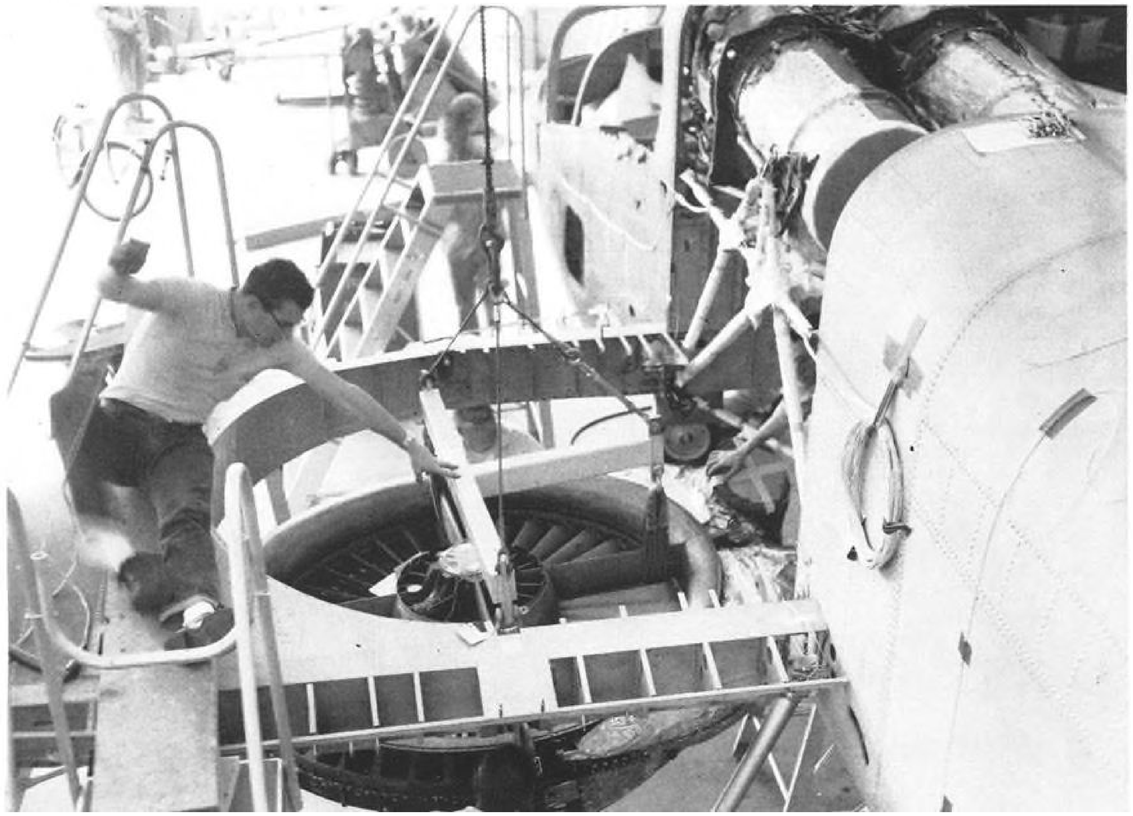
LEDEX *Ledex Inc., Designers & Manufacturers*
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Engineers direct installation of Army XV-5A V/STOL research aircraft in static test fixture prior to start of testing. This aircraft is research article number one; number two is scheduled for flight and ground resonance tests.

First Flight Model of XV-5A Nears Completion

General Electric lift fan propulsion system is installed (below) in XV-5A V/STOL aircraft at Ryan plant. Note twin J85 turbojets top right. Crossover ducting connections permit the single operating engine to divide its gas horsepower equally between the two fans in the event of a failure in one of the engines.

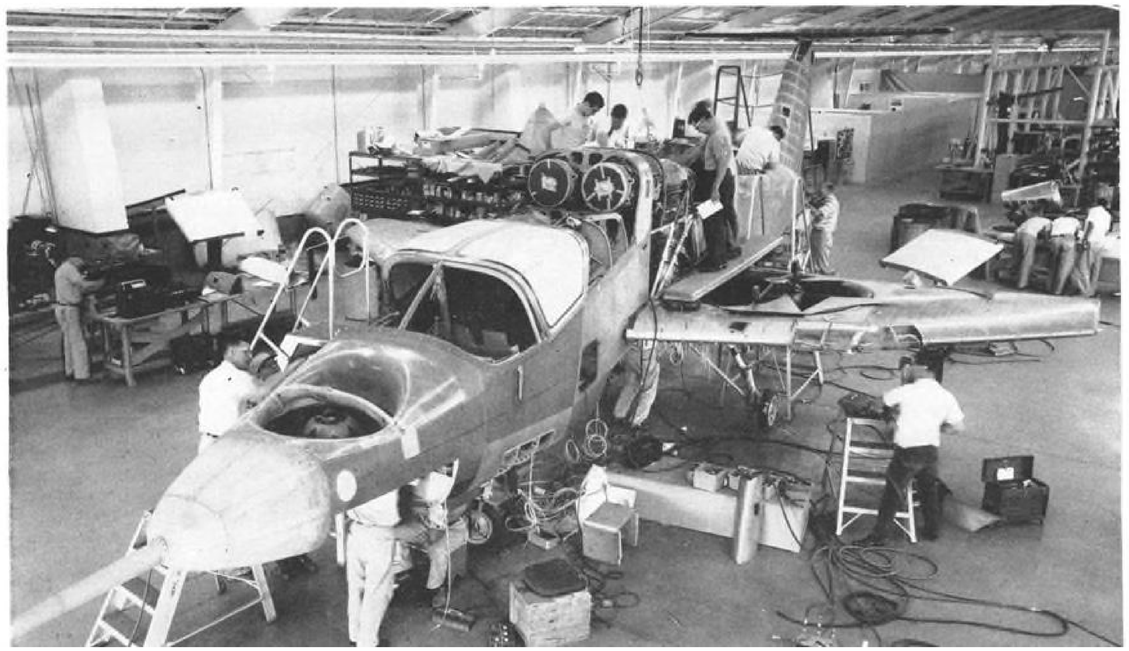


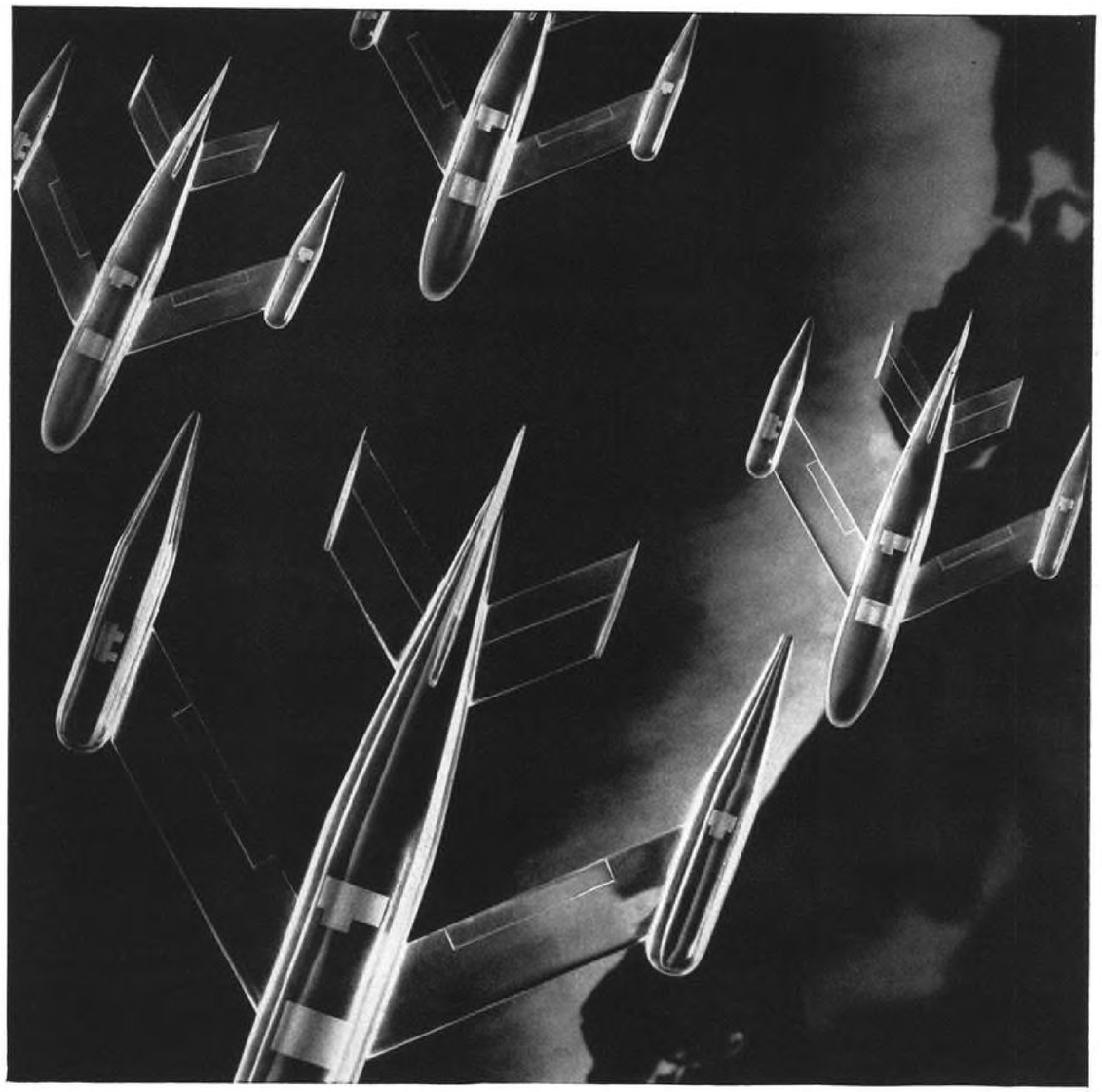


Ryan-General Electric XV-5A research aircraft number one (above) being backed into static test facility at San Diego. Note position of main landing gear struts, designed to keep gear assembly clear of fan exhaust in VTOL operations.



Scheduled for first flights, Ryan-General Electric XV-5A research aircraft number two nears completion in Ryan hangar. J85 turbojet engine is being installed (above). Forward view (below) shows nose pitch fan, driven by a pair of ducts from the main gas generator.





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Equipment has been designed and developed for the Army, Navy and Air Force for automatic control of two or more targets. The leader receives information from a standard UHF ground station while the other craft in the squadron maintain their desired positions through a radar link with the lead aircraft. Thus, perfect formation is achieved at various speeds, altitudes, and under all weather conditions.

Systems have flown the F6F-5K, QB-17, QF-80, F9F-6K, and Firebee target guided missiles. Applications include targetry, station-keeping for ASW, supply operations, mine laying, parachute drops and ordnance operations.

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Navy Gets First Operational A-6As

Navy has received first Grumman A-6A Intruder twin-engine attack aircraft, assigned to squadron at Oceana Naval Air Station, Virginia Beach, Va. Two-seat attack aircraft, in service earlier with Marines, uses Pratt & Whitney J52-P-6 turbojets with 8,500 lb. thrust each. Aircraft provides Navy with low-level, all-weather operational system using a pilot display tube which permits a variety of observations through heavy cloud cover. Using it, the crew can continue missions in poor visibility. Aircraft combines low-level, economical cruise and high load-carrying capability. External weapons cover a wide range of uses.



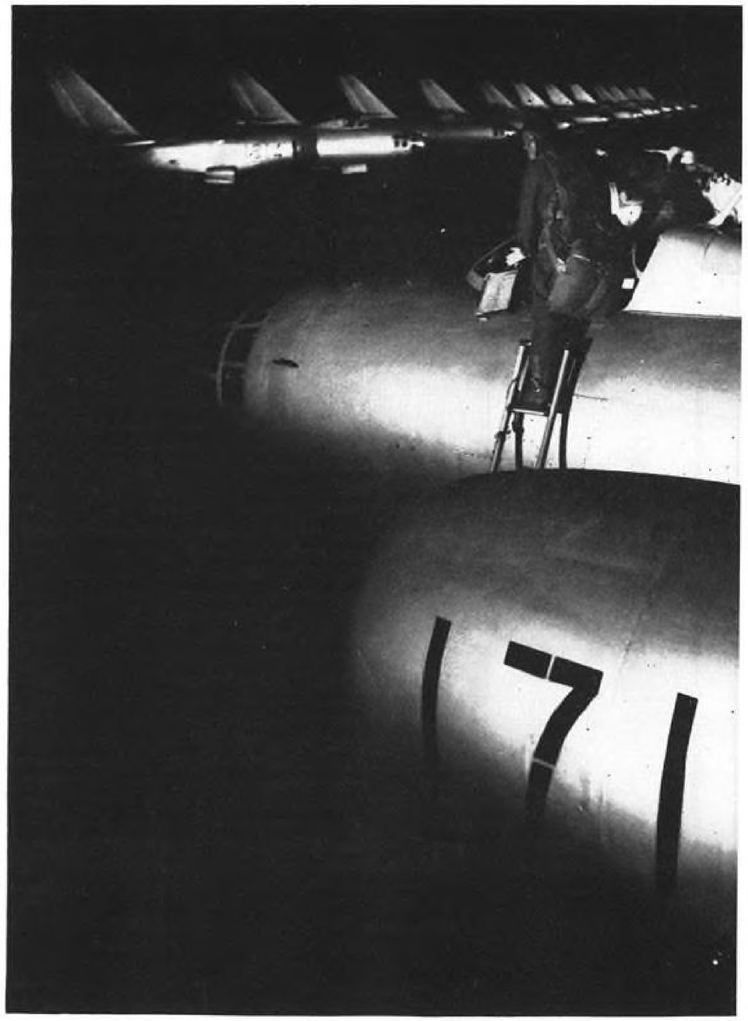
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Red Chinese Beagle Bombers Shown

In one of the rare officially released photos depicting Red Chinese military aircraft activities, a Chinese People's Liberation Army pilot is shown boarding a Soviet-built Ilyushin Il-28 Beagle twin-jet bomber, with other Il-28s in the background. The Beagle also has been deployed to air forces of other communist countries, including Cuba. Recent reports based on Nationalist Chinese U-2 flights over Red China indicate that the communist nation's air force has deteriorated (AW Sept. 16, p. 25). Red China has not been receiving late-model aircraft from the Soviet Union and has been forced to cannibalize parts from its MiG-15, -17 and -19 fighters to maintain squadrons, Nationalist Chinese sources say.

Ryan Studying BLC for Army

Ryan Aeronautical Co. is investigating applications of the company's boundary layer control system to Army aircraft under a $200,000 contract from the Army's Transportation Research Command.

The system is being sized for possible installation on a de Havilland YCV-2B Caribou in a follow-on program.

In the Ryan BLC system, air is both sucked in and exhausted just forward of the leading edge of the flaps on alternating spanwise sections of the wing.

The system is essentially the same as that which Ryan designed for its BLC-7 light twin transport (AW May 21, 1962, p. 87).

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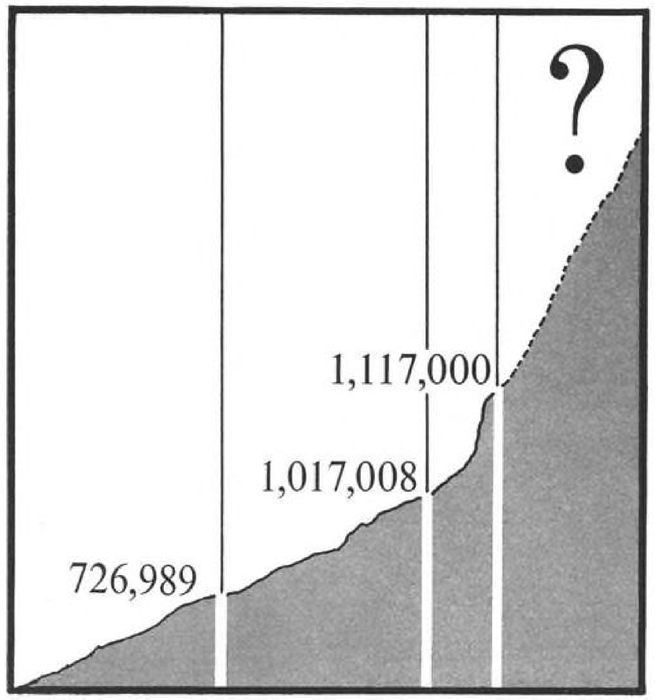
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are growing

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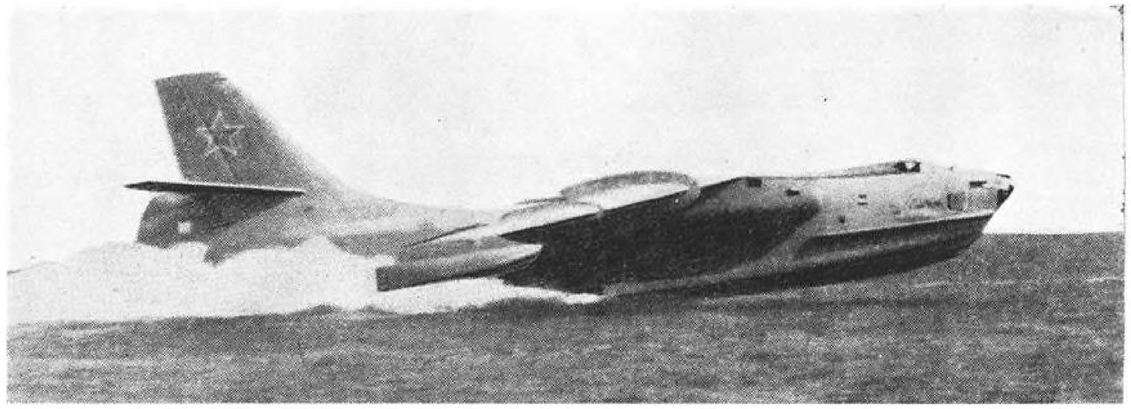
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BE-10 TWIN-JET SEAPLANE, shown during takeoff run, was first shown publicly in 1961. It later established 12 world speed, altitude and payload records. Its designer, Georgi Beriev, is now proposing construction of "flying ocean liners."

Beriev Urges 2,000-Passenger Seaplane

Georgi Beriev, Russian chief designer who built the record-breaking, twin-jet Be-10 seaplane, is urging construction of "flying ocean liners" weighing 1,000 metric tons and capable of cruising at 900 km./hr. (559 mph.) with 2,000 passengers.

Such transports, Beriev said in an article in the Russian magazine Nauka i zhizn', have been necessitated by the increasing difficulty in providing suitable airports for ever-larger, conventional, land-based airliners.

The 2,000-passenger seaplane Beriev envisions would operate at a cost of 0.31 kopeks (0.34 cents) per passenger-kilometer.

Comparative Costs

By contrast, Beriev says, operating cost for the 140-metric ton, four-jet, British Vickers Super VC.10 is about 1.9 kopeks (2.1 cents) per passenger-kilometer. Operating cost for the 59,-000-metric ton French ocean liner, France,–the third largest in the world –is estimated at 3.2 kopeks (3.55 cents) per passenger-kilometer.

A Soviet artist's conception of Beriev's proposed "flying ocean liner" (see this page) shows an eight-jet, delta-wing transport with at least three decks. Total engine thrust would be 64,000 kg. (141,100 lb.).

A giant door in the rear of the bulky fuselage would permit loading and unloading large cargo items directly from and onto the dock.

Beriev says that even at the present level of aviation technology, construction of a "flying ocean liner" weighing 1,000 metric tons or more could be undertaken. "Naturally," he adds, "when aviation engines using nuclear fuel are created, even more enormous perspectives will be opened up."

The huge seaplanes would be suitable for operation on "super-long," 7-8,000-km. (4,347-4,968-mi.) routes, according to Beriev. Most of such routes would be over water. But Beriev points out that even when flying over large land areas a "super seaplane" would find more safe places to put down than a land-based plane of comparable size.

The Russian designer says that a 2,000-passenger seaplane cruising at 900 km./hr. would be able to make one trip daily on an 8,000-km. route, carrying a total of 12,000 passengers in a six-day period. By comparison, he continues, the Vickers Super VC.10, also flying one trip daily, would carry 600.

The ocean liner France cruising at 56 km./hr., could make only one 8,000-km. trip in the six-day period. It could, therefore, only handle its one-trip capacity of 2,000 passengers.

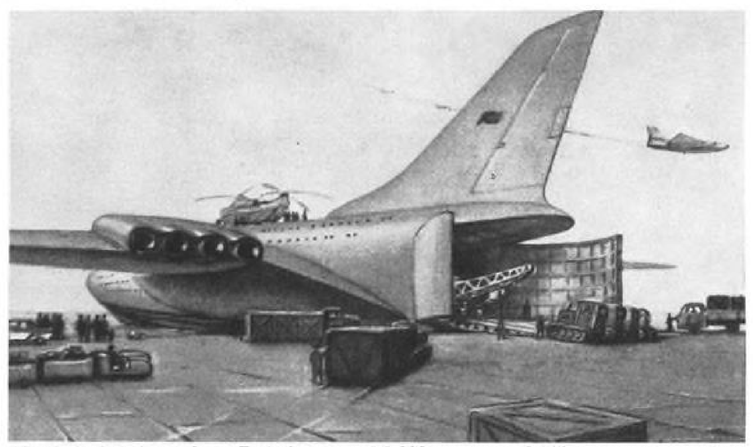
Thus, Beriev says, one "super seaplane transport" would do the work of 20 land-based jet transports of the Vickers Super VC.10 class and of six "France-class" ocean liners.

Beriev concedes that long-range, land-based airliners could be operated more efficiently than large seaplanes during the first two decades after World War 2, when the cost of constructing suitable airports was lower. But now, he contends, the situation is rapidly changing.

Transport Problems

He believes that the need for longer and thicker runways, combined with the noise created by very large jets flying over populated land areas, is creating an insurmountable problem. Practical STOL and VTOL transports are still far from a reality, according to Beriev.

"Also, it would be very difficult to build the landing gear for a super-heavy, land-based transport. It would require about 40 wheels 1.5 meters (4.9 ft.) in diameter, each weighing 500 kg. Together with the shock-absorbing struts and actuating mechanisms, the landing



ARTIST'S CONCEPT shows Beriev's proposed 1,000-metric ton, 2,000-passenger jet seaplane.



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Education: B.S. in E.E., M.E. or Physics. Articulate in communications. U.S. citizenship required.

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gear's total weight would be at least 50 metric tons.

"Runways for 1,000-metric ton, land-based transports would not only have to be many kilometers long but have concrete surfaces several meters thick. Cost of such airports would eat up any advantage derived from the plane's increased tonnage.

"As a result, most specialists believe that it is unthinkable to build land-based transports of more than 200-250 metric tons (441,000-551,000 lb.) gross takeoff weight," Beriev says.

By contrast, Beriev comments, the basic design of seaplanes, with their large hulls and the need for placing engines high above the water, makes them more efficient as their size increases.

The U.S., according to Beriev, has been unsuccessful in trying to build fast, jet-powered seaplanes. "At the present time, only the Soviet Union possesses such craft."

The Be-10 twin-jet seaplane was first shown publicly during the 1961 Tushino Air Parade in Moscow. The aircraft has set 12 world records.

Be-10 marks certified by the Federation Aeronautique Internationale include: 912 km./hr. (566.4 mph.) over a 15-25 km. course, 875.86 km./hr. with a 5-metric ton payload over a 1,000-km. closed course, altitude of 14,062 meters with a 5-ton payload, altitude of 12,733 meters with a 10-ton payload, altitude of 11,997 meters with a 15-ton payload, maximum weight of 15,206.4 kg. lifted to an altitude of 2,000 meters, and maximum altitude without payload of 14,962 meters.

Increased Synthetic Oil Use Seen for SST

Increased use of synthetic oils to lubricate current and future turbojet, turboprop and turboshaft engines is foreseen as a result of the operating requirements defined by Federal Aviation Agency for a supersonic transport.

Engine lubrication for the supersonic transport (AW July 8, p. 74) calls for an oil capable of operating in a −30 to 500F environment with localized heating as high as 800F. Synthetic oils are much less likely to evaporate at high temperatures or to lay down lacquer and coke deposits than petroleum oils.

Inhibiting engine corrosion by oxidation at these temperatures through the use of metal chelates has been proposed. At present, no synthetic oil exists which can provide both high- and low-temperature properties which are desired. Development of a fuel-oil heat exchanger which would cool the oil enough to provide optimum lubrication has been suggested by FAA as one method of ensuring mechanically reliable bearings, seals, gears and pumps.

DEFENSE CONTRACT AWARDS

THIRD FISCAL QUARTER SUMMARY—1963

Now available free from AVIATION WEEK & SPACE TECHNOLOGY are summary reports of defense contract dollar awards covering the third fiscal quarter of 1963. These reports show defense dollars awarded in 179 product/system categories as compiled by Frost & Sullivan, Inc. Information is also available on the fourth fiscal quarter 1962; first fiscal quarter 1963; and second fiscal quarter 1963.

Reports are available on an individual request basis in the following system areas:

Data Processing
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SYSTEMS ANALYSIS ENGINEERS

Will analyze systems performance, conduct servo analysis and solve trajectory problems using analog/digital computers and construct mathematical models. Knowledge of advanced calculus, vector analysis, classical mechanics, Bode diagrams, root locus plots and LaPlace transforms highly desirable.

SYSTEMS INTEGRATION ENGINEERS

Will integrate components into the inertial guidance system and the system into the vehicle and solve problems of interface, such as grounding, signal isolation, and hardware and digital computer interface. Knowledge of inertial navigation, gyros and accelerometers is required.

Qualified Applicants are invited to visit our facilities, meet our people and discover for themselves the many added advantages of working and living here on Florida's Suncoast. A brief note, describing your education, experience and specific area of work interest, addressed to **I. M. Keese, Honeywell 13350 U. S. Highway 19, St. Petersburg, Florida,** will bring a prompt, confidential reply.

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WHO'S WHERE

(Continued from page 23)

Changes

Col. Howard G. Cook, chief, Limited War Office, Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson AFB, Ohio, replacing **Col. Howard I. McIntire.**

Dr. Hans J. P. Von Ohain, chief scientist, Aerospace Research Laboratories, Wright-Patterson AFB, Ohio, replacing **Dr. William J. Price,** now executive director, Office of Scientific Research, Washington, D. C.

Brig. Gen. William A. Gross, director of transportation, Air Force Logistics Command, Wright-Patterson AFB, Ohio, replacing **Col. William T. Kemp,** now special assistant to Gen. Mark E. Bradley, Jr., AFLC commander.

Dr. Max T. Weiss, associate general manager, Laboratories Div., Aerospace Corp., El Segundo, Calif. Also: **Dr. Everett T. Welmers,** assistant to the division general manager of the newly formed Office of Plans Integration, Aerospace Corp.'s Systems Research and Planning Div.

Dr. Walter K. Stromquist, head of the newly formed Nuclear Technology Section, General Dynamics/Astronautics, San Diego.

Harry J. Schmidt, program manager-packaged liquid engine production, Thiokol Chemical Corp., Denville, N. J., and **Donald Zimmet,** program manager-Surveyor engine program.

Howard Speakman, product assurance branch lead engineer for Apollo, Lockheed Propulsion Co., Redlands, Calif.

Col. Sam Bruno (USAF, ret.), manager, Security Div., Liquid and Solid Rocket Plants, Aerojet-General Corp., Sacramento, Calif. Prior to retirement, Col. Bruno served as chief of security and law enforcement under **Gen. Bernard Schriever,** commander, AFSC, Andrews AFB.

Charles V. Gerdes, assistant manager, Government Agency Sales, Electronic Communications, Inc., St. Petersburg, Fla.

John F. McAllister, Jr., consultant-advanced development, General Electric Co.'s Engineering Services, New York, N. Y. Also: **Robert F. Koenig,** manager, Thomson Engineering Laboratory, GE's Small Aircraft Engine Dept., Lynn, Mass.

Donald J. Kasun, engineering manager, Westinghouse Cryogenic Systems Dept., Pittsburgh, Pa.

Robert E. Clifford, managing director, Honeywell's Military Products Group-Europe, with headquarters in Paris, France. **David C. Gerrish** succeeds Mr. Clifford as general sales manager, Military Products Group, Washington, D. C., and **Louis F. Westra** succeeds Mr. Gerrish as manager of the Washington Representatives Office.

Dr. Jacob A. Randmer, chief engineer-large power tube operation, Machlett Laboratories, Inc., Springdale, Conn.

James J. Hooper, director of sales and requirements, Martin Co.'s Electronic Systems & Products Div., Baltimore, Md.

John A. Teske, assistant manager, Garrett-AiResearch's Torrance (Calif.) facility.

Dr. Robert D. Gafford, manager, Life Sciences, Space Engineering Dept., Beckman Instruments, Inc., Fullerton, Calif.





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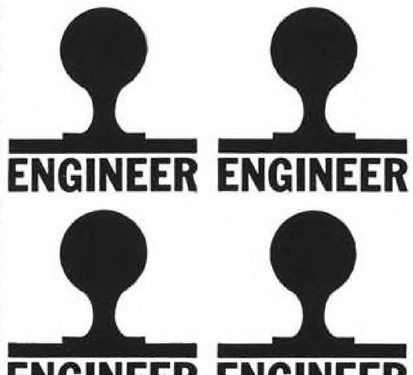
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LETTERS

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.

Dulles Lounges

The articles on U. S. airports have been very interesting and informative, however, I take exception to the cost figures on the Dulles lounges. The article (AW Aug. 26, p. 40) mentions that the average cost, for 21 lounges, now in use, is $232,000. This is hard to believe (since the first lounge cost $1,700,000), as the cost per lounge would be only $151,047.62 for each of the 20 remaining lounges.

I was through Dulles several weeks ago and was told, by one of the employes, that the lounges cost approximately $800,000 apiece. Even though the source probably wasn't the most reliable, this figure seems more realistic, as it's hard to visualize such a drastic cost reduction on so few vehicles manufactured. On a larger production order, of 100 vehicles or so, the $232,000 would seem realistic, but on 20 lounges, who's fooling who?

Mr. Cook leaves the reader with the idea that one lounge will service one airplane where it would take three smaller buses and therefore be cheaper to use the lounge. However, the lounge will only carry 90 people. A fully loaded jet terminating at Dulles would, in reality, require two lounges ($462,000 in equipment) or three standard buses ($200,000 in equipment). It appears, arithmetically, that the three standard buses would still be $262,000 cheaper and the money saved would almost buy four more of them. Where are the savings?

ROY P. GIBBENS
Orlando, Fla.

P.S. The photo of Miami International Airport in article No. 7 (AW Aug. 5, p. 47) does not show the new overhaul centers of Eastern or Pan American as stated. These buildings are located in the northeast corner of the airport, the photo is of the northwest corner.

(The $232,000 unit cost figure was a matter of bitter debate before Congress during FAA budget hearings, but is accepted as the official figure. It includes all R&D costs on the lounge.—Ed.)

DC-3 Replacement

We note in your issue of Aug. 19 (p. 38) the report of the Civil Aeronautics Board plan to reduce airline subsidies. In the last paragraph you indicate that the Board states there is no likely replacement on hand for the DC-3.

I would point out there is in fact a modern 24-passenger jet prop aircraft, the Potez 840, designed in France by Henry Potez to be manufactured in Ireland for the North American market. This aircraft has a direct operating cost, including depreciation, which is substantially less than that of the old DC-3. The CAB has in hand a study made in their behalf by one of the large trunk airlines which clearly demonstrates this fact. No other existing or planned aircraft included in this study could operate as economically as the Potez 840.

Our demonstrator aircraft is available here in Chicago for anyone who cares to evaluate it.

It has been difficult for the airline management to consider new small aircraft since the subsidy formula made it more interesting for them to put larger aircraft into service. Due to uncertainties on the future course of the subsidy formula and subsidy policy, the carriers have hesitated to incur the substantial debt required to re-equip with new small aircraft.

A sensible approach to the reduction of subsidy must take advantage of the availability of this new aircraft which can immediately reduce direct costs and increase passenger revenue by attracting more passengers. When the aircraft are fully depreciated then even greater savings will be realized. Nothing is to be gained by retaining the old DC-3s. The DC-3 does not even meet the safety standards required of today's modern transport category aircraft.

I submit the best public good is not being served when aircraft are in service which are less safe and more expensive to operate than an existing new aircraft.

DON PAYTON
President
Turbo-Flight, Inc.
Chicago, Ill.

P. S. I would like to point out that our Potez 840 aircraft meets the specifications laid out by Chairman Alan Boyd in an address to the Society of Automotive Engineers in April, 1962, as reported in AVIATION WEEK, Apr. 30, 1962, p. 49.

The Potez 840 aircraft also meets the specifications of the Assn. of Local Transport Airlines in their "Low Cost Plane Design Committee" final report of Apr. 30, 1963, with a direct operating cost which will come substantially closer to this committee's goal than any existing aircraft.

(For detailed coverage of the Potez 840, see: AW May 29, 1961, p. 71; Dec. 25, 1961, p. 70, and July 30, 1962, p. 80.—Ed.)

Northeast Ruling

I take strong exception to your article "Bid to Reverse Northeast Ruling Seen" (AW Aug. 5, p. 42). The article smacks of punchy political thinking and is highly unethical in its slanted favoritism towards Northeast. You have noted no economic facts in your article, such as the simple fact that three carriers are just too much for the New York-Florida run. If NAL had not obtained the West Coast run, all three carriers would be in dire financial shape instead of two.

It is very handy for you to jump on the petty political bandwagon in view of the fact that the Kennedy boys have taken a direct interest in the case. While the CAB has made mistakes, it is the best we have in the way of a body to determine route awards and such. The CAB is supposed to be free of political pressures in arriving at and maintaining positions on major decisions.

Local New England pride is of little value compared to the hard, cold economic facts of the case, and your article does nothing but degrade the integrity of Aviation Week. It is suggested you include, in a future edition, the facts of the case from a neutral viewpoint completely stripped of political considerations. Such articles as the aforementioned, in your Aug. 5 edition, will do nothing but detract from the value of your magazine in the future.

B. S. GLEASON
Marietta, Ga.

Photo Credit

Let me congratulate you on the article about our radar (p. 84) in the Aug. 19 issue. You have done a good job.

May I correct an error by pointing out that the picture credits for the cover as well as pp. 85, 87 and 91 should have been given to Cornell University rather than "USAF." I took the picture myself, as an employee of Cornell.

THOMAS E. TALPEY
Cornell University
Arecibo Ionospheric Observatory
Arecibo, Puerto Rico

Klystron Supplier

In the Aug. 19 issue, p. 84, there appeared an article on the Arecibo Ionospheric Observatory in Puerto Rico, in which it was stated: "The radar transmitter using Eimac klystron tubes, can be operated . . ." This is an error. The klystrons were supplied by Varian Associates, of Palo Alto, Calif.

I would just like to keep the record straight.

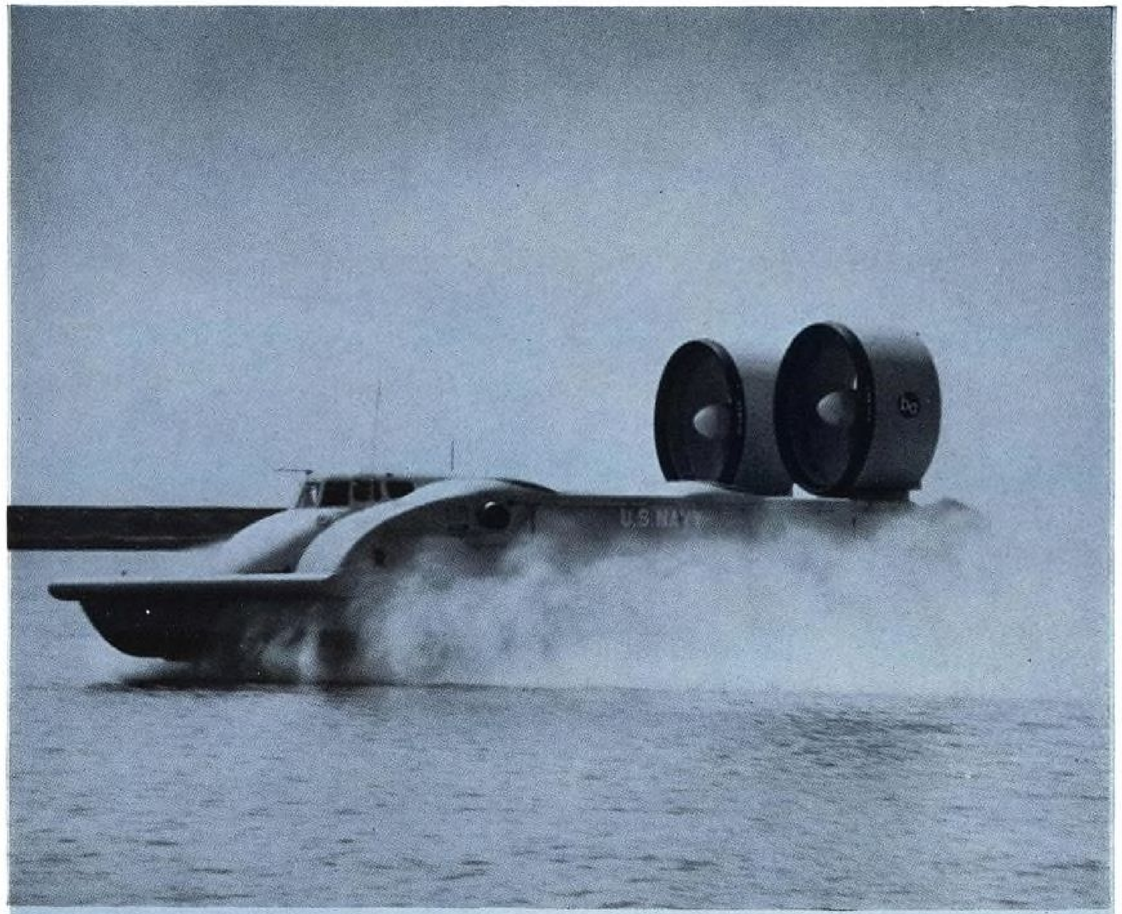
JOHN MASON POTTER
Cornell University
Ithaca, N. Y.

AMR Cable

I should like to call your attention to an error in your article on the AMR cable system (AW Aug. 5, p. 104). You state, "The new 715-mi. cable laid for the Atlantic Missile Range is only the second to provide 60-channel two-way communications within a single cable. The first, laid last fall by the Neptun, connects Canada and Iceland."

If you will refer to the January, 1957, issue of the Bell System Technical Journal, a paper by R. J. Halsey and J. F. Bampton describes a 60-channel two-way system within a single cable linking Newfoundland and Nova Scotia. This system was completed in May, 1956. Other systems of this type have been laid since that date, among which is the Cantat (Canadian Trans-Atlantic) system completed in November, 1961. (See Post Office Elec. Engr. J1.) Thus the AMR cable is certainly not the second system of this bandwidth with two-way transmission in a single cable.

MARSHALL G. SCHACHTMAN
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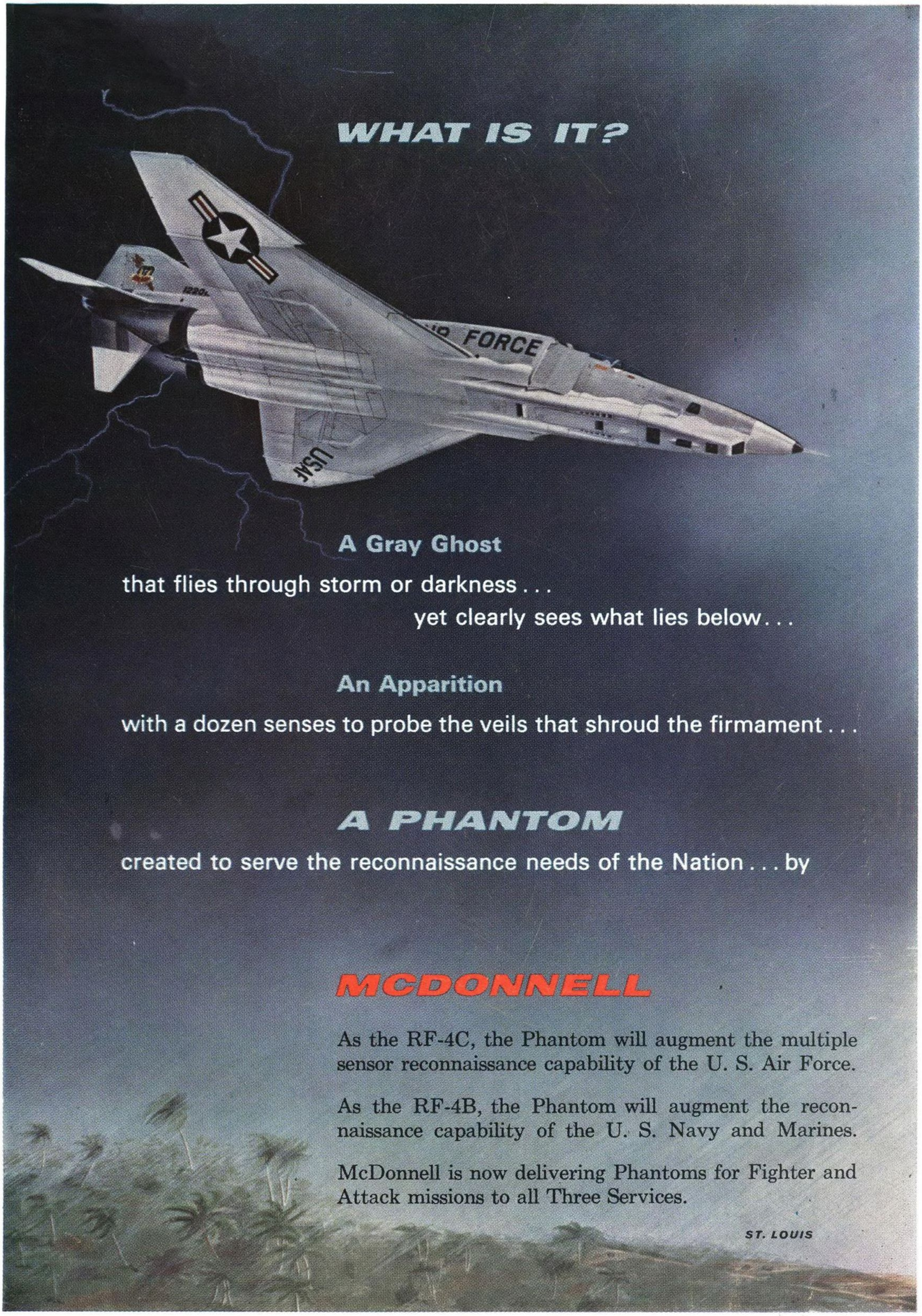
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The SKMR-1 Hydroskimmer, largest and most powerful air cushion vehicle ever built, successfully passed its initial acceptance trials in August. Built by Bell Aerosystems for the U.S. Navy Bureau of Ships, SKMR-1 overcomes many of the shortcomings of conventional craft by riding above the surface on a cushion of air. Even rough water presents no problem since the Hydroskimmer has the capability to skim over four-foot waves. Vital statistics: SKMR-1 weighs 22½ tons, is 65 feet long, 27 feet wide and is designed to carry more than 15 tons payload over water, land and in amphibious operations at speeds of 80 miles per hour. Future commercial and military missions envisioned for Hydroskimmers include personnel transport, landing craft, anti-submarine warfare, patrol, rescue and reconnaissance. The Hydroskimmer is another example of Bell's creative engineering at work.

BELL AEROSYSTEMS COMPANY
DIVISION OF BELL AEROSPACE CORPORATION—A textron COMPANY

SEP. 24 1963



A Gray Ghost

that flies through storm or darkness . . .

yet clearly sees what lies below . . .

An Apparition

with a dozen senses to probe the veils that shroud the firmament . . .

A PHANTOM

created to serve the reconnaissance needs of the Nation . . . by

MCDONNELL

As the RF-4C, the Phantom will augment the multiple sensor reconnaissance capability of the U. S. Air Force.

As the RF-4B, the Phantom will augment the reconnaissance capability of the U. S. Navy and Marines.

McDonnell is now delivering Phantoms for Fighter and Attack missions to all Three Services.

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