Aviation Week & Space Technology

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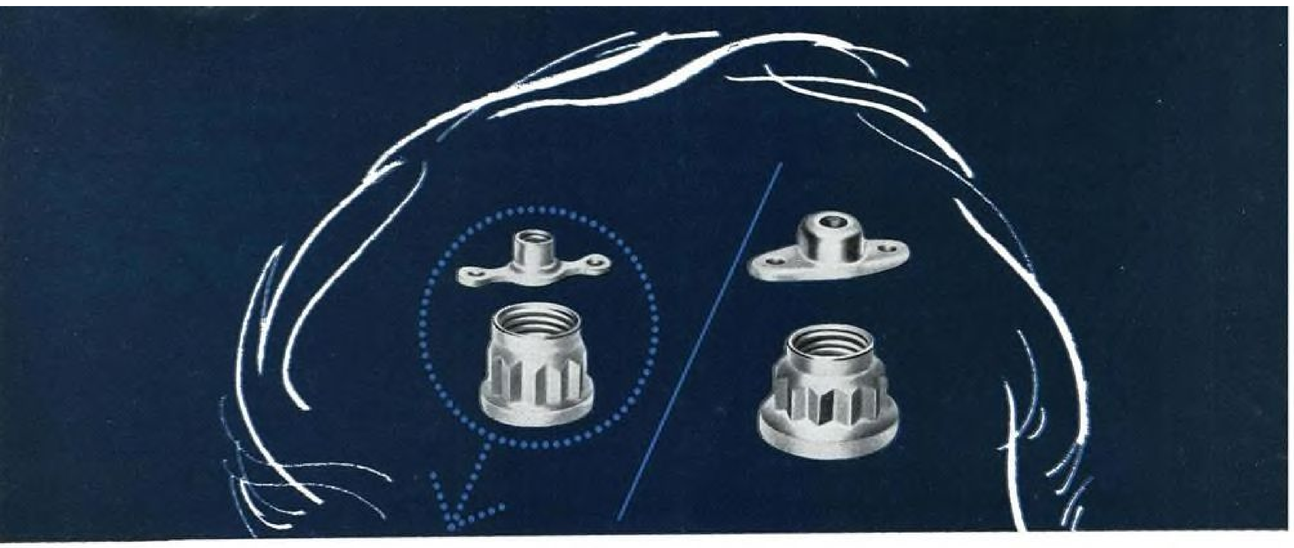
December 17, 1962

India's Aircraft Industry Reacts To China Threat

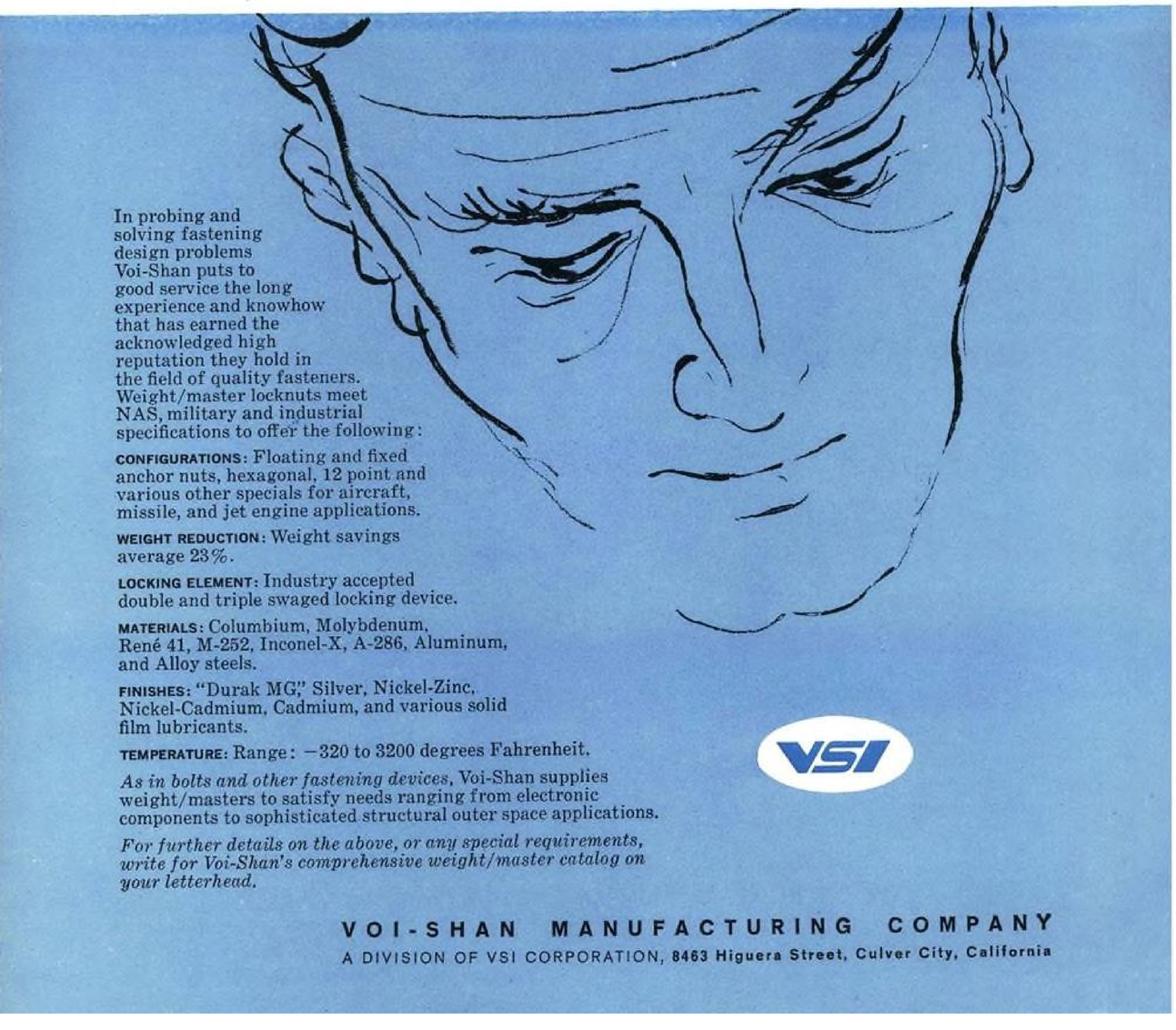
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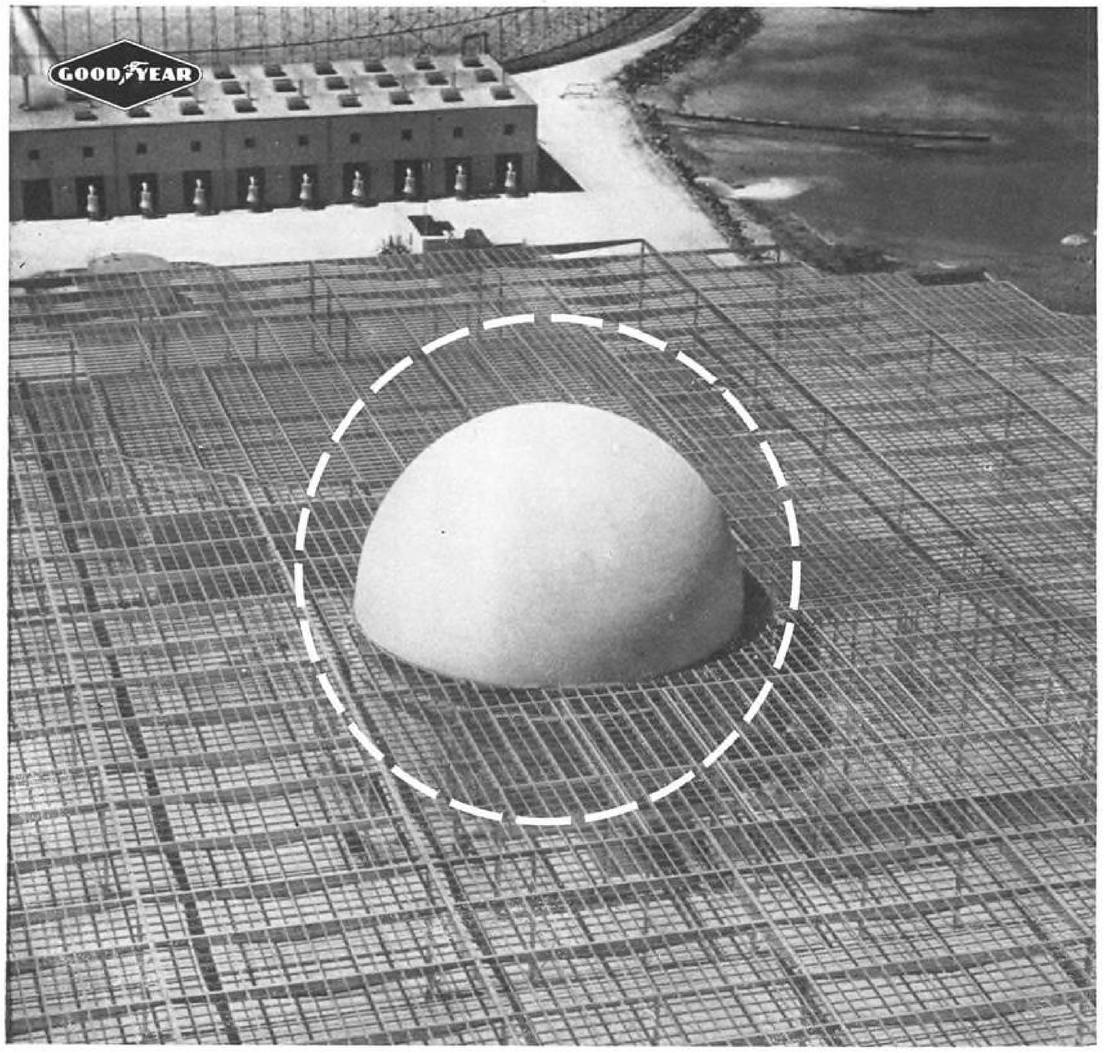
As in bolts and other fastening devices, Voi-Shan supplies weight/masters to satisfy needs ranging from electronic components to sophisticated structural outer space applications.

For further details on the above, or any special requirements, write for Voi-Shan's comprehensive weight/master catalog on your letterhead.

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Data provided by this antenna permitted computers to plot an intercept course for Nike Zeus, the Army's anti-missile missile system, which recently demonstrated the first successful intercept of an Atlas-boosted ICBM target vehicle.

This radar antenna measures 100 feet in diameter and contains tens of thousands of foamed plastic cubes embedded with metal particles. Yet for all its size and weight, the 1,800,000-pound lens and supporting structure rotate with the precision of a fine watch. It was designed and developed by GAC—Goodyear Aircraft Corporation—part of the nationwide industrial team brought together by Bell Telephone Laboratories and Western Electric to develop the Army's Nike Zeus system.

And radar structures are only one of GAC's many capabilities. We can also help you with advanced systems and aerospace support equipment . . . electronic subsystems . . . lightweight structures . . . or missile requirements. How? Write Goodyear Aircraft Corporation, Dept. 914AX, Akron 15, Ohio, or Litchfield Park, Arizona.

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Whatever your basic interest—higher impact resistance for cryogenic applications . . . better strength-to-weight ratios at room temperature . . . or improved stress rupture limits above 1900°—you will find at Wyman-Gordon the outstanding experience in forging any material you have under consideration. For in over 75 years of specialization with industrial and aerospace forged components, this organization has worked virtually every applicable metal and alloy—pioneering the closed-die forging of many. Operating one of the most completely staffed research facilities, devoted to advanced concept materials application, Wyman-Gordon is uniquely qualified to solve any temperature-oriented forging problem. The broad range of hot-working equipment available here assures full enhancement of mechanical properties in even most difficult-to-forge refractory metals and exotic alloys. To give your projects the reliability advantages of Wyman-Gordon materials selection and service application counsel, contact Product Manager, Special Products.



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AEROSPACE CALENDAR

Dec. 26-31—Space Physics Meeting, American Rocket Society and American Assn. for Advancement of Science, Philadelphia, Pa.

Dec. 27—American Astronautical Society Symposium on Scientific Satellites-Mission and Design, Franklin Hall, Philadelphia.

Jan. 7-10—Millimeter and Submillimeter Conference, Institute of Radio Engineers, Cherry Plaza Hotel, Orlando, Fla.

Jan. 13-16—15th Annual Convention, Helicopter Assn. of America, Cabana Motor Hotel, Palo Alto, Calif.

Jan. 14-18—Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Jan. 15-17—Ninth Annual Meeting, American Astronautical Society, Statler Hilton Hotel, Los Angeles, Calif.

Jan. 21-22—Annual Meeting, Assn. of Local Transport Airlines, National Aviation Club, Washington, D.C.

Jan. 21-23—31st Annual Meeting (including Wright Brothers Lecture), Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y.

Jan. 21-24—43rd Annual Meeting, American Meteorological Society, New York, N. Y.

Jan. 22-24—Ninth National Symposium on Reliability and Quality Control, Sheraton-Palace Hotel, San Francisco, Calif.

Jan. 28—Fifth Annual Army Aviation Contract Services Symposium, International Inn, Washington, D. C. Sponsor: National Aeronautical Services Assn.

Jan. 30-Feb. 1—Fourth Annual Solid Pro-

(Continued on page 7)

AVIATION WEEK and Space Technology

December 17, 1962
Vol. 77, No. 25

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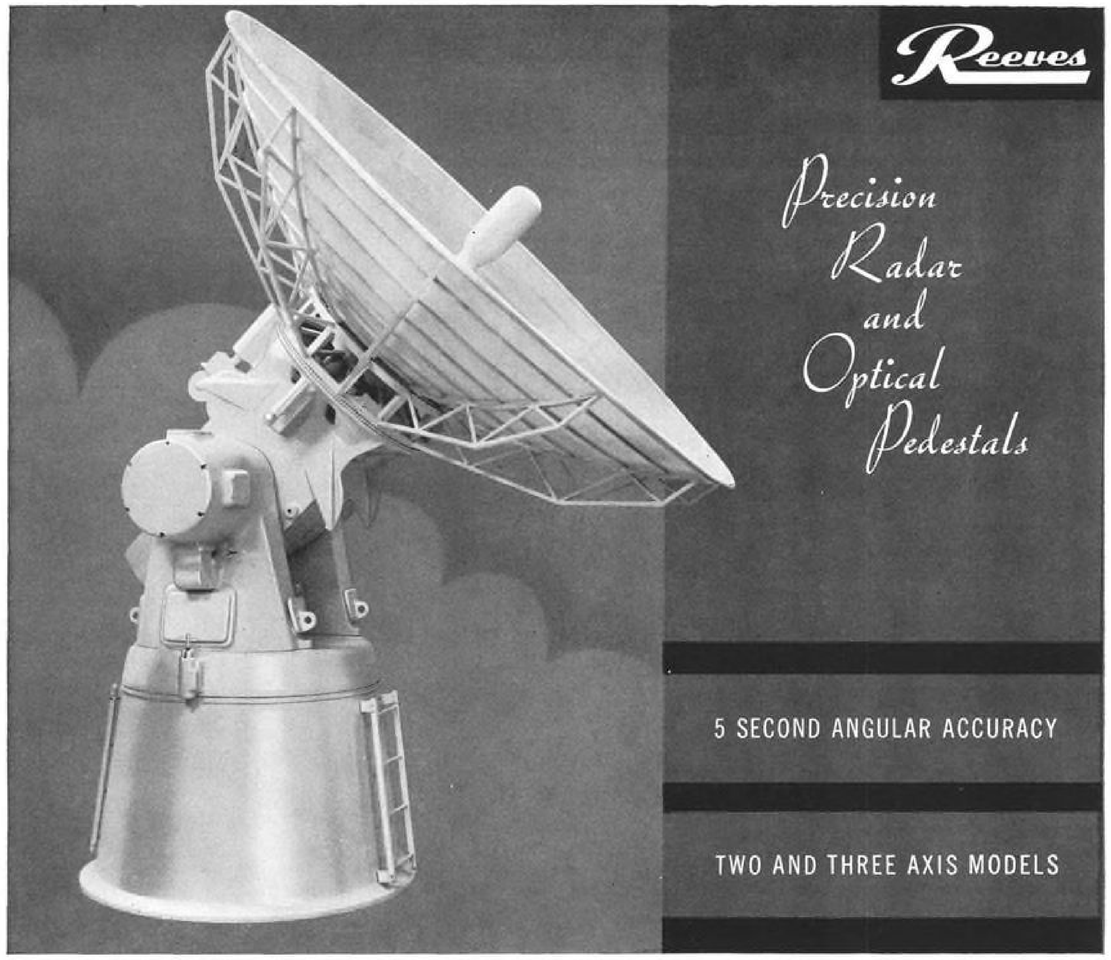
What are your requirements? These solid state relays are only 1 5/16" sq. . . . available in six standard types, with delay on pull-in or drop-out; timing ranges from milliseconds to hours, on pull-in or drop-out. Operation—18-32 vdc; -55c to 125c; load capacity to 5 amperes. *Write* Dept. SI-112 for data sheet. Or ask for a quotation on your special application requirements.

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AEROSPACE CALENDAR

(*Continued from page 5*)

pellant Rocket Conference, American Rocket Society, Bellevue Stratford Hotel and The Franklin Institute, Philadelphia.

Jan. 30-Feb. 1—National Winter Convention on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Feb. 1—Fundamental Phenomena in the Material Sciences Symposium, Hotel Sheraton Plaza, Boston, Mass. Sponsor: Ilikon Corp.

Feb. 5-6—Symposium on Engineering for Major Scientific Programs, Georgia Institute of Technology, Atlanta, Ga.

Feb. 5-7—Advances in Metalworking Seminar, American Society of Tool and Manufacturing Engineers, Park Sheraton Hotel, New York, N. Y.

Feb. 6-7—59th Meeting, National Aerospace Standards Committee of the Aerospace Industries Assn., Ambassador Hotel, Los Angeles, Calif.

Feb. 11-15—Third International Symposium on Quantum Electronics, UNESCO Building, Paris, France. Sponsors: International Scientific Radio Union; Office of Naval Research; La Federation Nationale Des Industries Electroniques.

Feb. 12-13—Space Vehicle Thermal and Atmosphere Control Symposium, conducted by the Aeronautical Systems Division, Engineers Club, Dayton, Ohio. Sponsor: ASD's Flight Accessories Laboratory.

Feb. 15-Apr. 14—International Aeronautics and Space Fair. Congresses and Competitions, Ibirapuera Park, Sao Paulo, Brazil. Sponsor: Santos Dumont Foundation.

Feb. 20-22—1963 International Solid-State Circuits Conference, Philadelphia, Pa. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; University of Pennsylvania.

Mar. 7-8—Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio.

Mar. 11-13—Electric Propulsion Conference, American Rocket Society, Broadmoor Hotel, Colorado Springs, Colo.

Mar. 18-20—Space Flight Testing Conference, American Rocket Society and Institute of the Aerospace Sciences, Cocoa Beach, Fla.

Mar. 18-21—1963 Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.

Mar. 19-21—Second Air Force-sponsored Symposium on Bionics, Biltmore Hotel, Dayton, Ohio.

Mar. 25-28—International Convention, Institute of Radio Engineers, Waldorf-Astoria and Coliseum, New York, N. Y.

Apr. 1-3—Fourth Annual Structures and Materials Conference, American Rocket Society and Institute of the Aerospace Sciences, El Mirado Hotel, Palm Springs.

Apr. 2-3—Eighth Annual Business Aircraft Safety Seminar, Flight Safety Foundation, Barbizon Plaza, New York, N. Y.

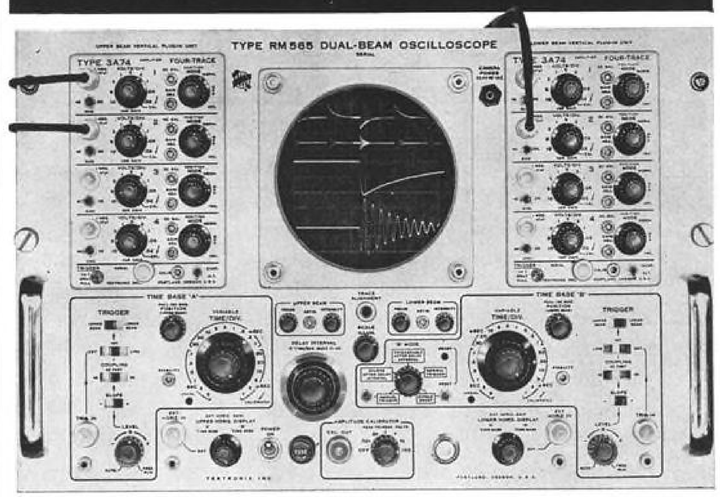
Apr. 2-5—Spring Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 10-11—Fourth Symposium on Engineering Aspects of Magnetohydrodynamics, University of California, Berkeley.

(Continued on page 9)

NEW TEKTRONIX DUAL-BEAM OSCILLOSCOPE

WITH SWEEP DELAY AND PLUG-IN VERSATILITY



The waveform display represents four time-related functions—two trace-intensified by use of delayed sweep and two expanded presentations of these intensified portions.

Four additional traces are available from this oscilloscope/plug-in combination.

Sweep-delay characteristics include delay interval range of 1 μsec to 50 sec, calibrated and continuously adjustable—with 0.5% incremental accuracy and wide-range, jitter-free magnification.

- 2 Completely Independent Beams
- 2 Identical Independent Sweep Systems
- 2 Vertical Amplifier Compartments
- Delayed-Sweep Operation
- Single-Sweep Operation
- Rear-Panel Output Connectors
- Rack-Mount or Cabinet Model

Rack-Mount Model, illustrated. (Mounts on tilt-lock, slide-out tracks to standard 19" rack.)
Type RM565 Oscilloscope (without plug-ins) . . . $1500
Cabinet Model
Type 565 Oscilloscope (without plug-ins) . . . $1400
U.S. Sales Prices f.o.b. Beaverton, Oregon

For more information on either model of this versatile new dual-beam oscilloscope, please call your Tektronix Field Engineer.

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AMPLIFIER UNITS TYPE	*PASSBAND (3-db down)*	*SENSITIVITY*	*PRICE*
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3A1—Dual Trace (Identical Channels)	dc—10 Mc. (each channel) 6-cm linear scan.	10 mv/cm—10 v/cm 1-2-5 sequence with variable control.	$410
3A72—Dual Trace (Identical Channels)	dc—650 kc. (each channel)	10 mv/cm—20 v/cm 1-2-5 sequence with variable control.	$250
3A74—Four Trace (Identical Channels)	dc—2 Mc. (each channel)	20 mv/cm—10 v/cm 1-2-5 sequence with variable control.	$550
3A75—Wide Band	dc—4 Mc.	50 mv/cm—20 v/cm 1-2-5 sequence with variable control.	$175

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KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Cold-Finishing of Alloy Steel Bars: Grinding and Polishing

Grinding and polishing of cold-drawn or turned alloy steel bars is the concluding discussion on the subject of cold-finishing. In the processes of turning and polishing, and grinding and polishing (both of which require removal of surface metal), the surface finish of the bars, as well as their dimensional accuracy and alignment, are improved. But the ultimate in quality of bright, smooth surface finish and accuracy is produced by grinding and polishing of either cold-drawn bars or turned bars up to 4-in. diam, inclusive.

GRINDING AND POLISHING

Sizes up to and including 4-in. diam, are generally confined to centerless cylindrical grinders. Larger sizes are ground on centers. A centerless grinder includes a grinding wheel, a regulating wheel for applying pressure against the bar, and a work-rest blade which both supports the bar and guides it between the wheel spacing. Automatic feed of the whole length of the bar is accomplished because the regulating wheel is set at an angle of inclination with respect to the grinding wheel, and thus within this system the bar rotates and feeds during grinding. The bar is then polished to a mirror-like finish by passing through straightening rolls.

Both processes of turning and polishing, and grinding and polishing, are applicable to normalized, annealed, or heat-treated carbon and alloy bars. These operations do not materially affect the mechanical properties. For this reason, the end product can be machined unsymmetrically, with little or no tendency to warp.

Technical Service. Bethlehem metallurgists have given long study to specifications with respect to chemical composition, grain size, hardenability, and the machinability of cold-drawn alloy steel bars. If you would like additional information on cold-drawn products, or alloy steels, our metallurgists will gladly give you all possible help, without cost or obligation.

When you need alloy steels, remember that Bethlehem offers the full range of AISI standard grades, as well as tool steels, special-analysis steels, and all hot-rolled carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Advertising Department, Bethlehem Steel Company, Bethlehem, Pa.

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AEROSPACE CALENDAR

(Continued from page 7)

Apr. 15-17—Hypersonic Ramjets Conference, American Rocket Society and American Society of Mechanical Engineers, Naval Ordnance Laboratory, White Oak, Md.

Apr. 17-19—International Nonlinear Magnetics Conference, Shoreham Hotel, Washington, D.C. Sponsors: American Institute of Electrical Engineers; IRE.

Apr. 17-19—Southwestern Conference and Electronic Show, Institute of Radio Engineers, Dallas Memorial Auditorium, Dallas, Tex.

Apr. 17-19—Technical Meeting: Nuclear Materials for Space Applications, American Nuclear Society, Netherland Hilton Hotel, Cincinnati, Ohio.

Apr. 22-23—Annual Meeting, National Aeronautical Services Assn., Washington, D. C.

Apr. 22-24—Second Manned Space Flight Symposium, Institute of the Aerospace Sciences in cooperation with NASA and AFSC, Dallas, Tex.

Apr. 22-24—Third Annual San Diego Symposium for Biomedical Engineering, Del Webb's Oceanhouse, San Diego, Calif.

Apr. 24-26—Seventh Region Technical Conference, IRE, San Diego, Calif.

Apr. 29-May 2—22nd Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton-Jefferson Hotel, St. Louis, Mo.

Apr. 29-May 3—Annual Conference, Society of Photographic Scientists and Engineers, Ambassador Hotel, Atlantic City, N.J. Cosponsor: Army Research Office.

May 1-3—19th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D.C.

May 2—Bioastronautics Conference, American Rocket Society and Aerospace Medical Assn., Los Angeles, Calif.

May 2-3—Fourth National Symposium on Human Factors in Electronics, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington, D.C.

May 6-8—Aerospace Reliability and Maintainability Meeting, Institute of the Aerospace Sciences, Washington, D.C.

May 7-9—Electronic Components Conference, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington.

May 13-15—National Aerospace Electronics Conference, Institute of Radio Engineers, Dayton, Ohio.

May 15-17—Connecticut General Flight Forum's Second National Symposium on Air Transportation, Hartford, Conn.

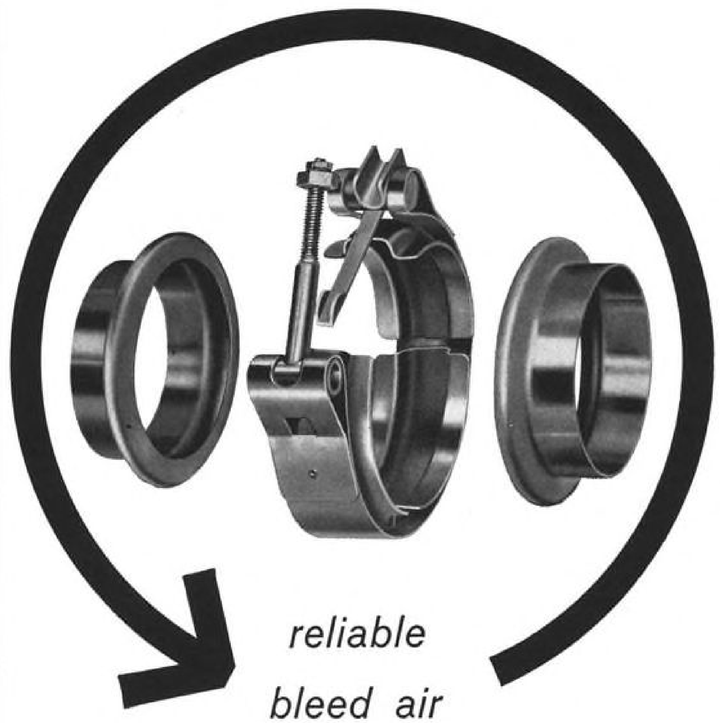
May 20-22—National Symposium on Microwave Theory and Techniques, Institute of Radio Engineers, Miramar Hotel, Santa Monica, Calif.

May 20-22—National Telemetering Conference, Hilton Hotel, Albuquerque, N. M.

May 21-23—Spring Joint Computer Conference, American Federation of Information Processing Societies, Cobo Hall, Detroit, Mich.

May 27-28—Seventh National Conference on Product Engineering & Production, Institute of Radio Engineers, Continental Hotel, Cambridge, Mass.

June 7-16—25th French International Air Show, Le Bourget, Paris, France.



duct couplings

If your concern includes the reliability of pneumatic duct couplings in aerospace applications, take a look at the Janitrol line. Janitrol bleed air couplings have industry-wide acceptance because they provide virtually 100% sealing with low nut torque; lower stresses mean higher reliability. Absolutely no gaskets are required. For the ultimate in safety specify Dubl-Lock® couplings that seal even if the bolt is disconnected. Janitrol clamps, flanges, duct supports and other hardware are used in the 707, 880, 990, DC-8, F-105D, F4H, F-110, F8U and other high performance aircraft.

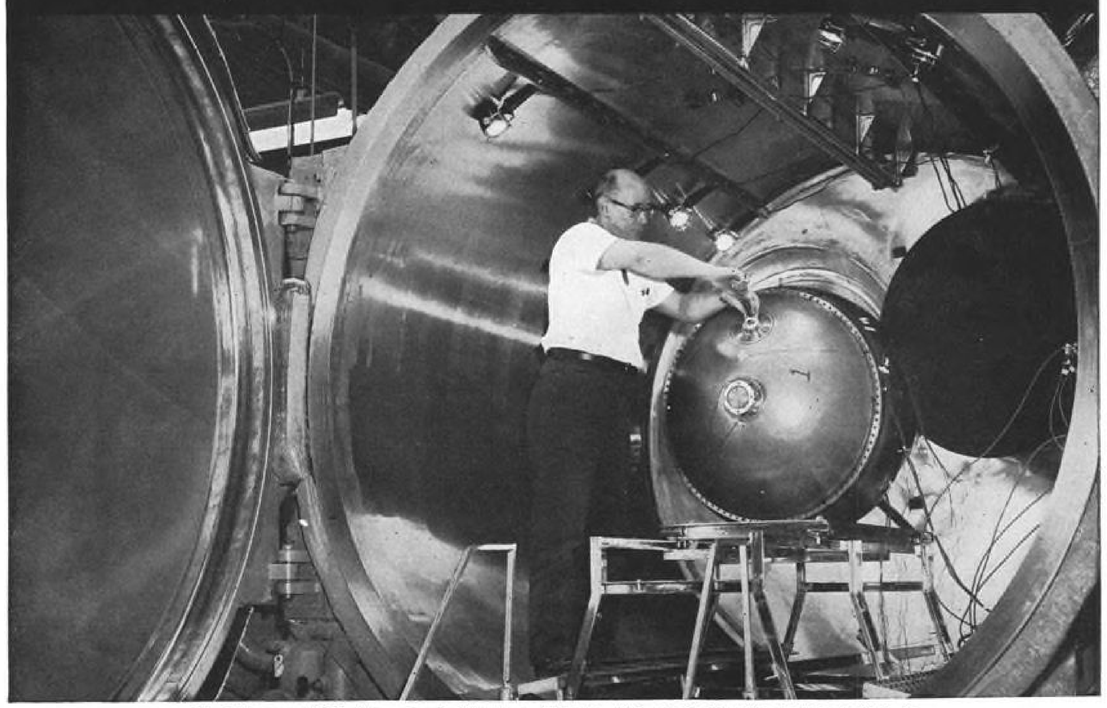
Janitrol standard and Dubl-Lock couplings are described in our 56-page catalog, a valuable reference for designers.

Janitrol also designs and builds couplings for special applications—extreme high temperature and pressure, and cryogenics. Request catalog JA 142 from Janitrol Aero Division of Midland-Ross Corporation, 4200 Surface Road, Columbus 4, Ohio.

JANITROL AERO

A division of Midland-Ross Corporation

"WORKHORSE" FOR GODDARD'S ENVIRONMENTAL TESTING



The 375-pound S-6 Atmospheric Structure (135 to 540 miles) Satellite being readied to undergo space environmental testing in the Stokes-designed and Stokes-built Goddard "8 by 8".

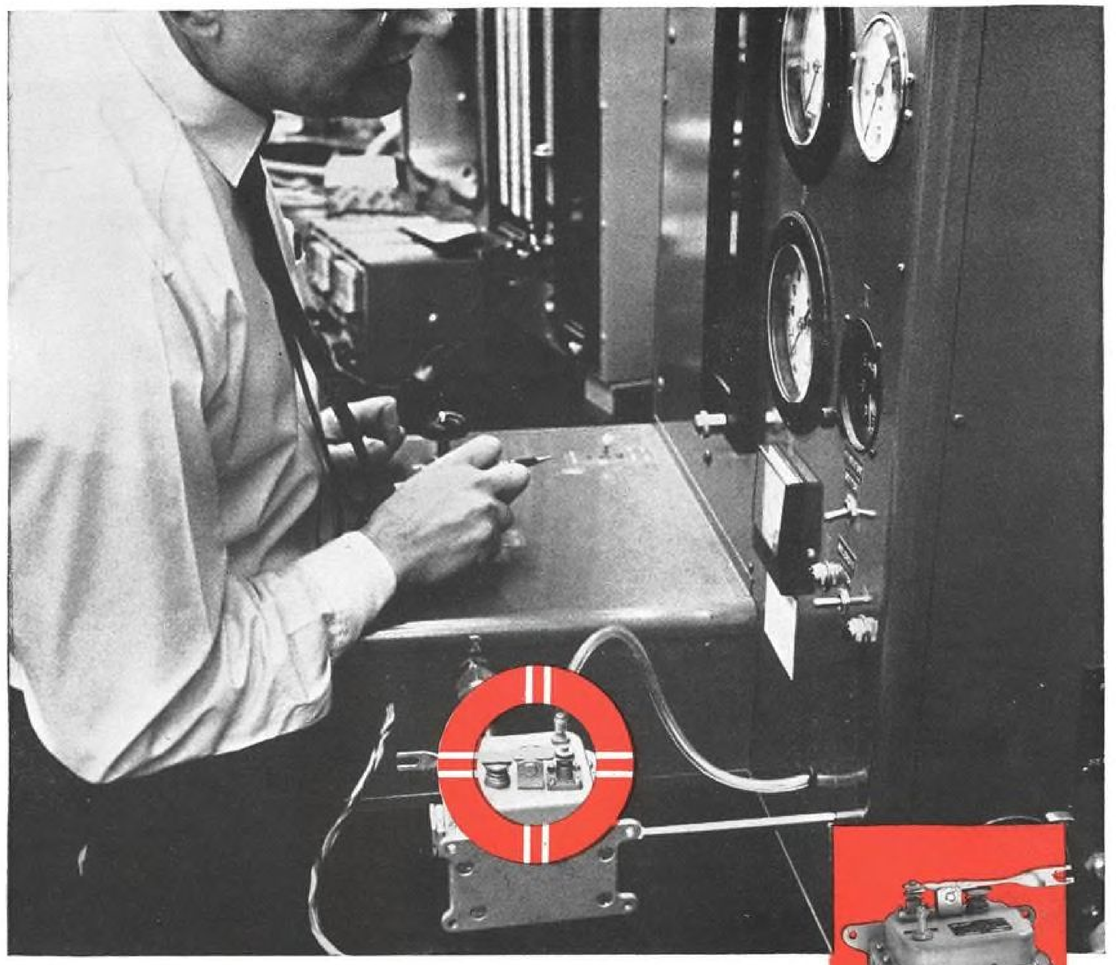
The Goddard "8 by 8" (8 ft. in diameter and 8 ft. long) horizontal test chamber is one of the key elements in the spacecraft testing program at NASA's Goddard Space Flight Center, Greenbelt, Maryland.

This Stokes-designed and Stokes-built thermal-vacuum unit was the first large space simulation facility installed at Goddard for testing unmanned vehicles under the full range of thermal and vacuum conditions, and is the largest presently in use there. It has a vacuum capability of 1 x 10^{-7} Torr (200-mile altitude) under full load conditions, and is equipped with a heat transfer system capable of handling radiant wall temperatures from —65°C to 100°C.

Goddard's "8 by 8" will continue to serve in the Space Flight Center's highly successful reliability testing program until the larger test and evaluation laboratories now under construction go into service early in 1963. Major space test chambers of this facility, which is expected to set the most advanced standards for spacecraft check-out, are two 35 ft. diameter, 60 ft. high thermal-vacuum environment simulators. Stokes was selected as the prime contractor to NASA for complete vacuum and cryogenic systems for these huge chambers.

We welcome your inquiries regarding our capabilities and facilities for designing, fabricating, and erecting simulation facilities well in advance of the state-of-the-art, or any portion of a simulation project requiring high-vacuum and cryogenic systems. **Space Systems Department, F. J. Stokes Corporation, 5500 Tabor Road, Philadelphia 20, Pa.**

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The LIFEGUARD of the future on schedule today at SCOTT

Passenger safety is a never-ending challenge at Scott. This Automatic Passenger Oxygen Flow Control Unit (Composite Regulator), undergoing exhaustive tests at Scott research laboratories, has been selected as standard equipment on the Boeing 727 jet. It automatically activates and controls oxygen flow to the passenger emergency oxygen system, replacing as many as seven previously required components including: pressure reduction, automatic turn-on and altitude flow control, activation surge, and turn-off.

The new Scott Composite Regulator is automatically actuated at cabin altitudes of approximately 14,000 feet, and turns off again automatically at cabin altitudes of between 8,000 and 10,000 feet. The unit can be manually reset to "off" position at any altitude in between, while still retaining the automatic features. As an added safety feature, the Regulator supplies a momentary surge immediately after activation of approximately 80 psi, lasting about 10 seconds. This assures immediate filling and pressurization of the distribution system and positive actuation of mask presentation devices. After this initial surge, pressure is maintained at required levels, automatically controlled in response to system flow requirements and changing cabin pressure.

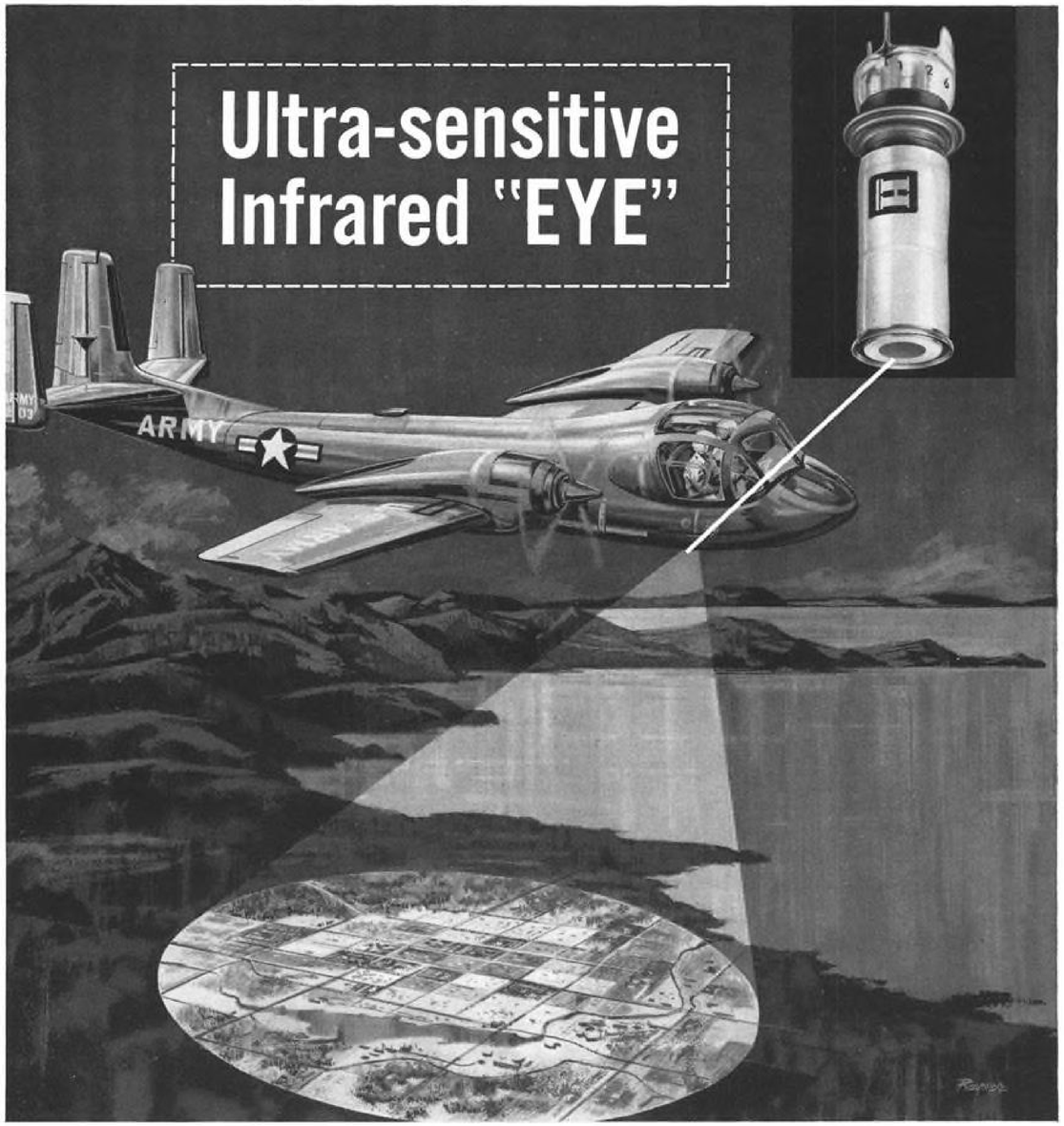
In addition to its many versatile features, the Scott Composite Regulator offers significant advantages in reduced weight, better efficiency, lower maintenance costs, and increased configuration flexibility.

For more information on the Scott Composite Regulator and how it can help you solve aerospace design and engineering problems write, phone, or wire:

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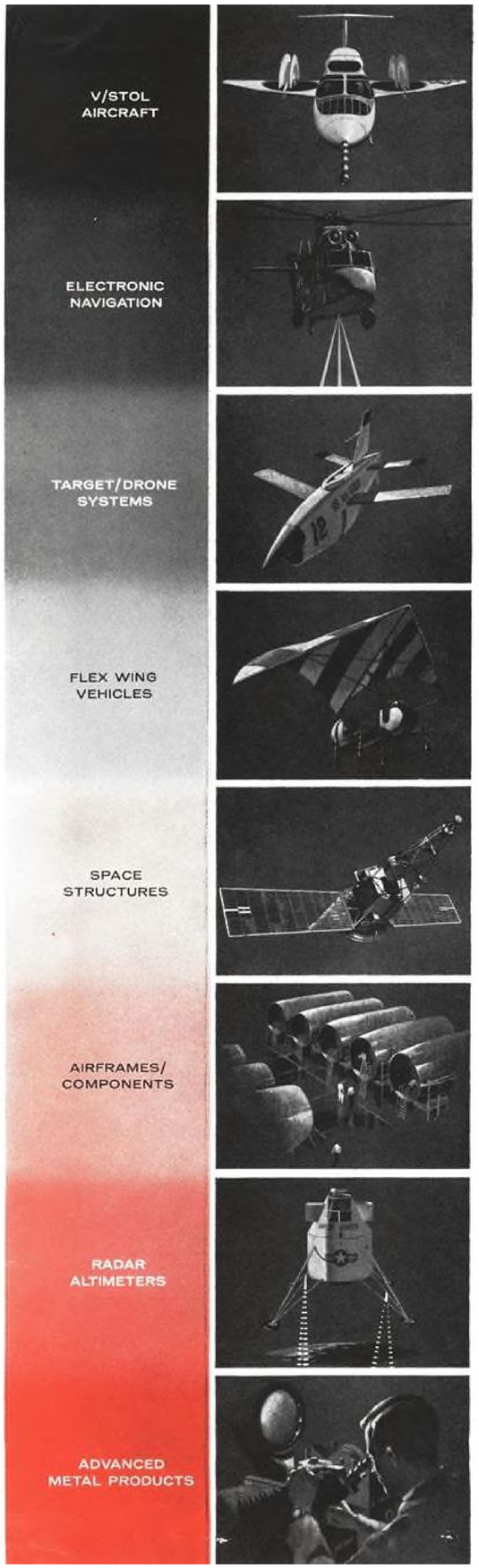
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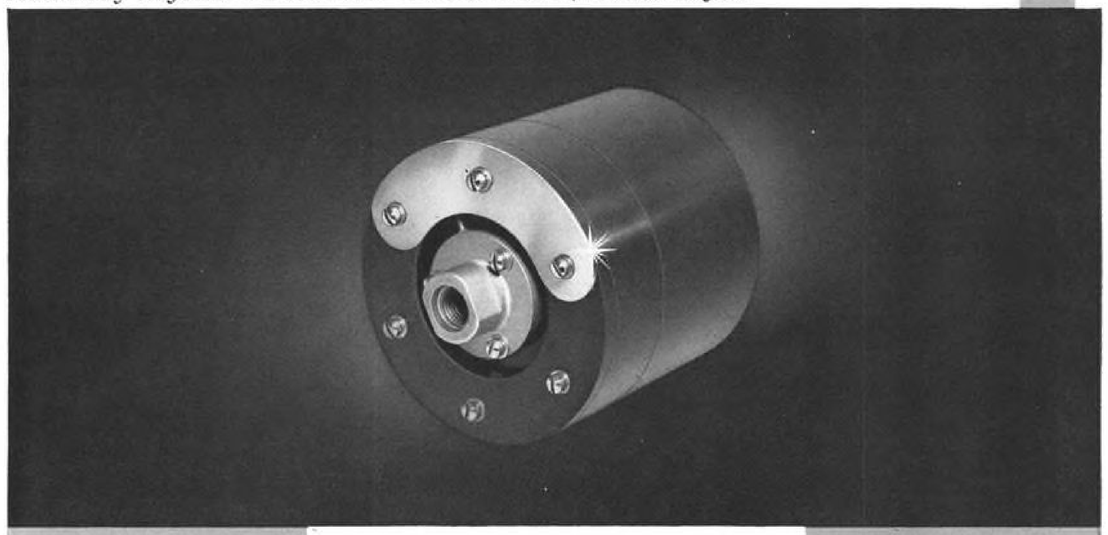
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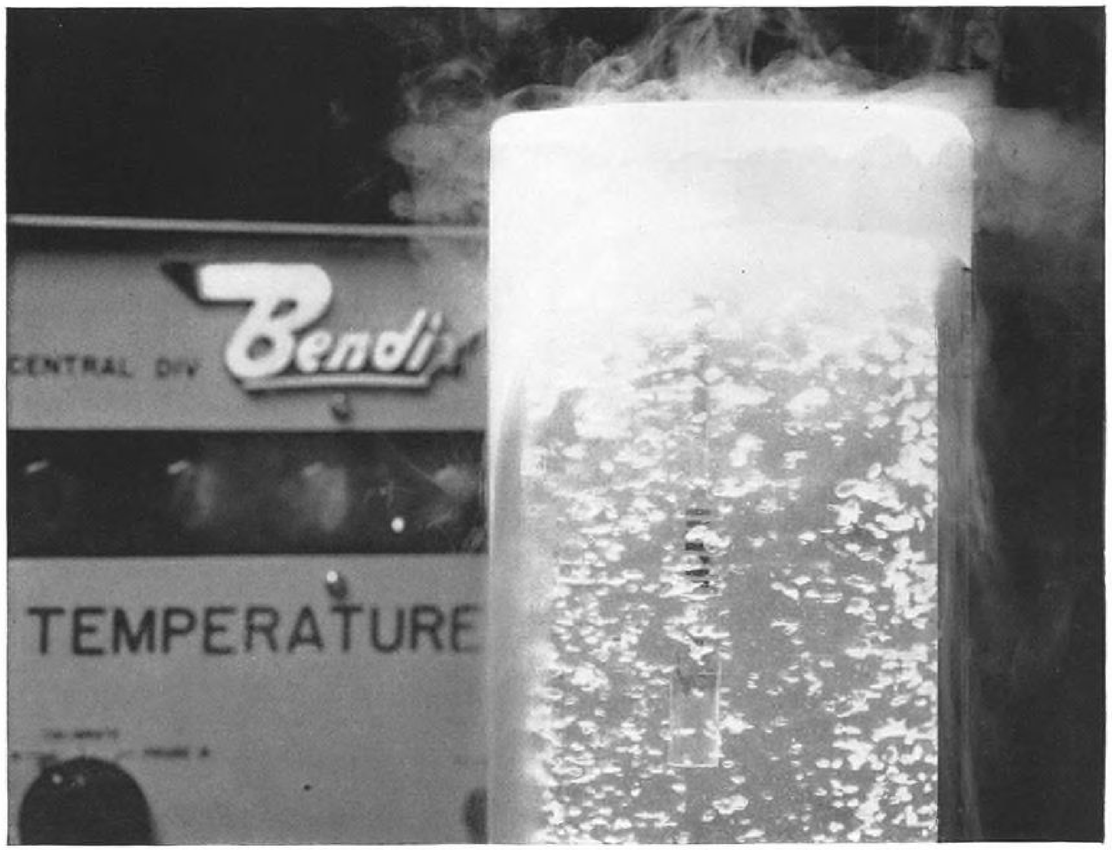
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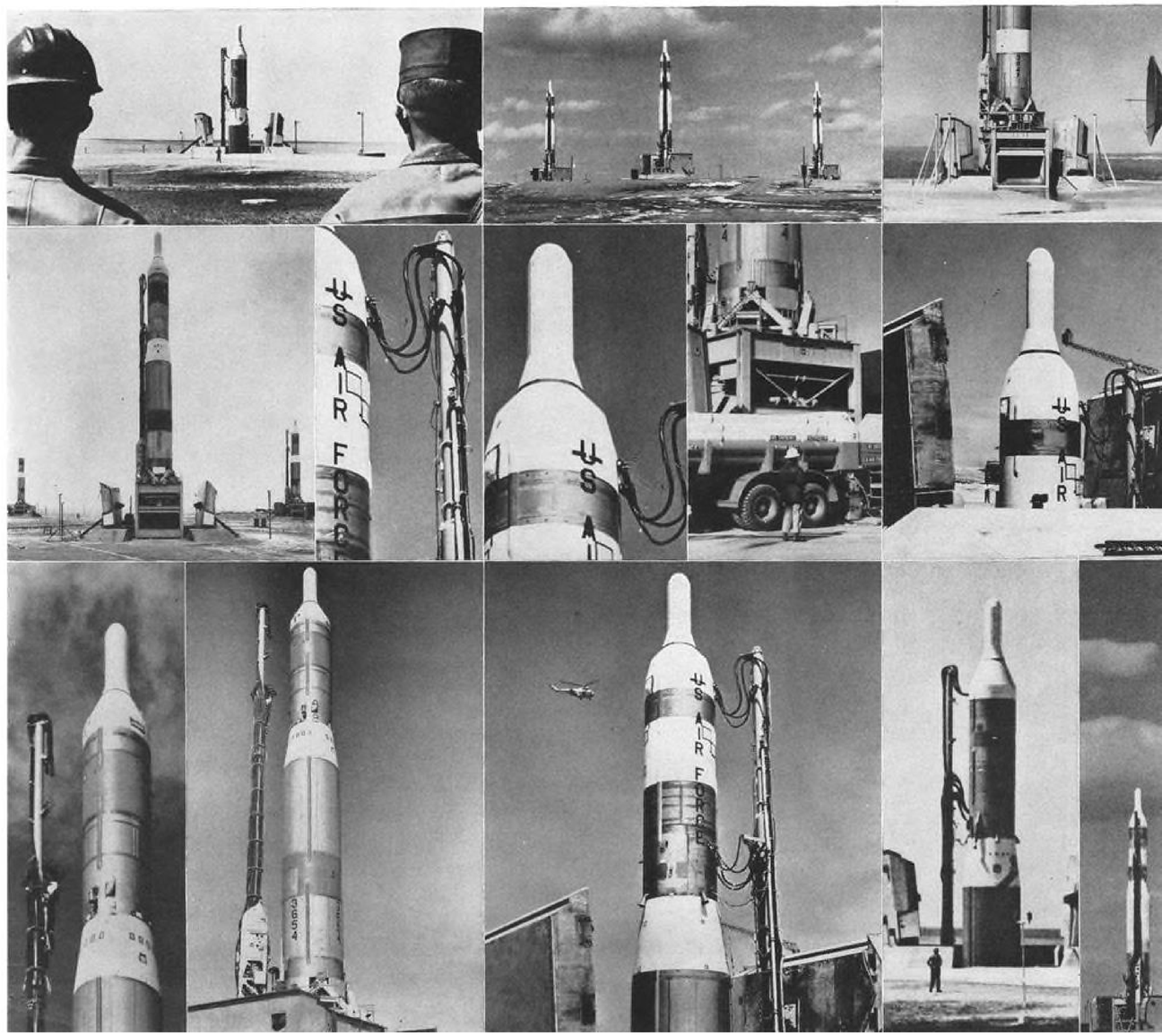
This achievement met a schedule laid down by the Air Force in 1959, calling on Martin Company to design, fabricate, test and deliver a reliable, operational Titan system.

Martin was also called upon to manage the simultaneous development and completion of steel and concrete underground silos to protect the missiles and hold them ready for firing against targets more than 6,300 statute miles away.

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Raytheon Company, Lexington, Mass.

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COVER: Piasecki 16H helicopter hovers near company hangars at Philadelphia International Airport during recent flight tests (AW Dec. 10, p. 79). Note unusual shrouded propeller on tail, which provides counter-torque in conjunction with deflectors when hovering and propulsion during cruise. Landing gear is retractable, and wings and rotor may be folded.

PICTURE CREDITS

Cover—Gary Weinberg, Piasecki Aircraft Corp.; 27—Boeing; 29—RCA; 30—Bell Helicopter; 32, 101—Dept. of Defense; 34—Martin; 35—Saab; 45—Sikorsky; 57—Chance Vought; 61, 62—Pratt & Whitney; 68—Assembly Engineers, Inc.; 67, 69 (top) Belock; 80—Pacific Semi-Conductors; 88—Indian Defense Ministry; 89—Vertol Div. Boeing Co.; 92, 93—Pilatus Aircraft Works, Inc.; 94—Frank Strnad; 97—Federal Aviation Agency; 98—Westland; 99—Canadair.



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St. Petersburg, Florida



EDITORIAL

The Skybolt Muddle

The current international muddle over the Douglas Skybolt air-launched ballistic missile is typical of the curious mixture of technology and politics that forms the developmental environment of any new weapon system. Fate of the program now apparently can only be decided at the top Anglo-American level at the coming Nassau meeting of President Kennedy and British Prime Minister Macmillan (see p. 26).

In the political portion of the Skybolt environment, there is no doubt that the British are absolutely dependent on this weapon for the future effectiveness of their nuclear delivery force. Their only effective long-range nuclear delivery system for the foreseeable future will be the Avro Vulcan bomber mated with a pair of Skybolt missiles. The U.S.-furnished Thor IRBMs already are being removed from their Royal Air Force pads in Britain; the de Havilland Blue Streak IRBM development program has been stopped short of production; the British Aircraft Corp. Blue Water MRBM has been canceled. All of these actions were taken because of British confidence that the U.S. would continue development of Skybolt to its operational phase, and that it would enter the RAF inventory as the prime nuclear delivery system for Britain's strategic deterrent force. Without the Skybolt, the Royal Air Force and Britain will face the future with no weapon more effective than the 100-mi.-range Blue Steel air-to-surface missile now going into service with the Vulcan and Victor bombers.

Britain's Suspicions

Thus there is a strong suspicion in London that the U.S. effort to wash out the Skybolt is a thinly disguised attempt to blackball Britain out of the nuclear weapons club, despite President Kennedy's recent assurance to the contrary. From the other side of the Atlantic it appears that if the Skybolt ploy is successful in dealing Britain out of the nuclear deterrent group, then it will be even more feasible to throttle the French effort to build its nuclear delivery systems based on the Mirage 4, Etendard and other future possibilities. Speaking for the Kennedy Administration, Defense Secretary McNamara has indicated disapproval of allies building their own nuclear deterrent forces, although he approved French purchase of the Boeing C-135 jet tankers necessary to make the Mirage 4 striking force effective.

If Britain and France are forced out of the nuclear deterrent business, it would polarize international relations between Washington and Moscow, leaving Chairman Khrushchev and President Kennedy free to negotiate without interference by troublesome allies in both blocs.

These nasty thoughts are one reason the Skybolt issue has far-reaching international implications that extend beyond any budgetary or technical problems. If these fears by the British and French are unfounded, there still remains the basic question of U.S. integrity in relation to its allies. U.S. is already on record as having pulled the technical rug from under French IRBM development, although no prior assurances were involved. If it now scuttles Skybolt and the British deterrent after repeated firm promises to deliver, it will be sad to watch the devaluation of U.S. stock on the NATO bourse.

Perhaps the kindliest political view taken of the current Skybolt muddle is that Mr. McNamara simply wants to raise the British ante in the Skybolt program from the rather meager $20 million now pledged to ease his Fiscal 1964 budgetary problems, which are growing more formidable with each passing month.

Aimless Development

On the technical side, it has been a long-time mystery among observers of the Skybolt program how the management of such a supposedly critical international development program was allowed to drift in such aimless fashion for so long by all responsible agencies concerned. Much has been accomplished to remedy these ailments recently, but lost developmental time can never be regained nor can technical morale ever be fully restored after such cavalier treatment. However, despite this now-ancient history in the Skybolt story, it is hard to substantiate all of the technical gloom being cast over the program from without. To pass technical judgment on the Skybolt program on the results of its initial five test firings would be rather naive, and smacks of finding a convenient excuse to support budgetary or political decisions, rather than any responsible technical judgment.

There are many competent engineers working on Skybolt who would challenge President Kennedy's recent statement that this weapon is "in a sense, the kind of engineering that's been beyond us." To toss in the technical sponge on Skybolt because its first five test firings were not completely successful would be as foolish as to curtail Minuteman ICBM deployment because of the recent failures in test firings at both Cape Canaveral and Vandenberg AFB. There are indeed formidable technical problems involved in perfecting an air-launched ballistic missile as an operationally reliable weapon, but they are of much less magnitude than those already surmounted successfully in developing the first generation ICBMs, and there is no real basis for believing they cannot be solved.

There may be some perfectly valid reasons for phasing out Skybolt development and curtailing its introduction into the Strategic Air Command and Royal Air Force bomber fleets, but we have seen nothing in either President Kennedy or Mr. McNamara's discussion of the problem to date that would qualify in this category. We expect that British Prime Minister Macmillan and the legislative bodies of both countries concerned will demand considerable more discussion on these points before they support any final decision on Skybolt.

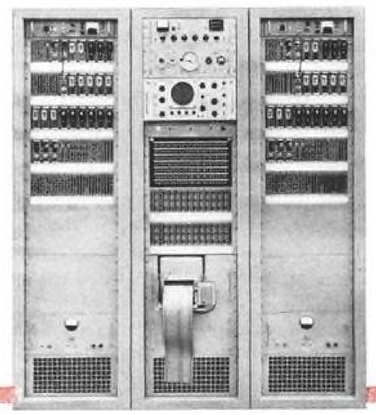
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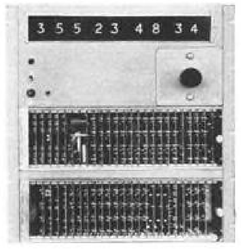
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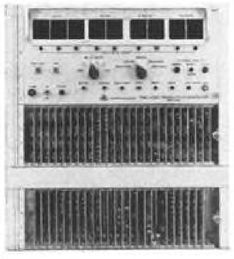
Model 6220 UNIVERSAL... translates all serial time codes to decimal display... parallel BCD output. Tape Search and Control Units (Models 6224, 6225, 6226) available for universal automatic tape search.

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For applications assistance when considering your timing system, contact your nearest Astrodata representative or the Timing Instrumentation Group direct.

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WHO'S WHERE

In the Front Office

John H. Striebel, vice president-Eastern operations, Houston Fearless Corp., with offices in Hudson, Mass.

Robert H. Shatz, division vice president, United Aircraft Corporate Systems Center, Windsor Locks, Conn. Named division vice presidents of Sikorsky Aircraft Division of United Aircraft Corp.: **Leete P. Doty**, operations; **Paul W. Holt**, programs; **Carlos C. Wood**, engineering; **James W. Clyne**, sales and service.

Maj. Gen. Robert J. Friedman, chief of staff, Headquarters, Air Force Systems Command, Andrews AFB, Washington, D. C. **Brig. Gen. Durward L. Crow** replaces Gen. Friedman as deputy chief of staff, comptroller, Headquarters, AFSC.

William S. Micchelli, vice president, Kentron Hawaii, Ltd., Honolulu, a subsidiary of Ling-Temco-Vought, Inc. Also: **Harry Kay**, secretary; **B. L. Brown**, treasurer.

R. H. Laidman, president and general manager, Pacific Western Airlines.

Astropower, Inc., Newport Beach, Calif., a subsidiary of Douglas Aircraft Co. has created three specialized divisions (Research, Engineering, Manufacturing) and announced the following appointments: **Vice President Dr. George Moe**, director, Research and Engineering Divisions; **Sidney Thurston**, manager, Engineering Division; **B. W. Clawson**, manager, Manufacturing Division.

William C. Love, vice president for sales-Eastern region, Trans World Airlines.

George T. Scharffenberger, a senior vice president, Litton Industries, Inc., Beverly Hills, Calif. Mr. Scharffenberger continues as head of the Electronic Systems Group. Also: **John C. Lindley**, a vice president of Litton Systems and director of marketing, Data Systems Division.

Chester G. Jones, executive vice president, All American Engineering Co., Wilmington, Del. Also: **Donald B. Doolittle**, vice-president-customer relations; **Vincent A. Theisen**, secretary; **John F. Stocki**, assistant secretary; **William H. Ryan**, assistant treasurer; **Robert B. Cotton**, consultant and adviser on production development.

Lear Siegler, Inc., Santa Monica, Calif., has formed Defense Systems Operations, and has named **Vice President Dan W. Burns** as head of the new organization.

Walter C. Imrie, vice president-marketing, Butler Aviation Co., Chicago, Ill.

Edward A. DeCrosta, vice president-atomic instrumentation, Baird-Atomic, Inc., Cambridge, Mass.

Dr. John J. Bohrer, a vice president, International Resistance Co., Philadelphia, Pa. Dr. Bohrer is the company's director of research and development.

Jack D. Samuelson, assistant vice president and administrative manager, Emerson Electric Manufacturing Co.'s Electronics and Space Division, St. Louis, Mo.

Dr. Charles P. Sonett, head of the newly formed Space Sciences Division at the National Aeronautics and Space Administration's Ames Research Center, Moffett Field, Calif. Formerly Dr. Sonett was chief of sciences for Lunar and Planetary Programs at NASA headquarters, Washington, D. C.

(Continued on page 107)

INDUSTRY OBSERVER

► Program definition and development competition for National Aeronautics and Space Administration's lunar logistics vehicle may begin before the end of Fiscal 1963 with request for proposals issued by Marshall Space Flight Center. Preliminary studies made by Grumman, Northrop and Space Technology Laboratories for MSFC were scheduled for submission this month and together with MSFC in-house study (AW Nov. 26, p. 35) probably will form basis for broad specifications for the vehicle. Some companies have begun independent study efforts in anticipation of the competition.

► **Two major technical problems, combined with a $125-million funding deficiency, are contributing to the four-month delay in the first Gemini launch (AW Nov. 19, p. 26). The problems: stowage and deployment of the paraglider, and development of the ejection seat system.**

► Competition for electronic countermeasures flight-test program (AW Oct. 15, p. 30) is believed to have narrowed to two teams: Raytheon, with Aeronutronic Division of Ford, and Sperry Rand, teamed with Avco. Program is aimed at exploring the feasibility and desirability of incorporating active ECM gear in Air Force ballistic missiles to confuse or jam enemy defenses. USAF's Ballistic Systems Division is managing the program, expected to include 25 test firings. Both Sperry and Raytheon have earlier Phase 1 studies from BSD for the program.

► **Anti-submarine warfare satellite system proposals will be submitted to Navy at the end of this month in a competition for a feasibility study. Purpose of the study will include definition of submarine target characteristics, such as oceanographic effects, and sea and atmospheric interactions, together with survey of advanced sensors and their applications.**

► Number of ballistic missile re-entry systems will be flight-tested by Air Force's Ballistic Systems Division under Program Green River. Systems will be launched from Deseret Test Center, near Green River, Utah, using Atlantic Research Athena rockets programed to impact in the White Sands Proving Grounds, N. M. Test program is intended to complement USAF's advanced ballistic missile re-entry systems program called Sleighride (AW Dec. 10, p. 27). Some new re-entry systems will be flight-tested in both programs.

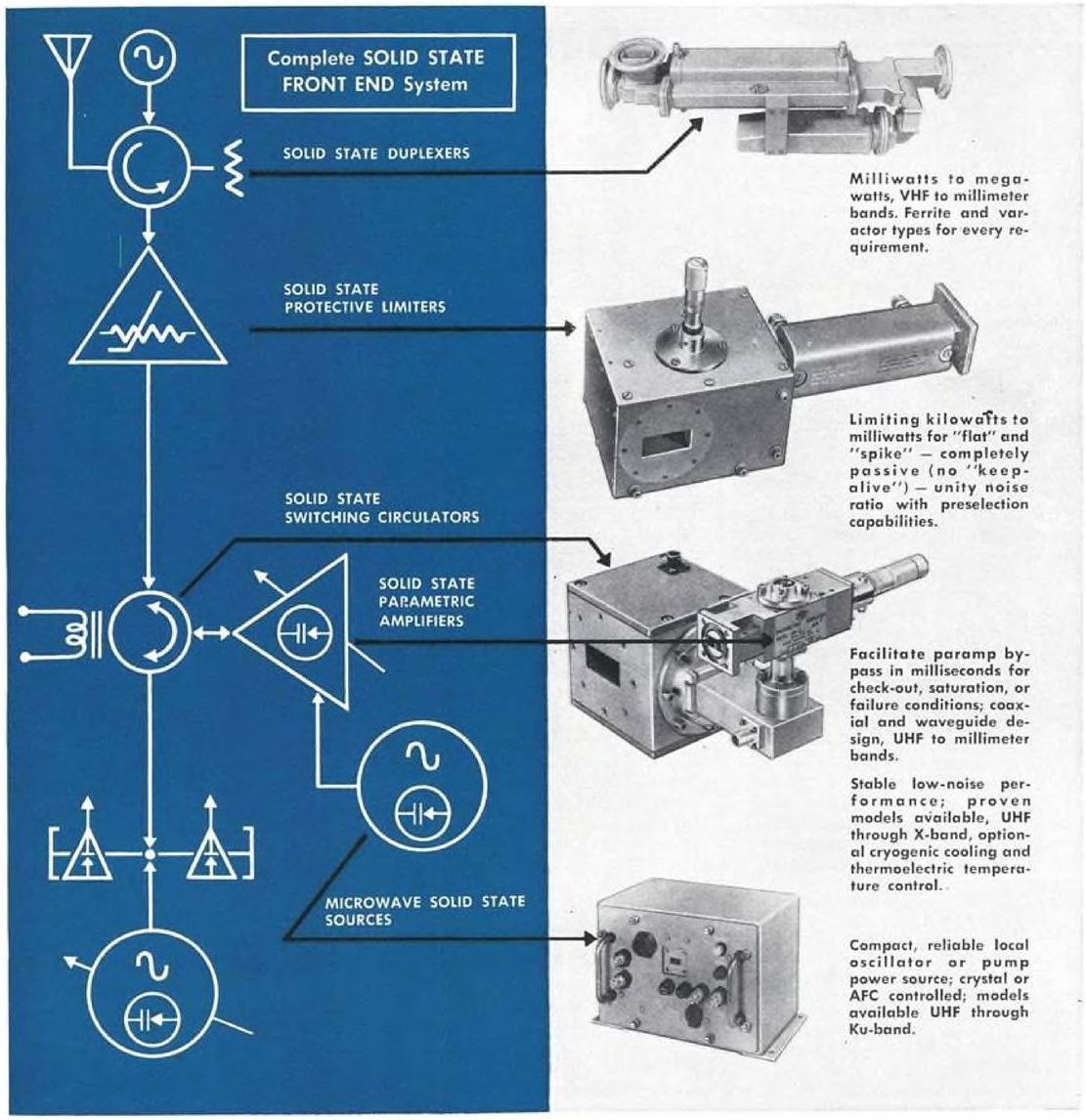
► **Procedure for using Saturn C-1's S-4 propulsion stage tankage for an earth-orbiting space station has been detailed to NASA by Douglas Aircraft.**

► Development contracts for solid propellants with specific impulses of about 280 sec., approximately 35 points higher than solid systems now operational (AW Nov. 12, p. 23), are expected to be awarded by Advanced Research Projects Agency to Aerojet-General, Allegany Ballistics Laboratory, Atlantic Research Corp., and Thiokol Chemical Co. Dollar value of the contracts may run between $250,000 and $500,000 each.

► **Applications of advanced nuclear rocket systems would be studied in industry proposals submitted in competition this week to Air Force Flight Test Center, Edwards AFB.**

► Mobile communications terminals capable of communicating with Air Force orbiting vehicles will be located soon in northeastern and northwestern United States. Stations will broadcast on VHF (Very High Frequency) band, and receive on both VHF and UHF (Ultra-High Frequency) bands. Industry proposals for outfitting two terminals were scheduled to be submitted late last week to USAF's Space Systems Division.

► **Methods for stopping, restarting and controlling thrust of solid-propellant rocket motors, with fast response to command signals and without degrading motor performance, are key features being evaluated at Edwards AFB's Flight Test Center in proposals submitted late last month in an industry competition.**



"IT'S WHAT'S UP FRONT THAT COUNTS!"

Sperry's new, high-reliability, solid state, C-band, radar front end has been successfully field-tested by a major defense agency under exacting MIL environmental specifications.

This system, the first completely integrated solid state radar front end in operation, includes a 3-megawatt ferrite duplexer and a solid state limiter group, followed by a low-noise parametric amplifier system — similar to the schematic diagram above.

"Up front" in microwave systems generally means high power levels, low component losses, dependable receiver protection and minimum noise for optimum system performance. Why take chances with less-than-optimum reliability and design parameters? Sperry Microwave solid state components deliver big *performance* and *maintenance* dividends in long-range systems.

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Other applications for solid state devices include: space communications, satellite systems, troposcatter networks, surveillance, instrumentation, acquisition and tracking radars.

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Washington Roundup

Soviet Anti-ICBM Effort

Recent spurt of Defense Dept. interest in sophisticated ICBM re-entry vehicles comes from evidence that the Soviets already are deploying a solid-propellant anti-ICBM missile around Moscow and other key Russian cities. Soviet missile defense system apparently is similar to the U.S. Sprint concept (see p. 26), which utilizes intercept of ICBM warheads at relatively low altitudes, where discrimination between genuine weapons and decoys becomes possible. Small nuclear warhead in the defensive missile would neutralize the large incoming warhead, resulting in a small amount of radioactive fall-out in the target area but saving the target from the blast, heat and heavy fall-out that a strike would produce. This system would be particularly effective in protecting semi-hardened missile sites or bomber bases and minimizing damage to large urban areas.

TFX Award Probe

Investigators for the Senate Permanent Investigations Subcommittee have already visited Air Force TFX personnel at Wright-Patterson AFB, Ohio, as part of the groundwork for possible hearings on the award of the Air Force-Navy tactical fighter to General Dynamics/Ft. Worth (AW Dec. 3, p. 26). Sen. Henry M. Jackson of Washington, second-ranking Democrat on the subcommittee, wants to know whether political rather than technical considerations caused Boeing, which is located in his state, to lose the award.

The investigators, Robert E. Dunne, assistant counsel, and Thomas Nunnally, accountant, will be ready to report to Chairman John L. McClellan by the time Congress convenes in January. Late last week, General Dynamics said no Senate investigator had contacted the company. It said it welcomed any probe, since it would confirm that the award was made on the basis of technical excellence.

Joseph C. Charyk is expected to leave his job as under secretary of the Air Force soon after the first of the year for a job in industry. Charyk left Aeronutronic Division of Ford Motor Co. in January of 1959 to become Air Force chief scientist. In June of that year he became assistant USAF secretary for research and development, and in January of 1960 he became under secretary.

Teddy Bugs Grumman

Senator-elect Ted Kennedy, brother of the President, visited Grumman's Long Island, N. Y., offices last week to point out the advantages Massachusetts offers in case Grumman needs to expand facilities to develop the lunar excursion module. Since subcontractors for the lunar bug have not all been chosen (see p. 36), he also explained the opportunity for subcontracting among Boston area electronics companies. Grumman said it told the senator-elect that it could not talk specifics because it is still negotiating the contract with NASA. New Mexico has made a similar bid for lunar bug facilities (AW Dec. 3, p. 28), and Grumman said it has had many calls and visits from senators and congressmen seeking business for constituents. Ted Kennedy met with Grumman President E. Clinton Towl; William T. Schwendler, chairman of the executive committee, and J. B. Rettaliata, director of public relations.

Chinese Communists have been giving a major propaganda play in recent months to the shooting down of five U.S.-made reconnaissance aircraft over the China mainland. They say that a McDonnell RF-101 was shot down over Fukien last August but that the Chinese Nationalist pilot survived; that another RF-101 was badly damaged over the mainland but crash-landed in Formosa; that a Martin RB-57D and an RB-57A, both piloted by Chinese Nationalists, were shot down in North China; that a U.S. Navy Lockheed P2V was shot down over northeast China in November, 1961; and that a Chinese Nationalist Lockheed U-2 was shot down over the mainland last Sept. 9 (AW Sept. 17, p. 29).

Millsaps to Quit USAF

Dr. Knox Millsaps, chief scientist of the Air Force Office of Aerospace Research and executive director of the Air Force Office of Scientific Research, will resign effective Jan. 11. Dr. Millsaps told Aviation Week & Space Technology that he is leaving because of fundamental differences with his superiors as to how Air Force research should be conducted. He has been with OAR since 1960. Before that he was chief scientist at USAF's Missile Development Center, Holloman AFB, N.M. Since World War 2, he has held four science posts with the Air Force and taught at four universities and institutes.

Strategic Air Command told reporters accompanying President Kennedy to SAC headquarters on Dec. 7 (see p. 28), that a situation portrayed in the novel "Fail-Safe," a McGraw-Hill Book Co. publication by Harvey Wheeler and Eugene Burdick, could not happen under SAC procedures. In the story, SAC bombers fly into Russia for an attack because of a failure in the communications box connected with headquarters. SAC said aircraft do not receive their commands through a black box, but by a coded vocal message transmitted only on orders of the President. In case of a communications breakdown, SAC officials said, the bombers would return to their bases rather than proceed to targets.

—Washington Staff

Skybolt's Fate Up to Kennedy, Macmillan

British protest bitterly at talk of cancellation; President cites difficulties of developing missile system.

Fate of the Skybolt air-launched ballistic missile remains unresolved despite Britain's bitter protests against the threatened cancellation of the program and President Kennedy's assertion that its development requires "the kind of engineering that's been beyond us."

The President said last week that no final decisions would be made on Skybolt until after he meets with British Prime Minister Harold Macmillan at Nassau on Dec. 19-20.

Possibility that the Skybolt program might be canceled was first disclosed by AVIATION WEEK & SPACE TECHNOLOGY on Nov. 26 (p. 27). Defense Secretary Robert S. McNamara told British Defense Minister Peter Thorneycroft in London last week that the Skybolt program was under review in the Defense Dept.

Increased Russian anti-aircraft capabilities and cost-effectiveness studies of the Boeing B-52-Skybolt combination have virtually convinced Defense Dept. planners that increasing the number of Minuteman solid-propellant intercontinental ballistic missiles would provide a better solution for the years in which Skybolt would have been operational.

President Kennedy said Britain would continue to "play a significant role as a nuclear power" even if the Skybolt is canceled. He said "the problem with the Skybolt is that it is the most sophisticated weapon imaginable. To fire a missile from a plane moving at high speed to hit a target 1,000 mi. away requires the most advanced engineering, and, of course, it has been really, in a sense, the kind of engineering that's been beyond us.

"We put a half a billion dollars into it already. To complete the system might cost—and to buy the missiles that we would want, might require $2.5 billion. The five tests have not been successful, so that there really is the question of how much it is worth to the British and ourselves to put in that kind of money when we have competing claims for our available funds."

On his arrival in England, McNamara said: "It is no secret that all five flight tests attempted thus far have failed and program costs have climbed sharply. Nevertheless, we have continued to release funds, fully support the project and nearly $500 million have been released to date. As I said previously, no decision has been reached . . . on the program for Fiscal 1964."

British response to the possibility the U. S. might drop or curtail Skybolt was vehement. Political leaders denounced the U. S., and a bill was proposed to the House of Commons calling for removal of the Polaris submarine base at Holy Loch, Scotland. The move was defeated 177 to 34, but insistence that the U. S. honor its 1960 commitment to equip Britain with nuclear-tipped Skybolts did not abate.

Several alternative methods for providing Britain with a nuclear deterrent capability if the U. S. cancels Skybolt have been suggested here and in England. These include continuation of Skybolt development by the British alone, providing the Royal Navy with Polaris missiles or arming the Royal Air Force with USAF-North American Hound Dog air-to-surface missiles, which are carried by B-52s.

Sprint Proposals

Request for proposals in Army Missile Command's industry competition for Sprint anti-missile missile in connection with an area defense system for ballistic missile sites (AW Aug. 27, p. 32)—Hard-Site program—are not expected to be issued before the middle of March, 1963. This would follow completion of initial Sprint studies now being performed by Douglas, Martin-Orlando, and North American-Columbus (AW Dec. 3, p. 23).

AMC will stress simplicity and reliability in the solid-propellant system for the high-acceleration Sprint missile, to ensure that propellant processing, logistics, and routine handling problems are minimized. Indications are that AMC technical personnel are closely scrutinizing the double-base nitroglycerine-type propellant system which Martin-Orlando is considering for its concept of the Sprint missile. There is even a strong possibility that AMC may ultimately control the propulsion aspect by designating the system as a government-furnished item, thus making procurement its own responsibility, instead of delegating it to the missile contractor.

Important feature of the propellant system will be grain geometry for super-fast burning and ability of the grain to maintain integrity under the forces generated by the very high acceleration of the missile, which is the key to the concept of effective intercept.

Douglas Aircraft Co. was awarded a contract in 1959 to develop the 1,000-mi., solid-propellant rocket for the Air Force. In 1960, former President Eisenhower and Prime Minister Macmillan agreed on a jointly-funded program in which Britain was to invest about $20 million. The cost to the U. S., with revisions for an expanded program, is now estimated at about $2.8 billion. President Kennedy said about $500 million has been spent on the program so far.

British government is intensely concerned over the fate of Skybolt, because that nation's entire nuclear posture depends on equipping Avro Vulcan and Handley Page Victor bombers with the weapon. Skybolt became Britain's sole hope for a powerful nuclear strike force after the Blue Streak IRBM missile and the Blue Water surface-to-surface missile were canceled (AW Aug. 20, p. 34). Phaseout of the Royal Air Force Thor IRBMs and cancellation of Skybolt would leave Britain with only 100-mi. range Blue Steel air-to-ground missiles.

Statements of President Kennedy and McNamara did not clarify the performance record of Skybolt. Air Force proponents contend the program is well within the state of the art, that it has been partially successful already and as of last week was only a week behind the schedule set more than two years ago. Defense Dept. opponents say Skybolt requires a very complex guidance system—one that is probably too complex and delicate for successful operation from the B-52 bombers.

Those who are familiar with the flight test program contend that the problems encountered are no more serious than those experienced in the Thor, Atlas or Titan development programs. Malfunctions, they say, have been random and with one exception, no test flight has duplicated the trouble of another. They cite this history of the flights:

• **First flight, Apr. 19, 1962,** was rated about 85% successful. After a clean drop from the B-52H, the missile's first stage ignited and burned properly. This was the primary objective of the flight. Second stage igniter failed to set off the stage's solid propellant and this secondary objective was not met.

• **Second flight, June 29, 1962,** was a failure. Igniters in both stages failed. Igniter systems for both stages were redesigned in two weeks to provide longer, hotter burning.

• **Third flight, Sept. 13, 1962,** failed when the programmer prematurely commanded separation of first and second stages before the first stage had ignited. However, programmer commanded normal ignition of the second stage about 1 min. after separation, and according to a reliable source, attempted to correct end-over-end tumbling of second stage.

• **Fourth flight, Sept. 25, 1962,** was nominal until shortly after second stage ignition, when the programmer prematurely commanded thrust reversal of the motor. Skybolt's second stage is equipped with blow-out ports on the forward end of the stage. When the correct velocity is achieved, these ports are blown and thrust is nullified.

• **Fifth flight, Nov. 28, 1962,** ended prematurely when the flight control system failed on both stages. The first stage system drives four aerodynamic fins around the base of the unit; the second stage system drives a gimbal-mounted nozzle. Both independent systems apparently failed in similar fashion, since the Skybolt flew a descending spiral into the ocean. Ignition, burning and separation of the stages was considered successful.

The last test flight was the first full test of the Nortronics stellar inertial guidance system, which replaced the interim programmer system used on the first four flights. Performance of the Nortronics system was described as "near perfect" during this daytime launch in which it tracked more than 36 stars.

Every major system of Skybolt has worked satisfactorily in one or more flights, but not all together on the same flight, according to one source. This source believes that problems encountered on the first five flights can be solved by straight-forward engineering and do not represent state-of-the-art advancements.

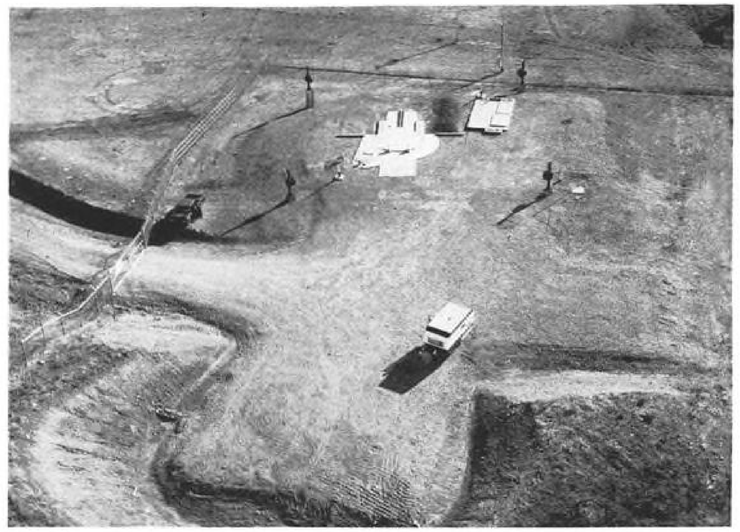
Some Defense Dept. officials who question the wisdom of continuing the Skybolt program point to these specific problems:

• **Successful operational use** of Skybolt requires precise launch position of the missile. To solve the same kind of problem, Polaris submarines carry three inertial systems—Loran gear, a dead-reckoning computer, celestial navigation devices and other equipment—far too much for a B-52.

• **It is imperative to know** the direction of the vertical very precisely. This is difficult on any moving platform and increases with vehicle speed and turbulence.

Avionics components on Skybolt are subject to bumps and jolts on takeoff, turbulence and other shocks to which similar equipment on a Polaris or Minuteman are not subject.

Political implications of possible cancellation of the Skybolt program appear to be as important as the technical considerations. The U. S. agreement with Britain provides for development of the missile by Britain, should the U. S. cancel its program.



HARDENED MINUTEMAN LAUNCH SITE leaves little visible to view near Malmstrom AFB. Concrete cover of the silo is in place and slides away from the viewer to open the silo for a launch. Also buried adjacent to the silo is the environmental equipment room. Four towers around the silo compose an electric "eye"-type security system.

First 2 Minuteman Flights Turned Over to SAC at Malmstrom AFB

Great Falls, Mont.—First two Minuteman SM-80 ICBM flights officially were turned over to Strategic Air Command at Malmstrom AFB here last week by Air Force Systems Command, more than a month after some of these missiles had been on alert during the Cuban crisis.

Flights included the Alpha and Bravo units—10 missiles each—of the 10th Strategic Missile Squadron, 341st Strategic Missile Wing, under command of 15th Air Force. Malmstrom wing is scheduled to be completely operational with a full complement of 150 missiles by next summer. Air Force expects to be receiving the missiles at the rate of one per day in the near future.

Addition of first operational Minuteman flights at Malmstrom complements Air Force inventory of operational ICBMs which include all D, E and F models of Atlas and all Titan 1 ICBMs.

Minuteman unit average cost was given as just over $4 million, including missile and silo and allocations for ground support equipment and launch control center, based on one tenth of the total for the 10-missile complex. Minuteman unit cost is substantially less than an emplaced Atlas or Titan, but the warhead is less than half Atlas size and a smaller fraction of the Titan size.

The 341st Wing at Malmstrom includes the 10th, 12th and 490th Strategic Missile Squadrons, each of which includes five launch control facilities (LCF).

Each LCF controls 10 missile launch facilities which are scattered peripherally around the launch center and connected to it by a 4-in. hardened, pressurized communications cable. Each launch facility is connected to at least one other launch facility, providing a redundant communications link to the launch control center.

Air Force has received funding for 800 Minuteman missiles and has designated four other sites for future wings—Ellsworth AFB, Rapid City, S. D.; Minot AFB, Minot, N. D.; Whiteman AFB, Knob Noster, Mo.; and Warren AFB, Cheyenne, Wyo. All will be under 15th Air Force except the wing at Whiteman AFB, which will be under 2nd Air Force. Ellsworth AFB is scheduled to start receiving Minuteman missiles next spring, followed by Minot AFB, which will get its first missiles next summer.

Minuteman Failure

Minuteman ICBM launched from Vandenberg AFB last week in a Strategic Air Command crew training exercise blew up along its trajectory about 34 sec. after liftoff. This was the second consecutive failure of the Minuteman missile in Vandenberg AFB firing trials. Minuteman weapon system was turned over to SAC officially last week.

Rover Funds Depend on Kiwi Performance

By George C. Wilson

Washington—President Kennedy indicated last week that the Rover nuclear rocket development program will continue at about its present level of funding unless tests of the Kiwi reactor between now and July justify the increases sought by the Atomic Energy Commission and the space agency.

The President reached this decision after visiting the Los Alamos, N. M., Scientific Laboratory and Nevada Nuclear Rocket Development Station to see for himself how Rover is progressing. Forestalling the final decision until July softens the blow to AEC and National Aeronautics and Space Administration leaders, who want Rover funding doubled in Fiscal 1964.

The two agencies want $380 million for Rover in Fiscal 1964, compared with this year's total of $173.5 million. Already the Budget Bureau has recommended cutting the request to $200 million, and President Kennedy's statement last week indicated he is not willing to go much above this figure now. However, he could raise the funding later by asking Congress for supplemental funds for Rover.

How the funding issue is resolved will determine how soon the nuclear rocket will be assigned a major role in the national space program. Backers of an accelerated program such as Harold B. Finger, manager of the joint AEC-NASA Space Nuclear Propulsion Office, contend the nuclear rocket could be flight-tested as early as 1968 if given about $1 billion between now and then. Other Kennedy Administration officials —notably Harold Brown, Director of Defense Research and Engineering, and Jerome B. Wiesner, the President's scientific adviser—claim that the technical problems are too formidable to justify a crash-type program, especially since the space program is running short of funds (AW Dec. 10, p. 27).

President Kennedy brought along Finger, Wiesner and Brown as he toured the Los Alamos laboratory Dec. 7 and discussed the Rover budget. Also present for the discussion were Vice President Lyndon B. Johnson; AEC Chairman Glenn T. Seaborg; NASA Associate Administrator Robert C. Seamans, Jr.; the New Mexico congressional delegation, including Sen. Clinton P. Anderson (D.-N. M.) who formerly headed the Joint Congressional Atomic Energy Committee, and Dr. Norris E. Bradbury, laboratory director.

During the secret briefings, the President was noncommittal on how he felt about the Rover project, but asked the type of questions which showed he had been well briefed before leaving Washington. For example, he asked about the failures of the Kiwi reactors, which are being tested on the ground as part of the development toward a flight-type reactor. He also asked why Rover test facilities at the Nevada Test Site at Jackass Flats were so expensive.

Neither Brown nor Wiesner recommended killing Project Rover. Their main argument was that there is just so much money to go around, and Rover is not far enough along technologically to warrant acceleration at this time. The others in the party, however, argued acceleration was justified by results to date. The technical arguments are heavily interlaced with political considerations. Vice President Johnson as chairman of the National Aeronautics and Space Council, Sen. Howard W. Cannon (D.-Nev.), Sen. Anderson and Rep. Thomas C. Morris (D.-N. M.) as members of the Senate and House space committees, are in position to push their view that Rover should be accelerated.

Sen. Anderson said after the Los Alamos meeting with President Kennedy: "We got what we wanted—a square-toed confrontation, and I think it was effective." Rep. Morris agreed, and said it was urgent to accelerate Rover so the U.S. nuclear propulsion lead would not be lost to Russia. "We don't want to have another Sputnik happen to us," Rep. Morris said.

These lawmakers and other nuclear enthusiasts will try to pass legislation next year to provide full funding for Rover if President Kennedy decides against accelerating the program.

This fiscal year, Rover has a total of $173.5 million in both the AEC and NASA budgets—$84.8 million for AEC and $88.7 million for NASA. Since the start of Rover in Calendar 1955, and including Fiscal 1963, the two agencies have spent $430.8 million, with AEC contributing $268.3 million and NASA $162.5 million. The Fiscal 1964 request of $380 million is just about double the Fiscal 1963 total, with $132 million slated for AEC and $248 million for NASA. The Budget Bureau has recommended cutting AEC's request by $41 million, from $132 million to $91 million, and NASA's request from $248 million to $109 million, a $139-million slash.

Originally, the Rover timetable called for the flight test of the nuclear engine for rocket vehicle application (Nerva) in Calendar 1966-67. Now, however, Finger estimates technical difficulties have pushed that flight test to the Calendar 1967-68 period if the Rover program is funded adequately.

Since the objective of the national space program is to land a man on the moon by February, 1968, there is no chance Nerva would be available for this first mission. It would take at least several months to man-rate Nerva after the first flight test, and perhaps as long as three years. This is why President Kennedy said at his press conference last week that Nerva will not be used for the initial manned flights to the moon. The Saturn C-5 booster will be used for the first manned lunar landing flights. It consists of five Rocketdyne F-1 engines as the first stage, five Rocketdyne J-2s as the second stage and one J-2 for the third stage.

However, Nerva is a strong contender for later direct flights to the moon and exploration of the planets beyond. President Kennedy said last week: "It should be understood that the nuclear rocket, even under the most favorable circumstances, would not play a role in any first lunar landing. This will not come into play until 1970 or 1971. It would be useful for further trips to the moon or trips to Mars. But we have a good many areas competing for our available space dollars, and we have to try to channel it into those programs which will bring us a result, first, on our moon landing, and then to consider Mars."

President Kennedy was the first U.S. President to visit Los Alamos Scientific Laboratory and the Nevada Test Site. He landed at Sante Fe, N. M., Dec. 7 in the presidential aircraft—Air Force 1, a specially equipped Boeing VC-137C—and then flew to Los Alamos by Sikorsky HSS-2 helicopter. Inside the Los Alamos laboratory Chemistry and Metallurgy Research Building, the President was shown a full-scale Kiwi-B reactor with the external casing removed to reveal the inner core, control system and coolant flow channels.

From Los Alamos, President Kennedy flew to Kirtland AFB, Albuquerque, N. M., by helicopter and drove to Sandia Corp., a non-profit subsidiary of Western Electric Co., working for the AEC in nuclear weapons research and development. The President received a classified briefing there and was shown models of nuclear weapons under development. The trend in nuclear weaponry development, Sandia officials said, is to smaller, less complicated weapons. A principal effort is to shorten the time it takes troops in the field to prepare nuclear tactical weapons for firing.

The President flew from Albuquerque Dec. 8 to Indian Springs AFB, Nevada, and then went by helicopter to the Nevada Test Site, circling briefly over the crater created by the Operation Plowshare explosion last July in a test of the use of nuclear power to remove earth. He walked through the reactor maintenance, assembly and disassembly building at the test site where the Kiwi-B4A was being taken apart to determine what went wrong during its test Nov. 30. The reactor was shut down after operating 260 sec. because blue flashes appeared in the exhaust.

Dr. Keith Boyer, director of the Rover test project at Nevada for Los Alamos, said the reason for the blue flashes had not yet been determined. President Kennedy looked through a 6-ft. thick lead glass window at the disassembled reactor and picked up one of its radioactive parts by manipulating the controls mounted in the shielded area.

Kennedy Lauds SAC for Crisis Performance

Omaha, Neb.—President Kennedy presented a special flight safety plaque here to the Strategic Air Command for its airborne alert performance during the Cuban crisis, which he called "a unique accomplishment in the history of airpower."

The presentation was made to Gen. Thomas S. Power, SAC commander-in-chief, during President Kennedy's tour of Offutt AFB Dec. 7. The President said the airborne alert which started Oct. 22 and ended Nov. 21 "provided a strategic posture under which every United States force could operate with relative freedom of action."

The President disclosed that during the alert, SAC bombers and tankers flew 2,088 sorties, which required 48,532 continuous hours of flight. Under constant positive control, airborne alert aircraft flew 20,022,000 mi. and transferred approximately 70 million gallons of fuel in 4,076 aerial refuelings, the President said. He praised the "extraordinary dedication and professional skill" demonstrated during the alert by SAC combat crews and support personnel.

The President pointed out that all the airborne alert sorties were flown without a single accident. "This noteworthy achievement reflects the intensive efforts expended by all personnel of the Strategic Air Command in promoting flight safety," he said.

Gen. Power said that SAC on Oct. 14 began "an intensive program of high altitude reconnaissance missions over Cuba. Covering almost every square foot of the island, our pilots brought back the first photographic evidence of the massive buildup of offensive weapons on Cuban soil."

President Kennedy spent three hours underground in the SAC command post here where he was briefed on how forces would be launched in time of war. He tried out the communications system by picking up the gold telephone which connects the command post to the Joint Chiefs of Staff in Washington and to other major command headquarters. He also studied the white projection screens which line one wall of the control room and show where U. S. forces are deployed on the basis of information supplied by a battery of International Business Machines computers.

It was also disclosed that on orders of President Kennedy, SAC was on 90% ground alert during the Cuban crisis and is currently on 50% ground alert. Previous to the Cuban crisis, SAC was on 30% ground alert, Air Force officials here said.

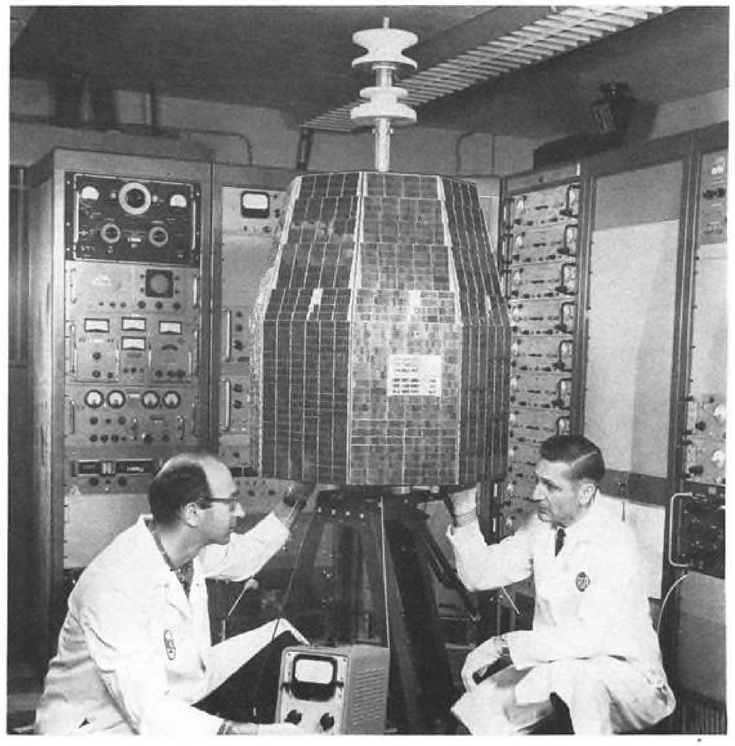
Soviet Missile Sites

Moscow—Russian medium- and intermediate-range missiles removed from Cuba are being placed along Russia's western border, pointed at West Germany, Soviet Chairman Nikita Khrushchev told the Supreme Soviet last week.

Signing of a Russian-East German peace treaty has become "more and more urgent," Khrushchev said. "If anyone thought the USSR was going to shelve it he was mistaken." The Soviet leader said the Berlin and East German problem "can bring more calamities than the Cuban crisis."

Soviet missiles under the command of Russian officers were "ready for launching, for action," before they were removed, Khrushchev said. They were put there as the result of a "well-founded alarm" from the Castro government that "an attack was only hours away" and were intended to make the U.S. realize "the serious threat of war if they attacked Cuba so that they would understand they were not omnipotent," Khrushchev said. "Had we wanted to start war against the United States we would not have agreed to dismantle the rockets . . . We would have brought them into play," he said.

Khrushchev said Russia will never leave Cuba "in a state of distress," and said the U. S. will have to come to terms with Cuba "sooner or later."



Relay Prepared for Launch

NASA prepared Project Relay satellite for launch from Cape Canaveral, Fla., late last week. Objectives of the experiment are to test intercontinental microwave communications by low-altitude, active repeater satellites, to measure space radiation energy levels and to ascertain extent of radiation damage to solar cells and electronic components. Delta rocket is programed to boost the satellite into an elliptical orbit. Relay was developed by Radio Corp. of America's Astro-Electronics Div. under contract to Goddard Space Flight Center.



Bell Helicopter's LOH Entry Is First to Fly

Bell Helicopter Co. Model 206, prototype of OH-4A light observation helicopter to be evaluated by U.S. Army along with similar-class Hiller and Hughes machines, was first of three entries to fly. It took off from company's Hurst, Tex., plant Dec. 8. First flight of the Bell helicopter was two months ahead of schedule, the company reports. Model 206 was built using production-type tooling and fixtures and is the first of five prototypes to be built by the company for Army-Federal Aviation Agency evaluation and approval. Powered by a 250-shp. Allison T63-A-5 turboshaft engine, the Model 206 is scheduled to be delivered to Army Materiel Command, Ft. Rucker, Ala., late in 1963, following FAA certification, for competitive testing. Note that the Model 206 bears both military markings and civil registration. Slip-ring test instrumentation gear is fitted to rotor mast; more data-gathering equipment is fitted in cabin. Two brief flight tests were conducted, each 15-min. duration. Helicopter reached 40 ft. in first flight. Second flight (above) included low-altitude circuit around Bell's heliport. Aircraft reached 40-ft. altitude; banked turns to 30-40 deg.; reached forward speed of 50 kt.

NASA Patent Changes Stir Controversy

By Edward H. Kolcum

Washington—Congressional and industry spokesmen expressed sharply divergent views last week during a public hearing on proposed liberalization of the National Aeronautics and Space Administration's patent waiver policy. Two senators opposed the move as a give-away, and industry representatives called for an even more liberal policy than the one NASA is proposing.

Although the agency is empowered to change the regulations to incorporate its proposed patent waiver provisions, both Sen. Estes Kefauver (D.-Tenn.) and Sen. Russell B. Long (D.-La.) served notice that the monopoly committees they head will investigate what Kefauver called a flouting of congressional intent expressed in the 1958 Space Act if the provisions are adopted. NASA said it will not make any changes in the existing regulations before bringing them before Congress.

New Patent Policy

The new patent policy (AW Nov. 5, p. 40) was announced by NASA as designed to promote more widespread use of space inventions by easing the administrative regulations that govern title waiver of inventions developed under NASA contract. The agency has established six categories of inventions, and its proposed regulations provide that NASA would retain the rights to inventions developed under three categories, and would waive rights to inventions developed under the other three.

NASA Rights

Rights to inventions would be retained by NASA in these circumstances:

- **If they pertain** to a field that has grown predominantly as a result of government sponsorship.
- **When the inventions are likely** to be required for public use.
- **When inventions are related** to a government program designed to develop goods or services for the public.

NASA Inventions

Washington—Contractors have reported that 600 inventions have resulted from work sponsored by the National Aeronautics and Space Administration since NASA was established Oct. 1, 1958. Since that date, there have been 79 petitions to the agency to waive title to inventions.

NASA has granted 27 petitions, denied three, and inventors have withdrawn 13 petitions before NASA acted on them. The remaining 36 petitions are pending.

Waivers would be granted for inventions under these circumstances:

- **When they fall within** the commercial area of the contractor.
- **If the invention** is so expensive to develop that exclusive ownership is an enticement.
- **When the contractor** made a patent application before signing a NASA contract.

Sen. Kefauver said these proposals would violate congressional intent and impede the fullest dissemination of data obtained from space research. Sen. Long charged NASA with "twisting the law" to give away the rights of the people and set up space industry monopolies.

Opposite View

An opposite view was expressed by Rep. Emilio Q. Daddario (D.-Conn.), who said the NASA proposals "will encourage science and invention." He said, however, that the patent law should be changed, and NASA should not attempt to change the regulations administratively.

Spokesmen from Electronics and Aerospace Industries associations and the National Assn. of Manufacturers indicated that they favor a NASA patent policy identical to that of the Defense Dept., which waives rights to all patents while retaining a royalty-free license.

Charles Gottschalk, representing NAM, said his organization is "opposed to the concept that the government should take title to patent rights resulting from research and development work conducted pursuant to government contracts.

Franz Olson, spokesman for AIA, said that only by waiving title to all inventions will NASA get the full effect of incentives in the U.S. patent system, and he added that the position of AIA is that any patent to which the government has acquired title, "regardless of the manner of acquisition, should be made freely available to the public."

Closed-Door Policy

Representing EIA, Robert W. Galvin also called for a NASA patent policy similar to that of the Defense Dept., and he objected to the waiver exception, which he said "seems to set the stage for a mostly closed-door policy on waivers."

In his statement, Sen. Long charged that the new provisions are heavily weighted in favor of a few contractors and would tend to establish space industry monopolies by concentrating in a small area technical and scientific competence. He said his Senate Small Business Committee monopoly subcommittee will investigate the provisions in hearings when Congress reconvenes next month.

Kefauver Position

Sen. Kefauver held the same position, saying that the provisions would make it difficult for new entrants into the space industry.

Sen. Kefauver said most NASA contracts already go to large companies. "Small businesses are lucky to get a few crumbs as subcontractors. Most of the patents given away to the contractor will thus go to large companies because most of the contractors are such large companies," he said.

If the provisions are adopted, Sen. Kefauver said, he will conduct an investigation in the anti-trust and monopoly subcommittee, of which he is chairman.

NASA Survey Team

Washington—Three-man survey team arrived in Japan last week to inspect potential tracking station sites for the National Aeronautics and Space Administration (AW Dec. 10, p. 29).

The team consists of Clarence R. Morrison, chief of advanced systems, Headquarters Office of Tracking and Data Acquisition; Larry E. Brown, head of the field facilities branch, Goddard Space Flight Center, and Marvin W. Robinson, deputy director of International Programs.

USAF Resubmits MODS Plan

Air Force's Manned Orbital Development System (MODS) is being given new impetus by resubmission of a development plan to Defense Dept.

MODS is a space station concept projected for study and hardware phases which has been curtailed for lack of high-level support because of possible conflicts with National Aeronautics and Space Administration's space station plans (AW Nov. 12, p. 56).

Technical coverage and an associated schedule has been prepared by Aerospace Corp. Program timetable calls for issuance of a request for quotations on the initial program definition phase by May 1, 1963.

Responsive proposals are to be submitted two to three months afterward, and contract awards, probably to as many as three companies, will be made as early as a month afterward.

Selection of a contractor for the development phase will be made late in the year after a three-month definition phase is completed.

In addition to the basic manned orbiting space station, it is expected that industry competitors in the definition phase will be asked to include in their proposals a design concept for an earth-to-station-and-return excursion module, or shuttle, for ferrying personnel.

Large Solids Plan Seeks Test Of Two 264-in. Motors by 1968

Washington—Proposal requests will be issued in January or February by the Air Force for a large solid propellant rocket development program. Two contracts are scheduled to be awarded in early spring for parallel, 18-month test programs.

The plan now is to select a single contractor in mid-1964 to complete the development process and to test at least two 264-in. dia. motors of flight weight and with flight components before the end of 1967. Program cost through 1967 has been estimated at about $200 million.

The program comes under a Defense Dept.-National Aeronautics and Space Administration agreement which has been in a confused state since early this year, when Air Force was given responsibility for large solid rocket development with the proviso that it be responsive to NASA requirements. Agreement between the two agencies finally was reached in November (AW Nov. 12, p. 38) on the way the program would be conducted. As recently as Dec. 1, USAF and NASA were considering test of a 276-in. dia. motor (AW Dec. 3, p. 26), but this size was reduced by a foot in the bid specifications.

Major terms of the contract are:

- **Parallel motor development** by two companies, one of which will be selected to complete development of a motor that could be used to launch planetary payloads.
- **Demonstration firing** of both half-length (60 ft.) and full-length (120 ft.) motors.
- **Component testing** of major systems such as thrust vector controls, nozzles, igniters, abort sensors and associated technology, to be accomplished in the Titan 3 program, and with 156-in.-dia. motors. Titan 3 uses a Titan 2 core with two 120-in. dia. strap-on solid propellant motors. The 156-in. dia. motor would not be fired.
- **Project management** for development will come under USAF Systems Command's Space Systems Division.

The half-length motors do not have to be flight weight, but the 120-ft. length motors do.

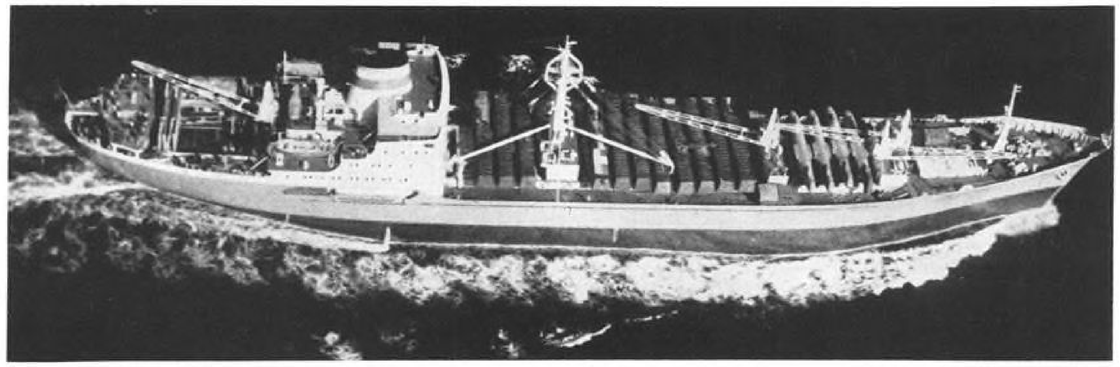
At best, the development program defined by the agreement would permit large solid propellant motors to compete with liquids on the later version of Nova that would be used for planetary flights in the early 1970s. In this time frame, the most opportune window for a Mars mission occurs in 1972. With a development program running through 1967, this would allow five years in which to perfect motors and stages for a manned mission to Mars.

Still unsettled is where the motors will be built and tested, although it is assumed that tests will be conducted either at Edwards AFB or a waterside facility near a manufacturing plant.

Centaur Review

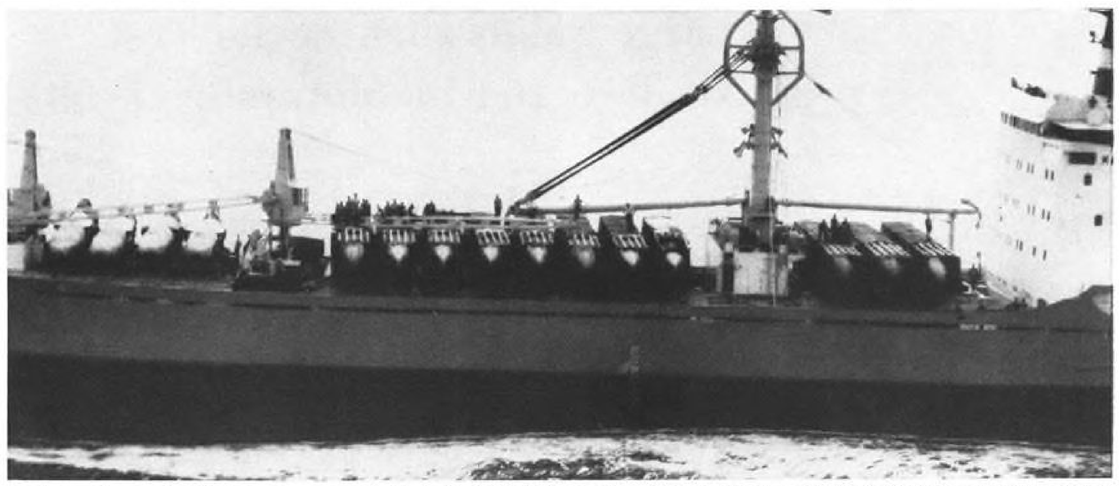
Los Angeles—Complete 90-day design review of the Centaur booster being conducted by Space Technology Laboratories for National Aeronautics and Space Administration's Lewis Research Center will be completed in January.

Review concerns itself with the entire Centaur design.



Fifteen more Soviet Il-28 jet-powered bombers were removed from Cuba on the Soviet cargo ship Kasimov (above). Besides the 12 aircraft removed by Okhotsk (AW Dec. 10, p. 34), 15 also have been removed by the Krasnograd, making a total of 42 aircraft.

More Il-28s Leave Cuba on Soviet Cargo Ships



Fuselage crates on the Kasimov were opened voluntarily for U. S. inspection. Kasimov (above and below) sailed from Mariel, a Cuban naval base west of Havana. Okhotsk sailed from Nuevitas, a port east of Camaguey on the northern coast of eastern Cuba.



RCA Awarded Ranger Camera Contract

Radio Corp. of America's Astro Electronics Division has received a letter contract from NASA's Jet Propulsion Laboratory to proceed with development of high-resolution camera payloads for Ranger spacecraft 10 through 14. This confirms an Aviation Week report (AW Sept. 3, p. 17) that the company would be selected to provide payloads for the Ranger follow-on spacecraft.

Payloads will be similar, though not identical, to the six-camera (vidicon) TV packages which the company is making for Rangers 6 through 9. These are designed to obtain high-resolution pictures of the lunar surface before impacting on the moon.

Meanwhile, Aeronutronic Division of Ford Motor Co. has received a phase one development contract from JPL for a survivable space capsule camera scanning system intended to get detailed close pictures of the lunar surface (AW Oct. 22, p. 23).

Presumably, the Aeronutronic camera scanning system, should its development culminate in flight hardware, could be substituted for an RCA camera package on one of the later Ranger spacecraft.

The camera scanning system is contained within a 25-in.-dia. balsa wood capsule, much like the seismometer capsules which flew aboard Rangers 3 through 5.

Associated with these earlier capsules was a small retrorocket intended to slow descent of the Ranger spacecraft before the capsule is jettisoned onto the lunar surface. A similar retro probably would have to be included on the Ranger bus to slow it down for the camera capsule.

Survivable camera capsule is intended to be able to take fine-grain pictures of the lunar surface from the capsule to its lunar horizon. These slow-scan facsimile pictures would be telemetered from a transmitter in the capsule to the earth.

Camera lenses may obtain views of the lunar surface by means of a mechanical window or appendage which would open or extend to permit the imaging system to secure its views of the lunar surface.

Partially as a consequence of the anticipated critical nature of the NASA Ranger review (AW Dec. 10, p. 25) there has been open speculation in industry that Jet Propulsion Laboratory might seek a contractor in industry for the Ranger buses (basic spaceframe and related equipment), a procedure it follows with Surveyor.

Doubts Are Growing About Value Of Satellite Inspection in Orbit

By Philip J. Klass

Washington—Defense Dept. is expected to approve Air Force plans to explore satellite rendezvous techniques using a manned Blue Gemini instead of the now canceled unmanned Satellite Inspector (Saint), but there is growing doubt at top levels over the military value of orbital inspection of Soviet satellites (AW Dec. 10, p. 36).

This viewpoint holds that the billions of dollars required to develop an operational satellite inspection capability might better be spent to expand the existing space surveillance network, and to give the Army's Nike Zeus anti-ICBM missile the capability to knock down potentially hostile satellites, if the situation demands.

There also is growing interest in the idea of using a high-power, earth-based telescope, designed for high-speed tracking, to get a close look at low-altitude satellites, as an alternative to orbital inspection.

This viewpoint has been strengthened by the results of analyses carried out by Radio Corp. of America, under its Saint contract. These indicate that an orbital inspection system would be "frightfully expensive" if the Soviets were to put low-cost decoys into orbit, each of which had to be inspected.

Defense Dept. officials believe that warhead-carrying satellites are not an attractive weapon delivery system either for the U. S. or the Soviets. But recognizing that the Russians could view things differently, Pentagon planners conclude that the Soviets would have only two choices in their deployment.

One would be to place only a handful of bombs in orbit, then use them as an instrument of blackmail. But under these conditions, the Soviets would be unbelievably foolish not to include their entire thermonuclear ICBM arsenal, numbering 100 or more missiles, in the total threat. Viewed in this context, the handful of bombs in orbit would be inconsequential compared with the threat of ICBMs, whose range and accuracy the Soviets already have shown.

If, instead, the Soviets suddenly were to start placing dozens of satellites in low-altitude orbit, this fact in itself would alert the U. S. and suggest their hostile intent without the necessity of inspecting each one to reach a consensus, according to this Pentagon view.

The Cuban incident is cited as an example. When the U. S. discovered a rapid build-up of long-range missiles, it did not wait to make a detailed inspection to determine if the nuclear warheads had arrived on the scene before it reacted. When it reacted, the U. S. had the capability of destroying the missiles if they were not voluntarily withdrawn.

Some Pentagon officials see an important lesson here which suggests that the U. S. should develop the capability to destroy unknown satellites if their numbers, or other aspects of the situation, suggest they pose a threat. They add that the quickest and cheapest way to develop this capability may be through use of an earth-based missile.

Those who doubt the military value of an inspector satellite question whether visual inspection even at close quarters can reveal the intent of a Soviet satellite. If the U. S. were known to have an inspector satellite capability, and the Russians wanted to place bombs in orbit, they would disguise the vehicle, according to this argument.

While visual inspection is useful to discover whether an unknown radar blip is an enemy bomber or an airliner strayed off course, an astronaut would have great difficulty in distinguishing between a Soviet meteorological satellite with television cameras and a reconnaissance satellite such as our Samos.

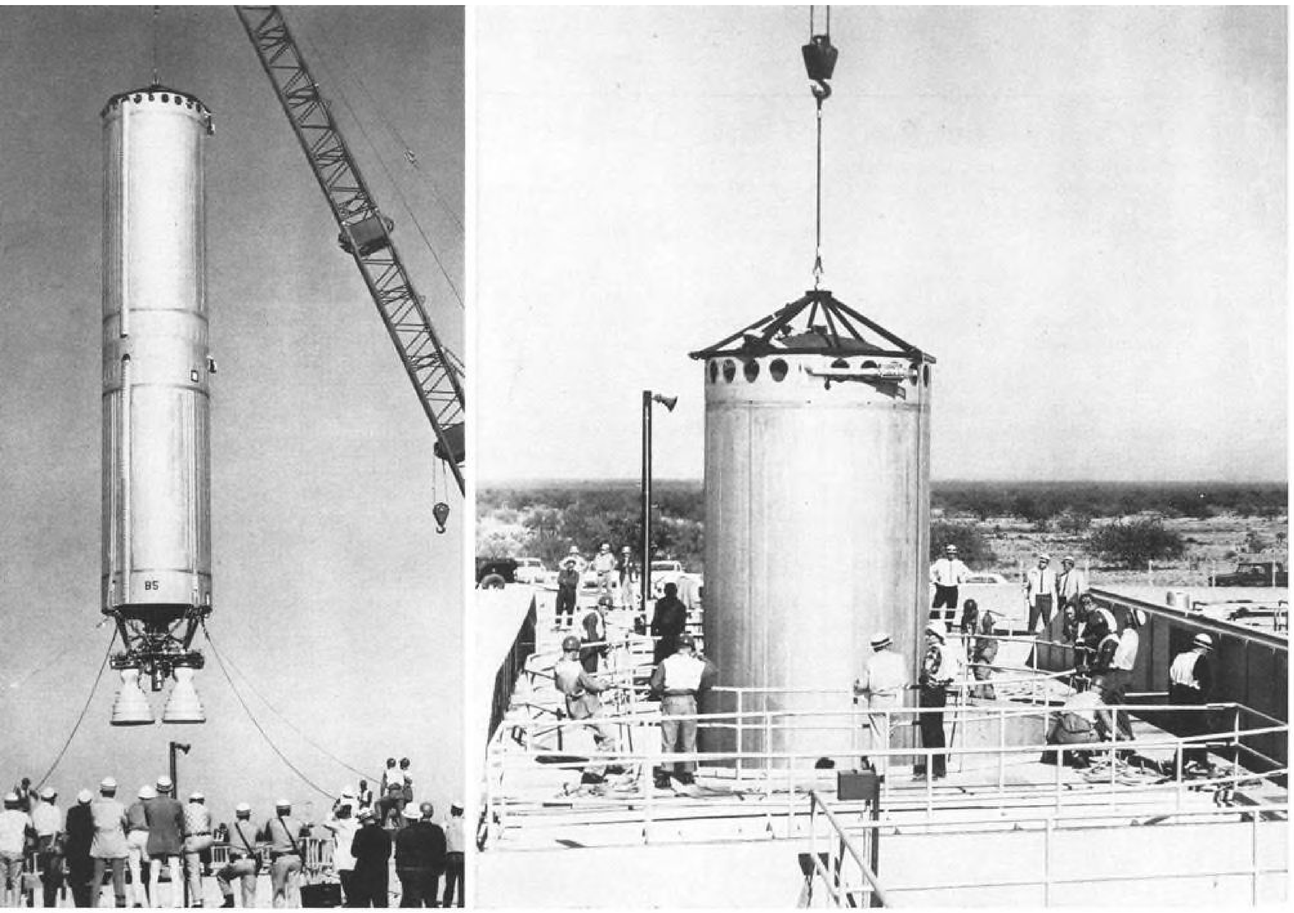
Those who question the value of a military orbital inspector concede that he could perhaps determine the mission of a Soviet satellite by disassembling it in space, assuming the Russians have not armed it with a proximity fuse to detonate upon contact.

However, if disassembly showed the satellite to have a peaceful mission, it is doubtful that the inspector could reassemble and make it operational again. If Soviet satellites are going to be disabled, it makes little difference to the Russians whether it is done by disassembly or by an anti-satellite missile.

Despite these doubts and reservations, Defense Dept. is expected to approve the Air Force plans to explore orbital rendezvous techniques in line with its philosophy of developing basic techniques which might be required for military space missions.

Backing up this program, observers expect that Bell Telephone Laboratories will be asked to step up its studies on the possible adaptation of Nike Zeus to the anti-satellite role.

Such action is likely to renew the Air Force-Army rivalry of several years ago over which service should be given responsibility for anti-ICBM defense, a fight which Army won for ground-based systems. This could also aggravate an existent schism within the Air Force. Some USAF officers in the North American Air Defense Command already support implementation of Zeus for anti-ICBM defense.



USAF Titan 2 Installed at Tucson Site

First USAF/Martin Titan 2 ICBM designated for operational duty sometime in 1963 is hoisted and then lowered into an underground silo launcher by a crane at Davis-Monthan AFB, 25 mi. southwest of Tucson, Ariz. There are 18 single-launcher complexes ringing the area. In addition to the Tucson complex, Titan 2 bases are under construction at Wichita, Kan., and Little Rock, Ark. First Titan 2 silo launch from Vandenberg AFB, Calif., is scheduled to take place early in 1963. Vandenberg launch facility—Operational Systems Test Facility—is now undergoing a test check of its equipment. Titan 2 measures 103 ft. in length.

Nike Zeus Intercepts Atlas Re-entry Body

Development model of an Army Nike Zeus anti-missile missile last week intercepted an Atlas ICBM re-entry body that had been fired from Vandenberg, AFB, Calif., on a 5,500-mi. course over the Pacific toward Kwajalein Atoll, Defense Dept. said.

Miss distance indicator in the re-entry body confirmed the intercept, which was made by the first of two Nike Zeus missiles fired from Kwajalein.

The second was destroyed by ground signal due to a malfunction in the second stage.

Defense Dept. said "the target vehicle was well within the lethal radius of a Zeus operational warhead." It was the second Atlas intercept by Nike Zeus. The first was July 19 (AW July 23, p. 19).

Solar Hydrogen Propulsion Evaluated

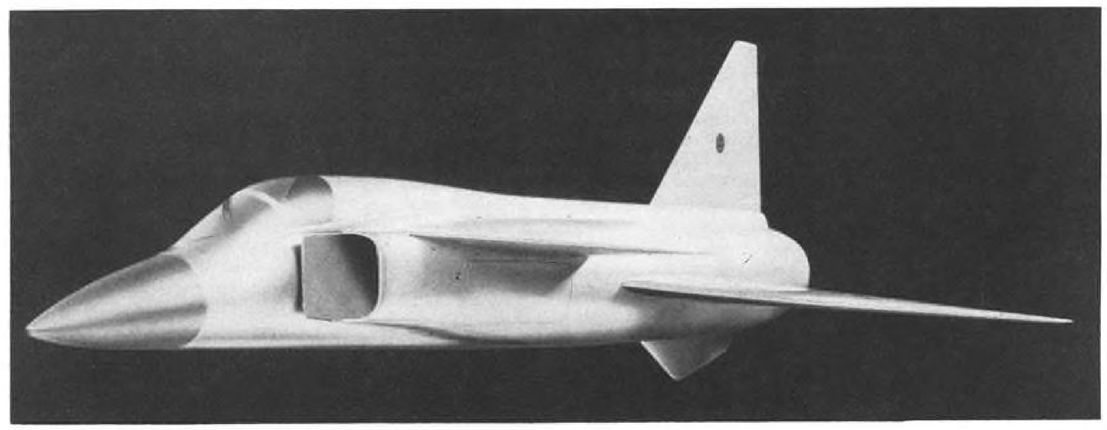
Industry proposals for research and development studies to increase the flexibility and efficiency of solar hydrogen propulsion systems are being evaluated at Air Force's Flight Test Center, Edwards AFB.

System would use a parabolic reflector, or concentrator, to focus solar heat on a heat exchanger to raise the temperature of hydrogen carried in the associated spacecraft as the fluid working medium for the generation of thrust.

One basic problem requiring solution involves the limited control flexibility of thrust vector, resulting from interference of the parabolic concentrator with swiveling nozzles. An approach to this problem might be to pipe hot hydrogen exhaust from the heat exchanger located at the focal point of the concentrator through a long, insulated line to a nozzle beyond the periphery of the concentrator.

This scheme could involve sizable performance losses, which probably could be eliminated or minimized by placing the heat exchanger beyond the concentrator periphery and using a system of mirrors or lenses to transfer energy from the concentrator focal point to the exchanger to allow free vectoring of the thrust.

Inflatable concentrators would offer weight and packaging advantages for launch in comparison with unfurlable metallic concentrators, but would embody surface deviations from a true parabolic shape, resulting in a concentration ratio of less than one-tenth that of metallic concentrators. To boost this by an order of magnitude to attain high specific impulses and efficiency, additional optical elements might be employed to compensate for the relatively inaccurate contour of the concentrator.



Saab Aircraft Plans Mach 2.2 STOL Fighter

Saab Aircraft Co. hopes to roll out the first prototype of its STOL multi-mission Mach 2.2 J37 successor to the Draken J35 series within the next two-to-three years. J37, incorporating a number of new design and management concepts for the Swedish aircraft and components industry, is scheduled to be ordered in quantity by the air force as an interceptor, strike fighter and reconnaissance aircraft (AW Mar. 12, p. 293). Designated the Vigeen (Thunderbolt), the aircraft will be powered by an improved version of the 14,000-lb-thrust Pratt & Whitney JT8D turbofan engine to be developed and produced under license by Svenska Flygmotor A.B. In its air-to-air mode, the aircraft will be equipped with Swedish-built Hughes Falcon missiles. Saab is developing a rocket-powered air-to-ground missile system for the aircraft in its strike fighter configuration. Advanced design techniques for the delta-wing aircraft include incorporation of a small canard plane on either side of the nose section just above and behind the air intakes for added stability. Flap blowing on the canard surface and thrust reversers also are planned to improve the J37's STOL characteristics. In a new management concept for Sweden, the government's Air Board also has relegated much of its traditional authority to Saab which will serve in a prime contractor role similar to that established for Convair for development of the B-58 supersonic bomber.

Sylvester Defends News Policy, Notes Government's 'Right to Lie'

New York—Defense Dept.'s philosophy of "news management" is based on the premise that "information is power," Arthur Sylvester, assistant secretary of defense for public affairs told the New York Deadline Club recently.

Sylvester, whose news policies have been under attack by various news-gathering agencies and organizations (AW Nov. 12, p. 156), said that America's failures in the international field have been because of "its failure to understand the power of the word, the power of information."

Sylvester continued by commenting on the possibility that political control of news might be introduced under the guise of security requirements.

'Basic Integrity'

"This, I think, goes to the basic integrity of the people in government. If the people that you put in government violate this trust, then obviously they should be clobbered and gotten out. Basically, I think it is characteristic of any party in power to make itself look as well as it can or to make its failures look not so bad."

Sylvester termed "basic" a government's right to lie, however.

When asked about half-truths which were told by various governmental officials during the Cuban crisis, he replied:

". . . . It would seem to be basic, all through history that a government's right—and by government I mean a people . . . that it's inherent in that government's right, if necessary, to lie to save itself when it's going up into a nuclear war. This seems to me basic."

Sylvester said that he made a mistake in announcing the policy of news management in an Oct. 27 memorandum:

"Twice since I've been there [as deputy secretary of defense], I forgot that I was no longer chief of the [Washington] bureau of the Newark News, and was the assistant secretary of defense for public affairs and therefore what you say takes on a much more heightened effect . . . I made a basic error there in phrasing it. But, if I can speak as a . . . newsman . . . I cannot see how any perceptive newsman does not know, does not see in the world we live in that information is power."

However, Sylvester said that Congress and the people have approved the President's decision on the Cuban situation and quoted from a speech by Rep. John Moss (D.-Calif.), claiming congressional backing for his position.

The quotation from the speech (AW Dec. 10, p. 112) was read by Sylvester:

"'These are the horns of the dilemma on which we find ourselves. We have in the past few weeks experienced a degree of government news management which is unique in peacetime. News generated by government actions admittedly was used as part of our Cold War weaponry and the weapons were successful. Seldom has our nation achieved a victory in international negotiations comparable to the victory in the Cuban crisis. Speaking and acting as the nation's own voice, President Kennedy prevented the Cold War from becoming a nuclear holocaust. As a result of his position there is every hope that the Cold War combatants will be brought closer to a solution of their differences.'"

DOD Directive

However, Moss, in the speech, also called the Defense Dept. directive requiring officials to report every contact with a reporter "absurd" and said "it does restrict the flow of news, for a directive to report all press contacts is nothing more than an attempt to channel information through the Pentagon publicity office.

". . . We had better get busy right now to make sure the people's need to know the facts of government is fulfilled. We must either protect the flow of information . . . or prepare to see our system of government dangerously weakened."

Gemini Mission to Retain Agena

Washington—Rendezvous with the Agena D will be retained in the Gemini mission, the National Aeronautics and Space Administration decided last week. The agency had considered eliminating Agena D from the mission, and effecting the rendezvous with a piggyback satellite carried into orbit (AW Nov. 26, p. 26).

The concept change was weighed as one method of saving time and money in the manned space flight program. After detailed study and discussions here and at NASA's Manned Spacecraft Center in Houston, the decision was made to keep the Agena D stage in the program on the basis that eliminating it would penalize the program technically, and the time and money savings would be small.

As a result of the decision, USAF is now able to proceed with its plans for Blue Gemini (AW Dec. 10, p. 27). Air Force has felt it could not go ahead with its plans until NASA made firm the concept for its program.

NASA Shifts Agena Management to Lewis

Washington—Project management of the Agena stage along with its Atlas and Thor boosters is being transferred from Marshall Space Flight Center to Lewis Research Center by the National Aeronautics and Space Administration, removing the last medium-class launch vehicle from Marshall jurisdiction.

With the transfer of the General Dynamics/Astronautics Atlas, Douglas Thor and Lockheed Agena from Marshall, that center will concentrate exclusively on the three Saturn vehicles—C-1, C-1B and C-5. Development work has been essentially completed on the vehicles transferred to Lewis, and the responsibility of that center will focus on product improvement and contract management.

The transfer makes Lewis the major medium launch vehicle facility in NASA. Centaur program was transferred to Lewis last September (AW Oct. 8, p. 40), along with the program management for the Aerojet M-1 stage.

In addition to its employment in Gemini (see box), Atlas Agena is on the firm NASA schedule for 10 scientific payloads—four Rangers, two eccentric orbiting geophysical observatories, two Mariners and two astronomical observatories. Twelve Agena D stages are being purchased for the Gemini.

NASA said it expects to complete transfer of the vehicle management to Lewis in three months.

LEM Subcontracting

Washington—Grumman Aircraft Engineering Corp. has been given more time to develop a subcontractor list for the lunar excursion module after National Aeronautics and Space Administration agreed that there has been insufficient time since Grumman won the prime contract for the firm to recommend the best subcontractor list.

As a result, many of the major subcontracts remain open for competition, a factor indicated in the decision to award parallel preliminary contracts for part of the propulsion system (AW Dec. 10, p. 35).

Grumman and NASA will enter into a negotiated contract for the module immediately, rather than have the company begin work with only a letter award. Prime contract will be negotiated by Dec. 21.

In its own post-award competition for subcontractors, Grumman was required by NASA to submit a list about five days after the firm was notified it had won. During the current contract discussions, it was decided to re-open the subcontract list and to provide prospective subcontractors with more precise specifications.

Lockheed-IAM Dispute Remains at Stalemate

Los Angeles—Collective bargaining talks between representatives of the International Assn. of Machinists, Lockheed Aircraft Corp., and Federal Mediation Service, which resumed here last week and continued for three days, again were recessed because no progress could be made between the parties.

Meeting had been held as the strike injunction against IAM had been extended for a full 80-day period under the Taft-Hartley Law, by the U.S. District Court in Los Angeles. Both Lockheed and IAM representatives were available to meet again "on call" from the Federal Mediation Service. IAM's latest suggestion in the dispute was that a representative group of Lockheed stockholders attend the next bargaining meeting. Observers felt that Lockheed management emphatically would reject this suggestion.

Establishment of a union shop remained the major obstacle blocking agreement between IAM and Lockheed negotiators. This basic difference took on added significance when, last week, workers at Boeing Co.'s facilities voted for the union shop clause in an advisory poll conducted by the National Labor Relations Board, which revealed that almost 74% of the production and maintenance personnel were in favor of the union shop.

News Digest

Indian pilots, now in training in the Soviet Union, are expected to fly the first consignment of MiG-21 aircraft from Russia to India late in December or early in January. Indian Defense Minister Y. B. Chavan said Russia also would honor its agreement to build a factory to produce the aircraft.

Civil Aeronautics Board last week said probable cause of the crash of a Northwest Airlines Lockheed Electra at Chicago's O'Hare Airport Sept. 17, 1961, was a mechanical failure in the aileron primary control system due to an improper replacement in the aileron boost system. The CAB report was critical of maintenance personnel and the carrier's Electra maintenance training procedures, which since have improved.

Pressurized Queen Air is under development by Beech Aircraft Corp., Wichita, Kan., and will sell for about $200,000. First flight of this new twin-engine business plane version will be in the summer of 1963 and customer deliveries are expected to start January, 1964. Pressurization feature probably paves the way to providing the Queen Air with turboprop engines in the future.

Short Skyvan transport prototype rolled out at Belfast plant of Short Brothers & Harland last week. Runup tests on two 390-hp. Continental engines have started in preparation for first flight. Production models will be powered by two Turbomeca Astazou 2s.

Garrett Corp. has bought a Sud Caravelle Mark 6 for use as a company executive aircraft as well as a showcase for company products.

North American Aviation sales and earnings for 1962 were the highest ever reported by the company. Sales of the company, which is developing the Apollo lunar spacecraft for NASA, reached $1,633,675,000 compared with $1,262,333,000 last year. Profit was $34,557,000 or $4.15 a share compared with 1961 figures of $27,750,000 or $3.38 per share.

Kaiser Engineers has been awarded a contract by the Army Corps of Engineers for design of the integrated mission control center (IMMC) at NASA's Manned Spacecraft Center.

Sud Aviation's 26-passenger Super-Frelon made its first flight Dec. 7. Triturbine helicopter project currently is running three months ahead of contract schedule. Super Frelon has a 26,000 lb. gross weight. This gross weight was erroneously reported at 37,730 lb. in AVIATION WEEK (Dec. 3, p. 31).

Airlane Jams Imperil High-Density Market

Holiday rush, bad weather snarls East Coast traffic; Washington National Airport condition is key factor.

By L. L. Doty

Washington—Traffic jams on the high-density Washington-New York-Boston airline routes during unfavorable weather threaten to place a ceiling on traffic growth in this market, which has expanded steadily since Eastern Air Lines introduced its Air-Shuttle service.

Although Eastern set a new record for the number of passengers carried on the Air-Shuttle during the Wednesday before Thanksgiving Day, weather restrictions and limitations on the flow of aircraft left many Air-Shuttle passengers stranded or seriously delayed. Flight delays and cancellations set up a chain-reaction of backlogged aircraft that resulted in two 90-min. periods at Washington when no Air-Shuttles took off, although an accelerated holiday schedule called for departures to New York and Boston every 20 min.

At one point during the day, Eastern had exhausted its supply of Air-Shuttle Lockheed 1049 aircraft at Washington, and for almost an hour, was unable to guarantee transportation to a rapidly-growing line of impatient passengers. Presumably, many of these customers either gave up their trip or resorted to other means of transportation.

One Allegheny Airlines flight, serving intermediate points between Washington and Boston, spent a total of 2 hr. 42 min. on the runways of three airports waiting for take-off clearances.

Key to the November 21 traffic jam is Washington National Airport. Its air traffic control system is incapable of handling a large volume of traffic under unfavorable weather conditions if wind directions prohibits the use of the single Instrument Landing System (ILS) located at the south threshold of the main north-south runway.

Weather minimums at Washington are 200 ft. ceiling and ¼ mi. visibility when the ILS can be used or when aircraft can land north from the south. When the wind direction forces aircraft to land south from the north, minimums are hiked to 600 ft. and 1 mi.

These high limits are due to the nearby 555-ft. high Washington Monument and a large restricted area that contains the White House and other key government buildings. The restricted area also prevents aircraft from making a direct approach from the north on the north-south runway.

As a result, aircraft landing south must use the shorter northwest-southeast runway, which means they are denied the use of the backcourse of the ILS on the north-south runway. Thus, all landings on the short runway are held to the high minimums and are conducted under VFR conditions.

Generally, this runway can handle a maximum of 45 operations per hour, compared with the 50 that can be accommodated on the north-south runway.

On Nov. 21, weather was below minimums for the shorter runway until 10 a.m. and all flights were operated on the longer ILS runways with a slight downwind component. When weather lifted to permit landings on the shorter runway from the northwest, traffic volume began to increase, reaching a high level at 1 p.m. that was sustained throughout the day and evening.

In the morning, Air Route Traffic Control Center placed a flow control restriction on Washington that limited the volume of aircraft to 20 incoming flights per hr.; four each from the Cleveland, Indianapolis, Jacksonville, Atlanta and New York centers. However, Eastern had planned a total of three Air-Shuttle flights per hour out of Washington between 1 p.m. and 10 p.m.

To operate these outbound flights, Eastern needed a comparable flow of incoming flights to maintain a proper inventory of aircraft. Traffic flow at the airport was further intensified by an additional 15 extra sections that United Air Lines added to its regular schedule that day.

Eastern operated 18 flights of the total 30 it had planned between 1 p.m. and 10 p.m. Fortunately, the air traffic control staff was able to handle more aircraft per hour from New York than the four that the flow control restriction called for. Between 1 and 2 p.m., nine

IATA to Review Piston-Fare Structure

Stockholm—International Air Transport Assn. will review its piston-fare structure for the North Atlantic at a special Paris meeting early in January in an effort to avoid a threatened rate war over the route when the present tariff structure expires on Mar. 31.

Decision to hold the emergency session was announced here last week by IATA Director-General Sir William Hildred following a warning by Scandinavian Airlines System officials that they would reject the piston-fare structure proposed at the Association's annual traffic conference in Chandler, Ariz. (AW Dec. 3, p. 41).

Sir William's announced reason for visiting Stockholm was his attendance at the Nobel Prize award ceremonies here. SAS officials said an exact date for the Paris meeting has not yet been set.

SAS move towards a veto of the Chandler rates was backed by the governments of Denmark, Norway and Sweden and based upon its contention that it cannot effectively compete against Icelandic Airlines under the present IATA plan. To meet the fares offered by the non-IATA carrier, a potent figure on the Scandinavian scene, SAS wants to lower its own fares across the North Atlantic to a point approximately $110 below those proposed at the Chandler traffic conference.

Paris meeting and the plan to review the piston-fare structure once again before present rates expire on Mar. 31 also frees SAS from its earlier obligation to approve or disapprove of the Chandler proposals by Dec. 15.

A SAS official said last week that he "assumes" that the Paris discussion will be restricted to piston equipment only and that jet fares will stand as proposed. He added that it would be "impossible" for SAS to live under the Chandler conditions for piston aircraft.

The airline contends that Icelandic, with four Douglas DC-6Bs, carried 68,000 passengers over competing North Atlantic routes last year as opposed to 80,000 for SAS's predominantly turbojet fleet. Icelandic contends that its total traffic for the year was only 52,000 passengers over all routes and that the 80,000 figure cited by SAS represents the total for only one of the carrier's routes.

aircraft were accepted from New York. During the next 2 hr., the total was 6 per hr. and the total steadily increased thereafter until 7 p.m., when 11 per hr. were being accepted at Washington.

Meanwhile, Eastern dispatched two aircraft between 1 p.m. and 2 p.m., one in the next hour, two in the following hour but none between 3:40 p.m. and 5 p.m. After 5 p.m., four aircraft were dispatched within an hour and operations were fairly normal until 7 p.m., when no Eastern Air-Shuttle flights took off until 8:40 p.m.

Although Eastern lost a substantial number of passengers because of the air traffic jam, the Air-Shuttle lost few friends. Eastern personnel at the Washington airport maintained a constant liaison with control tower personnel so that Air-Shuttle customers were regularly and frankly informed of the operational problem.

On the Sunday following Thanksgiving, with operations back to normal, the Air-Shuttle established still another one-day record for the service with a total of 13,439 passengers.

Meanwhile, the Federal Aviation Agency announced a plan which it hopes will crack the air traffic bottlenecks created during peak periods under bad weather conditions at congested airports. Last week, it began the simultaneous landing of aircraft on dual ILS runways at Chicago's O'Hare Airport as a means of reducing stacked aircraft in Chicago's traffic pattern.

Aircraft moving into final approach at O'Hare will be separated by 1,000 ft. vertically and 3 mi. horizontally up to within 8 mi. of touchdown.

Physical configuration of Washington National Airport, bordered on three sides by the Potomac River, leaves no area for the installation of a dual ILS operation. Diversion of local traffic to other airports serving Washington, D. C.—the new Dulles International Airport and Baltimore's Friendship Airport—is impractical because of the relatively long distance of these fields from the center of Washington.

Washington is a key point in the northeastern megalopolitan air corridor. Traffic delays at Washington National Airport create similar delays or cancellations at New York and Boston airports.

In this connection, a White House task force had this to say last week in a special report to President Kennedy:

". . . airways and airports of the northeastern corridor are already congested. Absorption of the new jets, therefore, assumes either costly increases in system capacity or more effective utilization of existing capacity . . . an alternative that might be considered is encouraging the transfer of some short- and intermediate-haul air traffic to improved surface facilities."

Airline Communications Network Will Get First Trial This Month

Washington—New electronic switching system which should greatly speed teletype and data communications between participating airlines in the U.S. and abroad will go into trial operation this month.

Three stations will form the network. The first, at Islip, L. I., N. Y., is expected to begin operational duties next month. A second station is to be constructed in Chicago, and is scheduled for operation late next summer. A third station is expected to be built in the Los Angeles area.

Inter-line reservations requests that today must pass through a number of hands and electro-mechanical switching mechanisms, sometimes requiring many hours to reach their destination, will be relayed directly and almost instantaneously, according to Aeronautical Radio Inc. (Arinc) which will operate the new network for the airlines. The electronic data processing which forms the heart of the new network was supplied by Collins Radio at a cost of slightly more than $2 million per station.

The Collins equipment will automatically route a teletype message to its destination or multiple destinations. When landline circuits are busy, it will automatically store messages on magnetic disks or tape until the circuits are available. Provision is made to permit transmission of priority messages by automatically interrupting a routine message, storing it and transmitting it later.

Another important feature is that greatly simplified procedures can be used for addressing messages to their destination without the need for including routing information, according to John S. Anderson, Arinc president. This is expected to simplify training procedures for airline personnel and minimize errors.

Anderson emphasized that the new switching system was made feasible by the low-cost, bulk-communications tariff, known as Telpak, established by American Telephone & Telegraph Co., which places an extensive national landlines network within financial reach of the airlines. The Telpak tariff currently is under investigation by the Federal Communications Commission because of objections raised by Western Union and Motorola. If the FCC should reject the concept, Arinc would be forced to consider construction of its own national microwave network to support its needs, Anderson said.

Airlines which will participate in the new system currently deliver about 16 million words per day by teletype, with an average of 24 words per message.

U.S. and foreign airlines will participate in varying degrees in the new switching system. Eleven airlines have arranged to participate fully, using the new switching centers both to handle inter-line teletype and data communications as well as for switching of their own intra-airline communications. These airlines include American, Central, Continental, Frontier, North Central, Northwest, Ozark, Pan American, Trans-Texas, Trans World and Western.

Delta, United and Eastern, each of which has its own intra-line automatic switching system, will tie-in to the Arinc system for inter-line teletype and data communications. Discussions are under way at present with Braniff and National Air Lines, Anderson said.

The switching station at Islip will be connected to the Atlantic submarine cable, while the Los Angeles station will connect to high-frequency radio links to Hawaii, making possible direct, speedy transmission of messages from Europe to the U.S. and Hawaii.

The transition from present individual airline electro-mechanical switching facilities to the new network will be gradual, so as not to disrupt service. Pan American will be the first airline to begin using the new Islip station, followed in January by American Airlines. The remainder of the participating airlines are expected to begin using the new system by early fall, Anderson said.

Pending construction of the second station in Chicago, Arinc will use Collins data processing equipment installed in the company's Cedar Rapids, Iowa plant. No date has been set for construction of the third station in Los Angeles. However, pending its construction, the facilities at Cedar Rapids and Chicago can be used, with West Coast messages routed to the Midwest and back.

The new electronic switching system is not intended to permit direct communications between individual airline reservations computers, a problem currently under study by the airlines. However, it can be used to route teletype space requests directly into a reservations computer where the airlines involved have the same type computers. Such an arrangement is planned by American, Delta and Pan American.

In addition to the automatic routing function, the new Collins equipment also will provide automatic accounting of message traffic so that system operating costs can be pro-rated to user airlines, as well as automatic recording of the time messages and are received and transmitted.

Completely dual data processing equipment is planned for each of the three stations, with both operating continuously. Only one will be on the line, but the other can take over instantly in event of failure. Electric power will be supplied by a continuously-running diesel generator operating in parallel with local power so that even a momentary failure of the latter will not disrupt service.

The new electronic switching system capabilities will encourage the airlines to implement ground-air data link for transmitting routine instructions and weather data to in-flight aircraft, Anderson predicted. Because data link is a pulse-coded communications system, compatible with the teletype facilities of the network, it will be possible for the system to automatically route a message from an airline operations office to the intended aircraft cockpit without human intervention.

Flying Tiger Ordering Two DC-8F Aircraft

New York—Advantage in bidding for military passenger and cargo contracts is an aim of the Flying Tiger Line in ordering two DC-8F jets. Cost of the airframes, engines and spare parts total $17,000,000.

Aircraft, capable of carrying 189 passengers in high-density seating, or 95,282 lb. of cargo, are scheduled for delivery in January and March, 1964.

Robert W. Prescott, president of Flying Tiger, said earlier this year in a speech at New York (AW Oct. 15, p. 49) that "any equipment additions we would make would be CL-44s," adding that this aircraft would satisfy the carrier's needs for 10-15 years.

Flying Tiger spokesmen said, however, that Prescott was speaking then in terms of freight service. The DC-8Fs, with their passenger capability, are desired to facilitate the airline's efforts toward more Military Air Transport Service passenger charters, the spokesman said.

Carrier made a $70,000 down payment on the order. Only last May Flying Tiger received the last of 10 CL-44s obtained at a cost of $55,000,000. It also operates nine Lockheed 1049H freighters and is negotiating for the lease of three Electra passenger aircraft from Lockheed.

Airline is reporting improving revenues as result of its use of the CL-44s, and has declared a stock dividend of 5% payable Feb. 15, 1963. Dividend is the third declared on outstanding stock; others were in 1958 and 1960.

TWA Hostess-Purser Strike Averted

New York—Strike by 1,600 hostesses and pursers against Trans World Airlines was averted last week when tentative contract agreement was reached with the Transport Workers Union.

Walkout was scheduled for noon Thursday, when the 30-day cooling off period following federal mediation expired. Tentative agreement followed a 22-hr. bargaining session between TWA and union Local 550.

Union did not disclose terms of the agreement, saying announcement must await final wording of the contract. Employes were seeking wage increases approximating 8%, reduction of work hours from 78½ to 70 hr. a month, and added sick leave.

Negotiations have been under way since February. Contract will be the first for TWA's hostesses and pursers under TWU representation. Membership recently transferred its affiliation from the Air Line Pilots Assn. to the TWU.

Carriers Expect 1962 Traffic Rise Despite Slump in Last Six Months

Washington—U.S. domestic trunkline passenger traffic continued to level off during the month of November, but chances now appear strong that revenue passenger miles will show about a 9% gain for the year, compared with a 1% increase in 1961.

Heavy traffic volume during the first half of the year is expected to offset the discouraging trend experienced during the latter half of 1962. However, despite an expected relatively good showing for the year, a dwindling load factor for all airlines is causing increased concern within the industry.

Industry load factor for November was 49.5%, the second consecutive month it has remained below the 50% mark. Highest load factor reported for the month was 57.6%, earned by Delta. Only four other trunk carriers were able to generate a load factor above 50%.

A further cause for concern in November is the continued inroads coach passenger traffic is making on first-class traffic. During the month, coach service accounted for 66.6% of total revenue passenger miles, compared with 58.9% in November, 1961. For the first 11 months of the year, coach accounted for 65.1% of the total, compared with 57.3% in the same period last year.

For all 11 trunklines, coach traffic increased 17.6% in November while first-class traffic dropped 15.7%. No trunk carrier registered an increase in first-class traffic, but only one airline, Northeast, failed to show a gain in coach revenue passenger miles.

Delta's coach traffic jumped 80% during the month and Continental's rose 50%. Coach available seat miles for the industry reached 3.1 billion, a 21% increase over the same period last year. First-class seat miles dropped 8.5% to 1.8 billion.

American Airlines showed no gain in revenue passenger miles for the month, while United reported a slight increase in traffic, about 2% over the volume handled in November, 1961. TWA registered a 10% increase and Eastern a 5% decrease.

The low load factors and the continued diversion of first-class traffic to coach is expected to have a serious effect on net profits for the year. These two problems are the source of a major industry split, with low fare advocates holding that a cut in prices will restore load factors while high fare supporters feel that closing the coach and first-class rate gap will stop the diversion.

In the center is W. A. Patterson, president of United Air Lines, who believes that a single fare concept will correct both problems simultaneously. During November, United's decline in first-class revenue passenger miles was substantially less than other trunklines and its gain in coach traffic was 7%.

Industry first-class load factors in November were the lowest in history for this category of service. First-class load factors of three trunklines dipped below 40% and the highest recorded was Delta's 49.3%, followed closely by American with 49.2%.

Delta also showed the highest coach load factor in the industry with 63.2%. It was the only trunkline to pass the 60% level in coach services. American had a 56.6% coach load factor.

Local service carrier traffic continued to show the steady traffic growth pattern it has experienced throughout the year. Revenue passenger miles reached 138 million, an 18.5% increase over the volume reported in November, 1961. Available seat miles, however, climbed to 333 million, a 20% increase over the corresponding period last year.

As a result, local service load factor dropped slightly from 42% to 41.5%. Bonanza, Ozark, Piedmont and Southern compiled major gains in revenue passenger miles during the month.

CAB Favors Common Fares Within Hawaii

Washington—Civil Aeronautics Board has ruled that it cannot compel Hawaii-U. S. mainland carriers to adopt common fares covering air services within the state of Hawaii, but said it would have "no hesitancy" in approving such fares if they are filed by the airlines.

In a final opinion in the Hawaiian Common Fare Case, the CAB reversed the stand on the fare issue it reached in 1949, when it found that common fares to consecutive points are ordinarily unsound in principle. The latest case was instituted when Aloha Airlines and Hawaiian Airlines proposed a fare between the U. S. mainland and various points in Hawaii at the same dollar value as the fares between the mainland and Honolulu.

The joint fare proposal was supported by the state of Hawaii and CAB Bureau Counsel, but was opposed by Northwest Airlines, Pan American World Airways and United Air Lines, the three mainland-Hawaii U. S. carriers.

Current Tariffs

Under current tariffs, passenger fares are computed by adding the mainland-Honolulu basic fare to the fares from Honolulu to the outer islands—Hawaii, Maui, Molokai and Kauai. Under the proposed plan, fare to all Hawaiian points from the mainland would be the same and revenues therefrom would be pro-rated between the mainland carriers and the local Hawaiian airlines.

In its 1949 decision, the Board found that since it was unable to prove justification for the common fares, such fares must be held "unjust and unreasonable." In its latest decision, the CAB agreed with the earlier opinion that, as a general proposition, charging the same fare for a longer distance as for a shorter one is unsound in the field of rate making. It added:

"However, as the 1949 decision clearly indicates, the Board did not find that the principle set up an absolute bar to common fares, but only that such fares should not be allowed in the absence of special justification. On the comparatively limited record before it in that proceeding, the Board found no special justification. Here . . . we have before us a comprehensive record which contains voluminous evidence bearing on the need for common fares and the special circumstances which justify them."

Unique Circumstances

In developing this "special justification," the Board agreed with the examiner who said that unique circumstances surrounding the economy of Hawaii have special significance in the support of common fares:

- **Hawaiian economy** has a narrow base.
- **Economy of outer islands** is centered on the principal economic activities of Oahu, site of the state capital—Honolulu. Economic growth of the outer islands is less than that of Oahu.
- **Outer islands have little** opportunity to improve their economies except through tourism.
- **The state must rely entirely** on air traffic for the movement of people between most of its counties and cities.
- **Hawaii—as a state—is** more of an economic unit or common trade area than when it was a territory.

In the 1949 decision, the Board found that there was strong competition between the individual islands for the tourist dollar and that common fares would tend to divert tourist business from the nearer to the farther islands. However, in the later investigation, the Board concluded that the people of Hawaii now seek a fare structure that will treat the state as a unit and will make all the advantages of the state available to travelers on an equal basis.

Tourist Trade

It further concluded that common fares will benefit all islands without affecting the ability of each island to compete for tourist trade with the others. In addition, the Board found that, not only does Oahu—now the center of the tourist trade—support the common fare, but that members in the state legislature have shown a willingness to appropriate money for the development of tourism in neighboring islands on grounds that the whole state will benefit by such action.

In its decision, the Board stated that "the outer islands and Honolulu are interdependent economically, and tourist destinations are more complementary than competitive."

The Board showed one major concern in its opinion. It said it is apparent that, over an extended period of time, additional capacity may be required to accommodate the new traffic generated by common fares. In addition, it suggested that it would be necessary for mainland-Hawaii carriers to stimulate an additional 12% traffic volume to offset the lower common fares.

It concluded that these opinions should not be taken as "a prejudgment of any joint fares which may be filed in the future" and then added:

"If the carriers were to conclude that common fares would stand a good chance of producing adequate revenues, the Board would not . . . be averse to a reasonable experiment in introducing common fares to Hawaii. If such fares do not work out satisfactorily, the carriers would cancel them."

ATA Directors

Washington—Air Transport Assn. last week elected five new directors to its 12-man board. They are:

Lewis W. Dymond, president, Frontier Airlines; C. M. Belinn, president, Los Angeles Airways; L. B. Maytag, Jr., president, National Airlines; D. W. Nyrop, president, Northwest Airlines; and Joseph H. FitzGerald, president Ozark Air Lines.

Re-elected directors are C. R. Smith, president, American Airlines, C. E. Woolman, president, Delta Air Lines; E. V. Rickenbacker, board chairman, Eastern Air Lines; Robert W. Prescott, president, Flying Tiger Line; J. T. Trippe, president, Pan American World Airways; Charles C. Tillinghast, Jr., president, TWA; and W. A. Patterson, president, United Air Lines.

Eastern's Air Shuttle Service Shows Increase

New York—Growing passenger volume on Newark-Boston schedules is the reason for air shuttle service expansion, according to Eastern Air Lines.

Flights now depart Newark each hour on the half hour from 7:30 a.m. to 10:30 p.m. every weekday. Accompanied by restoration of nonstop shuttle service between Boston and Washington, the expansion adds 2,340 seats to Eastern's daily schedules linking Boston-New York-Washington.

Service now provides flights each half hour between La Guardia/Newark and Boston. Previously, shuttle flights departed Newark 30 min. after each odd numbered hour. Hourly shuttle service from La Guardia to Boston between 8 a.m. and 10 p.m. continues.

Resumed Boston-Washington nonstop service offers departures from both points at 7:30 and 11:30 a.m. and 2:30, 5:30 and 8:30 p.m.

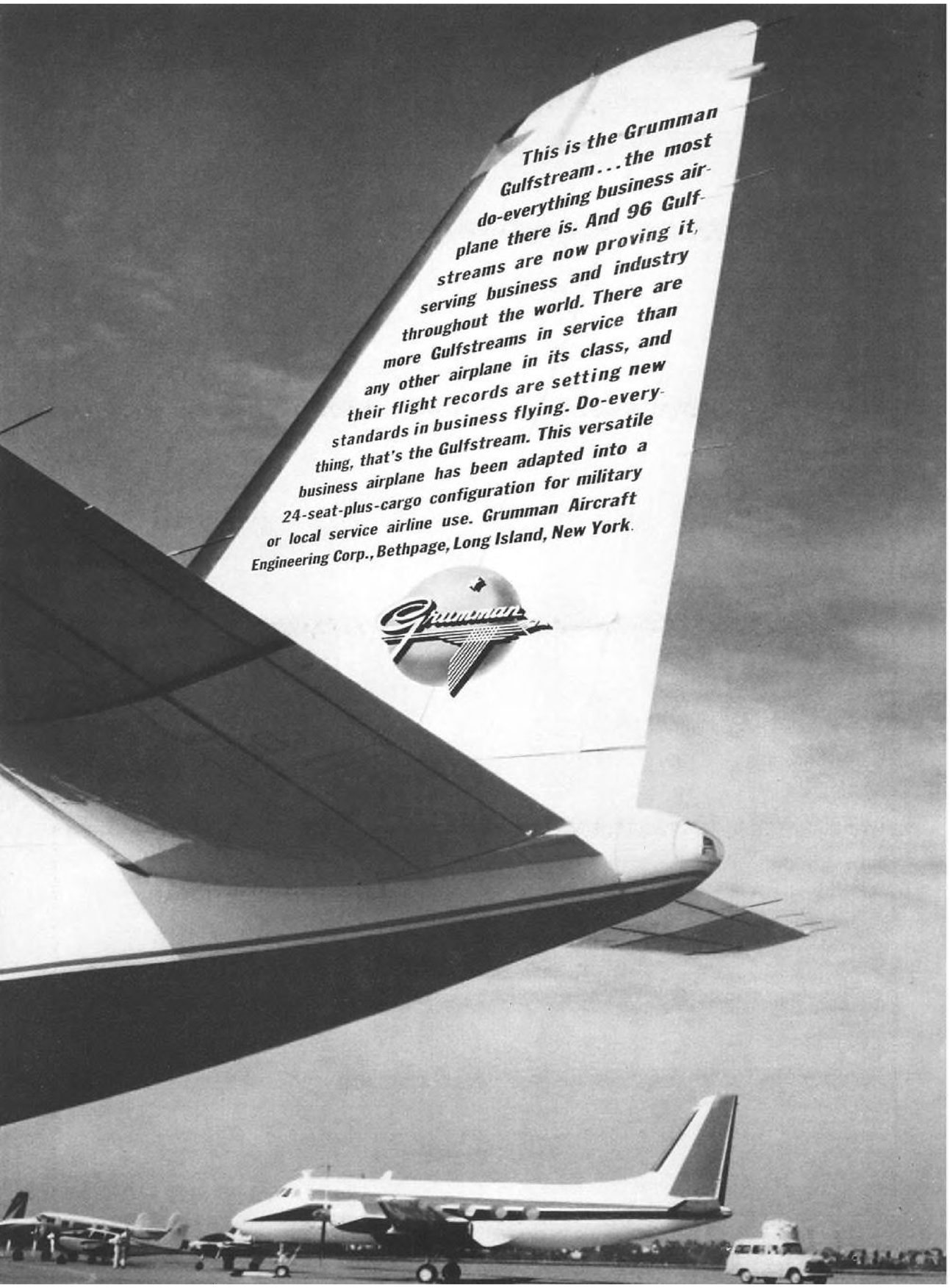
Hourly service from La Guardia to Washington and half-past-odd-hour departures from Newark to Washington continue unchanged, although Eastern spokesmen say volumes are increasing on these schedules to where a frequency matching that to Boston will likely be inacted soon.

"We were having to run so many extra sections on the Newark-Boston schedules that doubling the frequency was justified," an Eastern official said.

Lockheed Constellations with 95 seats are used on the shuttle between La Guardia-Boston and Boston-Washington, while 90-passenger DC-7Bs will fly between Newark-Boston.

Airline Traffic—October 1962

	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	11,259	697	550,157	54	71,838	6.4	11,292	98.1
Braniff	2,691	206	98,030	52	11,452	4.3	2,647	99.4
Continental	2,141	122	82,391	46	9,310	4.3	2,143	98.2
Delta	5,029	369	226,292	56	26,428	5.3	5,043	98.5
Eastern	8,253	646	292,332	42	33,129	4.0	8,373	97.2
National	2,595	154	114,083	47	13,389	5.2	2,596	97.8
Northeast	1,369	111	47,316	50	5,018	3.7	1,481	90.4
Northwest	2,636	177	116,268	51	14,072	5.3	2,646	99.1
Trans-World	8,345	436	397,625	48	47,382	5.7	8,303	99.3
United	15,746	979	652,579	49	81,444	5.2	15,891	97.3
Western	2,103	175	96,590	48	10,286	4.9	2,130	97.1
INTERNATIONAL								
American	164	9	9,174	52	1,245	7.6	164	100.0
Braniff	253	7	9,654	41	1,307	5.2	285	87.2
Caribair	134	38	2,997	53	311	2.3	123	95.3
Delta	109	2	3,043	33	367	3.4	112	97.5
Eastern	746	32	46,076	53	4,883	6.5	756	98.7
Mackey	65	5	1,580	40	160	2.5	40	99.3
Northwest	942	22	46,084	50	7,871	8.4	879	99.4
Panagra	339	11	18,219	58	2,721	8.0	330	99.5
Pan American	9,217	344	602,225	58	89,800	9.7	8,550	97.7
South Pacific	32	1	1,027	40	110	3.5	22	100.0
Trans Caribbean	269	12	30,798	74	2,988	11.1	124	97.1
Trans World	1,922	40	130,323	55	19,605	10.2	1,902	99.3
United	546	17	41,828	64	5,137	9.4	546	98.6
Western	133	6	9,618	70	1,045	7.8	133	100.0
LOCAL SERVICE								
Allegheny	971	90	18,434	42	1,956	2.0	997	97.0
Bonanza	499	37	9,530	50	948	1.9	502	99.2
Central	670	30	6,171	35	670	1.0	666	99.4
Frontier	924	34	8,760	32	965	1.0	935	98.4
Lake Central	573	40	6,501	40	709	1.2	568	97.8
Mohawk	965	95	20,691	50	2,116	2.2	957	97.0
North Central	1,266	92	16,362	40	1,799	1.4	1,254	98.9
Ozark	903	67	12,833	50	1,369	1.5	920	97.9
Pacific	479	43	9,760	49	970	2.0	512	93.3
Piedmont	935	65	14,969	42	1,597	1.7	940	98.0
Southern	895	49	9,258	35	991	1.1	884	97.7
Trans-Texas	715	35	8,258	38	883	1.2	694	99.0
West Coast	574	29	7,157	38	734	1.3	593	95.2
ALASKA & HAWAIIAN								
Alaska Airlines	308	7	4,997	37	2,203	7.2	155	94.4
Alaska Coastal	145	10	738	55	90	0.6	99	93.4
Aloha	176	26	3,955	56	325	1.8	175	96.6
Cordova	59	2	221	31	55	0.9	37	95.9
Hawaiian	248	33	4,851	52	566	2.3	253	90.0
Kodiak	34	1	70	42	9	0.3	16	99.5
No. Consolidated	137	2	574	31	187	1.4	109	94.8
Pacific Northern	363	11	9,211	27	1,707	4.7	370	96.5
Reeve Aleutian	93	1	1,266	35	330	3.5	79	88.6
Western Alaska	24	1	23	38	5	0.2	17	98.7
Wien Alaska	285	3	1,147	30	413	1.5	137	95.8
HELICOPTERS								
Chicago	35	7	132	39	13	0.4	34	99.3
Los Angeles	53	9	341	39	39	0.7	73	72.2
New York	44	19	395	38	40	0.9	52	78.0
CARGO & OTHER								
Aerovias	103	2	2,044	75	514	5.0	54	89.4
Avalon	30	6	325	56	32	1.1	10	89.3
Flying Tiger	1,432	5	20,733	73	22,709	15.9	404	96.9
Riddle	1,153	4	16,931	88	9,573	8.3	116	99.4
Seaboard	658	6	24,817	98	12,846	19.5	313	87.8
Slick	793	1	2,510	53	10,554	13.3	162	90.2
INDUSTRY TOTAL	93,580	5,480	3,870,274	51	539,215	5.8	89,598	97.7



Tests Seek Lower Caravelle Minimums

By Robert E. Farrell

Paris—Sud Aviation and Lear Siegler, Inc., have completed an 18-month test program of an automatic landing system which may permit user airlines to operate Caravelle aircraft under limited weather conditions of 100-ft. ceilings and ¼-mi. visibility.

Test program was sponsored by French civil aviation authorities and by U. S. Federal Aviation Agency. French-government-owned Caravelle 01 prototype was equipped with standard LSI Astronics L-102 automatic flight control system installed on all of Sud's Caravelles.

Linked with the L-102 autopilot is a Sud-Lear-developed automatic landing system which its designers claim provides automatic control of the aircraft, including throttle control from glide approach through flare-out to touchdown.

While program contract calls for 20 successive automatic landings, 250 automatic landings already have been made. Sud-Lear system is scheduled to be publicly demonstrated for the first time this week at Orly Airport, Paris.

French government and FAA officials in Paris confirmed claims that the test aircraft has exceeded contract demands. The 20 successive automatic landings had to be achieved within ±250 ft. of average touchdown point longitudinally and ±25 ft. laterally. Touchdown dispersion throughout the whole test program, however, has been about one-half the contract allowance. Automatic throttle control has maintained let-down speed on a ±3-kt. allowance.

FAA Participation

Sud-Lear automatic landing system is one of several such systems currently under study by French aviation authorities. FAA participation, however, is limited to the Sud-Lear program.

Commenting on the latter, one top French aviation official told AVIATION WEEK a decision would shortly be made which may permit Caravelle users to operate into certain French airports on basis of 100-ft. ceilings and one-quarter mile visibility. Presumably, these new minimums would be extended around Europe.

Generally accepted jet minimum landing requirements in Europe for Caravelles are 200 ft. ceiling and half-mile visibility. European studies have shown that if the 100-ft. ceiling, ¼-mi. visibility minimums were accepted, about 80% of canceled European flights due to weather conditions could be flown.

French approval of lower jet minimums for Caravelle operations would also assume high-precision ILS ground equipment. Such equipment is available at most of Europe's major airports, though local terrain conditions might nonetheless rule out any lowering of minimums.

"We don't quarrel with Sud-Lear claims that their system can be used with existing ground equipment," notes one French aviation official, "but we will only lower present minimums where the ILS signals are highly reliable and where local terrain isn't a factor."

Lear officials say their automatic landing system installed on the 01 Caravelle, while a developmental system, uses standard production electronic submodules supplied in other LSI Astronics' divisions systems. It is understood that the final production system will be only slightly different from the developmental automatic landing system now being used. Extra weight involved in the aircraft installation amounts to roughly 45 lb. and cost is described as negligible. Production of the automatic landing system, which is designed to operate with existing airport ground equipment, will be available for installation on present operational Caravelles late next year.

Only additional airborne equipment required in the cockpit for the Sud-Lear automatic landing system is a radio altimeter. This instrument is not used as a direct control signal but only as a command signal to regulate rate-of-descent during the last few seconds of flight. Caravelle test aircraft uses a French-developed radio altimeter designed especially to operate in the region of zero altitude to 200 ft. Lear engineers, however, claim most present day radio altimeters should be adequate for the mission.

For longitudinal control during descent, the Sud-Lear automatic landing system utilizes an instantaneous vertical velocity sensor (IVVS) which links ground control signals with the automatic pilot. IVVS is used as the primary control reference during approach, flare and touchdown, and once introduced into the system during engagement of glide path there is no further switching of direct control signals. Sud-Lear officials claim this to be a major feature of their system since the pilot knows before the flare is initiated that the basic system is working correctly.

At roughly 200 ft., the ILS glide path error signal, which has been used to command rate of descent, begins to fade out on command from the aircraft's radio altimeter. At 50 ft., the glide path signal is completely phased out and the radio altimeter signal is then the primary command signal for scheduling the aircraft's rate of sink. An exponential flare is then controlled to touchdown.

Tight Control

Lear engineers say their IVVS provides glide path control that is much tighter than normally obtained from standard approach couplers. Same degree of tightness, Lear-Sud officials say, is maintained throughout flare and touchdown.

Andre Turvat, former Nord Aviation test pilot and currently chief test pilot on the Caravelle automatic landing program, claims aircraft flight path is so smooth that the pilot knows the flare mode has been initiated only by a gradual slowing down of the rate-of-descent resulting in a glide path error above the beam.

Sud-Lear engineers also claim that use of high-gain lateral coupler permits substantial improvement in lateral path tracking accuracy.

Electronics necessary for the automatic landing system—including the lateral and longitudinal couplers and the throttle control system—are housed in a single package. This package represents the first step in the Sud-Lear program aimed at achieving automatic landings in zero-zero weather conditions.

Sud-Lear present thinking is that it may not be necessary for complete redundancy to meet operational safety requirements for zero-zero landings. Current French aviation official thinking, while willing to be convinced, does not agree with the Sud-Lear philosophy when it is used for zero-zero landings.

Production planning on the proved-out Sud-Lear automatic landing system is moving ahead to make it possible for Caravelle users to modify their aircraft with the new system and thus benefit from the expected decision permitting lower operating minimums.

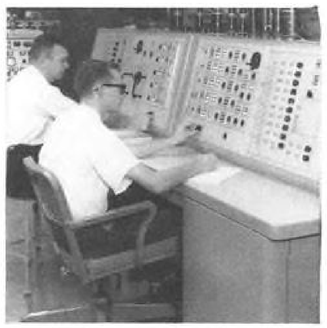
Concorde Lineup

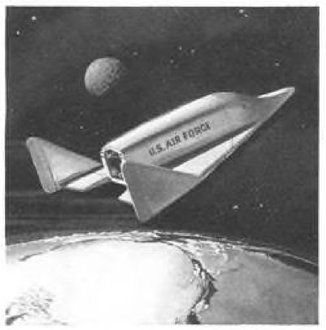
London—Sir Arnold Hall, chairman and managing director of Bristol Siddeley Engines, Ltd., will be the first president of a joint Anglo-French committee to develop the Olympus 593 powerplant for the Concorde supersonic transport.

Posts of president and vice president will be rotated every two years between British and French nationals, similar to the airframe design group (AW Dec. 3, p. 41). Next president will be Henri Desbrueres, president of Snecma, the French engine company, currently serving as vice president.


Weapon system management: BOMARC


System integration: MINUTEMAN


Electronics engineering and manufacture



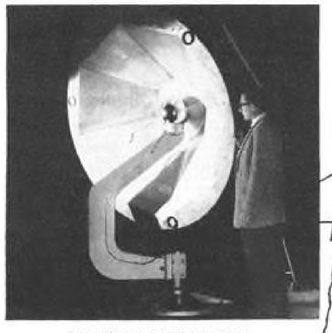
System contractor: DYNA-SOAR

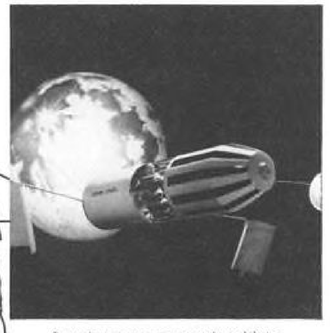

Space booster development: SATURN S-IC

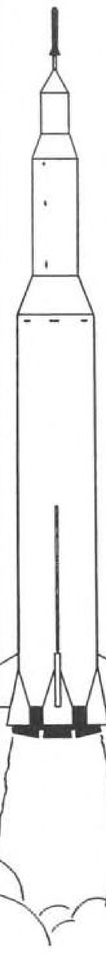


HYDROFOIL development, construction


Space medicine research


Satellite control research


Counter-moon research vehicle



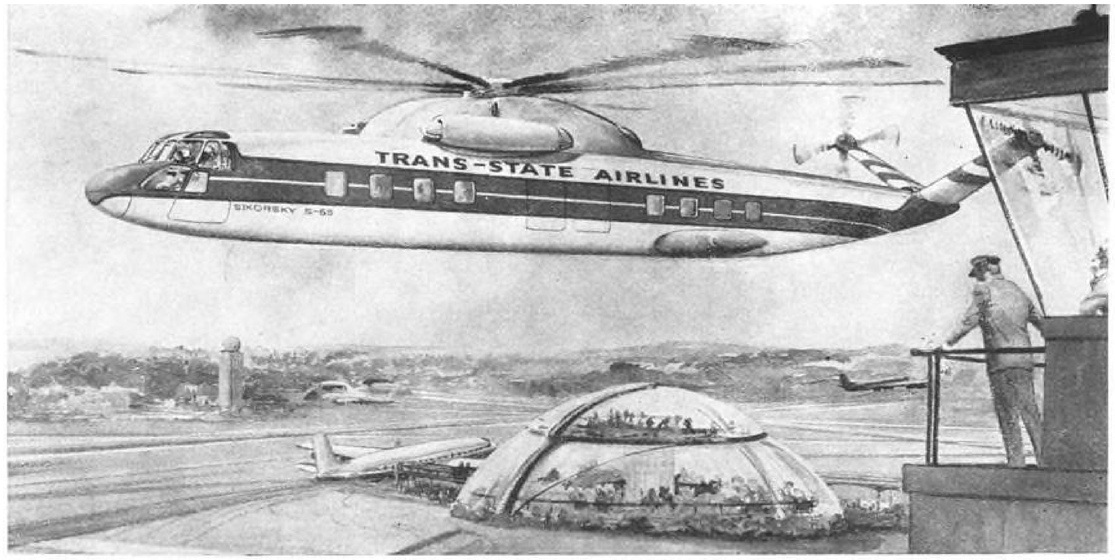
Management for today and tomorrow—by Boeing Aero-Space Division

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AERO-SPACE DIVISION



Sikorsky Revises S-65 Passenger Helicopter Configuration

Major revision in design of the Sikorsky S-65 50-60 passenger helicopter is shown in this new artist's concept. Previous concept (AW Jan. 8, p. 37) more nearly resembled the S-64 flying crane. New configuration has longer fuselage, redesigned engine mountings with the engines moved aft, twin tail rotors which are boom-mounted and an enclosed rotor head. Center fuselage doors have been added and the fuselage sponson has been moved aft. Original version was to have a 400 mi. range and cruise speed of about 150-200 mph.

Frontier Undergoes Refinancing Program

Credit agreement involving $3,500,000 has been extended by four banks in a refinancing program for Frontier Airlines.

Loan will retire existing long-term debt totaling $2,300,000 and will also cover the purchase of additional twin-engine Convair aircraft. Interest rate is 5¼%, compared with 5½% for the previous loan being retired.

Frontier officials said the new loan is based on the carrier's existing resources, and was made without the federal guarantee which applied to the previous debt.

Funds were provided for the new loan by the Colorado National Bank of Denver, Walker Bank & Trust of Salt Lake City, Valley National Bank of Phoenix and the Bank of New York.

FAA Changes Stand On Anti-Collision Plan

Washington—Federal Aviation Agency has changed its earlier views and now plans to fund new airborne anti-collision system programs. But primary emphasis will be on defining system requirements and how such a system would work in the air traffic control environment, rather than on hardware procurements.

The action follows airline and industry criticism of the agency's earlier plans to halt work on airborne anti-collision systems for lack of promising solutions (AW Oct. 22, p. 37; Dec. 3, p. 40). FAA's system management division currently is examining existing programs and will prepare a proposed program for Fiscal 1963 funding for top-level approval. Target date for getting approval is March.

The one area where the FAA might procure limited hardware for tests is airborne proximity warning indicators, but even here major emphasis will be on establishing feasibility by analysis and limited tests.

A new policy statement on anti-collision systems, which provides program guidance for FAA personnel, was approved recently by Robert J. Shank, deputy administrator for development. The policy statement sets out the following principles:

- **Air Traffic control system** is expected to be the "principal means of collision prevention," but the role of the collision avoidance system and proximity warning indicator "is recognized within this frame of reference."
- **Collision avoidance system** (CAS) effort will be conducted with two basic objectives in mind: to establish CAS system characteristics which can meet requirements and also be compatible with the air traffic control system and establish criteria which can be used for guidance of future development effort, either publicly or privately financed, as well as criteria for evaluating proposed systems.
- **"Significant benefits would result** from the use of an effective proximity warning indicator (PWI) by itself" and the FAA "will continue feasibility testing of promising PWI techniques."

At the recent meeting of the Radio Technical Commission for Aeronautics, Shank had responded to criticism of FAA's earlier policy by suggesting that the airlines and other airspace users could fund the development of PWI systems if they felt their use would be beneficial.

But an Air Transport Assn. spokesman replied that this was not feasible until the FAA had determined and advised airspace users how such devices would fit into the existing traffic control system. The FAA's policy statement appears to acknowledge the agency's responsibility in this respect.

Air Afrique Will Buy Two DC-8 Transports

New York—Purchase agreement for two Douglas DC-8s has been signed by Air Afrique, the airline operated by a consortium of 11 African republics.

Delivery of the two Series 50 turbofan-powered aircraft is scheduled for October, 1963, and January, 1964. Initial service will be between France and principal cities of the consortium. Cheikh Fal, president of the airline, says bilaterals are being sought for extension of routes to other nations outside Africa.

Financing for the aircraft is being arranged through the Export-Import Bank. A $600,000 loan to formalize the purchase order was arranged by Douglas Aircraft Co. through the First National City Bank of New York.

Aircraft will be the first turbine equipment operated by the African airline, which now owns three DC-3s and is leasing 15 DC-4s, one DC-6B and a Lockheed 1049.



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Tupolev Tu-124 is an adaptation of the Tu-104 geometry toward a short-haul transport of the BAC 111 class. Aircraft (above and middle) carries 40-60 passengers and has gross weight approximating 75,000 lb.

Soviet Tu-124, An-24 Shown in New Photos

Characteristic of Tu-124 evident in upper photograph is the uneven line of the wings' trailing edges, most likely a flap feature to give aircraft improved low-speed capability for short and unpaved field operation. Glass observer cone in nose and chin-type radome mounting have been retained as on Tu-104. Antonov An-24 (below) has also been modified to include a ventral fin, as on the larger four-engine An-12. An-24 also has the An-12's characteristic reverse dihedral on the outer wing areas. Medium-range aircraft entered regular passenger service for the first time in November in the Ukraine.







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AIRLINE OBSERVER

► Interest rates for airline equipment loans have dropped to a favorable level due to a general slack in the money market, but the benefit comes at a time when airlines aren't seeking new financing and don't need or want refinancing. Last year, banks were asking 5½%, or about 1% above prime interest rates for a term airline equipment loan. Indications now are that banks will settle for as little as ½% above prime.

► **Supreme Court decision on whether Pan American World Airways should be required to divest itself of its 50% interest in Panagra now is not expected until next spring. Because the decision will have far-reaching effects on U. S. carrier services in South America, the Civil Aeronautics Board's South American Route Investigation will undoubtedly be delayed until after the decision is issued.**

► Proposed Pan American World Airways-Trans World Airlines merger (AW Dec. 10, p. 41) has brought all governmental activities in the international airline field to a virtual standstill. Last week, White House steering committee, which is developing a proposed policy for U. S. international air transportation (AW Nov. 26, p. 38), passed its Dec. 15 deadline without reaching an agreement on recommendations to be submitted to the President. In recent weeks, State Dept. has undertaken no discussions on bilateral agreements with other nations. This apparent wait-and-see attitude establishes the proposed merger as the key to future planning in international aviation both here and abroad.

► **Spectacular growth of airfreight traffic so far this year is causing increasing number of carriers to focus more attention on this category of business as an essential supplement to a relatively unstable passenger traffic growth pattern. Volume of airfreight handled by trunklines and all-cargo lines had increased 21% the first 10 months of 1962 over the same period last year. Competitive sales programs were accelerated this year as each carrier pushed to win a share of this traffic, and will be expanded even further next year.**

► U. S. domestic trunklines last week reported a net loss of $8.9 million for the first 10 months of 1962, compared to a net loss in the same period last year of $17.2 million. According to the Air Transport Assn., the results do not include the same $16 million paid in operating revenues to Eastern Air Lines by nine other carriers under the provisions of the Mutual Air Agreement. Operating revenues of the industry during the 10-month period were $1.9 billion, compared with $1.7 billion for the same period in 1961.

► **Soviet Chairman Khrushchev has reported that Russia "topped its target" for air passenger transportation during the first four years of the current seven-year plan (1959-1965). Goal for 1965 is 50 million air passengers. Speaking before the plenary meeting of the USSR Communist Party's Central Committee, Khrushchev indicated—by omission—that Russian air cargo traffic has been below target thus far in the seven-year plan.**

► Indications are now strong that important headway is being made in the development of a bilateral air transport agreement between Japan and Red China for a reciprocal air service between Tokyo and Peking.

► **Oxygen leakage in the cockpit is suspected as a cause of a fire which destroyed an Air-India Boeing 707 bypass engine transport Dec. 1 on the ramp at Bombay's Santa Cruz airport. Flight engineer and catering personnel escaped before flames swept through fuselage, destroying all but the wings and engines of the aircraft. The 132 passengers scheduled for a flight to Delhi were not yet aboard. Sabotage has been ruled out.**

► Trans World Airlines is in the process of rewiring a Boeing 707-331 transport to couple the Doppler system to the autopilot, which will enable the aircraft to follow a Doppler track more accurately than is now possible by manual autopilot operation. Modification entails the addition of a command-softening system to eliminate the excessive autopilot lurch that would otherwise occur when the Doppler system automatically transfers from one stage to another.

SHORTLINES

► **Air Mali** has inaugurated service between Bamako, Capital of the Republic of Mali, and Monrovia, Liberia, with Soviet, four-turboprop Ilyushin Il-18 transports.

► **Allegheny and Piedmont** airlines have filed a joint tariff with the Civil Aeronautics Board which would allow foreign visitors to buy a $99 ticket good for unlimited travel throughout the U. S. on the systems of both airlines for a period of 30 days.

► **Bonanza Air Lines** has asked CAB permission to discuss with Alaska Airlines and other local service carriers a tariff that will provide for unlimited travel for a specified period at an established rate over all areas of the U. S. served by the local carrier system. Bonanza wants 90 days to discuss such issues as pricing of the fare, proration of revenues, time limitations, details of ticketing and accounting, eligibility for purchase and restrictions with other carriers. Bonanza calls its proposed tariff "AmericaLand."

► **Capitol Airways** has purchased a DC-8F convertible passenger-cargo transport to handle private charter operations and contract work for Military Air Transport Service.

► **Motor vehicle travel,** the airlines' chief competitor, increased 2.6%, in the U. S. during 1961, according to the U. S. Commerce Dept. Passenger cars accounted for 84% of the 737.5 billion vehicle-miles recorded during the year.

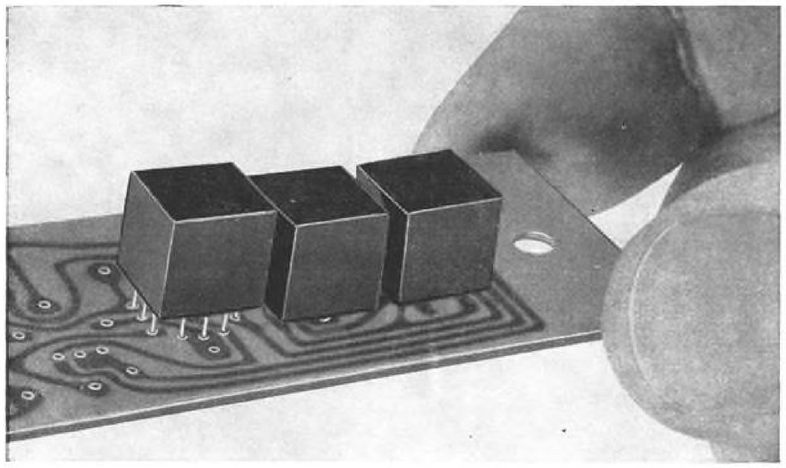
► **National Airlines** last week inaugurated DC-8 jet service between New York and West Palm Beach with one round trip daily.

► **Trans World Airlines** has asked CAB permission to discontinue air service into Ft. Wayne and South Bend, Indiana. TWA reported a steady decline in traffic at the two points, and added that the service "no longer constitutes a significant factor in air transportation at either of these points where unprofitable operations have been conducted."

► **United Air Lines** established a company one-day record of 366,321 ton-miles of cargo, mail and freight on Dec. 5. Company officials attribute the record to shipments of retail merchandise to stock inventories for the closing days of the December Christmas shopping period.

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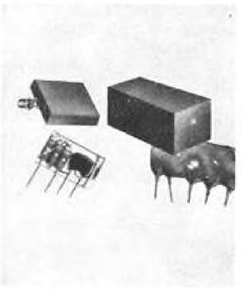


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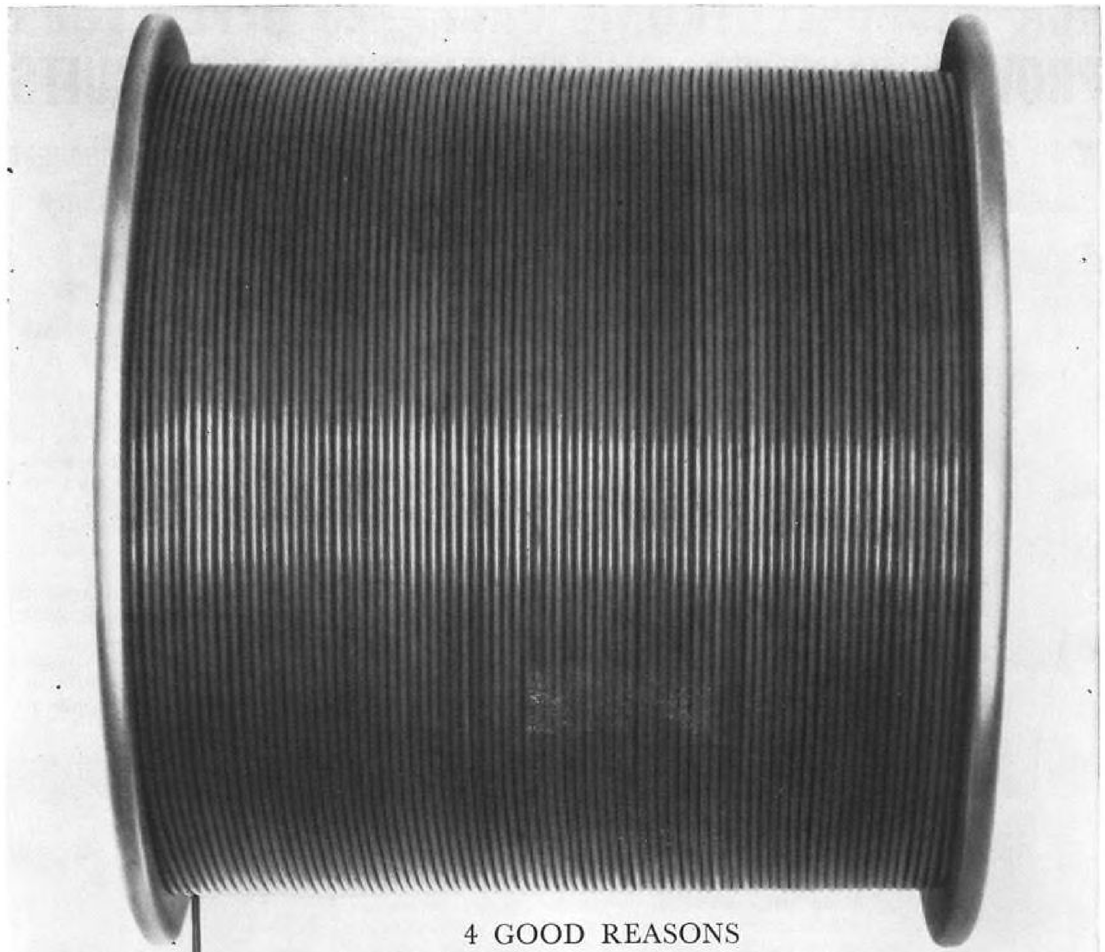
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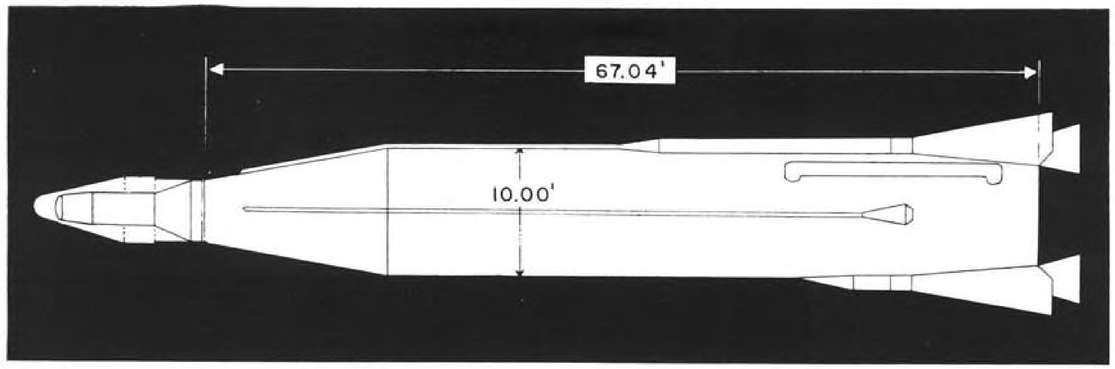
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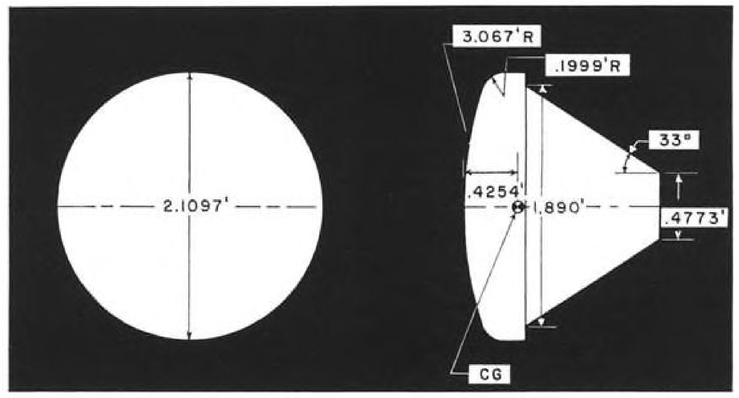
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FIRST DETAILS of the launch configuration for the National Aeronautics and Space Administration's Project Fire (above), which will yield data on various phenomena at near-parabolic re-entry velocities, show Hercules-Allegany Ballistics Lab. X259 Antares 2 second stage mated to General Dynamics Astronautics Atlas D booster. Second stage is shown covered with a modified Nimbus-type shroud for protection from aerodynamic forces during boost. Re-entry vehicle (right), being built by Republic Aviation Corp., is similar in appearance to Apollo re-entry module and will weigh approximately 200 lb. (front and side view shown). Test will measure total and radiative heat transfer, materials behavior and radio signal attenuation at velocities up to 37,000 fps.



Project Fire Design Nearing Completion

By Warren C. Wetmore

Design of the re-entry vehicle for the National Aeronautics and Space Administration's Project Fire—intended to obtain re-entry data at velocities approaching 37,000 fps., which will be applicable to Project Apollo and later missions—is now about 95% complete. Some initial fabrication already has begun.

Purpose of the tests is to measure total and radiative heat transfer, materials behavior, and radio signal attenuation (re-entry blackout) at speeds greater than escape velocity at which future spacecraft returning from lunar and interplanetary missions will re-enter the earth's atmosphere. The primary area of uncertainty is in the problem of radiative heat, according to NASA (AW July 2, p. 223).

Re-entry Velocities

At orbital re-entry velocities of about 25,000 fps., radiative heat transfer from the surrounding plasma sheath is a negligible fraction of the total, but beyond this velocity it increases exponentially. One NASA engineer said that theoretical computations have been made by General Electric, Avco Corp. and NASA, but the results of the studies vary widely. Radiative heating is proportional to some power of the velocity, which in the various studies range between the 12th and 24th powers.

Two re-entry vehicles are being produced by Republic Aviation Corp. under contract to NASA's Langley Research Center (AW Apr. 9, p. 34). Value of the contract is $5 million.

Launch Vehicle

Launch vehicle will consist of a General Dynamics/Astronautics Atlas D booster, and a second stage, or "velocity package," powered by a solid-fuel Hercules-Allegany Ballistics Laboratory X259 Antares 2-A2 engine, which develops a nominal thrust of 19,000 lb. This engine is also used in the third stage of the NASA Scout launch vehicle (AW Mar. 12, p. 185).

Chance Vought Astronautics, which is also the prime contractor for Scout, will build the second stages at a cost of approximately $3 million.

Appearance of the second stage is similar to the configuration of operational warheads on the Atlas and other ballistic missiles, consisting of a hemisphere for the nose, followed by a truncated cone, cylinder and a flared skirt for stability. Length of the second stage, which will weigh approximately 4,100 lb., is 12.2 ft. and the diameter at the base of the flared skirt measures 5 ft.

Static stability tests conducted in the Unitary Plan Wind Tunnel at Langley determined that this shape is the most stable of the five tested at Mach numbers ranging from 1.47 to 4.63.

During boost phase the second stage will be protected from severe aerodynamic loads by a modified Nimbus shroud, which will be jettisoned shortly after Atlas staging.

Second Stage Design

Design of the second stage is a joint effort with NASA, and currently is being held in the final stages pending some minor changes.

Systems integration contract, which has a value of $1 million, was recently awarded to General Dynamics/Astronautics. Company also will provide two



From beneath the ground as well as from the ground up, LSi Instrument Division's new Aerospace Development Center has been built to incorporate the latest techniques in simulating aerospace environment. Space atmosphere is simulated in a chamber where vacuum conditions are created for the testing of entire spacecraft systems in their operating environment. A 175 ton concrete table resting on pilings which extend 45 ft. into the earth provides a "stable table" for delicate instrumentation work without influence from movements of the earth's surface. Within the Center are engineering equipment and facilities specifically selected and specially designed to assist Instrument Division engineers in the establishment of new advancements in aerospace technology. Solid state and electromagnetic laboratories, large areas of engineering "clean rooms," gyro and guidance platform laboratories, radio frequency shielded rooms and many other unique facilities assure the Center and its technical staff of an increasingly important role in the development of highly reliable aerospace systems.

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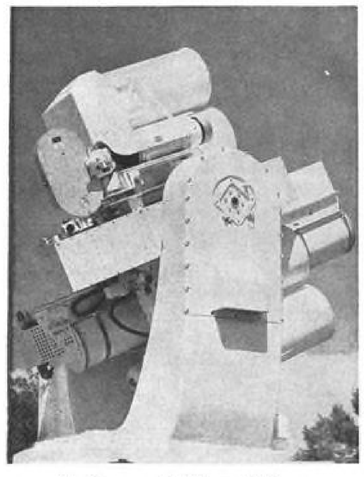
Atlas boosters at a cost of $3.2 million each.

Tentative mission profile, which is essentially an ICBM trajectory, entails booster engine cutoff (BECO), staging and shroud jettison at an altitude of about 250,000 ft. Sustainer engine cutoff is programed to occur at 165 naut. mi., followed by separation of the second stage from the booster by means of retrorockets on board the Atlas. The second stage then coasts to an apogee altitude of 370 naut. mi., during which time it is stabilized and oriented in its re-entry attitude by the Minneapolis-Honeywell Inertial Reference Package. The same system is used in the Scout, except that the control jets employ compressed nitrogen as a propellant, rather than a hydrogen peroxide-catalyst combination.

When the second stage reaches an approximate altitude of 160 naut. mi. and a velocity of 21,000 fps. on the downward leg of its trajectory, the external shell containing the inertial package and associated servomechanisms, second-stage telemetry and C-band radar beacon is detached.

The spin rockets are then fired, imparting a roll rate of approximately 3 rps. to the second stage, and the Antares engine is ignited.

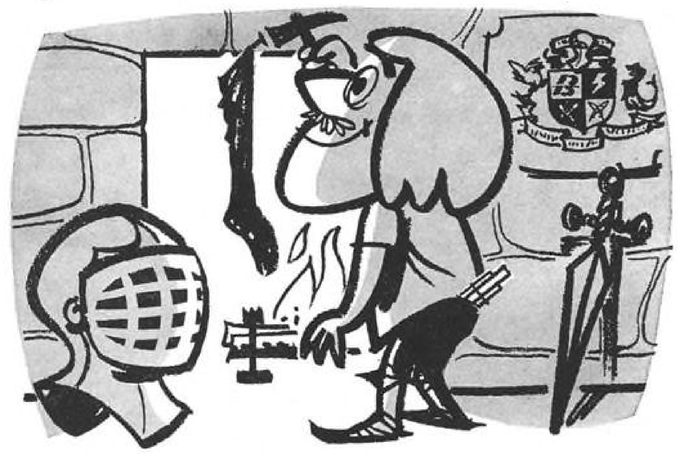
The vehicle is accelerated to 37,000



Infrared Tracking

Infrared missile tracking-measuring equipment, being installed just south of Cape Canaveral and on Ascension Island will measure radiation during launch and re-entry from 0.24 to 14 microns (ultraviolet, visible and infrared). Infrared tracker mounted on Nike-Ajax pedestal is expected to aim pedestal with error of less than 0.2 mils. Pedestal also carries infrared radiometer and photometer to obtain missile signature radiation data. System integration and installation was done under USAF contract by Metric Systems Corp., Fort Walton Beach, Fla.

MINUTES OF THE CURRENT MEETING



(Or: Summations and previews apropos the season)

If the year's-end meeting of the Budd Electronics Chowder and Marching Society will come to some semblance of order, the members and guests will be brought up to date.

The Treasurer wishes to report that the year's receipts of membership dues (which, as is well known, consist of good will alone) have been indeed heart-warming, and that our coffers are brimming over. The organization's officers renew their pledge to guard this uncommon wealth with care.

After long deliberation, the Rules Committee advises of its decision that a special liking for chowder is *not* an essential qualification for membership in the society.

The Business Committee reports that efforts to secure another 1925 automobile to give away have been unsuccessful.[1] However, a number of intriguing membership benefits have been lined up for the near future. Members will be duly advised of these by mail.

The Chairman of the Arms Committee thanks the members who have inquired about the coat of arms, and reports that your curiosity will be satisfied shortly, when you receive your daily reminder books for 1963.

A number of inquiries in the general category of "what *is* the BECMS, anyway?" are reported by the Correspondence Chairman. He has accordingly asked the venerable Chairman of the Tomes Committee to prepare a brief explanation, which we hereby include in the minutes:

"The Budd Electronics Chowder and Marching Society was founded in the belief that good will, comradeship and gusto are not necessarily excluded from competent business in this fast-moving age. To explain the society's origin, let us first examine the helmet that appears in the BECMS coat of arms.[2] This is a jousting or tilting helmet dating from the 15th century. It reminds us today that times do not change the need for men of courage and ability, dedicated to meeting and subduing the adversary, whatever its nature. This belief is part of the basic working philosophy of the original members of the society—the Budd Electronics Research and Engineering staffs. Another basic tenet is reflected in the society's motto: "Sententia Omnium Vires Noster.[3]"

"It soon became evident that this philosophy was shared by a great many men with whom we do business. Membership was accordingly extended to those of similar sentiment and technical interest."

Individual thoughts and amplifications of this theme from members are heartily welcomed. And if, by chance, you have not yet joined, you are cordially invited to do so. Simply tell us your name, title, organization, address, and a few words about your working interests. Write to Chowder and Marching Society, Budd Electronics, 43-22 Queens St., Long Island City 1, N. Y.

1. One of the year's highlights, you may recall, was the society's giveaway of a fully-restored 1925 Dodge sedan in the big Chowder Bowl drawing early in October.
2. Shown in the illustration above.
3. "Unity of Purpose is our Strength."

Budd ELECTRONICS
A DIVISION OF THE BUDD COMPANY, INC.

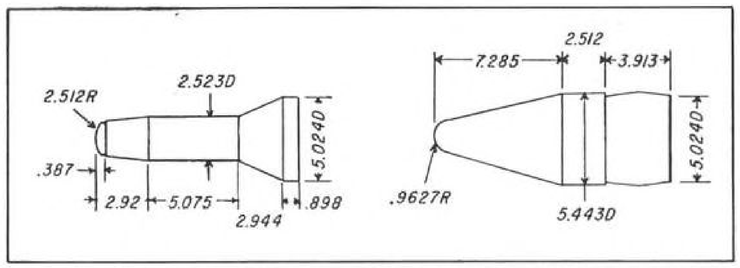
Data Processing & Display Systems
RF Systems • Earth Sciences
Environmental Control Systems
Dynamic Omniforce Facilities Eng.
Reliability Eng. • Field Eng.



GAMMA RADIATION TESTS on Navy computer circuit cards are being conducted at the cobalt 60 irradiation facility at The University of Michigan. Shown above are circuit cards being inserted in the irradiation test cylinder. After the cards are in place, the cobalt 60 source is raised around the test cylinder. The waveform characteristics of the cards are photographed during irradiation to measure both gamma dose rate and total gamma dose effects.

ATTACK SURVIVAL of our Naval forces depends in part upon the ability of shipboard electronic systems to operate after nuclear attack. Using the facilities of The University of Michigan Phoenix Laboratory, Bendix engineers are measuring the effects of gamma radiation on typical shipboard electronic circuits. This is one of a spectrum of Bendix programs covering design of systems tolerant of ionizing radiation from weapons, from nuclear propulsion systems, from nuclear space power systems, and from both natural and induced space radiation. Engineers interested in applications of radiation effects techniques are invited to contact our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division THE Bendix CORPORATION **WHERE IDEAS UNLOCK THE FUTURE**



DRAWINGS of Chance-Vought-ABL second stage (left) and its protective shroud (right) show details and approximate dimensions. Note configuration of second stage, which resembles an intercontinental ballistic missile warhead, and re-entry vehicle in nose. The bulged section aft of the cylindrical portion of shroud is not detached with shroud. This section contains telemetry, attitude controls and radar beacon.

fps. and is at an altitude of 400,000 ft. at burnout. A spring-loaded device separates the re-entry vehicle from the second stage, which is intentionally tumbled to increase the separation distance. The re-entry vehicle enters the lower part of the atmosphere at a flightpath angle of −15 deg. and impacts in the South Atlantic at a point 200 naut. mi. beyond Ascension Island and 4,500 naut. mi. downrange from the launch site. Total flight time is about 30 min.

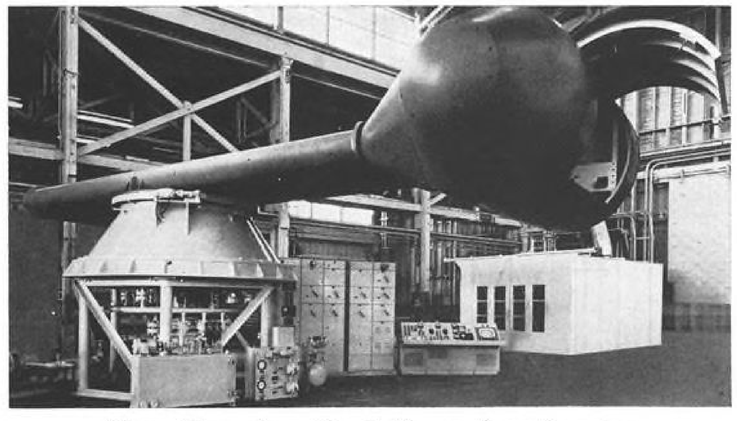
The re-entry vehicle—which resembles a small version of the Apollo re-entry module—has a heat-shield diameter of 2.1 ft. The afterbody is a truncated cone, with a half-angle of 33 deg. and base diameters of 1.9 and 0.5 ft. Overall length is 1.54 ft. and weight will be approximately 200 lb.

Ablative heat-shield is fabricated from three pairs of alternate layers of phenolic asbestos and beryllium. The latter is instrumented with thermocouples and will act as a calorimeter to measure heat flux through the shield. In addition, there are fused quartz-magnesium oxide windows through which radiometers will measure the temperature of the plasma sheath. Thermocouples and pressure transducers are on the afterbody.

Shape of the re-entry vehicle is inherently stable and the spin gives it an added margin of stability; therefore there was no need to incorporate an active stabilization system. FM-FM telemetry will be used for the data link, both in real time and by 40-sec. delayed transmission. A measure of the onset and decay of radio blackout will be obtained through a comparison of the overlapping signals.

First launch of the series is scheduled for the third quarter of 1963, with the second to follow three months later. Vehicle will be launched from Pad 12 at Cape Canaveral.

As yet no follow-on to the program has been approved, and details are still in the speculative stage. NASA is considering means to obtain a higher re-entry velocity, which may entail a different launch vehicle. One possible configuration being studied is an Atlas Agena, topped by a Scout third stage.



Man-Carrying Centrifuge Accelerator

Man-carrying centrifuge accelerator, developed by Rucker Co., Oakland, Calif., will be installed at Air Force's Aerospace Medical Center, Brooks AFB, Tex. System will simulate various forces astronauts will experience during lift-off, multiple stage separation and re-entry of space vehicles. Centrifuge and gondola will be mounted in a 56-ft. dia. concrete arena and will be driven by a 450-hp. engine, which is capable of maintaining loads on test subjects for 8 hr. Peak onset rate is 3g/sec. up to a maximum 50g force.



PUMP PRIMERS

ARTHUR A. NICHOLS

Value Analysis Report On Gerotor Pumps

► The rather unusual qualities of the Gerotor pump which have kept it intimately associated with aircraft pumping applications from the days of the earliest superchargers for reciprocating engines, can best be summed up as *inherent adaptability* and *high reliability.*

► **The Gerotor pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump—simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance at high altitudes and has low wear over a long service life. In addition, it is balanced and extremely quiet in operation.**

► Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors"— inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See Fig. 1.)

► **Gerotor pumps are valveless. Thus they are free from the mechanical troubles, operating complexities, servicing and wear problems inherent in pumps that employ valves.**



FIG. 1

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

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

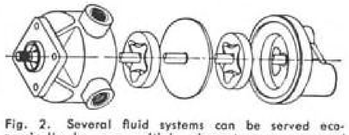


Fig. 2. Several fluid systems can be served economically by one multiple element pump arranged as shown in diagram.

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

W. H. NICHOLS CO.

Makers of Zenith Metering Pumps and the Nichols Milling Machine "the miller that uses its head".

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pable beacons / Dropprs / Drum memory devid test equipment / Echo ounding sonar / Edgebnectors / Educational astomers / Electrical prtrodes, Welding / Electlectromechanical devilectronic equipment (Gctronic systems / Electr equipment / Electro-optxperimental communica Experimental satellites acilities services / Facsng units / Facsimile hicanning / Feed horn as ed systems, Antenna / Fnts and devices / Ferrit Ferrous materials / Filtuits testers / Filters / Fire detection equipment light control, Automatic Foam plastics / Formed cuit connectors / Fuzes accelerators / Gates /Gar boxes, Precision / Gers / Germanium casting Germanium diodes / Ground sund transportation equand systems / Guided m Harnesses, Wiring / Haeight finding radar / Higgh-energy lasers / High-voltage cartridge rectnnectors / High-voltage dicators, Radar / Homianners / Horizontal disnd cold gas control syring devices / Hydrofoilc short range navigation pace systems / ICBM s

Landing vehicles, Lunar / Large-scale general purpose computers / Lasers / Launch control, Ballistic missile / L-C filters / Lenses / Light beam displays / Linear amplifiers / Liquid propulsion systems / Liquid transfer systems / Logistic information processing equipment / Logistic lunar and planetary systems / Long-range navigation systems / Low-altitude air defense Low-frequency equipment / Machine tool control computers / Machine tool controls / Magnetic devices / Magnetic materials / Maintenance equipment / Maintenance handbooks / Manipulators, Remote handling / Manipulators, Unpersonic space system ment / Mapping antenn arine equipment / Marmplifiers / Masers / Mechanical assemblies, dium frequency equip ontrol and guidance systems / Memo-Corder storage units / Memory heads, Magnetic / MEMO-SCOPE® / MEMOT systems / Meteorologic al satellites / Meters / Microminiature digital co lay receptacle connect MICROSEAL* transisto course intercept ballist communication satellit dling equipment / Milit stems / Miniature pres rors, Infrared / Miss dis issile units, systems an Mission control, Space ile equipment / MOBO fication kits / Molecular tion system / Monitor p dicators / Moving targe ers, Digital / Multimode ipment / Multiple-base second switching silico cal data systems / Navi uipment / Neutron linear electron accelerators / Noise generators / Non-ferrous metals / Non-inertial guidance systems / Non-metallic materials / NPN transistors / Nuclear environment handlers / Nuclear powered electric propulsion / Numerical controls / Oceanographic instrumentation, Sonar / Offense weapons / Offensive systems, Space vehicle / Omnidirectional antennas / Optical equipment / Orbiting vehicles / Oscillator tubes / Oscillators / Oscilloscopes / Packaging, Space environmental / Panoramic indicators / Panoramic type receivers / Parabolic reflector antennas / Para

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For prompt attention please address: Mr. S. L. Gillespie, Manager, Employment & Manpower, Hughes Aircraft Company, Culver City 13, California.

NEW

A basic advance in shaft encoders



CODE DISC FROM MODEL DV-15H 3.5 INCH DICOTRON ENCODER WITH 2¹⁵ RESOLUTION. REPRODUCED HERE ACTUAL SIZE.

SLIT RETICULE FROM MODEL DV-15H. 5X MAGNIFICATION.

MULTIPLE SLIT TECHNIQUE*

Until now, all optical encoders which read out directly in digital code have used one slit per track to admit light to sensing cells. Multiple Slit Technique*, radical new approach developed by 3C, involves the placement of many slits on each of more densely packed encoder tracks. Light passing through these tracks is increased by a factor equal to the number of slits.

Advantages? Higher resolution in any given case size. Increased reliability. Multiple slits also increase accuracy by averaging disc errors. They permit a simulated "V" slit width which achieves uniform signal and transition levels through a unique inside/out code disc.*

First production models employing the new technique realize a 4X accuracy increase over traditional single-slit encoders of equal size.

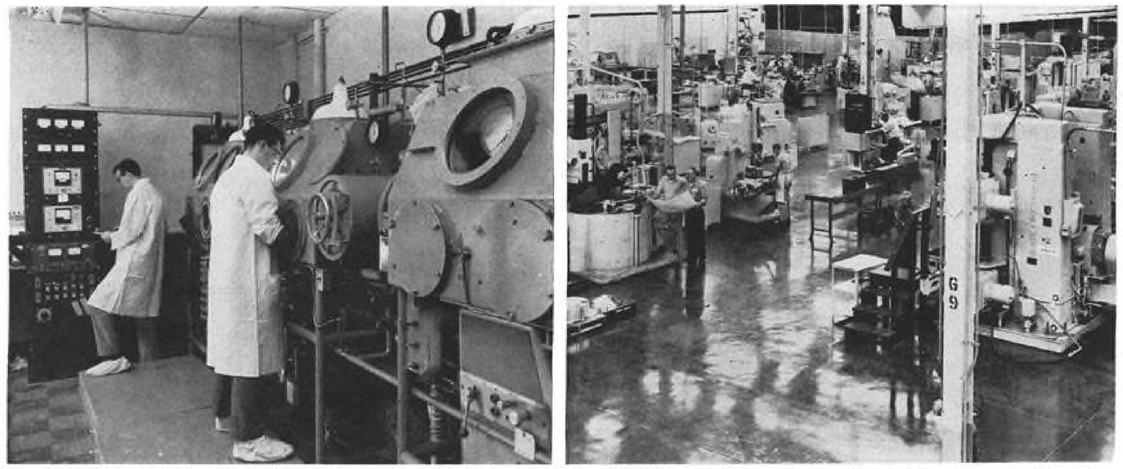
Write for the full story on Multiple Slit Technique, plus data on new 3C Dicotron encoders incorporating the new technique.

*Patent pending

3C

COMPUTER CONTROL COMPANY, INC.

OLD CONNECTICUT PATH, FRAMINGHAM, MASS. • 2251 BARRY AVENUE, LOS ANGELES 64, CALIF.



GLOVE BOXES CONTAINING AN INERT ATMOSPHERE are used by CANEL technicians for handling radioactive materials (left). Machine shop (right) contains conventional tools in unconventional environment almost like a "clean room."

Multiple Safety Features Protect CANEL

By David A. Anderton

Middletown, Conn. – Unique facilities of the Connecticut Advanced Nuclear Engineering Laboratory (CANEL) near here have been directed toward development of the Snap-50 space electric power system (AW Dec. 10, p. 32).

CANEL formerly was the plant where Pratt & Whitney Aircraft Division of United Aircraft Corp. was developing its closed-cycle nuclear engine for aircraft propulsion. When that program was canceled in March, 1961, the activities here were redirected to the development of prototype and follow-on reactor systems for the Snap-50. Both these systems feature the handling and processing of large quantities of radioactive materials.

Safety Record

This work has been accomplished with an excellent safety record ranking high among all industrial establishments.

First look at some of this work was made possible recently as part of the Atomic Energy Commission's program commemorating the 20th anniversary of the first sustained chain reaction in the United States. A tour of some of these government-owned facilities emphasized the extreme precautions taken to protect workers and their environment from the possible dangers of radioactive materials.

One standard recognition of this is in the safety awards made to CANEL. Five have come from the Atomic Energy Commission, for whom P&WA operates CANEL; two from Liberty Mutual Insurance Co., and one from the National Safety Council.

But a more practical criterion is in the pay scale. Grade for grade, technicians working at this location receive exactly the same as their counterparts in other P&WA plants.

There is no premium pay for working in the environment of this nuclear laboratory.

Over the years since work began with nuclear energy, the technology of safety and health on the job has grown tremendously. Standardized approaches have been developed, procedures have been unified, permissible exposures have been more clearly defined.

These standards are in evidence everywhere at CANEL: all employes wear film badges; in certain areas, they also wear disposable clothing; special shoes are worn, but never outside the lab; radiation monitors are located everywhere.

Behind these obvious precautions are a host of other unseen operations that protect the environment of the plant itself and of the countryside surrounding the 1,100 acres on the banks of the Connecticut River. A complete weather station checks the micrometeorology of the area to watch for changes in atmospheric diffusion which controls the movement and dispersion of air masses. A health and safety unit works continuously on laboratory tests and studies checking the exposures to employes and residents of the area. The processed water, pumped out of the river, is dumped through a sewage labyrinth and allowed to seep back through the soil to the river. Any liquid wastes from radioactive areas are held underground for testing before disposal. Solid wastes are cast in concrete and shipped out to AEC disposal areas. The river water, rain water and snow are monitored for radioactivity.

The current result of this extensive safety program is that 97% of all the 1,600 employes here have received no radiation dose.

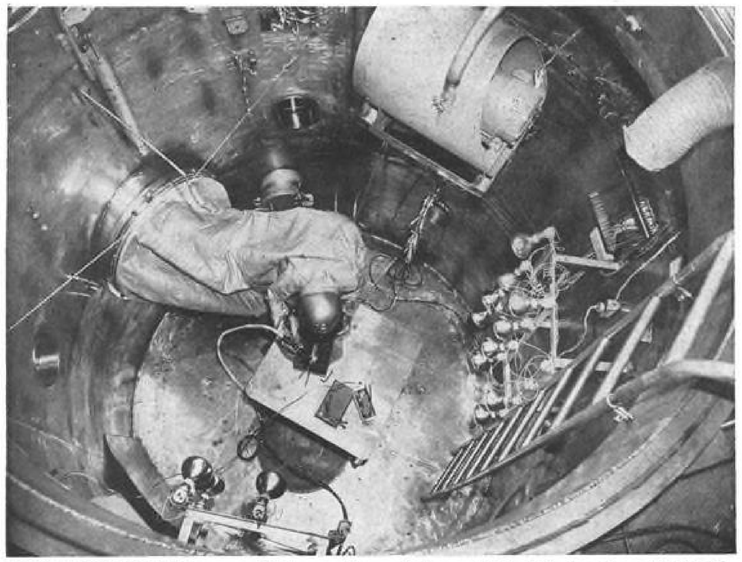
Of the remaining 3% none has received a dosage in excess of one-third the permitted amount.

Precautions Taken

One example of the great attention paid to possible personal contamination was demonstrated as a routine operation recently. Before entering the fuel laboratory, each member of the touring party put on cloth shoe covers and a long lab coat. When he left the area, he was checked by a monitor using a counter to measure the radiation level of the front and back of his hands, the bottom of his feet, and the inside and outside of his notebook. He was then told to wash his hands thoroughly and to remove the coat. He was directed to a narrow portal with a dark line painted on the floor and told to stand on one side, take off one shoe cover, step over the line with the uncovered foot, and take off the second shoe cover. On the other side of the line he was told to wash his hands again.

Fuel laboratory also featured a monitoring area where a large annunciator panel would indicate the presence of fire, motion, or radiation by colored lights superimposed on a floor plan of the laboratory. From this panel, a safety monitor could see at any time an incipient danger condition. Doors in the area had alarm systems; radiation detectors were conspicuous; fire heat detectors studded the walls and ceilings.

Fuel laboratory, one of about 24



INERT ATMOSPHERE surrounds the welder and the work in this chamber at CANEL. Welder enters through umbilical corridor (left) and puts on suit. Monitors outside can watch him, change airflow to the suit or current for welding.

buildings on this site, is the area where fuel elements are fabricated for nuclear reactors. Materials are received, checked in the chemistry lab and then routed to the powder room, where the powdered fuel constituents are blended by technicians working in "glove boxes"—closed work areas with access through sleeves built into the face of the box.

Small amounts of the radioactive compounds can be hand-carried from one area to another, using an open cube frame carrier with the container mounted at the center of the cube, a safe distance from the person carrying the material. Pass-through doors are used for moving these substances from one area to another, rather than taking them through the halls of the building.

Materials then are pressed into shapes required for their eventual use in fuel elements. A sign on the wall of the press room reminds the operator: "The press operator will throw his lab coat into a combustible barrel at the end of a pressing day."

Pressed shapes then are fired in furnaces in the sintering room, followed by sorting, weighing, assembling and examination procedures. The fuel samples are packaged for vault storage.

All through the fuel laboratory areas there are signs on the wall warning of some of the dangers. One typical sign: "Observe batch limit; keep batches apart; limit moderation and reflection." Film-badge inserts, containing the sensitive film which blackens after exposure to radiation, are taped to the walls.

CANEL's "hot" laboratory, where radioactive materials are tested and examined, is built around a core of seven shielded cells with concrete walls five feet thick. Set into the walls are sandwich windows, heavy glass sheets enclosing a 75% zinc bromide solution. The solution is transparent and acts as a shield for the radiation emitted from the materials in the cells. Sodium vapor light, which has the characteristic of being monochromatic, illuminates the interior of the cell. This lighting, viewed through the thick glass and zinc bromide windows, does not produce the refracted "rainbow" effect associated with non-monochromatic lighting.

Operators of these cells work with remote manipulators; 18 pairs of these versatile units are available in the seven cells. For objects heavier than the manipulators' 750-lb. capacity, there are three traveling cranes, one to handle loads up to three tons and the other pair to handle up to one ton apiece.

Radioactive materials in the cells can be worked, processed, tested, examined microscopically and spectroscopically, X-rayed and checked for hardness or structure, all by using the manipulators.

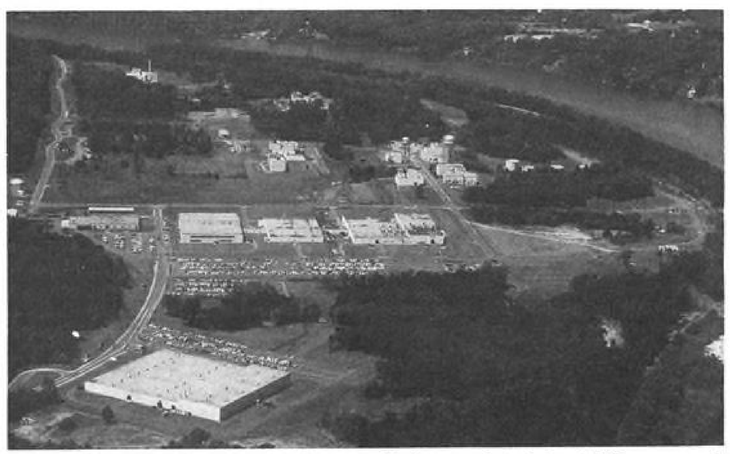
Liquid waste from one experiment was being neutralized during the CANEL tour, to convert it into a neutral salt solution. That solution was then mixed with plaster of Paris which would be poured into a standard container, allowed to harden, sealed hermetically and then put into a concrete disposal block for shipment to the AEC installations at either Oak Ridge or Savannah River.

The "hot" lab is divided into three areas which are designated by the jargon for the degree of radioactivity apt to be encountered. The "hot" area is where the seven test cells are located; there is a "warm" area, where materials are processed after their level of radioactivity has dropped to safe limit, and a "cold" area where there is no radioactive material at all. Air flow inside the building is controlled carefully so that it continually passes from the cold area toward the hot, to eliminate the possibility of any aerosols being carried to a less radioactive area.

The building has its own laundry; no clothing worn on the job ever leaves the building except in a decontamination block.

Nuclear physics laboratory is where the work of the reactor really begins. Fuel elements, moderators and control systems are assembled here on a large mockup reactor table, open on four sides, so that various configurations of reactor designs can be built and checked.

These reactors are allowed to operate at low levels of heat or power output,



CANEL PROPERTY shown in this first over-all photograph includes 1,100 acres on the bank of the Connecticut River. Facility is operated by Pratt & Whitney.

but are not permitted to approach any appreciable power level for safety reasons. The halves of the reactor can be moved together to start the chain reaction, and apart to stop it. In addition, spring-loaded control rods are held by electromagnets.

If the operator, viewing the reactor on the extensive instrumentation in an adjacent control room, observes that things are about to get out of hand, he pushes a large red emergency switch. This releases the electromagnets so that the control rods start to slow the reaction; it also starts the electric motor that separates the halves of the reactor.

Test Cells

There are two test cells in the laboratory, each a 40-ft. cube built of normal-aggregate concrete with walls five to six feet thick.

Basic Snap-50 system being developed by P&WA, is currently being assembled, less its reactor, in the heat-exchanger laboratory. There the major purpose is to test the transfer of five megawatts of power through two liquid-metal loops, using the cycle developed for the aircraft nuclear engine (liquid to liquid to air). This cycle work was continued because it was well along in development when the nuclear engine program was canceled last year.

Reactor is simulated in this test loop by an electric heater, powered by a 75-volt, 88,000-amp. direct current supply.

These extensive laboratory facilities, aimed at the eventual development of nuclear power systems, are supported by a number of other CANEL activities, including the shop laboratory, where low-hazard development tests are performed, and the machine shop itself, with a "clean-room" atmosphere that rivals that of instrumentation laboratories.

Basic work of the shop laboratory lies in the area of metals technology; much of the work on zirconium-columbium alloys used for containment of the liquid metals was done here. The shop laboratory develops new processing techniques for these metals and for other phases of nuclear power development.

Machine Shop Set-up

Machine shop at first glance looks like a standard shop, but a clean shop instead of the usually untidy area associated with machining. Floors are shining, almost slick; machines look new.

Standard machine tools are used for the most part, but work on refractory metals and alloys is done in a contained, inert atmosphere.

Small parts are welded in boxes filled with argon gas; the welder works through sleeves in the box. For larger parts, the welder works in a large room which is sealed and filled with an inert gas. He crawls through a tunnel and into a special suit for access to the room.

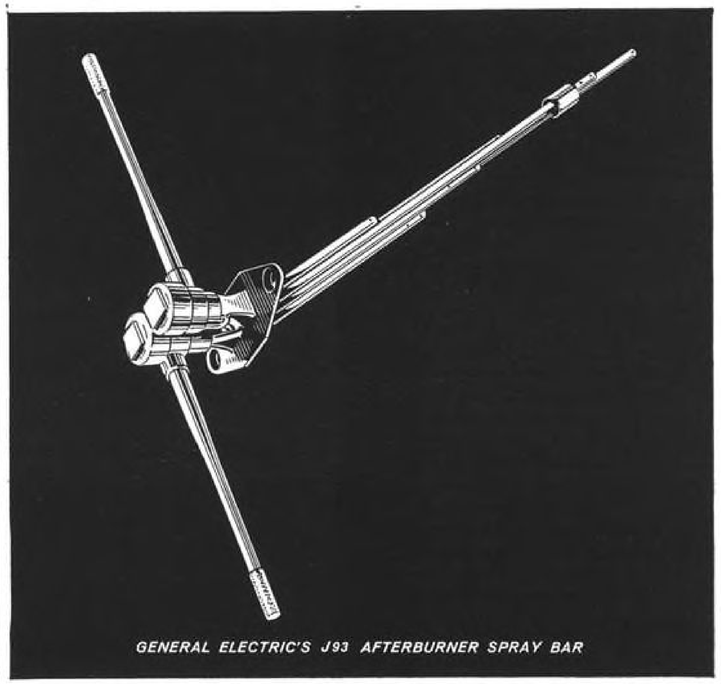
While inside, an intercom connects him with a monitor outside who can turn up the cooling in the suit, or increase the weld current, or handle any other problem that arises. The welder can stay inside for periods up to about two hours. Welding generally is limited by the amount of impurities given off during a specific time period rather than by any other factor.

These impurities change the composition of the inert atmosphere inside the box and tend to increase the impurities in the weld.

CANEL started in September, 1955, with the ground-breaking for the Connecticut Aircraft Nuclear Engine Laboratory.

The facility was financed with Air Force funds; USAF and the AEC were jointly supporting the development of the aircraft nuclear engine.

That engine development was canceled in March, 1961, and the work of the laboratory was redirected to the Snap-50 space electric system. The name was changed, keeping the same acronym, to the Connecticut Advanced Nuclear Engineering Laboratory. The facility is government-owned, and operated for the Atomic Energy Commission by Pratt & Whitney Aircraft.



GENERAL ELECTRIC'S J93 AFTERBURNER SPRAY BAR

A PRODUCT OF DELAVAN EXPERIENCE

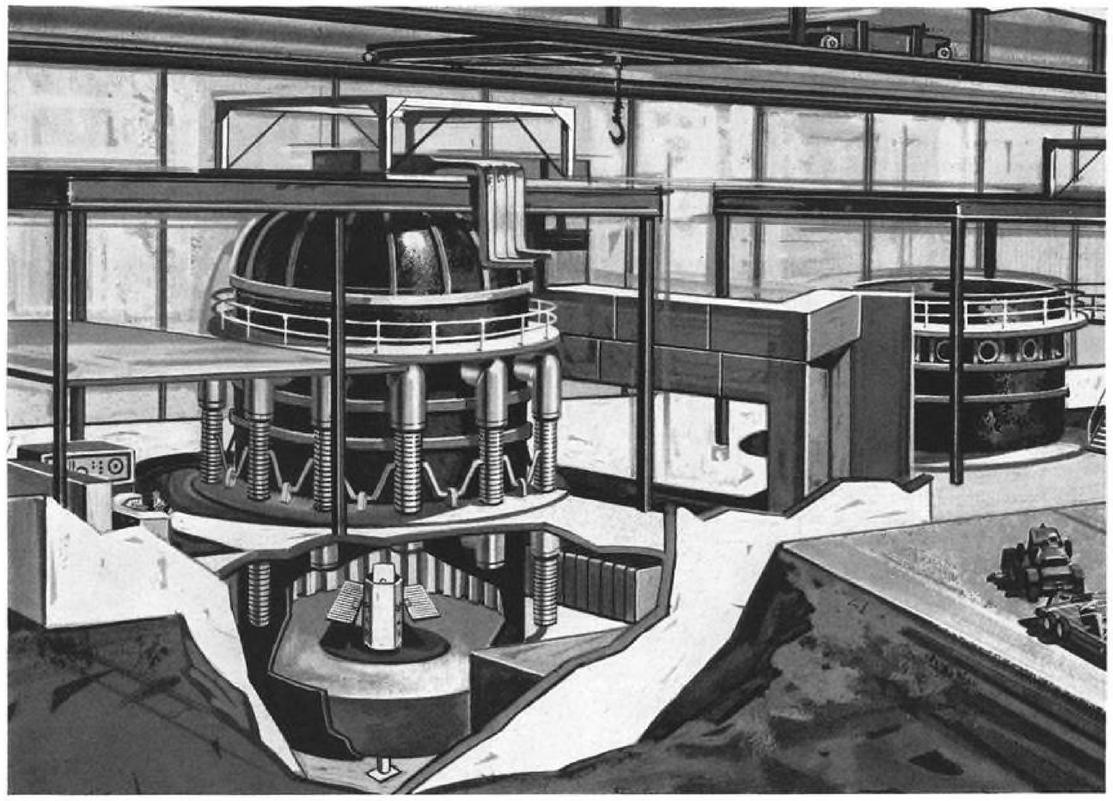
General Electric's J93 turbojet engine is designed to fly about 2000 miles an hour at altitudes between 60,000 and 70,000 feet. This is the Afterburner Spray Bar manufactured by Delavan for use on the J93.

Delavan's 15 years of experience have produced a multitude of fuel nozzles and afterburner spray bars for America's leading aircraft engine manufacturers. This experience extends to both the design and the large scale manufacture of functional, reliable fuel delivery and metering devices.

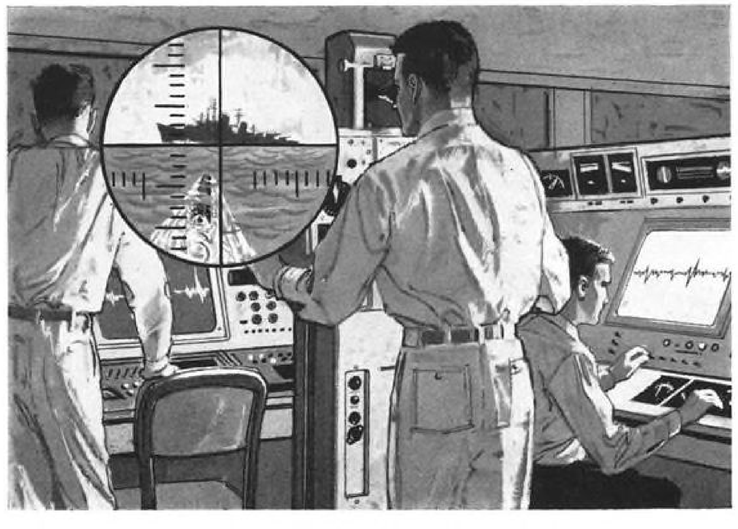
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NEW SIMULATION LAB



Nuclear submarine battles give crews realistic training on land



To supply the trained manpower necessary to operate America's fast-growing fleet of nuclear ballistic missile submarines, Honeywell is installing the Submarine Attack Trainer facility at New London, Connecticut.

Designed and built for the Navy by Honeywell, the trainer incorporates replicas of the attack centers of three operational nuclear submarines. Through realistic simulation of sonar, radar and periscope contacts with the "enemy", officers and crewmen are given valuable experience in making combat decisions.

The first floor simulates the three attack centers, while on the second floor a Honeywell H-800 solid state digital computer works out tactical situations to be solved by the officers and crewmen. A command center on the third floor is directed by master instructors and officers who create strategic and tactical problems and evaluate the trainees' responses.

DUPLICATES CONDITIONS OF OUTER SPACE

Honeywell chambers speed spacecraft testing with exact simulation of vacuum, temperature, solar radiation

Scheduled to go into operation next year at NASA's Goddard Space Flight Center is one of the world's most advanced space test and simulation facilities.

The new laboratory will house two giant chambers: the Space Environment Simulator (far left) and the Dynamic Test Chamber. These will provide the flexible test and evaluation capability required for flight acceptance tests of the Orbiting Astronomical Observatory. The Space Environment Simulator will reproduce the high vacuum, temperature and solar radiation conditions encountered in a flight through outer space. The Dynamic Test Chamber will test spacecraft performance under varying air pressures.

Honeywell, as prime contractor, is responsible for design and installation of the two chambers which will permit testing and evaluation without lost time due to weather, and at a greatly reduced cost.

This advertisement is paid for by Honeywell, not from Government funds. While it is a report concerned largely with our nation's defense programs, it is particularly addressed to companies seeking help in areas where Honeywell experience can be most useful. Your inquiries are invited. This material has been cleared for publication by the Government agencies and companies concerned. Minneapolis-Honeywell Military Products Group, Minneapolis 8, Minnesota. Sales and service offices in all principal cities of the world.

Entomology chamber creates controlled world for insect study

Breeding insects friendly to man and learning more about the life habits of harmful insects are but two of many uses of a unique environmental chamber recently completed by Honeywell at its Duarte, California facility for Purdue University.

The comparative behavior chamber measures 8 x 10 x 12 feet and will be housed in the Purdue Entomological Combined Environment Laboratory.

Equipped with an overhead bank of fluorescent and incandescent lights, the chamber is able to simulate a typical day in which the sun goes through a complete cycle—from sunrise to sunset.

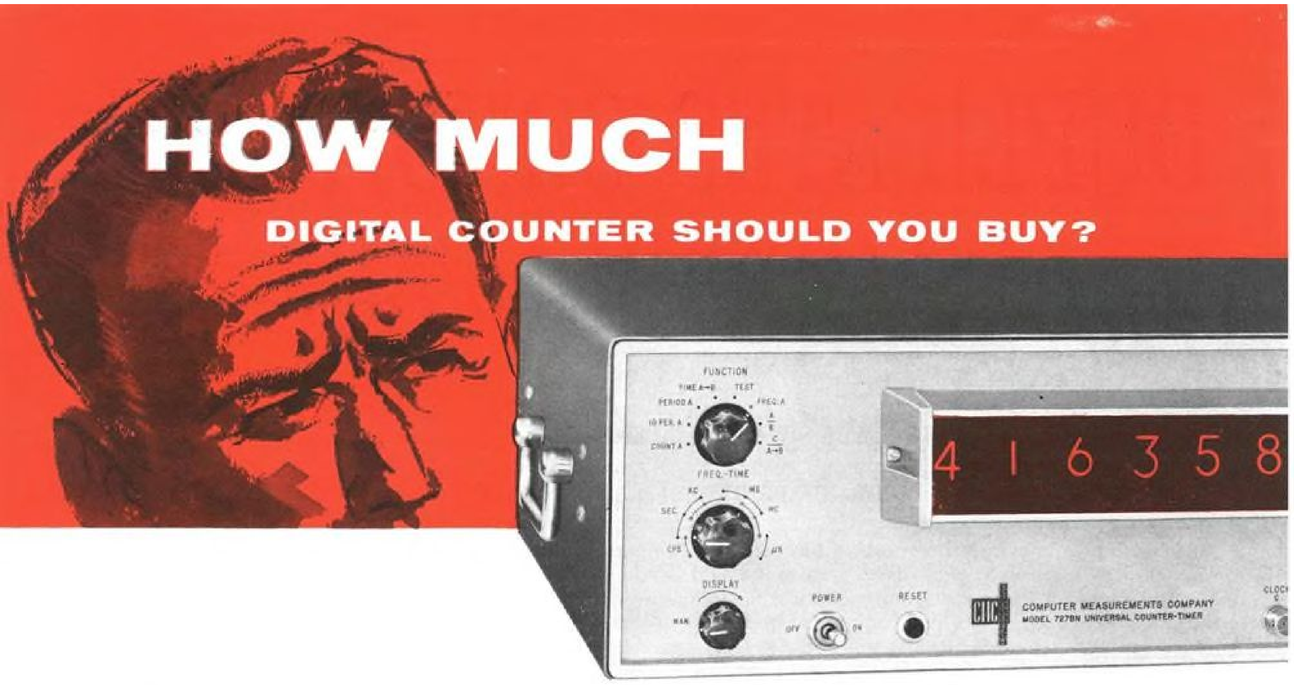


A Honeywell programming unit provides for automatic or manual control of temperature, humidity, rainfall and illumination conditions—similar to actual field conditions found throughout the world.

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ENGINEERS AND SCIENTISTS: Explore new professional opportunities—write Mr. Fred Laing, Honeywell, Minneapolis 8, Minnesota.



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13 Mc universal counter-timer (Model 727B)

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CMC offers solid state standard counters from dc to 1000 Mc with either vertical or inline nixie readout for low and high frequency models alike. Dc and ac coupled input with **1 megohm input impedance** is standard in most models. Calibration, maintenance and trouble-shooting operations are fast and simple with CMC counters because all PC boards are plug-in design. A maximum of five internal calibration adjustments makes CMC counters by far the easiest to operate in this respect. The readout is integral with the DCU and driver makinq trouble-shooting only a matter of a simple one-operation DCU replacement.

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- ☐ 50-400 cps operation (option G—$75)
- ☐ Additional Readout Decade (option H—$155)
- ☐ 1 part in 10^8 per day crystal stability (option M—$325)
- ☐ Inline Readout (option N1—$25 per decade)
- ☐ Multiple Period (option X)
- ☐ Rear Input Connectors (option Y—$15)
- ☐ External Time Base, rear input (option W—$50)
- ☐ Memory (option Z—$25 per decade)
- ☐ Rack Mount (option D—no charge)
- ☐ Remote Program (option R—$250—$50 for high frequency models)

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1 cps — 1 Mc	F-P	1,100	705B
dc — 5 Mc	F-P	1,400	706B
dc — 13 Mc	F-P	1,825	707B
1 cps — 35 Mc	F-P	2,300	709C
dc — 5 Mc	UCT	1,550	726B

Range	Function	Price	Model
dc — 13 Mc	UCT	$1,995	727B
1 cps — 35 Mc	UCT	2,550	729C
dc — 1000 Mc	F (including heterodyne plug-in)	2,700	737C
1 μsec to 10^7 sec	TIM	1,325	756B
0.3 μsec to 10^8 sec	TIM	1,580	757B

F = Frequency
FP = Frequency-Period
TIM = Time Interval Measurements
UCT = Universal Counter-Timer

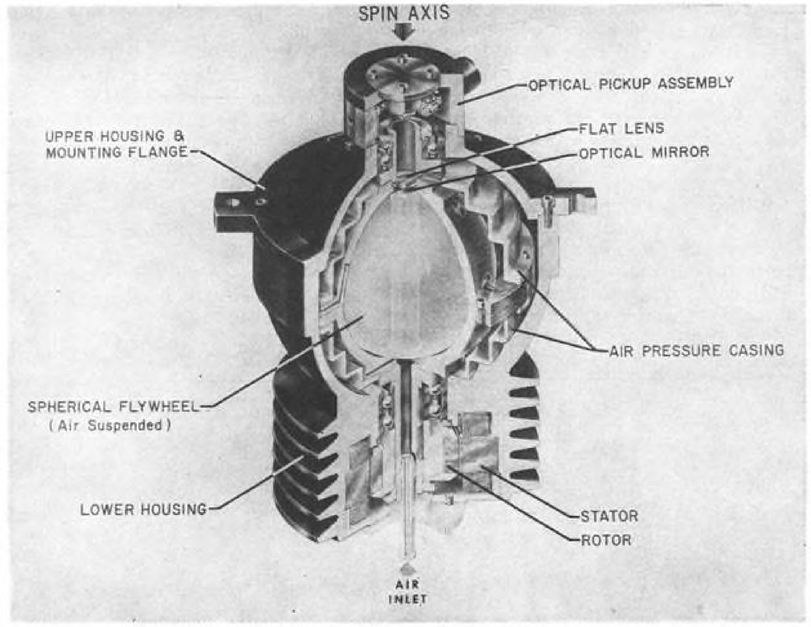
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NEW TYPE NORTH-SEEKING GYRO, which can determine direction of north to within 30 sec. of arc within seven minutes, is shown being operated by inventor, Dr. Fritz Mueller of Astro-Space Laboratories. Cutaway (right) shows concentric spheres which form heart of north-seeker. Solid inner sphere is supported on air cushion and caused to spin by rotation of outer sphere which is driven by electric motor. Entire unit weighs under 50 lb., including theodolite and power supply.

North-Seeking Gyro Proves Fast, Accurate

By Philip J. Klass

Basically different type of north-seeking gyro for alignment of mobile missile launchers, which can establish the direction of true north within several minutes, has been developed by Astro-Space Laboratories, Huntsville, Ala., a subsidiary of Belock Instrument Corp.

Within three minutes after power is applied, the new gyro can determine the true north direction to within 60 sec. of arc, or to within 30 sec. of arc after an interval of seven minutes, according to the company.

Entire unit, including theodolite, weighs under 50 lb. and is expected to sell for less than $10,000 in production quantities.

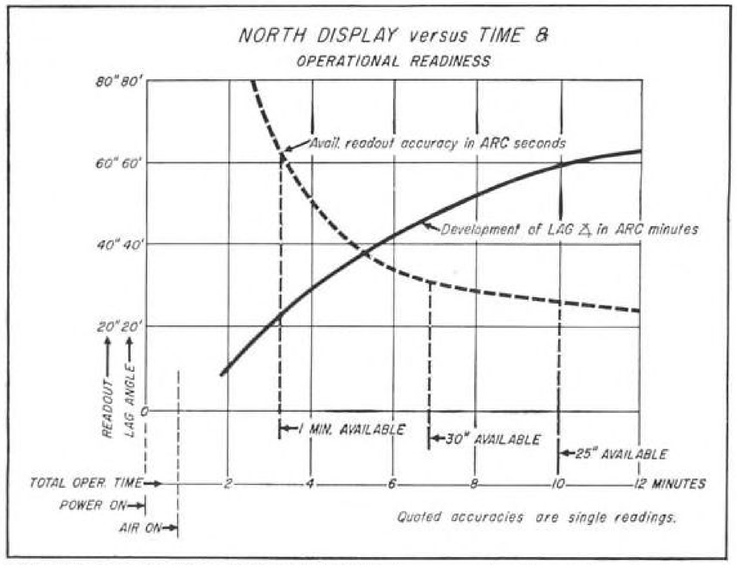
Direct Read-out

New gyro provides a simple direct read-out which does not require the taking of multiple readings and averaging as is the case with previous types of north-seekers.

Additionally, the design is relatively insensitive to external vibration and wind gusts, an important consideration for tactical field use.

New gyro is a byproduct of a company-financed program undertaken by Astro-Space Laboratories to design a simple, low-cost, low-drift free gyro. Basic patent on the new "sphere-within-a-sphere" gyro is held by company vice president Dr. Fritz K. Mueller who carried out the original work in 1958 when he was deputy director of the guidance and control laboratory of the Army Ballistic Missile Agency.

Idea for the new north-seeking gyro



ACCURACY OF NORTH-DETERMINATION is shown as a function of time after power is applied, based on single readings. Increased accuracy can be obtained by taking multiple readings. The 30-sec. accuracy is obtained seven minutes after unit is turned on, with accuracy increasing with time, according to manufacturer.

was the result of an accidental discovery made during early tests of a prototype model, AVIATION WEEK was told. During these tests, the gyro consistently drifted to the east by a constant angle in run after run, with no apparent mechanical unbalance to explain this effect.

Analysis showed that the gyro spin axis was holding its position so precisely that when the earth rotated about its own axis, the gyro spin axis appeared to an earth-bound observer to be drifting to the east. But an additional reaction, to be described below, limited the apparent drift angle to a fixed amplitude, complicating understanding of what was taking place.

Heart of the new north-seeker is a solid metal sphere inside another sphere which is driven by an electric motor at a speed of 6,000 rpm. When the two spheres have been brought up to speed, air at a pressure of about 14 psi. is pumped into the 0.001 in. clearance between the two spheres so that the inner sphere now is supported on a thin film of air.

Viscosity of the air cushion causes the inner sphere to spin in synchronism with the motor-driven outer sphere. A hole drilled through the center of the inner sphere, then plugged at both ends causes it to spin about the hole as an axis.

When the inner sphere is homogeneous and balanced, it performs as a near-perfect gyro and attempts to hold its spin axis fixed in space while the outer sphere, being fixed to the earth, will move in a westerly direction as the earth turns.

When the outer sphere spin axis is shifted by earth rotation, the viscous driving torque it produces no longer is applied at right angles to the spin axis of the inner sphere. This sets up torques which cause the inner sphere to precess to the east.

Inner sphere will precess until its velocity of precession just equals the horizontal component of the earth rotation acting on the outer sphere. This sets up a constant angle of displacement in the east-west direction between the spin axes of the two spheres.

To determine the direction of true north it is only necessary to measure the direction of the steady state shift of inner sphere spin axis with respect to the outer sphere and then establish a line normal to the direction of the shift.

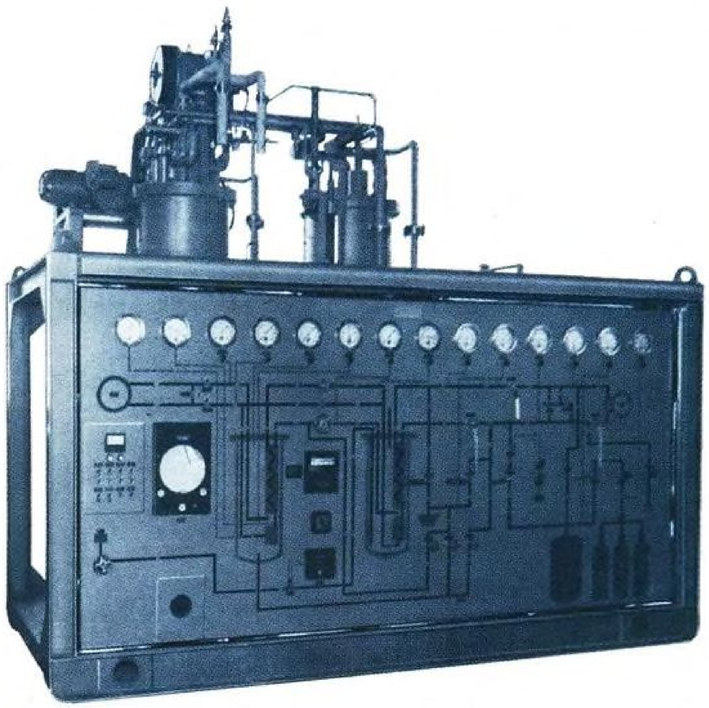
To measure the direction of shift, a small mirror is located atop the spin axis of the inner sphere with an autocollimating optical system provided to permit alignment to a theodolite mounted atop the external gyro case, shown in the diagram on p. 67.

For north determination, the magnitude of the angle of displacement need not be measured since it is determined by the earth latitude at which the instrument is being used and certain design parameters, such as rotational speed and the mass of the inner sphere.



Air-floated Gyro

Air-floated gyro has spinning sphere floated on eight pressure pads symmetrically spaced over surface. In late stages of development at Assembly Engineers, Inc., 3650 Holdrege Ave., Los Angeles, gyro has drift rate of 0.001 deg./hr., employs optical pickoff technique.

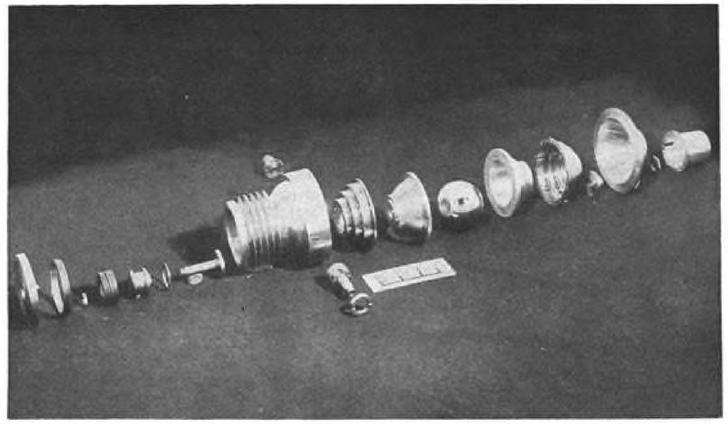


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Inquiries from qualified scientists and engineers regarding employment opportunities are invited



EXPLODED VIEW of the sphere-within-a-sphere type gyroscope shows relatively few number of parts required. Astro-Space Laboratories, a subsidiary of Belock Instrument Corp., expects the north-seeker to sell for under $10,000 in production quantities.

However, the magnitude of the steady state shift angle is important in that it determines the relative sensitivity of the device which affects the time required to obtain a true-north fix to any desired accuracy. The first model built by Astro Space Laboratories had a shift angle of seven milliradians at the 40 deg. latitude of Huntsville, Ala. But subsequent models have a shift angle almost three times this figure, which reduces correspondingly the over-all effect of errors in the optical read-out and cuts the time required to obtain a north determination to any desired degree of accuracy or provides higher accuracy for the same settling time.

Complete north-seeker weighs about 48 lb., including tripod, and the power pack which supplies air and 115 v., three-phase electric power. Total power consumption is about 195 watts d.c., of which 175 watts are consumed by the air-supply powerpack. Power source can be 12 or 24 v.d.c.

Simulated field tests and demonstrations indicate that the unit can be installed, placed in operation and the initial true-north readings obtained in about five minutes, according to Andrew Georgia, Belock vice president for planning. This initial reading should be accurate to within 60 sec. of arc. Four minutes later the accuracy will have improved to 30 sec. of arc, with a further gradual improvement with time, Georgia reports. If there is time for multiple readings and averaging, accuracies better than 20 sec. of arc can be obtained, company says.

North-seeking application of the new gyro has not diverted Astro-Space Laboratories from its original concept of applying the sphere-within-a-sphere concept to more general types of usage because of its low-drift, relative simplicity of construction and potential low cost. To date, Belock and Astro-Space Laboratories have invested more than a quarter of a million dollars of company funds in advancing the design concept. The Navy has awarded a contract to study possible use of the new gyro for an undisclosed application.

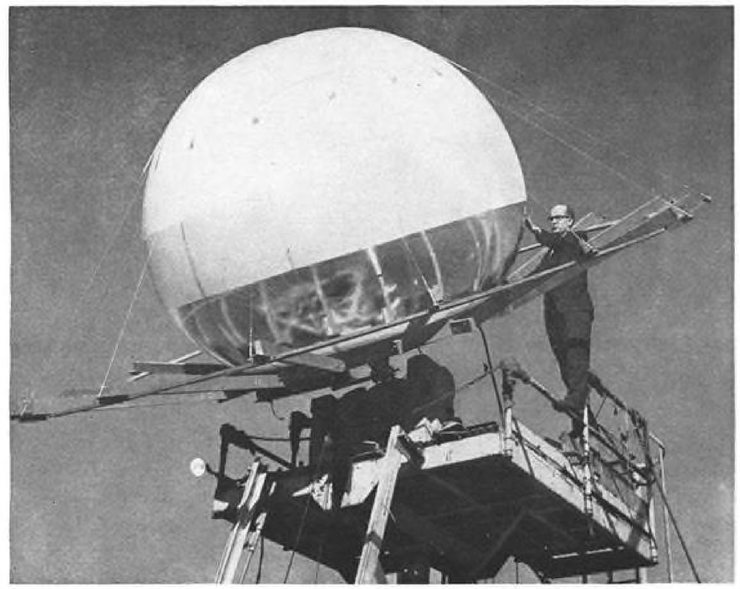
Similar type of air-supported sphere-within-a-sphere gyro is under development by the ITT Federal Laboratories in San Fernando, Calif. Details of the ITT development were reported by Gerald B. Speed at the Military Electronics Convention in Washington in June.

Because the inner sphere is brought up to speed initially by physical contact with the rotating outer sphere and kept spinning by viscous drag, it need not be made of a magnetic material as with conventional gyros. This permits the use of extremely dense non-magnetic metals, or even non-metal spheres. ITT Federal Laboratories, for example, uses an inner sphere made of fused quartz which can be accurately shaped using ordinary lens grinding techniques.

Astro-Space Laboratories conducted extensive tests on its north-seeking gyro over a three-month period in which the gyro was started up and shut down 20 times and a total of 599 readings were made to check on gyro stability and repeatibility. After each run, the outer housing of the instrument was intentionally misaligned and the instrument was physically moved to simulate field usage. The gyro used had a steady state shift angle of seven milliradians, making it less sensitive and less accurate than later models designed for a 20 mil shift.

Nevertheless, the one sigma deviation error for the 559 readings was 23.7 sec. of arc, while the mean deviation was only 0.8 sec. of arc, according to test data supplied to AVIATION WEEK.

Relative simplicity of the new gyro suggests it should have long life and good reliability, company spokesman says. This is supported by tests in which one gyro was operated for more than 2,000 hr. without signs of adverse wear or malfunction.



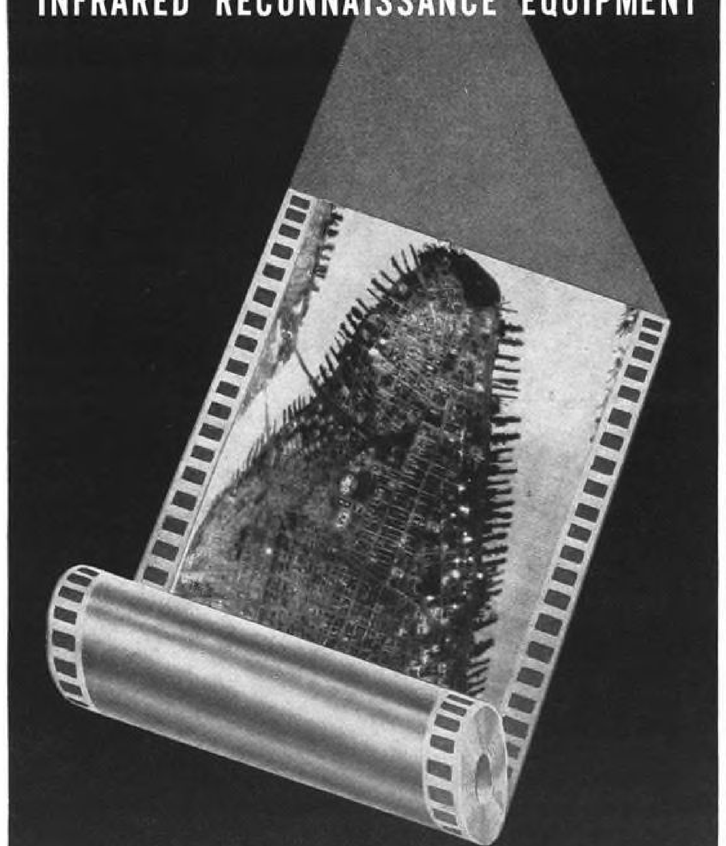
Inflatable Antenna Developed

Emergency post-attack inflatable antenna, designed to be stored in deflated condition underground, was developed by Goodyear Aircraft Corp. under Rome Air Development Center sponsorship. Inside layer of inflated radome is metallized to serve as reflector. Radio or radar energy is bounced off internal surface by a small rotating feed horn at center of structure, providing 360-deg. scanning.

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FILTER CENTER

► **Navy Tests New MDI System**—New miss distance indicator (MDI) system, which detects gamma radiation emitted by zinc or tantalum tag or ring attached to a missile or shell has been tested successfully by Naval Ordnance Test Station, China Lake, Calif. Target carries scintillator crystal and photomultiplier tube, which provides pulse, proportional to the number of gamma rays received by the target. The pulses are transmitted to a ground station which immediately indicates miss distance in feet. The MDI systems made by Electronic Specialty Co., Los Angeles, are being supplied to NOTS and General Dynamics/Pomona, in the latter case for testing tactical missiles. Range for one airborne unit is good between 5 and 50 ft. with a statistical error of 15% between 25 and 50 ft., 10% between 5 and 25 ft. Airborne detection unit weighs 5 lb.

► **Air Force Rancom Satellite Requests Due**—After months of delay, Air Force's Space Systems Division is finally expected to request industry proposals within the next several weeks for its random communication (Rancom) satellite system, a low-altitude randomly located satellite concept. Proposals for the high-altitude, synchronous satellite system may be sought some time thereafter. The two systems are intended to replace the now defunct Army Advent satellite program, which was scrapped earlier this year.

► **Laser Modulation and Scanning Program**—Program to investigate phenomena necessary to modulate at video frequencies and horizontally and vertically scan the output of a continuous wave visible optical maser will be conducted soon by USAF's Rome Air Development Center. The scanning mechanism to be employed is to permit visibility of at least 106 elements.

► **Optical Switching Effect Noted**—Simple technique for modulating coherent light beams at low megacycle frequencies by switching their deflection angles as a function of digitized signal inputs has been demonstrated by Ramo Wooldridge Division of Thompson Ramo Wooldridge. Output of an optical maser is passed through a Kerr cell which polarizes light according to a modulating signal applied to the cell. The beams are then deflected by prisms made of birefringent materials.

► **Navy Accelerates Shrike Missile Development**—Navy Bureau of Weapons is increasing funding level for the Shrike air-to-ground anti-radar missile (formerly known as Arm) being developed by Texas Instruments.

► **Microcircuits for Sonar Applications**—Navy Bureau of Ships intends to investigate possible applications for microcircuitry in its sonar equipment.

► **Command & Control Tradeoffs**—Proposal to explore possible tradeoffs in command and control during limited war may soon be funded by the Office of Naval Research. The proposal was prepared by Space Technology Laboratories.

► **Faster Microcircuits Coming**—Watch for Fairchild and Texas Instruments to announce soon a new line of high-speed semiconductor microcircuits for digital computer applications. Relatively slow speed of presently available unit has been a handicap to computer designers.

► **New Semiconductor Laser**—Semiconductor diode laser fabricated from a ternary compound, gallium arsenide-phosphide, emits coherent radiation in the visible as well as the infrared region previously achieved using gallium-arsenide diode, General Electric scientists report. Emission from 6,200 angstroms in the visible region to 8,400 angstroms is determined by choice of materials. An early application of the new type laser is expected to be to provide pump excitation for a ruby or neodymium glass rod laser, according to GE's Semiconductor Products Dept. New type laser appears to have same high conversion efficiency as earlier reported gallium-arsenide diodes.

► **Radiation Resistant Solar Cell Situation**—Avionics companies are taking a hard look at availability of the more radiation resistant N-on-P solar cell (AW Apr. 4, 1960 p. 123) in expectation that many earth orbital space vehicles powered by solar energy may need them to better resist degradation due to energetic electrons in the intensified Van Allen radiation belt. National Aeronautics and Space Administration recently considered, then discarded, a directive requiring its spacecraft contractors to switch to the newer cells. But most spacecraft companies and solar cell suppliers, under NASA prodding, see the switchover, at least for higher altitude earth orbital vehicles, as inevitable. Suppliers hope to time product line conversion and liquidation of P-on-N inventories with anticipated high purchase orders. To date, however, with exception of Telstar (using Bell Labs cells) only future vehicles to use appreciable quantities are NASA's S-48 topside sounder and an Air Force Midas-



Recognize these?

Most design and procurement people in the aircraft engine, missile and rocket fields will have little difficulty in identifying the fuel bottle hemisphere, missile aft closure, conical turbine shaft, turbine case and heat sink pictured here. They are quite typical of the hundreds of fine forged parts produced for these and other industries by Taylor Forge.

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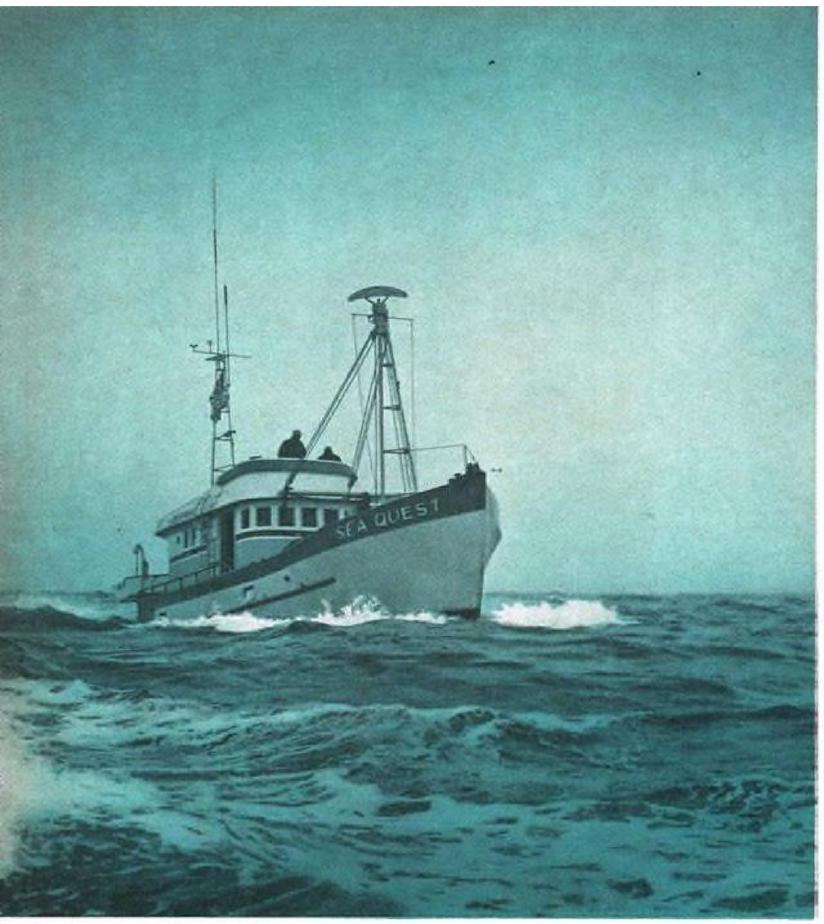
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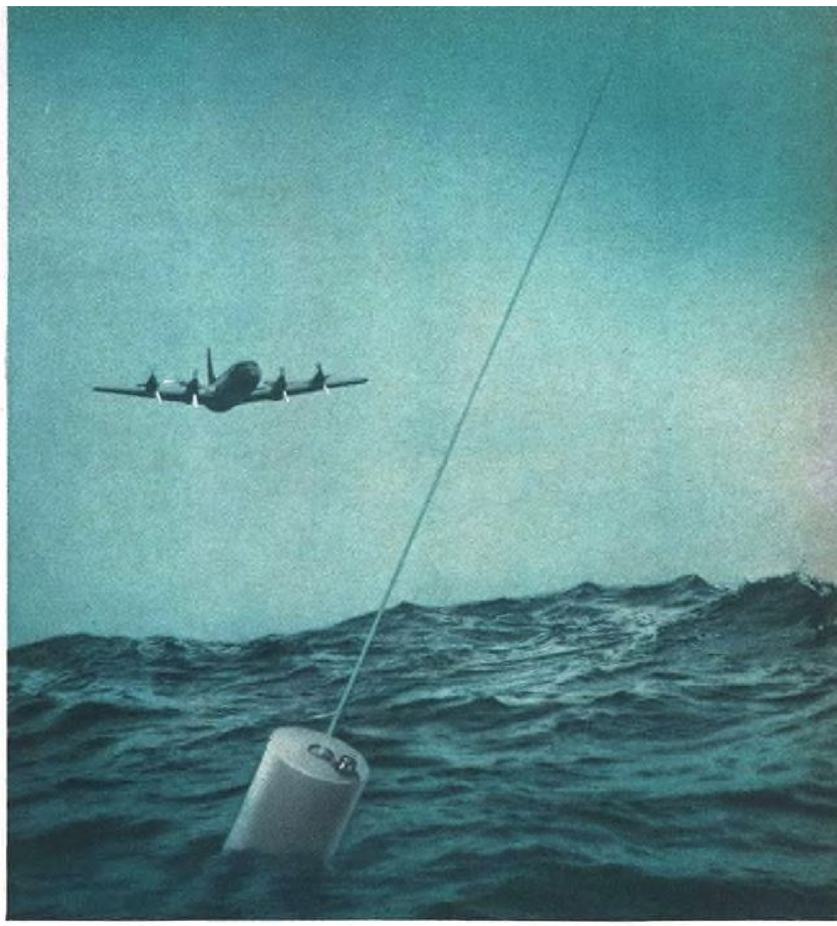


TAYLOR FORGE

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OPERATION OCEAN: basic research is probing the mysteries of The Deep

With growing fleets of potentially hostile subs prowling the world's sea lanes, the task of the Navy's anti-submarine warfare forces is increasingly difficult. Handicapped by man's inadequate knowledge of the sea and its workings, they must protect not only our ships, but our inland cities as well.

The greatest hope of meeting this challenge lies in continued basic research—the kind being carried on by Lockheed's ASW and Ocean Systems activities.

Lockheed's Sea Quest—a fully equipped oceanographic research vessel—ranges the Pacific coast, recording and classifying underwater sounds, measuring internal waves, investigating temperature gradients, sampling the sea bottom to determine its effects on sound propagation. Lockheed scientists are analyzing the sounds of porpoises, whales, and other undersea denizens, studying their codes and the structure and function of their sound-producing mechanisms. Others are charting the characteristics of underwater sound transmission. Improved detection systems such as sonobuoys with increased range and sensitivity are being developed for use with the Lockheed-built P-3A (P3V) Orion—deadliest combination of men, electronics, and armament ever pitted against submarines.

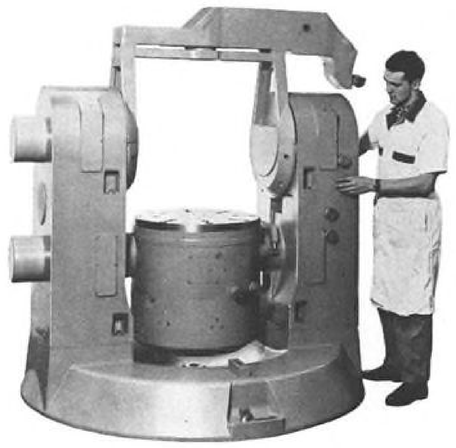
Lockheed-California's Anti-Submarine Warfare & Ocean Systems Organization coordinates a corporation-wide effort that runs broad and deep—from the depths to the surface to the aerospace above.

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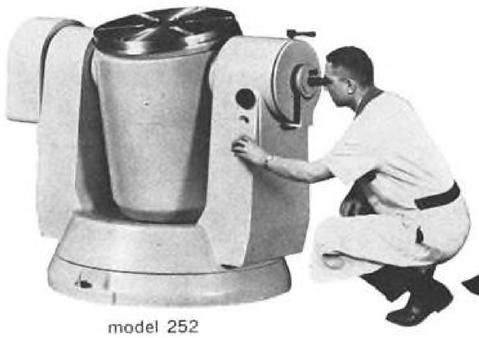
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION, BURBANK, CALIFORNIA


model 052


model 081


model 107


model 152


model 252

etc.

The total tops 25 different types of inertial guidance test systems designed and built by the J. W. Fecker Division of American Optical Company. One of the five accurate, reliable test systems shown here may meet your requirements. If not, Fecker capability—based on experience and engineering skill—can supply the test system to meet your needs. For more information on any one of these five systems or for details of Fecker's capability, write J. W. Fecker Division, American Optical Company, 4709 Baum Boulevard, Pittsburgh 13, Pennsylvania.

MODEL 052 Multimode Test Turntable—extremely flexible system for testing floated integrating gyros of precision inertial navigation type to an accuracy of 1 arc second. MODEL 081 Multiple Range Test Table—an economical, self-contained servo test system accurate to 10 arc seconds; 15 fixed speeds and continuously variable speeds from +45,000°/hr. to −45,000°/hr. MODEL 107 Astroinertial Calibration Set—automatically tests and calibrates 3 axes inertial and stellar guidance systems to an accuracy of 3 arc seconds. MODEL 152 Multimode Test System—operates in position, rate and servo modes with visual digital readout accurate to 1.5 arc seconds. MODEL 252 Air Bearing Test Table—a versatile, completely integrated test system for guidance systems and components in the .0001°/hr. drift class; readouts available with accuracies to 0.05 arc seconds.

FAO-2

Leading supplier of inertial guidance test systems

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equipment-carrying Discoverer. Current commercial availability of N-on-P cells shapes up as follows:

• **Heliotek Division** of Textron Electronics, Sylmar, Calif., has small quantities of flight efficiency N-on-P silicon cells available from stock at prices comparable to the next higher efficiency grouping of P-on-N cells. Delivery of larger numbers depends on quantity and efficiency. Yields on N-on-P tend to be lower because cells are made with higher resistivity silicon.

• **Hoffman Electronics,** Los Angeles, is in pilot production of N-on-P cells, has small quantities, in prices 10 to 20% higher than P-on-N depending on efficiency. The higher efficiency cells have a greater price difference. Company expects to be in full production within next several months.

• **International Rectifier,** El Segundo, Calif., is making the newer cells in small quantity.

• **Texas Instruments,** Dallas, has been producing them in small quantities. The company supplied a sizable order to Lockheed Missiles and Space Co. about a year ago.

► **Signed on the Dotted Line**—Among major contracts awarded recently to avionics companies are the following:

• **Eastman Kodak Co.,** Rochester, N. Y., will conduct research and development on long wavelength infrared detectors under a $96,487 contract from the Navy Bureau of Weapons.

• **hp Associates,** Palo Alto, Calif., will conduct advanced development on semiconductor microcircuits under $100,000 contract from USAF's Aeronautical Systems Division. A similar contract, for the same amount, was awarded to Texas Instruments.

• **Sperry Gyroscope Co.,** Great Neck, N. Y., $1.7-million Air Force contract to produce remote attitude directors for use in fighter and bomber aircraft. Sperry Gyroscope also reports $3.1-million award from Navy for check-out consoles to be used in Lafayette class Polaris submarines.

• **Sylvania Electric,** Mountain View, Calif., $2-million contract for development and production of security equipment to be used at Minuteman ICBM bases.

• **General Precision,** GPL Division, Pleasantville, N. Y., will build new lightweight AN/APN-153(V) Doppler navigation systems for Bureau of Naval Weapons.

• **Westinghouse Electric,** Tube Division, will develop a 93 kmc. (gc.) coaxial magnetron and microwave duplexer under two Army Signal Corps contracts totalling $279,204.

• **Collins Radio Co.,** Cedar Rapids, Iowa, reports contract for about $1 million from Boeing for flight director systems to be used on new 727 jet transports on order by American and Eastern airlines. Company also reports Air Force contracts totaling $974,000 for ground communications equipment for down-range tracking stations of the Atlantic Missile Range, and for flight directors and associated computers for aircraft use.

• **Motorola,** Military Electronics Division, Scottsdale, Ariz., will develop digital command (data link) system for the Gemini two-man space capsule under contract to McDonnell Aircraft Corp.

• **North American Autonetics Division,** $41 million from Navy for production of submarine inertial navigation systems (SINS) for installation on 10 new Lafayette class Polaris submarines. The 39 systems are Mark 2, Mod-2 types. The award makes Autonetics the SINS supplier for 24 of 29 Polaris submarines authorized to date.

• **Bell Aerosystems Co.,** Buffalo, $4.9 million to design and build secure radio command control system for Army SD-1 drone aircraft.

• **Ling-Temco-Vought,** Dallas, $79,000 contract from Bureau of Naval Weapons to study contactless switching techniques for use in military aircraft electrical systems. The 18-month study will include analysis of entire aircraft electrical system to determine where the contactless switching techniques can be employed.



High Power Klystron

Klystron output power of 22 megawatts has been achieved by Sperry Electronic Tube Division using new barrel-shaped permanent magnet instead of conventional electromagnet for electron beam focusing. New permanent magnet focuser is smaller, requires no external power or cooling and is expected to have unlimited life.

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FROM: Value Analysis Manager

TO: J.M.H. Dept 77-31

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- ★ Wide Grip Range
- ★ Positive Hole Fill

United States Patent No. 2931532. Qualifies under NAS Specification 1400 and meets Standard Pages NAS 1398 and 1399. For technical data on the Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

Cherry Rivet Division

Santa Ana, Calif.

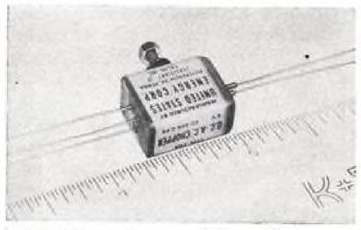
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NEW AVIONIC PRODUCTS



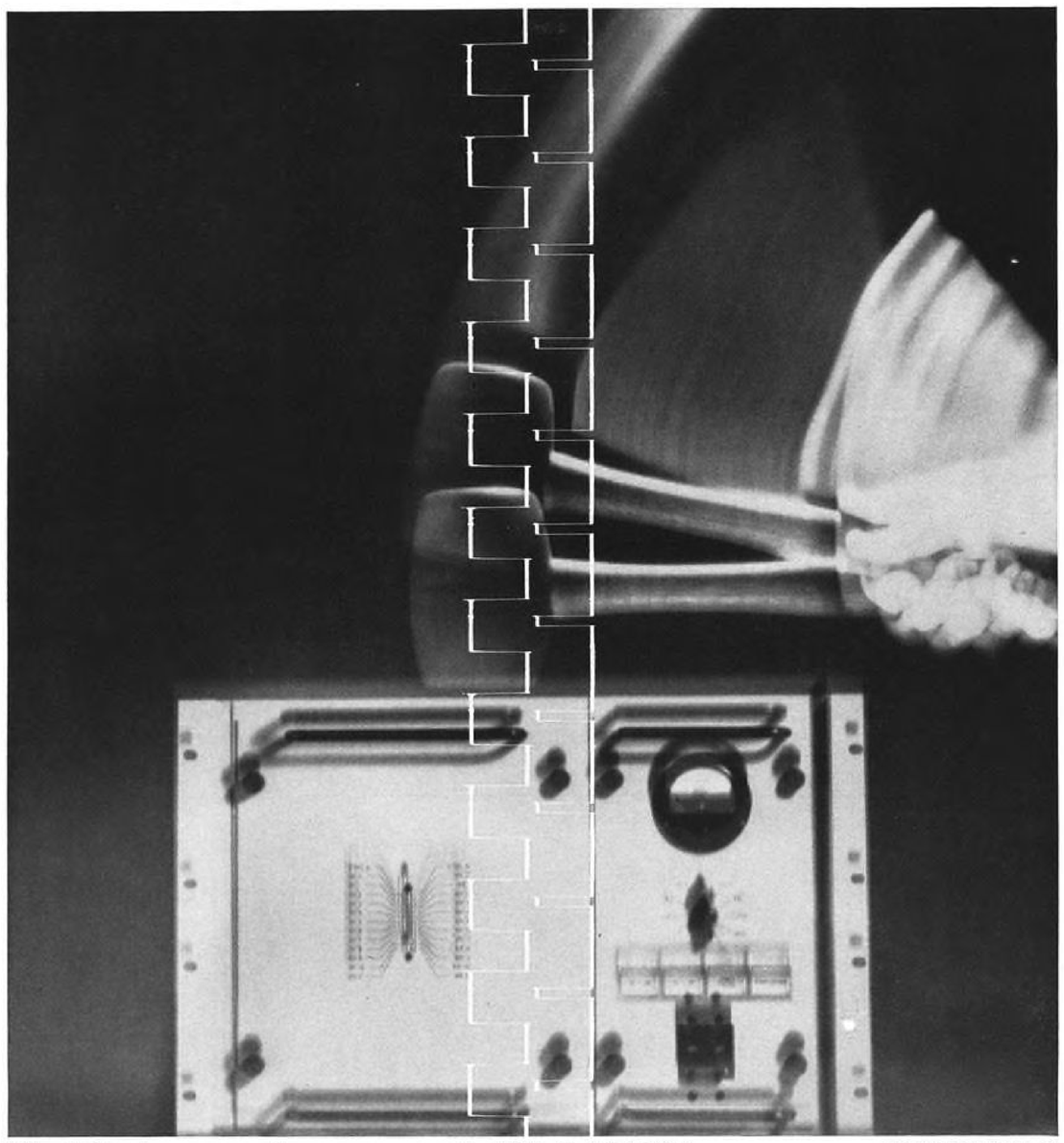
• **Miniature chopper,** Type 70A, operates from 20 to 200 cps. six-volt drive source over temperature ranges of —65C to 125C and withstands vibration of 20g from 5-2,500 cps., according to manufacturer. Contacts are SPDT configuration, rated 1 ma. at 10 v. Unit is packaged for printed circuit board mounting, measures ⅝ x ⅝ x ¾ in., weighs 9 gr. Manufacturer: U.S. Energy Corp., 300 Mt. Lebanon Blvd., Pittsburgh 34, Pa.

• **Miniaturized coaxial cable,** suitable for operation at 200C temperature, uses fluorinated ethylene propylene/dielectric which gives it a capacitance of 13 picofarads per foot for 95-ohm cables. Manufacturer: Microdot, Inc., 220 Pasadena Ave., South Pasadena, Calif.

• **Sensitive capacitor electrometer** Model 475, can measure currents less than one milli-pico ampere (10^{-15} amp.) and charges of less than one milli-picocoulomb. The device, called a Femtometer, can be used to measure transistor base or insulator leakage currents. Full specifications are available upon request. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland.



• **Rubidium frequency standard,** Model 304-B, provides long-term stability of five parts in 100 billion over a 90-day period with short-term stability of one part in 100 billion, according to manufacturer. Output is at 100 kc., 1 mc. and 5 mc. Unit weighs 39 lb., occupies 0.9 cu. ft. Manufacturer: General Technology Corp., 3510 Torrance Blvd., Torrance, Calif.

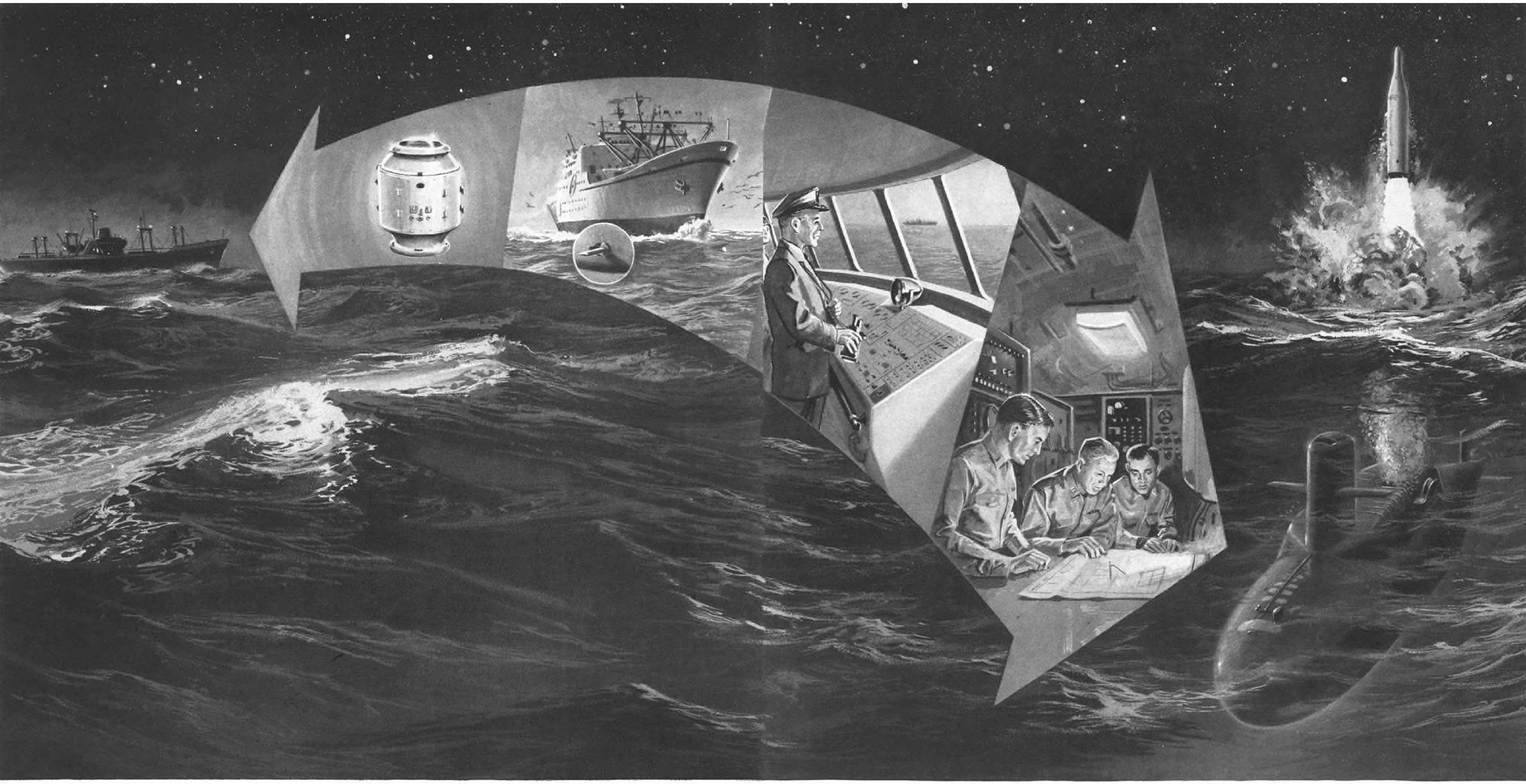


What 3-microsecond memory meets MIL-E-16400? **AMPEX RM-3**

Go ahead. Hit it, if you'd like. Our military customers can do just that—as part of the test for MIL-E-16400. This new Ampex RM-3 is the only core memory we know of that can meet the shock test of MIL-S-901. In addition to being tough, this memory is also fast, with a memory cycle time of only 3 microseconds. What's more, it can operate at temperatures that other memories would just as soon forget: +85°C down to zero and lower. The RM-3 is also flexibly packaged: the power supply is separable and modules may be rearranged to suit system requirements. This rugged, reliable memory comes from Ampex Computer Products Co., Culver City, Calif. A division of the only company providing recorders, tape and core memory devices for every application: Ampex Corporation, 934 Charter Street, Redwood City, California. Sales and service throughout the world. Term financing and leasing are available.



AMPEX 0/1



Over and under

Since the first Gyro-compass was demonstrated in 1911, Sperry has had undisputed world leadership in precision navigation—setting ever more advanced standards for the world's commercial and military fleets.

Today in hydrospace, significant Sperry achievements in sea systems are meeting more critical demands in navigation and control than ever before.

An example of the continued development and refinement of basic systems is the Mark 19 Gyro-compass—world-famous heading reference which has consistently kept in the vanguard of the navigational art.

Taming the unstable medium of the seas for many surface ships is the Gyrofin® Ship Stabilizer which compensates automatically for roll encountered in heavy weather. Gyrofin has a counterpart—the Gyro Stabilizer—aboard the latest nuclear subs.

SURIC—Surface Ship Integrated Control—will soon provide "hands off" control of destroyers and other vessels, displaying all functions in consoles on the bridge.

On Polaris-firing submarines, Sperry is navigation systems manager. Sperry SINS (Ship's Inertial Navigation System) equipment provides a continuous record of distance traveled, direction, ship's position, pitch and roll and every other critical motion—then supplies all navigational data for the exacting job of aiming the Polaris itself. Other Sperry sea systems range from periscope optics to passive underwater detection for ASW . . . from diving, steering and depth-keeping controls to the Celestial Altitude Recorder that focuses on the stars.

And Sperry is a leading producer of radars, Lorans, Gyropilots® and a host of other gear—plus expert field service—that lets ships of every kind sail over and under the sea with confidence. General Offices: Great Neck, N.Y.

SPERRY

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Advanced Transistor Production to Begin

By Barry Miller

Lawndale, Calif.—Pilot production line capable of turning out a family of five types of high-power transistors which may make possible entirely solid-state High Frequency (HF) airborne transceivers is expected to be in operation here later this month.

Working for the past year and a half under an $800,000 methods development contract from USAF's Aeronautical Systems Division, TRW Electronics/Pacific Semiconductors, Inc., soon plans to produce the first of five different types of npn silicon transistors on a single line.

System will use a maximum amount of common equipment for all transistor types. The effort is sponsored by the Manufacturing Technology Laboratory of ASD's Electronics Branch.

Sample devices fabricated under this program have been delivered to ASD and distributed to Air Force applications engineers. One interesting potential application for the transistors is their use in the transmitting ends of airborne transceivers as output devices, replacing tubes.

Air Force is interested in manufacturing methods for the devices and the pilot line, and samples will provide it with a measure of satisfactory performance, according to USAF Lt. T. W. Baily, project engineer on the methods development contract.

Three basic package types were developed for the five silicon transistor types, which are planar-epitaxial devices, rated from 1 to 100 amp. The five types are:

• **100 amp. transistor** capable of delivering 700 watts at 20 mc. with a power gain of 10 db. at a minimum efficiency of 40%. This device is packaged in an all-cold welded copper enclosure using ceramic seals and designed for water or air cooling. Devices of this type have been fabricated, but in the absence of suitable power-measuring equipment, have not been tested. Pacific says it expects that the device will meet its specifications, as it is made in an identical fashion as lower current types in this program except for the scaling factor. The package is 2¼ in. in dia., and not including lugs, measures 1¼ in. in height. It is mounted on a ⅜ in. 25/8 sq. in. flange.

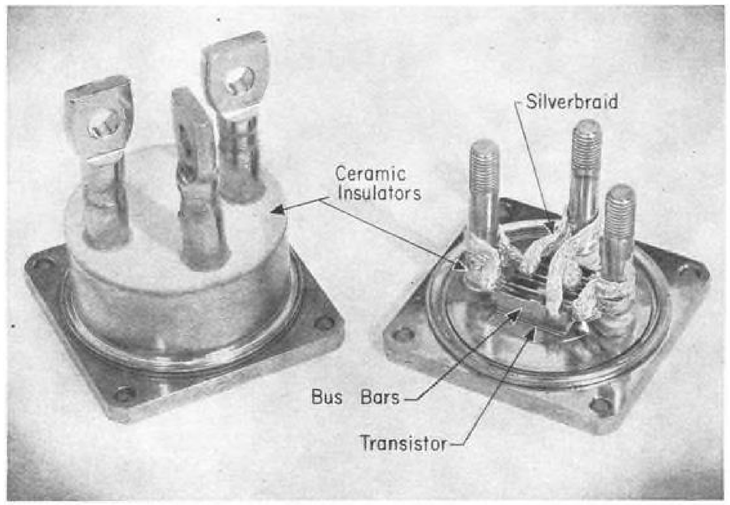
• **50 amp. transistor** designed to deliver 300 watts at 20 mc. with 10 db. power gain at an efficiency of 40%. This device uses the same package as the 100 amp. transistor and also has not been tested. The package, shown in an accompanying photograph, employs dual emitter leads which eliminate mutual coupling between input and output circuits in common emitter configuration. Typical improvement in gain, made possible by using dual emitters, was 3 db. measured on 10 and 20 amp. devices, according to Bernard Rappaport, head of transistor development at Pacific Semiconductors. The dual emitter also tends to boost efficiency, increasing at high frequencies.

• **20 amp. transistor** has delivered 125 watts at 25 mc. with 10 db. gain and 60% collector efficiency. The package for this device measures ⅝ in. in height, 1⅛ in. across its hexagonal base and 1⅛ in. in height including its stud.

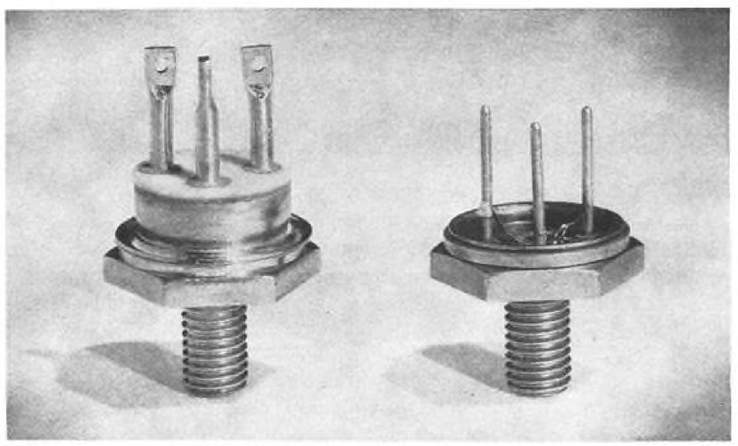
• **10 amp. device** has delivered 60 watts at 30 mc. with 10 db. power gain. This transistor uses the same package as the 20 amp. device.

• **1 amp. transistor** has delivered 10 watts at 100 mc. with 10 db. gain. This package measures ⅛ in. from flat to flat across its hexagonal base and ⅜ in. in package height with another ¼ in. for its stud.

Fabrication of high-power, high-frequency transistors is a particularly difficult task, compounding many of the normally troublesome problems in transistor fabrication. The basic semiconductor die from which the transistor



ABOVE ARE VIEWS OF THE 100-AMP., 20-mc. silicon transistor which is expected to be able to deliver 700 watts of average power. High power transistor is one of five types that are to be produced on pilot production line scheduled to go into operation at TRW Electronics/Pacific Semiconductors, Inc., later this month. At left is 100-amp. cold-welded copper enclosure. Facing terminal lugs are for dual emitters to eliminate mutual coupling between input and output circuits.



TRANSISTOR PACKAGE for 10 and 20 amp. devices capable of delivering 60 and 125 watts at 30 and 25 mc., respectively, is shown above.

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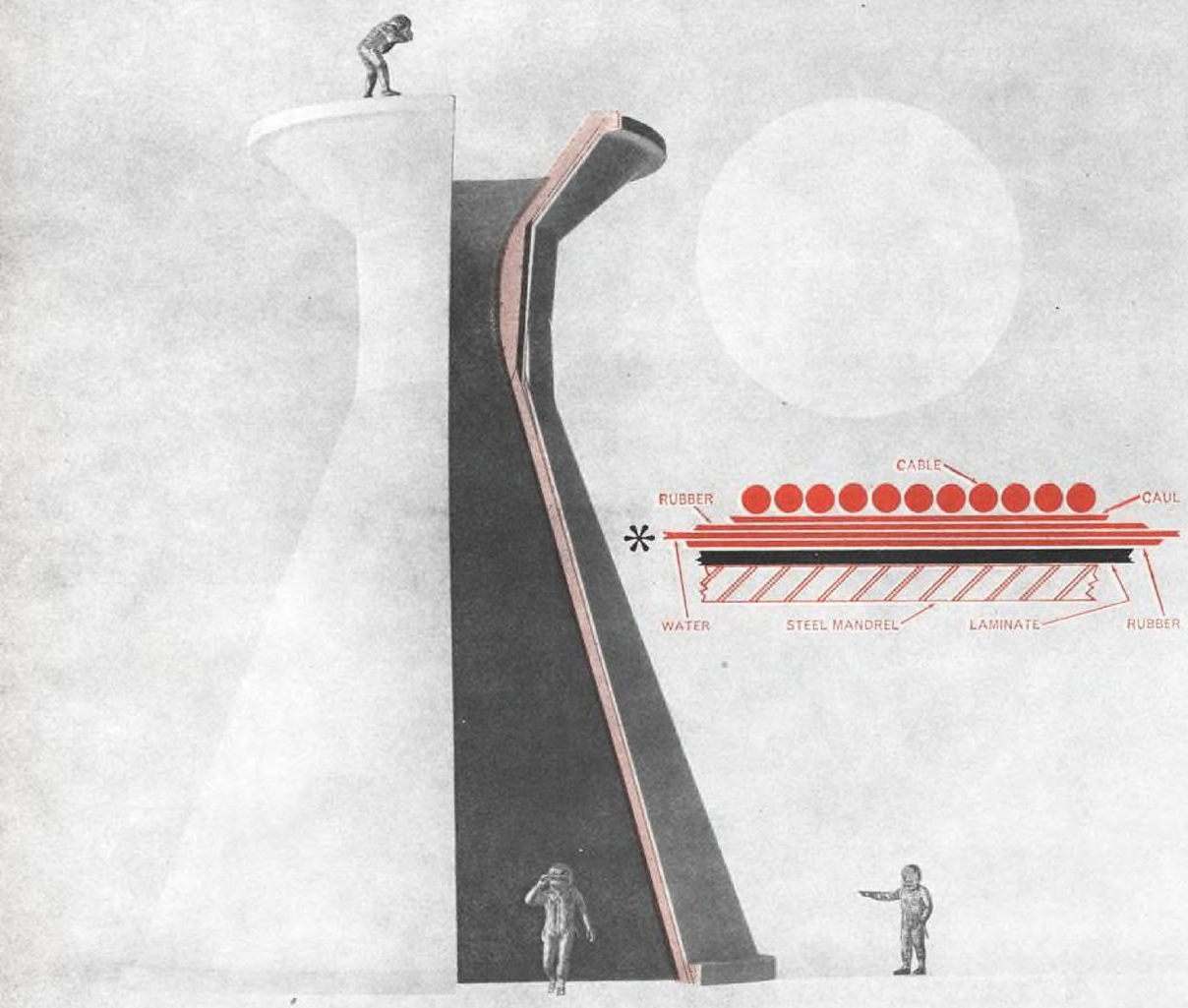
A boost for big nozzles...

Swedlow is solving the critical curing problem in the fabrication of large rocket nozzles with the development of a unique form of high-pressure containment. Known as the Cable-Clave* process, this method eliminates the extensive time and cost considerations involved in huge pressure vessels, and places the design of rocket nozzles to 400 inches within reach today. Simplicity, economy, unrestricted equipment mobility and immediate availability mark the Cable-Clave method as a significant advancement in plastics technology. Swedlow applied ingenuity developed this new technique in structures fabrication. Swedlow can solve your problem too, making *proven* plastics do new (and bigger) things. Write or telephone for complete technical information.

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The Cable-Clave process involves a laminated structure, with the uncured nozzle section sandwiched between a liquid pressure enclosure and a steel form. This assembly is cable-wound for pressure containment, then encased in a heated shell. Controlled pressure is introduced to program the complete curing process. *Patent Applied For. Cable-Clave is a Trade Mark of Swedlow Inc.*

©Swedlow Inc.

is made must be increased in size to increase output power, but this tends to increase capacity, thereby cutting the frequency.

The frequency, in turn, can be increased by reducing base thickness of the transistor so that size is traded for base thickness.

The typical base thickness, for the 100 amp. device is between 1 and 1.2 microns.

Since the size of the die is larger than in small signal transistors, the chances of contamination increase.

This imposes heavy demands on refining fabrication processes to offset the likelihood of low yields in the production process.

Fabricating Process

In fabricating the transistors, the semiconductor substrates are purchased out-of-house, their faces lapped and polished and collector regions epitaxially grown.

The company claims to have developed a production method for what previously was only a laboratory electrochemical polishing procedure. Semiconductor wafers are chemically polished by the action of a weak acid electrolyte through which current is passed.

Series of largely conventional processing operations follows with exception of a base diffusion involving vapor deposition of the impurity matter. Once diffusion steps are passed and metal contacts masked to base and emitter, the semiconductors are diced.

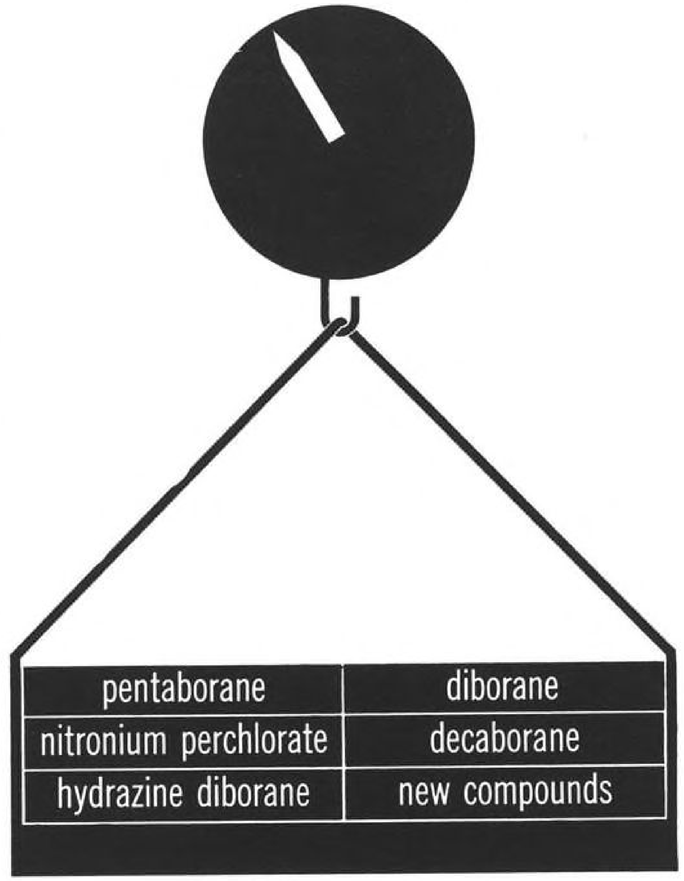
At this point the dice are placed in different jigs, depending on the size of the final device and furnace-mounted to their respective headers. The 1-amp. device is handled slightly differently from the other transistors and its leads are then thermal compression binded. In the larger devices, leads are attached by soldering. Finally the devices are capped.

Other Work

In addition to its work on this Air Force contract, Pacific is conducting other efforts on high-power devices under the sponsorship of the Army Signal Corps.

These include:

- **5 watt, 70 mc. (28 volt) device** scheduled to enter into pilot run this spring. This device uses a beryllia oxide tab on which the transistor is mounted so that the header is isolated from the transistor. This permits circuit design with the collector at other than ground potential.
- **25 watt, 100-mc. device** for which research and development contract is now being completed and a follow-on production engineering measures contract for a 75-watt transistor has been awarded.



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ALLOY NOMENCLATURE

1. Table I—Nomenclature of Aluminum Powder Metallurgy Alloys

Alloy	Old Designation	$\%Al_2O_3$
XAP001	M257	6
XAP002	M583 & M658	8
XAP003	M470	11
XAP004	M430	14
XAP005	—	6

APM PRODUCTS

2. Table II—APM Product Chart X—Products have been fabricated on a production or experimental basis.

Alloy	Sheet	Plate	Forgings	Impact Extrusions	Extruded Shapes	Drawn Tube	Fasteners
XAP001	X	X	X	X	X	X	X
XAP002	X	X	X	X	X		
XAP003	X	X	X		X		
XAP004			X		X		
XAP005	X	X	X	X	X	X	X

Alcoa capability at work . . .

guaranteed properties up to 900°F for an aluminum alloy

3. Table III—XAP001 Extrusions, Minimum Mechanical Properties

ROOM TEMPERATURE

	Longitudinal	Transverse
Ultimate Strength PSI	32,000	30,000
Yield Strength PSI	20,000	17,000
Elongation % in 4D	10	7

600°F

	Longitudinal	Transverse
Ultimate Strength PSI	13,000	12,000
Yield Strength PSI	11,000	9,000
Elongation % in 4D	5	3

900°F

	Longitudinal	Transverse
Ultimate Strength PSI	8,000	Not established
Yield Strength PSI	6,500	Not established
Elongation % in 4D	3	Not established

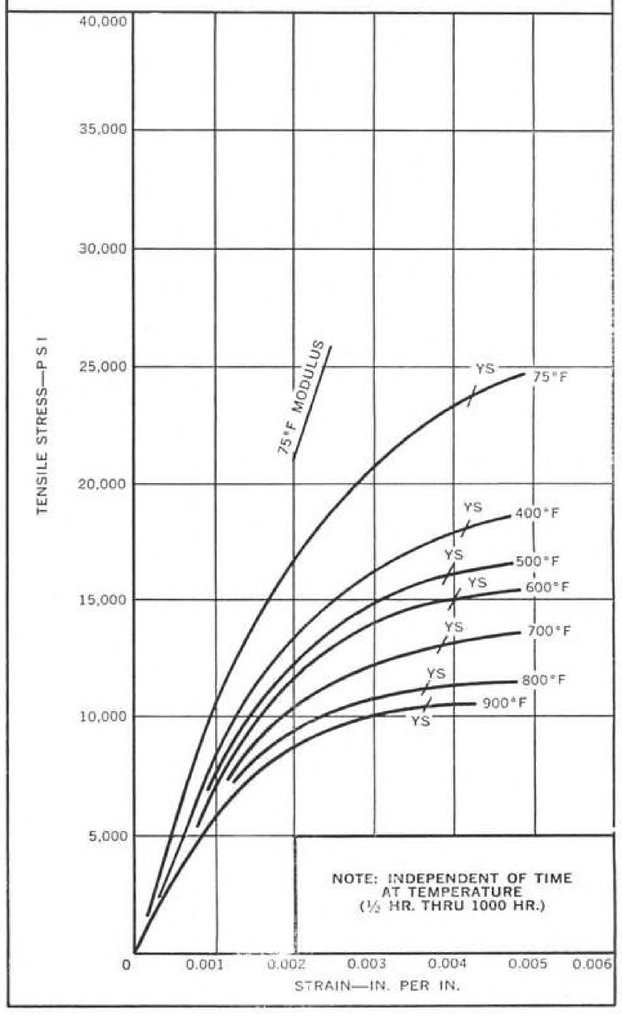
4. Table IV—Physical Properties of Alcoa's APM Alloys

		XAP001 XAP005	XAP002	XAP003	XAP004
Specific Gravity		2.74	2.74	2.75	2.77
Density, lb/cu. in.		0.099	0.099	0.099	0.100
Electrical Conductivity at 25°C (77°F) % IACS		47	44	39	34
Thermal Conductivity CGS Units (Calculated on Basis of Electrical Conductivity)	75°F	0.43	0.40	0.36	0.32
	400°F	0.44	0.43	0.39	0.36
	500°F	0.45	0.43	0.40	0.37
	600°F	0.45	0.43	0.41	0.38
	700°F	0.45	0.44	0.41	0.38
	800°F	0.45	0.44	0.42	0.39
	900°F	0.45	0.44	0.42	0.40
	1000°F	0.45	0.44	0.42	0.40
Average Coefficient of Thermal Expansion per °F x 10^{-6} Temp. Range, °F	68-212	12.0	11.8	11.5	11.1
	68-392	12.6	12.4	12.0	11.7
	68-572	13.1	12.9	12.5	12.1
	68-752	13.6	13.3	12.8	12.3
	68-842	13.9	13.8	13.0	12.5
Melting Range of Aluminum Phase (°F)		Solidus for All Alloys = 1180-1200 Liquidus for All Alloys = 1215 Oxide Phase Melts at 3700 (approx.)			
Specific Heat (cal/g) (Calculated) 68°F		0.213	0.212	0.211	0.210
212°F		0.225	0.224	0.223	0.223

Damping

Tests made at Alcoa Research Laboratories on 0.250" thick XAP001 and XAP004 plate showed that these alloys have 1½-2½ times as much damping capacity as other bare wrought aluminum alloys. Alclad products also exhibit unusually high damping capacity.

5. Tensile Stress—Strain Curves for Alloy XAP001 at Elevated Temperatures



Alcoa research has developed a series of new high-temperature (600°F to 1,000°F) alloys *made from aluminum powder*. These remarkable Aluminum Powder Metallurgy (APM) Alloys have higher mechanical properties at these temperatures than any other aluminum alloy.

Alcoa's Aluminum Powder Metallurgy Alloys also exhibit several other attractive characteristics including:

1. Stable properties at temperature regardless of the length of exposure time at temperature.
2. Retention of original room temperature properties and dimensions after repeated elevated temperature exposures.
3. High modulus of elasticity at both room and elevated temperatures.
4. Strength without heat treatment. All APM alloys are used in the as-fabricated condition.
5. Low neutron capture cross section and rapid decay of induced radioactivity.

Take Alloy XAP001 for example: Check its minimum mechanical properties in Table 3 reprinted from Alcoa's Development Division Report. (This is the first time minimum guaranteed properties have ever been published for any aluminum alloy at temperatures up to and including 900°F.) In addition, XAP001 has corrosion resistance comparable to 6061-T6 and is immune to stress-corrosion cracking. It has been ultrasonically spot welded, flash-butt welded and eutectic bonded to itself and other aluminum alloys. Alcoa® Aluminum Alloy XAP001 can be spun, machined with a minimum of tool wear, and anodized, hardcoated or plated.

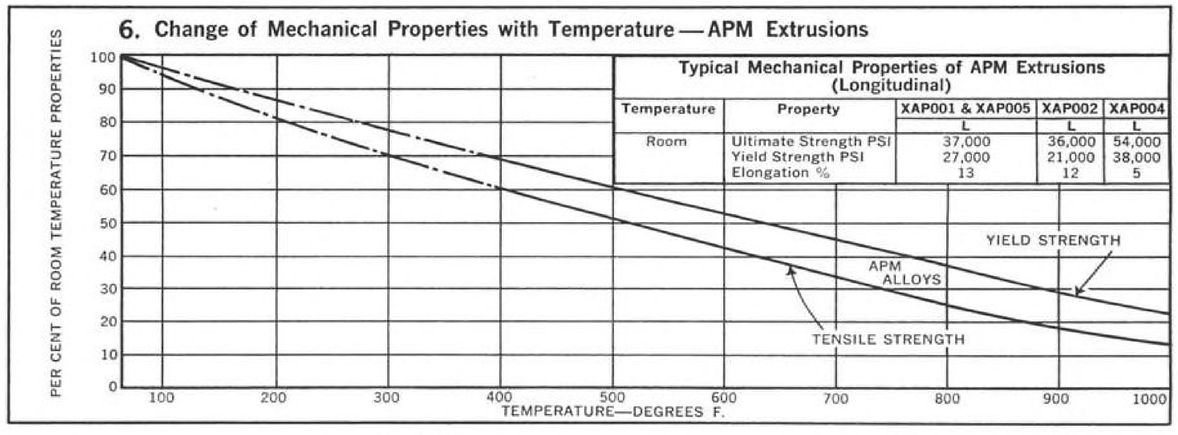
XAP001 is available in rods, forgings, extrusions, tubes, impacts and sheets—write us for procurement specifications on any of these items. Consider APM alloys for such applications as reactor core components, valves, pistons, piston rings, hydraulic and heating equipment, and jet engine accessories.

XAP005 exhibits mechanical properties similar to XAP001 but was developed for nuclear reactor applications.

Though extensive design information on XAP001, as well as on APM alloys XAP002, XAP003, XAP004, and XAP005, is already available, Alcoa will continue, as always, to investigate new APM alloys, new processes and improvements. Please keep in touch with us for current information.

NOTE: Graphs and data shown here were not compiled from special samples but are the results of many production runs.

6. Change of Mechanical Properties with Temperature — APM Extrusions



Typical Mechanical Properties of APM Extrusions (Longitudinal)

Temperature	Property	XAP001 & XAP005 L	XAP002 L	XAP004 L
Room	Ultimate Strength PSI	37,000	36,000	54,000
	Yield Strength PSI	27,000	21,000	38,000
	Elongation %	13	12	5

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- ☐ Have an Alcoa Salesman contact me concerning APM samples.

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Mergers and Acquisitions

Powertron Ultrasonics Corp. of Plainview, N. Y., has consolidated with Giannini Controls Corp., of Duarte, Calif., and is operating as a wholly owned subsidiary. Powertron builds equipment for missile fuel utilization systems, loading and tanking controls, submarine depth measuring devices and other systems involving control of fluids.

Kellett Aircraft Corp. has bought a controlling interest in J & K Precision Tools, Inc., of Line Lexington, Pa. J & K will operate as a Kellett division manufacturing precision tools for the metalworking industry. Production and sales will continue to be handled at the Line Lexington plant with purchasing and other business being absorbed by the Kellett offices.

National Union Electric Corp., a diversified industrial corporation, has acquired 73% of the common stock of Burr Electronics, Inc., a research firm specializing in aerial reconnaissance and surveillance, space and satellite communications, and digital and servo systems. Purchase was for an undisclosed amount of cash. Burr will be operated as a subsidiary of National Union Electric.



Canadians Use Aircraft Radar Tester

Radar tester for CF-104, Canadian version of the F-104 built by Canadair, Ltd., is housed in trailer. Aircraft nose and radome are inserted into rear of trailer containing an anechoic chamber to permit full radar operation and evaluation. Remote control console, shown to right of cockpit, enables operator to conduct tests while viewing cockpit radar scope. The RTS-103C radar tester is built by Remanco, Inc., Santa Monica, under $135,000 contract with Canadair.

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PROBLEMATICAL RECREATIONS 149



A cubic box with sides 'a' feet long is placed flat against a wall. A ladder 'p' feet long is placed in such a way that it touches the wall as well as the free horizontal edge of the box. If $a = 1$ and $p = \sqrt{15}$, calculate at what height the ladder touches the wall, using quadratics only. —*Contributed*

Rest ye, Merry Recreationers, for this message to all readers: Your large response to this series during the year has warmed our hearts and delighted our heads. We thank you all. May we at Litton Industries extend our wish to you for a gladsome holiday season and most propitious new year. May we also hope you will continue to solve the puzzles in 1963.

ANSWER TO LAST WEEK'S PROBLEM: $\frac{97,524}{10,836} = 9$ or $\frac{75,249}{08,361} = 9$ or $\frac{57,429}{06,381} = 9$

LITTON INDUSTRIES, INC.
Beverly Hills, California

PRODUCTION BRIEFING

Burtek, Inc., a subsidiary of Dorsett Electronics, Inc., Tulsa, Okla., has received the first training equipment production orders for the Boeing 727 program. Burtek will provide animated, backlighted panel trainers for the medium-range jet transport's air-conditioning, pressurization, hydraulic, electrical and fuel systems. Orders were placed by United Air Lines, which will take initial delivery of the 727 transport late next year.

Sperry Rand Corp.'s Vickers Division will develop an integrated pulse modulated, 60-lb. thrust chamber to prove specific design concepts for bi-propellant reaction control systems. Program, sponsored by National Aeronautics and Space Administration, will include design, fabrication and development phases of a prototype bi-propellant injector valve and thrust chamber. Apollo, Gemini and the Lunar Excursion Module are among vehicles which will require bi-propellant reaction control systems.

Hughes Aircraft Co. will build electronic data analysis systems, under a $27,610,000 contract from Boeing Co., which will indicate readiness of Air Force's Minuteman ICBM prior to launch and will signal when missiles leave silos.

Allison Division of General Motors has been awarded a $10,165,000 contract from Aerojet-General Corp. for continued production of titanium second-stage rocket motor cases for Air Force's Minuteman ICBM. Allison also has been awarded a $1,297,375 contract for development of a case to be utilized with an advanced version of Minuteman.

Bendix Corp. is building a sonar system that will help missile tracking ships pinpoint location of nose cones or instrument packages which land at sea. System, known as Ship Tended Acoustic Relay (STAR), is being developed under a $1 million Air Force contract. It is the first to use acoustic data transmission techniques for impact location, rather than using cables attached to shore-based monitors.

Belock Instrument Corp., College Point, N. Y., will continue development of an odometric navigation system for the ground launching vehicle of Army's surface-to-surface Mauler missile. Belock was selected in a competition recently conducted by General Dynamics/Pomona (AW Oct. 1, p. 13).

manager

AIRCRAFT MILITARY SALES

Major aerospace corporation in Southern California has an immediate opening for Department Manager in Aircraft Military Sales.

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Experience should include participation in, or direction of, the preparation of technical sales material. Technical or military operational background plus several years direct experience in military sales work, some of it in supervisory or managerial capacity, is required.

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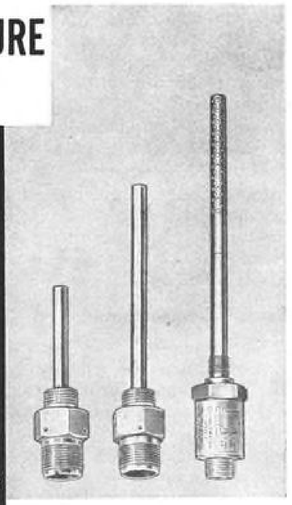
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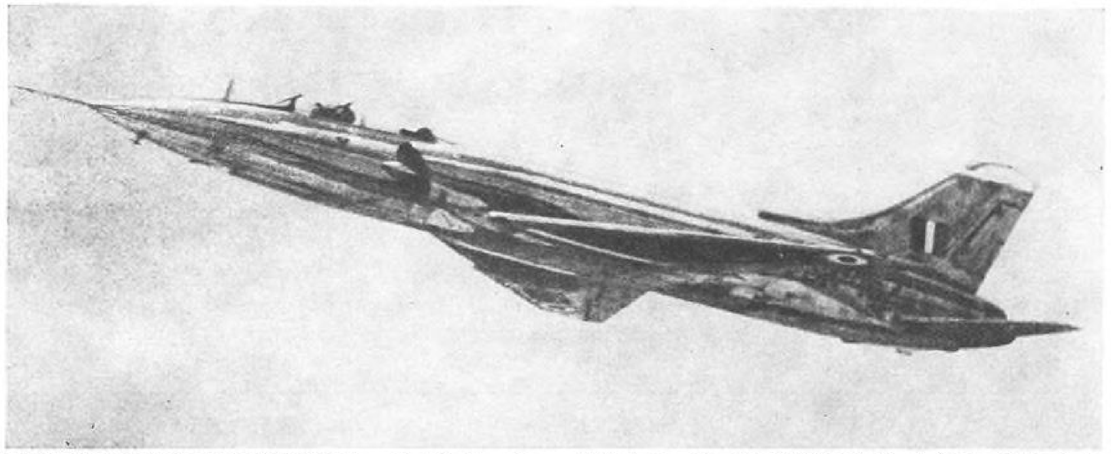
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HEAVILY RETOUCHED PHOTOGRAPH shows the Mk. 1 prototype of Hindustan Aircraft's HF-24 jet fighter in flight. Flight testing of the prototype has been under way with Indian air force pilots at the controls since June, 1961. Mk. 1, powered by two Bristol Siddeley Orpheus 703 turbojets, has a top speed that barely reaches the supersonic regime. Planned Mach 2 version is scheduled to be powered by two Soviet powerplants designated the RD9-F. Powerplant's rating is about the same as Bristol Siddeley's Orpheus 12.

India Spurs Domestic Aircraft Industry

By Cecil Brownlow

New Delhi—India's domestic aircraft industry now is attempting to gear for a major leap forward, both technologically and financially, as a result of the recent Sino-Indian border crisis.

The emergency, which has stirred political leaders here to the belated recognition that India must develop a broad-base defense production capability, also is providing its share of headaches, including the necessity of establishing a list of priority requirements on an accelerated basis, need of creating new support industries uncontemplated heretofore and a long-range appraisal of Soviet intentions.

Soviet Commitment

Of immediate concern is how far Russia actually will go toward meeting all of its pre-emergency commitments which are being relied upon to open new technological vistas as well as provide additional and sorely needed production facilities.

Prime Minister Jawaharlal Nehru and new Defense Minister Y. B. Chavan, regarded here as a political realist, have assured parliament that the Soviets plan to meet their commitments (AW Nov. 19, p. 38; Dec. 10, p. 33). There are still doubts, however, as to the full extent the Soviets will fulfill their promises to provide India with advanced production facilities in the near future.

Some officials believe that, in this respect at least, Russia will attempt to move slowly so long as the border dispute with Communist China remains an open issue with the probability of renewed conflict. Any such backoff could seriously affect two of the country's most ambitious projects within the aviation sphere.

MiG-21 Fighter

First is the plan to build the Mach 2 MiG-21 all-weather Soviet interceptor under license. Program was designed to provide India with a three-fold gain—a third major aviation production facility; a large boost in technology, particularly in fabrication of avionic components, plus a modern aircraft for the air force.

Equally affected, at least for the moment, are India's plans to build a Mark 2 interceptor version of Hindustan Aircraft, Ltd.'s, HF-24 jet fighter. Mark 2 version, with a maximum design speed within the Mach 2 range, is currently programed to be powered by two Soviet turbojet powerplants.

Indian officials here are reluctant to reveal details of the Soviet engine and will go little beyond identifying it by its official Russian designation, RD9-F. It is known, however, that the powerplant has been in operational service within the Eastern bloc for a number of years and that its rating is approximately the same as that of Bristol Siddeley's Orpheus 12 which had a basic design thrust of 6,810 lb.

Emergency also has forced a slowdown in the country's licensed production program for the Avro 748, which is scheduled to replace the over-age Douglas DC-3, still a transport mainstay for both the air force and the government-owned Indian Airlines Corp.

In a move to diversify its production potential centered at Hindustan Aircraft's plant at Bangalore in southern India, the government decided to have the 748 manufactured in Kanpur between New Delhi and Calcutta at the sprawling headquarters of the air force's maintenance command. The first Indian prototype of a Series 1 model was rolled out from there last year.

Kanpur Facilities

Now, however, the Kanpur facilities and technicians are absorbed almost completely with the day-to-day task of maintaining, inspecting and repairing the air force transport fleet which is flying a heavy schedule in logistics support of Indian army units located along the threatened Himalayan border areas of Ladakh and the North East Frontier Agency.

Due to the dearth of surface transport facilities within these mountainous areas, these top-priority flights probably will have to be continued so long as the army remains there.

Indian air force tactical fighter squadrons also are training on an accelerated basis, and 748 production is suffering accordingly.

Under original government plans, a portion of the maintenance command facility eventually will be split off, given an appropriate title and designated as a second source of primary aircraft production.

The planned third source in the capability buildup was to be the MiG-21 plant scheduled for construction in Orissa on the east coast of India south of Calcutta. Defense industry planners still hope such a plant will materialize there—if not for the MiG-21, then for a possible U. S. or British counterpart.

Other hoped-for licensed production agreements with the West probably also will boost the number of production facilities beyond this figure.

Construction of a separate plant for new production could be a political necessity as well as a material advantage in some cases. In one respect, at least, the U. S., Britain and Russia assume an identical posture—an insistence that any production of their respective military equipment be conducted in facilities separate and well apart from those building hardware from nations of another political stripe.

HF-24 Production

Production plans for the HF-24 also are being muddied by the new emphasis on defense as top-level Indian planners try to establish equipment priorities in line with immediate requirements and capabilities.

Problem is two-fold. Although relatively inexperienced in this field, officials here are not immune to the almost universal doubt that surrounds any defense production decision, i.e., the point at which to definitely decide upon an in-hand item when nearly completed research and development projects or possible licensed-manufacture programs appear so much more promising.

Second condition revolves around the fact that Hindustan also is a producer of railway cars, an item sorely needed for army logistics support. Decision on just how to split the government-owned firm's production between aircraft and railway cars still must be made.

Present plans call for the HF-24 to be built in two versions, the Mark 2 interceptor and the barely supersonic Mark 1 powered by two Bristol Siddeley Orpheus 703 turbojets of 4,850 lb. thrust each. Mark 1, prototype of which has been flying since June, 1961, would be used primarily for close support. Work on the lightweight swept-wing aircraft was begun in 1955 under the leadership of Dr. Kurt Tank, a leading World War 2 engineer who was chief-designer at Germany's Focke-Wulf.

Mark 2 version had been scheduled to be powered by the Orpheus 12 before that project was dropped in Great Britain because of lack of funding and an airframe development with requirements within its thrust range. India turned to the Soviet Union after Bristol Siddeley estimated that it would require an additional $11.4 million to complete development of the Orpheus 12.

Installation of the RD9-F in the existing airframe without major modification requires relocation of the accessory packages along the exterior of the Soviet engine. Russia agreed to undertake the redesign and, thus far, there has been no indication that work on this has been discontinued. There apparently also is little evidence that it has begun.

Concurrent with its airframe capabilities, Hindustan Aircraft has been developing a strong powerplant team, although, because of political considerations, the licensed production program for the RD9-F was scheduled for Orissa. In return, however, the Bangalore plant will become prime contractor in the licensed production program for the 550-shp. Turbomeca Artouste shaft-turbine powerplant designed to power a quantity of Sud Alouette 3 helicopters for the Indian air force.

Alouette Airframe

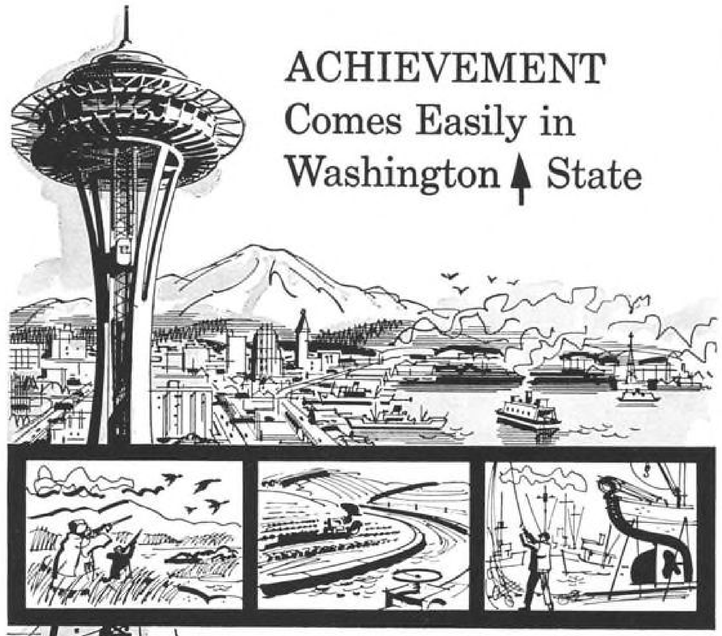
Government also may award Hindustan the licensed production contract for the Alouette airframe, but no decision on this front has yet been made. Before the present emergency, Kanpur also was a prime contender for the airframe project.

Powerplants already in production at Bangalore include the Orpheus 703 for the close-support versions of the HF-24; the Orpheus 701 for the Hindustan-made Folland Gnat lightweight fighter,



Vertol 107 Scheduled for RCAF Delivery in March

First of six Boeing/Vertol 107 helicopters for the Royal Canadian Air Force is shown during recent inaugural flight outside Vertol Division plant, Morton, Pa. Scheduled delivery date for this aircraft is March, 1963. Helicopters, designated CH-113 by the RCAF, will be used on search and rescue missions. Balance of the order is in various stages of assembly. The 107, shown above, is at Eglin Air Force Base, Fla., where it currently is undergoing climatic testing. RCAF 107s have special provisions for electric blanket outlets and for food heating in line with the helicopter's intended rescue mission role.



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a number of which are now in squadron service, and the 2,105 ehp. Rolls-Royce Dart R.Da. 7 turboprop scheduled for the Series 2 model of the Avro 748.

Series 1 version of the 748 powered by two Dart R.Da. 6 engines of 1,740 ehp. each does not have the high-altitude performance required by the air force for its operations into the Himalayas, and only four aircraft of this version are scheduled to be built at Kanpur.

Kanpur Schedule

After completion of these four, Kanpur is to begin work on airframes for the Series 2 model which was recently certificated in England. Air Force also has a requirement for between 40-50 MF748 freighter versions, and the government is expected to follow through with negotiations for licensed production of this particular model.

While the government moves to expand its airframe-engine production base, it is becoming increasingly evident that support industries also must be developed on an accelerated timescale if the country is to have a truly domestic aviation manufacturing capability.

At present, all the basic materials must be imported, down to the nuts, bolts and rivets. India has no production capacity in this area, although it is now considering, as a first step, establishment of two plants with foreign aid for the production of aluminum extrusions.

"We say we're building a supersonic aircraft," one official complains, "when we have to bring in every single item that goes into it. We're not producing —we're actually assembling."

Diversity of Orders

Diversity with which the government has ordered aircraft and helicopters from both East and West as part and parcel of its neutralist political policy—there are reportedly 21 different types in the air force inventory—provides an added strain all around, particularly in assuring adequate support, and suggests that sooner or later India must give some thought to at least partial standardization. At the moment, this is not possible, and it places an added burden upon defense planners who must decide what to build and to what specifications.

Industry, thus far, also has been plagued by a paucity of funding for actual defense items and, since financial support and active Defense Ministry encouragement were available here, turned to production of such products as electric coffee pots, hair clippers, pressure cookers, film projectors and, on the other end of the scale, Hindustan Aircraft's railway coaches.

The move kept technicians at their benches and undoubtedly aided in India's drive toward a better living for its people. It also reflected official policy of largely ignoring the military, and the machines used for the manufacture of coffee pots cannot readily be turned to defense.

In an effort to offset this shortcoming somewhat, at this relatively late date, the Defense Ministry has drafted a list of its machine tool needs on an itemized priority basis. The list is now being circulated among the industrialized nations of the world, East and West, who may or may not come to India's aid. The major portion of help, however, is expected from the U. S.

Capability of producing airborne and ground electronic systems is a glaring need—almost all the instrumentation for licensed-produced aircraft is now imported—and one that has been overlooked. As an example, a licensed production contract signed by the government with Bendix approximately two years ago has been largely ignored thus far (AW Nov. 26, p. 30).

Ground Units

Despite this, there has been a beginning. The government established Bharat Electronic, Ltd. (B. E. L.), near Bangalore in 1954, and, under the technical supervision of France's Compagnie Generale-de-Telegraphie sans Fil, the firm has been slowly developing its capability. To date, however, its production has been geared almost solely to ground units, including single sideband receivers and transmitters on the one hand, transistorized megaphones and "walkie-talkies" on the other.

Hindustan Aircraft, on the other hand, is an inheritance from British rule. Established in 1940, it assembled Harlow trainers and Curtiss fighters throughout most of World War 2.

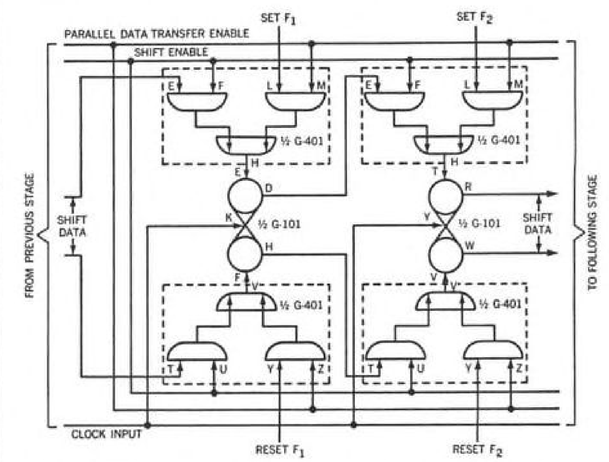
After the war, it converted to primarily an engine-airframe repair and overhaul facility until the new Indian government decided that, as a matter of national policy, it should become actively involved in original aircraft design and production.

First step was the HT-2, an all-metal basic trainer which made its first flight in August, 1951. It remained in production for almost 10 years to meet the requirements of the air force, navy and private flying clubs. Twelve HT-2s also were sold to Ghana.

Two other light aircraft of domestic design were subsequently brought out and are still in production—the two-seater Pushpak utility plane and a four-seater follow-on designated the Krishak. The company stepped into the manufacture of larger, more advanced aircraft in the 1950s with the licensed-production of the de Havilland Vampire jet fighter. The Gnat and then the HF-24 followed on the line.

EECo G-Series Circuit Applications

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True level: —6 VDC (nominal)
False level: 0 VDC (nominal)

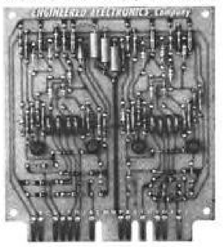
EECo Modules/Bit
One G-401 universal logic gating package
One-half G-101 dual JK flip-flop

Power
—12 VDC: 2F/F=60 Ma, each 401=32 Ma
—6 VDC: each 401=32 Ma
+6 VDC: 2F/F=6 Ma

Logic Input
True level: —6 VDC (nominal)
False level: 0 VDC (nominal)
Logic transfer frequency: up to 10 Mpps

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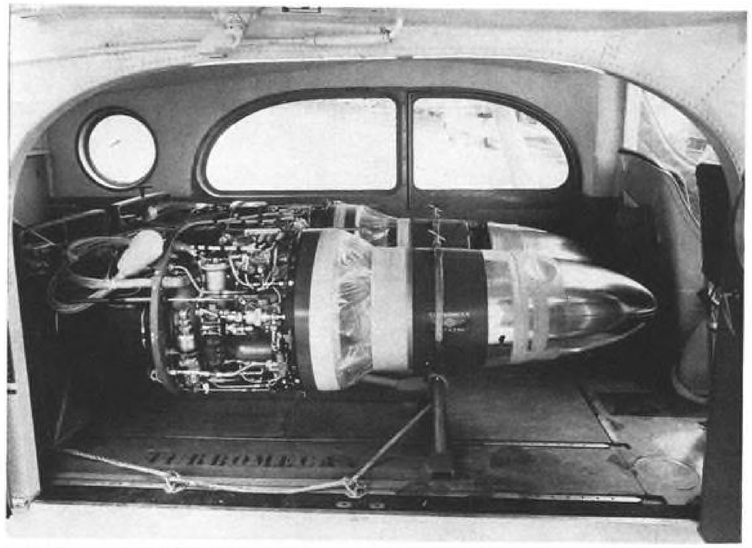
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FIRST OF TWO Turbo Porters ordered by Wien Alaska Airlines is scheduled for delivery by the end of the year. Wien already uses the piston-engine Porter version.



CARGO CAPACITY (above) is shown by loading two Turbomeca Astazou engines. Smaller wheels (below) can be replaced by oversized ones for landing on unprepared strips.





ASSEMBLY LINE for PC-6 Porter light utility aircraft is shown at the plant of Pilatus Aircraft Works, Ltd., Stans, Switzerland. Turboprop version is being flight tested.

Pilatus Turbo Porter Undergoes FAA-Required Changes

By Edith Walford

Stans, Switzerland—Swiss multi-purpose Turbo Porter with improved STOL capability, latest version in the Pilatus Porter PC-6 (AW June 11, p. 104) light aircraft series built by Pilatus Aircraft Works, Ltd., here, is undergoing several minor changes to meet Federal Aviation Agency requirements.

In addition to the alterations, deicing equipment is being fitted to the propeller spinner of the aircraft and its French-designed fire detector replaced by an FAA-approved type.

After modification, the aircraft will resume flight tests prior to its FAA certification, which is "expected within a few weeks," according to the company's managing director, Henry F. Alioth.

This summer, the Porter was fitted with a larger, steerable tail wheel, soon to become a standard feature of both the piston-engine and turboprop-powered versions and specifically designed to enable the aircraft to land on and take off from soft grass or other unprepared surfaces.

As an optional extra, larger, low-pressure, 11 in. by 12 in. dia. main landing gear wheels also are available. Using the same braking system as the standard 7½ in. by 10 in. dia. type, this oversize unit can be fitted to replace it within a few minutes.

At an altitude of 15,000 ft., the Turbo Porter can operate at a temperature of −15C with only a slight decrease in the cruise speed range. With a payload of 2,850 lb. over a range of 620 stat. mi., fuel consumption is 129 U.S. gal.

The 200-hp. additional power, provided by its Turbomeca Astazou 2 530-shp. engine driving a three-blade reversible propeller, enables the Turbo Porter to climb to an altitude of 10,000 ft. from takeoff within 8 min. Rate of descent is 1,000 fpm.

According to latest Air Transport Assn. figures, operating costs of the standard version compare favorably with other current aircraft being used for bush service and other multi-purpose duty. Porter costs 55 cents per aircraft mile.

Price of the Turbo Porter, including standard instrumentation, is $60,000 FAF.

The piston-engine Porter fitted with a supercharged 340-hp. Lycoming powerplant sells for about $45,000.

Present production rate here is three aircraft per month, but the company could handle up to twice as many if necessary.

It also would be agreeable to the plane's manufacture under license if ordered in sufficient quantity. At the moment, Pilatus is negotiating an initial Porter license production agreement with Officine Aeronavali, of Venice. If the agreement is signed within the near future, as expected, the Italian-produced aircraft will be designated and marketed in Italy as the Aeroporter.

According to Alioth, Indian manufacturers may be the next to apply for production rights to the Porter series. Five Lycoming-powered models sold to India have been giving good service there for some time, particularly in Nepal, he said, and Indian authorities are showing interest in acquiring several Turbo Porters, possibly for use as military transports. A firm order for these has not been received, however.

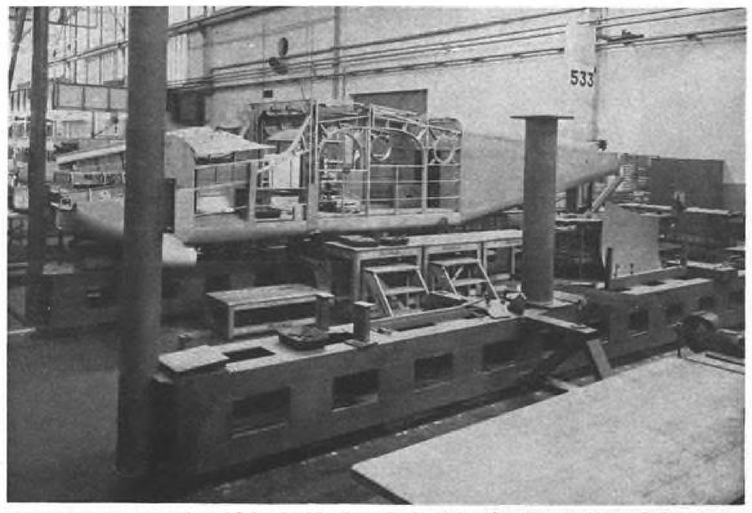
Reports that India is negotiating with Turbomeca S.A. at Bordes for production rights to the Turbomeca Artouste 3 turbine engine, which powers the Sud Aviation Alouette helicopter, have been confirmed by the French company.

First two of an undisclosed number of Alouette helicopters also were recently delivered to India. According to Pilatus, it is conceivable that India will later apply not only for the production rights to the Porter air frame but also to its Astazou engine as a next step in the Turbomeca engine series manufacturing program in India.

Following introduction of the Porter prototype at the 1959 Paris Air Show (AW June 15, 1959, p. 101), 43 aircraft have been built, of which 33 were fitted with single 275-hp. Lycoming engines and the remaining 10 with supercharged 340-hp Lycoming powerplants.

Except for 11 sold domestically, three used by the company for demonstration purposes and one or two retained by Pilatus as reserve aircraft, they have all gone to fill orders from Alaska, Finland, Sweden, Holland, West Germany, France, Algiers, the Sudan, West Africa and Nepal.

After a series of recent sales tours to North and South America, Africa, Asia



PORTER FUSELAGE has 5.3-ft. double door flush with cabin floor. Air ambulance configuration can accommodate two stretchers plus three passengers and the pilot.

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and the Far East—where the Porter's performance under varying conditions was demonstrated—Pilatus now is building five additional Lycoming-powered models, one each for delivery to Japan, the U.S. (Seattle), Mexico, Colombia and France.

First production series of seven Turbo Porters is awaiting shipment from Stans to Alaska, Italy and France—each with two on order. The remaining aircraft has been sold to a Swiss alpine rescue pilot, Hermann Geiger of Sion/Valais, who already has two Lycoming-powered Porters.

Pilatus says it is now working on completion of firm orders for five more Turbo Porters.

Alaskan Sales

Alaska is a marked example of the Swiss manufacturer's claim that its efforts to establish the Porter series in far-flung markets are successful. One domestic carrier, Northern Consolidated Airlines, Inc., based at Anchorage, Alaska, took delivery of its fourth Lycoming-Porter in October and has ordered a Turbo Porter for delivery later this year.

Wien Alaska Airlines, Fairbanks, which recently celebrated its 35th anniversary as the first scheduled carrier to be established in that state, received its first piston-engine Porter in November, 1961.

Wien's plane went into service last January on regular mail runs and also was used extensively to supply oil exploration and mining engineers in the mountainous region of North Alaska. Carrier president, Sigurd Wien, told AVIATION WEEK that by mid-October of this year, the aircraft had completed 1,000 flight hours, a record which he felt fully justified his choice of the Porter for use under the formidable weather conditions prevalent in his airline's area. Wien expects to receive its first Turbo Porter by end of this year.

Italian Outlet

Pilatus' hopes of finding a good outlet in Italy within the near future appear to be well-founded. Between Aug. 6 and Sept. 15, a 340-hp. Lycoming-powered Porter loaned to Societa Aeronautica Mediterranea (SAM), an affiliate of Alitalia, operated passenger flights between Venice and Cortina, the Italian Winter Olympic Games resort.

During this five-week trial period, the aircraft logged a total of about 100 flight hours and made more than 100 landings on the newly established Cortina airstrip.

SAM plans within the near future to form a new company, probably under the name of Aer-Alpi, Venice, to operate regular flights with Porter aircraft between Venice-Cortina-Belluno-Bolzano-Asiago.

Later, depending on initial popularity of the aircraft, flights will be started to several additional points along the southern slopes of the Alps—first with piston-engine Porters, and ultimately with turboprop versions.

Turboprop Order

Firm order for the first two turboprop types for earliest possible delivery was placed with Pilatus in late October by the company's Italian sales representative, Gen. Liugi Klinger, co-owner of Officine Aeronavali, at Venice.

Related recent development in Switzerland shows signs of boosting the Porter's future export prospects and considerably strengthening Pilatus' view that Italy may well become one of its best European sales areas.

Swiss hotel owners, at the urging of guests, are petitioning the government to limit, if not entirely prohibit, the disturbance caused by the growing number of small aircraft bringing tourists and skiers to their mountain resorts all-year-round.

Thus far, Swiss federal authorities are showing reluctance to pass any legislation to comply with this request. Swiss cantons themselves apparently will have to find their own solutions to the problem.

The cantons, it is assumed, will be unwilling to run the risk of losing this Swiss-pioneered air tourist service to any competitor.

Italian Resorts

While their Swiss neighbors are still pondering the issue, the Italians currently are busy with plans that would promote their own mountain resorts with the establishment of similar airlift operations.

Pilatus sees increasing Italian interest in the Porter as the first step toward this goal.

Another step lies in the fact that three Italian pilots have recently arrived in Sion for training by Hermann Geiger in his glacier landing technique (AW Apr. 4, 1960, p. 126).

Pilatus has a staff of 400. About one-third of these work on production of the Porter series, the rest in the company's fairly wide range of additional activities, including:

• **Production of the fuselage** of the Dassault Mirage fighter ordered for the Swiss air force and being built in Switzerland under license from the French manufacturer. Mirage fuselage work is a major part of Pilatus' production program, and a large, new workshop and hangar facilities are presently under construction at Stans. These will ultimately accommodate all work connected with the Mirage program and relieve the congestion stemming from



FIVE PC-6 PORTERS have been ordered by Northern Consolidated Airlines of Anchorage, Alaska. Aircraft will be equipped with skis and will be powered by 350-hp. Lycoming engine. Planes were air freighted to U. S. by Seaboard World Airlines for assembly.

U.S. Business & Utility Aircraft Shipments

August 1962

Make & Model	No. of Units	Net Billings
Aero Commander 500A, B	2	$637,000
560F	2	
680F	3	
Beech 18 Super	2	$3,152,000
33 Debonair	11	
35 Bonanza	15	
50 Twin-Bonanza	1	
55 Baron	16	
65 Queen Air	1	
80 Queen Air	8	
95 Travelair	2	
Cessna 150	33	$2,667,000
172 Skyhawk	46	
175 Skylark	4	
180	7	
182 Skylane	45	
185 Skywagon	14	
205	9	
210	14	
310	9	
320 Skyknight	2	
Mooney Mark 20	30	$397,000
Piper PA-180-150 Super Cub	13	$2,381,000
PA-22-108 Colt	38	
PA-23-250 Aztec	31	
PA-24-180 Comanche	1	
PA-24-250 Comanche	12	
PA-25-150 Pawnee	2	
PA-25-235 Pawnee	22	
PA-28-150-Cherokee	4	
PA-28-160 Cherokee	27	
Totals	426	$9,234,000

Note: Deliveries for 1962 through August totaled 4,396 units having a total factory net billing value (prior to distributor-dealer markups, which come to 25%) of $91,291,000. In the comparable 1961 period, the industry delivered 4,596 units valued at $83.7 million.



VHF Transceiver

VHF communication transceiver, Model SA-360, operates 118 to 136 mc., provides 50 kc. channel spacing. Unit, priced under $1,000, has 15 watt output power and automatic squelch. Model SA-90 covers 118 to 127 mc. band in 100 kc. channels as lower cost. Weight is 11 lb. including power supply. Manufacturer: SunAir Electronics Inc., 3101 SW Third Ave., Fort Lauderdale, Fla.

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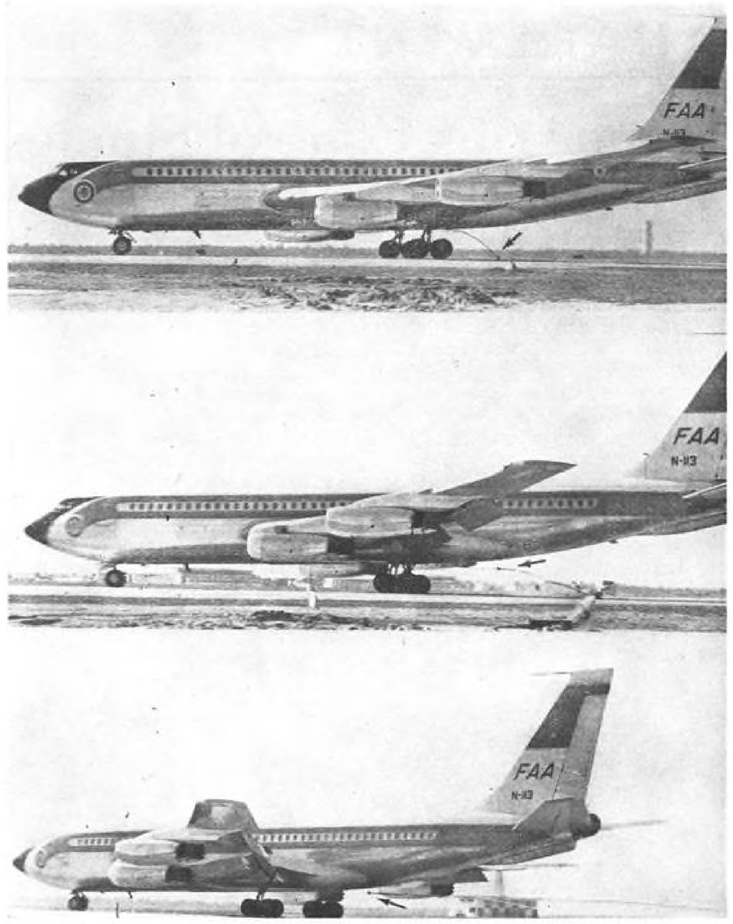
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FAA Completes Transport Arresting Tests

Federal Aviation Agency has completed its latest series of transport arresting gear tests with successful arrestment of a 220,000-lb. Boeing 720 transport (above), traveling at 120 kt. FAA is now evaluating the results and expects its evaluation to be completed by the end of the year, although deadline is April, 1963. FAA's 720 was arrested 35 times in the tests conducted at the National Aviation Facilities Experimental Center (NAFEC), Atlantic City. Convair C-131 was caught 10 times. Top impact speed in the series was 130 kt. with a recorded weight of 135,000 lb. Arresting equipment was manufactured by All American Engineering Co., Wilmington, Del., under $1-million FAA contract (AW July 9, p. 59).

use of the present facilities for both the Porter as well as Mirage production lines.

• **Production of wings** for the wire-guided Mosquito missile which is built by the Swiss Contraves-Oerlikon concern.

• **Overhaul of Pilatus P-3** two-seat trainer under order for the Swiss air force.

• **Maintenance of de Havilland** Venom two-seat, all-weather fighter. The de Havilland fighter also is in Swiss air force service.

• **Maintenance and repairs** on Douglas DC-3 transports for Swissair as well as repairs on private aircraft for sport flying.

PRIVATE LINES

New certification and operating standards have been proposed by the Federal Aviation Agency for agricultural aircraft operators. Under the new proposed regulations, each aircraft operator would be responsible for safety, including dispensing of chemicals.

Largest single order for business airplanes ever processed by Cessna Aircraft Co.'s International Sales Dept., covering 60 aircraft having a retail value of over $1 million, has been placed by Miles King, director of distributorships in Australia and New Zealand.



STRUCTURES AND DYNAMIC TEST ENGINEERS FOR ADVANCED MISSILES AND SPACECRAFT

Unusually interesting positions exist for qualified engineers who can perform on a variety of high interest aerospace vehicle studies and who have a capability for proposal preparation.

Responsibilities for the area will include: Preparation of preliminary concepts, structural and component installation designs for proposals and advanced studies in missiles and spacecraft programs; performance of weight, balance and inertia studies; providing written proposal materials.

Experience in aircraft or missile structural design is essential, with a working knowledge of preliminary stress analysis, effects of extreme environment, and applicable materials. Applicants should be generally familiar with various vehicle subsystems, particularly in the propulsion and attitude control areas.

Qualifications should include a B.S. degree from an accredited university with 5 to 10 years applicable experience.

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Bendix Completing Arms Control Studies

By Ward Wright

Ann Arbor, Mich.—First of a series of contract studies laying groundwork for possible U. S. participation in an international arms control agreement is nearing completion at Bendix Systems Division here.

The study, a $150,000 contract awarded by the U. S. Arms Control and Disarmament Agency (ACDA) last February (AW Feb. 12, p. 37), covers development of techniques to monitor production of strategic delivery vehicles, including ICBMs, IRBMs, air breathing missiles and manned bombers.

Monitoring techniques would be applied from the acquisition of raw materials through quality testing of the finished product. Development of hardware for monitoring was not included in the study.

In another study, Bendix and the University of Michigan (acting as one-third subcontractor) are working under a $95,000 Arms Control Agency contract, awarded last June, to study verification requirements of any disarmament treaty the U. S. might enter into. As part of this study, an over-all listing of possible treaty violations both as to intent and letter of the law will be made. Both studies are due for completion by January, 1963.

In outlying problems connected with monitoring strategic aircraft and missile production, Phil E. Chase, Bendix arms control and disarmament program director, said three aspects of production must be considered:

- **Critical hardware** and raw materials.
- **Unique manufacturing** processes and tools.
- **Capital equipment**—Standard types of production and test equipment, frequently expensive, that can be converted to produce strategic hardware with little or no alteration.

Early in the study, Bendix toured major U. S. aircraft and missile plants to catalog critical hardware and unique items common to these industries. In addition unique manufacturing processes, including the need for specialized tools, jigs and dies, were also cataloged, as was capital equipment.

By analyzing these components, Bendix will outline monitoring techniques, based on observable physical characteristics, to be applied to two broad areas: declared facilities and undeclared facilities.

Declared facilities, such as factories, assembly plants, raw material and power sources are susceptible to a number of types of remote, on-site, and inspection team monitoring that could expose clandestine production.

For instance, a remote sensor could be devised to detect any change in contaminants normally found in the atmosphere of a given area, thereby giving warning of a start-up or change in production in the vicinity. Similarly, sensors monitoring stream pollution could detect changes in contaminants, indicating different manufacturing processes such as heat-treating were taking place. In both cases an inspection team, under the treaty, would make a follow-up inspection.

Other remote sensors might include unmanned TV cameras scanning the sky for tell-tale smoke streamers left by rocket test firings, or vapor trails left by strategic bombers.

On-Site Monitoring

In on-site monitoring, TV cameras could be used to keep watch in factories or be aimed at one or more specific critical operations such as welding or metal forming, to determine whether any deviation from normal production were taking place. Acoustical monitors might be placed to detect any sounds of missile or aircraft testing taking place at the manufacturing site.

Electrical monitors could be placed at power generating plants and in factories to record changes or unusual demands. Personnel counters could also be employed to detect shifts or fluctuations in the labor force.

Under the treaty, inspection teams would have to be allowed to come and go, Chase said, "and here we're concerned with the expertise of the individual."

Accountants would check factory records concerning shipments or raw materials, fabricated parts, and changes in personnel. Engineers would check designs looking for modifications or possibility of modifications that could signal an intention to violate the treaty.

In monitoring undeclared facilities such as highways, rails, canals and air routes, the problems become more difficult, Chase said.

For monitoring transportation, rail and highway counting and weighing devices would have to be installed. In addition, overflights with reconnaissance aircraft and inspection of transportation records such as bills of lading, and cargo manifests would have to be carried out to detect any irregularities in the flow of traffic.

One of the principal problems here is the "asymmetrical" traffic pattern between the U. S. and the Soviet Union, Chase said. In the USSR the accent is on rail transportation whereas in the U. S. it is highway transportation.

A comparison of available transportation routes leading into Los Angeles and Moscow illustrates this point. If a ring 100 mi. in diameter were drawn around Moscow approximately 22 major roads, 12 railroads and four barge canals would be leading into the city.

A 40 mi. ring around Los Angeles would be broken by about 21 major roads, five railroads, and no canals, although there is a seaport nearby.

Transportation Monitors

Detroit on the other hand has about 68 major roads intersecting an imaginary ring 30 mi. in diameter around the city. As a rule of thumb, Chase said, a comparable U. S. city will have on the order of 10-to-1 more usable secondary roads leading into a city than Moscow, making the number and placement of transportation monitors a major problem.

Air transportation is the one symmetrical aspect of the transportation picture, Chase said. Here both the U. S. and the USSR operate under the same ground rules. In both countries ship-



Westland Wessex Mk.2 Shown in Maiden Flight

First production Mk. 2 Westland Wessex helicopter is shown on its maiden flight, flown by chief test pilot W. H. Sear from Westland Aircraft's Yeovil, England, production plant. The Mk. 2 Wessex is powered by two Bristol Siddeley Gnome free-turbine engines and can carry 16 soldiers with equipment, or 4,000 lb. hung externally. External changes from Wessex 1, adaptation of Sikorsky S-58, include single exhaust outlet on port side. Chin hardware is IFF aerial and its guard, plus two intakes for engine bay cooling. Ridging on belly is glass fiber casing to protect fuel tubing which has been mounted externally for ease of maintenance. Strong points for external loads are fitted in four places; front two are below gear strut on main fuselage. Helicopter is in production for Royal Air Force.



CL-41A Flies With J85 Engine

First flight of a Canadair CL-41A fitted with General Electric J85 turbojet engine took place recently. Other modifications on the aircraft are larger air brakes and a cut-away fuselage tail cone to save weight. Engines are being built under license by Orenda Engines, Ltd. CL-41R trainer also is being fitted with the J85. Original powerplant for the aircraft was the Pratt & Whitney JT12A.



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Zeus Firing

Army Nike Zeus blasts away an environmental protective cover during recent series of tests at Zeus test facility on Kwajalein Atoll in the Pacific. Protective cover is made of inexpensive, lightweight styrofoam and shields the missile, while in its launch cell, from adverse weather.

ments have to be brought to an airport where they could be monitored by inspection personnel or TV cameras.

"There's no single panacea for inspection . . . no one technique of disarmament control, Chase said. "The techniques will have to vary to suit the conditions."

Bendix will furnish the arms control agency with a handbook list of possible sensors and a gross listing of about 2,000 items and processes used in missile and aircraft production. From these about 25-50 items will be identified as critical items or processes.

Under the $95,000 contract to develop verification requirements, Bendix is conducting an extensive mathematical study to develop parameters that will leave the U.S. with adequate security during any step-by-step disarmament.

As part of this study, the University of Michigan is listing all possible ways and means of evading both the spirit and the letter of a treaty. Bendix's problem will be to use these possibilities and try to define mathematically what constitutes a treaty violation.

Another problem is estimation of the level of clandestine production taking place and how good the inspection system has to be to give us an adequate picture of it. If we overestimate, the armament race will start again, if we underestimate it could provoke an attack.

Bendix is working to establish parameters, which take into consideration the probably false alarm rate of violations, the capability of the enemy to violate, and a curve of how much destruction we could stand and still retaliate, to define a narrow zone of tolerance for violations. Ideally, any inspection system developed should be good enough to serve as a deterrent, guard national security and assure against violation, Chase said.

The Bendix studies are part of a larger pattern of ACDA disarmament contract and study grants which will eventually explore every angle of disarmament. Since 1961, ACDA's first year, expenditure for disarmament study has risen from $230,000, to $600,000 for Fiscal 1962 and $4 million for 1963.

Whereas in Fiscal 1962, contracts or grants went to about nine organizations, so far in Fiscal 1963, about 12 contracts have been let in about five disarmament study areas. Study areas include maintaining a defense balance during disarmament, political aspects of disarmament on the interests of the U.S. in relation to other countries and our alliances, general aspects of verification, how international organizations would handle disarmament and the economic impact of arms control including industrial readjustment.



727 Machmeter

Boeing 727 three-jet transport will be fitted with the KMA-1001 Machmeter designed by Smiths Aviation Division, of Wembley, England. Unit, provided with integral lighting, maintains accuracy to 50,000 ft., and now is in quantity production for Boeing.



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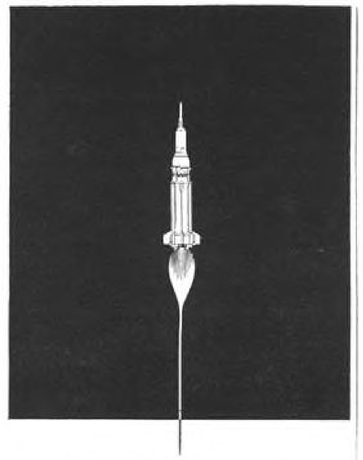
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Preliminary Design—establishes configuration feasibility to meet mission changes and future missions as dictated by program requirements.

Future Systems Analysis—studies advanced systems with consideration of tradeoffs between various parameters as well as projected availability of new and higher performance hardware.

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These programs provide for assignment involving the major elements of the structural, mechanical, and materials disciplines, including complete or partial feasibility studies, design, development, analysis, and testing. Tasks also are initiated in the areas of electrical systems, instrumentation, and automatic checkout. Component product improvement tasks will be performed to correct design deficiencies and marginal conditions detected in the evaluation and test programs.

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USAF and DOD Weapons Concepts Outlined at Ordnance Meeting

By Donald E. Fink

New York—Air Force research programs, ranging from space flight to the development of improved weapons based on conventional explosives, were outlined here at the recent American Ordnance Association meeting.

Preview was presented by Maj. Gen. Marvin C. Demler, commander of Air Force Systems Command's recently created Research and Technology Division.

Film clips of tests with the new weapons showed:

• **Delayed detonation tests** with large tanks of propane gas which had been dropped from aircraft. The tanks ruptured upon hitting the ground and spread their contents over several thousand square feet. A delayed fuse then ignited the whole area. Tests were aimed at proving the feasibility of producing bulk explosives with cheap, readily available materials.

• **Warheads which use** shaped charges to focus energy and disintegrate targets. Power of conventional explosives is greatly magnified, since the force can be directed. Film clips of tests on an F-80 target showed the aircraft disintegrated by a charge that normally would only inflict severe structural damage.

In the area of manned orbital flight and controlled re-entry, Demler said, work on the ASSET thermodynamic and structural test vehicle has progressed through the mockup stage. ASSET is aimed at obtaining data in the lifting re-entry regime to furnish aerodynamic, thermal and structural data for the X-20A Dyna-Soar program.

Six small unmanned vehicles, which have nose and fuselage configurations resembling the X-20A, will be boosted to glide trajectories at speeds up to 13,300 mph. at altitudes of 225,000 ft. They will glide for about 15 min. before they are recovered.

Present design has a bulky reaction control system, but this can be replaced with control fins to make room for more experiments in future flights. ASSET program should result in compilation of data on lifting re-entry about one year before the first Dyna-Soar flights, Demler said.

Part of the manned orbital flight program is the development of a spinning heat shield for windows of re-entering spacecraft. Called the "Bateye," it consists of a disk with uniform slots cut in it. Rotated at high speeds, the openings merge and the disk appears to be transparent.

Disk is mounted in front of the window and a cooling gas is injected between it and the glass. During tests, the shield reached a temperature of 2,200F, while the window reached only 350F. This device would replace the solid, jettisonable window covers proposed for the X-20A.

In the realm of propulsion several programs, ranging from nuclear ramjet engines to self-maneuvering back-packs are under development, Demler said.

Nuclear ramjet program has led to development and successful ground testing of Atomic Energy Commission's Tory 2A reactor at AEC's Nevada Test Site.

Air was forced through the reactor at speeds simulating Mach 3 at sea level. Fuel element temperature during the tests was above 2,000F and the power level exceeded 150 million watts.

Tory 2A required approximately 600 lb. of air per second, while the J57 turbojet, with maximum power output of about 13,000 lb. of thrust, requires less than 300 lb. of air per second.

Development of a Tory 2C reactor, a larger, air-cooled flight version, is entering its final phases and will conclude the nuclear ramjet feasibility program.

Development of three types of exotic gyros is another area in which Demler said progress is being made. These are aimed at solving problems in inertial guidance caused by lack of stability in gyroscopes.

Three gyros are:

• **Nuclear gyro,** which is a complete departure from conventional spinning mass approaches. It offers the possibility of precise reference orientation with no moving parts based on the nuclear magnetic resonance properties.

• **Electrostatic gyro,** which exploits the suspension sources between charged surfaces to support a spinning spherical rotor in an evacuated case. The rotor is accelerated to speeds approaching 30,000 rpm. by induction and is then allowed to coast down in the vacuum. Rundown time is estimated at 150 to 500 days.

• **Atomic clock system** for satellite navigation which uses clocks accurate to one part in 10 to the twelfth power. Called Gusto (guidance using stable tuning oscillations), the system will use one clock in the satellite and the other on the ground. Guidance information will be obtained either by comparing the clocks or measuring the Doppler frequency change that takes place in transmitting a signal from the ground to the satellite.

Defense Dept. speaker, Dr. John L. McLucas, deputy director of Defense Research and Engineering, took note of criticism of DDR&E that decisions are



Said Pierre de Fermat:

"The optical length of an actual ray between any two points is shorter than the optical length of any other curve which joins these points and which lies in a certain regular neighborhood of it."

The continuing requirements of space exploration projects for larger and more accurate antennas have resulted in the construction of a number of enormous parabolic reflector antennas. Each costs many millions of dollars. This tremendous expense is due to the difficulty of maintaining reflector accuracy as the huge structures are moved and tilted, and as wind forces and temperature changes distort the surface.

Lockheed Missiles & Space Company's Electromagnetic organization is developing a far more economical and practical solution to the problem. A 120' reflector antenna working model now is being erected. Its shape is spherical instead of parabolic, and it is firmly mounted on the ground. *Only the feed is moved to change the beam angle.* This type of antenna design now is feasible, thanks to successful Lockheed research in spherical aberration correction. The concept should find applications in radar systems, satellite communication systems, and systems for data reception from deep space exploration probes.

Many comparable scientific break-throughs are being evolved at Lockheed because scientists and engineers find here the creative freedom needed to pursue and perfect original ideas. Lockheed Missiles & Space Company is located on the beautiful San Francisco Peninsula in Sunnyvale and Palo Alto. If you are interested in correlating your specialty to one of Lockheed's many challenging assignments, please write: Research & Development Staff, Dept. M-30A, 599 North Mathilda Avenue, Sunnyvale, California. Lockheed is an equal opportunity employer.

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dragged out over too long a period.

In rebuttal, he said the total military budget for research, development, test and engineering continues to climb. Assuming buying is as efficient as before, this would indicate that DDR&E is not holding back the wheels of progress by taking too much time for decision.

Another criticism, Dr. McLucas said, is that DDR&E is taking away prerogatives of R&D groups in the services. This is not the intention of the Office of the Secretary of Defense, he said, and added that most military development programs pass through DDR&E with only slight modification or redirection. A small percentage are drastically affected, and a few programs have been canceled or instigated at DDR&E request, he asserted.

Specifically, Dr. McLucas cited the recently awarded TFX bi-service fighter program (AW Dec. 3, p. 26), as a source of some criticism because of delays.

McLucas said the TFX is an example of a development program which is tailored to meet the needs of more than one service. The work now initiated has been under study for more than a year to work out requirements of both Air Force and Navy.

Actual development of the airplane in the various configurations needed for defense, attack and reconnaissance will cost more than $1 billion. Savings estimated by the contractor on the combined service development, as opposed to two unrelated programs, is several hundred million dollars.

Over the full term of the program, the savings may amount to $600 million, according to McLucas.

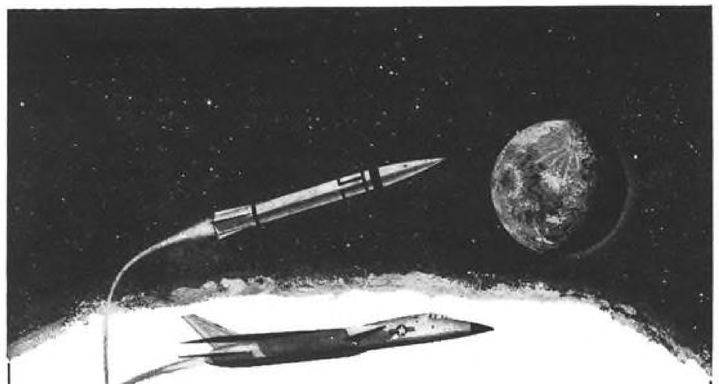
McLucas said the dual-service approach has been criticized by many who feel the delay in the program will offset the gains achieved.

In answer to this, he said that under the TFX program as it now stands, services will have to go on buying existing designs for only six months longer than they otherwise would have.

A large portion of the year delay probably would have been taken up by the contractor in firming up his design anyway, McLucas said.

Future tactical weapons requirements, the area of Dr. McLucas's responsibility, were listed as including:

- **Navigation system** to provide for aerial delivery of conventional ordnance for an accuracy of 25-50 ft. out of distances of 100 mi. or more beyond friendly territory and from altitudes down to 100 ft.
- **Small-size countermeasures** equipment for tactical aircraft penetrating enemy territory.
- **Improvements in accuracy** of delivery of ordnance by aircraft in troop support by an order of magnitude, and in capability of aircraft of any service to support ground troops.



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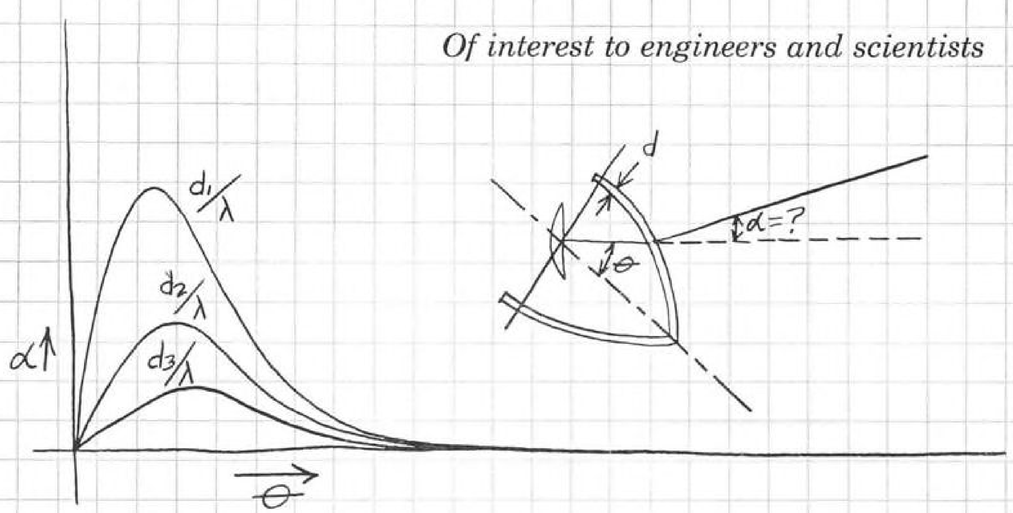
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WHO'S WHERE

(Continued from page 23)

Honors and Elections

H. Webster Crum, vice president of Lycoming Division of Avco Corp., has been elected president of the Aviation Distributors and Manufacturers Assn., succeeding **George R. Galipeau**, vice president of Van Dusen Aircraft Supplies, Inc. **Roy Backman**, Pacific Airmotive Corp., and **J. R. Church**, A. C. Spark Plug Division of General Motors Corp., elected vice presidents of ADMA.

James T. Duane, manager of aerospace motor and generator engineering for General Electric Co.'s Direct-Current Motor and Generator Department, has been named the nation's "Outstanding Young Electrical Engineer of the Year" by Eta Kappa Nu for "his achievements in design, development and management related to aircraft and aerospace generators . . ."

Changes

John H. Wolvin, director of research, Chicago Aerial Industries, Barrington, Ill., and **Jerome S. Goldhammer**, staff assistant for planning to the vice president-engineering. Also: **William H. Danaher**, administrative manager of the Pacific Optical Corporation Division, Inglewood, Calif.

Kenneth H. Drummond, Washington, D. C., representative for the Science Services Division of Texas Instruments, Inc.

W. B. Causey, engineering manager, Technical Sales and Service Department, Cherry Rivet Division, Santa Ana, Calif., of Townsend Co., and **B. F. W. Lambe**, Western sales representative.

Dr. Roy Scott Hickman has joined the technical staff of Heliodyne Corp., Los Angeles, Calif.

Harold J. Black, director of the newly established Engineering and Development Department, Avco Corp.'s Aerospace Structures Division, Nashville, Tenn.

W. J. Cecka, Jr., manager, Neosho (Mo.) plant of Rocketdyne, a division of North American Aviation, Inc., succeeding **E. A. Wright**, now assistant general manager of the company's Space Engine Product Operation, Canoga Park, Calif. Other appointments at Canoga Park: **W. E. Fore**, director of manufacturing programing and facilities; **J. E. Thompson**, director of facilities, succeeding Mr. Fore; **J. E. Kendall**, director of engineering operations, succeeding Mr. Thompson.

Col. John S. Turton (USAF, ret.) has joined Aerojet-General Corp., Azusa, Calif., as a corporate specialist on procurement and materiel.

Francis Aubrey Roberts, director of contracts, Sperry Gyroscope Co., Ltd., Brentford, England, and **Peter A. Houghton**, manager, Twin Gyro Platform Group.

Col. Russell E. Schleeh (USAF, ret.), executive adviser to Douglas Aircraft Division's Advance Systems and Research Department, Long Beach, Calif.

Dr. Samuel B. Batdorf, director, Office of Research, Aerospace Corp.'s San Bernardino (Calif.) Operations.

Richard W. Powell, associate director, Aerojet-General Corp.'s Snap-8 Division, Azusa, Calif.

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Letters written offering Employment or applying for same are written with the hope of satisfying a current need. An answer, regardless of whether it is favorable or not, is usually expected.

MR. EMPLOYER, won't you remove the mystery about the status of an employee's application by acknowledging all applicants and not just the promising candidates.

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We make this suggestion in a spirit of helpful cooperation between employers and employees.

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SATURN S-IVB...

Career challenge for SCIENTISTS AND ENGINEERS

The Saturn S-IVB stage is a key element in the U.S. Manned Lunar Program. An S-IVB vehicle will be used to thrust the manned Apollo spacecraft into earth escape-trajectory to the vicinity of the moon. Apollo's first orbital and re-entry tests will utilize the S-IVB vehicle prior to the final development of the Saturn C-5 Launch Vehicle.

VEHICLE ELECTRONICS

The success of the Manned Lunar Program requires the development of advanced telemetry and instrumentation systems to provide accurate development information during ground and flight tests of the Saturn S-IVB. The success of S-IVB systems depends on innovations in packaging techniques to insure reliable operation during extensive space flight.

Douglas is seeking vehicle electronics specialists with experience in field station test, circuit design, electronic packaging, or other related areas who can meet the Saturn S-IVB challenge in initial design, hardware design and development tests. Send your resume to Mr. W. C. Ames, Saturn S-IVB Recruitment Director, Douglas Missile and Space Systems Division, Dept. M-3, 3000 Ocean Park Boulevard, Santa Monica, California.

DOUGLAS
MISSILE & SPACE SYSTEMS DIVISION

An equal opportunity employer

LETTERS

MHD Generator

The photo caption describing Avco-Everett Research Laboratory's MHD power generator development program (AW Nov. 19, p. 84), indicates that the Mark 2 experimental MHD generator has been operated for more than 140 hr.

In the interest of accuracy, it should be pointed out that the 140 hr. refers to the time a water cooled channel for the MHD generator was tested in the Long Duration Test Facility rather than in the Mark 2 MHD generator itself. This test facility duplicates an MHD generator in all respects except for lack of a magnet. It is used to investigate the performance of generator components for increasingly longer periods under the severe gas flow and heating conditions of MHD generators.

On the other hand, the Mark 2 experimental generator pictured in AVIATION WEEK is an actual power generator and has, incidentally, recently increased its output from 1,350 to 1,480 kw. However, it is designed for runs up to one minute which has proven more adequate for studies of fluid mechanics and problems associated with actual power generation.

By using the Mark 2 generator to study fluid mechanics while the Long Duration Test Facility is used to study components for long time periods, experience is gained in high power and long duration operation simultaneously. Consequently, the heavy capital expense of building intermediate sized plants that would achieve these high power levels and long duration runs in a single facility is omitted.

VINCENT J. COATES, JR.
Avco-Everett Research Laboratory
Everett, Mass.

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.

Wrenching Situation

Read your cover for Nov. 12. Come now! The right tool for the right job?

Maintenance people have been trying for years to get the Crescent wrench out of the airman's hands.

Let's not have General Electric refute their motto, "Progress is our most important product."

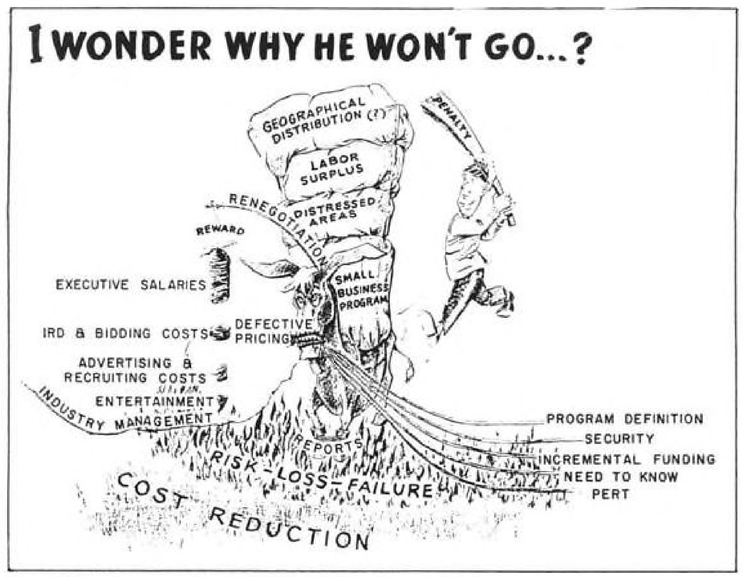
W. W. HELLMANN
Lockheed Aircraft Service Co.
Ontario, Calif.

No Rights Purchase

Please inform your readers we did not purchase the type certificate and manufacturing rights for the Fairchild C-82 as stated in AVIATION WEEK of Nov. 12 (p. 131). Fairchild Aircraft has been extremely helpful and cooperative with us in our program to upgrade their years-ahead C-82 World War 2 design into the world's best short and medium range airfreighter, but we have never purchased any rights from Fairchild.

Thanks again to AVIATION WEEK for its fine coverage of our program.

DAN THOMPSON
Vice President
Steward-Davis, Inc.
Long Beach, Calif.



CARTOON being distributed to National Security Industrial Assn. members shows a heavily loaded donkey, obviously representing the defense industry, sadly watching its incentive carrot being chopped away.

Outlawing Pickets?

Re: work stoppages at missile plants and bases.

This has happened numerous times in the past, and at most a palliative has been suggested. Would simply outlawing the picket line solve this dilemma?

The rights of minorities have been championed against the wishes of the majority. But the majority, in this case 180 million other Americans, certainly also has rights, especially against a small group that insists the nation must accept its demands or sacrifice the country's defenses.

Outlawing the picket line would not mean forced labor; (it) is better than compulsory arbitration and would replace coercion with persuasion and allow those wanting to work to do so. Don't you believe with some of these mechanics making more than the Secretary of Defense that most of these workers are not only satisfied but prefer to work?

Should your first inclination be to reject this idea, if you give it a second thought you will see it not only has good points but is also a fair and practical way to solve certain labor problems.

JOHN FRIER
St. Louis, Mo.

Disenchanted Engineer

I have received and appreciated your publication for quite a long time. My main reason for not renewing the subscription is that I am no longer involved with the aircraft industry. As you can see from the letterhead, I am now completely on the ground, or water, having left the aircraft industry to start up this company some six years ago, and I haven't regretted one minute of it.

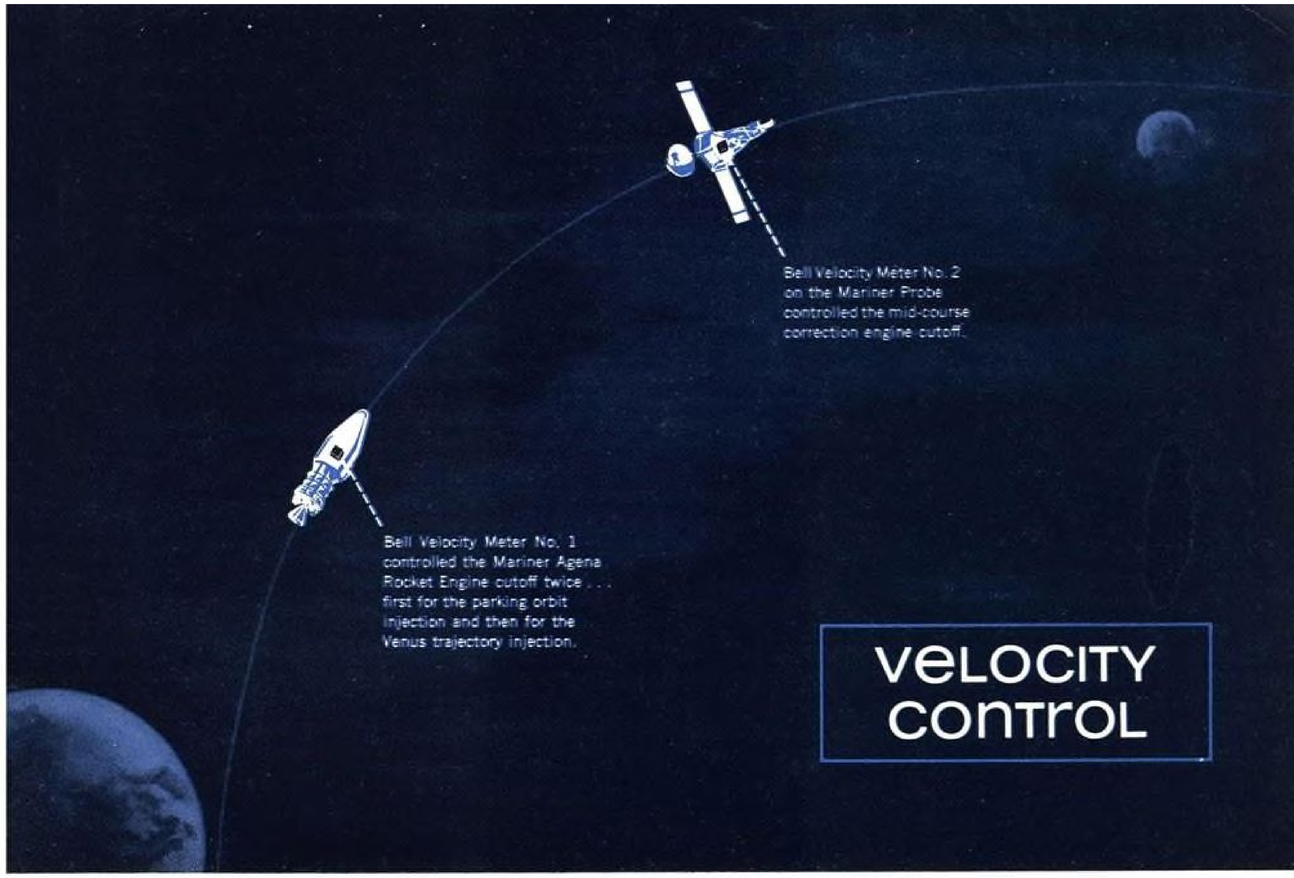
I had continued to take the magazine as a matter of interest, but somewhere in the last few years you left me hanging in the air and blasted off into outer space. Fortunately, I fell back to earth and am quite happy to sail along at six knots.

Incidentally, having been a consulting engineer to the aircraft industry, I had followed the "engineer shortage" controversy for some time. There is no shortage of engineers, as such, but there is a shortage of really good engineers, and that is the fault of the industry and of government with its cost-plus contracts. One good engineer who can design something simple is worth the 50 engineers it takes to make something complicated. But with the government making it profitable to utilize a vast army of engineers, the result is a $100 million aircraft that should cost $1 million.

And while I am griping, I might as well say that I side with that small group who complain about the pseudo-liberal scientists who have "invented" a new language to describe their adaptations of old ideas to the space age.

I am not bitter or disillusioned or disappointed, but I am disenchanted with the aircraft industry.

TRACY S. HOLMES
Mariner Co.
Santa Monica, Calif.



BELL VELOCITY METERS CONTROL MARINER, RANGER . . .

A Bell Digital Velocity Meter (with its Bell Model III-b accelerometer) integrated acceleration to provide critical velocity data for both Agena rocket engine cutoffs in the successful Mariner flight. A second type of Bell-built digital velocity meter in the Venus-bound probe functioned in the mid-course correction.

Bell has built more than 100 velocity meters for use in important space programs. More than 25 of these velocity meters have already been utilized in space shots. Every one has performed flawlessly. Over 1,000 Bell accelerometers, the heart of the Bell Digital Velocity Meters, have demonstrated their precision and reliability in actual service.

Bell can provide velocity meters for rocket engine cutoff control as well as for use on inertial platforms. The velocity meters were originally developed for use as part of the Bell family of Hipernas (HIgh PERformance NAvigation Systems) guidance and attitude reference systems.

The digital velocity meters used in the Mariner are considered space building blocks because of their accuracy and versatility. The cutoff velocity can be inserted in the digital integrator by telemetry if a reprogramming in orbit is desired. The accumulated velocity can be telemetered from the vehicle upon command. More than one cutoff velocity can be loaded prior to launch and each utilized during different engine burns. These and other features can be provided utilizing proven circuitry and techniques.

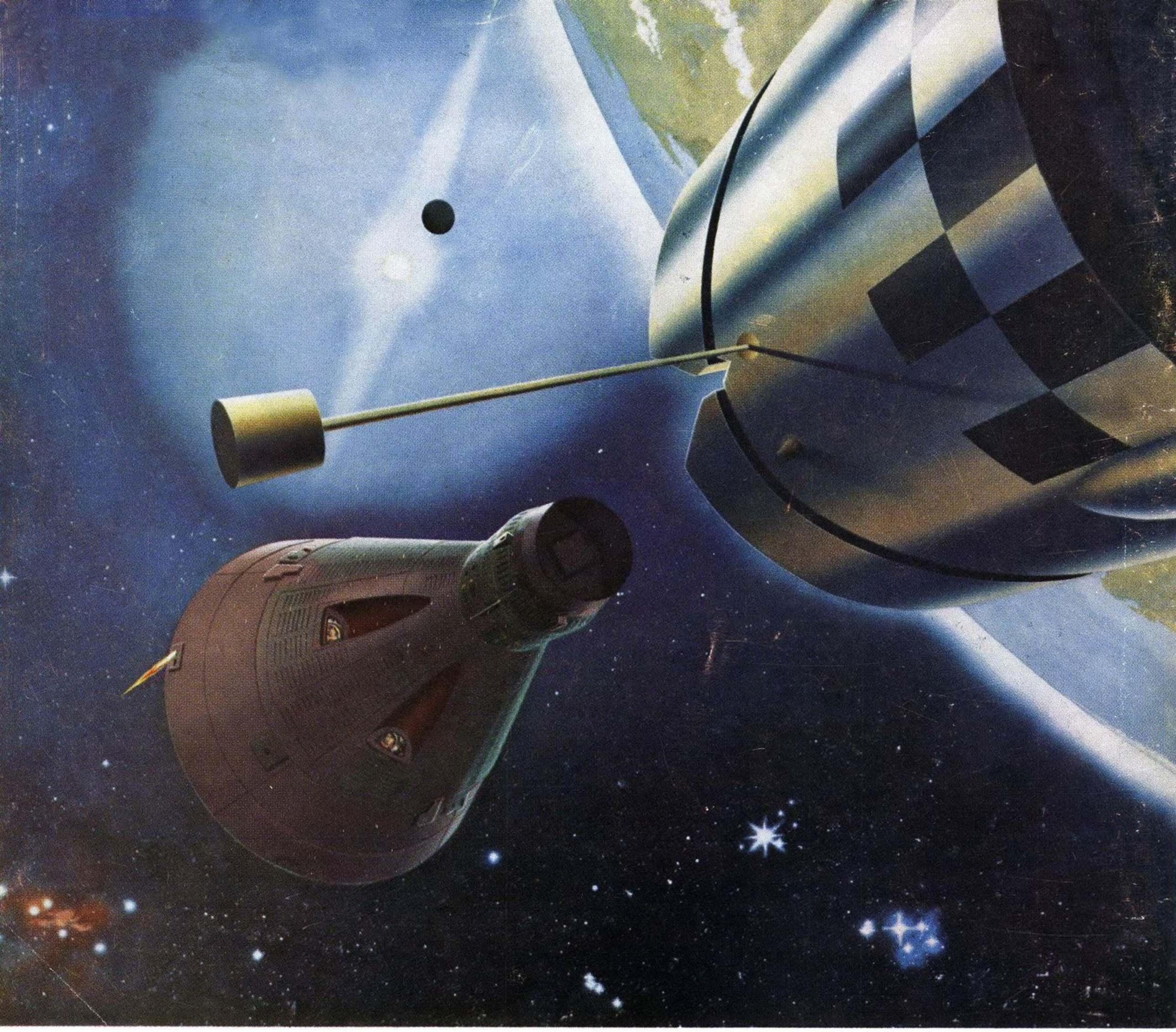
Advanced digital velocity meters are currently being laboratory proven. Velocity meters can be furnished weighing less than 5 pounds including the digital integrator and comparator. These units will withstand even the most rigorous environmental conditions. Inquiries are invited.

The Bell Agena Rocket Engine which placed both Ranger and Mariner in parking orbits and then propelled them on their trajectories to the Moon and Venus respectively. The 16,000 pound thrust Agena has fired more than 60 times in space... has put more scientific payload in space than any other engine.



BELL AEROSYSTEMS COMPANY • *Buffalo 5, N.Y.*
DIVISION OF BELL AEROSPACE CORPORATION

A textron COMPANY



RENDEZVOUS CONTROL: By Astronaut

DEC. 19 1962

Primary control responsibilities during Gemini rendezvous and docking operations will be assigned to the Astronauts. Man, with his ability to see, analyze, reason and judge, will be fully utilized for this important phase of America's first spacecraft rendezvous operation.

Gemini is a two man, extended mission, orbital rendezvous and docking spacecraft now being designed and built for the National Aeronautics and Space Administration by McDonnell.

Rendezvous in space can have several applications in speeding America's space exploration efforts. Rendezvous will permit launching of multiple payloads with two or more smaller boosters rather than one large vehicle. With such techniques it will be possible to assemble large space stations, ferry space crews and supplies, refuel and/or assemble chemical upper stages for deep space missions, and refuel re-usable nuclear upper stages for deeper space explorations.

Space Rendezvous, the key to a quickened pace in manned space exploration, is another facet of manned space flight being pioneered by McDonnell.

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