CONRAD LAU

Conrad Albert Lau, aeronautical engineer, inventor, executive, known to his friends and business associates as "Connie", was born on February 8, 1921 in Port of Spain, Trinidad, British West Indies to Mr. and Mrs. Egbert Lau. He was one of a family of four, all boys. His brothers were Neil, Roy and John. He and his wife Nancy Page Lau had three children, Conrad, Jr., Sally and Michael.

Conrad attended school in Trinidad through his sophomore year at Queen's Royal College. He entered Massachusetts Institute of Technology in his junior year. He received his B.S. Degree in 1942 and his Masters Degree in Aeronautical Engineering in 1943. While at MIT he was on the Dean's List for high scholastic achievement, and he was elected to membership in TAU BETA PHI, National Honorary Engineering Fraternity. Also, at MIT, in recognition of his Christian leadership, he was elected Secretary of the Technical Christian Association, a student organization of all Christian denominations dedicated to practicing and encouraging the Christian life.

Conrad joined Chance Vought Aircraft, Division of United Aircraft Corporation, upon graduation from MIT in 1943. He devoted his entire professional career to the Company that had become Ling-Temco-Vought, Inc. at the time of his untimely death, April 18, 1964. Through his initiative, superb intelligence, and human warmth, he had advanced rapidly from the position of Junior Aerodynamics Engineer to Director of the U. S. Navy VAL Light Attack Aircraft program for LTV.

OCTOBER 20, 1958

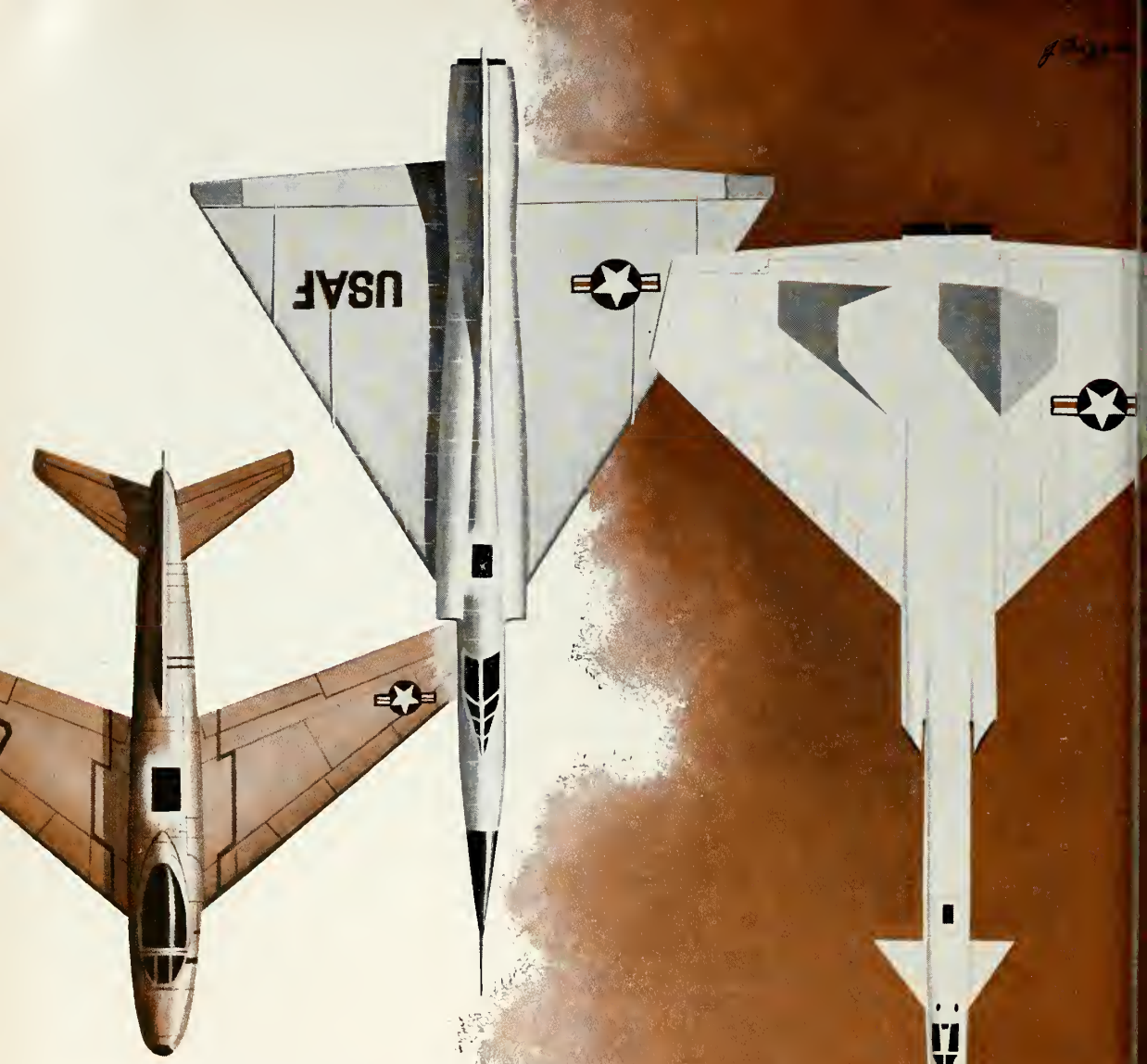
ION ENGINE—ABMA's Stuhlinger Sees Barriers to Success—p. 20

missiles and rockets

INCLUDING MISSILE ELECTRONICS

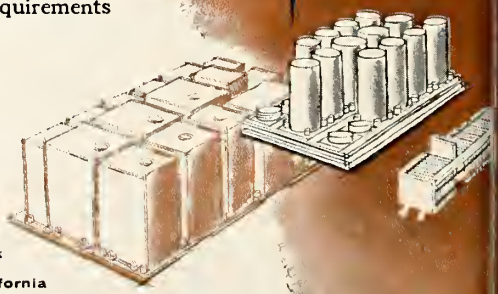
Engineering and Electronics Edition

AN AMERICAN AVIATION PUBLICATION



SPACE-ABILITY

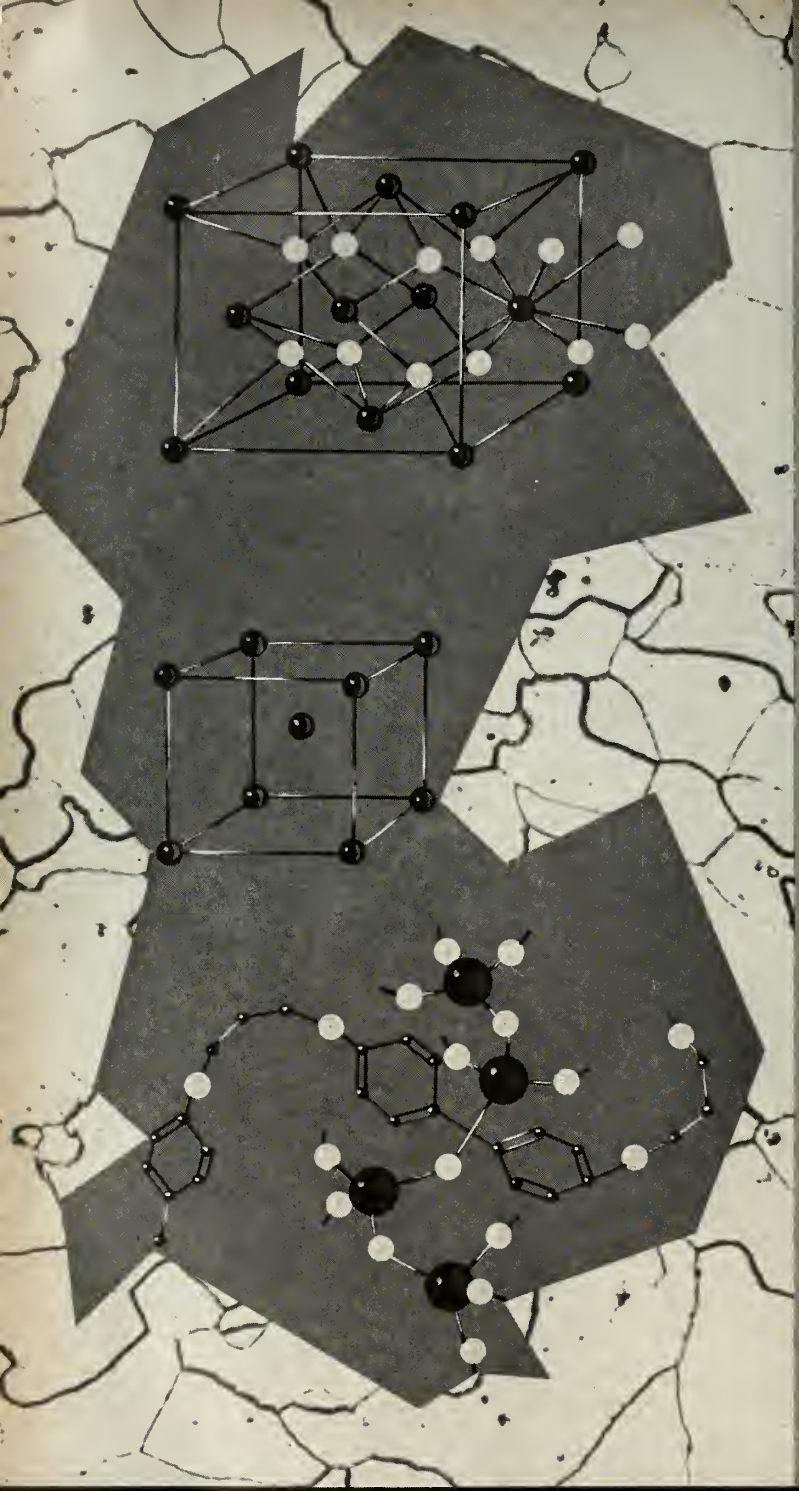
Servomechanisms' proven ability to design and produce consistently smaller and more reliable Central Data Computers, has established SMI as the pace-setter in this exacting science. This experience, coupled with our major scientific advances in new materials research and deposited film circuitry techniques, will meet the requirements of even smaller and more reliable subsystems for the spacecraft of tomorrow.



SERVOMECHANISMS SMI INC.

SUBSYSTEMS DIVISION, Hawthorne, California
MECHATROL DIVISION, Westbury, L.I., New York
SPECIAL PRODUCTS DIVISION, Hawthorne, California
RESEARCH LABORATORY, Goleta, California
GENERAL OFFICES • 12500 Aviation Boulevard, Hawthorne, California

The products of **SMI** *are available in Canada and throughout the world through Servomechanisms (Canada) Limited, Toronto 15, On*



NEW APPROACH TO "OLD" MATERIALS

By today's standards, the "old" refractor metals are outdated. The ultimate in high-temperature studies of 10 years ago is several generations behind in terms of modern aircraft and missile developme

Today's material requirements surpass anything envisioned 10 short years ago. Molybdenum and beryllium, for example, are still exciting metals with much promis for space vehicles and ultra-high-speed aircraft. It now appears, however, that the full promise of such metals may be fulfilled when they are used, not alone, nor as alloys, but when combined with other materials to form totally new types of structural materials.

Such a "marriage" of metals, ceramics and plastics is a promising approach to high-temperature problems that is being vigorously pursued at Avco. It opens new potential applications for many exotic combinations.

These bold steps forward are possible at Avco, where materials research include concurrent basic studies and applied research, plus developmental programs th extend through the solution of processing and testing problems.

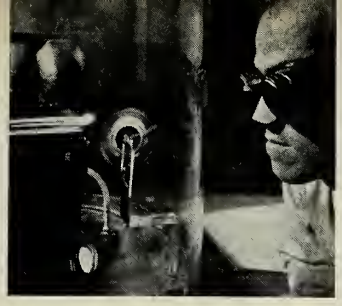
The search for new knowledge goes forward simultaneously with the creation advanced technology at Avco's Research and Advanced Development Division. Tl creative man, whether he is interested in basic studies or practical problems, finds effort enhanced by the stimulus of interdisciplinary contact and feedback from other related fields.

Research and Advanced Development is more than a descriptive title at Avco. It is a concept that promotes creativity.

Avco

Research and Advanced Development DIVISION

For information on unusual career opportunities for exceptionally qualified scientists and engineers, write to: Dr. R. W. Johnston, Scientific and Technical Relations, Avco Research and Advanced Development D 201 Lowell Street, Wilmington, Mass.



COVER: *Miniature laboratory ion-propulsion model, operating at near vacuum conditions in NASA's Lewis Research Center, produces thrust which propels the small wheel behind the jet. ABMA's Dr. Ernst Stuhlinger (see page 20) discusses barriers which must be overcome before ion engines can become a reality.*

missiles and rockets Vol. 4, No. 16, Oct. 20, 1958

Published every week by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C. Printed at the Telegraph Press, Harrisburg, Pa. Second class mail privileges authorized at Washington, D.C., with additional entry at Harrisburg. Copyright 1958, American Aviation Publications, Inc.

Subscription rates: U.S., Canada and Postal Union Nations—1 year, $8.00; 2 years, $12.00; 3 years, $14.00. Foreign—1 year, $20.00; 2 years, $30.00; 3 years, $40.00. Single copy rate—$.75. Subscriptions are solicited only from persons with identifiable commercial or professional interests in missiles and rockets. All subscription orders and changes of address should be referred to: FRANK R. WILLIAMS, circulation fulfillment manager.

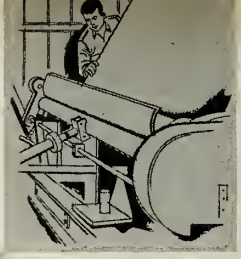
in this issue

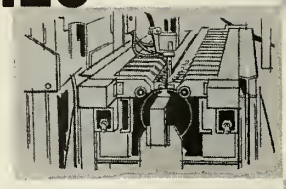
OCT 20 HEADLINES

MISSILE ELECTRONICS

DEPARTMENTS

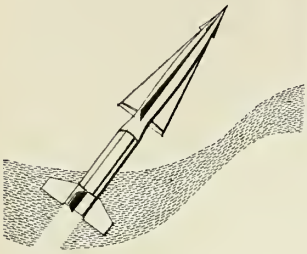
CAPABILITIES AND FACILITIES



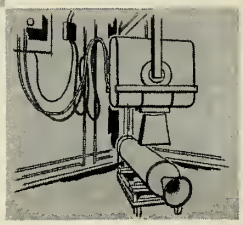


New methods in forming rocket motor body shell.

Welding facilities assure strong, uniform welds.



Xray-inspection before annealing.



National Electric's Contribution to The Rocket and Missile Program

ENGINEERING... A staff of engineering specialists with extensive backgrounds in physics, mathematics, stress analysis, metallurgy, thermodynamics, hydraulics, electronics and structural, mechanical and electrical design. Their efforts have resulted in mass production methods and techniques for the fabrication of rocket bodies and components faster, more economically and to closer tolerances than ever before achieved.

RESEARCH AND DEVELOPMENT... Since 1949 National Electric has been executing classified research and development contracts for the government. The results . . . an enviable record of pioneering achievements in the production of rockets and guided missiles . . . from the first Jato motor bodies to the famous Nike Hercules.

MASS PRODUCTION... Mass production has been achieved through continuing technical advancements and modern techniques. Currently extensive research and development projects are being conducted on several highly critical and important rocket motor bodies including mass production on the Nike Hercules.

Write for your free copy of our Rocket and Guided Missile booklet. Our experience can be an added asset to your experience.

A NATIONAL ELECTRIC FIRST

Advanced heat-treating methods developed by National Electric provide new and highly important br through in rocket and missile production.

NATIONAL ELECTRIC PRODUCTS — ROCKETS & MISSILES

ROCKET AND GUIDED MISSILE DIVISION

National Electric Products Corporatio

TWO GATEWAY CENTER • PITTSBURGH 22, PA.

Circle No. 35 on Subscriber Service Card.

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

You may wonder what the future holds for the engineer who decides to build his career in the aircraft/missile industry.

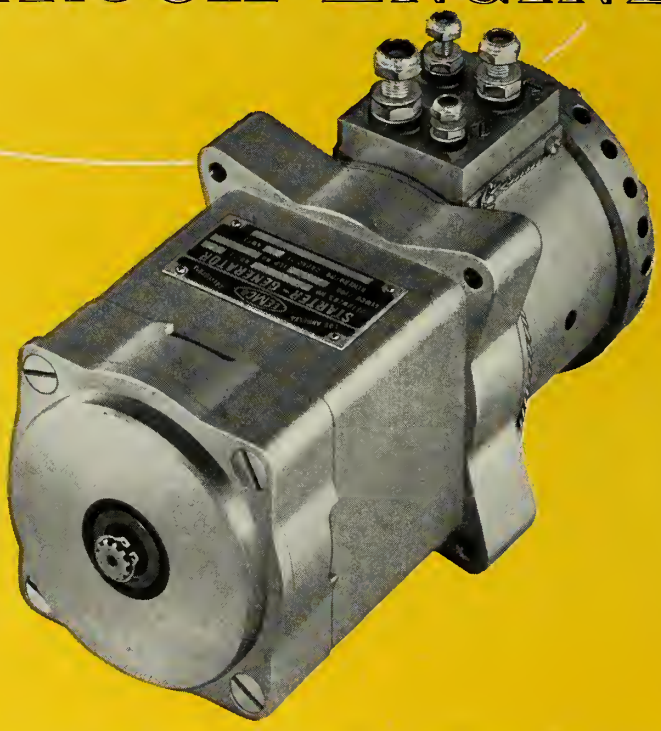
In terms of permanent demand, this industry probably requires a greater proportion of engineers to total personnel than any other. Here at Douglas we are now employing more engineers than we did during World War II.

In regard to professional standing, the aircraft/missile industry deals always with the latest state of the art in every engineering and scientific specialty involved. Its engineers are in one of the best informed and highest prestige fields in their profession.

Whatever your present activity, if you decide to move into aircraft, missile and space technology, we would like to talk with you.

Please write to Mr. C. C. LaVene,
Douglas Aircraft Company, Box 620-R,
Santa Monica, California

MISSILE PRECISION for a MOTOR TRUCK ENGINE



EEMCO Starter-Generator Type D-1025 Chosen for New Turbine Truck Engine

When one of the largest motor truck manufacturers developing a new type turbine truck engine requested EEMCO to design a starter-generator for the engine, it was recognition of the power, precision and reliability that is built into such EEMCO products. Now in an advanced stage of development, this new turbine engine may revolutionize the entire motor truck industry. EEMCO is proud to participate in this type of "revolution."

For years, EEMCO has been a specialist in the design and manufacture of special motors and actuators for the aircraft and missile industry. Now EEMCO's starter-generator Type D-1025 is an example of EEMCO's flexibility in related fields. EEMCO motors or actuators are on the majority of the latest missiles and supersonic military aircraft for these reasons:

1. Sixteen years of continuous experience in research and development, as well as exhaustive environmental and performance testing, assure maximum reliability of all EEMCO products.
2. Ratio of output to weight is extremely high in all EEMCO units.
3. Production schedules are met on time under stringent military specifications that require the most precise tolerances and performance.

EEMCO starter-generator Type D-1025 is an example of such precision manufacturing. Scores of other EEMCO products have been designed and produced for special uses. Your inquiry is invited.

SPECIFICATIONS FOR EEMCO STARTER-GENERATOR TYPE D-1025

Starter performance: Breakaway torque of 220 inch-pounds with terminal voltage of 20 volts.
Generator performance: Delivers 40 amps continuously with intermittent peaks up to 80 amps at 28 volts.
Weight: 14½ pounds.

EEMCO ELECTRICAL ENGINEERING & MANUFACTURING CORP.

4612 West Jefferson Boulevard, Los Angeles 16, California—Telephone REpublic 3-0151

DESIGNERS AND PRODUCERS OF MOTORS, LINEAR AND ROTARY ACTUATORS, AND RELATED EQUIPMENT...EXCLUSIVELY!

Circle No. 37 on Subscriber Service Card.

the missile week

washington countdown

Contrary to popular . . .

opinion, one high Washington source told m/r that Air Force and Army are not competing on a time schedule as to who will make the next lunar probe. Army picked its own dates—most probably December for the first try—because it was tied up with *Explorer*. Reason: Gen. J. B. Medaris did not want undue public pressure on his team.

Air Force was assigned . . .

two "space probes" in addition to three lunar probes several months ago by ARPA's Roy Johnson. The order said "get two *Thor-Ables* ready," and AF would receive later instructions on where to send them. It doesn't mean Venus either, although the planet is astronomically ripe in June, 1959; while Mars will not be in position until November, 1960.

Second generation *Polaris* . . .

missiles are a dime a dozen, insofar as studies and proposals are concerned, according to a top Naval source. Code name *Atlantis* has been mentioned, but it's one of two dozen similar studies.

The three R's . . .

Dr. James R. Killian says, should be actively expanded to include L, M AND S—languages, mathematics and science. They've been neglected, and emphasis on them could strengthen the free world and provide a better standard of living for all men, he added.

A local storm . . .

prevented planned photography on the Oct. 12 eclipse. But the National Academy of Sciences-sponsored expedition managed to launch five *Nike-Asps* and one the following day. The sixth rocket was fired to compare normal conditions with those existing during the eclipse.

Pioneer was successful . . .

and NASA apparently is a little embarrassed by the publicity it got as "administrative agency." The facts: Hardwork of coordinating and insisting on every possible checkout of all components was by ARPA, with NASA getting in on the act only days before launch.

Use of Sidewinders by Chinese . . .

which set Peiping to shouting "dirty pool" at Washington, racked up high batting average for the Nationalists pilots. Out of the first six fired, four were definite kills. The other two were fired before Chiang's fighters were within range.

Air Force Unveils X-15—First Space Ship

RELEASE from mother aircraft.

FLIGHT trajector over range (see p. 84).

2 BASIC PROBLEMS in testing electronic systems

Many complex electronic systems—missile guidance is a good example—may require testing that takes days by conventional methods. Yet the end function of such a system may last only a few minutes—**even seconds.**

Other systems, though less complex, must be tested in such large numbers that adequate personnel are frequently unavailable to perform tests by conventional means.

The SCATE system of automatic test equipment can solve **both** problems. It provides **self-checking** automatic testing which is **fast, flexible** and **foolproof.**

The system evaluates all important parameters of equipment under test, including:

1. RF sensitivity, center frequency, band width, power output, noise figure.
2. Audio frequency gain, band width, power output.
3. Video pulse circuitry, including pulse decoding, logic, digital comparison, pulse delays.
4. Voltage levels, DC and AC.
5. Servo response.
6. Mechanical response.

Stromberg-Carlson has standing designs for all the standard components which go into a SCATE system, and is fully experienced in designing custom components which may be required in any test system.

Complete details on the SCATE system and other Stromberg-Carlson automatic test equipment are available on request.

* Missile guidance system can be tested automatically by the SCATE system.

"There is nothing finer than a Stromberg-Carlson"

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS CORPORATION
1463 N. Goodman Street • Rochester 3, N. Y.
Electronic and communication products for home, industry and defense

industry countdown

Boeing has accelerated . . .

its missile expansion program in preparation for possible awards on the *Dyna-Soar* and air-to-surface weapon systems. The company is currently undertaking one of the biggest engineer recruitment drives in history with the Pilotless Aircraft Division striving to hire 1,200 engineers before the end of the year. In addition to the possible *Dyna-Soar* program, Boeing is producing the 250-mile *Bomarc* and has been awarded a contract for development of a 400-mile plus version of the same missile.

Missiles have boosted . . .

Temco Aircraft Corp's earnings for 1958 to nearly 10% above 1957 income. Temco, currently in a development program on the *Corvus* air-to-surface missile, expects its business to be half airframe and half electronics and missiles by 1961.

Missile industry veteran . . .

Northrop in the meantime has shown a much greater earning record again as a result of increased missile orders. With approximately 60% of last year's backlog in electronics, unmanned aircraft and missiles, earnings jumped 23 percent above the preceding year. Major projects include the *Snark, Hawk,* target drones, and research and development contracts involving missiles and space craft.

Cryogenics is receiving . . .

widespread applications in the field of infra-red guidance systems and is providing a large income to such companies as Air Products and the Linde Division of Union Carbide, leading research groups, and Arthur D. Little and Perkin-Elmer Corp. producers of cryostats for laboratory and military use. Cryogenics, essentially a fractional distillation for obtaining very low temperatures, although in use for many years for the manufacture of ammonia, is now receiving an immediate military application in the solid state cooling of infra-red devices for increased sensitivity.

A billion dollars . . .

in extra missile and aircraft funds, provided by Congress, will not be spent at this time according to acting Defense Secretary Donald A. Quarles. Slated for such programs as the *Hound-Dog* air-to-surface, *Polaris* IRBM, *Minuteman* ICBM, and the KC-135 utilization of the funds will depend on rate of development of the individual systems. In addition, the Secretary emphasized that no ceiling would be placed on the 1960 budget request leaving all three services free to request additional monies as needed to support next year's defense program.

Chemical milling . . .

of component parts of the *Atlas* with a resultant weight savings of approximately 500 pounds has added an additional 100 miles to the range of the ICBM. New light-weight construction techniques utilizing the dynamic etching process for the thrust cylinder, fairing and nacelle sections of the missile have been developed since the time the original *Atlas* design was formulated.

MIS (Man In Space) . . .

for placing a man in orbit for 24 hours or approximately 10 to 12 orbits of the earth, currently has $40-million available for getting it underway. First companies to profit are General Electric (Philadelphia) and North American Aviation, selected out of five firms involved in a 90 day study and feasibility programs. To date program is the sole development responsibility of the Air Force with management responsibility still in the area of indecision. ARPA feels the project, in any analysis, is a military project. NASA is of the opinion that the first phases of the project are of a scientific nature with future military responsibility. NASA further contends that whatever project their agency is involved in can eventually be utilized for military applications.

Nike-Zeus . . .

will, for all practical purposes, be an almost fully automatic electronic weapon system only calling on men for maintenance and logistics. One of the most important components of the system will be the acquisition, identification, and tracking systems. Some $20-million of the recent $135-million contract will be spent on the development, production and maintenance of several missile computers—an award received by the Remington Rand Univac Division of Sperry Rand Corp. The computers will be three times as fast as any comparable computers now in existence.

Thiokol Chemical Corp. . . .

reportedly has received contracts totalling $1.5-million from the Navy for packaged liquid propellant rocket engines. The awards are unofficially reported in connection with the *Bullpup* air-to-surface missile. A solid propellant auxiliary power unit will be demonstrated by Thiokol at the annual meeting of the ARS November 17 in New York.

BRUNSWICK'S *SBP* SAVES POWER FOR THE PAYLOAD

A unique advantage of Brunswick's Strickland B Process (SBP) is weight savings in missile and aircraft components. Consequently, there's more power for the payload weight. SBP, a unique machine method, maximizes laminated strength, even for extremely high temperatures, by precise orientation of juxtaposed fiberglas to points and kinds of stress.

The use of SBP filament-wound laminate results in the highest strength and stiffness characteristics possible, and absolute minimum weight. Brunswick's SBP also produces a laminate that meets rigorous space age specifications for close tolerances and precision. It is a method that allows mass production by fully automated machines, as well.

More and more designers are turning to SBP laminates for use in new designs now on the drawing boards. Brunswick, a leader in research and development, can also help *you* find new uses for SBP laminates in the design, fabrication or testing stage. Write The Brunswick-Balke-Collender Co., Defense Products Div., 1700 Messler St., Muskegon, Mich.

BRUNSWICK

MAKES YOUR IDEAS *WORK*

OCTOBER 20, 1958
VOL. 4, NO. 16

missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

AF Alters *Pioneer* For Third Moon Try

by William O. Miller

CAPE CANAVERAL—Not withstanding the unprecedented achievements of the October 11 attempted lunar probe, the Air Force is far from satisfied and is giving the entire vehicle a complete reappraisal.

Pioneer failed to follow the predicted trajectory because the first stage of the Douglas *Thor* burned three seconds too long. The thrust gave the first stage too much loft and it fell short—by 850 feet per second—of attaining the programmed speed. The guidance system failed to correct a 3.5 degree error in angle.

While pleased with *Pioneer's* 43-hour trip into cislunar space, AF officials say it just didn't work well enough and did not do what it was supposed to do. As a result, a number of changes before the next attempt are being considered, including possible changes in the payload and Alterations in the thrusts of the various stages.

Meanwhile, the AF is striving towards a more successful attempt in November. Since the moon completes and orbit of the earth each 27.3 days, the next attempt would be made about noon, November 7.

Despite the accomplishment, the National Aeronautics and Space Administration would not predict whether Army or Air Force would make the next probe attempt.

The November shoot would be the third and final lunar probe which the Air Force is authorized to carry out under supervision of NASA.

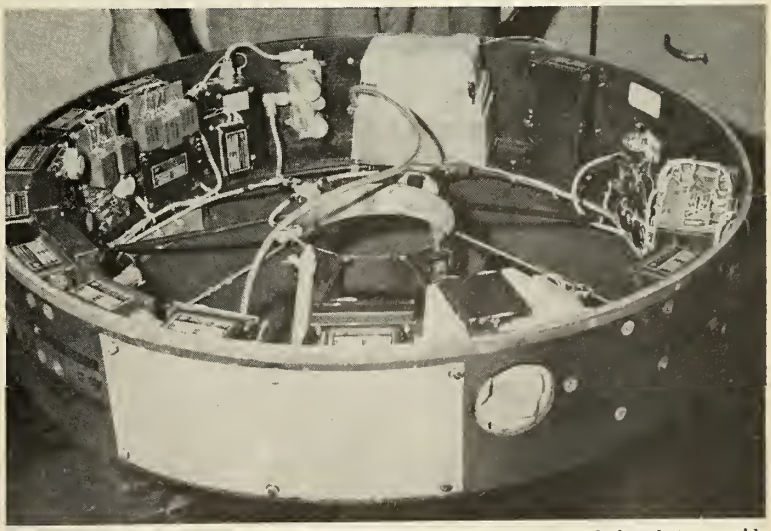
However, the total number of probes probably will be raised. Indications are that the Air Force will make the November attempt as anticipated and the Army's first attempt—of two authorized—will be made with a modified *Jupiter* in the first week in December.

Maj. Gen. John B. Medaris, commanding general of the Army's Ordnance Missile Command said the Army plans to apply a corrective in the flight trajectory from the ground, and he believes the probe has a 50-50 chance of success.

If such correction could have been applied to the Thor-Able, chances are that the unplanned high angle would

(Continued on page 14)

LAWMAKERS JOIN MILITARY AND SCIENTISTS in jubilantly discussing details of *Pioneer's* top-like fourth stage, (L. to R.) Maj. Gen. Donald N. Yates, commanding general AF Missile test Center, Rep. Joe Kilgore, Texas; Rep. James G. Fulton, Pennsylvania; John Truesdale, NAS; Col. H. H. Eichel, AFBMD; Dr. Abe Silberstein, NASA; and Brig. Gen. O. J. Ritland, AFBMD.



INSTRUMENT PACKAGE OF *PIONEER'S* fourth stage was designed to provide five types of information, including radiation, gravitational fields of earth and moon, temperatures, meteorite impact and a TV picture.

. . . AF Alters

have been normal and the correct velocity—35,250 feet per second—would have carried *Pioneer* to a 50,000 mile vicinity of the moon.

• **Angle detected**—The erroneous high angle was suspected by trackers within three hours after blast-off. However, only raw data had been received from the five channels on which *Pioneer* was transmitting, and it took six hours before a crude trajectory could be plotted.

Pioneer almost "floated in space" for some two hours when it reached altitude of 79,212 miles above the earth's surface. Gravity was estimated at only four-hundredths of the gravity on the earth's surface.

Instrumentation weighed 39.6 pounds in five major packages:

1. An ion chamber to measure total incident radiation. Instruments were calibrated to measure the extremely high readings anticipated thereby eliminating weight-costly lead shielding.

2. A magnetometer to measure the gravitation fields of the earth and the moon.

3. Temperature gauges to determine internal temperature levels and to determine if fluctuations affected the instrumentation.

EIGHT VERNIER ROCKETS of third stage adjust its speed after separation.

4. Instruments for measuring micrometeorite impacts.

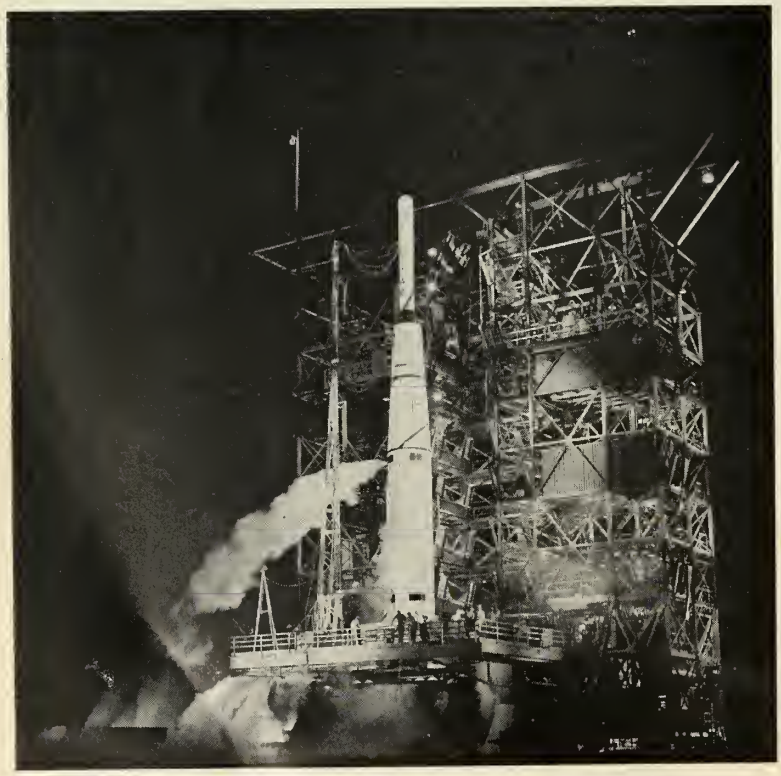
5. A TV-type scanner to provide a crude picture of the moon's surface. The scanner was not activated because it was tied to firing of the terminal stage.

To permit incorporation of the ion chamber which provided for radiation measurement, one or two levels of sensitivity previously planned was eliminated. This was considered one of the most important kinds of information sought, as preliminary *Explorer* findings had indicated radiation might prove a barrier to human entry into space.

However, telemetered data from *Pioneer* indicated a passenger aboard would have experienced less than 50 roentgens. The tolerable level is well above this. The radiation counter showed the rate was four roentgens per hour at 5,000 miles, three per hour at 10,000 miles, and two per hour at 17,000 miles.

• **Button not fired**—The button which would have fired the terminal rocket was never fired because of a battery "freeze up." If all had gone well, the solid propellant payload rocket would have been fired from Hawaii. However, it could have been triggered from Canaveral as well.

The Thor-Able reportedly had no gyroscopic guidance system but used a Douglas-built autopilot with Minneapolis-Honeywell gyroscopes. When the gyro started to drift, either the stabilization servo or the telemeter radio command link did not work. There probably would not have been a battery failure if "on the shelf" batteries capable of operating down to Arctic temperatures had been used.



PIONEER'S **THREE STAGES plus the instrumented payload tower 88.1 feet.**

Boeing Gets Prime *Minuteman* Contract

Boeing Airplane Co. has added the *Minuteman* ICBM to its growing list of missile development and production programs with the Air Force award of an assembly and testing contract. Contract amount was not disclosed.

The award was made to Boeing after the Air Force had evaluated approximately 18 bids from companies such as Douglas, NAA Missile Division, General Motors, Northrop and Lockheed. A company spokesman said the *Minuteman* test program will be the most demanding and critical of the entire weapon system. The three-stage solid propellant missile will be the most fully automatic long range system in existence.

Current concept will have the missile sites widely dispersed with the rockets in hard positions underground ready to go at the push of a button. The underground enclosures will hold the weapon at controlled temperature and humidity. Guidance system will be in constant readiness possibly with no prewarmup time required.

Boeing will center its *Minuteman* work at the main Seattle plant where the B-52 is now being produced. Phase-out in production of the B-52 sometime in February making available the high bay, large space areas for the assembly and testing of the missile in a vertical position, if necessary.

Lobber

System may be small *Project Adam* version

Army's *Project Adam* being researched by Army Ordnance Missile Command for its troop-cargo-carrying potentials is getting a healthy boost from industry.

Convair Division of General Dynamics Corp. has announced a smaller development—the *Lobber*, which could be *Adam's* short-range parallel project.

Project Adam originally was proposed to Advance Research Projects Agency by scientists at Army Ballistic Missile Agency as a means of getting man into space for a few minutes. Army had proposed rocketing an occupant to about 150 miles in a *Redstone* nose section which would have been parachute recoverable. The project was turned down by ARPA because it was felt its flight test would come about the same time as the X-15. Army, however, was authorized to research the project's potentials as a troop and cargo carrier.

The small Convair *Lobber* missile will be for short ranges, possibly under 25 miles. However, it can deliver rations, ammunition, medicines, communications equipment or other vital supplies accurately and in quantity to front-line troops, wherever and whenever needed, Convair said. The missile and its launcher can be hand-carried, if necessary, by a team of three men in the field.

Quick-disconnect *Lobber* payload sections can be pre-loaded at supply depots and at least 70% of every missile will be recoverable and can be re-used.

Maj. Gen. A. T. McNamara, quartermaster general of the Army, sparked development of the *Lobber*.

Lobber is also adaptable to offensive weaponry, carrying payloads of napalm, chemicals, high-explosives or small nuclear warheads, and has other uses in military engineering and communications.

Immediate capabilities of the *Lobber* are to provide emergency supplies for troops isolated by terrain or enemy action; monitoring radioactivity in contaminated areas; rapid buildup of supply depots under cover of darkness or weather; augmenting the mobility of beachhead assaults, and supporting purely offensive actions.

Most important in the Lobber concept, Convair said, "is utility when delivery is paramount; when bad weather prevents or restricts air drops, and when maximum mobility of a ground force must be maintained."

Wayward *Jupiter* Follows *Polaris*

For the second time in recent weeks a large ballistic missile has tempermentally gone astray within seconds of launch and had to be destroyed over the Cape Canaveral launching site.

An Army *Jupiter* IRBM was destructed directly above its launching pad creating alarm to the test personnel on the base. Personnel in the immediate area were well protected in the control bunker, but night crews working in other areas of the center were in danger of flying debris.

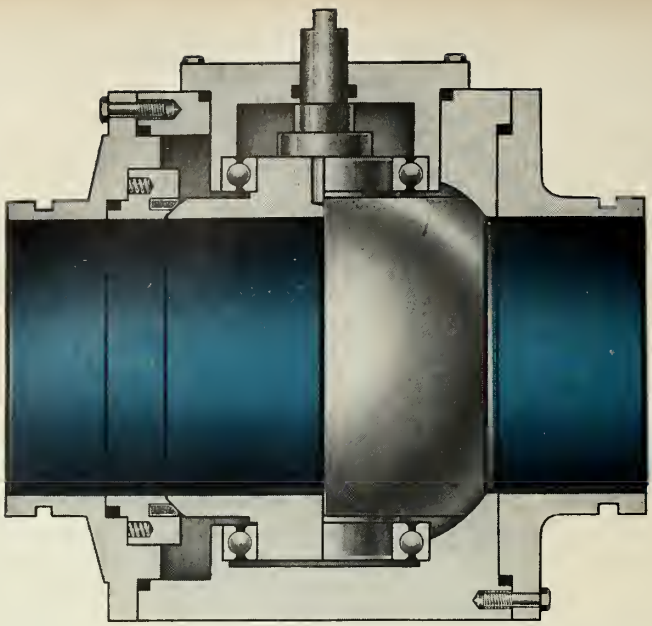
Two explosions rocked the missile before it fell to earth. At least one piece fell near the *Thor-Able* gantry where the second Air Force rocket vehicle was being prepared for its lunar probe shot.

Several days before the *Jupiter* firing a two-stage *Polaris* fleet ballistic missile forced Cape Canaveral personnel to take cover when it had to be destroyed shortly after take-off. Part of the missile went inland and impacted near a congested area of Cocoa Beach.

Hawk Readied for Deployment

U.S. Army

LOW LEVEL RAIDERS will be the target of Army's *Hawk* to be deployed in Washington area this year. Radar homing, the two stage missile with a range up to 22 miles will be the third member of the Army air defense missile team. Unlike *Nike Ajax* and *Nike-Hercules, Hawk* is highly mobile and can he transported on its mobile launcher, by aircraft or by helicopter. First emplacements prohably will he in New York City and Washington, complementing present *Nike* installations.



HYDROMATICS *FLO•BALL*® VALVES

The accepted standard of maximum performance and reliability

100% FLOW EFFICIENCY

Hydromatics' exclusive FLO•BALL design pravides a straight-thru unrestricted fluid poth, exactly equal to the pipe line diometer.

PERFECT SEALING

Zero leakage is assured through the use of a precision ball—the ideal geometric form for perfect sealing contact.

LOW OPERATING TORQUE

Ball rotates in precision bearings which absarb all pressure loads. Pressure balanced valve seat further minimizes farces on ball, reducing frictional drag.

LONG LIFE

Seat is always in sealing contact with the ball surface, resulting in a self-wiping, self-lapping action that insures long, trouble-free life.

HIGH SPEED ACTION

Only 90-degree rotation is required to fully apen or close valve. Full travel as fast as 5 milliseconds.

RELIABILITY

Simple construction, with only ane ratating part, provides built-in reliability ond rugged, dependable operotion.

CRYOGENIC AND CORROSIVE APPLICATIONS

Hydromatics' FLO•BALL volves, with new diophragm sealing and unrestricted fluid poth, have been proved the best volves for operotion with LOX, Liquid Nitrogen, Helium, Hydrogen Peroxide, Red Fuming Nitric Acid and Hydrazine.

MODULAR ARRANGEMENT

Only FLO•BALL design, with its rototing valve action, permits side-by-side grouping of severol volves, all driven simultaneously by o single actuator.

VERSATILITY

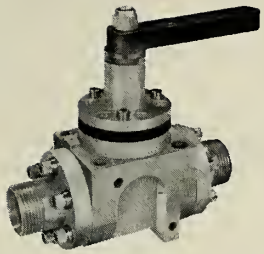
Only FLO•BALL design makes possible the interchanging af manual, motor or pressure actuators without changing the valve body.

HYDROMATICS, the world's leoding designer ond monufocturer of high performance ball valves for military ond industriol opplicotions, offers the most extensive selection of designs to meet all your requirements; Monual, motor or pressure operoted. For cryogenic, corrosive or general service medio. Pressures from vocuum to 10,000 psi. Sizes from ¼ inch to 12 inches.

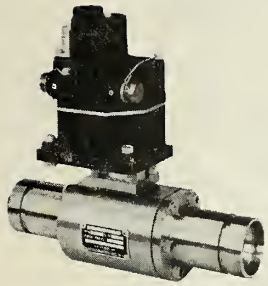
Hydromatics, Inc.

70 Okner Parkway, Livingston, New Jersey

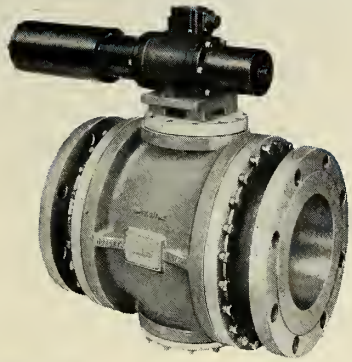
HYDROMATICS FIELD ENGINEERING OFFICES: *Pasadena, 35 N. Arroyo Pkwy., RY*



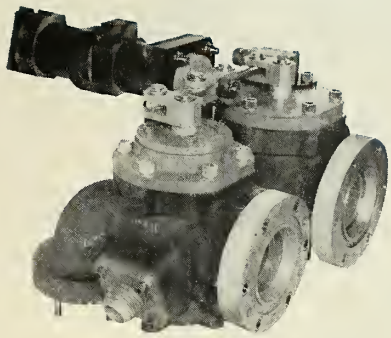
1.



3.



2.



4.

1. MANUALLY OPERATED FLO•BALL CONTROL VALVES

Sizes from ¼ inch to 12 inches. Pressures from vacuum to 10,000 psi. Operating temperatures to —350 degrees F. Low torque operation; typical model requires only 5 pound force to operate at 10,000 psi. Fast, finger-flip action with 90-degree full travel. Positive open and closed indication with detent locks at extreme positions. Interchangeable flanges per AND10050, AND10056, Female NPT or ASA. Materials of construction include 2024 and 7075 Aluminum; Stainless Steel; Nylon, Teflon or Kel-F seals. These FLO•BALL manual valves are only one-quarter the size of any other type unit suitable for operation at comparable pressures and flow capacity.

2. PRESSURE OPERATED FLO•BALL CONTROL VALVES

For airborne and ground support applications where maximum flow and minimum valve size and weight are required. Sizes from ¼ inch to 12 inches. Pressures from vacuum to 10,000 psi. Interchangeable flanges. Sealed double-acting actuators, specially developed by Hydromatics to achieve maximum operating speed and efficiency. Full travel operating times as fast as 5 milliseconds. Actuator is thermally isolated from valve body to guarantee fast, positive action when operating at LOX temperatures. Open or closed valve position remotely indicated by a signal light, controlled by mechanical actuation of a sealed snap-type switch.

3. MOTOR OPERATED FLO•BALL CONTROL VALVES

Sizes from ¼ inch to 4 inches. Pressures from vacuum to 10,000 psi. Interchangeable flanges. Driven by D.C. motor actuators, these FLO•BALL valves provide an extremely smooth, fast acting response both on opening and closing. Motor actuator is thermally isolated from valve body. Full travel operating times from 0.5 to 20.0 seconds. Valve position is positively locked by a Geneva-Lock mechanism. Models available with remote light indication of valve position. Motor input voltage is 18 to 30 VDC. Automatic current shut-off is provided at the end of each operating cycle. Available with electrical connector, pigtails or pigtails with connector attached.

4. MULTI-LINE FLO•BALL PROPELLANT VALVES

Designed to handle LOX, JP-4 and all other missile and rocket fuels and oxidizers, these mechanically linked propellant valves are available in hundreds of line size combinations from ¼ inch to 6 inches. Pressures from vacuum to 10,000 psi. The precision linkage insures constant valve timing and reliable control. A positive-lock "lead" adjustment is available to vary the valving sequence between the lines. Special designs include 3-way or by-pass arrangements. Pressure-driven actuators may be specified to operate with gas or liquid at input pressures from 200 to 3,000 psi. Fast valve action, with full travel response times as short as 10 milliseconds.

Hydromatics, Inc.

...29 15th St., AMherst 6-2714 / Washington, 1413 K St. N. W., STerling 3-3612

Arc-Furnace Gages Solid Life

In a program sponsored by Hughes Aircraft Co., Stanford Research Institute has developed several techniques for indicating when a solid propellant charge should be retired.

The project originally was aimed at solid propellants under consideration for Hughes' *Falcon* missile, and how they would stand up when exposed to extreme environmental conditions. However, the results may be applied to solid propellants in general. The information is being applied also to establish the basic causes of aging, and the end target is to reduce effects that cause solid propellants to lose their effectiveness.

One approach is a non-destructive involving ultrasonic principles to predict a propellant's remaining service life when it is installed in a "ready" missile or held as a replacement.

A ceramic plate is cemented to the charge and an electrical signal applied to the plate. This creates ultrasonic vibrations which are absorbed by the propellant. Any change in the degree of energy absorption reflects changes in propellant character, and an electrical measure of progressive change is obtained.

Another technique utilizes an arc-image furnace to measure ignition requirements and ignition behavior of solid propellants.

The arc-image furnace transmits radiant energy from a carbon arc through a reflecting mirror and shutter system that controls the amount of energy applied to a propellant specimen. Effects of propellant aging upon ignitibility can be determined by comparing the ignition energy requirements of fresh and laboratory-aged samples.

The effects of propellant aging are being observed by other methods—the measurement of burning rates and determination of physical properties such as tensile strength, shear strength and creep. The character and concentration of degradation products are being determined also by microscopic examination of propellant surface regions and various types of chemical analysis.

Lewis Lab Shuffles Top Scientific Personnel

CLEVELAND—Concurrent with the establishment of the National Aeronautics and Space Administration, Lewis Research Laboratory here has made organizational changes.

Eugene J. Manganiello was appointed associate director of the center, succeeding Dr. Abe Silverstein who has been appointed director, Space Flight Developments, NASA headquarters.

Dr. John C. Evvard and Bruce T. Lundin were appointed assistant directors. Dr. Walter T. Olson and I. Irving Pinkel were named special consultants to Center Director Edward R. Sharp.

Dr. Evvard will direct the activities of the Materials and Structures Division, Nuclear Reactor Division, Instrument and Computing Research Division (formerly the Physics Division), and a newly created Advanced Propulsion Division.

Lundin will direct the research conducted in the Fluid Systems Division, Propulsion Aerodynamics Division, Propulsion Chemistry Division and Propulsion Systems Division.

The Advanced Propulsion Division will be concerned with research into thermonuclear, ion, plasma, magnetohydrodynamics and other energy sources for propulsion of aerodynamic and space flight vehicles.

Main changes within the Instrument and Computing Research Division was the transfer out of aerodynamic noise research and incorporation of the work in the computing sections of the present Research Services Division.

Appointments within the research divisions are:

Advanced Propulsion Division, Wolfgang E. Moeckel, Chief; Instrument and Computing Research Division, Jesse H. Hall, Chief; Propulsion Aerodynamics Division, Carl F. Schueller, Chief; William A. Fleming, Assistant Chief; Propulsion Systems Division, David S. Gabriel, Chief.

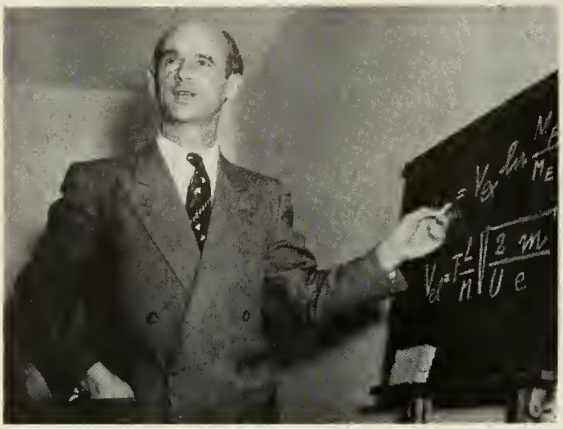
No changes were made in the Fluid Systems, Materials and Structures, Nuclear Reactor, Research Reports, and Propulsion Chemistry Divisions.

Henry C. Barnett was appointed as Assistant to the Director.

Cold Matter Researched By U. of C. Electromagnet

Ultra-cold matter will be researched with the free world's most powerful, continuously operating electromagnet, just installed at the University of California. Studies at temperatures approaching absolute zero (—459°F) should aid in work with radar, missile guidance systems, and computers; also give exact information on non-available energy contained by various materials.

Chemists plan to use the newly-installed electromagnet to study matter in its degenerate state at the low temperatures. Recent findings over the past few years about the behavior of solid state materials at low temperatures have created a need for such facilities.



STUHLINGER compares chemical and ion propulsion velocities.

WITH HIS CHILDREN, on a tour of Rocket City's Observatory.

Stuhlinger: Maybe Mars Before Moon

ABMA's research director thinks man may walk on Red Planet first; Ion propulsion may do trick

by Erica Cromley

If Dr. Ernst Stuhlinger's prophetic calculations are as accurate as his mathematical computations, you will open your newspaper one morning in 1978 to this headline: MAN LANDS ON MARS.

The director of the Army Ballistic Missile Agency's Research Projects Laboratory believes it is even possible that man will get to Mars before he tries the moon, because of our satellite's formidable 300° temperature spread and the problems involved in lunar landing.

The top research scientist on the Army's moon probe program and a top-runger on the famed von Braun team has already made inroads on the problems involved in ion propulsion—the ticket that will give man entrance to space travel. Mathematically investigated from all angles by Stuhlinger, the ion-propelled vehicle would use electrical power from solar or nuclear energy.

Despite his leaning toward a Martian-landing-first approach, Stuhlinger does not underestimate the importance of an American man-on-the-moon coup. Otherwise, his quip to a reporter in answer to how long it will take us to get to the moon may bear the germ of an unhappy truth. "Twelve hours," Stuhlinger said "One to get there and eleven to get through Russian customs."

Although such Stuhlinger witticisms are considered rare—"serious" is the word used most often to describe him—his close friends maintain he has a sharp and ready sense of humor.

Dr. Stuhlinger, at first appearance, is a mild-manner, excessively polite man. Closer inspection discloses a man who is a curious combination of scientific—almost pedantic—intensity and marked self-effacement. Praise of his work is met with noticeable embarrassment and protestation that any applause should be shared by the entire Redstone team.

"Our group is a big one and it works only because everyone works together," he said. "The success of the *Explorer* belongs to the von Braun team."

Wernher von Braun reveals that his research chief was upset when newsstories spotlighted Stuhlinger as the man who "pushed the button" for firing the second stage of *Explorer* I. "They have blown up my golden finger to make ill-conceived publicity," he told von Braun.

Nonetheless missile engineers feel the acclaim was justified. Although the space scientist had made advance theoretical calculations, Stuhlinger had exactly 3 2/3 minutes to recalculate at the time of flight on the basis of actual performance. As *Explorer* passed over San Francisco, Stuhlinger gave the signal and America's first man-made moon was on its way.

For all the publicity that comes to Stuhlinger via the *Explorer* and his work on ion propulsion, these areas are a minor part of the overall picture.

Says von Braun: "Stuhlinger's work covers the whole pie. Research in the field of plasma-flow—hydromagnetics, the cosmic radiation belt, and wave propagation. But his main job is to keep his eyes and ears open for progress in other fields that can be used in the missile field."

Stuhlinger has his own research budget and can select and let his own contracts. But like so many scientists who concentrate on pure research, he has to fight a continuous battle for funds. Governmental purse-string holders, never known for lavishness, are especially chary if they don't see the promise of a practical item.

• **Research problems**—Stuhlinger now has "a little money" for ion propulsion research. He lists the main problems as follows:

MOISTURE PROOF

EVEN AT VARYING ALTITUDE PRESSURES

CERTI-SEAL, AMP's all new moisture proof window connector, prevents moisture breathing at altitude. Tin plated copper rings are crimped over wire insulation to seal out vapors and fluids. Made for over 100 different insulation diameters in military specifications, CERTI-SEAL exceeds all specifications for:

- **corrosion resistance**
- **vibration resistance**
- **flame resistance**
- **tensile strength**
- **dielectric strength**
- **immersion tests**

Send for samples and literature from:

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

Circle No. 42 on Subscriber Service Card.

STUHLINGER CONCEPT of ion-propelled space vehicle.

(1) the ion source must give 90% to 95% ionization.

(2) the ion beam must be so formed and controlled that it won't hit electrodes.

(3) the beam must be neutralized after leaving the thrust chamber.

(4) lectrical energy must be produced.

(5) other ion sources should be investigated, particularly heavy molecules of atomic weight on the order of 200.

(6) design of the turbine must take into account lubrication, weightlessness, bearing sealing, high temperature operation.

(7) the electrical generator must be designed to present no cooling problem, no brush and commutator problems.

(8) the radiation cooler must be lightweight and not overly sensitive to meteors, perhaps segmented so that if one part gets punctured it can be cut out of the circuit while being repaired.

(9) guidance system must be perfected for interplanetary space.

(10) adequate crew compartment must be developed. Other problems to be faced include artificial gravity, feeding and communications in space.

When the Redstone scientist talks about his work and problems to be solved, he becomes an intense and persuasive salesman with a cause. The hesitant voice takes on a professorial, almost autocratic tone. When asked a question, he invariably starts out with: "The answer to that is the following: . . ." During the short space of the statement, his mind prepares the answer, which he gives in his rolling German accent while he draws out his pencil and illustrates with a diagram.

• **Background**—The two-toned Stuhlinger personality had its beginnings at Niederrimbach, Germany. He was born in 1913 in a family of teachers—they were his father, mother, two grandfathers and most of his uncles and aunts. His two sisters and two brothers-in-law also are in teaching. Young Ernst went along with the family tradition when, after receiving his doctorate in physics, he was appointed assistant professor of the Berlin Institute of Technology's physics department.

He was a faculty member from 1935 to 1941, working closely with Dr. Hans Geiger, developer of the Geiger counter. It was not until after a stint in the German Army that Stuhlinger entered rocket work, and met von Braun who was technical supervisor of the Rocket Development Center.

"When he was assigned to Peenemunde in the spring of 1944, he was still wearing his Army uniform," von Braun recalls. "He was a one project man in guidance and control and in no way a big wheel. It was quite awhile before we discovered we had a golden egg."

Stuhlinger's new assignment was a welcome challenge after surviving the battle of Stalingrad and a 600-mile hike through the Russian winter. A combination of a minor wound and the German Command's need for engineers brought him the V-2 assignment.

In 1946 he came to this country as one of the top ten of von Braun's 100 German V-2 sicentists. He first ducted research and development work with guided missiles at Ft. Bliss, and assisted in high-altitude research firing of captured V-2's at White Sands Proving Ground. In 1950 he went to Redstone Arsenal where he has become, in his boss's words, "a kind of vice president in charge of research." The von Braun team has grown to 4,000 engineers, scientists and technicians.

• **Part of the team**—Stuhlinger, like others of the von Braun team, has been offered jobs by industry paying many times his present salary, but his loyalty to von Braun and the team won't permit him to consider these offers. "I would rather work on the Huntsville team than any other" he said. "It has a record of real achievement in space activity."

One of the rare scientists able to bridge the gap between theoretical physics and practical research programs, Stuhlinger is a prolific contributor of papers at IAF meetings and technical journals, including the article "Ion Propulsion and Why" which appeared in m/r in June of last year. He plans to publish a book on the subject.

Stuhlinger says "Ion propulsion never will be practical for small interplanetary vehicles. I believe 50 tons is about the smallest size spacecraft which would use it. Smaller than that you would use chemical propulsion. I visualize a very large craft for a Mars expedition—several hundred tons."

The man who forsees a Martian landing in 20 years, and who will have played an important role in its achievement, earnestly hopes we will put more money into pure research before too long. "This is the way to scientific progress," says Stuhlinger. "Science should not have to ride piggy-back on the military."

Navy-Air Force Asking Bids For Rocket Target

The Navy and the Air Force want a medium sized rocket or ramjet propelled target aircraft for missile firing fighter and interceptor aircraft.

A joint design competition among manufacturers, seeking an air launched high altitude, expendable target with short flight duration has been announced by the two services.

Requests will be mailed late in October to manufacturers asking for detailed design proposals for competitive evaluation.

In addition to rocket or ramjet propulsion, air turbo rocket also has been considered for the target vehicle which must be low in cost and high in speed.

Circuit Development Group Leader Ralph Wolcott (left) considers future changes in computer output unit for bombing—navigational systems.

Ground-floor opportunities in

COMPLETELY INTEGRATED B-70 WEAPON SYSTEMS *at* IBM

Project Engineer Robert J. Cantwell (left) uses a system of gimbals to describe navigational problems in the analysis of a new system design.

Staff Engineer William Howard (center) reviews gearing accuracy requirements of test equipment with electronic circuit designers.

The design and development of advanced airl computers for the B-70 exotic-fueled bomber an unusual opportunity to highly qualified engi and scientists today. At IBM Owego you now a chance to work on **completely integrated** we systems for this jet "flying computer." And real challenge joining this new Division — helpi develop this new long-range, high-speed bo which will usher in entirely new characteristic manned aircraft. In addition, you have all the a tages . . . all the security . . . of IBM.

Challenging assignments now open:

- **Airborne digital & analog computers**
- **Inertial guidance & missile systems**
- **Information & network theory**
- **Magnetic engineering**
- **Maintainability engineering**
- **Optics**
- **Units & systems test equipment**
- **Radar electronics & systems**
- **Servomechanism d & analysis**
- **Theoretical physics**
- **Transistor circuits**
- **Other openings in related fields to bro your skills and kno**

QUALIFICATIONS: B.S., M.S. or Ph.D. Degree in trical or Mechanical Engineering, Physics, or M matics, and proven ability to assume a high d of technical responsibility in your sphere of int

FOR DETAILS, just write, outlining backgroun interests, to: **Mr. P. E. Strohm, Dept 604W**
Military Products Division
International Business Machines
Owego, New York

IBM is a recognized leader in the rapidly expa electronic computer field. Its products are use both military and commercial applications. Yo find ground-floor opportunities for technical ac ment and professional advancement at IBM O IBM's liberal company benefits set standard industry today. Salaries are commensurate with abilities and experience.

IBM® MILITARY PRODUCTS

Plants and laboratories: Endicott, Kingston, Owego, Poughk Yorktown, N. Y.; Lexington, Ky.; Rochester, Minn.; San Jos

Crosley Div. Readies For Avcomb Production

The Crosley Division, Avco Manufacturing Corp., Cincinnati, has announced development of a stainless steel honeycomb sandwich.

Called Avcomb, the lightweight paneling will be of value in missile and spacecraft applications, Crosley spokesmen said.

The material is said to have the strength of solid steel with but a tenth the weight. It reportedly will stand air friction heating up to 600 degrees F. without significant strength loss. This is about three times as much as aluminum, the company said.

Avcomb is in pre-production stage at Nashville, Tenn. Test and experimental quantities are being produced and studies are under way on mass production methods. The material has been produced in flat and curved panels. It was tested in late September.

NASA Appointee Hailed 'Fortunate' Choice

John A. Johnson, general counsel of the Air Force for six years, has been named chief counsel of the new National Aeronautics and Space Administration.

In making the announcement Administrator T. Keith Glennan, disclosed that Walter T. Bonney has been appointed public information officer. Bonney, who has been acting PIO, formerly headed the Public Information Office of the National Advisory Committee on Aeronautics which was absorbed by the new agency.

The appointment of Johnson was hailed as a "fortunate" one by Andrew G. Haley, president of the International Astronautical Federation who is known as the Dean of Space Law.

"A very thoughtful and prudent appointment," said Haley, "in view of his aeronautical and State Department experience. The two combined give him a basic 'feeling' for the law of outer space."

Johnson was with the State Department for two years (1946-1948) as assistant for International Security Affairs in the Office of United Nations Affairs. In that capacity he worked on international legal problems that involved the Security Council, Atomic Energy Commission, the Military Staff Committee of the United Nations and the United Nation's Commission for Conventional Armaments.

As head of the Air Force's legal department since 1952, Johnson has been aware of the problems involved in the development of international space law. He has had responsibility for several comprehensive studies of the subject made by the department. However, he feels this is strictly a long-range problem. "The law will follow man's activities," Johnson said, "it always has."

He thinks control of space will be a long time coming. Meanwhile he has suggested that all satellites be subject to international inspection prior to launching and that "certain types of information" obtained for space activities be made freely available.

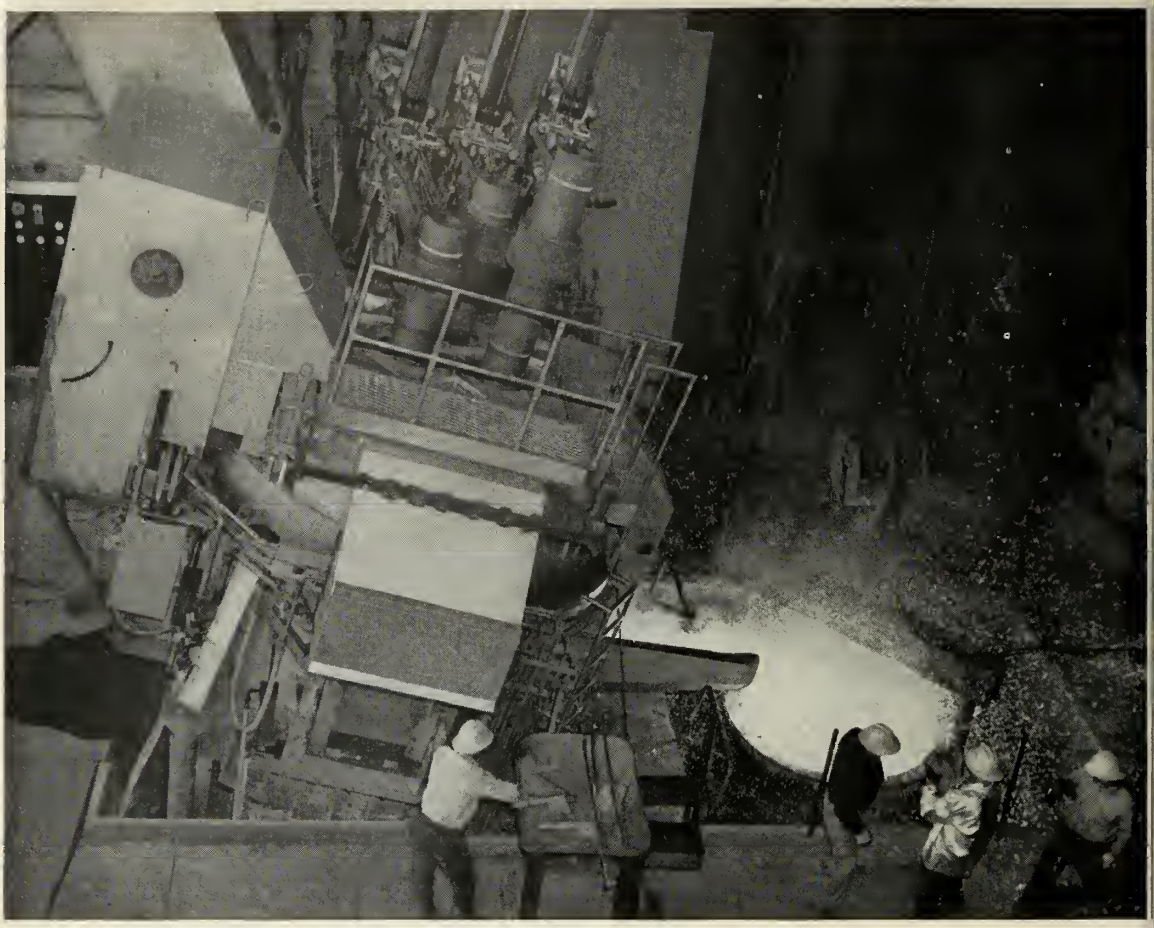
The 43-year-old attorney, who holds degrees from De Pauw University, the University of Chicago and Harvard, joins NASA October 27th. Meanwhile, Paul G. Dembling, formerly NACA general counsel has been acting general counsel.

Missile Displays Set For AOA Annual Session

Missiles again will have the spotlight during the annual meeting of the Association of the U.S. Army in Washington, October 20-22.

Among exhibits will be a *Redstone* engine recovered from the sea after re-entry, an aluminum replica of the *Jupiter* nose cone, and the first exhibit of some new Signal Corps missile monitoring radar equipment.

Pointing up the missile theme will be a *Jupiter* C.



Wide variety of alloy and stainless steel products made possible with Standard's new electric melting furnace

With installation of our new electric furnace, we at Standard are now equipped to give you even better service—even faster deliveries—and much greater variety of steel analyses—than ever before.

These expanded facilities provide you with an in-plant source of forgings, castings, rings and flanges from virtually any specialty alloy steel, including bearing grade steels, tool steels, high temperature steels, and stainless steel.

Discuss your next requirements with us. You will appreciate our service as well as our quality. Write Dept. 6-K

Standard Steel Works Division

BALDWIN · LIMA · HAMILTON

BURNHAM, PENNSYLVANIA

Rings • Shafts • Car wheels • Gear blanks • Flanges • Special shapes

BALDWIN BLH LIMA-HAMILTON

Liquid Engines Lead Space Power Race

But with Russia leading in single-chamber work, improved propellants must evolve with engine development

by Alfred J. Zaehringer

Despite the gains being chalked up by solids during the past year (*Pershing, Polaris, Minuteman*) liquid propellant rockets are still far out front in the propellant race, both from the standpoint of performance and size. Though solids have put a big dent in terrestrial weapons, liquids are reacting vigorously by expanding out into space.

Even though the push toward raising specific impulse of liquids is still on, liquid engine manufacturers are not wanting in scale-up. The *Jupiter* IRBM engine is to be regarded as the first major step away from the old V-2 engine. The *Redstone* engine, which has attained a powerplant reliability of some 94%, can be regarded as the prototype for the *Jupiter* engine. *Jupiter*'s engine, with a nominal rating of about 165,000 pounds thrust, also serves on *Thor* and *Atlas*.

In the same manner, the German A-10 engine (rated at 441,000 lb) probably served as a model for the current Soviet T-2 engine. The T-2 engine, a single-chambered affair, is definitely rated above the 220,000 lb thrust class. More probably it is in the 250,000-270,000 lb thrust class—making it the world's largest existing single-chambered engine.

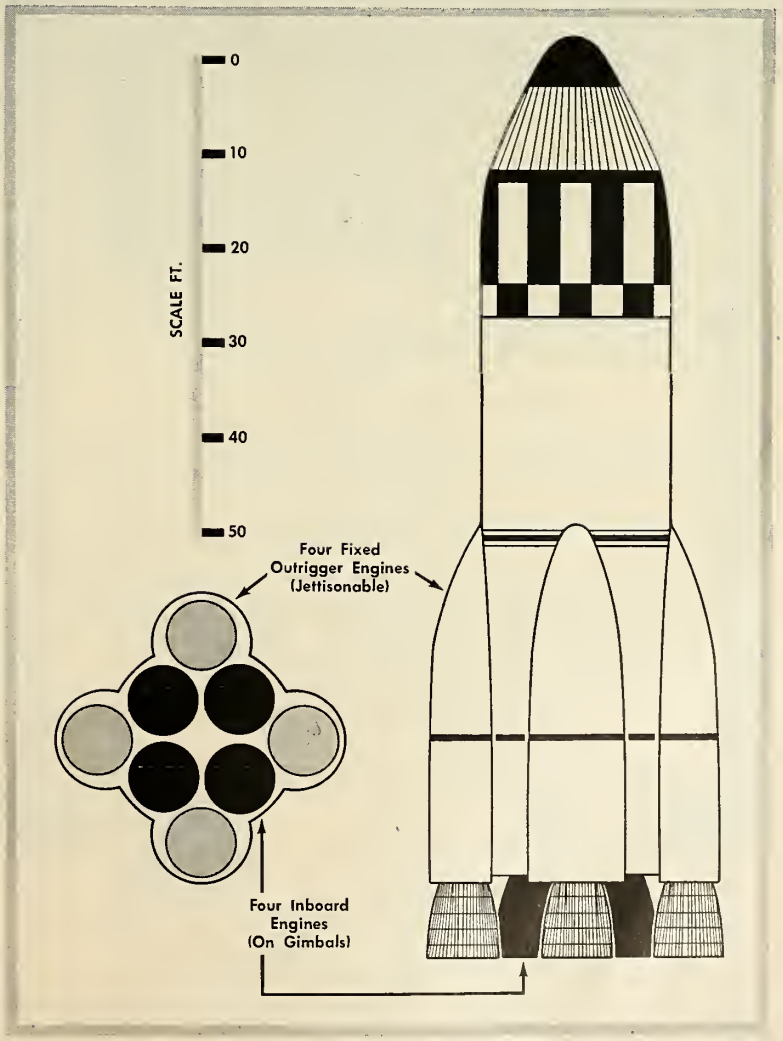
Whether the T-3 powerplant is single-chambered or is clustered is not known with any degree of surety. An accompanying table lists some of the liquid engines that show the evolutionary pattern mentioned.

• **Million-pound goal**—It is now becoming apparent that the Soviets have been working on a single-chambered rocket engine of at least one million pounds thrust for about 8-12 months. In another 4-6 months, this mammoth engine should be ready and should pave the way for more startling satellites and space missions. Even *Sputnik* III should then be small stuff and the US will again be shocked. The one meg Russian engine is already in the test stand.

By contrast, the million pound US engine is still some years off, estimates George Sutton of Rocketdyne, member of the single-chambered engine developers for the Air Force. Taking into account the lead time involved in the *Atlas* program and subtracting the learning process, the best guesstimate is that the megapound engine will not be ready for missile use before 1962.

• **1.5 Meg-cluster**—For this reason, this nation has placed a back-up program into effect for developing a clustered engine of at least one million pounds thrust. Roy Healy, Rocketdyne's *Jupiter* engine manager, figures that by clustering the proven *Jupiter*

How Jupiter May Be Clustered



. . . liquid engine

engines, the million pound goal can b ready in about a year.

Eight *Jupiter* engines could be clu tered to provide 1.3-1.5 megs of thrus Possibly the inner four clusters wou be on gimbals to provide stabilizatic while four outriggers could be use for boost and later jettisoned.

Much larger vehicles (and hen payloads) can be boosted into spa with these high thrust engines. Hov ever, for more sophisticated space ve tures, engines of at least 6-15 millic pounds of thrust will be required. Thu the eight engine *Jupiter* cluster wou eventually have to bow out to the si gle-chambered 1 meg engine. For ov 10 million pounds thrust, a 2-5 m single-chambered engine will have evolve.

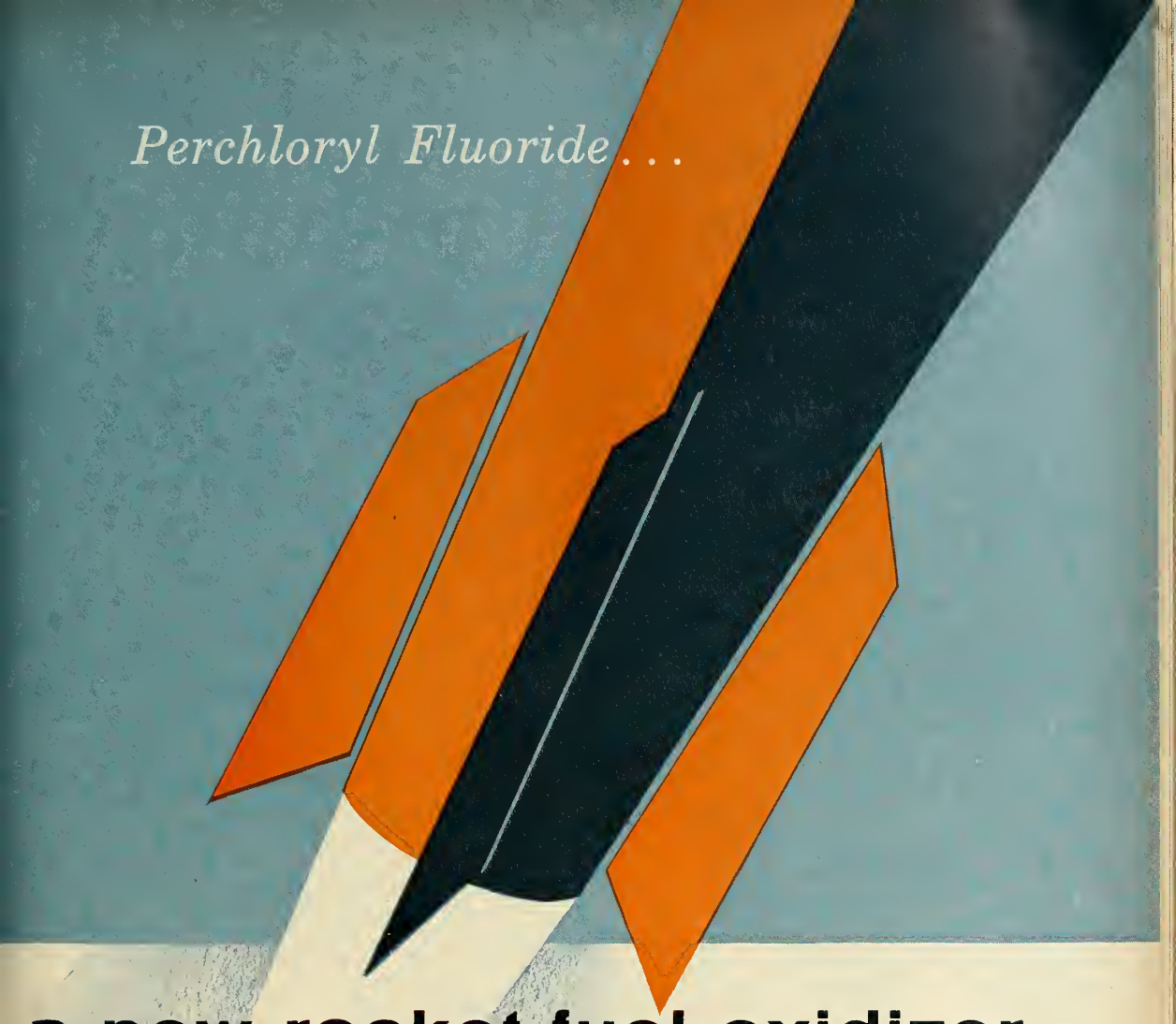
• **Propellant prospects**—It will l much easier if propellants could al evolve with the engines if serious spa missions are to be considered. Use fluorine-hydrazine could materially r duce the size of the ICBM and t moon impact rocket. Although LO utilization will continue for some tim new storable liquids appear destined take over terrestrial liquid rock weapons systems.

Fluorine rockets will probably l used for major space applications un nuclear and ion rockets take over. looks as if fluorine will be extensive used for boosting space aggregate providing, of course that solids do manage to snag this field also.

• **LOX vs. storable**—The curre feeling is that if you are going to ha to work with a messy cold fluid lil LOX, then you might as well get me sier and go to something with high performance. Many difficulties assoc ated with LOX systems probably c be attributed to the low temperatur encountered in dealing with this flu (–297 F). Pumps, seals, and valves a especially critical items.

Therefore, storable liquids are b ing seriously considered as the ne step in improving the characteristics liquids. Foremost among the LO replacement candidates is nitrogen te roxide. Available in tonnage quantitie N_2O_4, is a high density (about 12 lb/g at 77 F) liquid with a boiling point about 70 F at atmospheric pressur The vapor pressure is about 62 psig 140 F., which means that it can l stored without refrigeration.

One large producer, Allied Che ical, reports that both Bell Aircraft a Rocketdyne have done work with th oxidizer. In addition, there have be



Perchloryl Fluoride . . .

a new rocket fuel oxidizer . . .

offering important chemical and physical advantages

Pennsalt "PF"® (*Perchloryl Fluoride*—ClO_3F) is the first oxidizer designed for rocketry. The unique chemical properties of "PF" include high oxidizing power . . . and its physical properties offer notable advantages. Your investigation is invited.

STORABLE. Readily shipped and permanently stored in liquid form without refrigeration (M.P., minus 231°F; B.P., minus 52.3°F).
Non-corrosive—safer for personnel.
Compatible with common materials.
Low toxicity.

STABLE. Not sensitive to shock.
Thermally stable in all climates.
Non-incendiary, i.e., not hypergolic with clothing, wood, tissue, etc.
Permanently storable without decomposition.

SUPERIOR PERFORMANCE.
Provides high specific impulse. I_s = approx. 270 sec. (with hydrazine @ p_c = 500 psia: frozen equilibrium)
Readily ignited . . . extremely smooth combustion.

WRITE for technical literature. Pennsalt "PF" is available in small cylinders, 100-lb. cylinders and ton quantities for shipment in the United States.

Commercial Development Department 660, Technical Division
PENNSALT CHEMICALS CORPORATION
Three Penn Center, Philadelphia 2, Pa.

Pennsalt Chemicals
ESTABLISHED 1850

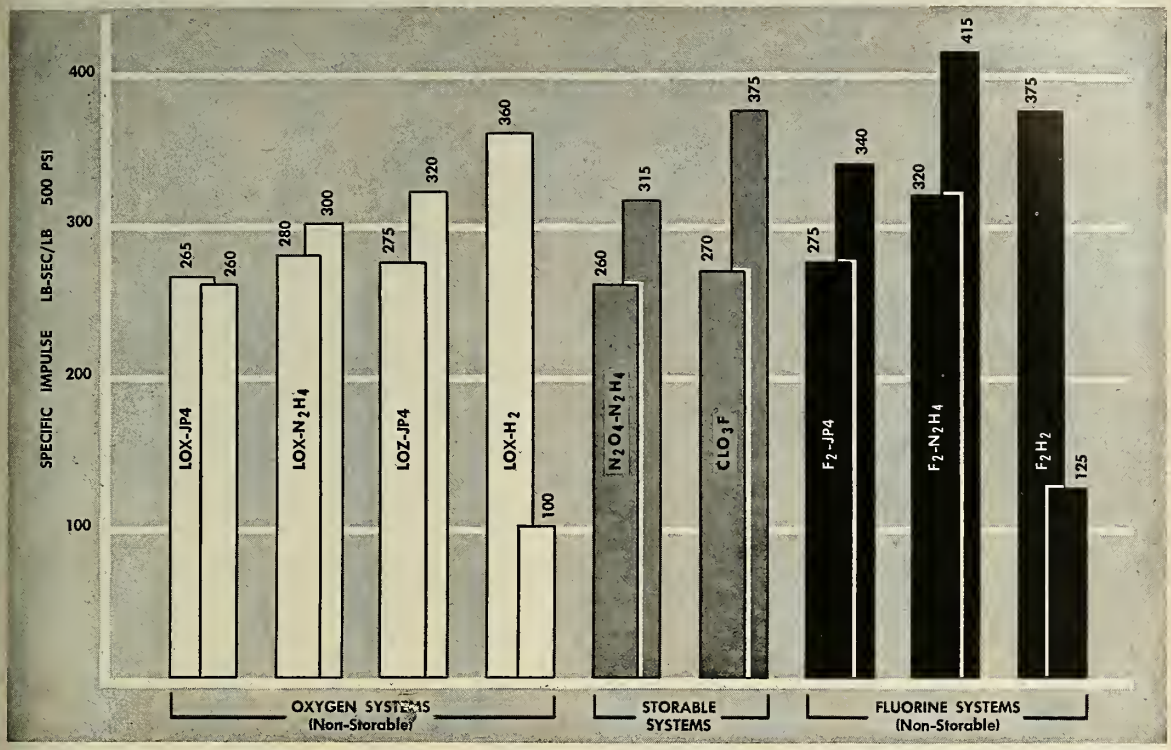
Circle No. 45 on Subscriber Service Card.

Bendix* has long been a leader in supplying controls and fuel systems for all types of aircraft engines. Today, Bendix is proving to be a natural for new challenges in related missile fields—on ram jets, rockets, nuclear power, and other advanced propulsion systems. So, when it comes to controls, remember that Bendix has the background—and is anxious to share it in solving your problems. *REG. U.S. PAT. OFF.

BENDIX PRODUCTS DIVISION **SOUTH BEND, IND.**

Bendix AVIATION CORPORATION

Circle No. 46 on Subscriber Service Card.



LOX-BASED systems are phasing out, storables will be used to bridge gap between LOX and fluorine. Small bar with each propellant combination on the chart gives the impulse times density ratings of the combination.

reports that Redstone Arsenal has taken a serious look at the tetroxide as a substitute for LOX. The oxygen content is about 70% by weight.

Performance is slightly under LOX but the higher density makes the difference. In a V-2 type vehicle, the use of N_2O_4 will give a 12% increase in range because of the higher density. The oxidant is hypergolic with such fuels as hydrazine, cyclic hydrazines, aniline, toluidine, and xylidine with furfuryl alcohol, cyclopentadiene, pyrocatechol, and metal carbonyls. Another advantage is the fact that it is non-corrosive to ordinary carbon steel under anhydrous conditions.

Another bright prospect for a storable liquid is perchloryl fluoride (PF), ClO_3F. Pennsalt has rushed this oxidant out in time to hit the increasing storable liquid interest. Performance is slightly greater than for nitrogen tetroxide, though it has a better impulse-density rating. PF melts at –231 F and boils at 53 F. Vapor pressure at 71 F is 176 psia. PF also is non-corrosive when anhydrous. Density of liquid PF is about 1.4 g/cc.

• **Ozone out**—The application of liquid ozone to rocket propulsion is practically dead. Of considerable interest is the fact that Clark Thorp, one of the nation's outstanding ozone exponents, has left Armour Research Foundation. ARF was one of the last strongholds in advocating use of liquid ozone for an oxidant.

On the other hand, it appears that the Russians have not given up on ozone and, in fact, may have already applied it for liquid rockets. It may be that the Soviets are using liquid ozone in combination with LOX to give immediate propulsion gains.

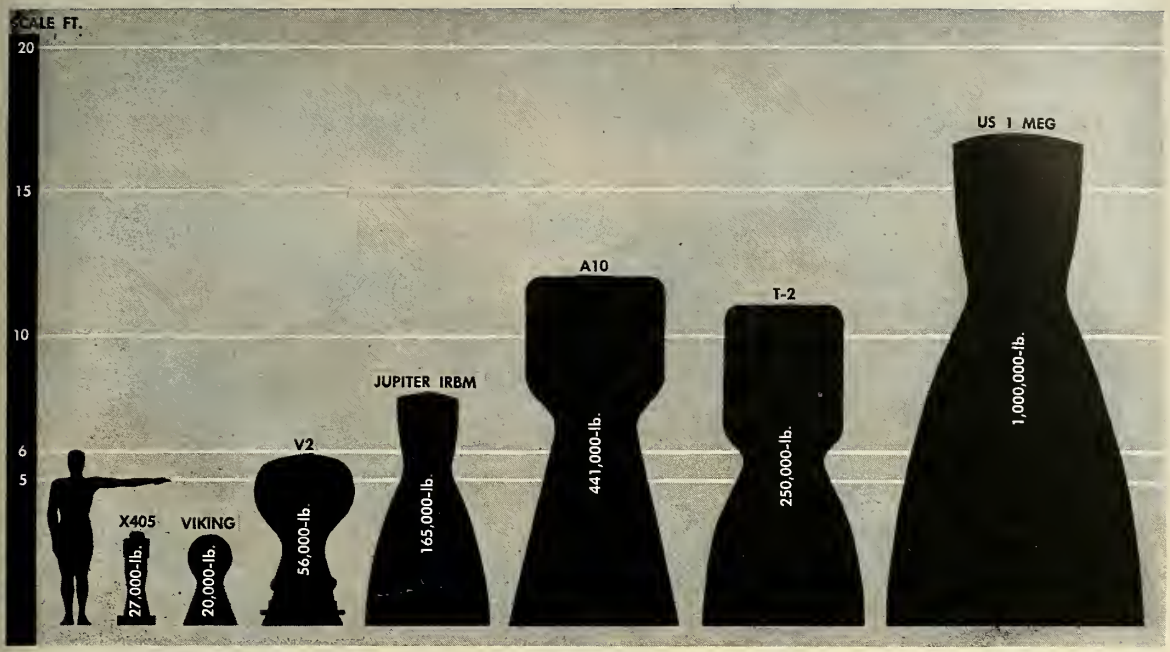
• **Monopropellants uncertain**—Despite the wild claims about liquid monopropellants, the fact remains that only a handful of US groups are actively working on liquid monopropellants. These are: NARTS, Phillips Petroleum, Stauffer Chemical and Wyandotte Chemicals.

Performance over 250 I_{sp} apparently is not too hard to achieve; the big stumbling block is sensitivity. Aside from low performance auxiliary power systems, no liquid monopropellants are operational—nor are they likely to be for at least 5 years—and then only in small engines.

• **Fluorine in lead**—The most likely

Leading Liquid Rocket Engines

Engine	Sea Level Thrust (lb.)	Engine length (ft.)	Engine diameter (ft.)	Exit Nozzle diameter (ft.)	Notes
Viking	20,000	2.85	1.6	1.6	RMI
Vanguard	27,000	3.2			X-405 by GE
V-2	56,000	5.67	3.1	2.4	German, LOX-alc.
Jupiter-C	~ 79,000				Hydyne fuel-LOX Rocketdyne.
Jupiter	~ 165,000	7.0	2.5	4.0	LOX-RP Rocketdyne.
Saenger	220,000				German, LOX-oil.
T-2	> 250,000	11.0	5.0	5.5	Soviet IRBM.
A-10	~ 441,000	12.0	6.0	6.0	German, LOX-oil.
T-3	> 500,000				Soviet ICBM.
	1,000,000	17	7	8	Rocketdyne.



EVOLUTION of liquid rocket engines. Drawn to scale, growth from 27,000 lb. thrust *Vanguard* engine (at left) to 1 million lb. thrust Rocketdyne model. Soviet T-2 engine is about twice as powerful as *Jupiter* engine.

chemical contender to succeed in liquid rockets will probably be liquid fluorine. Despite messy handling, toxicity problems, and high cost, fluorine figures big in future space applications.

Both Rocketdyne and Bell Aircraft have fired medium thrust fluorine rockets, while NACA has put in several years of work on fluorine systems. With NACA forming the nucleus of NASA, it is expected there will be a pitch for large fluorine rockets.

Fluorine is probably the last chemical plateau that rocket engineers can look to. It shouldn't be too difficult to get an I_{sp} of at least 300 seconds immediately. Large fluorine rocket engines is not too far off. The Air Force rocket engine test stand at Edwards is getting ready to handle a liquid fluorine engine (probably a modified *Jupiter* IRBM) of about 170,000 pounds thrust for a duration of up to one minute.

Fluorine has been trucked around the country for some time, but supplying this material on overseas bases may be another matter. For this reason, it looks like anhydrous HF will be shipped to remote bases where it can be electrolyzed to form elemental fluorine.

• **Fuel fiasco**—For a long time there had been a mistaken belief that fuels were the thing to look for in radical rocket performance increases. It has been found that, with a given oxidizer, the range in specific impulse from the hydrocarbons to the exotics to hydrogen lies in a quite narrow band. For this reason, other factors such as cost and handling are often more compeling deciding parameters.

Currently, the swing has been from the alcohols to petroleum hydrocarbons. The next step will be toward hydrazine base stocks. Whether the boron exotics will move into the rocket engine field is debatable. Boron hydrides are having a hard enough time proving themselves in turbojets and ramjets, let alone in rockets. One of the big stumbling blocks is the high combustion temperature which, in large rockets, means short durations or cooling.

The thermal stability of boron exotics will probably preclude them from use in regeneratively-cooled engines. For this reason, boron may make a bigger dent in the solid rocket picture than in the liquid field.

MIT'S Weber Named Advisor in Army R&D

Dr. Harold C. Weber of the Massachusetts Institute of Technology and member of the Army Scientific Advisory Panel, has been appointed Chief Scientific Advisor Consultant to the Army's Chief of Research and Development.

Professor of chemical engineering at MIT since 1921, Dr. Weber is the author of numerous technical articles and the textbook "Thermo-dynamics for Chemical Engineers." He was also a contributor to "Marks' Mechanical Engineers' Handbook."

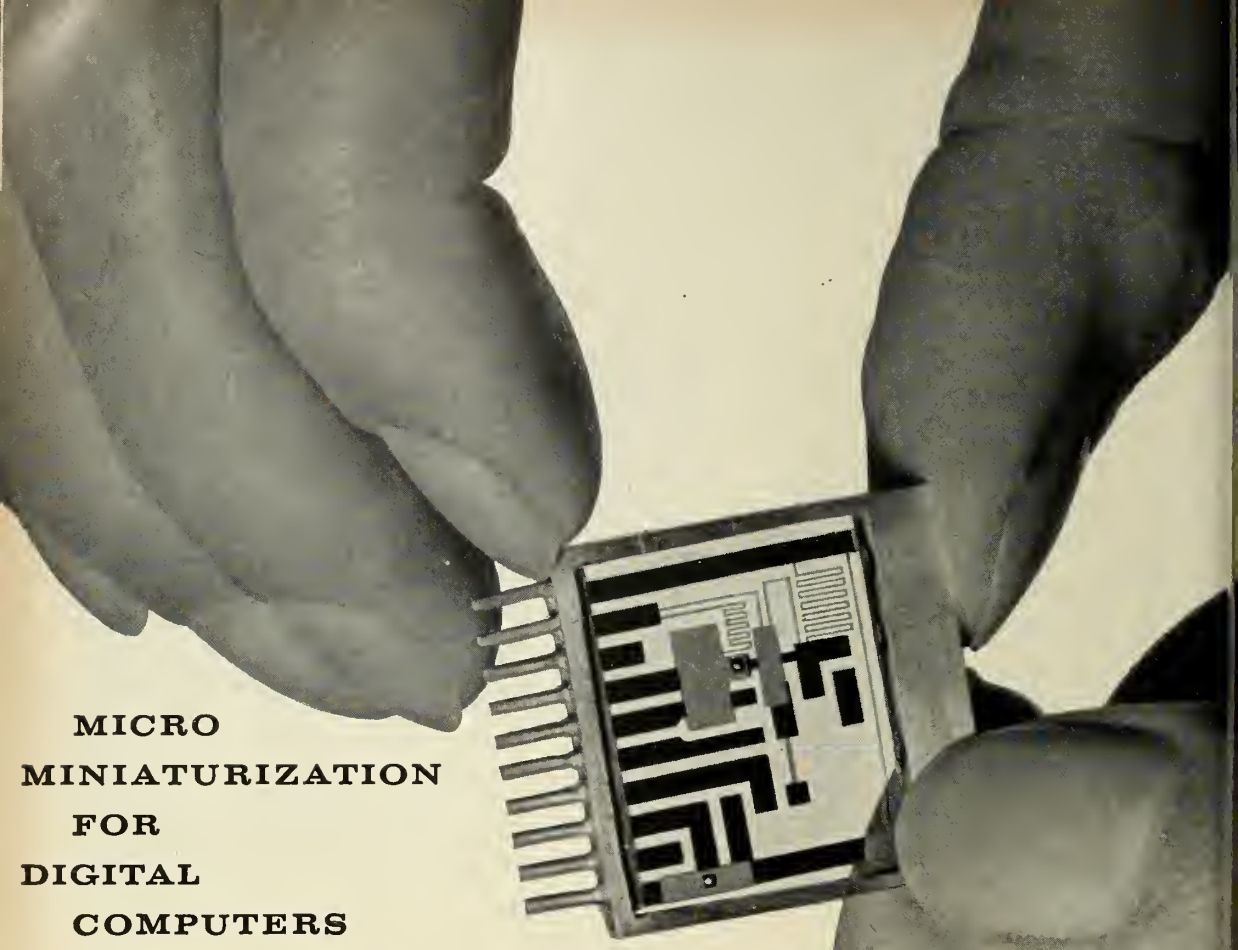
The new scientific advisor received his BS from MIT in 1918 and his doctorate in science from the Eidgennoische Technische Hochschule in Zurich, Switzerland.

French Army, Air Arms To Split Missile Work

French Minister of Defence Guillaumat has ordered what official communiques called a "specialization of the efforts" of the Army and Air departments in the fields of missiles, it was recently announced.

Under the order, the Department of Ground Forces will concentrate its efforts on development of all types of ground-to-air missiles. The Department of Air will concentrate on the development of ground-to-ground, and air-to-ground—as well as air-to-air weapons. These latter will include the short-range SS 10/11/12 anti-tank missiles.

The order, however, specifically does not forbid the Army to work with aircraft manufacturers in future missile development.



MICRO MINIATURIZATION FOR DIGITAL COMPUTERS

12 resistors, 4 capacitors, 4 diodes and 4 transistors...
all are contained in the complete flip-flop circuit illustrated above.

At the Hughes Research & Development Laboratories, dramatic reduction in component size is symbolic of the advances in the digital computer art...advances which are preparing the digital computer for its role as a system control in space.

In addition to developing new digital circuits and components, Hughes engineers are delving into other digital computer space mission tasks such as navigation guidance and control, communications processing and display, vehicle control, mission programming.

An intensive Hughes program in digital computer systems has created openings for creative engineers and physicists with degrees from accredited engineering universities in the following fields:

CIRCUIT and COMPONENT DEVELOPMENT: Digital Computer Analysis, Microcircuitry and Cryogenics, Solid State Physics, Magnetic Storage Devices.

SYSTEMS ENGINEERING: Closed-loop Digital Control, Digital Sensing and Conversion, Radar and Communications Information Processing, Inertial Navigation.

The salary structure for these personnel reflect the exceptional backgrounds required and the unusual challenge of the projects.

Inquire by writing directly to:
Dr. Allen Puckett, Associate Director
Systems Development Laboratories

HUGHES

Hughes Aircraft Co.,
Culver City 13, California

Tooling for Space Age Feature of L.A. Show

The challenge of space age tooling requirements highlighted the technical sessions held in connection with the first biennial Western Tool Show in Los Angeles under the sponsorship of the American Society of Tooling Engineers.

With 250 exhibitors displaying more than $5 million worth of products ranging from automation to assembly and fastening devices, theme of the five-day event was "Tooling for the Space Age."

Precision, in the future, will be measured in millionths rather than tenths of thousands. "And when we stop to reflect that such tolerances encroach upon the measurement perimeters of our own Bureau of Standards one must certainly ask 'where do we go from here?'" observed A. S. Turner, assistant chief tool engineer for the Northrop division of Northrop Aircraft.

The job of tooling the *Snark* missile was found in the inner components rather than in the outer structure, Turner reported in a paper on the Air Force's first intercontinental missile. Fine tolerances that defy conventional tooling techniques are the rule rather than the exception in the guidance section of the *Snark*. He told how equipment to generate gear teeth of 5.0 secs. of arc from tooth to tooth, noncumulative over 54 teeth, was developed.

The use of optical measurement will increase to the point of becoming routine practice in missile tooling, Turner said.

L. G. Granstedt, chief tool engineer for Convair-Astronautics, also emphasized the use of optical tooling in obtaining the alignment of the component pieces that go into the assembly of a missile, such as the *Atlas*. From the *Atlas*, Convair learned that tool designers must get into the field of special mechanized tools and the jig and fixture man must become, to a degree, a machine tool builder.

"Automatic controls on tools are not a thing of the future, but, as on the *Atlas*, are an established fact of the present," Grandstedt declared. The broadening field of tool engineering is encompassing previously unrelated fields of machine design and electronics, he added.

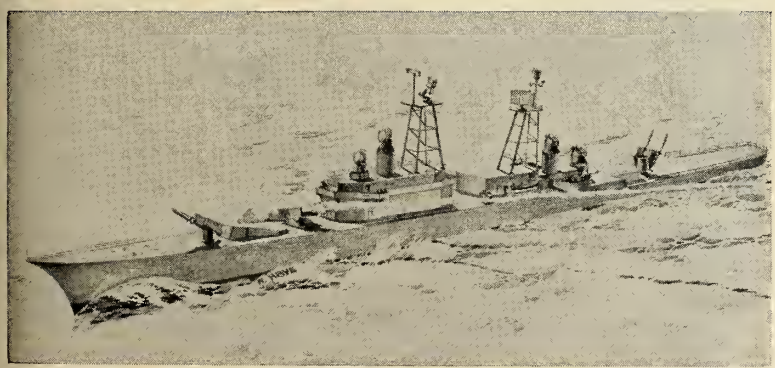
In this age of phenominal engineering developments, manufacturing must be as visionary as engineering, said T. F. Vajda, supervisor of tooling and manufacturing methods at Plant B-9 of Lockheed's Missile Systems division. He declared that tooling, methods and ingenuity become synoymous.

Nike Hydraulic Test Stands Awarded Hufford

Nike missile system hydraulic test stands will be provided by the Hufford Division of the Siegler Corp. under a contract in excess of $350,000 awarded by Douglas Aircraft Co., according to Dan W. Burns, Hufford president.

Under the terms of the contract, the second of its type to be received, Burns said, Hufford will provide an undisclosed number of test units to be used in *Nike* sites for periodic functional tests of hydraulic components in the ground-to-air missile's launching equipment. Test stands of this nature are required, he said, to make certain all segments of the launching equipment's hydraulic system are operational following a protracted period of setting in the ready position.

Newest for Navy Missiles



GUIDED MISSILE FRIGATE will be built by Bethlehem Steel, at Quincy, Mass., which recently received a letter contract for design and construction for $10 million, with fixed price contract to come. Scheduled for delivery in January, 1962, the ship —designated DLG(N)—will have twin *Terrier* missiles fore and aft, plus conventional armament. Bethlehem already has contracts for the first nuclear-powered guided missile cruiser, the "Long Beach," and installation of *Terrier* handling and guidance systems for three conventionally-powered guided missile frigates.

11-53

Man-Machine Relationships: A New Field for Scientists and Engineers

A new field for Operations Research Specialists, Engineers, Computer Programmers and Behavioral Scientists has arisen from System Development Corporation's work on relationship of men and machine systems.

It involves two major projects: 1 *creating and conducting large-scale training programs in present and planned air defense systems; and* 2 *operational computer programming for SAGE.*

Attaining the most effective interaction between men and machines is of prime importance. It requires intensive effort in an unusual combination of technical and scientific areas; it is a new field of endeavor.

Both activities also have these elements in common: they are constantly changing • they are long-range in nature • they are essential to the welfare of the United States.

The close interrelationship of these two major projects, the widely diversified specialties involved in them, and the dominating influence of man-machine relationships make SDC's work unique. Operations Research Specialists, Engineers, Computer Programmers, Behavioral Scientists—all find their assignments reflect the unique qualities of this new field.

The expanding scope of SDC's work has created a number of positions in these fields. Inquiries are invited. Address: R. W. Frost, 2414 Colorado Ave., Santa Monica, California, or phone collect at EXbrook 3-9411 in Santa Monica.

SDC

SYSTEM DEVELOPMENT CORPORATION
Santa Monica, California

11-53A

An independent non-profit organization.

Admiral Weaves Another Trap

Problems of "Liquid space" offer challenge to industry—help needed to meet submarine missile threat, Thach says

by William O. Miller

Task Group Alfa consists of an aircraft carrier—the "Valley Forge"—its air group of fixed wing anti-submarine aircraft, a helicopter squadron, destroyers, shore based patrol aircraft, lighter-than-air patrol craft, and submarines. It is the sea-going "laboratory" for the Navy's Anti-Submarine Defense Force, which was formed July 1957 to meet the growing threat of defending this country against enemy submarines.

The man saddled with a large part of the responsibility of facing up to this defense challenge—Rear Admiral John S. Thach, commander of the Navy's special Task Group Alfa—looks it squarely in the eye, and says:

"The submarine-launched missile is the greatest single threat facing this nation today. None of us have any illusions about the problem, but one thing we know for sure—it's got to be met and solved. It's our job to see just how good we are with what we have."

During World War II, the same Thach helped solve the problem of fighting faster, more maneuverable Japanese Zeros—these new fighter tactics became famous as the "Thach weave."

Task Force Alfa operates around the clock with one exercise following another, improving old tactics, experimenting with new approaches (both from the viewpoint of the sub-hunting units and the target submarines), trying out new equipment when asked, and welding men into an integrated team.

However, there is one thing—and it is a key point—that the Task Group Men don't agree on: the sub hunters are pretty sure they can take on any sub, and the submarine crews are equally convinced that they have the edge.

All-hands job—In response to personal orders of the Chief of Naval Operations, Admiral Arleigh Burke, the force was set up last Spring and is being given the latest and best the Navy has in the way of ships, personnel, equipment and weapons. A unique feature of Task Group Alfa is that for the first time, the Navy is assigning units to an anti-submarine force on a semi-permanent basis. But there is still much to be desired. Admiral Thach explains it this way:

"The research and development of adequate weapons and search and identification equipment is an all-hands evolution. The Navy has not ignored the anti-submarine problem in the years since World War II, but it has been difficult to generate nationwide interest in such an unglamorous program. Consequently, effort and money have been concentrated in other areas. What we need are some major break-throughs to meet the threat we were made aware of by our own development of Fleet Ballistic Missile System.

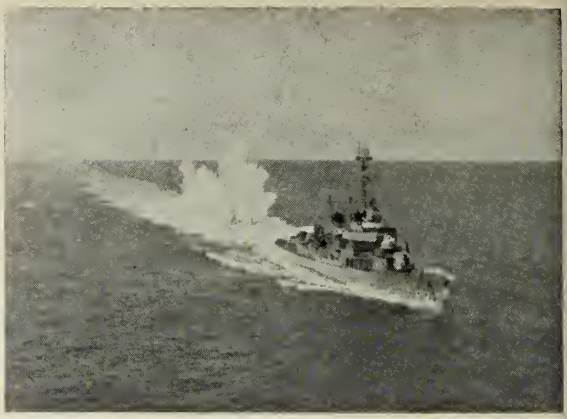
"These break-throughs cannot be made overnight. Discovery of new principles results from years of research and concentrated effort. We cannot expect results without it. It's never been so when we have had to meet other challenges, and we'd be kidding ourselves if we thought differently now. We need help and need it badly, from every segment of industry concerned with the tools we need, and from many people who probably aren't even aware they might be able to help us."

Admiral Thach points out that the preoccupation of the nation and the military with the problems of space, earth satellites, missiles, and counter measures can be turned to an advantage.

"All across the country thousands of people in industry and privately operated laboratories are working on the problem of space. I am sure that they will make discoveries, and bring to light new principles which could assist in the break-through we need in solving anti-submarine problems—if they are aware of the problem."

Liquid space—Admiral Thach likes to refer to the sea's vast subsurface ex-

THREE ELEMENTS of sub-killing team—helicopter, seaplane and destroyer—are ready for their jobs.



DESTROYER FINISHES "kill" with depth-charge, after aircraft have marked location of target.

panses as "liquid space." He points out that the major difference is the density of the element, a lack of knowledge concerning the nature and topography of the ocean bottom, and detailed information in many areas.

"You might call us sea-going psychiatrists," Admiral Thach continues, "We know our subject quite well from surface observations. We know many of its moods and physical features. But as we probe further into the depths, we encounter many phenomena and observe many things for which we can offer no explanation."

All these phenomena, Thach says, are interesting and often very strange. And some are nothing less than disturbing. For example:

"The concealment offered by the ocean depths provides the biggest launching pad in the world to any enemy intent upon destroying this country. The disturbing thing is that this launching pad is free to be used by anyone with the knowledge to use it. It extends right to our front door from Maine to Texas, and from Canada to Mexico."

Ocean research lags—Earthmen actually know more about the surface of the moon than is known about the bottom of the oceans—a large proportion of the earth's surface.

"The Russians probably will make available more IGY information of an oceanographic nature than they will concerning their satellite and space programs," Thach commented.

Oceanography as a science is relatively new. It actually began with the round-the-world cruise of the HMS Challenger from 1872 to 1876. There had been other similar voyages before, such as the "Beagle" with Charles Darwin; but none gathered the vast new scientific information that the "Challenger" accomplished in its three and a half years and 69,000 mile exploration in the Pacific and Atlantic.

In oceanographic research ships, the United States lags behind several nations. Foremost among them is the Soviet Union. The largest U.S. ships are the 2,700 ton "San Pablo" and the "Rehoboth" of the Hydrographic Office, but the majority are of the 500 ton class or less.

The Japanese have been active because of the importance of the fishing industry to that nation. Great Britain has a number of modern units. The Russians have several in the 5,000 ton range and two 12,000 ton ice breakers, which are classified as oceanographic research ships. This may or may not have some bearing on the fact that the first announced use of nuclear power for ship propulsion by the Russians will be for an ice breaker.

It is not only on numbers and size that the U.S. lags, but in the design and facilities on the ships. The 298-ton ketch "Atlantic" is the only American vessel originally designed for research purposes, while the Russians are building specially-designed vessels which have a number of laboratories and up to 60 scientists aboard. Of special interest is the first cruise in the North Atlantic, completed late in 1957, by the Russian 5,960-ton "Mikhail Lomonosov."

The most optimistic estimates of the situation are that the U.S. has about 10 years to catch up and carry out a 25-year replacement program.

Why needed—A better knowledge of the element is a prime requisite for efficient undersea warfare. The sea is a strange and noisy place. All sorts of marine life make noises that either sound like ship noises or contribute to the general sonar confusion so as to cover up the noises of another ship or a submarine. The ocean bottom, for the most part, is an unexplored jungle.

The vast undersea rivers and currents which conceivably could be used by submarines, just as aircraft use jetstreams, are not completely located. The differences in temperatures of layers of water which bend and distort sound waves and provide a protective cover for submarines must be penetrated. And there are always those strange phenomena for which there is no explanation. The decoys are many and varied.

Greatest need—"Our greatest need," Admiral Thach says, "is for longer range detection equipment and the weapons to give us the kill capability by the time we have the extended range search and identification gear."

Sonar is still the basic means of searching the depths. There is limited capability in determining what the target is. The range of weapons, other than the nuclear depth charges and warhead, has gone little beyond World War II. To sum up, what is needed:

Improved detection, classification and kill ability.

Weapons presently on hand include the fixed wing aircraft and helicopters of the aircraft carrier. The Grumman S2F Trackers can employ a variety of weapons including the Mark 43 homing torpedoes, depth charges of both the conventional and nuclear type, and Mark 5 rockets which are effective only against a submarine on or very near the surface. Important in its search equipment is the magnetic aerial detection gear (MAD), which though limited in range, can differentiate between metallic and non-metallic contacts.

The destroyers of the task group have in addition to World War II type depth charges and the Hedgehog,

Weapon Able and the Rocket Assisted Torpedo (RAT) which have limited range and other shortcomings.

The submarine major weapons are the old model Mark 14 torpedo, the smaller and slower acoustical Mark 27 and 28, the homing torpedo, and the now-available wire-guided torpedo.

The 16 helicopters on board the Valley are Sikorsky HSS-1, which employs the dunking sonar to detect and hold a contact until the killer sub, surface vessels or aircraft can arrive on the scene to assist. The HSS-1's can employ the Mark 43 torpedo and depth charges, either conventional or nuclear. Greater endurance and greater life capability is needed here. Thach said that one shortcoming, a night capability, will be met with the delivery of HSS-1N's due in about a month.

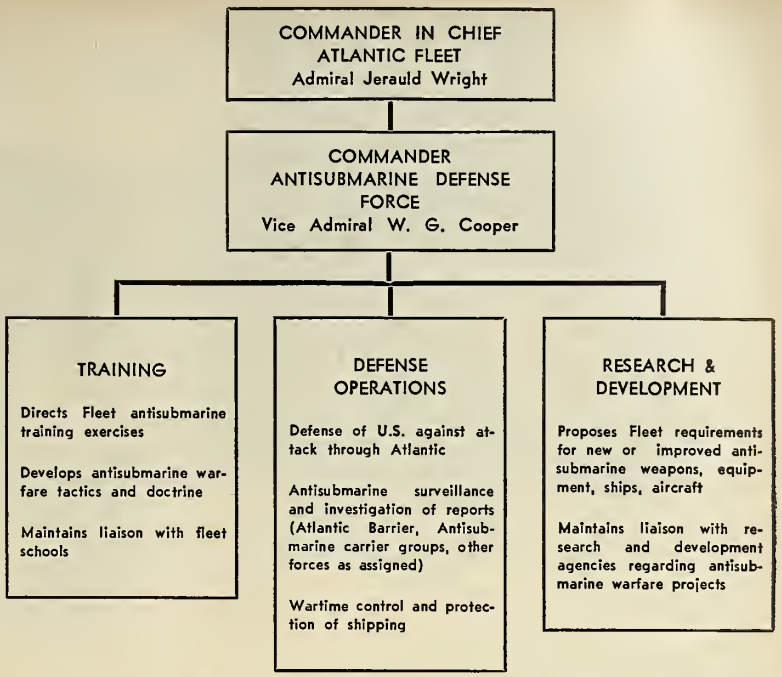
Other areas in which there is need for improvement are synthetic trainers to instruct personnel in the most effective use of varied and complex equipment, easier maintenance of the electronics equipment, automatic navigation equipment for aircraft, and an automatic means of plotting the tactical situation so that the units may be directed to make the most effective attack upon the target.

Subs on team—Probably the greatest innovation developed by TG Alfa is the utilization of the killer submarine as a part of the hunter-killer team. The submarine is particularly valuable because of its ability to drop sonar detection gear lower than the helicopter. The information thus obtained can be sent to attacking aircraft and ships. Surface noises can be minimized, and the submarine can get below the gradient that ships and helicopters can't penetrate.

Despite advances of four to five times the effectiveness of World War II sonar, stepped-up investigations of the complete sound ranges from very low to the very high frequencies are badly needed.

Communications is a special problem for the submerged submarine. The sub can talk by underwater telephone to surface ships, but the range is extremely short.

The submarines vitally need a breakthrough which will give them a weapons system to match those in other vessels. Present weapons are not up to detection ability. Control of highspeed underwater vehicles such as torpedoes are a special problem inasmuch as even limited use of control surfaces can cause wildly erratic movement of the torpedo. A number of possibilities are under consideration, including chemical torpedoes or even rocket propelled torpedoes to provide high speeds and better control.

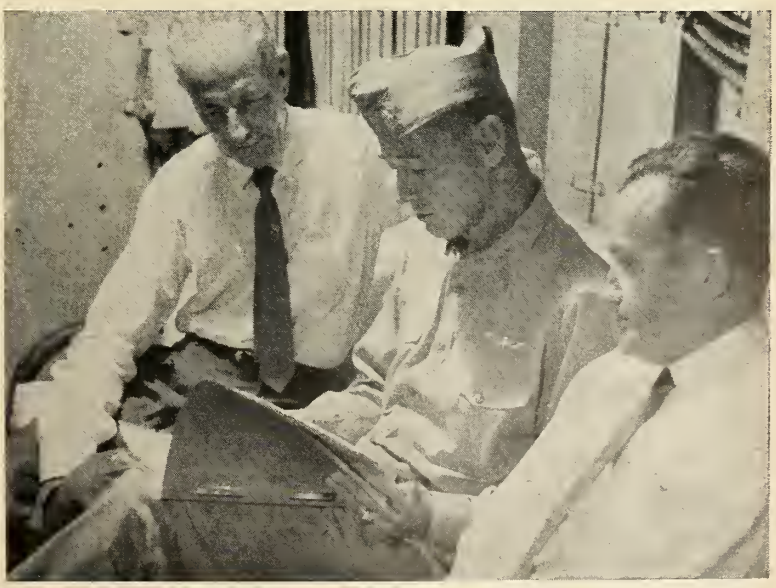


ORGANIZATION of Navy's efforts to combat undersea attack is clear from chart.

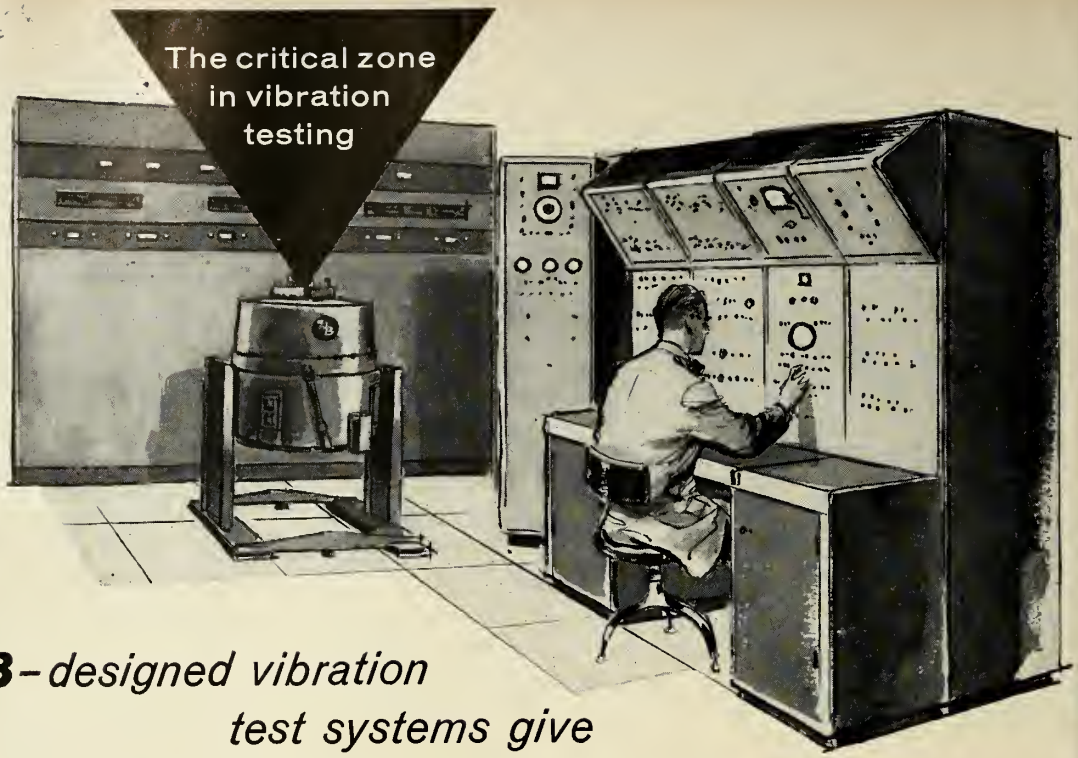
Part of the Force—Task Group Alfa is only a part of the Anti-submarine Defense Force commanded by Vice Admiral W. G. Cooper. It is part of the training operations, but in time of emergency, TG Alfa would join the other anti-submarine carrier groups in the defense forces. Adm. Cooper has four such hunter-killer groups under his operational control, as well as other ASW forces. He is responsible for all phases of anti-submarine defense, including resarch and development.

The heart of the system is the operations control center at Norfolk, where all reports from aircraft flying the Atlantic Barrier from Newfoundland to the Azores, merchant ships' reports, or contacts from any source are plotted, evaluated, and if necessary, investigated.

In some ways, the peacetime job is



ADM. THACH considers held of industry men essential to his task.



MB – designed vibration test systems give

high performance table motion

It's *System Performance* that counts most in vibration testing.

Whole purpose of a vibration test system, large or little, is to subject specimens to *motions* that simulate service conditions as closely as possible. Such motion gives you *reliable* information on vibratory response and performance of structures, products, components. It helps reduce risk of malfunction or failures in the field.

But many factors contribute to this motion. Among them: force output and characteristics of the exciter; ample and undistorted power supply to meet all shaker-plus-specimen load relationships; meticulous matching of components in the entire system from input signal to output at the shaker table.

INTEGRATED SYSTEM OFFERS OPTIMUM RESULTS

As the manufacturer of *complete* systems, MB intimately knows the operational needs of shaker, builds amplifiers and controls around those needs. Each MB system is integrated toward the highly desired end result . . . *delivering optimum performance at the shaker table* for present and future needs.

The largest field service organization in vibration testing is ready to help you achieve that result. For latest information, call on MB.

HIGH FORCE HIGH PERFORMANCE SYSTEM

Shown above is a typical MB test system. It includes a Model C70 7000 pound force vibration exciter fit for environmental testing chambers.

The MB T996 amplifier is rated at 50KVA output and can handle the most adverse reactive shaker loads for broad-band sine wave and random motion testing. The T68MC control console is easy to use, also provides automatically cycled testing. The T88 console expands system for complex motion work.

Send for Bulletin 470 which gives detailed specifications on the high performance available from this system; and from others to 25,000 pounds force.

largest producer of complete systems for vibration testing

MB manufacturing company 1055 State Street New Haven 11, Conn.

A Division of Textron Inc.

more difficult than a wartime task. It's not as simple as making contact, evaluating it as an enemy and proceeding to attempt a kill. Under international law and in peacetime, a capability of prolonged surveillance is necessary, which points up the necessity for major breakthroughs in detection and classification methods.

As Admiral Thach says, "The problem is new; therefore, the defense must be new—and when we have to cope with nuclear submarines, our job will be more difficult than it is now—detection by present-day conventional means will be much more difficult, for instance."

There seems little doubt that some of the current reports of unidentified submarine contacts are genuine. In all probability, they are probes and tests of our defenses and our ability to detect such probes.

"We've got to be able to detect and identify," Thach says, "or else our potential enemies can use their submarine forces to blackmail our weaker allies by pointing to our inability in this area."

Observers—The cabin door is wide open in Task Group Alfa. Since its formation, there has been a continuous stream of some 60 guests from all segments of industry. They have witnessed the operations, seen what the problems are, and are better able to appreciate the task which must be carried out by the naval force.

From such visits as this, Admiral Thach hopes to stimulate an interest in his Task Group. Although his Task Group cannot be an equipment research and development organization, he said he is willing to try out anything offered to fill the present gaps in communications, weapons, detection and identification gear. However, he points out that actual cognizance for such equipment comes under the appropriate bureau, and proposals concerning them should be sent to the proper naval bureau first.

As his Task Group busies itself in its 10,000 square mile training area, always ready to move in any direction to investigate unidentified contacts, Thach considers the 12 million square miles of water that forms the North Atlantic and says:

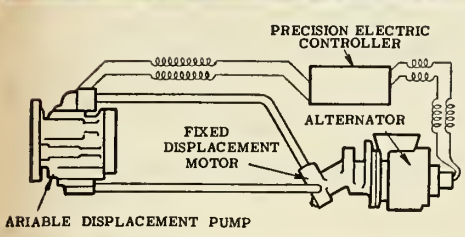
"Everybody is busy looking at satellites. We're like the man worried about the chandelier falling on his head, who then gets the rug pulled out from under him—we need help in nailing down the rug."

New VICKERS building block concept applied to

CONSTANT SPEED DRIVES

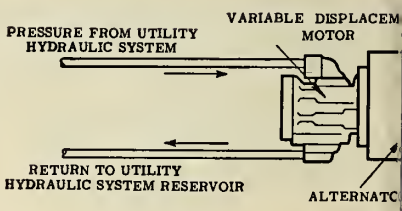
for 400 cycle A.C. electrical systems

1. Unlimited Versatility
2. High Efficiency
3. Fast Delivery
4. Low Cost



Frequency control ± 0.1%. Uses electronic frequency controller to regulate pump displacement. System pressure is function of load.

Frequency control ±0.25%. Uses load sensitive system to match infinitely variable electrical load. System pressure is constant, flow demand is load dependent.



● Using this "building block" construction, Vickers Constant Speed Drives are assembled to exact requirements from the abundance of Vickers standard and proven components. Practically any characteristics you need can be quickly adapted to the existing Vickers product mix. These include:

FREQUENCY CONTROL

± 3% with hydraulic control
± 0.1% with electronic control (or better if desired)

VERSATILITY

1 to 75 hp with standord hardware
Flexibility of pockage shope and location

HIGH EFFICIENCY

Volumetric efficiency of either pumps or hydraulic motors is 96% at 3000 psi. This together with optimum matching of components results in very high system overall efficiency.

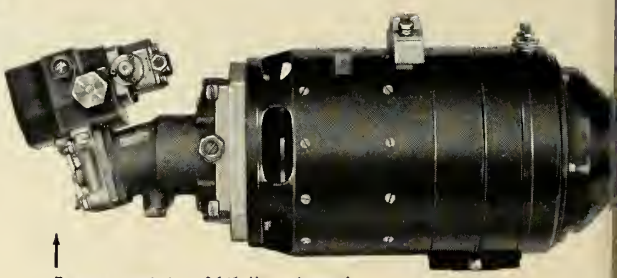
MINIMUM WEIGHT

Significant optimization engineering can be opplied to your system design considerations from similar Vickers application experience.

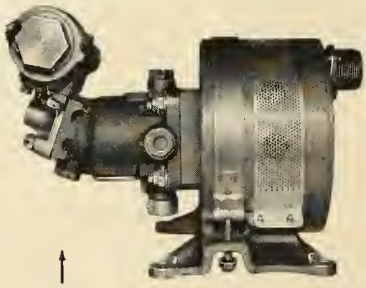
OVERLOAD CAPACITY

Depending upon system requirements, overload capacity of from 120% to 200% can be provided.

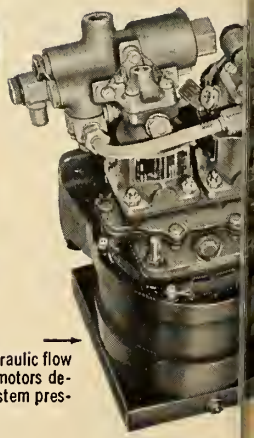
For further information, write for Bulletin SE-100.



Frequency control ± 0.1%. Uses electronic frequency signal to trim hydraulic flow control. System pressure is constant.



Frequency control ± 3%. Uses hydraulic flow control only. System pressure is constant.



Frequency control ± 3%. Uses hydraulic flow control to supply single or dual motors depending upon load variations. System pressure is constant.

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Aero Hydraulics Division—Engineering, Sales and Service Offices:

ADMINISTRATIVE and ENGINEERING CENTER
Department 1470 • Detroit 32, Mich.

TORRANCE, CALIFORNIA
3201 Lomita Blvd. • P.O. Box 2003
Torrance, California

Aero Hydraulics Division District Sales and Service Offices:

Albertson, Long Island, N. Y. • Arlington, Texas

Coal's Place in Space: Rocket Fuels from Tars

Bureau of Mines Studies Hydrocarbon Fractions For Fuels of the Future

Howard W. Wainwright*

An intensive research program to find uses for the hydrocarbon fractions of low-temperature coal tars as high-energy rocket fuels is being conducted by the Bureau of Mines of the Department of the Interior.

This has been made possible by reviving interest in low-temperature (950°)F carbonization of both coking and non-coking coals because of the successful application of fluidized-bed techniques.

Fluidized carbonization offers new commercial markets for coal, and should allow it to play an important role as high energy rocket and jet fuels. However, regardless of the end use of the char, the tar must be utilized profitably before low-temperature carbonization processes can be established commercially.

The Bureau of Mines is researching the characterization and upgrading of tars from both experimental and commercial low-temperature carbonization processes. The hydrocarbon fractions amount to about 60-70% of the whole tar, and consist mainly of polycyclic aromatic and naphthenic compounds.

• **What's needed**—The key requirement for a high-energy fuel is a high heat of combustion, along with good thermal stability. An increase in energy content per unit volume or unit weight of fuel results in increased range and greater speed of the vehicle.

Other characteristics of the fuel that must be considered include freezing point, gravity, distillation range, aromatic and olefinic content, corrosion, smoke volatility index, additives and inhibitors.

However much research must be done before a completely satisfactory fuel is found that meets the stringent requirements of high-performance rocket and jet engines.

• **Solutions suggested**—The Air Force has suggested that "if these fuels are to remain principally in the hydrocarbon class, major inmprovements can be realized by several methods for their respective engines: 1) Selecting a pure hydrocarbon which will satisfy all the . . . requirements. 2) Systematic blending of hydrocarbons to produce a very precisely controlled mixture of known and unvarying composition, 3) Addition of non-hydrocarbon chemicals to hydrocarbon base fuels, and 4) Petroleum-derived chemical fuels."

The last possibility does not preclude the use of coal-derived chemical fuels. It appears that completely hydrogenated polycyclic aromatic hydrocarbons of the type found in coal tar may be desirable for this use.

B. F. Wilkes, of Development Headquarters, U.S. Air Force, told the Western Petroleum Refiners Association: "Widespread press releases about high-energy-exotic-ultra energy fuels have certainly increased public interest in fuels of all types.

"But be reassured the glamorized '20 mule-team' derived fuels, free radicals and ions won't replace, but will only supplement hydrocarbon fuels.

"Even for missiles, hydrocarbon fuels will long be with us. However, the way things change so fast nowadays, I must clarify this paper and state: 'This is good for 1 February 1958 only.' "

• **Research findings**—Bureau of Mines became interested in the possibility of using certain coal-tar fractions as jet and missile fuels through a U.S. patent (2,765,617) assigned to Monsanto Chemical Company.

Gluesenkamp and Kosmin, the inventors, proposed the use of perhydro-

**Chief, low-temperature tar laboratory, U.S. Bureau of Mines, Department of Interior.*

Coal and Missiles—so far, a secondary relationship

It may be hard to visualize, but coal has a place in this nation's space program. The hardware sent into space, and most of the energy that powers these vehicles, come from prosaic holes in the earth.

Coal's first contribution—although an indirect one—is its use as a fuel for generation of electricity. Nearly 70% of the electrical energy generated by utility companies in 1957 was derived from 160 million tons, with a considerable amount of this channeled for use in the production of metals required for the space age. For instance, approximately 32,000 KWL is required to produce a ton of aluminum and a ton of magnesium. Approximately 1,200 KWH are required to liquify a ton of oxygen, and 15-20,000 to liquify a ton of hydrogen.

Coal also will contribute to the production of the "oxidizers"—fluorine and ozone. Approximately 6,000 KWH are required for the production of a ton of fluorine by the electrolytic method.

The fuels of the future may come by using low-temperature coal tar as the raw material. As pointed out in the accompanying article, fully hydrogenated polynuclear hydrocarbons appear desirable because of their high heating values per unit of volume, low viscosity, low vapor pressure, and low pour point. Some of these perhydroaromatics in coal such as decahydronaphthalene—have an advantage over petroleum fuels of the JP-types because of higher heats of combustion per unit of volume. Thus, there are bright possibilities for coal research.

NEW

ASCOP ELECTRONIC COMMUTATORS

Provide Greater Accuracy In Analog Sampling Systems

HIGH ACCURACY: 1% or better input-to-output accuracy for any mixed source impedances up to 25 K ohms, including linearity and offset.

NEGLIGIBLE BACK CURRENT: Maximum 1 microampere back current during channel "off" time.

These and other advantages make solid-state ASCOP Electroplexers® ideal for your data handling systems.

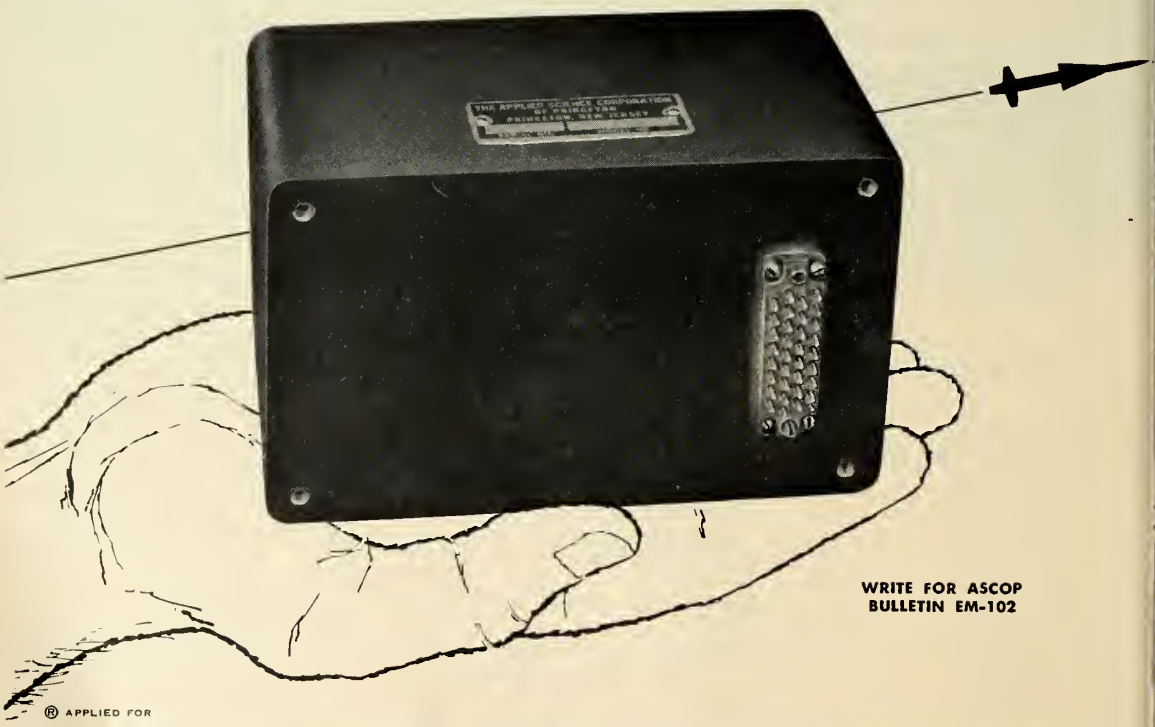
ENVIRONMENTAL EXCELLENCE: Meets MIL-E-5272A specification. Operates from −60°C to +85°C with special packaging available for extreme intermittent temperatures.

STANDARD OPERATION: Time-division multiplexing for 0-5V inputs in all IRIG standard PAM and PDM sampling rates.

INCREASED RELIABILITY: No moving parts. 5,000 hours of maintenance-free life.

LOW POWER CONSUMPTION: Less than 3 watts.

SMALL AND LIGHT: Size, 45 cubic inches; weight 2 pounds (typical).



WRITE FOR ASCOP BULLETIN EM-102

® APPLIED FOR

APPLIED SCIENCE CORPORATION OF PRINCETON

ELECTRO-MECHANICAL DIVISION

GENERAL OFFICES: PRINCETON, NEW JERSEY

DISTRICT OFFICES:

PRINCETON, NEW JERSEY: P. O. Box 44, SWinburne 9-1000
COCOA BEACH, FLORIDA: 1 N. Atlantic Ave., COcoa Beach 3900
VAN NUYS, CALIFORNIA: 15551 Cabrito Rd., STate 2-7030
DALLAS, TEXAS: Exchange Bank & Trust Co. Bldg., Exchange Park, FLeetwood 1-0657

condensed cyclic hydrocarbons as jet fuels. They proposed preparing the starting polycyclic aromatics by high-temperature pyrolytic decomposition of single-ring aromatics, such as benzene and toluene, and to hydrogenate the polycyclic aromatics at temperatures of 100°-250°C. and pressures up to 700 psig in the presence of a nickel catalyst.

One example cited in the patent is a mixture of solid hydrocarbons boiling above 350°C at 760 mm. pressure that was formed in the synthesis of biphenyl by the pyrolysis of benzene. This mixture was hydrogenated in the presence of a nickel catalyst until a product having the following properties was obtained:

Specific gravity at 30°C	About 1.004
Heat of combustion	145,500 B.t.u./gal.
Pour point	+5°C
Flash point	149°C
Flame point	200°C
Distillation range	About 340 to about 396°C

Although this product has a rather high pour point of 5°C, the inventors cite examples in which the pour points are as low as –70°C.

The products are characterized by combination of properties that render them eminently suitable for use as high-energy fuels for aircraft engines, and particularly for turbojet engines. These include:

1) A heat of combustion within the range of 125,000 to 160,000 B.t.u. per gallon.

2) A specific gravity at 30°C. in the range of 0.85 to 1.5.

3) Low vapor pressure or high boiling point.

4) Low viscosity

5) Low pour point.

6) Substantially no sulfur or vanadium compounds.

7) No water.

8) Burn cleanly without substantial formation of solid combustion products.

9) Uniform materials with relatively narrow boiling range.

10) Substantially free from straight-chain and/or branched-chain aliphatic hydrocarbons except when blended with other materials.

11) Substantially non-corrosive.

12) Substantially non-gum forming.

• **Sources**—The inventors point out that the starting polycyclic aromatic hydrocarbons can be obtained from coal-tar or petroleum fractions. They believe that coal-tar stock hydrogenation products would probably have good heats of combustion, but unless carefully selected, would probably have rather high points.

There exists in crude low-temperature coal tar a certain amount of fully hydrogenated polycyclic aromatic hydrocarbons of at least two rings, such as decalin, but the majority of the hydrocarbons present are polycyclic aromatics with varying degrees of saturation and containing up to 7 rings per molecule. These include anthracenes, phenanthrenes, fluoranthenes, pyrenes, chrysenes, benzfluorenes, and many others.

Although polycyclic aromatics have high decomposition temperatures, their use as fuels is unsatisfactory because of excessive carbon deposition upon combustion. Also, the corresponding hydrogenerated derivatives have considerably higher heating values; perhydrofluoranthene, for example, has a heat combustion of 18,130 B.t.u./lb, or 148,450 B.t.u./gal.

An important feature about the composition of low-temperature coal-tar hydrocarbons, insofar as high-energy fuels are concerned, is their high degree of alkylation. Alkylation generally improves the quality of a fuel by lowering its freezing point and viscosity and increasing its heating value per unit weight and per unit volume.

Ring analysis on certain low-temperature coal-tar pitch fractions showed them to consist of heavily alkylated anthracenes and phenanthrenes—the alkyl groups, for the most part, being

. . . coal in space

no larger than the ethyl group.

This alkylation undoubtedly will persist throughout the higher molecular weight hydrocarbons present in low-temperature tar. These alkyl groups will probably be preserved during hydrogenation as alkyl groups, as aromatic nuclei generally are resistant to hydrogenation.

• **Not from petroleum?**—Robert A. Wells of the Gulf Oil Research Center, recently stated that "Unfortunately, with hydrocarbon fuels from petroleum as the B.t.u./gal. increases the B.t.u./-lb. decreases and aircraft range moves along the same lines . . . This condition does not remove hydrocarbon fuels from the realm of high-energy fuels but pretty well rules against hydrocarbons directly from petroleum.

"Fortunately, there are several hydrocarbons which can be synthesized from coal and petroleum chemicals which branch off from this seesaw and yield fuels with both higher B.t.u./gal. and B.t.u./lb." Perhydrofluoranthene, mentioned above, is one of these hydrocarbons.

How successfully can these selected coal-tar fractions be hydrogenated?

Although the Bureau has no experimental results at present, some indication can be obtained from a recent patent of the Coal Tar Research Association in England. This patent is concerned, in part, with improvements in producing fully hydrogenated polynuclear aromatic hydrocarbons from aromatic hydrocarbons, or their partially hydrogenated derivatives, present in coal tar.

The process consists in passing the hydrocarbons in the vapor phase over a hydrogenation catalyst at 20-100 atmospheres partial hydrogen pressure and temperatures of 200-500°C. A tar fraction boiling between 200-280°C. containing mainly napthalene and methyl napthalenes gave a 95% fully hydrogenated product. A fraction of boiling range 300-380°C., consisting mainly of anthracene and phenanthrene, gave a product of 84% fully hydrogenated material.

• **Russians on track**—The literature reveals that a considerable amount of work is being done in Russia on hydrogenating high molecular weight aromatic hydrocarbons from both petroleum and coal tar. Recent work has been done on a hydrocarbon fraction consisting of polycyclic aromatic and naphthenic rings having aliphatic side chains.

The side chains represented, on the average, 47 to 60% of the molecular

ENGINEERS NEEDED IN FLORIDA

MARTIN ORLANDO, newest integrated engineering and production center of The Martin Company, is now in operation at Orlando, Florida.

Immediate and outstanding positions exist in the following areas:

Aero-Thermodynamic Specialist
ME, AE, ChE

Advanced degree desirable, however not necessary, with 3 to 6 years experience in analytical and experimental studies related to aerodynamic heating of Hypersonic Missiles.
This specialist would initiate, plan and execute analyses and experimental studies concerned with boundary layer heat transfer research in continuum, slip, and free-molecule flow.
Development studies will consist of transient temperature calculations on structure and equipment resulting from boundary layer and internal heat sources.

Test Site Supervisors

For static and systems test sites located in Northern Alabama and East and Central Florida.
Will be responsible for the technical direction of instrumentation for the guidance and control systems performance, and for functional systems tests.

Propulsion Specialists

Ability and experience in design and development of solid rocket motors: cases, grain configurations, internal ballistics. Design and development of liquid rocket engines: pump and pressurized, uncooled and regeneratively cooled, propellant thermodynamics injection and heat transfer.

Electronics Specialists

Exceptional opportunities for those electronics engineers talented in the practical and theoretical aspects of electronic warfare systems design. Vacancies for both design engineers who prefer to work essentially alone as well as for group leaders in the design of analog and digital computers, pulse circuitry, display techniques, servo-mechanisms, communications and radar equipment.

Electronic Tooling Specialists

Electronics production test engineers with experience in designing and analyzing production test equipment. Production test group engineers, experienced in production test techniques, such as control systems, guidance systems, and complete missile systems. Detail test design engineers experienced in missile production test equipment and practical application of automatic testing involving all electronics and guidance systems of a missile.

Test Planning Engineers

Experienced in the design of missiles and associated complex electronics and electro-mechanical circuitry.

Test Equipment Standardization Specialists

Experienced in field of electronics test equipment design and standardization of electronic equipment.

SEND RESUMÉ TO: JOHN F. WALLACE
Director of Employment
THE MARTIN COMPANY
P.O. Box 5837,
Section MR-10
Orlando, Florida

. . . coal in space

weight. Hydrogenation converted the aromatics into polycyclic naphthenes containing 4 to 6 rings per molecule. Sixty percent of molecular weight of these polycyclic naphthenes was represented by paraffinic side chains, indicating that the side chains present in the feed material were not removed during the hydrogenation.

• **Sulfur is problem**—It is realized that the hydrogenation of coal tar-derived stocks, or the equivalent hydrogenation feedstocks from aromatic cuts of refinery products, might prove to be somewhat troublesome owing to the presence of sulfur compounds. Also, it might prove difficult to obtain precisely controlled hydrogenated fuels in view of the usual variations in the feedstocks.

There is a strong possibility that the selected coal tar fractions need not be limited to polycyclic aromatic and perhydroaromatic hydrocarbon fractions, but can also incluse mono-and dihydric polycyclic phenols. Laboratory results have showed that the same complexity of structure apparently persists throughout all classes of compounds in the tar, and that if a particular structure is found for one class of compounds, this structure will likely exist in other classes.

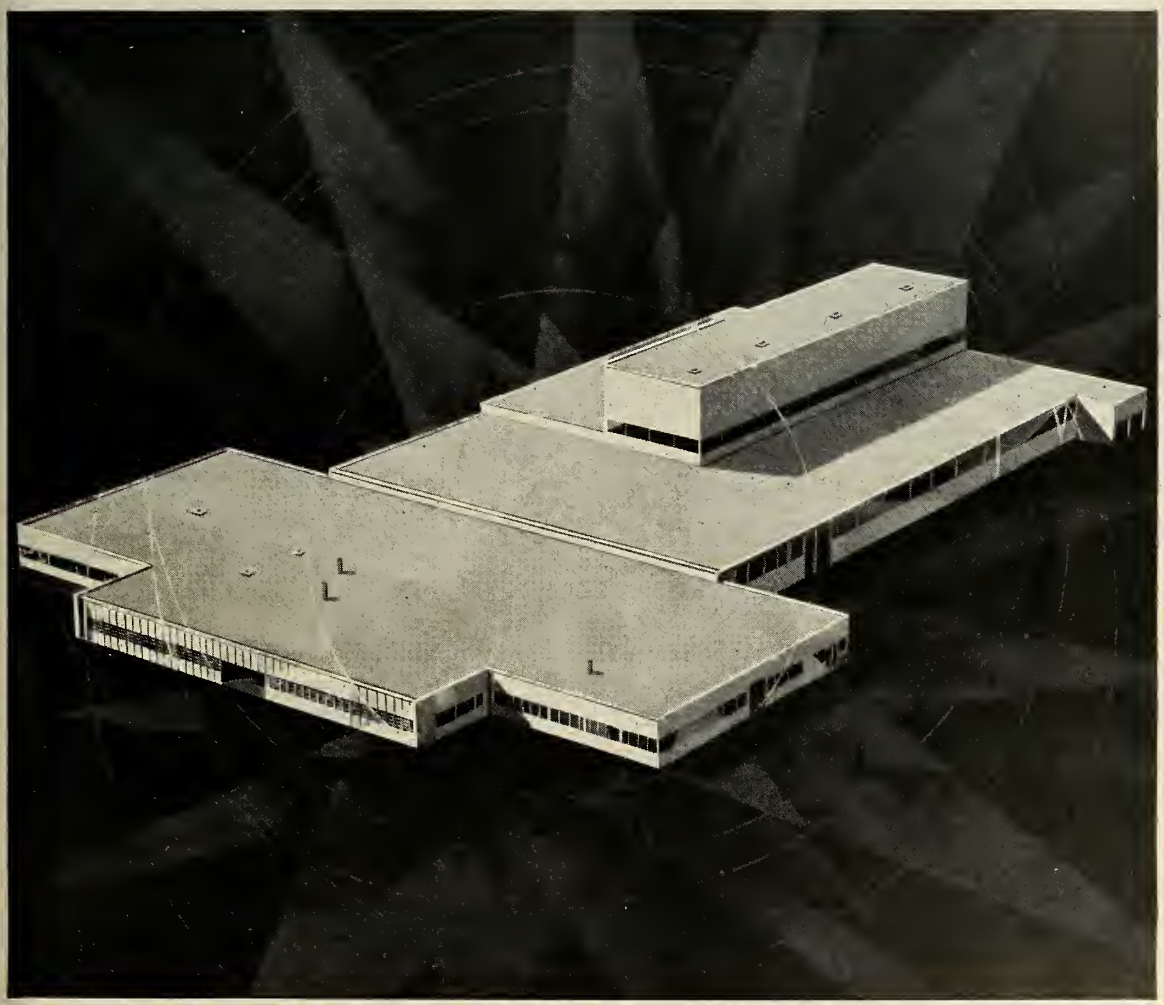
Little is known of the composition of the higher molecular weight phenols in coal tar, but it would appear that if a particular polycyclic aromatic hydrocarbon is present in the tar, the corresponding polycyclic phenol will also be present.

Experimental results have proved the presence of biphenyls and alkylated naphthalenes in low-temperature coal tar. Also, the corresponding alkylated naphthols, such as 2-methyl-1-naphthol and 4-methyl-1-naphthol, and o-and p-phenanthrols, and even higher molecular weight phenols are present.

It may be possible through a one-step hydrogenation process to remove the hydroxyl group from these polycyclic aromatics and simultaneously hydrogenate them to the corresponding perhydroaromatics. The significance of this lies in the fact that, in chemical processing, a class separation between phenolic material and hydrocarbons would not be necessary.

However, much research is needed to prove the feasibility of such a process. Some work on the reduction of polycyclic phenols is reported in the literature. Pelletier and Locke of the Rockefeller Institute have published their work on the reduction of polycyclic phenols to hydrocarbons, and Russian information also is available.

Metals Division of Kelsey-Hayes expands in New Hartford . . . to produce vacuum induction metals for all industry



Capacity: 1 Million Pounds Per Month

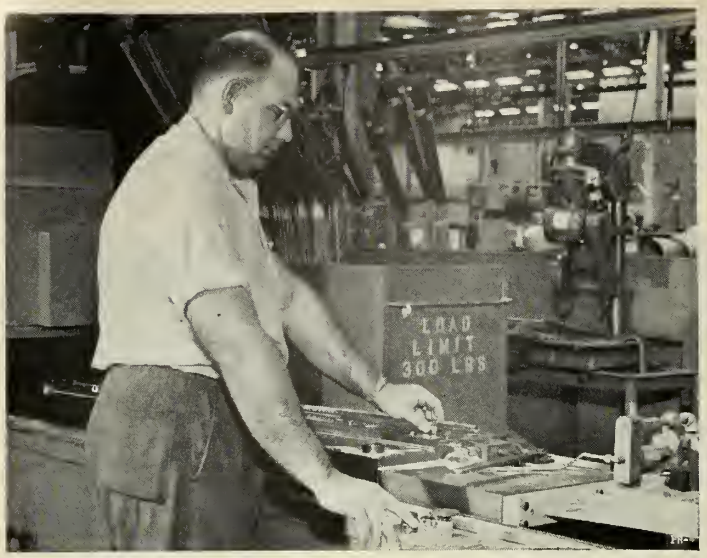
Our new facilities make it possible for all industry to obtain vacuum induction melted alloys on a production tonnage basis—ingot, billet, bar, sheet, strip and wire to specifications. *New areas of application, perhaps in your field, are opening up every day.* For information on the latest developments and technical brochure on new and improved alloys, write Metals Division, Kelsey-Hayes Company, New Hartford, New York.

U DI MET® ALLOYS

METALS DIVISION OF KELSEY-HAYES

SOME ALLOYS COVERED BY U.S. PATENT #2809110

®TRADE MARK REGISTERED



ROUND NICKEL TUBES, .045 in diameter, are pressed into rectangular form.

FORMED TUBES are stacked on mandrel.

Assembly Line Produces Rocket Engines

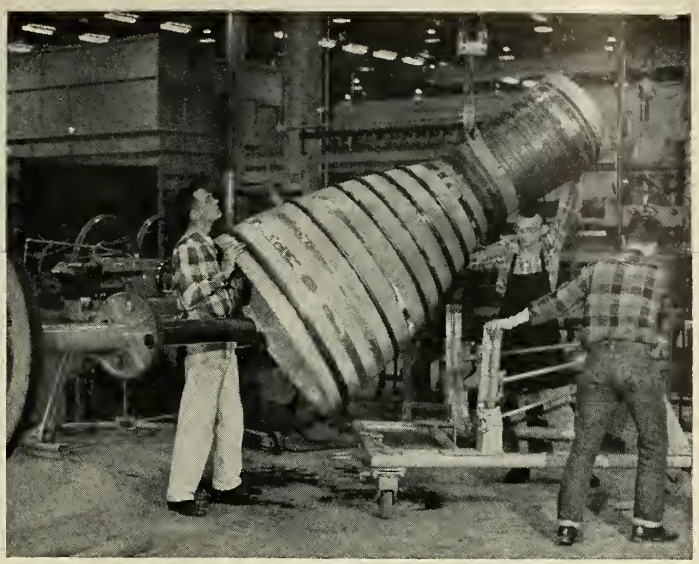
Thin nickel tubes, brazed with solder and held in place with thin steel bands, form the envelope for the United States' largest liquid propellant rocket—in production for *Thor, Thor-Able, Atlas* and *Jupiter*.

by Norman L. Baker

PENETRATION of solder checked by X-ray.

DRILLING OPERATION at manifold end of chamber for attachment of injector.

MOST CRUCIAL operation is tube soldering.



THRUST CHAMBER is mounted on large lathe for manifold preparation.

NEOSHO, Mo.—The Air Force lunar probe attempt of August 17 was started on its way by the first production rocket engine to roll from Rocketdyne-Neosho's assembly lines.

The largest single chamber unit in production in the United States, its status as a mass assembly item represents one of the most radical advancements in missile technology. The technique employed in fabrication is a unique approach to the weight/cooling problem that has plagued engineers for many years.

Although the Neosho engines are being produced for the *Thor* IRBM, similar construction is used on the booster and sustainer engines for the *Atlas* ICBM and the Army-developed *Jupiter* IRBM. Major differences in the engines are in the propellant feed system. Fabrication of the thrust chamber proper is, for all practical purposes, identical.

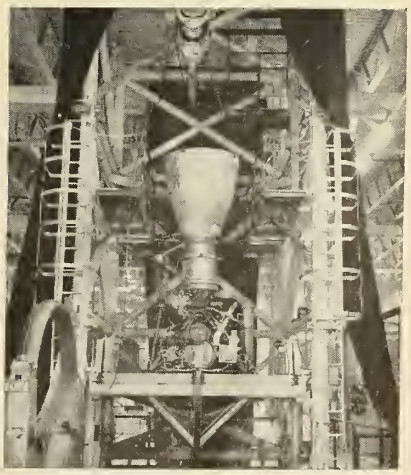
Round nickel tubes, .045 inches in diamcter, form the envelope for the combustion chamber, nozzle and exit area of the thrust chamber. The tubes are changed to rectangular form in a tube press, which not only changes the tubes from straight and round to rectangular, but to the exact cross-sectional contour of the chamber.

After the pressure forming, the tubes (approximately 300) are placed against a torch-weld jig and held in place with steel bands for the welding operation. The tubes are joined in the jig by brazing with silver solder.

Approximately $300 worth of solder is used in this operation. The steel bands holding the tubes in position are welded to the tubes at intervals as reinforcing bands to absorb the stress resulting from the combustion pressure and heat expansion. In the region of the combustion chamber, the reinforcing bands form a solid continuous band.

Following the brazing/welding operation, manifolds are attached to the ends and the injector plate mounted into position. After X-ray examinations, pressure checks and cold flow tests, the thrust chamber is ready for the installation of the main propulsion package of turbo pump, gas generator, main lines.

HOT AIR HEATER dries thrust chamber after cold-flow calibration.



ENGINE in thrust alignment power.

space age

by Norman L. Baker

CETEX Committee—A number of scientists planning for the first landings on the moon have expressed concern unless proper precautions are instituted to prevent undesirable contamination from terrestrial sources. To meet this problem, the International Council of Scientific Unions (ICSU) set up a committee on Contamination by Extra-Terrestrial Exploration, under the auspices of COSPAR (Committee on Space Research), to specify conditions of landing that would keep contamination to acceptable levels. The second lunar probe attempt by the Air Force, anticipating a 25% possibility of impacting the lunar surface, had its payload sterilized with a DDT-type of disinfectant.

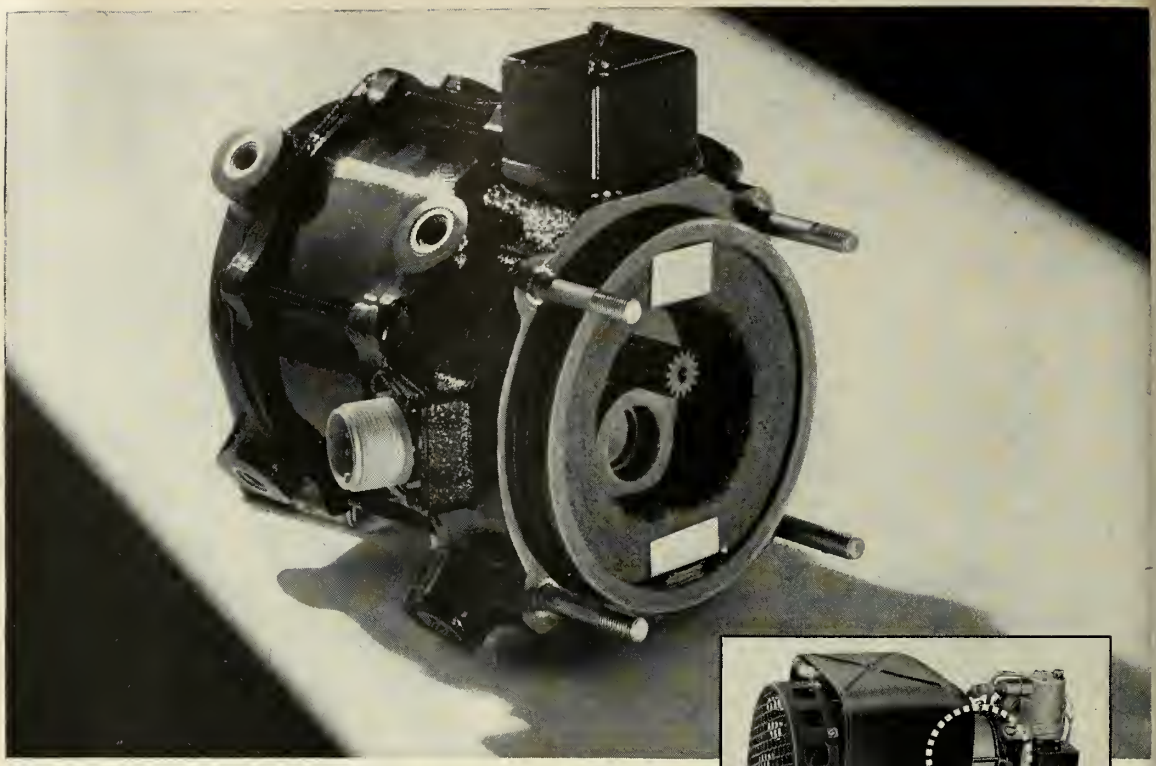
Shades of negligence—The reason for the Air Force's first lunar probe failure has finally been determined. An instrument package, reportedly attached to a frail oil line feeding one of the propellant turbine bearing mounts, produced such severe vibrations during the first stage engine firing that the line separated, starving the bearing of oil. After a few seconds, the bearing froze, either stopping or drastically slowing the turbine until upstream pressure forced a line system to give way.

van Allen Belt major experiment—The first stage engine modification requirement was only a secondary reason for postponing the planned September lunar shoot. The van Allen-Singer recommendation that vertical high altitude probes be made of this radiation belt to determine its limits apparently were recognized by the Air Force lunar team. Their determination to modify the scanner-magnetometer payload, as engineered for the first attempt to include radiation counters, forced an understandable stretch-out of the originally planned program. Main question—is the 40,000 mile line, as theorized by Singer, the limit of the radiation belt or does it continue to an infinite limit in space?

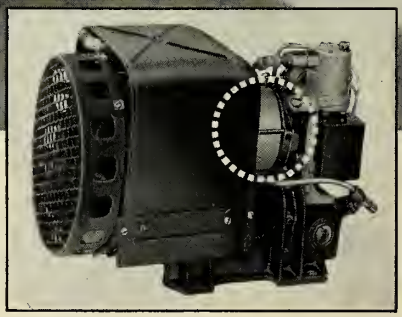
Russia's next move?—Albatoli A. Blagonravov, *Sputnik* scientist, has repeatedly denied that Soviet scientists have experienced failures during their satellite program. If this is a fact, it would indicate a thoroughness of pre-countdown check-out and rocket component reliability not practiced in this country. As for the nearness of the next Soviet space venture, Leonid Sedov alerted us with his statement that unmanned space flights to the Moon, Mars and Venus would be made "within the nearest future." Early in September 1957, the Russians announced they would attempt to launch a satellite in "the near future"—a report American scientists took too lightly.

X-15 apologies—This column erroneously reported Sept. 8 that the Reaction Motors Division of Thiokol was being assisted by North American's Rocketdyne Division in the development of the first X-15 60 k rocket engine. A back-up Rocketdyne engine is under development, but the first engine development was Reaction's. X-15, rolled out on Oct. 15, was equipped with an XLR engine (type used on earlier X-series craft), which will be replaced before first powered flights by the Reaction powerplant.

Silent satellite—*Explorer* IV, with an estimated life of six years, has joined *Explorer* I as space debris. Its second transmitter ceased operating profitably two weeks before the final signal was heard. The signals during the last days of power life were unintelligible, serving only as an aid in tracking. The satellite's original tracking transmitter quit transmitting September 9.



Model E6440-1 exemplifies Airborne capabilities in the design and development of large special motors. Inset shows application on Walter Kidde & Company lightweight compressor package (2.4 scfm, 3000 psi) used for auxiliary pneumatic power on jet tanker.



Phata courtesy Walter Kidde & Company, Inc.

AIRBORNE CAN HELP YOU WITH LARGE SPECIAL-DESIGN MOTORS

Airborne can design and develop almost any type of large special motor you need and supply it in any quantity you require. Evidence of this capability is found not only in current projects, but also in the many different motors developed over the years for use on our own actuators and electromechanical systems.

Typical of the large special motors designed and produced by Airborne is the one above developed for Walter Kidde & Company to power one of its outstanding lightweight compressor packages. Special features include magnesium castings for weight savings; modified high-temperature insulation and lubricants; and a special thermal overload protector (Type C protection) to prevent winding damage at temperatures above 400°F.

Whatever your particular requirements in large special-design motors, it will pay you to consult Airborne. Chances are we can solve your problem in good time and at reasonable cost. Write, phone or wire for more information.

GENERAL ENGINEERING DATA

Airborne Special Design Motor E6440-1

1. 115/200 v a-c, 400 cycle, 3 phase (conforming to MIL-M-7969A)
2. Rated 1.7 hp at 10,900 rpm—10 in-lb full load torque; 25 in-lb starting torque
3. Duty cycle: 30 min. on at full load/30 min. off
4. Ambient temperature: −65 to +165°F
5. Altitude: to 50,000 ft
6. Weight: 8.8 lb

See us at the Aircraft Electrical Society Shaw in Los Angeles

LINEATOR® • ROTORAC® • TRIM TROL® • ROTORETTE® • ANGLgear® ROTOLOK

AIRBORNE®

AIRBORNE ACCESSORIES CORPORATION

HILLSIDE 5, NEW JERSEY

NEW CATALOG SAM-58

Describes Airborne special actuators and motors. Write for a copy today.

Represented in Canada by: WINNETT BOYD LIMITED • 745 Mt. Pleasant Rd., Toronto 12, Ont.

missile business

by Fred S. Hunter

Some years ago, Robert E. Gross almost put together a merger of Lockheed Aircraft Corp. and Hughes Aircraft Co. The late Harold Talbott, then secretary of the Air Force, blocked it. Talbott didn't think it would be good for the government to have a prime contractor operating a major electronics facility turning out components for other prime contractors.

Gross, who thinks in big terms, had gone after Hughes because it had become a big company, making big inroads into the electronic and missile fields. At the same time, Gross felt Lockheed was lagging behind some of the other companies in the industry. Since then, of course, Lockheed has more than caught up by the successful organization of its own Missile Systems division.

But another reason Gross and the Lockheed people liked the idea of buying the Hughes Aircraft Co. was to give Lockheed a ready-made start in electronics and missiles. There was only one stockholder to worry about. Howard Hughes was the sole owner of the Hughes Tool Co. of which the Hughes Aircraft Co., at that time, was a division. Once a price was reached with Howard Hughes only legal formalities would have remained to complete the consolidation of the two companies.

Working out a big merger is an extremely difficult job. There's much more to it than an examination of a couple of financial statements. There are such considerations as location, facilities, labor agreements, management characteristics, workloads and countless legal details. After you settle all these, you start studying the stock structures. And here's where many proposed mergers fall apart. You have to have a deal that fits two sets of stockholders.

Witness the attempts of Whitley C. Collins to bring about a merger that would make Northrop Aircraft bigger and better. He had a consolidation with Vertol Aircraft Corp. all but finalized, only to have to call it off at the last minute because no satisfactory way could be found to mesh the stock structures of the two companies. Recent negotiation with American Bosch Arma ended the same way. The two companies were unable to agree on several points, but the big stumbling block was the exchange of stock.

Gross would still like to bring an electronics company into the Lockheed fold. He has engaged in talks with several companies. Not long ago a financial commentator attributed the strong position of Lockheed's stock to the possibility of a merger with the Hazletine Corp. There also have been reports of talks with Sylvania Electric Corp. Whether anything may materialize from these or any of the conversations Gross may be having elsewhere remains to be seen. But they represent a further illustration of the difficulties that are encountered in trying to bring about a favorable merger when companies of the scope of Northrop or Lockheed are involved.

Company briefs: Polarad Electronics Corp. reports a new peak in sales —$9.6 million—for the fiscal year ended June 30, 1958 . . . **Temco Aircraft Corp.** has arranged to acquire $5 million in capital through first mortgage and 5¼% sinking fund bonds, to finance a new office building and engineering center . . . **Solar Aircraft Co.** announces it is building gas turbine-powered pulse generators, for use by Navy in mine-destroying units for Navy minesweepers . . . **American Welding Society** has issued specifications for low-alloy steel electrodes, insisting, among other matters, that electrodes must now meet chemical as well as mechanical requirements . . . **Lukens Steel Co.** has succeeded in rolling what it calls the widest sheet of high strength steel ever produced, for use in rocket motors. Sheet is 160 in. wide.

ARMY

Ford Instruments Company, Division of the Sperry Rand Corporation, Long Island City, New York, was awarded $1,209,277, details of which are classified.

By Headquarters, Redstone Arsenal, Ala.:

Firestone Tire and Rubber Co., Guided Missile Div., Los Angeles, Calif., received $34,627 for furnishing to the government twenty-four (24) man-months of technical services of full qualified field engineers and services, to be utilized in connection with courses of instruction and programs for training groups of military and other personnel.

Philco Corp., Philadelphia, Pa., received $46,499 for furnishing and supplying manhours of fully qualified technician instructors to the U.S. Army Ordnance Guided Missile School.

By U.S. Army Engineer District, St. Paul, Minn.:

Power Engineering Co., Inc., Sioux City, Iowa, received $46,500 for construction of Anti-Intrusion System for Launcher Boxes, Minneapolis-St. Paul Defense Area.

By San Francisco Ordnance District, Oakland, Calif.:

Lockheed Aircraft Corp., Missile Systems Div., Sunnyvale, Calif., received $58,317 for Missile Borne Television Systems (*Jupiter* Missile Program).

By U.S. Army Ordnance District, Philadelphia:

Douglas Aircraft Co., Inc., Charlotte Ordnance Missile Plant, Charlotte, N.C. received $36,939 for *Nike* Spare Parts and Components.

Douglas Aircraft Co., Inc., Charlotte Ordnance Missile Plant, Charlotte, N.C. received $23,131 for *Nike* Spare Parts Components.

Douglas Aircraft Co., Inc., Ocean Park Blvd., Santa Monica, Calif. received $18,539 for Blue Streak & Emergency Spare Parts.

AIR FORCE

By AFB Cambridge RC, ARD&DC:

Sylvania Electric Products, Inc., Waltham, Mass. received $48,708 for a study of electromagnetic and magneto-hydrodynamic properties of ionized gases associated with high speed missiles.

By Headquarters, AFOSR, AR&DC:

Vitro Laboratories, Div. of Vitro Corp. of America, received $66,111 for research on "Energy Exchange in High Intensity Arc Plasma."

By Oklahoma City Air Material Area, Tinker AFB, Okla.:

Hayes Aircraft Corp. received $28,699 for overhaul and repair of fuel valve assembly.

NAVY

By District Public Works Officer, Sixth Naval District; Charleston, S.C.:

Seth E. Glen and Associates, Memphis, Tenn., received $167,490 for Minitrack Facility, Receiver Site at the Naval Silver Lake Site, Greenville, Miss.

By Bureau of Ships:

Roller Smith, Inc., Newark, N.J., received $334,747 for switchboards for *Terrier* guided missile fire control system.

AIR FORCE

By Air Force Office of Scientific Research:

Vitro Laboratories, Division of Vitro Corp. of America, West Orange, N.J., received $66,111 for research on "Energy Exchange in High Intensity Arc Plasma."

Ohio State University Research Foundation, Columbus, received $49,464 for continuation of research on "Certain Phases of the Interactions Between Electromagnetic Radiation and Matter."

Atlantic Research Corp., Alexandria, Va., received $49,862 for continuation of research on solid propellant combustion.

The Mobile Missile Market

Like a mobile . . . the missile market is made up of separate parts and different elements. Many industries and thousands of companies compose the mobile missile market. Aircraft companies build missile frames and prime systems. Automobile companies manufacture missile systems . . . a cereal company builds missile subsystems.

And like a mobile . . . there is constant movement and change in the missile market. New developments happen fast. That's why missile men in management, engineering, production and procurement need an undiluted missile book to be posted constantly and accurately. Throughout the complex market missile men look to MISSILES AND ROCKETS as the number one missile book.

MISSILES AND ROCKETS

AMERICAN AVIATION PUBLICATIONS, INC.

WORLD'S LARGEST AVIATION PUBLISHERS

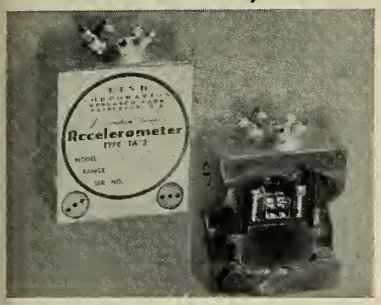
1001 Vermont Avenue, N.W. • Washington 5, D.C.

ABC

ABP

new missile products

Accelerometer Has Low Cost Sensitivity



Lind Corporation, Princeton, N.J. has put on the market the type TA2 accelerometer. The new unit is a seismic mass system which possesses low cross sensitivity by virtue of the high transverse stiffness of the self compensating E springs.

It is totally immersed in a silicone fluid with a viscosity selected to provide a damping ratio of 0.65. Volumetric changes in the oil with temperature rise are compensated by expansion chambers in the case. This allows an operating temperature range from -40°C to +100°C. Dual pots are provided for high level, redundant output. According to Lind, life tests reveal that units can stand 10 million reversals without affecting calibration.

Circle No. 231 on Subscriber Service Card.

Transfer Digital Circuits In Two Packages

The Components Division of Epsco, Inc., Boston, Mass., has placed on the market a complete line of transistor digital circuits in two package styles and three temperature ranges.

Package Style A is for mounting in 9 and 14 pin miniature tube sockets. Package Style B is for 15 pin in-line mounting. The three available temperature ranges are: -10° to +60°C, -10° to +71°C, -55° to +71°C. The circuits are designed for 100 KC operation, but permit operation up to 200 KC, and in some cases, up to 400 KC. A duplicate line of one megacycle circuits is being engineered.

Available circuits are flip-flops and counters, diode and gates, diode or gates, nor gates, parallel gates, cascade gates, inverter amplifiers, non-inverting amplifiers, emitter followers, power drivers, one shot delays, pulse shapers, level converters, neon indicators, incandescent indicators, blocking oscillators, level shapers, 6, 12, 18 volt power supplies, and clock pulse generators (O-250C).

Circle No. 237 on Subscriber Service Card.

Disconnect Coupling Stands 22,000 psi

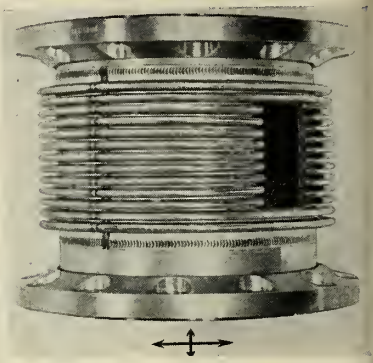
A new quick disconnect coupling for hydraulic and fuel lines in missiles which withstood 22,000 psi in a burst test, is in production at **On Mark Couplings, Inc.,** Los Angeles. Designated On Mark Type 5-5002-8, the new coupling may be connected and disconnected manually under high pressure through the elimination of commonly used steel balls and "dogs" which avoids inherent difficulties such as Brinell type indentures in the retainer seat. Remotely actuated couplings of this new design are also available.

Even under high pressure this coupling may be connected simply by pushing the halves together, and disconnected without effort by pulling back on the actuating ring, with practically no loss of fluid. Locking mechanism is smooth and positive, will compensate itself as wear occurs, which assures utmost in reliability and long life since a full 360° gripping action is used. End fitting may be altered to suit various applications.

Circle No. 242 on Subscriber Service Card.

. . . new products

Flexible Connector Reduces Turbulent Flow



A new lined flexible connector has been designed by **Flexonics Corporation** for ducting systems of missiles and advanced aircraft. The lined connector greatly reduces turbulence and pressure drop through the flexible elements of the ducting system where turbulence of an undesirable degree was often set up in conventional flex sections.

The liner is an especially designed interlocked flexible tube, formed of stainless steel strip. The interlocking convolutions are an axial motion for which the connector is designed. The liner is relieved so that the corrugated element is the sole pressure carrier.

The lined flexible connector has proved especially useful in liquid oxygen systems, where it cuts turbulence and prevents cavitation in centrifugal pumps. It has also proved effective in pneumatic power piping, where it helps designers by eliminating some of the variables that result from pressure drop.

Circle No. 234 on Subscriber Service Card.

Kearfott Producing Miniature Servo Valves

Kearfott Co., Inc., Clifton, N.J., has in production miniature lightweight servo valves which, according to the manufacturer, by virtue of a totally new approach in the design of electrohydraulic feedback amplification has resulted in a servo valve having only two moving parts—the spool and the torque motor armature.

The new units are designed so that clogging and silting are effectively prevented through use of oversize orifices which also permit operation even with highly contaminated fluids. In addition to high frequency response, these units also exhibit minimum null shift.

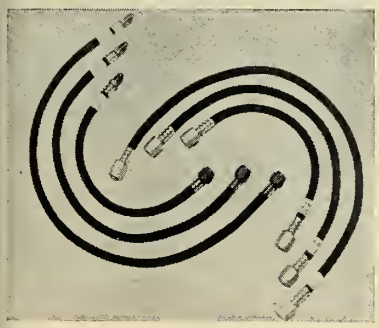
Employment of unity hydraulic feedback eliminates springs, and com-

pensates for pressure and temperature variations. Inherent unity feedback of spool position also reduces sensitivity to load, pressure, and vibration. Since control ports of these servo valves are of closed center design, quiescent flow is low, thus reducing pump requirements.

High flow rates are possible, ranging from O-2, O-5, and O-10 gpm at a supply pressure of 3000 psi. Supply pressures range from 500 to 3000 psi. The standard motor is a permanent magnet DC type. The four-way is free floating, accurately matched to its sleeve, and has inherent dither which acts directly upon it. The driving amplifier is somewhat simpler, since a dither signal need not be supplied.

Circle No. 240 on Subscriber Service Card.

Specialized Hose Assemblies for Missiles



Zep Aero of El Segundo, Calif., announces a new nylon covered tygon hose assemblies with An, MS, or special fittings. These hose assemblies are for use with oxygen and special corrosive fluids and gasses, burst pressures to 2000 P.S.I. and temperature range from —68 to +215°F. They are lightweight with extreme flexibility yet allowing minimum bend radius without collapsing—excellent shelf life far surpasses rubber compositions.

Circle No. 235 on Subscriber Service Card.

Sylvania Adds Ka-band Magnetrons for Missiles

Three new Ka-band magnetrons rugged enough for missile applications have been developed by **Sylvania Electric Products, Inc.**

The new tubes bring to five the number of magnetrons for Ka-band (33-36 kilomegacycles frequency) applications available from Sylvania. The new types—M4063 and M4155—plus the earlier 5789 and 6799, cover a power range from 20 to 100 kilowatts.

These tubes, developed at Sylva-

. . . new products

nia's Special Tube Operations plant in Williamsport, Pa., are used for radar equipment requiring very high resolution. As the source of the pulsed outgoing signal, they are the "heart" of a radar set.

Typical applications of the new tubes are in cloud-finding, mapping, and missile guidance equipment, according to the manufacturer. The 20-kilowatt M4063 weighs only nine pounds, while the 70-kilowatt type M4064 weighs 13 pounds. Between these is the 11-pound M4155, a ruggedized version of the 5789, with a rated peak output power of 40 kilowatts.

Circle No. 236 on Subscriber Service Card.

Vernistat Potentiometer Made By Perkin-Elmer

A new miniaturized version of the precision Vernistat a.c. potentiometer has been developed by the **Vernistat Division of the Perkin-Elmer Corp.,** Norwalk, Connecticut.

The Series 4 Vernistat potentiometers are size 11 components (1.062-inch diameter, with a weight of only two ounces. They are available with maximum output impedances of 200, 100, and 40 ohms, combined with high input impedance, and low output quadrature. Minimum output voltage increment (resolution) is 0.01% and terminal linearity is 0.05%.

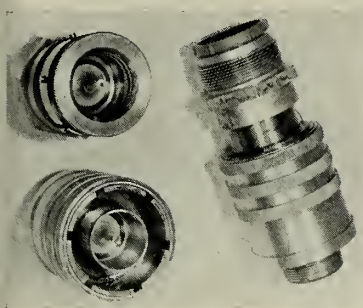
The Series 4 also can be produced in nonlinear versions with 30-chord accuracy.

The new series operates in essentially the same manner as the Series 1 and 2 Vernistat potentiometers, and according to manufacturer combines the best features of a multiturn interpolating potentiometer with a precision multi-tapped autotransformer, for relating mechanical shaft rotation to a voltage. Applications for the Vernistat are found in servo systems, control systems, and analog computers. Among the military systems in which it is currently being used is the *Atlas.*

Circle No. 232 on Subscriber Service Card.

. . . new products

Quick-Disconnect Unit For High Pressures



A high temperature (+400°F), high pressure (3,000 PSI), self sealing quick disconnect coupling has been developed by **Arkwin Industries, Inc.,** for use with hydraulic fluids such as OS-45, Oronite 8515, and MIL-H-5606A oil.

The unit is said to be capable of operation in a temperaure range of –65°F (54°C) to 400°F (+204°C). Two classes of Tpye III system quick disconnect couplings are available according to the company:

A. Class 600-Six hundred PSI rated pressure furnished in 1¼, 1½, and 2 inch tube sizes.

B. Class 3,000-Three thousand PSI rated pressure furnished in ¼, 3/8, ½, ¾, and 1 inch tube sizes.

When MIL-L-7808 synthetic oil is used, the quick disconnect coupling conforms to Military Specification MIL-C-7413A (USAF) dated 5 October 1955 and is for use in Type I and Type II systems (low pressure to 600 PSI).

Circle No. 225 on Subscriber Service Card.

Phase Angle Voltmeter Fills Many *Atlas* Needs

A multi-functional Phase Angle Voltmeter, designed and manufactured by **North Atlantic Industries, Inc.** fulfills a prime function in the *Atlas* program. This unique instrument, designed also for phase-sensitive null indication, as a ratiometer for zeroing and testing precision synchros, servomechanisms and transducers, is used to align highly critical control equipment in the *Atlas*.

North Atlantic is a prime supplier of high precision phase sensitive voltmeters to the electronics and missile industries for precision nulling and alignment of control systems, direct reading of in-phase and quadrature voltages, phase angles plus a wide range of other applications in diversified fields.

Circle No. 226 on Subscriber Service Card.


from any point of view
CON

DIESEL IS GROUND SUPPORT

TEST
SERVICE
LAUNCH
HANDLING
DATA PROCESSING
POWER SUPPLY

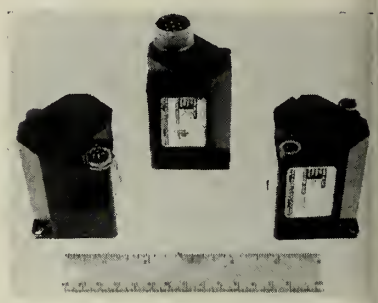
ore than half the brains and cash invested in missiles goes into **missile support.** Both missiles and aircraft ommand the most precise ... advanced technological experience available. Such broad experience can only be cquired through a consolidated background in the many complex areas of Ground Support. This has been Con- olidated's endeavor ... for over a decade. The unique is the usual at Condiesel. Our experimental, development, nd scientific staff is anxious to study your problems and offer a sound economic solution.

CONSOLIDATED DIESEL ELECTRIC CORPORATION

IRCRAFT EQUIPMENT DIVISION, Stamford, Conn. • POWER EQUIPMENT DIVISION, Stamford, Conn.
EST EQUIPMENT DIVISION, Stamford, Conn. • CONSOLIDATED AVIONICS, Westbury, L. I., N. Y.
ONSOLIDATED CONTROLS CORP., Bethel, Conn. • LIMA ELECTRIC MOTOR CO., Lima, Ohio
ONDIESEL WESTERN, Inglewood, Calif. • C.D.E.C., Rexdale, Toronto, Ontario

. . . new products

Floated Rate Gyros Withstand Heavy Shock



Floated rate gyroscopes capable of withstanding 150 g shock or acceleration are being built by the **Garrett Corporation's** AiResearch manufacturing division, Phoenix, Arizona.

The rugged units, designed for maximum versatility, operate from either direct, or one, two or three phase alternating current. Regulated or unregulated voltage from 350 to 2500 cycles per second can be used for the AC power supply.

The 210 Series gyros are of completely floated gimbal construction. Damping is held nearly constant over an ambient operating range of minus 67° to plus 165°F. This is accomplished by use of silicone oil flotation together with a special variable gap ring and cam design, rather than with vibration-prone rate springs.

A typical gyro weighs less than a pound and measures 2 1/8 inches square by 3½ inches long. With extreme accuracy the unit will withstand sustained 75 g acceleration in any axis and absorb twice that force without damage.

Under severe environmental conditions, operating life of the new AiResearch gyros ranges from slightly over 150 hours for the DC units to more than 1000 for the AC models.

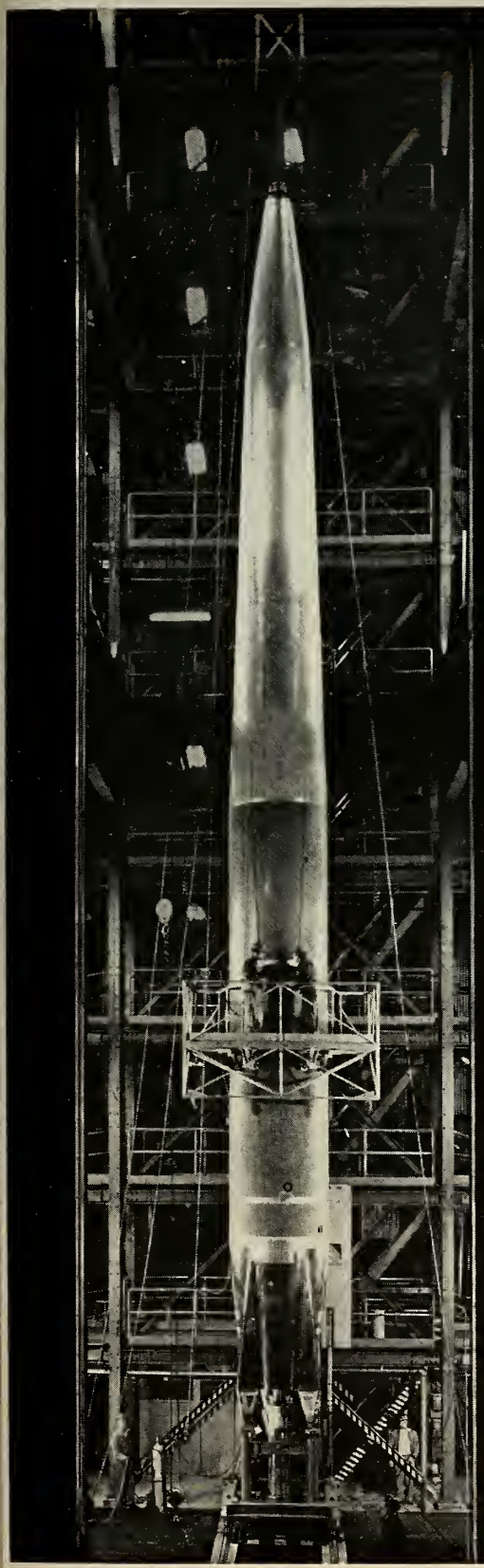
Circle No. 227 on Subscriber Service Card.

Tantalum Capacitors Provide Broad Range

A new line of tantalum capacitors made by **P. R. Mallory & Co. Inc.,** designated the TAP2 series, provides a broad range of ratings.

Only 0.226″ in diameter and 0.625″ long, the TAP2 capacitors come in ratings covering the range from 140 mfd., 6 VDC to 11mfd., 90 VDC. They are rated for ambient temperatures from −55° to +85°C, and will meet the 2000 cycle, 20G vibration requirements of specification MIL-C-3965B.

Circle No. 228 on Subscriber Service Card.



No other missile test lab can do all the things we can do

Take our 100-foot test tower. With it we can simulate the pressure and aerodynamic loadings that occur during the actual launching and flight of a missile.

This is just one of the many specialized facilities and tools that we have built up in the last ten years. During this decade—because of our complete responsibility for the development of a major weapon system—we have also piled up a wealth of experience in many related fields.

The upshot of this is that we can handle any project from far-out basic research to static and dynamic testing of complete airframes.

For example, we can simulate aerodynamic heating and loading at the same time...on a complete wing or a large section of fuselage. We're old hands at applying heat gradients from leading to trailing edge and spanwise. And we are equipped to compute temperature differentials, and to predict specific area temperatures.

We're completely qualified to work with any kind of metals or nonmetals; materials and processes; electrical, hydraulic and pneumatic components and systems; structures; reliability; environmental testing (including re-entry); and instrumentation.

Now we'd like to solve your problems. The tougher the better.

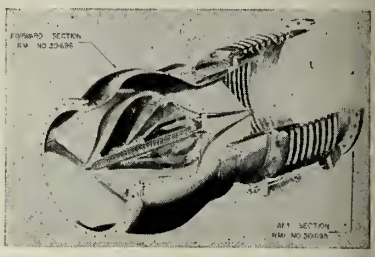
Please write to E. R. Schenkel, Missile Division Test Lab Manager, North American Aviation, 12214 Lakewood Blvd., Downey, Calif.

MISSILE DEVELOPMENT DIVISION

North American Aviation, Inc.

. . . new products

Check-Disconnect Unit Has High Flow Rate



A combination check valve and quick-disconnect unit for cryogenic (–300°F), corrosive or conventional fluid service, has high flow rates, up to 6,500 GPM of liquid oxygen at 70 psi. Maximum pressure drop, through three and a half foot unit length, is less than 4 psi, and has been developed by **Reaction Motors** division of Thiokol.

Extreme light weight results from use of brazed and welded, spun sheet metal construction. The largest current unit, 11-inch line size, weighs less than 50 lb.

The fore section can be used alone as a check valve. In certain applications fluid flows in either direction and the check valve comes into play only after valve and nozzle sections have separated.

This flight qualified item meets rigid leakage requirements for critical missile applications. Special features can be incorporated into the valve to meet operational requirements. Other size units can be provided.

Circle No. 229 on Subscriber Service Card.

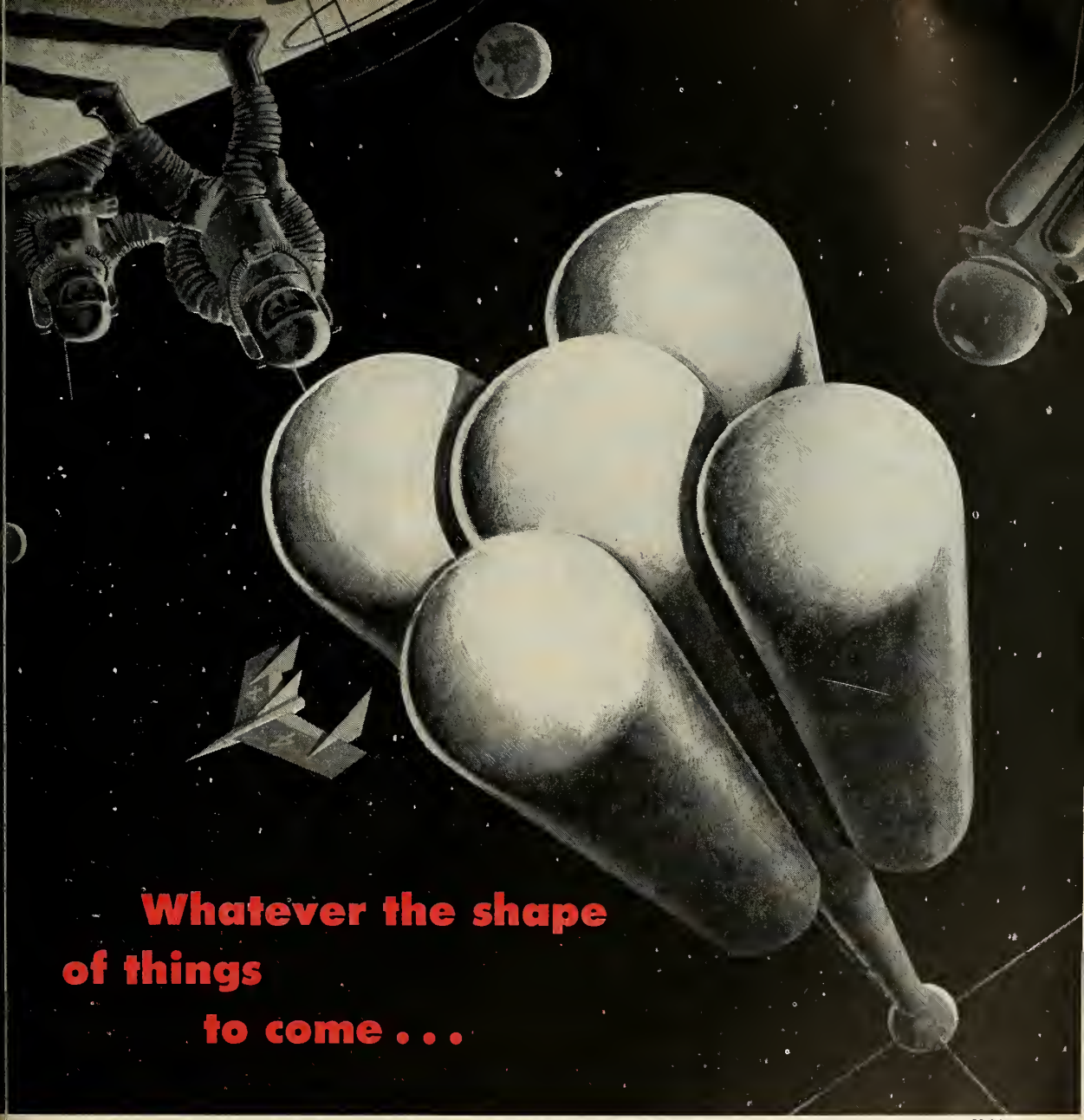
Cavity Filter Covers Wide Frequency Range

A cast-aluminum Tunable UHF Cavity Filter has been developed by **Adams-Russell Company, Inc.** of Cambridge, Mass. The filter is silver plated for low loss and pressure-tight to prevent the entrance of moisture and dust.

The Model 210 covers the frequency range of 200-420 Mc and has a power rating of 300 watts C.W. This filter provides: reduced interference between adjacent transmitter-receivers operating in same location; preselection for receivers with reduced images and other spurious responses; reduced harmonic radiation from transmitters, (40 db typical for second harmonic); and the capability to multiplex several receivers or transmitters into a common antenna.

Specifications include: Insertion Loss: Approx. 0.5 db; "Q" Factor: Approx. 150; VSWR 1.3.

Circle No. 230 on Subscriber Service Card.



58-16

Fantastic shapes for the space vehicles of the future already are on the boards. Even more radical designs are taking form in the minds of engineers. And their parts and components will just as radically differ from those produced today. New standards of precision and new methods of working new materials will be required.

One thing at least is certain: the same design, development and manufacturing experience which made the transition from aircraft piston engines to jets will be needed to produce these shapes of the future. Since the early 1920's, Ex-Cell-O has been among the major suppliers of machines, parts and assemblies to the aircraft industry. In that time it has built a reputation for extending the frontiers of precision.

Today, Ex-Cell-O manufactures such components as: rotors, blades, fuel nozzles, actuators, valves and fuel controls. Tomorrow? Well, perhaps you yourself have a problem which Ex-Cell-O's long experience in the production of precision controls and assemblies might help you solve. If so, why not contact Ex-Cell-O today?

EX-CELL-O FOR PRECISION XLO

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

Circle No. 56 on Subscriber Service Card.

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O.

soviet affairs

by Dr. Albert Parry

While Soviet scientists on the whole are friendly toward their American counterparts, the Soviet government doesn't like this warm interest. Khrushchev is rather suspicious of the pro-Western feelings sometimes displayed by Russian experts of astrophysics and astronautics.

To make sure that Red rocketry will not become a nest of opposition to the Communist Party through too much fraternization with the West, Khrushchev resorts to some noteworthy measures. Increasingly he puts into Russia's rocket and missile laboratories young men from the families of his most trusted Communist henchmen. Recently Khrushchev revealed that he placed his own young son to work in Russian rocketry.

Khrushchev also tries to counteract his scientists' friendly attitude toward Western scientists by ordering his press to keep up attacks against the latter. Typical of such stepped-up onslaughts is an article in the Moscow TRUD by Y. Kornilov aimed at Andrew G. Haley, President of International Astronautics Federation and his alleged remarks on efforts to shoot rockets to the moon.

Kornilov quotes Haley as saying: "Guard the moon! Otherwise the Russians will surely try to annex that unprotected planet. We know these Reds: yesterday it was rockets with them, today it's *Sputniks*, but tomorrow —look out!—they will land their agitators on the moon . . ."

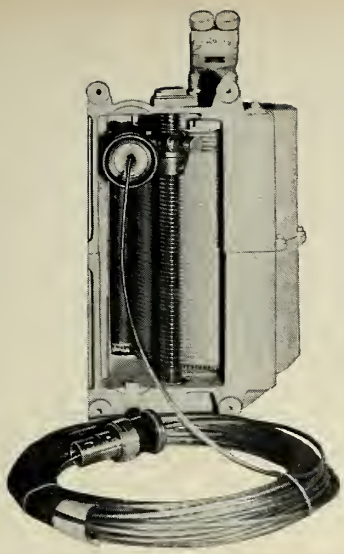
Haley is further quoted by the writer as declaring that should Russia hurl a rocket to the moon and use this as her basis for territorial claims, international tensions would greatly increase and "he would be glad if the Russians would specifically assure him that they have no claims on the moon's territory."

The Moscow journalist asks this question: "Why is Mr. Haley so worried about the fate of that distant planet?" Kornilov solves his own puzzle:

"The reasons are plain. Time was when Americans noisily advertised their future satellite of the earth. But the first *Sputnik* flew into cosmos from the USSR, not from America. A short while ago much hullabaloo was raised in the USA around a rocket to be launched to the moon. One enterprising firm even organized a sale of lots on the moon—at one dollar per lot. However, Americans have not succeeded in reaching the moon. And now Haley, taught by bitter experience, apparently is worried by the possibility that the lots for which those credulous Americans have already paid their money would wind up in Russian hands . . ."

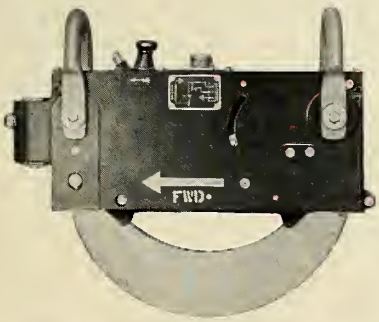
"Haley and his masters are accustomed to view everything from the standpoint of annexation and expansion. And even when the talk is about the moon, they are interested not so much in science as in the problem of who will be the first to grab the territory of that planet."

The attack in the Moscow TRUD is accompanied by a cartoon showing an American policeman wearing eyeglasses with a sour expression and walking the earth on stilts made of dollar signs while raising his threatening billy against the background of the moon. A sign, hanging from the moon, reads: "It is forbidden to land on the moon." The moon's face has a look of painful dismay at such Yankee "imperialism."

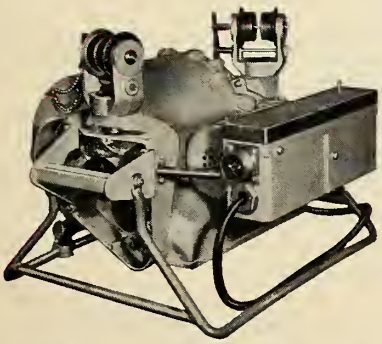


Rescue Haist, 600 lb. capacity; hydraulic matar drive winch; 100 ft. cable, 100 ft. per minute rate. Weight, 51 lbs.

Precision Hoists by BREEZE



Carga Haak, 10,000 lb. capacity; 26 volts, D.C. Automatic tauchdawn feature apens haak to release laad at tauch; also manual release.



Carga Winch Assembly, 2,000 lb. capacity; 28 volt electric matar and gear train. Overlaad clutch; 50 ft. cable, speed 10 ft. per minute.

For many years Breeze design and engineering of special purpose hoists and winches has consistently kept pace with the swiftly advancing world of aircraft design. Whether you require a hoist for rescue work, cargo handling, stores handling, ground support or other functions, Breeze has the right model, designed for specific applications, or can build it to your requirements.

Get in touch with our engineering specialists. Write for detailed literature concerning any of the units listed here or other data on hoists.

BREEZE MARK

BREEZE

CORPORATIONS, INC.

BREEZE CORPORATIONS INC., 700 LIBERTY AVE., UNION, NEW JERSEY

Academician Leonid Sedov gave these figures at the Fifth Assembly of the IGY body in Moscow: *Sputnik* I resulted in 60,000 measurements on the basis of radio tracking and 400 measurements based on visual observation. For *Sputnik* II, such measurements were 12,800 and 2,000 respectively; while for *Sputnik* III (up to July 7, 1958) they were 52,750 and 2,000 respectively.

"Super-precise" tracking of *Sputnik* III is being done by the Alma-Ata Mountain Observatory of the Astrophysical Institute of the Soviet Kazakhstan Academy of Sciences, with the aid of what is described by the Russians as a special meniscus telescope of the Maksutov System. It is equipped with a printing chronograph, a special oscillograph, and a quartzitic generator. The resulting photographs fix the *Sputnik* track with an extraordinary exactitude in relation to the stars at each given moment. These photographs are then sent to the Moscow offices of the IGY.

The lifetime predicted by Soviet scientists for *Sputnik* III is not less than 500 days from the day of its launching (May 15, 1958). Its carrier rocket will last about six months from the moment of its orbiting. This compares with 94 days of the existence of *Sputnik* I and the 60 days of its carrier rocket.

Ultra-short radio waves, reflected by meteorite traces, can be utilized for man's radio communications over long distances. So declares A. L. Mints, a corresponding member of the Soviet Academy of Sciences. He maintains that a method of such communication has already been worked out, but admits he does not know how practical it may prove.

He also asserts that, instead of using meteorite-trace radio waves, a radio-wave reflecting "mirror" can be created artificially "high in the sky" by shooting a rocket into the upper reaches of the atmosphere. The rocket, at the highest point of its trajectory, releases—as dust—a quantity of metallic potassium.

The resulting cloud of the thinnest possible powder becomes ionized under the effect of sun rays, and acquires its capacity of reflecting radio waves—thus replacing the meteorite traces. Such a cloud can last 45 minutes and may be used for radio communication for longer periods than without the aid of the artificial "mirror" made by the potassium-sprinkling rocket.

Eight different postage stamps honoring the *Sputniks* have so far been issued by the Soviet government. Pictures of the *Sputniks* have also been placed on Soviet postal envelopes. The Communist governments of East Germany, Czechoslovakia, and Rumania have also honored the Russian *Sputniks* with postage stamps.

The Soviet Union continues its far-flung and feverish search for new minerals and metals to use in the atomic and missile age. P. Y. Antropov, minister of geology and conservation of ores of the USSR, states that this year more than 5,000 scientific expeditions, with a total personnel of nearly 290,000 men and women, are out in the field all over the country engaged in this search.

The future lunar city to be built by the Soviets, once Red rockets reach the Moon, will utilize the Moon's caves rather than its well-known craters. This is stated by Alexander Shternfeld, the celebrated Soviet astrophysicist. He also suggests digging tunnels on the Moon, at the depth of 15 to 18 meters, to reach underground levels where "vacillations of temperature are already insignificant."

Shternfeld proposes protection of such underground lunar cities by a system of inner doors and partitions, also of "tambours," or circular frames, each of two hoops, one fitting into the other. These "tambours" are to be made of sheet iron covered with a coat of silver, and, "yet better—of glass yarn impenetrable by air."

The next *Sputnik* may be the brightest celestial body, next to the Moon. Such are the latest plans of Soviet experts who are working on the ways and means of illuminating *Sputnik* IV when it is launched and orbited, and keeping it brightly lighted for most, if not all, of its existence.

International cooperation of scientists is once again being strongly advocated in the Soviet press. PRAVDA and IZVESTIA have published numerous editorials on the subject, which has been repeated time and again during the IGY and especially during the recent conference in Moscow. The editorials point out that 32 prominent scientists were among those chosen for membership in the Academy of Sciences of the USSR and that 514 delegations of the Academy visited 44 other countries. In addition, during 1957, 139 delega-

tions of the Academy participated in the work of 62 international congresses.

The relations between scientists of the Soviet Union and "other Socialist countries" and their strong creative friendship are inspiring examples for the scientists of all the world, according to PRAVDA. The Soviet newspapers say that it is not accidental that Moscow was chosen as the site of three great international conferences. The international conference of architects, the regularly scheduled assembly of CSAGI (Special Committee for the International Geophysical Year), and the Tenth International Conference of Astronomers were all held in Moscow.

Photographic observations of Soviet satellites are being carried out in the USSR with the aid of the 50 cm. Maksutov Meniscus telescope, resulting in an accuracy of ±2″ and $0^s.001$ of coordinates and time, respectively. Various methods of making such observations of satellites were tested at the mountain observatory of the Astrophysics Institute of the Academy of Sciences of the Kazakh Soviet Socialist Republic.

A small, wide-angle, fast camera is used for the purpose, including a camera with a "Sapphire Boyet" objective which was used for observing the carrier rocket of *Sputnik* I. More attention has been given, however, to the organization of more accurate *Sputnik* observations by means of an adequately equipped meniscus telescope of Maksutov design (D=50 cm, F=120 cm).

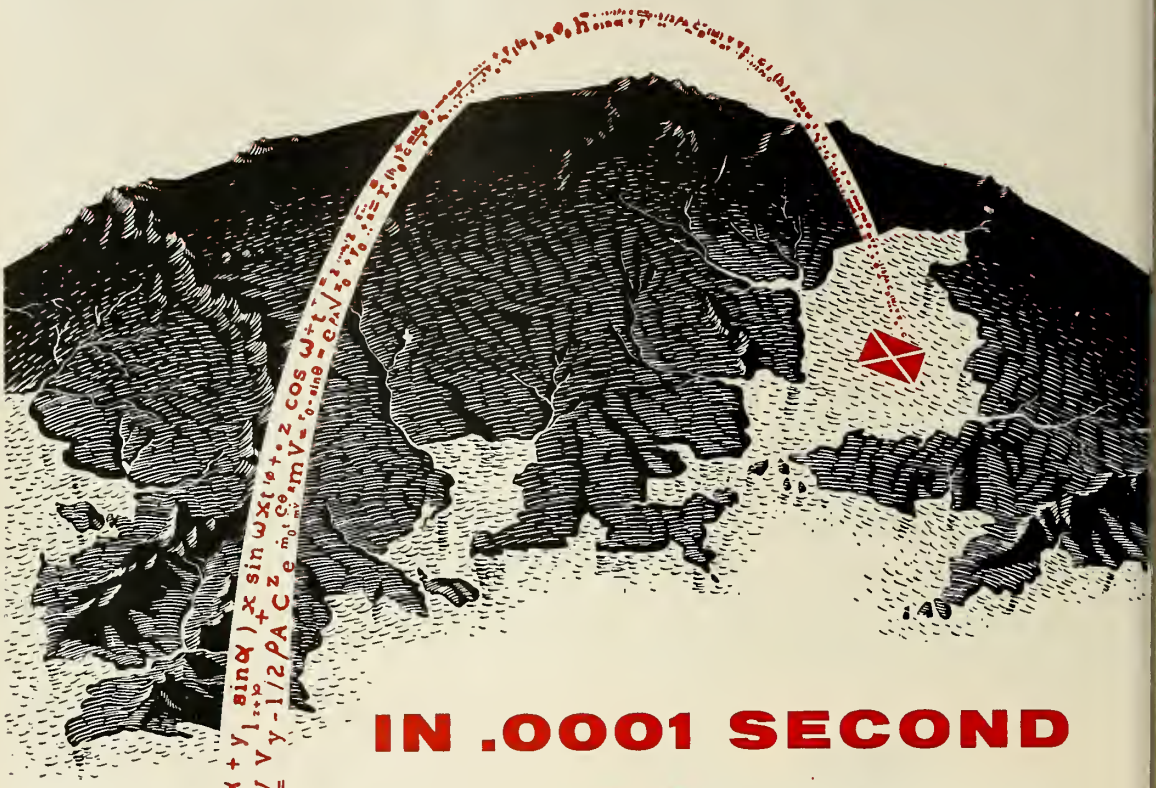
The Purple Mountain Astronomical Observatory, located on a mountain a few miles east of Nanking, China, houses the largest telescope presently used in China. Situated 875 feet above sea level, the observatory has at least four domes, the largest being a little over 26 feet in diameter. The Red Chinese government claims that prior to "liberation", there were only ten workers at this observatory. Now there are more than a hundred. Facilities of the installation include an astronomical clock accurate to thousandths of a second; an observatory without a dome, but with a long narrow roof opening on a north-south line for observing star transits of the meridian; and electrically operated calculating machines.

Three types of propulsion have been advanced by Soviet scientists as the only practicable methods for creating thrust in outer space. According to R. G. Perelman, Candidate of Technical Sciences, these systems are Ion, Nuclear and Quantum. Ion rockets are stated to be best, and credit for their creation is given to K. E. Tsiolkovsky.

Satellite computing equipment has been the center of recent enigmas concerning Soviet capabilities in this field. Dr. Fred Whipple, head of the Smithsonian Astrophysical Observatory at Cambridge, was reportedly quite annoyed at Soviet failure to release any information on their tracking and computing methods. The Soviet scientists with whom Whipple dealt were even reluctant to explain why the American delegation could not see any of the equipment or installations. There never has been any real information available on the methods used. General statements are available, such as that dealing with telescopes, but nothing on computing equipment.

It may be recalled that very soon after the launching of *Sputnik* I last October, there were announcements from Moscow giving the exact time and location where the satellite could be seen in various parts of the world. Such a rapid and precise system was thought to be almost impossible and not within the capability of the USSR, the only alternative suggestion being that the Soviets were so sure of their launching vehicle that they computed all the data in advance.

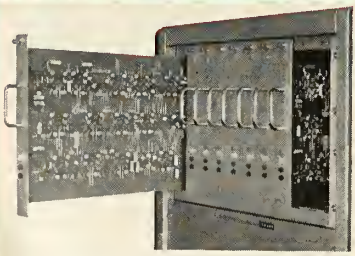
MISSILE IMPACT PREDICTION



IN .0001 SECOND

TRICE, the world's most advanced computer, saves many minutes over time currently required for ballistic missile impact prediction. TRICE modules (Integrators, Multipliers, etc.) can be assembled as a special purpose computer for dynamic systems or as a digital differential analyzer. Its incredible speed of 100,000 iterations per second *in parallel* is unaffected by the size of the problem. The first model is in operation at the U.S. Army Ordnance Missile Command, Huntsville, Ala.

Write for literature describing TRICE and its many uses: aerodynamic stability, control system stability, impact prediction, stable platform calculations, satellite orbit predictors and others.



ENGINEERING BEYOND THE EXPECTED

TRICE (Transistorized Realtime Incremental Computer, Expandable) is the first computer to combine the accuracy and repeatability of a digital computer with the speed, flexibility and ease of programming of an analog computer.

PACKARD-BELL COMPUTER CORP.

a subsidiary of

PACKARD BELL ELECTRONICS

12333 W. Olympic Blvd.
Los Angeles 64, Calif. BR. 2-2171

When and Where

OCTOBER

Sixth Annual USAF Weapons Competition, Interceptor Phase, Air Defense Command, Tyndall, AFB, Fla., Oct. 20-30.

University of California, Aviation Medicine Meeting, UCLA, Los Angeles, Oct. 22-24.

Fourth Annual Symposium on Aviation Medicine, Miramar Hotel, Santa Monica, Calif., Oct. 22-24.

Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif., Oct. 22-24.

1958 National Simulation Conference, sponsored by Institute of Radio Engineers Professional Group on Electronic Computers, Statler-Hilton Hotel, Dallas, Texas, Oct. 23-25.

SAMA Laboratory Apparatus and Optical Sections' Midyear Meeting, Westchester Country Club, Rye, N.Y., Oct 26-28.

Institute of Radio Engineers East Coast Conference, Aeronautical and Navigational Electronics, Lord Baltimore Hotel, Baltimore, Md., Oct. 27-28.

1958 National Metal Exposition and Congress, American Society for Metals, Public Auditorium, Cleveland, Ohio, Oct. 27-31.

Armour Research Foundation, Illinois Institute of Technology, 5th Annual Computer Applications Symposium, Oct. 29-30.

IRE, 1958 Electronic Devices Meeting, Shoreham Hotel, Washington, D.C., Oct. 30-31.

NOVEMBER

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

School of Aviation Medicine, International Conference, Physics and Medicine of the Atmosphere and Space, Hilton Hotel, San Antonio, Texas, Nov. 10-12.

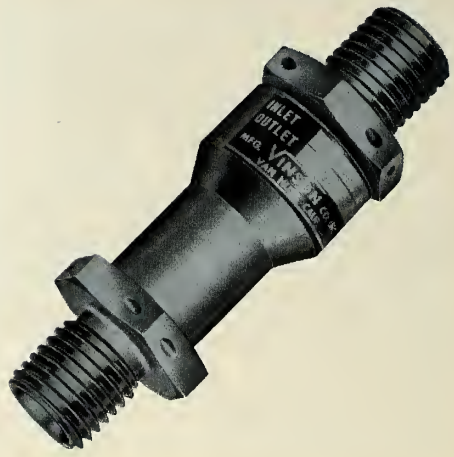
1958 Annual Meeting, Society for Experimental Stress Analysis, Hotel Sheraton-Ten Eyck, Albany, N.Y., Nov. 12-14.

Conference on Scientific Information, AFOSR/Directorate of Research Communication, NAS, NSF and the American Documentation Institute, Mayflower Hotel, Washington, D.C., Nov. 16-21.

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

This FLOW REGULATOR is simpler in design and lower in cost

This unit exceeds MIL-V-8566 specifications in both regulation accuracy and pressure drop, thus confirming the tradition, *You can expect more from Vinson.*



OPERATION

PRESSURE	PROOF	BURST
3000 psi	4500 psi	7500 psi

Media
Hydraulic fluids & fuels. Available in stainless steel for corrosive liquids.

AMBIENT RANGE
-65° to 275° F.

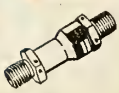
OTHER CHARACTERISTICS
In stainless steel body, up to 600° F. Contains no seals; can replace restrictor valves; unaffected by back pressure. Sizes: ½", ⅜" and ⅝" have interchangeable parts. Available in ⅛" up to ¾"; larger tube sizes to order. Any type port available.

Externally adjustable types available for laboratory use and system evaluation. Internal elements available for cartridge evaluation.

WHAT'S YOUR FLOW PROBLEM? Your inquiry will receive an immediate reply from engineers experienced in the specialized problems of flow control.

Expect more from **VINSON**

PRESSURE REGULATORS
RESERVOIRS · ACCUMULATORS



VALVES: RELIEF · SHUTTLE · RESTRICTOR · UNLOADER · SNIFFLE · SOLENOID · BUTTERFLY

TELEPHONES: ST 3-2750 — ST 3-2576

8044 WOODLEY, VAN NUYS, CALIFORNIA

Thompson–Ramo Merger OK'd STL Remains as Separate Group

by Raymond M. Nolan

Thompson Products stockholders in a special meeting in Cleveland voted to approve the merger with Ramo-Wooldridge by the overwhelming majority of 600 to 1. 99.8% of the 2,216,000 shares of the Thompson common stock voted in favor. Total stock outstanding is 2,764,639 shares. Ramo-Wooldridge shareholders, meeting in Los Angeles, approved the merger unanimously. Space Technology Laboratories, presently an autonomous division of Ramo-Wooldridge, becomes a separate subsidiary corporation with complete operational independence on November 1st.

In a foreword to the proxy statement sent to shareholders, Fred C. Crawford, retiring chairman of the board, said, "The company (Thompson) participated in the organization of Ramo-Wooldridge in 1953 and since then has supplied most of the financing for it. Thompson presently owns approximately 57½% of the total outstanding common shares of Ramo-Wooldridge; and has options (obtained in 1955 and exercisable at specific periods beginning in 1964) which, upon exercise, would give us approximately 85% of the equity ownership. The faith we had in 1953 in the future of Ramo-Wooldridge has been amply justified since that time and we now have the opportunity of obtaining 100% ownership at a price which we believe is substantially less than the price we would be required to pay in the mid-1960s."

Ramo-Wooldridge, organized in 1953 with financial assistance from Thompson, now employs about 4000 people. Out of the original organization have come Pacific Semiconductors Inc., organized in 1954, Space Technology Labs, civilian managers of the USAF ballistic missile program, and Thompson-Ramo-Wooldridge Products Company, organized early this year to develop and market the RW-300 process control computer.

Thompson Products, in business since 1900, has about 17,000 employees. Its major area, until the merger, has been as a supplier of components and sub-systems to the aircraft and automotive industries, although they have been moving into the electronic and nuclear fields gradually.

R-W got its start when Dean Wooldridge and Simon Ramo, then vice presidents of Hughes Aircraft, obtained financing from Thompson Products in exchange for 49% of the new company's stock. Their original 1000 foot building (now a barber shop) in Los Angeles has grown to a total of 17 buildings with 987,300 sq. ft. of which 585,900 sq. ft. are located in the company's partially completed electronics complex on a 41-acre site south of Los Angeles International Airport. When the complex is completed in 1959, it will total some 850,000 sq. ft.

The merger results in a fairly impressive sales picture for the new corporation. When it becomes effective on October 31st, TRW will have over 20,000 employees, assets of more than $200 million, and estimated sales for 1958, "somewhere between $300 and $325 million" according to a Thompson spokesman.

One problem which could have become thornier has been solved by the formation of Space Technology Labs as a separate corporation. Mr. E. C. Jones, secretary of Thompson Products, in a special notice to stockholders, said, "Because of the special nature of its participation in the ballistic missile program of the Air Force, Ramo-Wooldridge has, in effect, been excluded from the fabrication of equipment for use in the *Atlas, Titan* and *Thor* production missiles planned for the Air Force weapons inventory. While the proposed merger might result in an application of this type of exclusion to manufacturing activities of the company, Ramo-Wooldridge has presented to the AF and is presently engaged in a program for the separation of the activities of Space Technology Labs (STL) which, it is expected, will permit the merged company to compete for production contracts in the AF ballistic missile and space weapons programs."

STL will become a separate corporation on November 1st with a majority of its directors persons not connected with the Thompson Ramo-Wooldridge group. General James H. Doolittle will become board chairman on January 1st. All of the announcements to date have stressed the fact that the parent corporation will have no hand in STL's policies because of its involvement in the ballistic missile program.

In the merged group, J. D. Wright, now Thompson's president, becomes Board Chairman and Chief Executive Officer. Fred Crawford, present chairman of the board will retire but will continue as a director and head of the executive committee and will be retained as a consultant (at $85,000 yearly) to the company. Dr. Dean Wooldridge, now president and a director of R-W, will become president of the merged company, and Dr. Simon Ramo, now a vice-president and a director of R-W, will become executive vice-president.

A number of rumors which have been circulating about the merger were scotched by Thompson's Operations Vice-President Horace Shepard (who will become assistant to the Board Chairman in the merged company.) One report, Mr. Shepard said, was that Mr. Wright would be less active in the company. He pointed out in answer to this that Mr. Wright's significant title is that of chief executive officer and as such he will be as active as he has been.

Another rumor—that Thompson would go out of the auto business—was dismissed as ridiculous by Mr. Shepard. Nor is there any truth, he said, in a report that the new corporation may consider closing its Cleveland plants.

In a talk before a Thompson group recently, Dr. Wooldridge said that the merger is being made from a position of strength with the resulting organization designed to tackle military and commercial systems that neither Thompson or Ramo-Wooldridge could have handled separately. He also stated that there is no intention of interfering with the lines of activity of either company.

36-Inch 'Scope To Probe Space From Balloon

WASHINGTON—Plans for a 36-inch telescope to be sent to more than 80,000 feet by unmanned balloon to photograph planets, nebulae and galaxies has been announced by the National Science Foundation and the Office of Naval Research, joint project sponsors.

Called Stratoscope II, the telescope is a continuation of the ONR-backed 12-inch Stratoscope I telescope flown last fall to photograph the sun (m/r, June 1958, p. 73).

Dr. Martin Schwarzschild of Princeton University's Department of Astronomy will direct the Stratoscope II project, and the continued use of the Stratoscope I sun telescope.

The 36-inch telescope—currently the subject of a design study by the Perkin-Elmer Corp., Norwalk, Conn., which designed and built the Stratoscope I telescope—will have a television link with the ground.

The first flight of Stratoscop II is scheduled for 1961.

Inflated, Painted Sphere Ideal For Testing Radiation Belt

• Scientist Suggests New Methods That could Also Improve Sphere Visibility

by Peer Fossen

Exploration of the van Allen Belt by deliberately releasing large quantities of gas in the belt and observing the rate of expansion of the glowing gas cloud was proposed by German scientist Savo Coric in the July 14 issue of m/r. Since then, *Explorer* IV has been successfully launched, and its payload immediately revealed a series of secrets of great value to space technologists.

The recent Lunar Probe carried with it radiation measuring instrumentation to an altitude of approximately 80,000 miles, and the scientists have reported that preliminary findings indicate the van Allen Belt is less serious than expected from the standpoint of future space travel.

The telemetered findings of the probe showed that activity was at a rate of four Roentgens per hour at 5,000 miles, three Roentgens per hour at 10,000 miles and two Roentgens per hour at 17,000 miles. It is calculated that had a human being been aboard the rocket in its ascent, the space traveler would have suffered less than 50 Roentgens of radiations. The lethal dose is about 450 Roentgens.

Answers to these and other related questions will undoubtedly come from the lunar probes, but it is uncertain whether the lunar probes alone can explore all the secrets of the radiation zone.

• Army Project Best Bet For Exploring Belt

In the opinion of scientist Coric, there is one existing U.S. satellite project which, if properly adapted, could be instrumental in revealing further secrets of the radiation belt.

The project referred to by Coric is the Army's plan to place a balloon-like satellite in orbit to determine the air density in the upper regions of the Earth's atmosphere. A large inflated plastic sphere would be used for the tests.

Such a sphere is particularly well suited to carry out air-density measurements in the extremely tenuous atmosphere it would encounter in the lower parts of its orbit. It has a large surface-to-mass ratio, which means it will experience a much larger air drag than a smaller and denser metallic satellite.

This in turn will result in a correspondingly rapid descent to lower altitudes, where the balloon will finally be destroyed by the air friction in the denser atmosphere. The sphere's rate of descent, determined by means of optical tracking, will make it possible to compute the air density along the lower part of the orbit.

Coric's suggestion is that this balloon-like satellite be given a second task to perform; exploration of the radiation belt.

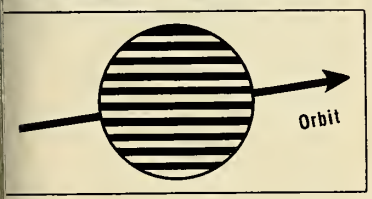
Along the higher part of the orbit it will hardly encounter air molecules but more and more charged particles of the radiation zone. What these particles are and how they behave in space is still a subject of conflicting theories but it seems certain that there are currents of charged particles around the earth whose fluctuations seem to be responsible for the perturbations of the earth magnetic field one or two days after a period of increased activity o

sun spots. If such currents cross the orbit of the balloon, they will be detected and their intensity and course determined by means of the observed deviation of the satellite's orbit.

When these currents are mapped, other satellites, or research rockets, equipped with radiation counters could be sent to record the fluctuations of the intensity of currents after an increased activity of sun spots has been observed. At the same time, other apparatus at the ground stations would record the fluctuations of the earth's magnetic field induced by the fluctuations of the charged-particle current. By comparing the fluctuation curve of the earth magnetic field with the fluctuation curve of the charged-particle current, the course of the current being known, the nature of the charged particles—protons or electrons—could easily be determined.

Larger fluctuations in intensity of a charged-particle current could, according to Coric, be detected by the balloon itself, but it would be a pure chance because the balloon-satellite has a very short life-time.

• Stripes on balloon will lengthen its visibility



The outer surface of the balloon is to be covered by a reflecting paint so the balloon can be optically tracked at dawn and dusk when the satellite is catching sun rays, while the observing stations are still (or already) in the dark. The time during which a satellite is visible in passing over a tracking station is very short (a few minutes), and this is a serious drawback for a satellite whose lifetime is short.

However, Coric has come up with a very simple trick to lengthen—to a considerable extent—the time of visibility of this satellite. It involves covering only one half of the outer surface of the balloon with painted circular stripes separated by stripes of unpainted satellite's skin, as shown in the above sketch.

When the painted satellite is circling through the radiation belt, the charged particles will bombard it and, being energetic enough, penetrate its skin. Inside the satellite they will excite and ionize the filling gas which will glow in its characteristic color, and this glow will be visible from the earth through the unpainted transparent portions of the balloon. By this method, tracking of the balloon will be possible both when it is catching sun rays and when it is orbiting in the shadow of the earth.

The balloon will naturally lose some of its reflectivity after it is painted. The loss, however, will be less than 50% since some of the sun rays penetrating into the balloon through the unpainted stripes will be reflected from the back surfaces of the painted stripes and caught by the ground stations. In Coric's opinion this is no serious handicap for a large satellite, and the benefit of prolonged tracking time will far outweigh the loss of reflectivity.

An alternate method is to use painted spots instead of the painted stripes.

• NASA Project Could Also Benefit From Method

Coric also visualizes that another U.S. project can benefit from the prolonged tracking time obtainable in the above-mentioned manner. Here, he has reference to the 100-ft.-diameter balloon-like satellite NASA plans to put in orbit next year. The purpose of the satellite is to study the possibility

of using huge electric-wave-reflecting spheres in space to reflect back to earth the electric waves directed to them from radio, TV and radar transmitting stations in an attempt to greatly extend the range of these stations.

The electrical reflectivity of such a balloon would hardly be affected by the fact that only one half of the balloon's outer surface is covered by reflecting metallic paint. In effect, the electric waves are much longer than the light waves, so they would not penetrate through the narrow unpainted stripes into the interior of the balloon. If they did, they would be reflected because the ionized gas is a good electric-wave reflector.

Westinghouse Discovers New Chemical Compounds

Scientists of Westinghouse Research Laboratory, Pittsburgh, have discovered a new "family" of chemical compounds which promise to be among the most unusual in science. The alloys use uranium, molybdenum and other metals. Electrical currents flow in them undiminished and apparently forever.

Dr. J. K. Hulm, manager of the laboratory's solid state physics department said, "Because of uranium's widespread application as a nuclear fuel, the metallurgy of uranium and its alloys has been extensively explored. But no comparable research has been carried out on the electrical properties of these materials. Our purpose was to study the unique electrical resistance of uranium alloys down to very low temperatures and to continue a basic investigation of superconductivity that has been pursued in these laboratories for many years."

Measurements of resistance were made on uranium-molybdenum and uranium-niobium alloys that had been stabilized in crystal structure by heating to 1650 degrees F for 24 hours and subjecting them to rapid quenching in water.

Contrary to all known alloys, the electrical resistance of the uranium alloys became progressively larger as the temperature was decreased down to one or two degrees above absolute zero. Then they suddenly became superconductors. The superconductivity was surprising to the Westinghouse scientists because of the rise in resistance preceding it.

The next compounds studied by Dr Hulm and his associates were a group of intermatallics using uranium with such metals as aluminum, manganese iron, cobalt and nickel. These were the studies which led to the discovery of the new superconductors.

The four superconductors were among the intermetallic compounds. Two of these were the first reportedly ever known to contain manganese and iron. Since the presence of these elements has always been regarded as undesirable to superconductivity, the Westinghouse group may have turned up a development of future usefulness.

Superconductors such as these could cause a revolution in the electronic and electrical industries if the operating temperatures could be raised to more easily attainable values. This would make sub-miniature electronics devices for missiles and space vehicles a reality, since the amounts of current required for operation would be so much smaller.

Closed-Circuit TV Used For Missile Instruction

The U.S. Army Ordnance Guided Missile School at Huntsville, has begun telecasting a two-hour closed-circuit course in maintenance of Army missiles to the U.S. Army Armor School at Fort Knox, Ky.

Instruction covers the *Nike-Ajax*, *Nike-Hercules*, *Corporal*, *Lacrosse*, *Hawk* and *Redstone*. The courses which will enable the two training centers to share equipment and instructors will run through next June on the first three Wednesdays of each month, was announced.

The Army said that the technique could also make available for instruction purposes the school's missiles and equipment valued at $100 million.

Hughes Develops 3-D Radar for Air Defense

WASHINGTON—The development of a new "three-dimentional" radar—called Frescanar—capable of detecting airborne targets at extreme ranges and simultaneously computing distance, bearing, and altitude has been announced by the Department of the Army. According to Army spokesmen, this is the first time simultaneous computation of range, bearing, and altitude has been accomplished.

The new radar and its associated electronic system is considered one of the most remarkable advances made in the field of electronic detection since the development of radar. Developed for the Army by Hughes Aircraft Company, Fullerton, Calif. the new radar will function as the eyes of *"Missile Monitor,"* a mobile Army air defense guided missile fire distribution system. The radar itself was originally developed by Hughes for shipboard use by the Navy.

In comparing the new "3-D" system with conventional radars, the Army points out the following advantages:

1. Range performance. By concentrating all available power in sharp pencil beams, Frescanar pinpoints targets at great distance with extreme accuracy.

2. Single antenna and operator. Conventional systems need two or more radars, operators, and master consoles for comparable results.

3. Triple function by simultaneous computation of range, bearing and altitude.

4. Greater speed. All three types of data are transmitted to missile batteries, helping them to direct missiles at targets more rapidly.

5. Sees more targets clearer. Electronic beam scans rapidly and greatly increases number of targets which can be tracked at the same time. This provides better separation of closely spaced targets with minimum of ground clutter, and pinpoints targets faster.

The mobile system consists basically of an equipment van housing all radar gear with exception of the antenna, a power truck, and an antenna trailer.

All units of the system—which will provide information needed to fire missiles such as *Nike-Hercules, Nike-Ajax* or *Hawk* at airborne targets—are interconnected and can communicate with each other even though a portion of the system may be destroyed or inoperative. Thus a fragmented system still could operate effectively. The group commander at each weapons' monitoring center has complete information on all aircraft in his area.

August Transistor Sales High

WASHINGTON—After the slight decline in the transistor market in July, Electronic Industries Association reports that factory sales of transistors in August attained the highest level in the history of the solid state industry. With 4.226 million units sold in August, the total number of transistors sold during the first eight months of 1958 is brought up to 25.310 million. In comparison, sales recorded by EIA for the entire year 1957 amounted to 28.738 million units.

The following chart, prepared by EIA, shows factory sales and dollar values of transistors for the January-August period of 1958. The unit figures for the corresponding months in 1957 are included for comparison purposes. The 14.611 million units sold during the first eight months of last year had a total value of $42,063,000.

	1958 Sales (units)	1958 Sales (dollars)	1957 Sales (units)
January	2,955,247	$ 6,704,383	1,436,000
February	3,106,708	6,806,562	1,785,300
March	2,976,843	6,795,427	1,904,000
April	2,856,234	7,025,547	1,774,000
May	2,999,198	7,250,824	2,055,000
June	3,558,094	8,232,343	2,245,000
July	2,631,894	6,598,762	1,703,000
August	4,226,616	9,975,935	2,709,000
TOTAL	25,310,834	$59,419,783	14,611,300

These figures lend themselves to some interesting observations pointing out the continuing downward trend in transistor prices. The unit and dollar totals for the first eight-month period of both 1957 and 1958 show the following increases over a one year period:

	Units sold	Dollar value
Jan.-Aug. 1958	25,310,834	59,419,783—
Jan.-Aug. 1957	14,611,300	42,063,000—
Increase	10,699,534	17,356,783—

On a percentage basis, this means a 70% increase in number of units sold, while the dollar volume was increased only by a factor of roughly 40%. The average price per unit from factory in the January-August period of 1957 was close to $2.60. The figures for the same period in 1958 leaves a unit price of $2.35, indicating an average drop of $0.25 per unit.

Unit costs will continue to decrease for quite a while yet. With most of the initial research and development money already absorbed, the semiconductor industry foresees that mechanized production techniques, plus development of new devices, will significantly lower manufacturing and production costs within the next decade, and that the realized savings will be passed on to the customer. The full impact of modern mechanization is expected to be felt in 1965. This, along with device developments such as the glass transistor—already built in developmental quantities by some manufacturers—will put the industry in a position to lower the average germanium transistor unit price, to a point where it is directly competitive cost-wise with vacuum tubes. Silicon transistor prices are also expected to continue the downward trend as manufacturing economies are realized.

The transistor business which grew from nothing in 1952 to nearly 30 million sold units in 1957 is expected to market 100 million units in 1965.

Ball Bearing Retainer Gives Long Lubrication

A new ball bearing retainer, developed by the Barden Corporation of Danbury, Conn., and called NYSORB, minimizes oil mass shifts and provides long-time lubrication.

The retainer is sintered from a finely divided nylon powder and impregnated under vacuum with an instrument oil. Since the oil is evenly distributed, there is little mass shift. The unit retains 20 to 25% of its own weight of oil under accelerations of over 800 g's.

The generally severe preload, speed, and environmental conditions present in missile gyro applications make the problem of lubricant mass shift an annoying one. Navigational errors are introduced which must be either tolerated or compensated.

Barden claims that many bearings with oil-impregnated NYSORB retainers as their only lubricant have operated within specifications for more than 5000 hours under extreme preload and speed conditions. In the same tests, bearings using conventional phenolic retainers had an effective life of only 200 hours. The new retainers absorb 10 to 20 times as much oil.

RCA Gets $3 Million Semiconductor Contract

Two USAF contracts totaling $3 million have been awarded to RCA by AMC and Wright Air Development Center, for the development of high-temperature devices using gallium arsenide and indium phosphide.

The contracts call for the development and production refinement of a computer diode, and power rectifier, a general-purpose transistor and a power transistor. The main requirements for each unit are that it will be capable of operation at 400 degrees Centigrade and that the case will be able to withstand temperature of 600 degrees Centigrade. One rectifier already developed by RCA operates at 350°C.

"Gallium arsenide and other compound semiconductors," an RCA spokesman said, "possess high temperature characteristics which permit the construction of semiconductor devices that can operate efficiently at temperatures substantially higher than is possible with germanium or silicon units. In addition, the use of these materials in transistors promises to provide the high-temperature advantage of silicon.

A special high-temperature laboratory has been established at the Somerville plant to carry out portions of the Air Force contract and reportedly is capable of furnishing research during most phases.

Automatic Tool Program Is NAA-AIA Development

A new development, called APT (the automatic programming of tooling), a joint development of North American Aviation and Aircraft Industries Association, will allow the direct and automatic conversion of design intent to tooling or finished parts.

A combination of the three-axis numerical control system NUMILL and the general-purpose, all-transistorized, digital computer RECOMP II—products of Autonetics, a division of North American—slashes the time-span from design concept to hardware.

On display at the Western Tool Show in Shrine Exposition Hall, Los Angeles, are airfoil sections—templates and scribed lines—produced directly and automatically from design intent.

In the new system, an engineer can feed logical design possibilities into the computer and optimize design, which is then converted to mathematical equivalents on tape. From the tape information, NUMILL directs one or many standard machine tools in producing high-precision parts. Tolerances of .0002 inch are claimed to be repeatable for the system.

keeping track

by Peer Fossen

One watt of electricity is sufficient to power the transmission of a rough TV-type picture of the moon's far side, according to Dr. Charles Sonnett, head of Applied Physics in the Instrumentation Division at Ramo-Wooldridge's Space Technology Laboratory. Used in conjunction with a 60-ft. receiving paraboloid, the one-watt unit would be able to transmit the picture over the 240,000-mile moon-to-earth distance in about 30 minutes to one hour. Current lunar probe TV instrumentation is believed to have a power demand much higher than one watt.

Once a lunar probe is successfully on its way into space, we must turn to Britain to get part of the answers to two vital questions: "Where is it?" and "How is it doing?" The answers will come from the University of Manchester, or more specifically from its 250-ft. steerable radio telescope at Jodrell Bank. The giant disc—the world's largest—will play a dual role in the moon shot programs; 1) pick up signals relative to the probe's position, and 2) pick up information telemetered back from the probe's instrumentation package.

All data gathered at Jodrell Bank will be forwarded to USA for final reduction and analysis. The Jodrell Bank telescope is of particular value in the tracking of lunar probes, since it has the narrowest beamwidth of all steerable instruments in the world. Should a probe go off course and escape, the telescope is capable of staying with it for a distance of one million miles, provided the batteries powering the transmitters in the probe are still functioning.

The Jodrell Bank telescope will cease to be the "world's largest" when Navy finishes its 400-ft. steerable paraboloid at the Sugar Grove, W. Virginia Naval Radio Research Station. Work on the $60-million giant telescope—to be used in the study of outer space, advanced scientific research on the characteristics of the earth's atmosphere, and geodetic and geomagnetic studies of the earth itself—is anticipated to commence no later than October 15.

This tracking business is as fascinating as it is intricate and accurate. Recently, two Minitrack stations were temporarily out of commission for maintenance purposes. When put back in operation again, they were simply tuned in and locked on the *Vanguard* satellite, saving all the time and effort thrown into the calibration and lining up normally required to place one of these stations in operation.

With the death of the *Explorer* IV transmitter, *Vanguard* is the only U.S. satellite capable of maintaining radio contact. The transmitters in the *Vanguard* sphere are powered by Hoffman Electronics' silicon solar cell batteries.

From Britain come words of considerable progress in the development of photoelectric equipment for long-range detection of infrared radiation. According to Minister of Supply Aubrey Jones, the devices are so sensitive that they can detect immediately the launching of a ballistic missile 1000 miles away. The new devices are as yet not incorporated in a ballistic missile counter-weapons system, but work is being carried out toward this end.

Florida Development Commission's third Business Research Report shows that the state added 296 new industrial plants or major expansions between January 1 and July 31. More than 10,000 new factory jobs were created. Of these, more than 25% were in electronics.

North American Rolls Out X-15 For Test Flights

LOS ANGELES—The first X-15 space vehicle has rolled from North American's assembly plant to move into the final phase—flight test—of a program started six years ago for sending man beyond the atmosphere in powered flight.

With completion of the third vehicle, the program is expected to cost $121.5 million in direct contract costs, plus sizeable additional indirect costs. The costs primarily are for laboratory and wind tunnel testing done by the National Aeronautics and Space Agency and the Air Research and Development Command. NASA has supported the program from its operating budget without contributing funds to defray direct contract costs.

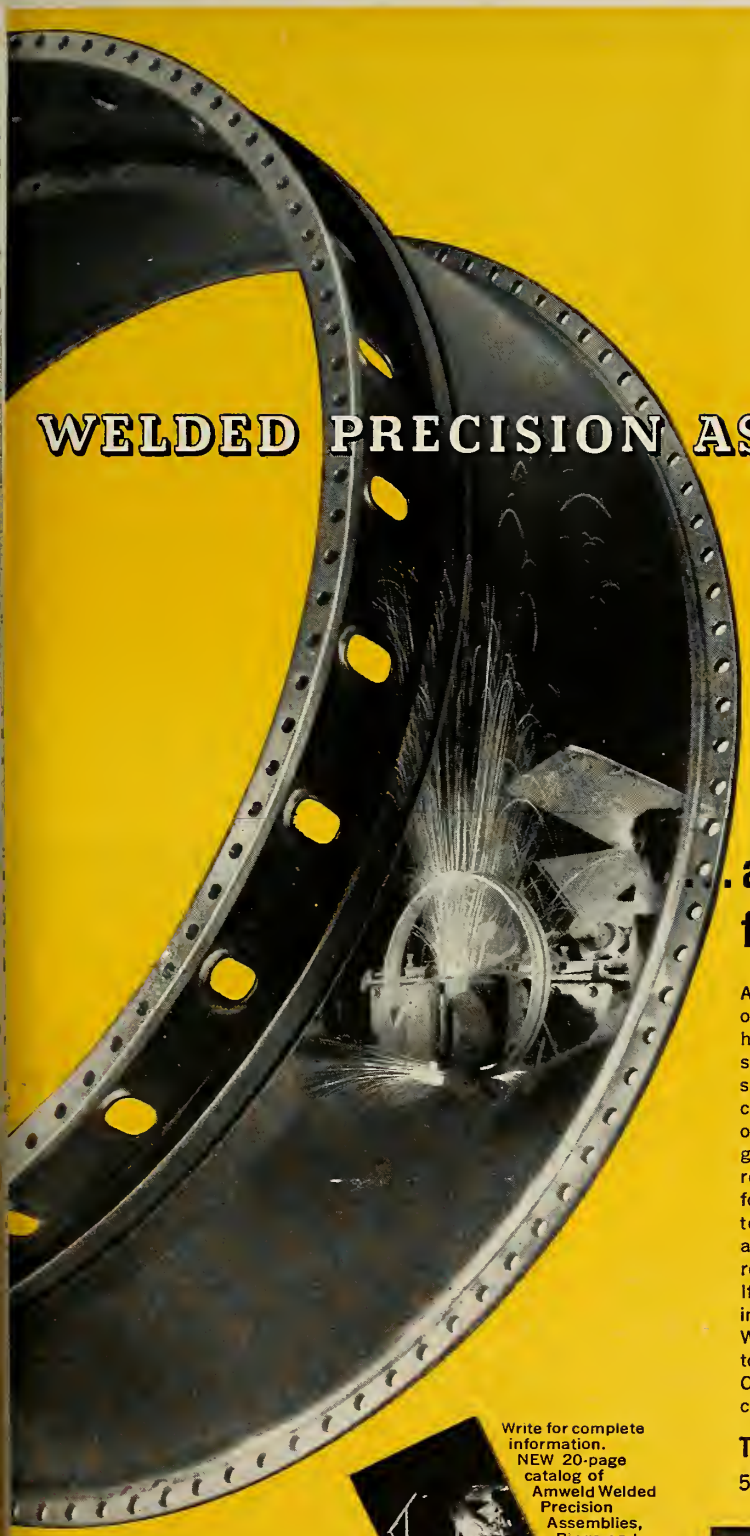
With the roll-out of the hybrid air/space craft, additional details of its make-up were made available (m/r, Oct. 6, p. 17). The vehicle was designed around eight major sub-systems and components—engine, propellant system, hydraulic system, primary flight controls, auxiliary power units, ballistic control rockets, landing gear, and air conditioning/pressurization system.

The XLR-99, basic engine for the X-15, will not be delivered until sometime next year. While awaiting the 50-60 k Reaction unit, two RMI-XLR-11 engines (used in earlier X-1 rocket planes) will be utilized for initial flight tests. A single RMI-XLR-11 engine develops approximately 15 k. The 30 k thrust of the two engines is deemed sufficient for the early low apogee ballistic flight paths.

Propellants for the XLR-99 engine are liquid oxygen and ammonia fed at a flow rate of 10,000 pounds per minute. A hydrogen peroxide steam generator will drive a turbine pumping the propellants to manifold pressure. Helium is used for tank pressurization and liquid expulsion.

The horizontal and vertical tail control surfaces, speed brakes, and the landing flaps are operated by two 3,000-psi systems operating in parallel. The primary flight controls are a further development and extension of the conventional aircraft method designed to withstand increased surface loads, high g forces, and extreme temperatures. Above the atmosphere the X-15's controllability will be dependent upon hydrogen peroxide steam jets located in the nose and wingtips. Proper attitude will be maintained during the ballistic trajectory by actuating the jets from a three-axis control system.

Two auxiliary power units, developed by General Electric, operating in parallel will supply electrical and hydraulic power.



WELDED PRECISION ASSEMBLIES...

...a major AMWELD® fabricating service

American Welding has produced thousands of complicated welded assemblies, which have satisfactorily met the stringent specifications for aircraft, missiles, submarines and atomic reactors. These components are welded from a wide range of materials, including most stainless grades, titanium, aluminum, and heat-resistant alloys. Amweld's fabricating, forming, and machining facilities, plus testing and research departments, are available on a subcontract or research and development basis.

If you would like to obtain complete information on the capabilities of American Welding and how we can be of assistance to you — phone or write today.

Our local representative will be happy to call and discuss your requirements.

Write for complete information. NEW 20-page catalog of Amweld Welded Precision Assemblies, Rings and Bands.

The American Welding & Mfg. Co.

554 Dietz Road • Warren, Ohio

AMERICAN WELDING

Pentagon Starts Annual Budget Battle Early

The annual struggle within the Pentagon over how much money to request from Congress is well along. The individual services, skirting the official "guidelines" laid down by DOD top echelons, have proposed budget requests running well over the DOD party line recommendations, and threaten to boost the defense budget by about $1 billion for FY 1960.

The reasons for establishing guidelines seem to rest in a concentrated effort to stop a runaway defense budget from mounting to higher and higher figures every year—at the rate of $1-billion jumps.

Although Deputy Defense Secretary Quarles emphasized that the guidelines were not intended to have the effect of ceilings on individual service requests, the Defense Department cannot conceivably overlook wholesale disregard of its recommendations.

Secretary Quarles added that the guidelines were intended to control expenditures, not appropriations, but admitted that there were no plans to change the DOD budget request to Congress. He said that planning was very much in the formulative stage and no final decision have been made. If made necessary by future developments, Quarles said, an alternative budget may be submitted, if a form can be agreed on by all concerned no later than January.

Declining to release information on the amount of excessive requests involved in the controversy, Quarles commented only that the heads of the various services are trying to iron out the situation with top DOD officials.

Secretary Quarles gave an indefinite answer when asked about rumors of cancellation on the B-58 Hustler and the *Titan* ICBM. "I would not like to imply that plans for cancellation are underway," he said.

• **Some Withheld**—When questioned about the billion-dollar fund that Congress supplied for such projects as the *Hounddog, Polaris,* and *Minuteman* Secretary Quarles commented that this money would not be spent "at this time." He noted, however, that this decision may change, depending on future developments.

The individual service heads have consistently held that they cannot maintain their defense programs at levels set by the DOD guidelines. Quarles, stressed that the services are free to request whatever funds they need to support their defense programs for the next fiscal year. The tentative limit, $500 million, on budget increase by DOD planners for this year if accomplished, would be a considerable departure from recent years, which saw the budget increase at a rate of $1.8 billion this year over the previous year.

Aerojet Infrared Tracker Cheaper than Minitrack

AZUSA—A team from Aerojet-General Corporation's Avionics Division recently tracked Soviet's *Sputnik* III using the Aerojet Model S8 infrared tracker. The team, headed by C. E. Dunning brought the equipment up in the San Gabriel Mountains north of Glendora, California where they set up a mobile laboratory.

Mounted on a five inch naval gun mount, the infrared tracker is a small instrument—total weight about 20 pounds—with a folded reflecting optical. Measuring only six-inches in diameter, the system has the same basic configuration as the Palomar and Mt. Wilson telescope.

According to company officials, the purpose of the tracking experiment was to obtain radiation characteristics of the satellite. The resulting data are being used to establish the sensitivity and optical requirements for specialized infrared trackers capable of tracking every passage over a monitored area. The data will further be used for continued research into the problem of using infrared instruments for navigation in space.

In an interview with Dr. R. H. McFee, Director of Research for the Avionics Division, m/r learned that work on the S8 infrared tracker was started about two years ago for the Navy. The current equipment, however, is being developed on Aerojet's own funds. Although the device is still considered in the R and D stage, Dr. McFee feels it is abreast of the state of art in the infrared field and that it would result in savings if incorporated in the tracking equipment used by the United States today. As an example, if the infrared tracking device replaced the radar instrumentation of the Minitrack stations, a saving of approximately 20% could be realized. (Price of one Minitrack station amounts to about $250,000—plus construction and installation.)

Sputnik III was at an altitude of 250 miles above the earth when the Aerojet team successfully proved their tracker. Maximum range of Aerojet's infrared device is not obtainable.

As reported on page 83, Britain has recently completed a development of an infrared device capable of detecting the launching of a ballistic missile at a distance of 1,000 miles.

Single-Stage Soviet Rocket Reaches 280-Mile Altitude

Vehicle carries dogs and instruments aloft at 3800 MPH to test space cabin design and stabilizing equipment

Sovfotos

Design of Soviet space suit is tested for flexibility at control mockup in USSR.

The Soviet Union launched a second single-stage rocket to altitudes of 280 miles recently, and sent two dogs along as passengers.

The official announcement gave the weight of the "geophysical scientific apparatus, radio telemetering devices, power sources, the hermetic cabin with the experimental animals and auxiliary systems together with the instrument section" as 3725 pounds. As in previous such statements, there was no mention of total vehicle weight or total payload weight. (See m/r, Sept. 15, p. 25.)

The launching was made to test equipment and perform biological experiments on the dogs involved. The Soviets also released a photo (above) of one of their full-pressure space suits.

The announcement stated that the rocket was completely stabilized throughout the entire flight, including the inertial portion. Mention was made of the fact that the cabin involved insures the necessary condition for life at altitudes of 60 to 130 miles. However, the vehicle ascended to a height of 280 miles and there are no details on the equipment performance to that altitude.

According to the official Soviet scientific announcement, the rocket ascended at a velocity of 1.057 miles per second and descended at 1.059 miles per second.

)OGS ARE TRAINED in rocket prior to launch.

TEST DOGS "Kozyavka undergoes vibration stand test.

advertiser's index

EMPLOYMENT SECTION

Advertising correspondence should be addressed to Advertising Sales Manager, Missiles and Rocket, 17 East 48th Street, New York 17, N.Y.

REGIONAL OFFICES:

New York City: 17 E. 48th St., New York 17. Edward D. Muhlfeld, Advertising Sales Manager; P. B. Kinney and G. T. O'Mara, regional adv. mgrs. Phone: PLaza 3-1100.

West Coast: 8943 Wilshire Blvd., Beverly Hills, Calif. Fred S. Hunter, manager; Walton Brown, regional adv. mgr.; James W. Claar, regional adv. mgr. Phones: BRadshaw 2-6561 and Crestview 6-6605.

Florida: 208 Almeria Avenue, Coral Gables, Fla. Richard D. Hager, regional adv. sales representative. Phone: HIghland 4-8326.

Chicago: 139 N. Clark St., Chicago 2, Ill. George E. Yonan, regional adv. mgr. Phone: CEntral 6-5804.

Cleveland: 244 Hanna Bldg., 1422 Euclid Ave., Cleveland 15, Ohio. Douglas H. Boynton, regional advertising manager. Phone: PRospect 1-2420.

Detroit: 201 Stephenson Bldg., Detroit 2, Mich. Kenneth J. Wells, regional advertising manager. Phone: TRinity 5-2555.

Canada: Allin Associates, 12 Richmond Street East, Toronto 1, Ontario. Phone: EMpire 4-2001. Allin Associates, 1487 Mountain St., Suite 4, Montreal, Que.

Geneva: American Aviation Pubs., 10 Rue Grenus, Geneva, Switzerland. Anthony Vandyk, European Director.

London: The AAP Company, 17 Drayton Road, Boreham Wood, Hertfordshire, England. Phone: Elstree 2688. Cable address: STEVAIR, London.

Paris: Jean-Marie Riche, 11 Rue Condorcet, Paris (9e), France. Phone: TRUdaine, 15-39, Cable address: NEWS AIR PARIS.

General Electric – A Leader for the Free World in the Development of Instrumented Re-Entry Vehicles – Seeks Systems Engineers Who Can Contribute to a Variety of Outer Space Programs

We are looking for the highly capable professional engineer — skilled in the development of operational requirement parameters, systems design, and specifications for re-entry and space vehicle systems and sub-systems.

Our needs are in the fields of systems synthesis, propulsion, ground support, air and space borne instrumentation and communication, navigation and control, space frame design and configuration, and systems test and reliability studies.

Please write — in full confidence — to
Mr. Richard Eddy

MISSILE & SPACE VEHICLE DEPARTMENT

GENERAL ELECTRIC

3198 CHESTNUT STREET PHILADELPHIA 4, PENNA.

The Pentagon's Real Manpower Shortage

There has been a great deal of debate, public and private, about the amount of money being spent in all areas of the missile business, for research, for development and for production. So great has this volume of words been that it has tended to obscure a greater problem involved in the nation's technological advances.

This factor is—that the man in the program is at least equally important to the money. For it is the man in the program who makes the decisions —or perhaps fails to make them—as to how the money available will be spent. Money spent for the wrong program may be less dangerous, actually, than money which is not spent for the right one.

This leads almost automatically, then, to the men we get or are able to get in government today, their qualifications, their motives, their authority, their frustrations.

The danger in the Pentagon, where the great majority of missile and space projects survive or perish, is the frightening pyramidal system whereby civilian official has been piled on civilian official, by the hundreds. Many of these officials are honestly motivated and capable. Others are just plain incompetent.

And, the even greater danger is that the vast majority of these officials, even those in the highest ranks, haven't the power to approve projects, but they do have the power to stop them. This inevitably brings about the situation which exists to some degree now. Some of the dedicated men stay on, fighting because they are so dedicated. Others, less so, give in to the frustrations and leave. The result is a tendency toward mediocrity—men who have the talent and training to question a project but not sureness and courage to approve it.

A case in point at the moment is the inability of Defense Secretary McElroy to find a man sufficiently capable to take the vitally important job of assistant for Research and Engineering. The truth is that the terms of reference for this job are so vaguely defined that, as some one has remarked, anyone smart enough to handle the job is too smart to take it.

To do any kind of an adequate job, the man who accepts needs a great deal of authority. He should, in effect, be able to:

1. Approve a project.
2. Allocate the money.
3. Direct one of the services to carry it out.

As matters stand, no one knows for sure (if Mr. McElroy does, he isn't telling) whether the new appointee will have authority over the service assistants for R&D; what his relationships will be with Missile Czar William Holaday, a notable stumbling block in his own right; with ARPA's boss, Roy Johnson; with Comptroller McNeil, who doesn't give up authority on money easily; with NASA or even with his own two bosses, McElroy himself and Deputy Secretary of Defense Donald Quarles, another man with well defined ideas in the research and engineering fields.

The nation's missile and space program is reasonably well muddled now, with some pretty vague areas of operation and authority. The appointment of the right man with the right terms of reference could clear up the situation a great deal. Otherwise we have just added another factor in a space age equation whose components are highly unlikely to add up to a correct answer to as vital a problem as this country has ever faced.

SUBSCRIBER SERVICE
missiles and rockets

For additional information about any product or service advertised or mentioned in the editorial pages of this issue of Missiles and Rockets:

Use the attached **prepaid** reply cards. Circle numbers shown on the reply card that correspond with numbers appearing beneath items described. If no circle number accompanies the article or advertisement, give page number (and advertiser's name) on line provided at bottom of the card.

Your requests for information will be forwarded promptly to the companies concerned.

NEW PRODUCT BRIEFS

ECTOR—Acromag, Inc., Detroit, re- y announced development of a el 510 Cyclemag magnetic fre- cy detector to measure audio fre- cies directly, using only static com- nts. It is recommended for critical le, aircraft and industrial control pments where accuracy, reliability long life are important. The new delivers 0-5—ua of DC output for) CPS input. Accuracy is better 1%, despite large changes in driv- voltage and in driving waveforms. nal power sources are not required he detector uses the signal source s sole source of energy.

No. 243 on Subscriber Service Card.

VER—Development of a 24-32 volt 00 ampere DC power supply, com- ly transistorized and militarized, has announced by Perkin Engineering ., El Segundo, Calif. The new r supply designated Perkin Model M-1136A operates from an AC in- of 208 volts ±10%, 3 phase, 57-63 s per second. The unit has a DC nt overload capacity of 125 am- for a duration of 15 minutes. regulation accuracy is ±0.1% for ges from no load to full load. mic regulation is ±.1% for step ges of 10 volts in the AC line be- 187-229 volts and dynamic load ation is ±2 volts for step changes no load to full load or full load load. The output impedance is han 0.025 ohms from 0-20KC and is 20 millivolts RMS maximum.

No. 244 on Subscriber Service Card.

GRAMMER—Model FP 2 and l FP 6, Pamona Electronics Co. new sequential programmer is a lectro-mechanical precision timing , with missile application. The eight unit eliminates the need for es, cams, snap-action switches, and ny instances relays, according to anufacturer. Accuracy of 0.2 sec- can be obtained, and total oper- time available is from 15 seconds 8) seconds, with other time settings le. Switching contacts during the timing run can be as short as 0.5 seconds or as long as the total operating time.

Circle No. 245 on Subscriber Service Card.

THERMAL MACHINE—A thermal fatigue test machine located at International Nickel Company's Bayonne Research Laboratory in Bayonne, N.J., automatically heats alloys to high temperatures, then cools them to produce repeated thermal shocks. The machine helps engineers learn more about the complex effects of repeated stressing induced by thermal cycling. The problem of temperature measurement, as the machine automatically indexes through the heating and cooling cycles, is neatly solved with a Leeds & Northrop Co. radiation pyrometer. A specially mounted Rayotube radiation detecting element on the machine connects to an L&N Speedomax AZAR (adjustable range, adjustable zero) recorder.

Circle No. 246 on Subscriber Service Card.

SERVOS—Servo Dynamics Corp., of Somersworth, N.H., has announced a complete line of miniature precision servo AC motors of 60 and 400 cycles in the frame sizes 8, 10, 11, 15, 18 and 23. The line includes damping generators, inertia damped motors, precision tachometer generators, synchronous motors, and a variety of associated precision gear trains. The motors are guaranteed to operate within ambients up to 200°C and are designed to give the maximum enclosure for protection against environmental conditions. All units are designed to meet BuOrd specifications and are either certified or can be certified to meet the environmental requirements of MIL-E-5272A.

Circle No. 247 on Subscriber Service Card.

DELAY LINES—Three new distributed parameter electrical delay lines, having delay periods ranging from .05 to 1.0 microsecond per six inch length, have been developed by Technitrol Enginnering Co., Philadelphia. The new delay lines types 25E, 25F and 25G are available in a variety of standard case styles.

Circle No. 248 on Subscriber Service Card.

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY CARD

First Class Permit No. 2455-R (Sec. 510 P.L.&R.) Washington, D. C.

MISSILES and ROCKETS

17 EAST 48th STREET

NEW YORK 17, N.Y.

SUBSCRIBER SERVICE DEPT.

POSTAGE WILL BE PAID BY ADDRESSEE

MISSILES AND ROCKETS

OCTOBER 20, 1958

Expires Three Weeks After Above Date

NAME_____

TITLE/POSITION_____

COMPANY_____

Product Mfg./Service Offered_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

Card cannot be processed unless all information is given. Please limit requests to ten items.

CIRCLE NUMBERS BELOW FOR INFORMATION ON PRODUCTS, LITERATURE OR ADVERTISEMENTS

• • Advertisements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175

• • Missile Literature

200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224

• • New Missile Products

225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249
250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274
275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299

For Other Information Give Page Numbers:_____

MISSILE LITERATURE

ELECTRONICS—A four-page short form catalog is available from Eldorado Electronics, 2821 Tenth Street, Berkeley, California. The new bulletin briefly describes Eldorado Electronics Accelerator Current Integrator, Universal Photomultiplier Photometer, Milli-Microsecond Time-To-Pulse-Height Converter, Multi-Channel Pulse Height Analyzer, Non-Overloading Linear Amplifier and Milli-Microsecond Time Measuring System. Features, specifications and price are noted.

Circle No. 200 on Subscriber Service Card.

RECTIFIER—General Electric has published a 17-page booklet, entitled "Application Notes for ZJ-39A Silicon Controlled Rectifier" which describes circuit fundamentals for use of the newly developed rectifier. The controlled rectifier is basically a rectifier which is modified to block in the forward direction until a small pulse of current is injected into the gate terminal. After this, it assumes the forward characteristic of a conventional rectifier. The booklet covers general circuit design considerations, firing circuit design and typical applications for the silicon controlled rectifier. "Application Notes for ZJ-39A Silicon Controlled Rectifier" is General Electric publication number ECG-327.

Circle No. 201 on Subscriber Service Card.

FILTERS—The Bausch & Lomb Optical Co. has recently published Progress Report No. 3 entitled "Near-Infrared Transmission Filters." The report summarizes the technical data which has been compiled by the optical company on the selective transmission of energy through multilayer interference filters. The text of the third report provides a detailed description of "Band Pass Filters" and "Long-Wavelength Pass Filters." Each is outlined according to specific terminology and filters characteristics. Statistical tables and charts supplement the text. In addition, the report includes data on auxiliary filters, composite filters and substrates as well as general information on size, maintenance and availability of items.

Circle No. 202 on Subscriber Service Card.

COMPONENTS—Wyle Associates Bulletin Number Six describes a new line of environmental test equipment for mass-testing of production components. "Building Block" units are available in combinations. Environments obtainable include high-low temperature, salt spray, altitude, humidity, vibration, shock, temperature shock, sunshine, fungas, rain, sand-and-dust, radiant heat, immersion, accelerated corrosion, and explosion.

Circle No. 203 on Subscriber Service Card.

CABLES—A new four-page booklet describing Triangle Control Cables, the various construction available as well as suggested applications, is offered Triangle Conduit & Cable Co., I New Brunswick, N.J. The booklet the various sizes of control cables describes the sheaths and insulati used.

Circle No. 204 on Subscriber Service C

MOTORS—A 10-page catalog desc ing four basic models and sizes of A hysteresis synchronous and induct motors and 129 spur and planetary g reductions, is available from Glove dustries, Inc., 1784 Stanley Avenue, D ton 4, Ohio. The motors operate A.C. voltages to 200; 400 or 60 c 1, 2 or 3 phase. Geared outputs ra to 2000 oz. in. Performance, MIL sp fication and other technical data given.

Circle No. 205 on Subscriber Service C

VALVES—A four-page brochure scribes the basic types of air valves actuators manufactured by Barber-C man Co. Temperature control and p tioning systems, and specialized el trical test equipment are also includ

Circle No. 206 on Subscriber Service C

FEEDERS—RCA has a full line broch on automatic parts feeders. These clude: non-mar feeder-orientors for h dling fragile and highly finished pa elevating oriented feed hoppers, st feeders, and rotary hoppers. Also sh are automatic high speed hardness t ers, inspection machines, grinder c trols and other products of RCA's Industrial Automation Equipment S tion.

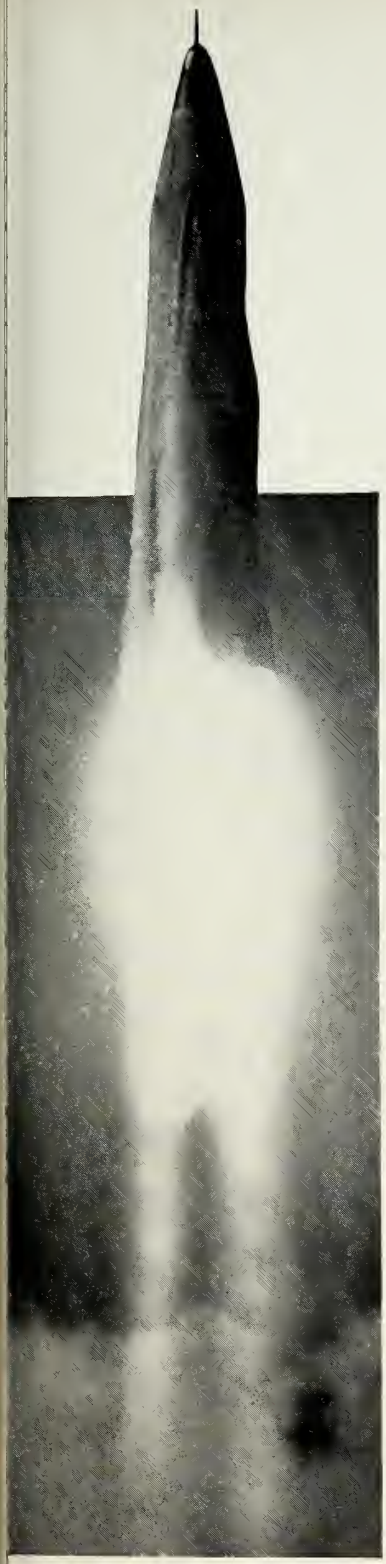
Circle No. 207 on Subscriber Service C

OSCILLOSCOPES—A bulletin availa from the Industrial Products Divis International Telephone and Telegr Corporation, 250 Garibaldi Aver Lodi, New Jersey, describes the 40BG and AC-40BG 17" bar-gr oscilloscopes. Any 40 related or u lated variables which can be conver into electrical impulse may be sir taneously compared or measured their change or drift studied by me of the instrument which provides large and accurate display. Model 40BG is a polarity-indicating low-l system, Model AC-40BG is a wide b system. The illustrated bulletin inclu recommended applications, a gen description of the instruments plus t special features, and technical spe cations.

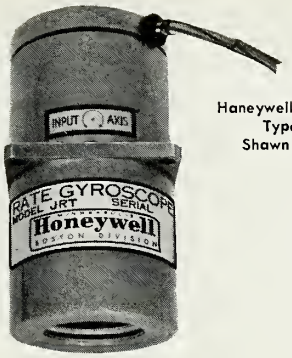
Circle No. 208 on Subscriber Service C

CONVERTERS—A new six-page fol describing the complete line of Li Liquid Oxygen and Nitrogen convert is now available from Linde Co., I sion of Union Carbide Corp. Maxin use of aluminum in these converters counts for very low weights.

Circle No. 209 on Subscriber Service C



First test firing of the ATLAS ICBM at Cape Canaveral, Florida, June 11, 1957.



Honeywell Rate Gyro
Type JRT
Shawn ½ size

Flight Control for the ultimate weapon

Three Honeywell Rate Gyros, Type JRT, provide missiles with precise three-axis directional stability and are currently being supplied to the ATLAS missile program.

The Type JRT is a highly accurate precision instrument for measurement of absolute rates of rotation in inertial space. Viscous damping is electro-mechanically controlled to maintain a constant damping ratio over the entire operating temperature range of −65°F. to +175°F.

This new Honeywell Rate Gyro is designed expressly for flight control of missiles and flight instrumentation in missiles and aircraft where severe ambient conditions prevail . . . and at the same time where low threshold, minimum hysteresis, excellent linearity, high natural frequency and ruggedness are essential.

Honeywell inertial components and engineering experience are available to assist in the solution of your Gyro system problems. Write for Bulletin JRT . . . Minneapolis-Honeywell, Boston Division, Dept. 45, 1400 Soldiers Field Road, Boston 35, Mass.

Honeywell

H HONEYWELL *Military Products Group*

DESCRIPTIVE DATA

- EXCELLENT LINEARITY: 0.25 % af full scale.
- LOW HYSTERESIS: Less than 0.1 % af full scale.
- LOW THRESHOLD: Less than 0.01 degree/secand.
- MICROSYN PICKOFF: Variable reluctance type praviding infinite resalutian and high signal-ta-noise ratia.
- FULL SCALE RATE: Up to 1000 degree/secand.
- FULL SCALE OUTPUT: Up to 12 volts.
- RUGGED: Withstands 100 G shack.
- VIBRATION: Withstands 15 G ta 2000 cps.
- SIZE: 2 7/64" diameter 4 5/16" lang.
- WEIGHT: 2 lbs.

Circle No. 2 on Subscriber Service Card.

prescription for a successful orbit

"SHAKE WELL BEFORE USING"

Ling vibration testing proves reliability of Explorer satellites before launching

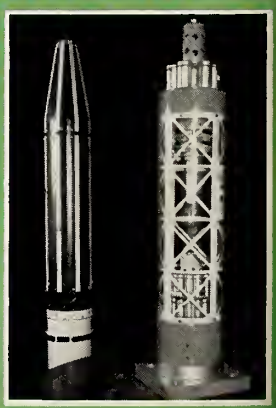
THE SUCCESS STORY of the Explorer Satellites actually began long before the countdown. Every piece and component was vibration "flown" again and again through endless testing and checkout procedures.

In fact, the *fully assembled* Explorer Satellites now in orbit were given a thorough vibration testing at Caltech's Jet Propulsion Laboratory in Pasadena, California.

The actual conditions of space flight were computed in a synthesized program, and, using Ling Electronic power generators and advanced techniques, space flight conditions were duplicated in the laboratory!

The ability to develop complex test equipment for new and challenging areas such as this is one of the reasons Ling is recognized as a leader in high power electronics.

Because of the conditions encountered in the flight to space, a random wave program was the only vibration test considered realistic enough for the Explorers. Tests at JPL included random noise band limited to 20-1500 cps with an amplitude as great as 25 G rms perpendicular to the thrust axis. Shown on the shaker table is an Explorer instrumentation package.



LING ELECTRONICS INC.

9937 West Jefferson Blvd., Culver City, California • Telephone: TExas 0-7711

Circle No. 3 on Subscriber Service Card.