JUNE 15, 1959

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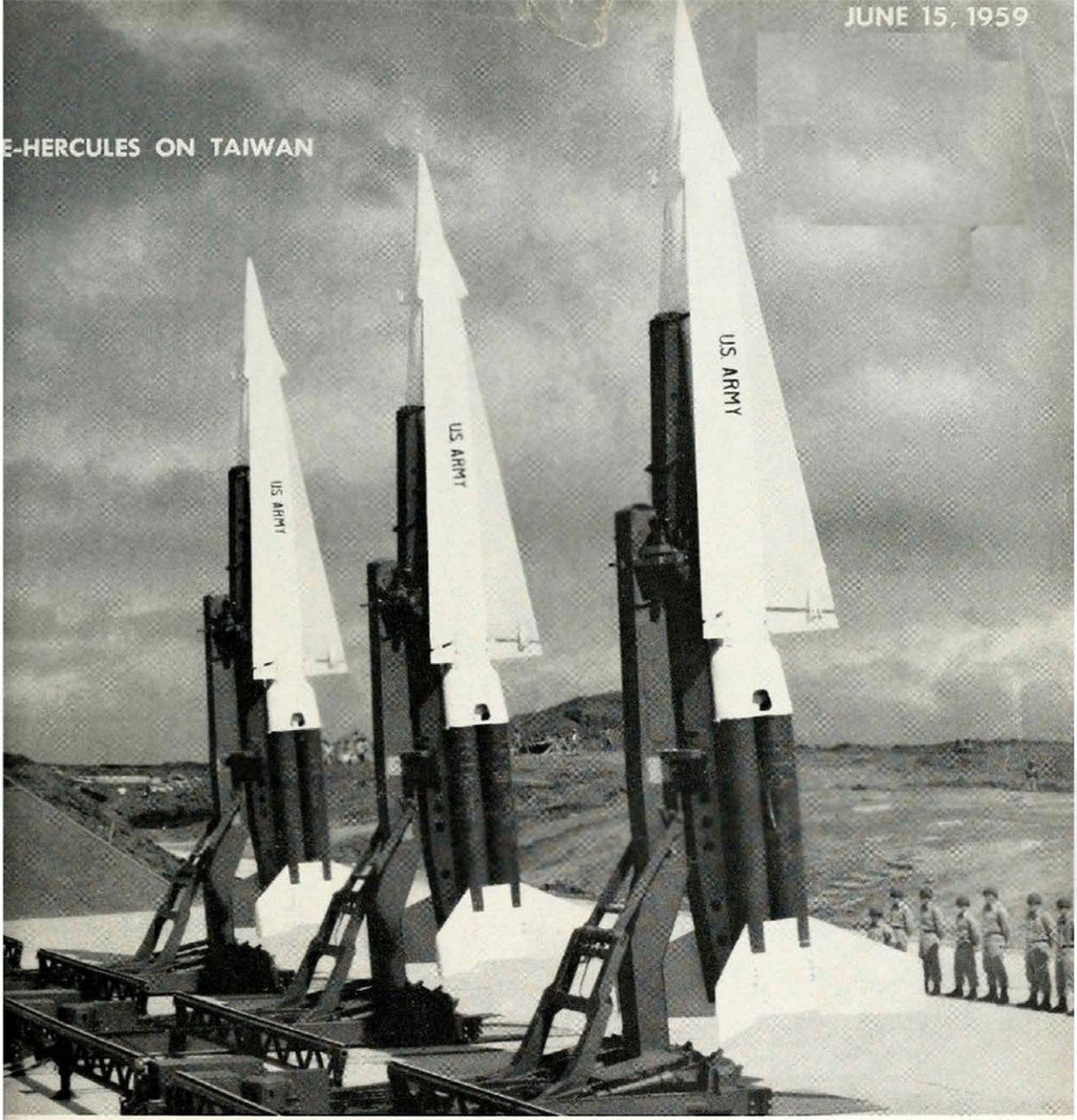

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

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CONTRIBUTORS
Propulsion Engineering .....MICHAEL LOR
Industry .....JAMES J. HAGGERTY
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A. H. STACKPOLE .....*Vice Pres*
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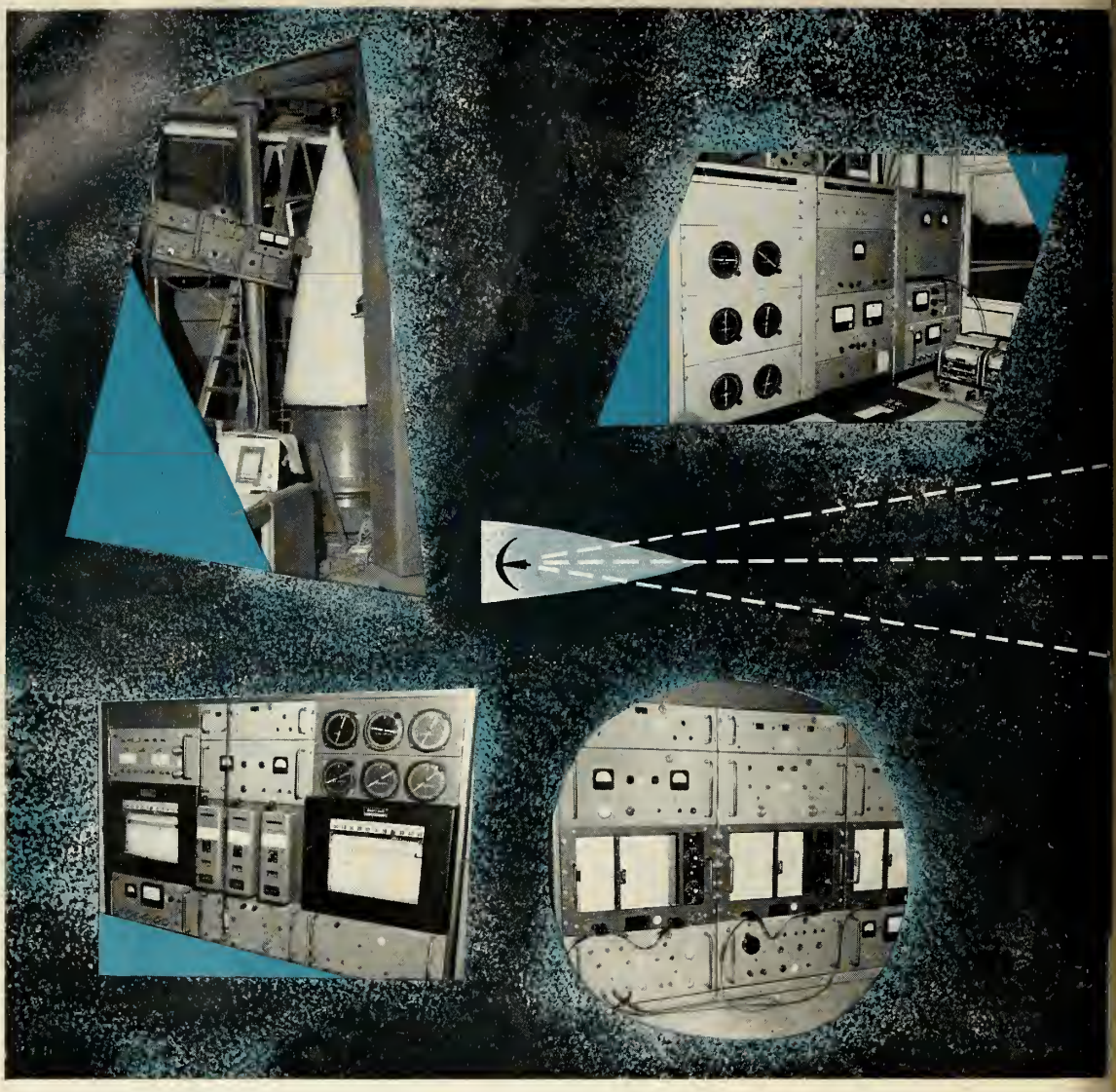
COVER: Nationalist Chinese will take over a *Nike-Hercules* battalion on Taiwan (See p. 22)

ATLAS GETS A LIFT

ATLAS ERECTOR-LAUNCHER slated for use at operational bases is shown in recent successful test by Convair at San Diego. This type of mechanism will be installed at *Atlas* complexes at Warren AFB, Wyo. Missile with erector-launcher will be enclosed in a concrete building. Stored in horizontal position, missile is quickly raised by a 75-hp motor. After it is erect, the nose cone clamp opens and the boom swings out of the way. Westinghouse produced controls.



BORESIGHT ACCURACY TO 1/15 MILLIRADIAN? SEE BRUNSWICK

Brunswick-built radomes are setting new highs not only for strength-to-weight ratios, but accuracy as well. The reasons for the accuracy are simple: Brunswick has the test facilities and know-how that are without peer in the industry. Three radome ranges which automatically detect boresight error to an accuracy of 1/12 to 1/15 milliradian are now in full operation at Brunswick.

Soon to be in operation: two 1,000-foot ranges, manually operated, that will assure even more refined accuracy, detecting errors as small as 5 seconds of arc. Also, as an aid to design, quality control and maintenance of electrical tolerances, Brunswick is currently utilizing a one-horn interferometer for accurate IPD measurements and corrections before final range testing.

Behind these extensive test facilities operates an engineering team skilled in both detecting and *correcting* boresight error. To learn how this combination of facilities and engineers can give you uniquely accurate, tough and lightweight radomes, write to: Brunswick-Balke Collender Company, Defense Products Division Sales Manager, 1701 Messler St., Muskegon, Michigan

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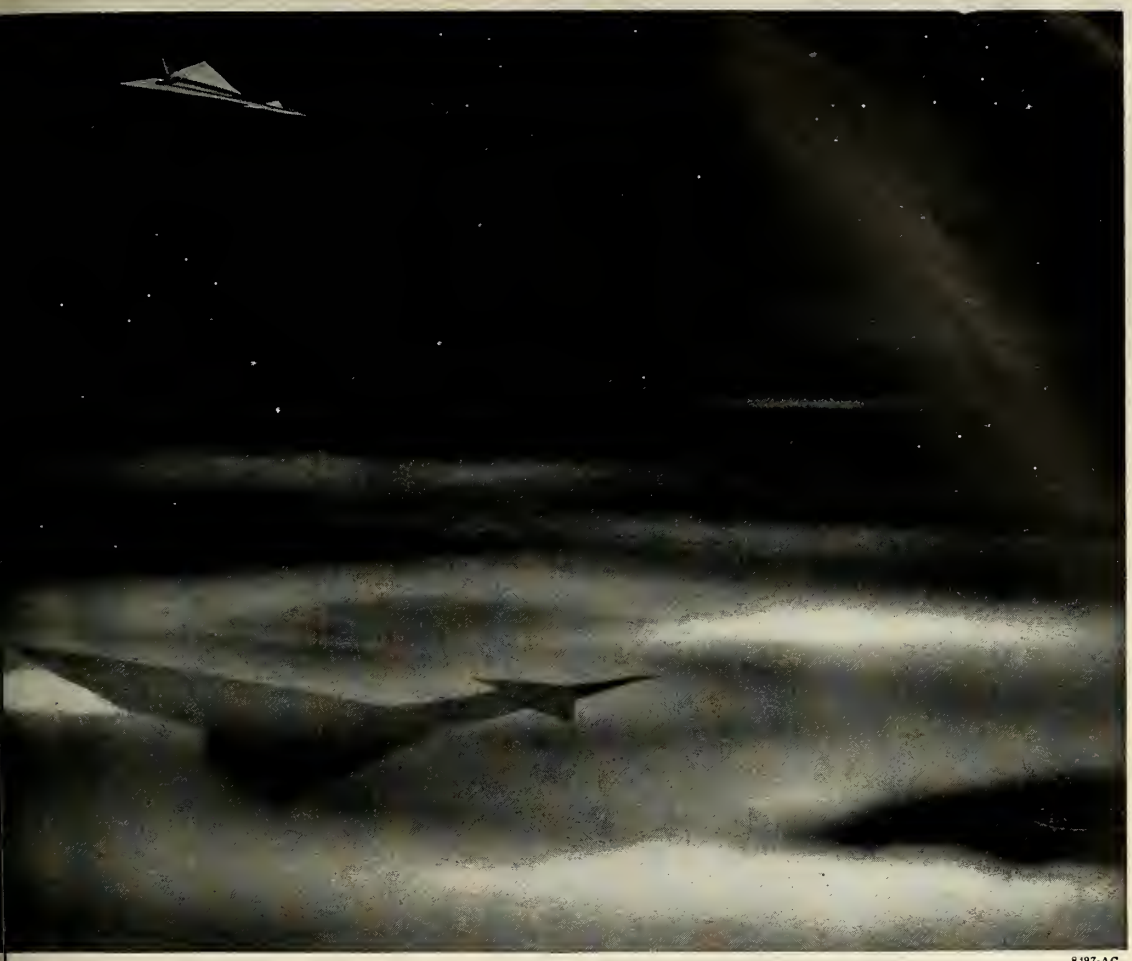

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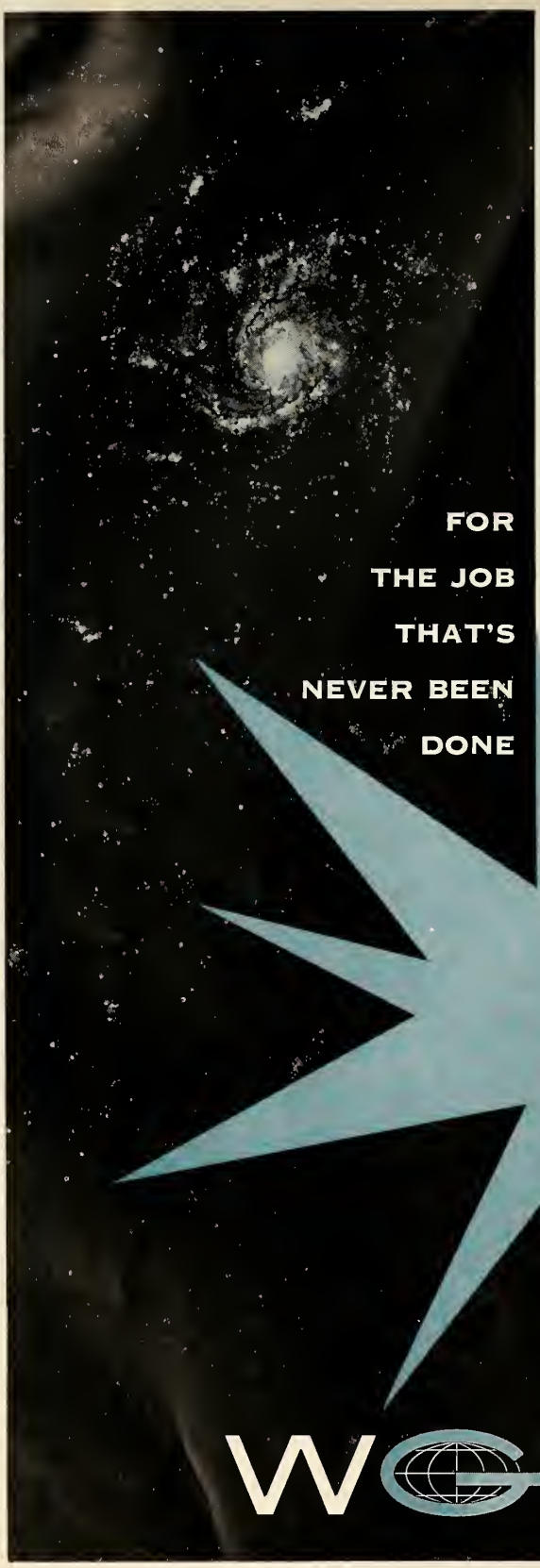

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The New Deputy Secretary of Defense

Early in May, when Thomas S. Gates had resigned his place as Secretary of the Navy and expected to leave public service behind him probably for all time, he sat down and wrote a farewell address. These apparently were not words put together by a speechwriter, but Gates' own thoughts and reflections after some ten years of Government service both in and out of uniform.

He wrote:

"Tonight I am going to let the chips fall. I do so in hope that I can be helpful. I do so as I reach the beachhead of so personal a D-Day."

The talk was delivered to the Navy League and as such was inevitably pointed toward the Navy viewpoint, but the convictions and philosophy of Thomas Gates as an American carry a certain reassurance in their calm tolerance and soundness. He said:

"It is not to banish hope but to achieve realism that we seek to penetrate the clouds that hang low over our country. Peace we hope for and believe in, but it will be an uneasy peace. The basic concepts of communism will not change quickly—if at all. The United States has no thought of varying from the ideals of freedom on which this nation was founded. No true partnership can be built between these directly conflicting philosophies. Temporary arrangements might be made, from time to time, in mutual self-interest, but a partnership requires more substance.

"The struggle between two great power blocs and two great religions of the spirit will stay about as it is for years. The intense effort of trying to convince and win the respect of the uncommitted rising people of many lands will go on and on in extra innings. This we must accept and learn to live with.

"The USSR will continue to probe and test our determination and our will.

"As an essential part of this forecast, we will see an indefinite requirement for strong military services, large defense spending, alert and combat-ready forces in being with which to back up our foreign policy.

"The need will continue and grow for more enlightened American leadership, foreign help to those less fortunate—a need to travel, to see, to talk the languages, to invest, experiment, to gamble and to sell."

Mr. Gates is a Navy man and believes in the Navy, but he had a word of warning which fits the three services equally:

". . . If in our preparation for the future we are influenced by self-interests; if we tend to divide internally into traditional blocs of interest; if we continue to jealously watch the other services and to resist change, it is not going to be a very good destiny.

"For example, we should not focus on differences with the other services, but rather learn from them, help them and work with them. We might even buy some of their strong convictions."

Although agreeing that the horror and destruction of a major nuclear war made such a prospect virtually unthinkable, his words conveyed the thought that we have no alternative but to accept the concept of deterrence. It was, he said, "common sense."

His thoughts on the subject of limited wars revealed his attitude toward the other side of the coin. He said:

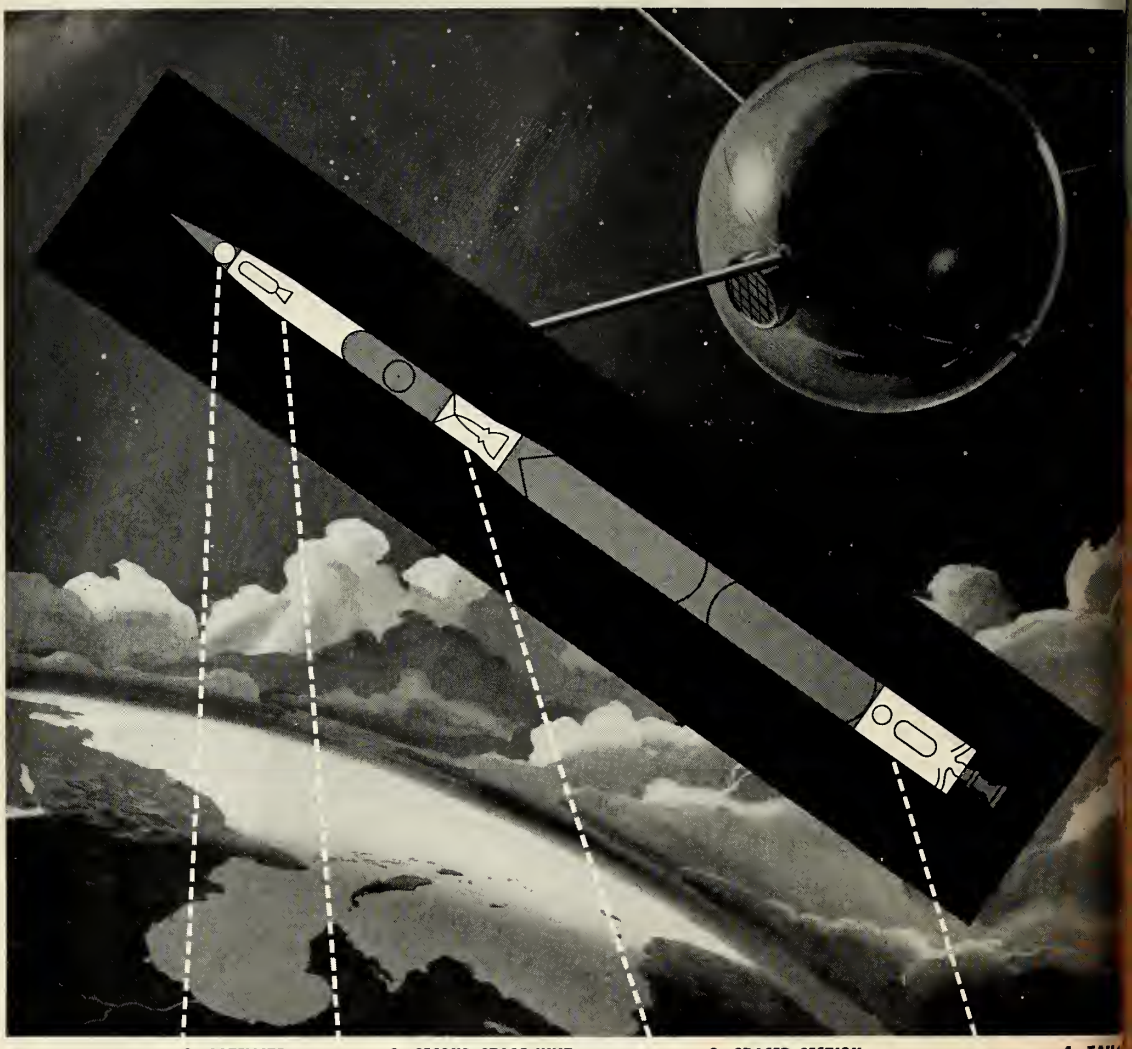
"The cold and limited war problem is not simple, but it is vital to understand it. In a limited war situation, the Navy must maintain a capability to use either nuclear or conventional weapons to the controlled degree necessary to achieve the objective. More funds are required for this purpose. More accent on its importance is needed. This support will have to come from the elimination of certain of the very expensive mass-destruction, single-purpose weapon systems which have a priority of claims against our national resources."

In general observation, Mr. Gates said:

"The Joint Chiefs of Staff continue to struggle with divided opinions as to the emphasis to be placed on various systems; and the Secretary of Defense continues to struggle handicapped by traditionally divided service opinions. The kind of constructive, objective teamwork that enabled us to win wars would help him. Again, good sense argues for understanding and agreement. Intelligent answers can be found within the informed minds of the best of our military and civilian officials."

There are few things there that any of the services can quarrel with, and much to give hope of wise judgment in an assignment where the lack of it can be a costly thing. If he can inspire—or create by organization—the kind of teamwork he pleads for, if he can do this alone he will have been successful.

Clarke Newlon



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The rigid external skin of the weather satellite is made of magnesium alloy, AZ31B. It is plated with gold and other materials to reflect heat.

2. SECOND-STAGE UNIT
The skin is made of HK31A, magnesium-thorium alloy sheet. This elevated temperature alloy must withstand temperatures of 700° F. and above.

3. SPACER SECTION
The skin is formed of AZ31B magnesium alloy sheet. Magnesium was selected for its light weight and high strength-to-weight ratio.

4. TAIL
Again AZ31B magnesium alloy ... chosen because it is the world's ligh... structural metal.

LIGHTWEIGHT MAGNESIUM SPEEDS WEATHER ROCKET FOUR WAYS

The shell of the satellite and several parts of the Vanguard Rocket are made of standard magnesium-aluminum-zinc and magnesium-thorium alloys. Why was magnesium chosen for this project? Because it is the lightest commercially available metal that could be easily fabricated—one with a high strength-to-weight ratio and able to withstand elevated temperatures encountered during flight. Magnesium alloys met these demanding requirements, as pro... by tests conducted by the Naval Research Laboratory ... Washington, D. C.

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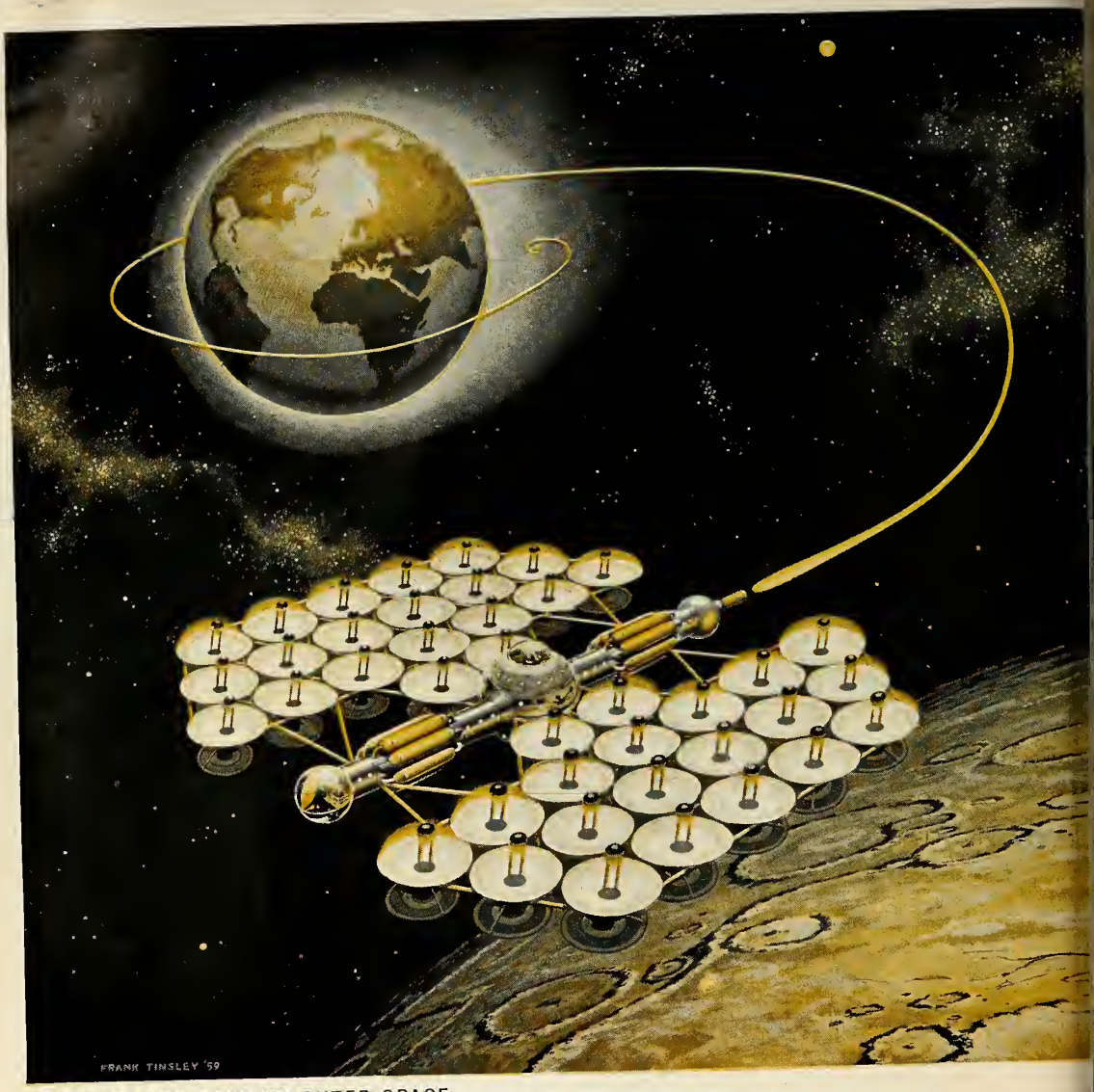

STEPS IN THE RACE TO OUTER SPACE

Cosmic Butterfly

Spreading its wings to absorb the eternal flow of solar energy is the Cosmic Butterfly, a space vehicle of a type first conceived by Dr. Ernst Stuhlinger of Redstone Arsenal.

Each of the fifty-foot parabolic mirrors in the wings concentrates the Sun's rays on a boiler at its focal point. Steam is developed, which drives a 200-kw turbo-generator in the base. Cooled by frigid outer space in heat diffusers, the steam reverts to water and is pumped back to the boiler to be used over and over again.

The current thus generated drives the main propulsion unit, an ion rocket in which powerful electric fields accelerate charged particles, shooting them from the rear of the rocket exactly as the electron gun in your TV set bombards the screen. Sunlight, then, is the power source, whereas cesium is the propellant.

While the recoil thrust is relatively small, the weightless vehicle is operating in a vacuum and the push is enough to enable the Butterfly to reach interplanetary speeds. Unlike conventional rockets, the Butterfly is under power the entire trip. Half way to its destination it turns around, and the ion thrust is used to slow the craft down to arrival speeds.

Since its thrust is entirely inadequate to cope with the gravity of major planets, the Cosmic Butterfly never lands. It is assembled in space and shuttles betw artificial satellites.

The Cosmic Butterfly could carry passengers and 50 tons of cargo an Earth satellite to a comparable orbiting around Mars in about one of continuous travel.

Inertial navigation systems will pla increasing role in the exploration of space. ***ARMA***, now providing such tems for the Air Force ATLAS ICBM be in the vanguard of the race to space. ***ARMA*** . . . Garden City, A Division of American Bosch Arma

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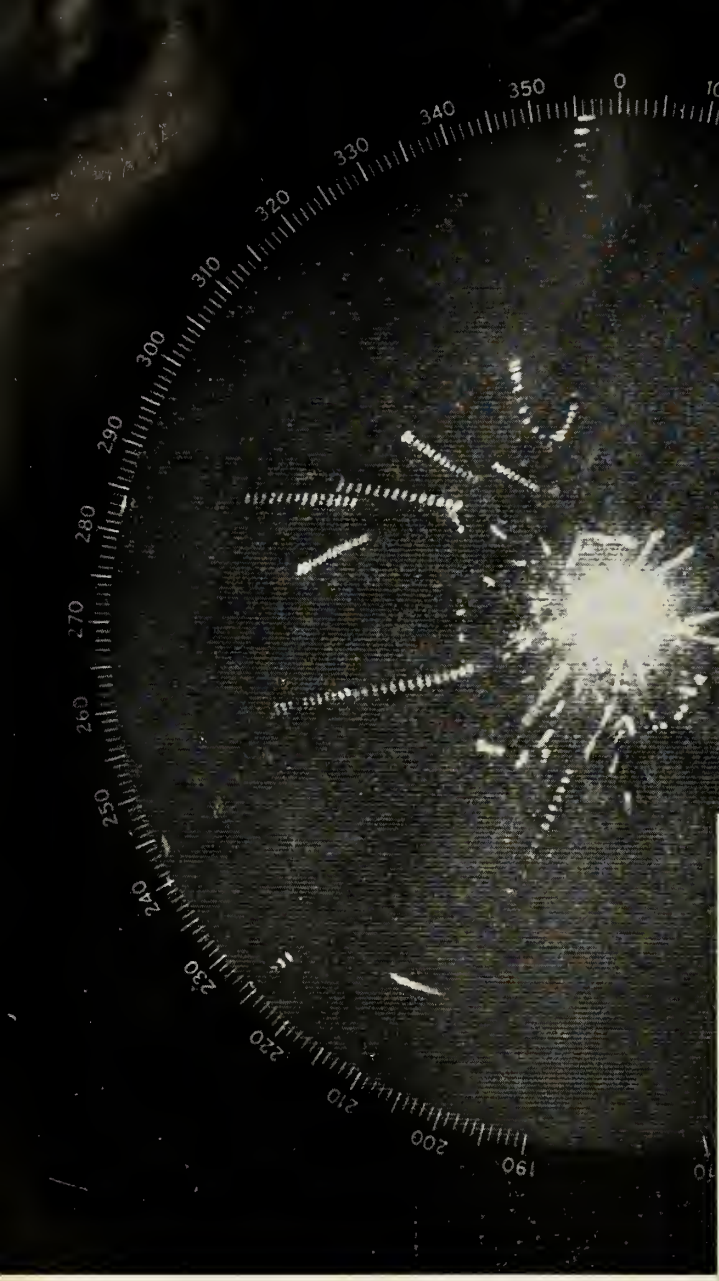
missiles and rockets, June 15,



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washington countdown

IN THE PENTAGON

The Administration still withheld announcement of its so-called "master plan" for missile air defense as M/R went to press. However, all signs pointed to a new compromise between the Air Force and the Army with both the **Boeing** *Bomarc* and **Western Electric** *Nike-Hercules* programs cut back somewhat, *Nike* probably getting the worst of it. Inter-service fighting over the basic issue of anti-air defense is expected to continue regardless.

A new interservice hassle . . .
may be in the offing over ARPA's Project *Transit*—development of a navigation satellite. The Navy has been handling much of the work, under overall ARPA management. But now that development is reaching advanced stages the question is which service is going to be given the system.

• • •

The Army is expected . . .
to pump the bulk of the extra $200 million voted it by the House into a production program for **Western Electric's** *Nike-Zeus*. That is, if the Senate goes along with the increase. The Army expects to be able to fire the 450,000-pound-thrust solid missile in 1960.

• • •

Move to establish . . .
a Strategic Command encompassing both Navy and USAF forces will probably live or die on the point of organization. Proposed now is a vertical Navy command, a vertical Air Force command for the strategic forces of each, with a unified commander over both. To say Navy is reluctant is putting it mildly, but it might agree if guaranteed certain command lines.

• • •

Maj. Gen. Charles M. (Sandy) McCorkle . . .
will leave the Pentagon early in July to assume command of the Air Force Special Weapons Center at Kirtland AFB, Albuquerque. His successor as assistant chief of staff for guided missiles will be Brig. Gen. Robert E. Greer, present deputy.

Both the Convair *Atlas* . . .
and the **Martin** *Titan* are all but certain to be used as second stages for *Saturn*—the clustered 1.5-million-pound-thrust engine being developed by the Army and **Rocketdyne.** *Atlas* will be used at first, *Titan* later.

• • •

***Discoverer IV* scheduled . . .**
for late this month or early July will not carry mice as did the ill-fated *Discoverer III*. However, if all goes well there will be another attempt to recover the satellite's biomedical capsule. The main purpose of the launching will be to check out all of the *Discoverer*'s equipment before making another attempt to recover an animal from orbit.

ON CAPITOL HILL

The Pentagon . . .
may be about to give a green light after all to speeding up development of the nuclear-powered plane—strategic companion of the ALBM. The Pentagon is scheduled to give the Administration's decision to the Joint Congressional Atomic Research Subcommittee this month. And congressional sources say chances are good for a go-ahead.

• • •

Candidate for star-studded . . .
congressional investigation of the year: The House Armed Services Investigating Subcommittee's forthcoming inquiry into the hiring of retired military and government officials by defense contractors. It's expected to begin about July 1. And it could result in a headline-hunt for alleged "collusion"—enlivening many a front page while Congress is in recess.

AROUND TOWN

Some of the reports . . .
that are being passed as the "latest" in the nation's capital:

. . . The Air Force is thinking of developing a rocket-ground effect train for transporting missile cars swiftly.

. . . If the cold war gets hotter, both Republicans and Democrats will vie with each other to become the "Big Defense" party during the 1960 election year.

. . . The Senate Space Subcommittee headed by Sen. Stuart Symington (D-Mo.) will recommend major shakeups in the organization of the nation's space agencies.

Bloodhounds ready for launching during acceptance trials at Woomera

EFFECTIVE

More advanced Bloodhound for defence of UK confirms particular suitability for European defence needs

Already in operational service with the RAF and adopted by non-NATO Sweden, Bloodhound Guided Weapon System is now to be further developed for the RAF.

This developed Bloodhound possesses substantially increased operating range and altitude, with advanced technique ensuring still greater lethality at these increased ranges and heights. Low altitude performance is further improved to counteract the threat of low-flying targets.

Development, rather than replacement, of Bloodhound offers the obvious economic and operational a inherent in making use of an existing system.

Proved in many hundreds of test firings; Europe's largest missile-manufacturing com particularly suited to European defence need Ferranti Bloodhound forms *the world's most e fence system now and for many years to come.*

Security forbids publication of full details following facts about Bloodhound can now be g

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The Bloodhound is powered by two Bristol amjets—jet engines with no moving parts. nsure power and range flexibility, burn kero- mple and safe to handle.

System. Semi-active: i.e., ground crew directs a on to target, which is reflected to a receiver in d, ensures highest accuracy—regardless of siles may be fired, singly or in salvoes, using dar.

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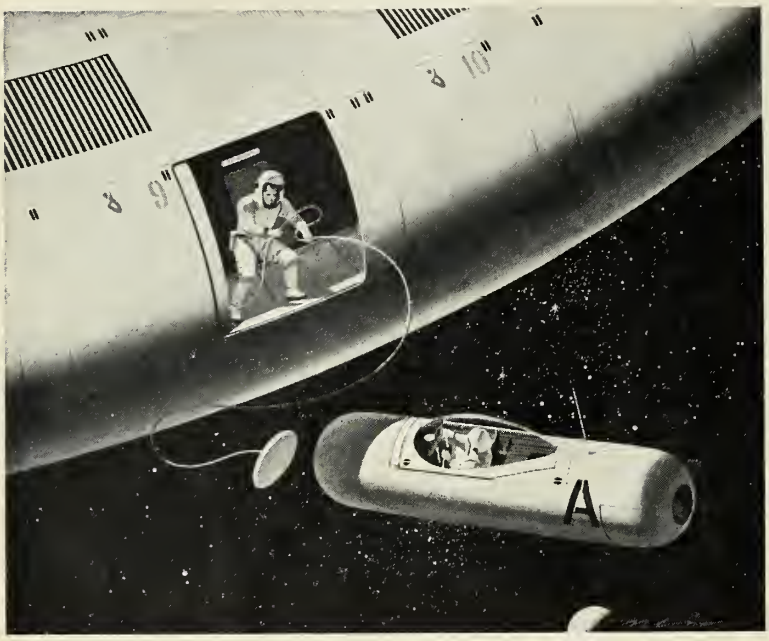


WHAT KIND OF ENGINE FOR A SPACE-JEEP?

It takes a unique engine to jockey a space-jeep in for a landing on an orbiting space station—one that will give a space pilot instant control and precise maneuverability.

Such an engine is the fully controllable rocket engine—ideal for space travel yet as easy to operate as an automobile engine.

The rocket engines are ready now

Although the space-jeep is still a gleam in an engineer's eye, the controllable rocket engine is available now...and has immediate application for existing aircraft. The pilot of a plane with auxiliary rocket power can switch it on for sudden, swift acceleration at high altitudes . . . the aircraft's air-breathing turbojets supplying power for ordinary flight operations. This is the mixed-power theory. Since World War II several mixed-power concepts have been developed in foreign countries, including Russia, France and England.

Extra power for today's aircraft

Rocketdyne already has designed, tested, and manufactured rocket engines for mixed power applications. The AR-1 rocket engine is a liquid-propellant system, as are the large power plants for the Atlas, Thor, Jupiter, and Redstone ballistic missiles. The AR-1 passed stringent flight tests as a supplementary power plant on modern jet aircraft. Substantial improvements over normal near-sonic speed and 50,000-foot altitude capabilities were demonstrated in more than 100 test flights.

The AR-2, second in a series of four rocket-engine models developed by Rocketdyne, is a fully-throttleable engine that provides varied thrust. Using fuel from the airplane's t—which automatically ignites hydrogen peroxide—these eng have full stop and restart capabi

More value for taxpayers' mone

The auxiliary rocket engine present aircraft superperform capabilities at a relatively low co provides the increased speed and neuverability that could spell the ference between the success or fa of an intercept mission. Almost existing jet aircraft, as well as now on the drawing board, ca adapted readily for AR engines

Looking forward to tomorrow

Beyond a doubt, rocket power leading role in the Free W future. Rocket-propelled airpl such as the X-15, will pave the for man's entry into Outer S The multi-million-pound-thrus tems that are now under develo at Rocketdyne will be man's r to explore interplanetary Space meanwhile, these rapid advanc rocketry can add great streng America's present deterrent ar

THE MEASURE OF ROCKET PO

The liquid-propellant AR engines are "static test Rocketdyne's field labora measure thrust and perfo

FIRST WITH POWER FOR OUTER SPACE

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

industry countdown

STRUCTURES

Preoccupation with the *Bomarc-Nike-Hercules* scrap has held up a decision on the *Dyna-Soar*. But most insiders think that since both **Boeing** and **Martin** had many good points in their separate proposals for the boost-glide bomber, the contract is unlikely to go to either company exclusively. They will most likely get the contract as a team, with one being named prime agent.

Announcement is due shortly . . .
that lucrative arming and fusing contract for *Polaris* will go to **Crosley Division,** Avco Mfg. Crosley, which does *Titan* fuzing, will get the contract from the Naval Ordnance Laboratory.

• • •

Vehicle test programs . . .
of **Lockheed-Convair, Martin** and **McDonnell** ALBM concepts are continuing under AF contracts—with results going to **Douglas** which has development contract. Over Cape Canaveral last week, Martin successfully fired its two-stage solid-fueled *Bold Orion* concept. It traveled more than 1000 miles.

PROPULSION

There are indications . . .
that NASA may undertake another parallel development program in multi-meg liquid boosters with contract ball possibly being passed to **General Electric.** GE has plugged nozzle concept which is creating a good deal of interest and speculation; has put about $1 million of its own money into the concept—designed to eliminate heavy and complex metallurgy such as thrust vectors, jetavators, gas bleeds, verniers, etc. Material for cone-shaped plug and fabrication techniques are closely guarded proprietary information, and there are patent rights to be settled. GE isn't talking except to opinionize that conventional design for large-meg boosters will be too costly and will run into too many combustion and stabilizing problems.

• • •

The cheaper fuels . . .
probably will have to be used in million-pound thrust boosters. Just multiply costs per pound of propellant at flow rate of 6000 pounds per second at 1.5 meg and you come up with astronomical fuel charges.

ELECTRONICS

Some market analysts . . .
are predicting silicon transistor sales to upswing sharply from estimated 47.1 million units in 1958 to 69.6 million in 1962. Switching performance reportedly is the best feature of silicon in missile and computer applications, with low reverse current an important factor.

• • •

With many problems . . .
still unsolved in visual search and recovery of space vehicles, look for stepped-up action in the next few months in connection with Project *Mercury*. While water landings are still planned, new techniques for sighting capsules are under investigation for mountainous terrain, wooded and snowy areas.

• • •

High altitude recovery . . .
of 15,000-pound *Atlas* used as *Mercury* booster is programmed before end of this year. Method is being developed by **Space Recovery Systems Inc., CBS Laboratories** subsidiary, utilizing "marriage" of electronics and aeronautics to trigger parachute and return equipment to pre-determined area.

• • •

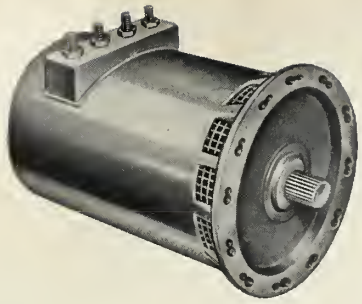
Booster recovery . . .
would save millions of dollars worth of hardware which could be used over again. But some industry skeptics believe development of reliable recovery system will cost more than boosters—particularly if they can be made cheaper in mass production.

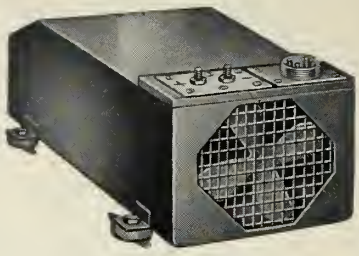
ASTROPHYSICS

"Moon-chips" . . .
is name given to stone meteorites by Dr. Harold C. Urey, University of California, who theorizes they may come from collisions between meteors and face of the moon. Chemical composition of "chips" is unlike anything found on earth. Measurement of their cosmic radiation exposure content indicates age of 2 million to 90 million years, which Urey believes would put origin near earth's orbit. Iron meteorites on other hand have exposure time of 100 million to 1.5 billion years, suggesting they may have originated between the orbits of Mars and Jupiter.

SPACE MEDICINE

Required reading . . .
for astronauts: *Human Tolerance to Prolonged Forward and Backward Acceleration.* Report on g effects found in tests on WADC human centrifuge is available through OTS, U.S. Department of Commerce.





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NE 15, 1959—VOL. 5, NO. 25

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

AF Cataloguing Support Items

Massive volume due July 1 should save millions in wasteful development of redundant equipment and should standardize handling and checkout gear

by William E. Howard

Sixth of a Series on Missile Support

WASHINGTON—Within a few weeks Air Force—with industry's help—start closing the missile support formation Gap."

Coming off the presses about July 1 the first 500 pages of what eventu- will be an encyclopedic catalogue ng missile/aircraft support equip- it purchased or under development the Air Force. It will be called the port equipment "Technical Informa- File."

As the first inventory of the vast port field, TIF appears destined hape the industry's future for years ome. Pentagon procurement policy ers already are counting on it to me the key instrument in:

- Saving millions of dollars by inating wasteful development of ndant equipment and continued urement of obsolete equipment.
- Standardizing ground handling checkout devices at a further sav- in more efficient procurement and ing of maintenance personnel.
- Bringing about development of lti-purpose" support items—capable erving more than one missile, or aps both a missile and its carrier ane.

Moreover, the Air Force TIF is the runner of a Defense Department e to standardize missile/aircraft ort equipment development and urement throughout the armed es, M/R has been told. A study ect (MISC0001) headed by the Air e is trying to establish a system an Army-Navy-Air Force TIF.

he study group already has reached rvice agreement on a format for sheets to describe equipment. It nilar to the Air Force TIF format. the knottier problems of organiz- ing a catalogue so that it can be used as a common purchasing and design reference by all three branches of the military remain to be resolved.

• Unification step?—Success of this project might in itself be a giant step toward bringing about practical realization of the old, much-talked-about, long-pigeonholed dream of unifying the services.

The Air Force TIF is a half-step, at least, in this direction. The DOD is making its use mandatory by Army and Navy procurement officers and contractors.

Differences in weapon systems and sheer magnitude of their ever-multiplying back-up requirements make even the compilation of a one-service technical information file an enormous task. Following up the first 500 AF TIF data sheets will be 23,000 more in a month or two. Listings eventually will reach the hundreds of thousands.

The TIF is being put together by the Air Force Directorate of Supply in the Air Materiel Command at Wright-Patterson AFB. Heading up the job is Martin Connelly, chief of standardization in the Office of Cataloguing and Standardization.

The spawning of whole new families of support equipment during the past few years to service new missiles, says a high Pentagon official, "has created a horrendous problem in training maintenance personnel. Even the checkout equipment has to be checked out.

"It's like fleas having fleas."

TIF will be mostly unclassified. The catalogue will be loose-leafed, so that pages may be removed and new ones inserted as equipment becomes outmoded or there are other changes.

Distribution presently is planned to all prime weapon system and support contractors and military procurement officers. Additional copies will be available at local Air Force procurement districts. An initial press run of around 2600 copies is planned.

But Lt. Col. Oscar B. O'Neill, who headed the industry-Air Force task group which created TIF, concedes that demand very likely will dry up the supply in a twinkling. "This is going to become the Sears & Roebuck catalogue of the missile business," he says with a smile.

O'Neill is chief of the support equipment division, Logistic Support Office, Aeronautical Systems Center, at Wright-Patterson. As chairman of the industry-Air Force group, he supervised the overall development of TIF.

Contributing from industry were representatives of Aerospace Industries Association, Electronic Industries Association, the Society of Automotive Engineers and the National Security Industries Association.

To obtain complete Air Force representation, members were seated on the group from USAF Headquarters, from every AF directorate, the AMC, every air materiel area and depot, all commands such as SAC and TAC and from overseas units.

Field technical requirements came from 16 Air Force Equipment Advisory Groups, comparable to Weapon System Phasing Groups, which are charged with maintaining a continuity of experience in support equipment.

Support equipment catalogue . . .

EAG's were formed also to help promote more "commonality" among ground systems.

Today, an effort is being made to put together in the Air Staff an equivalent group—perhaps informal—to keep going where O'Neill's TIF group leaves off. This would be a support equipment "management panel" to act as a watchdog, keeping a cross-system check with TIF as the guidebook.

"For the first time," says an Air Force official, "we are going to be able to comprehend the size of the support effort." Missile support alone is estimated at more than $3 billion a year. But until TIF no effort had been made officially to compile a complete support equipment inventory between two covers.

• **Designers' quandry**—For some time Air Force regulations have enjoined weapon system contractors to recommend and design into a missile equipment that is currently in use—either "as is" or with modifications. If this is not available, they are to utilize off-the-shelf commercial equipment currently in the Air Force supply system, or other off-the-shelf commercial equipment. Only as a last resort are they supposed to design a piece of equipment from scratch.

The big problem for designers, however, has been in learning what is available, or is likely to be available when they need it, and if it will meet the specs of their system. In some cases, industry officials say, acquiring this information would have entailed major research. So it was faster to design what was needed rather than waste time hunting for a piece of equipment which might not exist.

"Everybody realizes that this produced an awful lot of redundant equipment that was wasteful," comments a member of AIA. "But what were you to do when a weapon was wanted in a hurry?"

TIF will eliminate this information gap. Henceforth, designers will only have to flick through its pages to know what can be turned to their use. This includes equipment which is still in the development stage, but which has progressed far enough to be described on a data sheet.

On the other side of the coin, military procurement officials will have in TIF a handy reference to police contracts. They can tell whether a contractor is following the requirement to utilize equipment that is procurable, or is proceeding willy-nilly to develop it over again.

• **Data sheet format**—Listings will be only of equipment that has procureable status. This means that a manufacturer will have his piece of equipment entered in TIF only if it is in use or on order by the Air Force. The item won't be included otherwise—even if it is identical down to the angstrom with a competitor's item that has status.

Since data sheets will give the name of the manufacturer, some DOD authorities believe the advent of TIF will provoke some "real wild" competition. The low bidder gets in the catalogue, and thus will have an advertising "track" for his item to be designed into future weapons.

Specifications for data sheet preparation by companies, as detailed in MIL-D-19731A, call for sufficient precise data to familiarize maintenance and engineering personnel and government contractors with the "characteristics and physical make-up of the equipment used in support of aircraft and missile systems."

For contractors, they are "intended to provide sufficient information for determination that an item of equipment is suitable or unsuitable for a contemplated application, usually without recourse to supplemental detailed data." However, the data sheets require the reporting of where detailed information is available. This can be requisitioned if the information needed for possible modification of item.

In addition to an illustration of t item, the data sheet also will provi a brief functional description, applic tion and what it is used with. Its re tion to similar equipment also is giv along with a technical description.

This latter description, in tabu form, gives the frequency range, pow output and/or input—including amp age, KVA, number of wires, pha type of receptacle or plug—other p tinent electrical and mechanical ch acteristics, dimensions etc.

Once the TIF compendium is co plete, Air Force officials believe th will be able to proceed to "optimiz standardization of such items as liq fuel generators, fuel transport, stor and service equipment, and other h dling items required by missiles. Th hope to come up with automatic che out equipment for air-to-air and to-surface missiles that is compati with and capable of checking out s tems of launching plane or other m siles.

And, important to suppliers, che out equipment also would be standa ized in Air Force bases and depots that if the mission of a base is chan equipment may be transferred to other base and not junked.

An Air Force official was aske TIF and the mounting push tow missile support standardization m tend to "freeze" some weapon syst and hamper future development others.

"That might be so," was the re "But, on the other hand, where do stop on gold plate? By knowing wh we stand, with the Technical Infor tion File, we will have a better cha of striking a balance of optimum formance with optimum economy."

About the Cover

The *Nike-Hercules*—the Army's entry in its rivalry with the Air Force to maintain the nation's anti-aircraft defenses—is being turned over to Nationalist Chinese troops to guard Formosa (Taiwan).

The Western Electric *Nike-Hercules* first appeared on Formosan soil last year during the Quemoy-Matsu crisis.

U.S. troops set up and manned a 48-launcher battalion of the 75 to 100-mile range missile capable of knocking down enemy aircraft with both conventional and nuclear warheads.

About half of the U.S. troops who manned the *Nike-Hercules* on Formosa already have been withdrawn. Their posts have been taken over by Nationalist Chinese. The switch is scheduled to be completed by mid-August.

Nikes in the hands of the Nationalist Chinese will not be equipped with nuclear warheads.

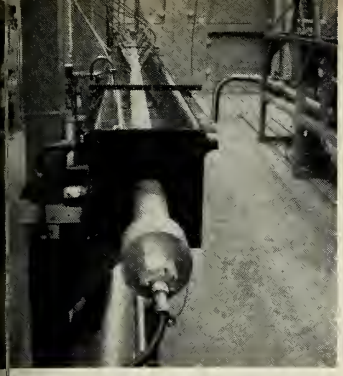
However, U.S. Air Force units on Formosa will continue to man nuclear warhead-tipped Martin *Matadors*.

Heat and Meteorite Impact Effects Studied

DOWNEY, CALIF.—A study of interaction of surface materials and high-temperature boundary of air rounding a high-speed moving has been undertaken by the Aero-S Laboratories at North American tion's Missile Division.

The advanced research proje sponsored by the Army.

A second area of investigation, for the Army, is a laboratory in which minute particles simul meteorites will be bombarded a various materials to determine in effects. Speeds near those of par in space will be achieved with high-velocity equipment being veloped by the laboratories.



CK WAVES resulting in pressures up 0,000 pounds psi are measured in the less steel detonation tube. Walls are half inch thick.

AF Pushes Research On Detonation Problem

by James Baar

WRIGHT-PATTERSON AFB—A multi-ion-dollar missile is on its test d. Its propellant ignites. Seconds a blast rips through the missile leaves it a pile of blazing ruins.

Why?

And what can be done about it?

One of the keys to answering these tions is a better understanding of phenomenon known as "combus- instability." Some call it "oscil- y combustion."

It results in considerably higher normal pressures, temperatures rates of heat transfer.

A team of scientists at the Aero- ical Research Laboratory at Wright Development Center has been in- gating the phenomenon in a newly- laboratory for the past year.

Their research could lead to:

• Much greater reliability of missiles spacecraft boosters.

• More efficient combustion systems lighter and smaller engines.

• Removal of a principal roadblock to "scaling up" the huge rocket systems needed for space exploration.

The Air Force scientific team headed by Bernard T. Wolfson has constructed for their investigations a special high-pressure detonation research facility. Their equipment enables them to measure fundamental detonation parameters under the conditions present in rocket engine combustion chambers.

The pressure of exploding gases at the time of detonation and the velocity of the resulting shock wave are measured in a stainless steel 15-foot detonation tube. Its diameter is 1½ inches. Its walls are one-half-inch thick.

Pre-mixed gases from remotely located high-pressure storage tanks are fed into the tube and ignited. An electronic timing system capable of clocking passage of the shock wave to within one-tenth of a microsecond takes five readings as the wave moves down the tube. Pressures are measured by a recently developed system capable of accurately measuring large pressure changes ranging to 100,000 pounds psi in a reaction time of less than one-half of a microsecond.

The scientific team also is using:

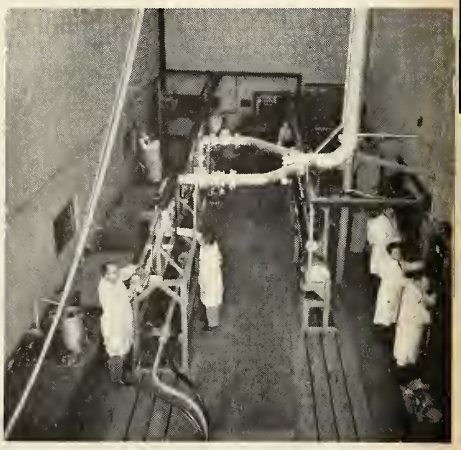
• An 18-foot shock wave-flame interaction tube to investigate the interaction of a shock wave with a stabilized flame front and ignition of a gaseous mixture by shock.

• A 25-foot flow detonation tube for observing the influence of gas flow on detonation wave characteristics.

Both the deflagration and the flow tubes are equipped with windows for visual observation by means of high-speed photography. The 3-inch-wide tubes are made of chromium molybdenum steel.

The investigators are using a Beckman and Whitley ultra-speed framing camera to take pictures of the detonation waves which reach speeds of Mach 10. The camera takes 25 pictures of the wave as it passes an observation window in 1/15 of a millisecond.

LW TUBES for investigating shock- ar: interaction and influence of flow n detonation wave characteristics.



OVERALL VIEW of Air Force high-pressure detonation research facility. Lab has blow-out panels in case of accident.

How Do We Make Weapon System Integration Work?

AF has established Project Offices with broad authority for overall management of all phases

by Betty Oswald

WASHINGTON—Traditional methods of doing business with the Defense Department will have to go by the boards in the years ahead. This means, according to Gen. Edwin B. Rawlings (USAF, ret.), long-time boss of the Air Materiel Command, that the development of new and complex missiles, rockets, space ships and other weapons is forcing the disappearance of the traditional distinctions between research and development, procurement and production, and maintenance and supply.

Quantity production is a dead issue with the high-yield weapons of the future. Today, the talk is of building 40 B-58's in a year—little more than three a month—and of 70 B-52's with fiscal 1960 money. And very limited numbers of very high-cost missiles are obviously in the cards.

These facts, together with the complexity of new weapons and the difficulty of making a complete weapon system operational in the earliest possible time period, lead inevitably to weapon system management and integration and to less rather than more advertised bidding, according to military spokesmen. This is hard for Capitol Hill to swallow because with the shift to limited production, costs are soaring, plants are closing and will close, and small business is perennially in trouble.

This means that the Congress, looking at the highly undesirable end results, is blaming this new and admittedly creaky process known as the weapon system management concept, rather than the change in weapons, according to both military officers and men who deal in weapon system management from industry.

As they see it, the job is to make weapon system integration work. Key to the effort is the Air Force Weapon System Project Offices now set up both by the Air Materiel Command and the Air Research and Development Command.

• **No delegation**—In talking of Project Offices, which are the focal point of the effort to push out a complete weapon at the earliest possible time, AF officers make it plain that they are not delegating their authority or responsibility to the prime weapon system contractor, despite charges sometimes made.

The Weapon System Project Office is basically responsible for the overall management of development, procurement, production, supply, maintenance and integration of each assigned weapon into the Air Force inventory. Hence it is the contact point for both the Air Force itself and industry.

It was created in its present important place in the AF structure in full recognition of the fact that y can't manage development—or for th matter procurement and productio supply or maintenance or even traini and operation, in a vacuum. Integ tion, according to the modern day e perts in logistics, represents the key.

It's important to know right fr the beginning, when the launching pa will be needed, the type of person which will operate and maintain t equipment, the training effort wh will be required to obtain necessa skills, and the facilities which will needed both to produce and to ma tain the new weapons.

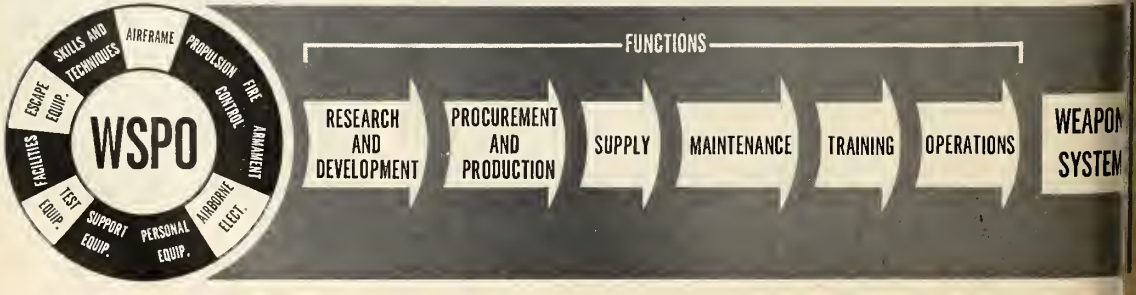
This means that the WSPO's staffed by experts in all of the ma elements of the system, including frame, propulsion, fire control, borne electronics, support and t equipment, facilities, aircraft esca equipment, as well as by people w know what skills and techniques w be required for an operational syste

• **Responsibility**—Management the office depends on whether weapon is only in development, whether the decision has been made produce it for inventory. If the p gram is still in the technical devel ment stage, ARDC has what is kno as "executive management respo bility." If a decision to produce been made, "EMR" shifts to AM This by itself could cause unnecess delays in the program.

In an effort to cut across the wh structure of the AF and eliminate problem, ARDC and AMC weap system project officers are kept wo ing together—either in the sa room or across the hall and on Weapon System Phasing Groups w representatives not only from AR and AMC but also from the Train and Using Commands and from Force headquarters.

These groups meet at least onc month under the chairmanship either ARDC or AMC, depending which command has executive m agement responsibility.

How each group handles its pr lems will be the subject of l articles.



Aerojet's New Sounding Rockets

Company is already taking orders for Astrobee series reportedly costing less than Aerobee but offering improved ease of handling, thrust alignment and attitude accuracy

by Frank G. McGuire

AZUSA, CALIF.—A new series of sounding rockets to take over where *Aerobee* leaves off has been proposed by Aerojet-General Corp.'s Systems Division. Named *Astrobee*, the rocket would consist of two basic vehicles, the *Astrobee-200* and the *Astrobee-500*, with an attitude-control system available if desired.

The *Astrobee* design grew out of an Air Force request through its Cambridge Research Center for a staged solid-propellant rocket with 200-mile-altitude capabilities carrying moderate payloads. The resulting design, *Astrobee-200*, will carry 120 pounds of useful payload to that height.

The larger version, *Astrobee-500*, will carry a gross payload weight of 250 pounds to 725 miles. These performance figures assume a 5° launch angle at sea level.

The first flight test in the series is due in late fall from Fort Churchill, Canada.

Costs on the *Astrobee* run somewhat below the *Aerobee;* the *200* costing about $10,000 to $15,000 and the *500* from about $15,000 to $20,000. Standard materials, such as aluminum fins, are used for construction. The nose cone is composed of an ablative material for re-entry.

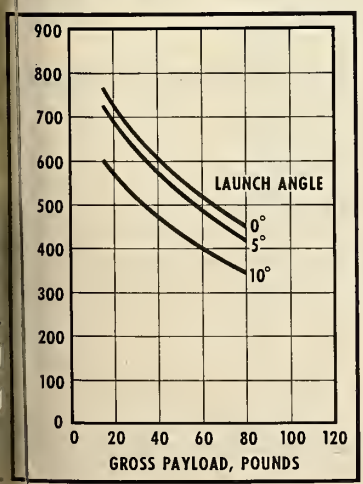
Aerojet has received orders for two *Astrobee-500* rockets and has quoted prices on four more.

Advantages of the new series, as cited by AGC, are ease of handling and servicing, improved thrust alignment, and close manufacturing of longitudinal and lateral centers of gravity. Both versions were designed for launching from rails, and feature fin stabilization and high initial acceleration.

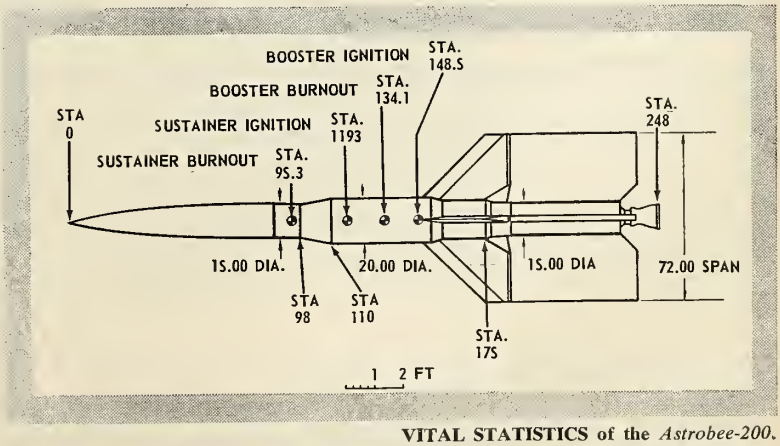
• **Breakdown**—Gross launching weight of the two-stage *Astrobee-200* is 1689 pounds (with zero useful payload). Breakdown of the rocket booster, 593.5 pounds; sustainer, 1071.5 pounds; payload compartment, 24.0 pounds. Payload compartment weight includes that of the heat shield. The booster is a modified MB-1 solid-propellant motor such as used in the *Genie* AAM.

Astrobee-200 is approximately 20.6 feet long overall and its total span is 72 inches. (Booster and payload compartment diameter is 15 inches and sustainer diameter is 20 inches.) The length breakdown: booster, 73 inches; sustainer, 77 inches, and payload compartment, 98 inches.

Aerodynamic heating on the *Astrobee*'s surfaces has been calculated by AGC engineers, and appears as a sharp climb after 25 seconds of flight. At this point, temperature at three inches from the nose is about 175°F,



PERFORMANCE of *Astrobee-500* in sea level launchings with 12-sec. coast time.



VITAL STATISTICS of the *Astrobee-200*.

ASTROBEE-200 TRAJECTORY SUMMARY

Data for: Sea-Level Launch 5° Launch Angle

USEFUL PAYLOAD, LB	100	175	250
BOOSTER BURNOUT VELOCITY, FT/SEC	1340	1290	1240
BOOSTER BURNOUT ALTITUDE, FT	1380	1320	1270
SUSTAINER BURNOUT VELOCITY, FT/SEC	8200	7150	6370
SUSTAINER BURNOUT ALTITUDE, FT	111,000	101,000	93,600
MAXIMUM ACCELERATION, G	20.8	19.9	19.2
PEAK ALTITUDE, STATUTE MILES	215	160	131
SLANT HEIGHT, STATUTE MILES	232	173	141
RANGE, STATUTE MILES	174	130	104
TIME ABOVE BURNOUT ALTITUDE, MINUTES	8.8	7.7	6.9

ATTITUDE CONTROL SYSTEM AZIMUTH AND ELEVATION ERRORS

CAUSE	ERROR CONTRIBUTION (3S VALUE) ASTROBEE-200	ASTROBEE-5
Mass unbalance drift @ 1.2 deg/hr/g	Negligible	Negligi
*Anisoelastic drift @ .02 deg/hr/g²	0.018°	0.020°
Random drift 0.20 deg/hr	0.0167°	0.049°
Alignment of input axis of gyro to gyro case	1 MIL.R	1 MIL.R
Alignment of gyro case to reference axis	1 MIL.R	1 MIL.R
RMS Total	0.085°	0.097°

*For purposes of this study, an environment of 100 g² was assumed.

climbing to 1300°F by 45 seconds. At 18 inches from the nose the temperature shows a rise from 125°F at 25 seconds, to over 600°F at 45 seconds. Leading edges of fins show similar temperature rises, but none of the heat increases reaches a critical stage.

The three-stage *Astrobee-500* achieves a maximum altitude of 765 miles with a 15-pound gross payload. This performance changes as payload weight changes, and a 600-mile peak altitude is reached with a 40-pound payload.

Launching weight of *Astrobee-500* is 1862.3 pounds, without payload section, with breakdown as follows: first stage, 602.5 pounds; second stage, 1050.5 pounds; third stage, 209.3 pounds.

Overall length is about 25.5 feet and the span is 72 inches. The first two stages are the same as in the *Astrobee-200*. With the MB-1 booster and the 30KS-8000 second-stage motor (eventually to be used with *Thor-Delta*), is the third-stage *ASP* rocket.

• **Optional equipment**—An attitude-control system has been developed as an optional addition to the *Astrobee* series. Designed to carry a special camera, the payload section can be recovered intact, as well as properly oriented during photography. Dispersion of the film magazine on its return to earth is kept at a minimum. The attitude control is in operation during the entire ascent of the vehicle and the initial phases of descent.

The attitude control equipment for the *Astrobee* series is comprised of an inertial reference system, a reaction-jet servo system, electrical power supply, and a reaction-jet fuel supply. High-pressure nitrogen or air is used as the working gas for the reaction jets. The servo valves control reaction-jet thrust in proportion to a dc electrical signal received from the guidance mechanism by discharge of the compressed gas. A closed-loop pressure-regulation system is used to obtain good linearity and essentially constant thrust sensitivity.

Although the control system for the *Astrobee-200* is also applicable to the *500*, there is an independent system used for the booster of the *500*. Due to the large difference in thrust and total impulse of the two upper stages and the booster, the attitude-control system for the booster is large enough to correct maximum thrust misalignment during operation. The system is contained within the booster and separates with it.

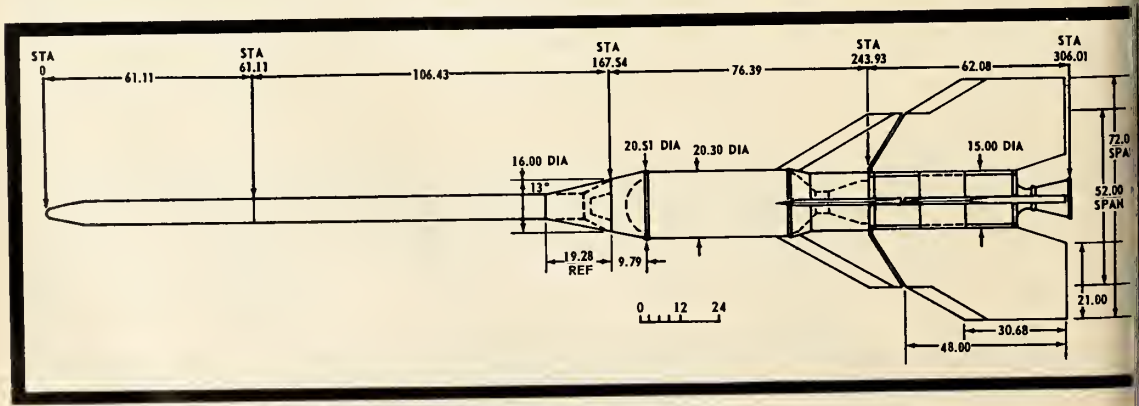
• **Guidance**—The guidance system uses a body-mounted inertial reference of floated rate and rate-integrating gyros. It provides varying rate dc voltages to the appropriate actuation members for the purpose of attenuating disturbing influences on the vehicle. The three miniature rate-integrating gyros accept command voltages to the control system, sense angular velocity about the three major axes, and pr duce corresponding integrated r error output voltages.

The rate damping package has thr orthogonally-mounted rate gyr aligned to the major axes of the v hicle. They measure angular velocit about these axes and supply inform tion to the system for correction.

The electronic compartment, whi provides for the acceptance of d placement and rate information, w forward the data to the appropri polarity-sensitive actuation assembli Other functions of the compartm include gyro temperature control, g monitor circuitry, power amplifiers the gyro spin motors, gyro pickoff citation, preamplifiers, demodulato filters and summing preamplifiers.

Power supply for the guida package and servo-valve assembl consists of 26-volt, 400 cps out from a 21-cell silver-zinc battery w static inverter. The supply occup 150 cubic inches and weighs pounds. Effective rated capacity is watt-hours/pound. Provision will made for possible programming wind shears, coriolis accelerations other effects, as the situation requi

Accuracy of the attitude system been analyzed by AGC, and it has b estimated that maximum angular r about a resultant axis at apogee be less than one-half degree second.



DETAILS of the *Astrobee-500*.

COMMAND DESTRUCT

The flight testing of second generation missiles—more versatile and powerful than their predecessors—requires a device for sure termination of any missile flight that might endanger the test range or surrounding area.

Ramo-Wooldridge engineers, under a United States Army Signal Corps contract, have successfully developed and delivered the first sub-miniature, completely transistorized radio "command destruct" receivers.

Specifically designed for missile flight safety operations, the receiver (AN/DRW-11) can actuate safety mechanisms or destruct devices. It has three command channels, each of which actuates a control relay.

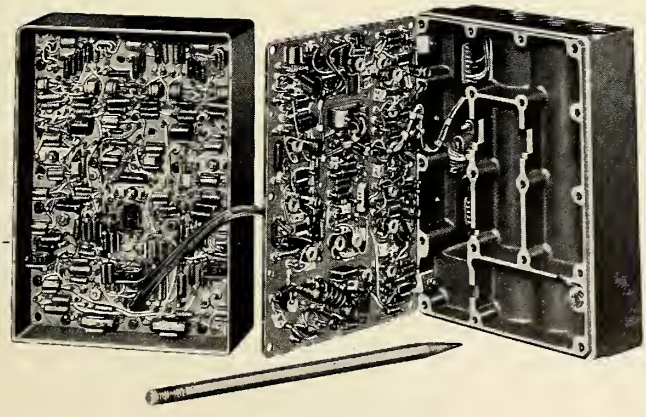
The "command destruct" receiver accepts frequency modulated signals in the UHF radio command control band. It is designed to operate with closer radio frequency and command frequency channel spacing than has been used to date, thus making possible more efficient use of the available radio spectrum.

Compact and rugged, the radio receiver's modular construction permits rapid and complete accessibility to all components. One module houses the basic receiver. The second module contains the three command channels and relays. This integrated package occupies 115 cubic inches, and weighs 4 pounds. The receiver requires no pressurization and operates reliably under the adverse environmental conditions encountered in missile flight testing.

Engineers and scientists interested in being associated with some of the nation's most advanced research and development programs are invited to acquaint themselves with current opportunities at Ramo-Wooldridge. The areas of activity listed below are those in which R-W is now engaged and in which openings exist.

Missile electronics systems
Advanced radio and wireline communications
Information processing systems
Electronic language translation
Anti-submarine warfare
Air navigation and traffic control
Analog and digital computers
Infrared systems
Electronic reconnaissance and countermeasures
Basic and applied physical research

For a copy of our brochure, *An Introduction to Ramo-Wooldridge,* or other additional information write to Mr. Donald L. Pyke.



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Space Feeding: Big $$ Market

Air Force contracting with industries on four lines of space food with bulk of work being handled through Quartermaster Food and Container Institute

by James Baar

WRIGHT-PATTERSON AFB—When the first U.S. astronaut eats his dinner in space, he will be munching on products that may put millions of dollars in the pockets of the nation's food industry.

Both industry and government food experts expect that many of the special new products being developed for space travel will be highly adaptable for sale at the corner supermarket.

At present, four main lines of space food are being developed under the direction of the Aero-Medical Laboratory at Wright Air Development Center:

• Semi-solid food in tubes—A wide range of fruits, meat and vegetables. Some of these are junior baby food with some seasoning added.

• Bite-size solid food—These are such things as bacon tablets, cheese tablets and malted milk tablets.

• Solid-food "lipstick" rods—Many of these are highly-nourishing grain mixtures in a variety of flavors. A main course item: Cheese and smoky rye. Dessert: Chocolate peppermint.

• Dehydrated foods—A wide range of fruits, meat and vegetables. Even casserole dishes. Just add water and stir.

The Air Force also is attempting to develop space food containers that can be eaten. There are two varieties of these: those that can be eaten without harmful results and those that provide some nourishment as well.

Most of these items are being designed not for the first manned space flights but for the much longer space flights to come.

The first flights will be only a matter of days at most. Therefore, semi-perishable food can be used to make up the bulk of the first astronauts' diet. It is when flights lasting a week, a month or even years are taken that the new space foods will be needed.

• **Water recovery**—Moreover, their use—particularly the dehydrated foods—is closely tied to development of a water recycling system. Such a system would make possible the reuse of human liquid waste products and eliminate the need for carrying great quantities of water in storage tanks.

American Machine & Foundry Co. has found in a study contracted by the Air Force that in week-long flights involving one or two men water could be recovered by a vacuum distillation technique. Impurities not removed by distillation could be removed by an ion exchange system or absorption.

The Air Force now is planning further studies on which techniques would be most practicable for water recovery in flights involving two men over periods of more than a week.

At the same time, the Air Force has contracted with AMF to develop a waste collection unit and with the Massachusetts Institute of Technology for studies of methods for recycling solid waste products.

However, a number of scie close to the space food program not overly enthusiastic about the As Dr. Harry C. Dyme, chief of Aero-Medical Lab's Nutrition Sec put it:

"We all know that the recy process is what keeps the world g We use fertilizer to grow food tha eat. But to have the recycling goin in such a closed environment space ship might be a little disqui psychologically."

Still, Dyme said, such a sy might be essential in order to pr enough food for a crew during i planetary flights that could last than a year.

For example, algae might be g on waste products. Then, after p cation, it could be mixed with drated cereals.

• **Participation**—The bulk of Aero-Medical Lab's space food opment is contracted through the termaster Food and Container stitute. Much of the recent worl the Institute has been handle American Can Co., Gerber Pro Co., Colton Machinery Corp. Dryve Foods. Work also has been by such meat packing firms as and Armour.

American Can, Colton and G produced the tubes of space food rently being tested by the Air Fo

The sterilized tubes are lined

(Continued on page 32)

Martin Lacrosse Plays Deadly Game

Mobile as a chess queen, quick as a rapier thrust and as lethal as brass knuckles, the Martin Orlando Lacrosse is a handy weapon in a scrap. Developed, designed and built for the U. S. Army, the Lacrosse can flit like a ghost behind the battle area, fire in the general direction of the target and be pin-pointed by a forward guidance station.

The Lacrosse's ability to change its mind while in high velocity flight is another in the growing list of accomplishments by the men of Martin Orlando. Additional prime contracts include the Bullpup, air-to-surface missile, the Pershing, selective-range surface-to-surface missile and the Missile Master, electronic detection and control system for missile batteries.

Blue sky vision plus feet on the ground know-how has projected Martin Orlando to its place of leadership in electronics and missiles. Martin Orlando needs men with gray matter, the solid propellant needed to reach ever higher degrees of sophistication.

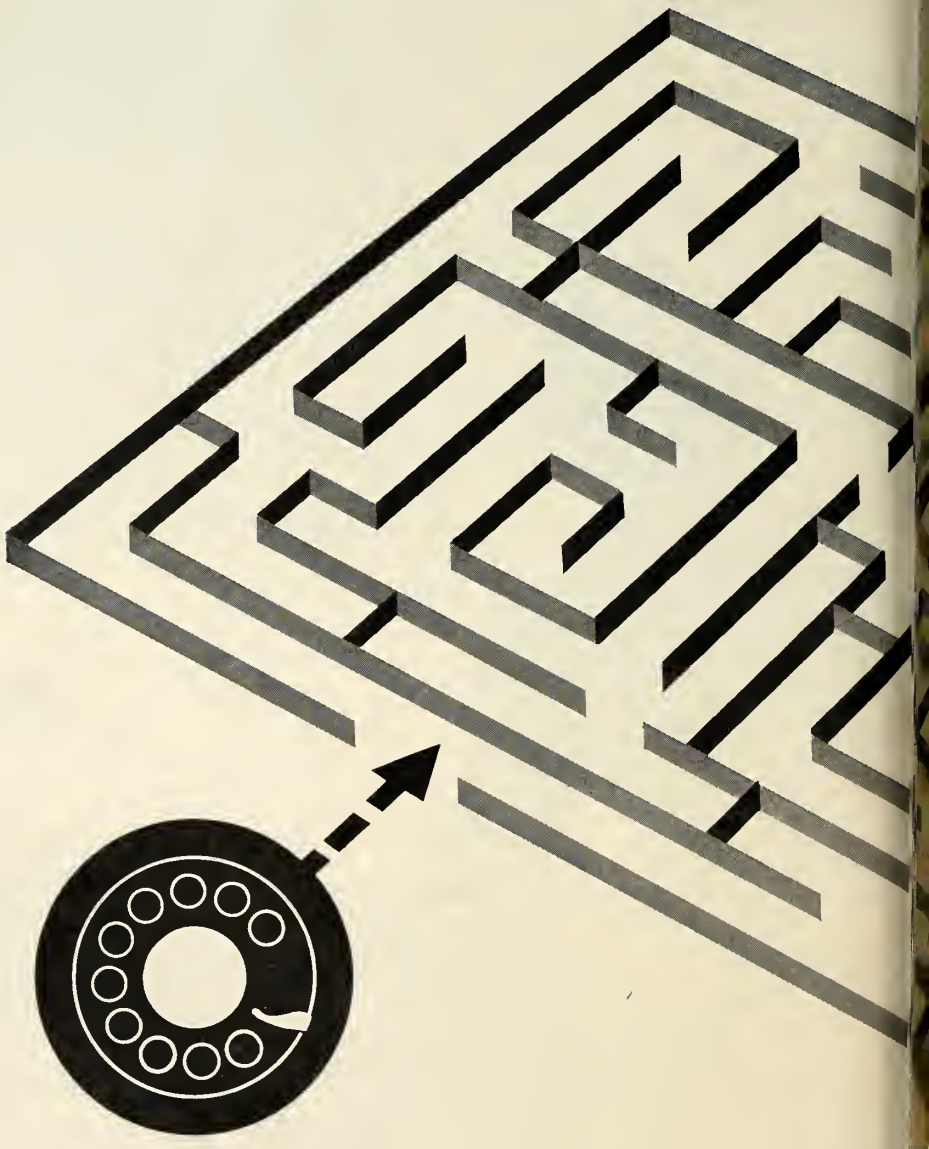
Immediate openings at senior level exist for Electronic Engineers, Physicists and Electrical Engineers in these areas: pulse circuitry, electronic packaging, transistor circuitry, electronic production test equipment, digital and analog computers. Also opportunities for men experienced in calculating solid state parameters, molecular distribution and quantum mechanics. Send confidential resume to: J. F. Wallace, Director of Professional Staffing, The Martin Company, Orlando 44, Florida.

MARTIN
ORLANDO

Ft. Sill, Okla., June, 1959—The first two U. S. Army Battalions employing highly accurate Lacrosse surface-to-surface missiles will be activated this month. Martin Orlando is supplying all the material required for the activation, including maintenance, training devices, launchers and missiles.

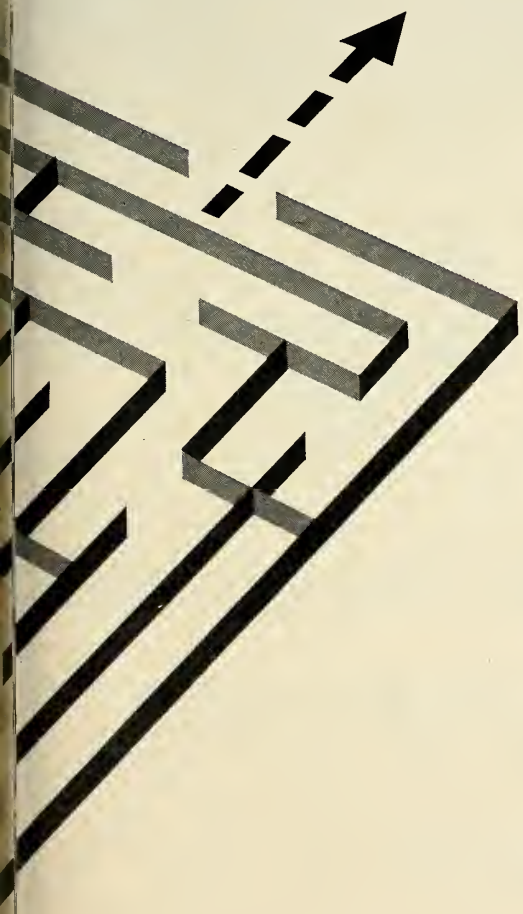
Automation cut its teeth on th

...how ITT's early work in telephony advance



elephone

e art of automation



The dial telephone exchange was one of the first examples! Today, automatic switching and new electronic techniques for automation are altering the operations of virtually every business and industry.

It was natural that ITT System companies, pioneers in the first, should be leaders in the second.

Customers have ranged from mail-order houses, railroads, libraries and oil companies to the air forces of several NATO governments.

There have been dramatic results.

One example is the automatic check-processing system developed by ITT System companies for one of the nation's largest banks. It codes, sorts and verifies checks. It performs all normal bookkeeping and accounting operations for demand deposits.

Another is the automation system for a large steel mill which records the program of requirements for every job, then feeds back information to production control centers as each phase is completed.

Still another: the first automatic U. S. post office, now under construction in Providence, Rhode Island.

Hundreds of others could be cited. Each required a complete understanding of automation from the design of a simple switch to the functioning of a fully-integrated electronic complex.

The ITT System has many specialists in this field. Among them: Intelex Systems Incorporated in retained-document automation; Kellogg Switchboard and Supply Company in automatic switching; Airmatic Systems Corporation in automatic-switch pneumatic tube and document-conveyor systems; ITT Federal Division in automatic test equipment, both military and industrial. ITT's European subsidiaries add to this experience.

To learn more about ITT's abilities in the area of automation, write for further information.

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STANDARD ELECTRIC CORPORATION LABORATORIES AND MANUFACTURING PLANTS IN 20 FREE-WORLD COUNTRIES

SPACE FEEDING

(Continued from page 28)

epoxy resin and hermetically sealed to prevent spoilage. They can be stored indefinitely. To use in the weightless environment of space, an astronaut would screw a specially-developed pipe to the top of the tube and press the food through it into his mouth.

The Air Force also is testing a special metal tube squeezer designed to make emptying the tube easier.

American Can and Gerber have provided the Aero-Medical Lab with nine varieties of tubed food. They include veal, pork, chicken, tomatoes, macaroni, peaches and beef soup.

The Bradley Tube Division of American Can also has done some work on putting oleomargarine and fresh water in tubes.

Dryve Foods of Kansas City, Mo. has developed about a dozen varieties of solid space food items in the shape of rods. An astronaut can feed these into his mouth through his helmet by using a rod container that operates as a lipstick.

The Institute itself has developed a number of the bite-size solid items such as cheese tablets.

• **On the shelf**—Actual Air Force investment in space food research has been small because of the eagerness of a number of food industrialists to explore the field for commercial development. Many contractors have paid for much of the work themselves. And some of the ideas developed are already appearing on store shelves.

Peanut butter is being packaged in tubes. So are a number of luxury items.

"Acceptability is the big thing," Dyme said. "We want to get items that will appeal to astronauts over long periods. Many such items, of course, would have commercial appeal also."

In order to achieve acceptability, the seven *Mercury* astronauts now in training as well as others will be called on to test space food items over various periods of time both for its appeal and for its nutritional qualities. Probably a training table will be set up.

In the end, the food put aboard the first U.S. manned space capsule will be tailored to the astronaut who will ride inside of it.

"It's of the utmost importance," Dyme said. "You know, this man will be under terrific stress. And the three things that relieve stress are women, liquor and food. We can't send any women or liquor along. The least we can do is give him food that won't add to his stress—or maybe will even lessen it a little."

more about the missile week

X-15 Has Dry Run; Powered Flight Next

Powered flight test of **North American's** *X-15* rocket plane is expected around July 1 following "100% successful" glide June 8. With Pilot Scott Crossfield at controls, *X-15* was dropped from B-52 at 38,000 feet with air speed 517 mph and landed at 185 mph after 310-second glide over the Mojave Desert, at Muroc, Calif.

First U.S. Post Office delivery of mail by missile was accomplished June 8 when a subsonic **Chance Vought** *Regulus I* carrying 3000 letters was dispatched from the submarine Barbero 100 miles at sea to Mayport Auxiliary Naval Air Station, Jacksonville, Fla. Envelopes bore pictorial cachet and the words: "First Official Missile Mail." Stunt was to demonstrate feasibility, but it is expected to be a long time before regular system is developed.

White House Press Secretary James C. Hagerty predicts an instantaneous, global telecast relayed by earth satellites will take place within 30 months. Hagerty says there is a "40% chance" the feat may be accomplished within the next 18 months—while he is still in the White House.

Saturn Blockhouse

Contract for domed, 9000-square-foot *Saturn* blockhouse at Cape Canaveral has been awarded to **Diversified Builders, Inc.,** Cocoa Beach, on a bid of $819,000. **Paul Smith Construction Co.,** Orlando, has $529,000 Corps of Engineers contract to erect a 22,000-square-foot engineer facility and other buildings at the Cape.

The Navy has named **Sperry Gyroscope Co.** navigation systems manager for four second-generation 608 class *Polaris* submarines . . . **Callery Chemical** has AF contract to supply boron-based high-energy HiCal for secret missile project . . . Special construction totalling about $4 million is underway at AOMC's White Sands Missile Range in preparation for *Nike-Zeus* tests.

Small business firms were awarded $79 million worth of government contracts during April under the Small Business Administration set-aside program. This was an increase of about $10 million over March.

Discoverer Back-Up

Back-up to *Discoverer III* mice-in-space attempt was complete bio-medical task force on wheels built by **Consolidated Diesel Electric Corp.** Six over-sized stainless steel trailers—air-conditioned—were brought to Vandenberg AFB as part of **Lockheed** missile systems division. Two trailer house identical laboratories, another contains altitude simulating chamber, fourth contains telemetry and data processing and the remaining two are service units.

Gladding, McBean Reveals Ceramic Brazing Jig

Brazing jigs from ceramic compositions have been fabricated successfully by **Gladding, McBean & Co.** The Los Angeles firm says the jigs, for use in making rocket motors, are of low thermal conductivity permitting tubes to be thoroughly brazed together. Moreover, the brazing material does not become brittle upon hardening because of too rapid cooling; the ceramic resists being wet by the brazing material; and the jig can be precisionformed.

Equally suitable for furnace or torch burning, according to G-MB, the jig's original manufacturing costs are small and it can be used repeatedly because it does not lose its shape.

McDonnell has awarded **Burton Mfg.,** Santa Monica, a contract to produce hermetically sealed longitudinal accelerometers for *Mercury* capsule. Case will include air-damped seismic weight. Movement is transmitted through linkage for visual readout of gravity forces. Instrument has memory indicators showing maximum positive and negative g-forces, and operates over 32-g range.

Closed-die forged turbine wheel 4 inches id and weighing 520 pounds—reportedly the world's largest—has been produced by **Wyman-Gordon** for use in 1500° to 1800°F range from high-temperature nickel-base alloys. Wheel is expected to open up possibility for higher-performance rocket engines.

The National Academy of Science elected as a foreign associate of the Academy Prof. V. A. Ambartsumian—noted Russian astrophysicist and director of the Burakan Observatory in Soviet Armenia. Ambartsumian is the fifth Russian to be named a foreign associate of the Academy. He is the third since the Russian Revolution. First Russian to be so honored was Pavlov.

Recorder Size and Weight Cut

Ampex AR-200 weighs one-third as much and is half the size of previous magnetic tape recorders

by Charles D. LaFond

REDWOOD CITY, CALIF.—The quan- of telemetered data acquired in missile efforts has been increasing ithmically—its complexity is as- ding. Since man's ability to process wealth of information reached an limit, recognition of the great ntial of magnetic recording tape only a matter of time. Its storage bility and its speed make an un- lled contribution to technical data isition. The development of better recording devices and steadily im- ed recording and analyzing tech- s has been continuous.

Almost all phases of missile check- launching, and subsequent moni- g involve the use of magnetic tape ding. Through the use of tape, tive space vehicles have been d the ignominy of failure; scien- theories and carefully engineered ns have been proved; the direc- for optimizing successor space sys- has been revealed; human error e performance of long and tedious ntial control operations has been nized.

ne of the problems associated with etic tape recording equipment in al was the large size and weight isting units, including the mobile Much progress was made in izing performance and increasing ility, but there still remained the y large physical size. In recent there has been steady progress in ing recorder size.

Transistorized model—Comple- ng standard recorders—and pos- the forerunner of future missile- tape devices—is a new airborne/- e magnetic tape recorder devel- by the Instrumentation Division npex Corporation.

ss than half the size and a third the weight of its predecessors, the system is fully transistorized, employs modular construction, and is fabricated from lightweight metals throughout most of its chassis.

Designated Ampex AR-200, the basic system is comprised of two units: the tape transport and the amplifier housing, in which different interchangeable amplifiers may be installed to achieve particular recording characteristics. An instrument-panel remote-control unit and a test unit (go/no-go type for complete checkout and alignment) are the two principal accessories to the system.

Considered by its developers to be extremely rugged and highly reliable, the tape transport unit utilizes a single-piece cast aluminum chassis and rigid cast cover which can be opened from either front or back, or removed altogether. Total weight is 90.5 pounds.

Although it is designed for normal operation in a lateral position, a change of shock-mount arrangement will permit operation in any position.

In environmental tests, the equipment has shown sustained satisfactory performance under shock tests up to 15gs and vibration to 10gs at altitudes of 10^4 feet, under temperature changes of from –65° to 160°F, and up to 95% relative humidity.

Many diversified factors have entered into the machine's high environmental adaptability. Summarized below are some of the features which combine to give the recorder its resistance to temperature extremes:

- Silicon transistors have been used throughout the system because of their extended operating temperature range (as compared with other available semiconductor materials).
- A special irradiated, thermally-

A COMPLETE airborne or mobile type AR-200 magnetic tape recorder system is shown from left to right: power converter, electronics box, remote control unit, AR-200 tape transport, and test unit. Design includes an alternate-opening transport cover permitting opening from front or back or complete removal. Total weight: 90.5 lbs.

Table 1. AR-200 Recording Modes and Characteristics

Direct record amplifier (for highest frequency response)	± 1½ db from 50-80,000 cps; ± 1½ db from 50-200,000 cps at constant ambient temp. of 20°C; ± 3½ db from 50-200,000 cps over ambient temp. range of 0° to 75°C
FM-carrier record amplifier (for greatest signal amplitude accuracy)	± ½ db from DC to 10kc at 60 in./sec.
Digital (PCM) write amplifier (for max. number of data samples)	Input rate: 18,000 bits/sec/track (32 tracks—576,000 bits/sec) Transfer rate: 75,000 bits/sec.
Pulse duration modulation (PDM) (for quasi-static variables)	Pulse accuracy: ± 2m sec at 30 in./sec. Pulse length: 50-700 m sec at 30 in./sec.

ilized composition has been used some of the AR-200's electronic ing. The wiring for the power drive plifier is covered with a tough and atile polyethylene base composition. barded with gamma rays during nufacture, it later is exposed a few seconds to a temperature approximately 275°F. This causes material to shrink and form a re-kably tight mechanical bond with wire over which it has been placed. Resistant to chemical acids, bases, hydrocarbon solvents, including tion gasoline and oils, the covering apable of retaining stability under emely adverse conditions. It with-ds temperatures from −100°F to 0°F while maintaining flexibility strength. When subjected to these erature extremes, it will not melt, len, crack, run, or blister, accord-to company engineers.

• **System details**—Six standard tape ds are available: 1⅞, 3¾, 7½, 30, and 60 in./sec. Start and stop s of 0.5 sec. are attained in the transport and the speeds are con-ed by a synchronous motor for fidelity. Reel size is 10½ in. for accommodating ½- or 1-inch magnetic tape widths and up to 3600 feet of tape.

• Magnetic heads—To accomplish the various recording modes for the two tape sizes, improved plug-in, positive-contact surface, magnetic heads have been developed for each track configuration. Inter-track relief areas permit more efficient disposal of tape-oxide accumulation.

In track-to-track phase relationships, time displacement error among all tracks on one headstack is held to approximately 60 μsec. at 60 in./sec. To achieve this precision, total gap scatter for all heads in one stack is held, in manufacture, to 10^{-4} in. or better and azimuth of gap axis to 90°00′ ±1!

• Power requirements—Because of its designed airborne/mobile mission, the system operates from a 28v dc supply with a total power requirement of 150 watts. By using accessory power converters, other standard ac sources (115v, 400 cps; 208v, 400 cps; 117v, 48 to 63 cps) can be employed.

• Recording modes—Versatility of the AR-200 system is demonstrated in its recording-mode interchangeability. Four basic recording modes can be accomplished by changing the amplifier: direct record, FM carrier, digital, and PDM. (See Table 1.)

From 7 to 32 recording tracks are available, depending on tape width and recording mode. A ½-in. tape will accommodate either 7 analog-recording tracks or 8 digital recording tracks. A 1-inch tape offers 14 analog, 16 or 32 digital, or 16 digital and 7 analog tracks. By employing multiplex techniques, analog tracks could handle over 1000 data channels at one time.

A unique part of the circuitry in the tape transport is the tape speed sensing circuit (or logic circuit). The heart of the successful operation of any magnetic tape recorder is its ability to control its speed. In addition, the operator must be aware of proper performance at all times. The AR-200 employs an indicator light on its control section of the tape transport. Also, the remote control unit contains a similar light.

• Logic circuit—The tape speed sensing circuit located in the tape transport assembly is designed to monitor tape speed when the transport is in the operating mode and permit engagement of the pinch rollers on the capstan shaft only when the tape speed and capstan resolutions are compatible. Components necessary for this function are mounted on a printed circuit board.

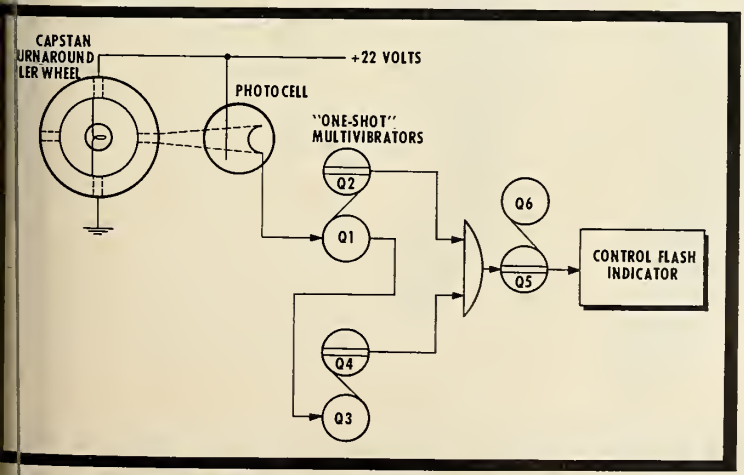
A 1-in. diameter turnaround idler on the tape transport has four windows through which light may pass onto a photo-cell. (Refer to the block diagram.)

At a tape speed of 60 in./sec. approximately 80 pulses/sec. are generated by the photo-cell. At a tape speed of 30 in./sec. approximately 40 pulses/sec. are generated by the photo-cell.

The pulse repetition rate represents periods of 12.5 and 25 m sec. respectively, only when the tape is at the correct speeds. Two uni-vibrators operate as coincidence gates that determine the instant the tape is up to speed for pinch roller engagement.

Pulses from the turnaround idler trigger the input uni-vibrator having a time constant adjusted to produce a 5-msec positive pulse for each photo-cell pulse. The negative-going portion of this pulse triggers a second uni-vibrator having a time constant adjusted to produce a 10-msec positive pulse for each trigger signal.

The output pulses from the input uni-vibrator and the second uni-vibrator are fed to a gate circuit clamped at a potential slightly higher than either output. When the tape is not up to speed, with insufficient pulse repetition rate present from the input uni-vibrator, the combined outputs do not over-



AE LOGIC block diagram of the AR-200 Record Indicator and Speed Sensing Device.

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1934 Stratosphere Suit

B.F.Goodrich

At B.F. Goodrich the space age started in 193

That was the year B. F. Goodrich dev oped the first rubber stratosphere flyi suit for attempts at setting altitu records. Through the years this suit h been constantly improved to meet t needs of higher-flying pilots. And wh the first man sets foot on the moon will probably be wearing a modificati of today's B.F.Goodrich Full Pressure Su

B. F. Goodrich engineers are worki in many ways to help man break t bonds of earth—and return safely. Miss nose cones, improved solid fuels, prop lant heaters, missile battery box heate instrument heaters, printed and etch circuits, stronger metal and plastic str tural materials, insulating materials, p cision rubber seals and gaskets, bl fasteners—these are only a few of t items that may help solve *your* sp age problems. For specific R & D inf mation, write: *B.F.Goodrich Aviat Products, a division of The B.F.Goodr Company, Dept. MR-69, Akron, O*

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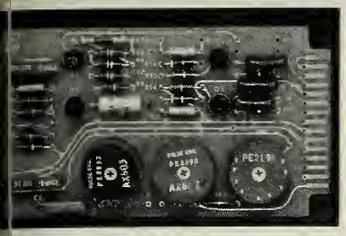
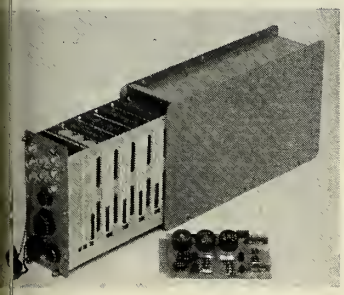


YPICAL fully solid-state and printed it direct-record amplifier consisting f wo stages of amplification and a bias s lator stage. All of the interchangeable h-in boards are installed in a card rack ne housings for seven (analog) or eight ital) amplifiers.



to produce a cumulative output in x ss of the clamping voltage.

As the tape speed increases, a point s eached where the input pulse repe- it n rate is sufficient to permit coinci- e e of a portion of the positive u es. At this instant, the cumulative o ntial is greater than the clamp e ntial. The pulse is steered through o he third uni-vibrator having a long time-constant of approximately 1 second.

With the first pulse steered through, a relay is energized whose contracts complete the circuitry for pinch roller engagement. At the same time, another relay, whose on-off cycle follows the uni-vibrator, is energized and the corresponding contacts complete the circuitry for the panel indicator light to show that correct tape speed has been attained.

While the tape is at correct speed, the light will blink at a rate of approximately once per second. For any other tape condition, it will not blink.

• **Reliability and maintenance**—Flutter, a problem present in all recording devices as a result of the many variations in component velocities, was the object of a long but fruitful design exercise during the development of the AR-200. In the final production model, cumulative flutter is negligible—less than 0.1% (60 in./sec. at a 300-cps cutoff frequency).

With its modular construction and easily removed access panels, all components in the recorder system are easily reached and quickly replaceable. Despite this accessibility, the units are dustproof when closed. All sensitive control and operating areas are sealed with gaskets. (For operation above 71°C a filtered connection is provided for an external cool-air source. The intake and exhaust parts are capped when not used.)

All bearings in the transport unit are life-sealed ball bearings, eliminating the need for lubrication.

ner Van Allen Radiation Belt Identified

IVERMORE, CALIF.—Positive iden- ifi ation of the inner Van Allen belt N R June 8, 1959; p. 11) was made y Drs. Stanley C. Freden and R. S hen White of the Lawrence Radia- ic Laboratory, University of Califor- ni As a result of their efforts, the d tity, flux, and energy distribution f apped particles in the earth's mag- ne field were described for particles pe trating more than 6 g/cm² of ma erial.

A stack of ten sheets of nuclear em lsions, Ilford K.5 emulsion—1⅜ in. x 1⅜ x 600 μ, were hermetically se d in a stainless steel box. This va installed within the nose cone of a *Thr-Able* and secured on the instru- ne t board, 1¾ in. from the side wall. Th plane of the emulsions was parallel o he normal to the wall.

On April 7, 1959, the missile was launched from Cape Canaveral, reaching a 1230-kilometer max. altitude. After travelling for 15 minutes above 1000 km between latitudes 20°N and 3°N, the cone re-entered the earth's atmosphere and was recovered in the South Atlantic. Then the emulsions were returned to Livermore for analysis.

The study of emulsions was limited to the identification of protons with energies greater than 75 Mev and electrons with energies above 12 Mev. An isotropic distribution was assumed since the nose cone was not oriented in space.

• **Results**—No evidence of electrons was observed. The analysis of observed proton energies was indicated roughly as follows: 700 Mev or higher—1%; 300 Mev or higher—10%; the bulk of the tracks were spread between 75 and 300 Mev. An omnidirectional flux, based on the observed data, was computed at 1300 protons/cm²/sec (which is consistent with previous data). Total radiation level at 1200 km altitude was calculated to be 1 roentgen/hour.

• **Conclusions**—Conclusions resulting from the experiment and subsequent analysis were directed by the scientists at the two principal theories concerning the origin of trapped particles in the inner belt: (1) solar injection and (2) earth neutron albedo.

Freden and White stated that the solar origin theory is unable to account for the high-energy protons observed.

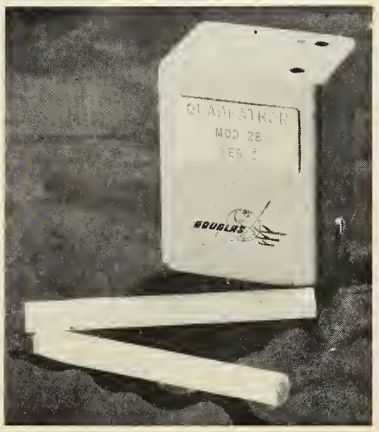
But in the neutron albedo theory, neutrons from upper-atmosphere cosmic ray interactions travel to the trapping region and decay into protons and electrons. The scientists believe this theory satisfactorily explains the experimental data, since sufficient high-energy neutrons are formed to provide a quantity of protons comparable to those observed.

Plug-in Computer Matches Systems 700 Times Bigger

EL SEGUNDO, CALIF.—A new miniature plug-in computing unit, called a Quadratron, is a passive non-linear device capable of performing nearly 25 of the basic, commonly used, nonlinear functions. Developed by the Douglas Aircraft Company here, the unit replaces systems 700 times larger and thousands of dollars more costly, said the company.

Designed to deal realistically with nonlinear mathematical factors, the Quadratron is expected to permit a precision not normally achieved in certain practical engineering problems.

First applications probably will be in control systems, automation, analog computing, instrumentation, simulation, and data reduction. Cost will be a few hundred dollars. Douglas has indicated the units should be available to industry later this year.



Radar Is Strongly Defended at AFCEA Convention

by Hal Gettings

WASHINGTON—In contrast to Sir Robert Watson-Watt's statement at the Missile Industry Conference last week that radar is obsolete, consensus of experts at the 13th annual convention of the Armed Forces Communications and Electronics Association here is that radar is capable of doing its job today and in the foreseeable future.

Described as the most successful convention to date, the AFCEA convention had 80 exhibitors and an attendance of close to 4000. Exhibits overran the Sheraton Park exhibit hall into adjoining rooms and the lobby and even onto the lawn. Special events included a tour of the Ft. Meade Missile Master site and a banquet at which Gov. Leo Hoegh, Director of Civil and Defense Mobilization, was the principal speaker.

• **Growth claims**—Speaking in a panel on space tracking, Dr. H. G. Weiss of Lincoln Laboratories said that radar capability had grown with need. He said the problem is definition of requirements, rather than inability to design capable equipment.

Dr. Weiss pointed out that over the past few years the sensitivity of radar had increased 10,000-fold—which yields an increase of ten times in detection range. Present technology allows creditable performance at ranges of several thousand miles. According to Dr. Weiss, a thousand-fold increase in sensitivity is foreseeable in the near future. This would make possible effective ranges of 5-10,000 miles for small targets and up to 25,000 miles for large targets. (The *Atlas* satellite would be considered a "large" target.)

Present radar satellite tracking antennas, with their associated computation facilities, can track a satellite for a few seconds and determine its orbit. Conceivably, such a system could also track a missile for a short period and determine its trajectory—a vital factor in anti-ICBM defense.

Radar development can progress by several different means within today's state-of-the-art: larger antennas, more power, and by taking advantage of low-sky noise temperatures.

Based on present techniques, tracking antennas up to 250 feet in diameter can be built within the required mechanical accuracy tolerances. Fixed multilobe antennas can be built of almost any size. Transmitted power can, of course, be pushed up to practically any reasonable limit required. Since received power decreases as the fourth power of range, receiver sensitivities, too, are especially important. The further development of low-noise parametric amplifiers offer considerable help in this area.

Other interesting aspects of space tracking were reviewed by members of the panel. R. L. Easton of NRL described the southern radar fence for detection of satellites, and Dr. H. L. Richter, Jet Propulsion Laboratory, discussed the facilities for tracking deep-space probes (*Pioneer III* and *IV*) using the TRAC(E) radioastronomy system. The present three probe-tracking stations will be supplemented soon by the establishment of overseas facilities by NASA.

Other systems described included the BRL-ARPA DOPLOC (locked-doppler) satellite fence, the world-wide Smithsonian optical tracking system, Minitrack, and Spacetrack programs.

• **Panels**—Problems and developments in space communications were covered by a panel moderated by Rear Adm. John Clark, of ARPA. Other panels discussed photography, R&D management, and men and machine reliability in space travel.

General Curtis LeMay, AF Vice Chief of Staff, said at the keynote luncheon that "communications could prove to be the 'Achilles heel' of our nation's defenses." He pointed out that communications are lagging behind the needs of our rapidly expanding operational requirements, and called for increased effort, radical thinking, and rapid development of equipment to meet the growing demands.

Examples of needed improvements cited by the General:

• Range extension and improvement in tropospheric scatter systems;

• Improved reliability and security in cryptographic devices for voice, data, and pictures;

• Increased speed for teleprinter communications—up to pages per minute;

• A reliable worldwide voice capability.

STRAC STRIKES !

They left in 30 minutes. With them went field kitchens, mortars, new battlefield missiles, barracks bags. All went aboard swift transport planes and headed for trouble 4,000 miles away. They arrived the same day, for this is a battle group of the Strategic Army Corps – world's most mobile army and our "defense on the double" against limited war. STRAC's kind of war has flared 18 times since V-J Day. STRAC's mission is to put out these "brushfires," or keep them from spreading. By quickening U. S. reaction to limited war, this crack Army corps helps lessen the prospect of global war.

—people—

KISTIAKOWSKY

George B. Kistiakowsky, a Russi born Harvard ch istry professor, been named by President to succ **Dr. James R. K lian** as special sistant for scie and technology. K lian resigned M 28th "for com ling personal r sons." He will turn to the Massachusetts Institute Technology, where he was president u his appointment to the scientific advis post in November, 1957.

Kistiakowsky, 58, became a natu ized citizen of the United States in 19 after emigrating from Russia where fought against the Communists in White Russian Army from 1918 to 19 He was a member of the National A demy of Sciences' Atomic Energy Co mittee as early as 1941 and chief of Los Alamos Laboratory's explosives di ion in 1944-45. He also headed seve wartime projects sponsored by the N tional Defense Research Committee.

In accepting Killian's resignation w "very sincere regret," the President e phasized "the vital importance" of work to the future security of the Uni States.

Killian, whose resignation is effect in mid-July, leaves what has, in the l two years, become one of the most fluential positions in government. (S M/R, Dec. 22, 1958, pp 22, 23.)

WICKERSHAM

Robert O. Wickersham has been pointed director of Space Technology Laboratories, Inc.'s program management staff, Systems Engineering Div. Prior to joining STL in 1956, Wickersham was manager of military sales for Lockheed Missile Systems Division. From 1951 to 1953, he was assistant the vice president for engineering at B Aircraft Corp.

C. Robert Shaeffer was elected sec tary-treasurer of American Electro Laboratories, Inc. **Raymond S. Marl witz,** a senior engineer of the compa was elected assistant secretary.

The Board of Directors of Gene Applied Science Laboratories, Inc., nam **B. J. Driscoll** to the newly created po tion of vice president-general manag Driscoll comes to GASL from the N tional Academy of Sciences-National R search Council, where he was associ director of a special study of long-ra research and development trends of terest to the Air Force. He has h executive positions at the M.I.T. Linc Laboratory, the NATO Advisory Gr

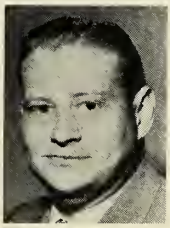
f Aeronautical Research and Develop-nnt, and the Air Force Scientific Ad-vory Board.

HEBENSTREIT

William B. Hebenstreit has been named program director for communication satellites, Systems Engineering Division, of Space Technology Laboratories, Inc. He once was director of special programs for the Systems Engineering Division, and prior to that he headed Rno-Wooldridge Corp.'s Computer Systes Division.

Maj. Gen. Otis O. Benson, Jr., Com-ndant of the Air Force School of Aation Medicine, has been named presi-dt of the Pan American Medical As-sciation's section on Space Medicine. D **S. Fred Singer,** professor of physics at th University of Maryland and contribut-in editor of M/R, was named secretary.

David E. Lewis becomes assistant nager, applica-tis engineering at BElectronics, Bg-Warner Corp. Aormer USAF of-fir, Lewis headed th on-board re-c er section, mis-si test track, at Holoman Air Force Be.



LEWIS

The National Academy of Sciences-National Research Council has announced appointment of a 1-man committee on the Scope and Condt of Materials Research.

Dr. Clyde Williams, President of Clyde Williams and Co. of Columbus, Ohio, is chrman of the Committee. A former president and director of Battelle Memial Institute, he served as chairman of the War Metallurgy Committee of the Academy-Research Council during World War II. Other members of the Committee ar **Dr. Allen Astin,** director, National Bureau of Standards; **Dr. Harvey Brooks,** dean of Engineering and Applied Physics, Harvard University; **A. J. Herzig,** president of Climax Molybdenum Co. of Michig and chairman of the Materials Advisory Board; **Dr. A. B. Kinzel,** vice president, Union Carbide Corp.; **Thomas H. Miller,** assistant director, U.S. Bureau of Mines; **Dr. John D. Morgan, Jr.,** consultant, Washington, D.C.; **Dr. Thomas B. Nolan,** director, U.S. Geological Survey; **Dr. Albert J. Phillips,** vice president, American Smelting and Refining Co.; **Dr. C. F. Rassweiler,** vice chairman of the board, Johns-Manville Corp.; **E. Duer Reeves,** executive vice president, Esso Standard Oil. Co.; **Professor Frederick Seitz,** Department of Physics, University of Illinois and chairman of the Committee on Perspectives in Materials Research; Professor **Cyril S. Smith,** Institute for the Study of Metals, University of Chicago, and **David Swan,** vice-president-Research, Linde Co.

west coast industry . . .

BY FRED S. HUNTER

Youngest corporation president . . .
in the industry is Tom Jones, Northrop Corp.'s new chief. At 39, Jones is two years younger than Donald Douglas, Jr., who previously held this distinction. Jones is highly regarded, both as an engineer and company executive. He has vision, a quality that's very important in today's product competition. In this connection, keep your eye on Northrop developments in boundary layer control.

There's another Tom Jones . . .
who is president of a company in the industry, Thomas Roy Jones of Daystrom, Inc. On the coast not long ago, Jones observed his company is likely to lose money on its Daystrom Systems division in San Diego for the next three years. But he looks for a fine future. One of the Division's newest products is a 2000-point monitoring system for tests of a nuclear aircraft engine.

Fast-growing Daystrom, Inc., which had sales of $81,713,986 in Fiscal 1958, is shooting for annual sales of $200 million five years from now. "We hope to do it through internal growth and some acquisitions," said Jones. And to insure future growth, Daystrom this year will spend about 10¢ of every sales dollar on research, of which 4¢ will come back from the government.

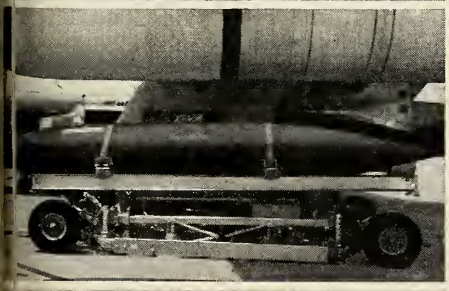
Cost of an *Atlas* ICBM . . .
was estimated at $10 million during Senate hearings this spring, and ever since this has been the generally accepted figure. Convair's portion, however, comes to something under $2 million. This represents the cost of producing the missile frame and assembling the complete *Atlas*. It does not include the cost of engines, guidance system, nose cone or nuclear warhead. These are government-furnished. Only figure ever made public about the cost of nuclear warheads was $240,000 for a warhead for the Douglas *Genie*, an air-to-air rocket. *Atlas* warhead, of course, would cost much more. Launching sites also add up to a pretty penny. It's when you crank in all these costs that you get to $10 million.

Lockheed surveyed Santa Barbara . . .
before finally deciding the Newport Beach area would be a better location for the general and engineering offices of its new Electronics and Avionics Division. Newport Beach is closer to such soul-satisfying attractions as the Dodgers and Disneyland and this is an important factor to employment managers. It may be a couple of years, however, before the move is made since the Maywood plant provides an ample temporary facility.

The Air Force ALBM award . . .
to Douglas is a six-months development contract after which the government can take another look. The Air Force wanted to award a production contract on the ALBM, but William M. Holaday, Department of Defense director of guided missiles, decided it would be wiser to take a more conservative approach. There's little doubt that the Douglas contract will be extended into production. Support for the mobile platform concept keeps growing.

Aeronutronic Systems, Inc. . . .
the Ford Motor Co. subsidiary, is developing computer components that are 10 times as fast as those currently in operation. Computers with "learning" capabilities is another project. People learn by trial-and-error methods. "Why not a computer system which detects errors and corrects them?" says Dr. Ernest H. Krause, vice president and general manager of Aeronutronic's computer and range systems division.

...NEWS IS HAPPENING AT NORTHROP



Shown above: Northrop's T-38 Talon, F-89 Scorpion and SM-62 Snark – all served by Nortronics' mechanical, electronic and servo-hydraulic GSE applications.

For the Hawk missile, Nortronics supplies Raytheon Manufacturing Co. with the loaders, launchers, and auxiliary handling equipment. Throughout concept, design and production, Nortronics has kept this program on – or ahead of schedule.

NORTRONICS TOTAL GROUND SUPPORT – KEY TO DEFENSE READINESS!

By integrating mechanical, electronic and servo-hydraulic skills into a wide variety of ground support equipment applications, Nortronics demonstrates an understanding of the total weapon system.

Nortronics conceives, designs and manufactures GSE around a knowledge of the weapon's mission, its operational and maintenance concepts, and the facilities and skills of its field operators.

Twenty years of specialized experience gives Nortronics the ability to get the job done – to translate your most complex GSE requirements into reliable hardware – on time – and at minimum cost.

For immediate help with your GSE requirements, call Nortronics today. Or write: Chief Applications Engineer, Dept. 2003-G3, Nortronics, 500 E. Orangethorpe Ave., Anaheim, California.

NORTRONICS
A Division of
NORTHROP CORPORATION

propulsion engineering

New high-temperature material . . .

Carborundum Company offers for nozzles and nose cones combines advantages of both silicon carbide and graphite—and each cancels the other's disadvantages. Silicon carbide has excellent erosion, oxidation, and heat resistance characteristics. Thermal shock resistance is good, but not good enough for many missile applications. Graphite, on the other hand, offers only fair erosion resistance and poor oxidation resistance. However, graphite has outstanding thermal shock resistance.

The new material consists of small graphite particles embedded in a dense silicon carbide matrix. The SiC shields the graphite which absorbs uneven expansion. Carborundum calls the material GRB silicon carbide. It can be tailored to meet different uses by changing the composition. Carborundum says thermal shock and erosion resistance over the full range of compositions—20% to 45% of graphite by weight—is excellent. However, generally speaking, maximum erosion and oxidation resistance comes in low graphite compositions. Thermal shock reaches a max in the high graphite compositions.

Physical properties of GRB SiC of interest to missile makers:

Thermal conductivity, high of 700 BTU/°F at 400°F down to 350 BTU/°F at 1600°; coefficient of thermal expansion, about 2.70 inches/°F over the range 70° to 2460°F, controlled by varying the SiC matrix; density, controlled by graphite composition, 2.3 to 2.8 grams/cm^3; flexural strength over a wide temperature range is "much higher" than that of standard graphite bodies.

Nozzle and nose cone shapes . . .

machined from GRB SiC have passed tests with flying colors. Carborundum says: "In highly erosive environments, under conditions of extreme thermal shock and temperatures in excess of 4500°F, this composite body of silicon carbide and graphite has consistently shown negligible or minor erosion and no evidence of thermal stress failure."

Almost any shape can be fabricated from the new high-temperature material. The free graphite bodies can be machined to tolerances of plus or minus 0.010 inches, the high free graphite bodies within 0.015 inch. By diamond grinding, it's possible to come within 0.003 inches of specification. At present, Carborundum says, fabricated sizes of GRB are limited to about 13 inches to 20 inches. However, a company official says larger sizes will be available soon.

The material will be turned out in a new plant getting under way at Niagara Falls. The $750,000 facility will be a pilot plant, but it will produce GRB at a commercial rate. Other products to come from the new plant, due on stream about the turn of the year, include boron nitride and a KT grade silicon carbide.

Here's a safer method . . .

of melting reactive metals. U.S. Bureau of Mines researchers have developed a way of reducing the risk of explosion that accompanies melting of zirconium and other reactive metals. They use air-cooled molds to catch the molten metal. The Bureau says some explosions have occurred in plants where water-cooled molds have been used. In studies at the Metallurgical Research Laboratory, Albany, Ore., Bureau scientists found that the air-cooled molds offer "a significant reduction in explosion hazard" and will perform as efficiently as water-cooled molds. The technique is applicable also to titanium, columbium, tantalum, and hafnium. Full details are available in Report of Investigations 5443, "Air Cooled Crucibles for Cold Mold Arc Welding." Write: U.S. Bureau of Mines, Publications Distribution Section, 4800 Forbes Avenue, Pittsburgh 13, Pa. The Bureau gives credit for the development to physicist M. M. Kirk and electrical engineer P. C. Magnusson, both with the Albany lab, and G. L. Schmidt, former Albany engineering aide who is now with Atomics International.

EW ROCKET BLAST PROTECTION — by Swedlow

w a ative/insulative wrapping by Swedlow protects Atlas missile nch tubes from direct rocket blast up to 5000°F. The materials and thod developed to meet this extreme demand hold great promise for ny ther applications requiring resistance to elevated temperatures.

To m t the rigid standards for this CONVAIR missile Swedlow has velo l methods of:

(1 Impregnating a refractory silica fabric with a Swedlow modified high temperature phenolic resin, and

(2 Covering the ¼" to 1" tubes and pressure vessels shown above, by tension winding with augmented pressure—a highly skilled operation, and

(3) Special heat treating or curing for maximum shock temperature resistance.

Here is another of Swedlow's contributions to industry, including high temperature resistance welded honeycomb core products, high temperature materials, heat reflective laminates, stretched acrylic transparent glazing materials and others.

Write for technical bulletin "S" entitled "High Temperature Phenolic Laminates." Please refer to Dept. 21.

vecow

SWEDLOW Inc. Los Angeles 22, California / Youngstown 9, Ohio
Formerly Swedlow Plastics Company

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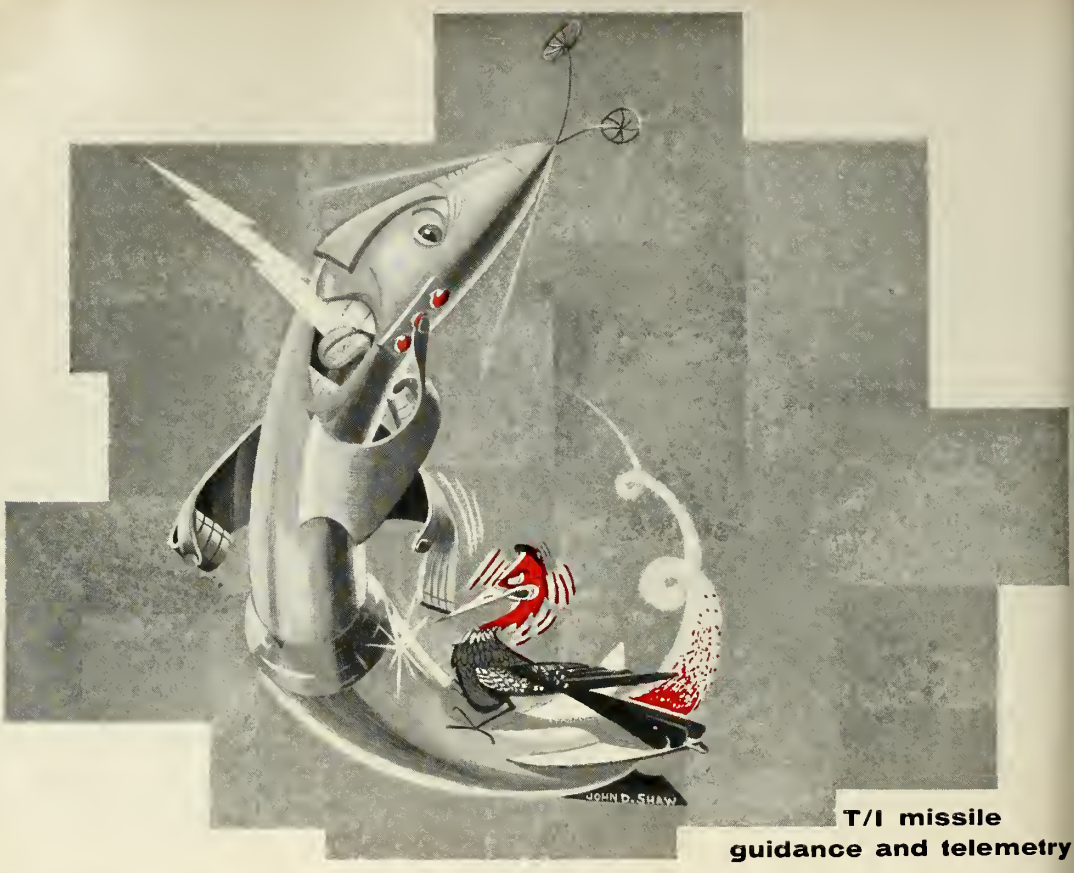

T/I missile
guidance and telemetry

BEEPS WITH A HIGH IQ

...for missile sensing, guiding and telemetering

Electronic signals that report the truth, the whole truth, and nothing bu . . . wring the best performance from missile systems. By pushing beyon known capabilities in sensitivity and accuracy, Texas Instruments is producin "high IQ" systems and equipments for a dozen guided vehicles used in ever basic mission: air-to-air, air-to-surface, surface-to-air, surface-to-surface - IRBM and ICBM—plus drone sensors and satellite instrumentation. T exceeds tough specs against tight deadlines, regularly . . . specs askin solutions to problems never posed before. For detailed discussion, cleare personnel please write or call: SERVICE ENGINEERING DEPARTMENT.

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APPARATUS DIVISION

TEXAS INSTRUMENT INCORPORATED

6000 LEMMON AVENUE
DALLAS 9, TEXAS

reviews

EDICAL SCIENCE AND SPACE TRAVEL,

illiam A. Kinney, Franklin Watts Inc., ew York, 149 pp., $3.95.

One of the generally overlooked areas f space research is the medical pro- ssion's attempt to fit man into the space nvironment. Though such research repre- nts only a small part of the $7 billion issile and rocket industry, it holds the ey to the industry's ultimate goal—flight space.

This book is a narration of the air nd lab experiments presently being con- ucted by flight surgeons. Weightlessness, iet and solitude, radiation, meteors, and mperatures of outer space are some of e problems discussed, with conjecture to what some of the eventual solutions ay be. An interesting analysis of man's tempt to chart his unknown reactions the totally alien environment of spacc.

GH ALTITUDE AND SATELLITE ROCKETS,

e Philosophical Library Inc., New York, 6 pp., $15.00.

A compilation of papers given at a e-*Sputnik* symposium on British high- itude and satellite rockets by the Royal ronautical Society, the British Inter- anetary Society, and the College of ronautics. The papers are by both nerican and British experts in the vari- s areas of rocket research.

WASHINGTON—The May issue of U.S. *overnment Research Reports* lists a mber of reports of interest to the ssile industry which are available to the blic. Subjects include Astronomy, Chem- ry, Earth Sciences, Engineering, Engines d Propulsion Systems, Materials, Me- anics, Nuclear Physics, Physics, Radia- n, and others. The monthly listing may obtained from the Dept. of Commerce, U.S. Government Printing Office. An- al subscription fee is $6.

WASHINGTON—Two articles of partic- ar importance to the missle industry ear in the April issue of the monthly val Research Lab report of progress.

The first describes in detail the tech- ques and equipment used in the first ccessful photography of the solar disk radiation from the Lyman-Alpha line of drogen. The March flight of the *Aero- b-Hi* rocket climaxed four years of ort to get such photographs.

A second article describes the com- te data-reduction system (ARRF) used reduce *Vanguard* telemetry data. The tem, one of the fastest and most pro- ssive of any missile program to date, s completed in 1958 and has been nificantly successful in operation.

The report also contains notes on the gress of various unclassified NRL re- rch studies now under way.

A candle in a dark room?

Transverse and/or Visible electromagnetic waves?

A universal constant?

How many wave lengths in a photon?

Is light affected by gravity?

A full appreciation of light and all its phenomena is essential to the successful completion of our energy conversion mission.

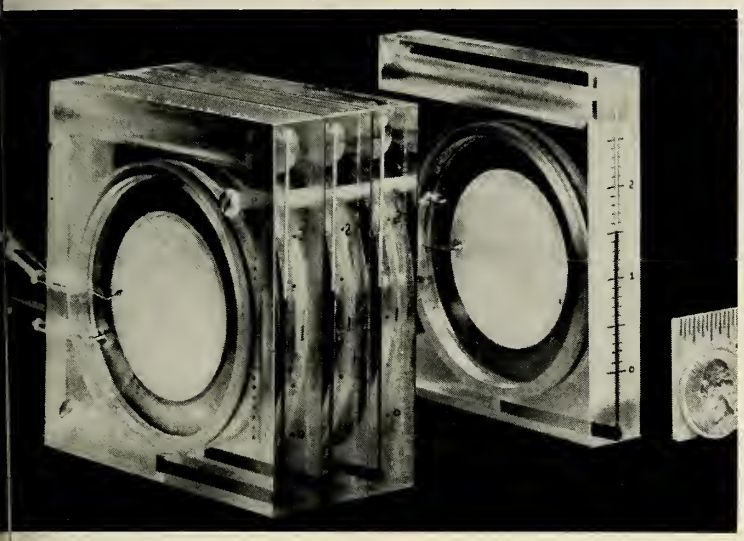
We use this knowledge constantly—as, for example, in our recent development of a photo-voltaic conversion system and a mechanical-optical system to convert light energy to electrical energy.

To aid us in our inquiries we call on the talents of General Motors Corporation, its Divisions and other individuals and organizations. By applying this systems engineering concept to new research projects we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and weapons systems.

Energy conversion is our business

ALLISON

Division of General Motors, Indianapolis, Ind



Electrostrictive Discs Measure Voltage

Prototype models of a new type of cage meter have been built by the **Electronics Department, Mullenbach Division, Electric Mfg. Co.,** using electrostrictive ceramic discs as the dynamic moving elements.

Each meter consists of a small transparent block enclosing two opposing metal discs on which smaller discs of white ceramic have been bonded. Each ceramic wafer is coated on both sides with silver frit, forming a capacitor. When an electric potential is applied, the ceramic contracts, cupping the metal disc.

Colored fluid contained in the reservoir between the two plates is forced to rise in a capilliary tube at the front of the meter, providing a visual indication of the voltage being measured. A surge chamber at the top of the block prevents the building up of back pressure.

The prototype models constructed by Mullenbach measure less than ¾ths of an inch in width, allowing a number of units to be mounted in the space normally required by a single voltage meter of conventional design. Even smaller units could be built, following the same basic concepts.

The new electrostrictive ceramic that makes possible the new meter design is the result of Mullenbach's continuing research in the field of ceramic materials for electronic applications.

Circle No. 225 on Subscriber Service Card.

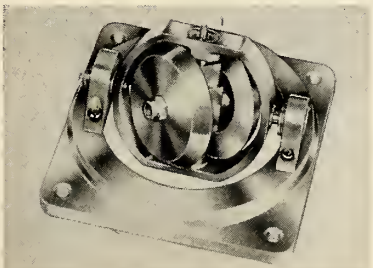
Split Rotor, Solid Bar Gimbal Gyro Ready

Clary Dynamics has announced the production of a split rotor, solid bar gimbal gyro which combines accuracy with economy.

The spring wound gyro is designed for use in small, short range missiles and drones.

The two-axis Clary instrument will resist shock to 100 G's, acceleration to 10 G's and vibration to 10 G's while attaining drift accuracies of 0.1 degrees per second.

An uncaging method cuts total time to speed and uncage to 0.1 seconds maximum. The optimum performance running time is 4 minutes with an 8 minute rundown time. The gyro may be kept in wound condition indefinitely



and may be rewound and used as many times as required without loss of accuracy.

The flexible design is said to offer a choice of resistive, commutator or selsyn pickoffs for custom specifications.

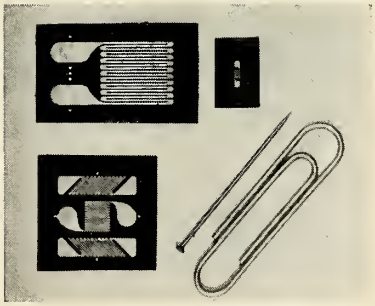
Circle No. 226 on Subscriber Service Card.

Strain Gages Feature Rosette Shape, Minature Size

Three high accuracy MetalFilm strain gages are going into full production at **Tatnall Measuring Systems Co.,** a subsidiary of **The Budd Co.**

The gages are tiny. The smallest one measures 1/32 in. wide, 5/32 in. long and 1/1000 in. thick; the largest is 1/2 in. square and also 1/1000 in. thick. Weight of the gages ranges from 1.1 mg. (.00003883 oz.) to 9.3 mg. (.0003282 oz.). Two of the three gages are fully temperature-compensated for four alloys.

Features of the three gages are: rosette gage to determine magnitude and directions of principal strains;



miniature gage for use in areas of very steep strain gradient; high fatigue life gages for structures undergoing severe dynamic strains.

Rosette MetalFilm gages (top, left), whose geometry is of the three-gage, 45° type, are generally used for determining the magnitude and directions of principal strains.

This gage, designated 121 R3A, is temperature-compensated for four alloys; steels, 19.8 stainless steels, magnesium alloys and aluminum. A prefix before the gage designation specifies for which alloy a particular package of gages is intended.

Rosette gage specifications include resistance of each section—120 ohms; resistance tolerance of each section—± .2 ohms; gage factor tolerance—± .5%; length of each gage section—1/8 in. All gages are epoxy-backed and

at least 1/16 in. of border material is supplied on all sides of the rosette pattern. Reference marks on the gage establish two center-lines to bisect the pattern, which is symmetrical in both planes.

Miniature Metal Film gages, (bottom, left) with a working area only 1/32 in. long, are being produced for use in very steep strain gradient areas such as exist around fillets, cut-outs or holes.

Designated 1X1-321, this miniature unit incorporates the same four-alloy temperature compensation feature as the 121-R3A rosette gages.

Specifications for the 1X1-32A gages include: resistance—60.0 ohms; resistance tolerance—±.2 ohms; gage factor tolerance—±1%. All gages are epoxy-backed.

Dynamic strain measurement Metal Film gages (top, right) has a fatigue life 5-10 times that of an equivalent gage made of advance alloy.

Dual advantages of the gage are: high gage factor (approximately 3.2) and maximum endurance limit.

Tatnall's dynamic strain measurement gages are manufactured from an iso-elastic type alloy and have been designated the 301 series; they cannot be supplied in temperature-compensated types. The 301 series are not recommended for static measurement because of their high positive temperature coefficient.

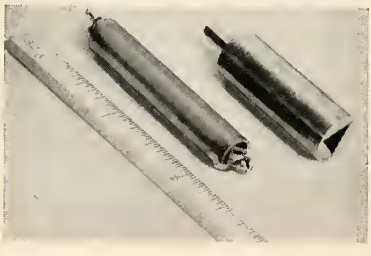
Specifications for the type 341-500 gage in the 301 series include: resistance—500 ohms; resistance tolerance—±1 ohm; gage factor tolerance—±.5%. Dimensions of the gage are ¼ in. square excluding tabs. The 301 series are also epoxy-backed and can be applied with the same standard technique used for Tatnall's 101 series MetalFilm gages.

Circle No. 227 on Subscriber Service Card.

Current Sensitive Relay Can Withstand 100 G's

A current sensitive relay of the "Powrmite" micro-miniature relay series has been produced by **Filtors, Inc.**

Known as the "S" type, this new



addition to the rotary "Powrmite" series meets shock tests of 100 G's for 11 milliseconds and vibration tests of 10-55 cps @ .06 double amplitude, 55-2000 cps @ 30G's.

Other specifications: contact arrangement: 2C (DPDT); ambient temperature range: −65°C. to 125°C., dielectric test: (at sea level) 1000V. (750 V. between open contacts); contact rating: 2 amps resistive; pull-in time: 5 milli-seconds maximum; drop-out time: 5 milliseconds maximum; 0.5 oz. maximum weight. Coil resistances from 185 to 10,000 ohms are available as standard values.

Circle No. 228 on Subscriber Service Card.

Portable Device Measures Nonmagnetic Metals

A new portable eddy current instrument has recently been made available by the **Magnaflux Corporation.**

By accurately measuring electrical

conductivity, the battery-powered Magnatest FM-110 Conductivity Meter performs a variety of testing jobs, including the determination of hardness, alloy, and heat treat condition; sorting mixed nonmagnetic metals; checking tensile strength of aluminum; investigating fire damage to aircraft, and many others. Readings can be taken on a comparative basis using known samples, or in absolute electrical conductivity units as a percent of the International Annealed Copper Standard.

The FM-110 induces eddy currents within the test piece by means of a ½" diameter hand-help probe. These currents affect the impedance of the probe coil as a function of the conductivity of the material. With the probe on one side, the large knob is turned to zero the meter and conductivity is read on the left-hand scale.

This compact 3⅜" x 8¾" x 6 instrument, weighing only 4½ pou can be used for both product and on-site testing. Total range 8% to 107% I.A.C.S., with an curacy better than ± 3% of sc reading, and usually better than ± when used on a comparative basis.

Three volts from two stand flashlight batteries power the self-c tained unit. A built-in battery chec indicates whether the batteries m the required operating voltage ran

Circle No. 229 on Subscriber Service Car

Low-Cost Chemical Pump Produces High Vacuum

A simplified titanium getter pump utilizing the chemical react between gases and titanium vapor produce vacuums in the 50 micror 1 x 10^{-9}mm Hg range has been veloped by engineers at **NRC Eq ment Corp.**

Said to cost less than 25% as m as equipment previously availa the pump has applications in resea testing and production when it is ne sary to avoid even a trace of b streaming fluids that might cont nate a vacuum chamber, and/or w it is desirable to pump down and m tain either an open system or a cl chamber, such as a demountable t at high vacuum for long periods.

The unit consists of a stainless cartridge $7\frac{5}{16}$ inches long and than ½ inch in diameter. Inside tungsten filaments overwound titanium wire. When the cartridg connected to a source capable of plying 60 amp, 3 volt power, titanium is vaporized and form highly reactive layer on surroun surfaces.

A large percentage of the gas m cules striking this layer are abso and chemically bound. Thus, pum is accomplished by gettering. The no pump fluid to contaminate chamber that is being evacuated, periodic firings of the filament sufficient to maintain a high vac in chambers with slow out-gassin materials or slight in-leakage of

The frequency of firing depend

Armco PH 15-7 Mo Stainless elected for the B-70 Valkyrie and F-108

It's the primary sheet metal for construction of newest air weapon systems being developed and built by Los Angeles Division of North American Aviation, Inc.

he B-70 Valkyrie and the F-108, Mach 3 aircraft signed for 70,000 ft. altitudes, will add powerful ng-range weapons to America's air armor. Both the artically-new intercontinental bomber and the in-rceptor being created by North American, in col-boration with a team of major defense firms, are to constructed primarily of stainless steel.

Because Armco PH 15-7 Mo Stainless maintains its rength at the high temperatures caused by speeds ceeding 2000 mph, it has been specified for the major rts of the airframes.

This special stainless steel, in foil and sheets, will be fabricated into high strength, honeycomb panels for wings, fuselages, and control units. It will also be used for other key structural elements of both aircraft.

Selection of Armco PH 15-7 Mo, newest of Armco's widely used family of precipitation-hardening stainless steels, demonstrates the superiority of this high strength, heat and corrosion resistant metal. For complete information on the properties and fabrication of Armco PH 15-7 Mo Stainless Steel, write Armco Steel Corporation, 2539 Curtis Street, Middletown, Ohio.

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

Circle No. 21 on Subscriber Service Card.

the system. The longer the power is applied, the more the titanium that is vaporized and the greater the pumping action—up to, the design limits of the pump. Unlike that of mechanical or diffusion pumps, the action of the titanium adsorber cartridge continues after the filament is turned off.

Pumpdown speed is approximately 5 liters per second. Pumpdown times are dependent on the size and nature of the chamber, sealing method and bakeout and other operating techniques.

Filament life is about 500 evaporations of 1 minute, or equivalent, at 1 micron or less, based on tests to date. A complete filament assembly can be replaced in less than 2 minutes and new filaments can be overwound with titanium wire in under 5 minutes.

No provision for ionization is required. Essentially all of the pumping is by gettering action.

The pump may be used directly following mechanical pumping to the 10 micron level or below.

It can be used following pumping by trapped oil or mercury diffusion pumps or molecular drag pumps where pressures in the 10^{-4} or 10^{-5} mm range are first attained.

In either case the volume to be evacuated, including the titanium pump, is completely isolated by UHV valves or seals prior to final pumping. With suitable initial pumping and bakeout, and careful technique, pressures in the 10^{-9} mm range are attainable and these can be maintained by intermittent evaporations of short duration at increasing intervals.

Circle No. 230 on Subscriber Service Card.

Economical Track Antenna Is Highly Mobile

A tracking antenna which combines maximum economy with utility is now available from **D. S. Kennedy & Co.**

The transportable tracker has three important features: a folding 28-foot reflector, hand-operated elaz drive system and self-contained trailer m and tower.

The reflecting surface is a sp reflective cloth which folds compa and the ribs of the reflector are hi around the center section. When reflector is collapsed into a con bundle and the supporting lowered onto the flat trailer bed antenna is easily towed to an location by a light truck or st wagon.

While the elevation and azi drives are intended to be operate hand, motors and selsyns can be added if desired.

Circle No. 231 on Subscriber Service C

Carcinotrons Eliminate Frequency and Power H

A new family of eight electr compatible carcinotrons is being duced by the **Electron Tube Di** of **Litton Industries.** The carcin are the first such group to use bands sole tuning without frequer power holes when a tube is op into as much as a 2-to-1 mismat

With wider-than-normal-ban output couplers, the Litton ca trons minimize other component as antennas, waveguide plumbin load isolators. Tuning rates are siderably faster than on any tube viously obtainable, with size weight the smallest to date.

Circle No. 232 on Subscriber Service

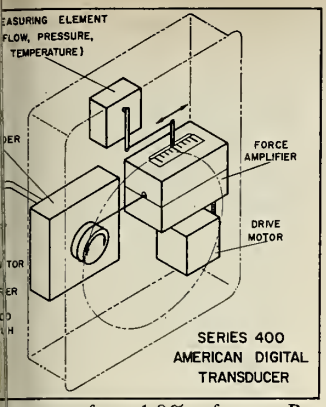
Process Variables Meas by New Digital Transc

A new Series 400 transducers measure process variables and p digital encoding for flow, liquid pressure or temperature has bee duced by the **American Meter C**

The new transducers empl completely mechanical American Amplifier—actuated directly by ard measuring elements, to positi shaft of a precision encoder (to digital converter).

The use of the Force Ar eliminates the need for ele servos, vacuum tubes, magnetic fiers or electronic component resultant reduction in initial cost maintenance cost, and an incr reliability.

The Series 400 transduce available in vacuum and p ranges to 10,000 psi, temp ranges to 600°F, and in merc bellows type manometers for level or flow applications. The ducers are conservatively rate



curacy of ± 1.0% of span. Re- cibility is better than ± 0.5% n. Linear or square root encoders available. The transducers are d in standard all-weather meter

No. 233 *an* Subscriber Service Card.

ro Plotter Eliminates ual Data Reduction

n electronic device which auto- lly checks out servo systems and luces the test results in graphic has been brought out by **Republic on Corporation.**

e unit, an automatic Servo r, is said to eliminate long hours nual data reduction required for outs with non-automatic systems. lic says its plotter produces a on of 40-point curves within 12 es from the beginning of the

lieved to be the only automatic plotter on the market, the Re- analyzer can be used with vir- any electronic servo system. It and plots phase and amplitude nships in the data-frequency from .3 to 30 cycles. Harmonic ions are compensated for auto- lly.

ilt of standard modular rack nel construction, the Servo Plot- ive feet high by two feet square. rketed by Republic, the Plotter omplete unit requiring no ac- parts. It utilizes conventional plot paper and provides, among Bode, Nichols and Nyquist

No. 234 *an* Subscriber Service Card.

mic Capacitor Touted place Paper Varieties

kard Bell Electronics announces application on a new capacitor olutionary design which is ex- to eventually replace most paper ors in the .01 and .25 micro- ange and mica capacitors in no-drift capacities of 300 micro-microfarad to .01 microfarad.

The capacitor is made of ceramic in two forms: extruded and molded. The extruded model is a tube with a triangular cross bracing which performs double duty as a structural core and as a surface area to increase capacitance. The molded type is of solid construction which may be manufactured automatically in one piece without the use of leads or terminals. Both types are suitable for high temperature. The molded type is capable of withstanding extreme temperatures due to its elimination of soldered terminals.

In the 300 micro-microfarad to .01 microfarad range a no-drift capacitor can be made for values of NPO up to N6000 for temperature compensation. The capacitors are non-inductive and have indefinite life since no active elements are used in their manufacture. They reduce mounting area, cost and installation time, and are suitable for printed circuitry and dip soldering techniques without price penalty.

Circle No. 235 *an* Subscriber Service Card.

Transducer Measures Pressures to 10,000 psi

A precision pressure transducer designed to measure gauge or absolute pressures in the 100-10,000 psi range and give exceptionally high performance under severe environmental conditions was announced by the Components Division of **Fairchild Controls Corporation,** a wholly owned subsidiary of **Fairchild Camera and Instrument Corporation.**

The Model TPH-175 is a dynamically balanced pressure transducer which employs twin spring linkage to eliminate pivots or bearings thereby eliminating friction points and giving the unit excellent repeatability characteristics.

The pressure sensing elements are twin bourdon tubes which actuate the wiper of a precision wire-wound potentiometer giving either linear or nonlinear outputs. Overall accuracy including linearity, friction and hysteresis is ± 2% with resolution as low as 0.25%.

Utilizing the new design, the unit can withstand 55 to 500 cps at 10g's vibration with less than 1% error and 2000 cps at 25g's without permanent shift in calibration or damage.

The TPH-175 can withstand an acceleration force of 25g's in each of the three mutual perpendicular axes and shock up to 25g's without damage. Over-pressure up to 100% of the unit's range is possible with negligible calibration shift.

Circle No. 236 on Subscriber Service Card.

contract awards

WASHINGTON—The Pentagon's Advanced Research Projects Agency awarded contracts totalling more than $400 million to private industry and other government agencies during Fiscal Year 1959.

Here is an official breakdown, giving a description of the work, the participating government agency, the principal contractor(s) with whom a contract has been placed or is being negotiated, and estimated project funding through FY '59.

Military Space Technology Satellite Systems

Project *Discoverer*, Sec/AF, Lockheed Aircraft Corp., $106,000,000; Project *Midas*, ARDC, Lockheed, $10,800,000; Project *Score*, ARDC & ASC, Convair, Div. of General Dynamics, $704,000; Project *Sentry*, Sec/AF, Lockheed, $96,600,000; Delayed repeater system (*Courier*), ASC (Primarily in-House), $3,000,000; Doppler navigation system (*Transit*), BuOrd., Johns Hopkins Lab., Lockheed, $1,383,000; Subsystems for meteorological project, ARDC, $1,151,000; Launch vehicles, ARDC, Douglas Aircraft, $18,300,000; Active repeater communications satellite (launch and control), ARDC, $1,000,000; Active repeater communication satellite (payload), ASC, $1,000,000.

Propulsion and Launch Facilities

Project *Saturn*, AOMC, in-house with engines from Rocketdyne Div. of North American Aviation, $24,508,000; Project *Centaur*, ARDC, Convair, Div. of General Dynamics, Pratt & Whitney, $16,000,000; Static Test Tower and Launch Stand construction (*Saturn*), AOMC, $9,492,000; Large thrust test stand, EAFB (1 million lb. thrust single chamber engine), ARDC, $240,000.

Tracking and Ground Environment

Project *Spacetrack*, ARDC (Primarily In-house), $1,299,000; JPL ground space surveillance, AOMC, JPL, $226,000; Spain and Japan tracking installations, ASC, $7,601,000; Instrumentation ship PVT. Joe E. Mann (PMTR), Philco Corp., $1,100,000; 2 VC-2 vessels (PMTR) BuAer., $2,300,000; Minitrack modifications and extensions, NRL (Primarily In-house), $11,740,000; Doppler system installation, BRL (Primarily In-house), $6,875,000.

Exploratory Research

Stagnation point ballistics, Army, R&D, Metallbau Semler, Munich, Germany, $290,000; Properties of materials at low temperatures, NBS, In-house, $184,000; Nine studies in space power research, ASC, $961,000; Study in space power research, BuShips, $200,000; Research in high temperatures and pressures, NOL, Bjorksten Research Labs, Inc., $115,000; Feasibility Studies (space propulsion and power sources), ONR, Princeton University, Curtiss-Wright, Republic Aviation Corp., University of California, $413,000; Feasibility studies (Project *Orion*, Adv. space propulsion and power sources), ARDC, General Atomic, Div. of General Dynamics, Aerojet-General, Reaction Motors of Thiokol, Plasmadyne Corp., Experiment, Inc., Aeronutronic Systems, Inc., Atlantic Research Corp., AVCO Research Lab., Rocketdyne Div. of North American Aviation, Fairchild Aircraft, Aero-Chem Research, Vidya Associates, RCA, $2,809,000; Feasibility studies (Heat rejection from space vehicles, advanced power sources), AOMC, Electro-Optical Systems, $182,000; Magnus effect study, BuAer, Flettner Aircraft Corp., $28,000; Plasma electron study, Army, R&D, Batelle Memorial Institute, Frankfurt, Germany, $307,000.

Ballistic Missile Defense (Project *Defender*)

Info. center on high altitude weapons effects, ARDC, Rand Corp., $144,000; Reentry physics studies, ARDC, Mass. Inst. of Tech., $4,646,000; Omni-Range Digital Radar, ARDC, Columbia University, $1,328,000; Electronically Steerable Array Radar, ARDC, Bendix Aviation Corp., $2,144,000; Missile Range measurements, ARDC (Primarily In-house), $3,435,000; ACANIA assignment to AMTR, ARDC, Stanford Research Institute, $575,000; H.F. ionospheric radar research, ONR (Primarily In-house), $535,000; Ballistic missile defense system studies, ARDC, Convair, Div. of Gen. Dynamics, $1,375,000; Atmospheric and ionization studies, ARDC, A.D. Little Co., Convair, Div. of Gen. Dynamics, $1,435,000; Radar discrimination, ARDC, Raytheon Corp., $680,000; Down range ship operation, AOMC, Radio Corp. of America, $2,700,000; High power radar research, AOMC, Cornell Aeronautical Lab., $1,361,000; Advanced radar research, ARDC, Mass. Inst. of Tech., Lincoln Lab., $515,000; Vertical probe launching, ARDC (In-house), $397,000; Decoy sorting radar, ARDC, Raytheon Corp., $1,180,000; Microwave radar, ARDC, RCA, $850,000; Artificial electron clouds study, ASC, Itek Corp., $39,000; Catalytic effects in discharges, BRL (In-house), $80,000; Design of hypersonic intercept system, ARDC, Convair, Div. of General Dynamics, $1,033,000; Hypervelocity impact research, BRL (In-house), $525,000; Hypervelocity impact research, BRL (In-house), $300,000; Photodetachment cross-section studies, NBS (In-house), $30,000; Digital phased array radar, AOMC, Sylvania Electric Products, Inc., $1,434,000; Transmission of ion and atomic beam studies, ASC, American Machine & Foundry, $100,000; Feasibility studies (Primarily GLIPAR) ONR, Gen. Atomic, Div. of General Dynamics, Stanford, Research Institute, Westinghouse Corp., Aeronutronic Systems, Inc., Allied Research Associates, University of Chicago, Convair, Div. of Gen. Dynamics, General Electric Tempo, General Mills, Inc., Houses Aircraft Co., Industrial Research Assoc., Ramo-Wooldridge, RCA, Republic Aviation Corp., Technical Operations, Inc., $1,780,000; Feasibility studies (satellite defense systems, missile phenomenology), ARDC, RCA, Convair, Div. of General Dynamics, General Electric, Lockheed, Gen. Atomic, Div. of Gen. Dynamics, Republic Aviation, Dikewood Corp., Allied Research Associates, $3,805,000; Feasibility studies (Space intercept, re-entry, and target studies), AOMC, Solar Aircraft Corp., Bendix Aviation Corp., AVCO Research Lab., Raytheon Corp., Convair, Div. of Gen. Dynamics, $3,257,000.

Solid Propellant Technology

Studies of light element compounds, NBS (In-house), $500,000; Solid propellant research, BuOrd., Minnesota Mining & Mfg. Co., American Cyanamid, Aeronutronics Systems, Applied Physics Lab., Magna Propulsion, Atlantic Research Corp., Olin Mathieson, New York University, Navy (In-house), Allegany Ballistics Lab. (In-house), NOTS, NOL (In-house), $5,201,000; Solid propellant research, ONR, Ohio State University, Princeton Univ., Aerojet-General Corp., Aerochemical Research Lab., Univ. of Calif., Polytechnic Inst. of Brooklyn, Penn State Univ., $700,000; Solid propellant research, ARDC, Dow Chemical, Gallery Chemical, Monsanto Chemical, Pennsalt, Borden, Penninsular Chemresearch, Ethyl Corp., Atlantic Research Corp., National Research Corp., Univ. of Texas, Stanford Research Institute, Aerojet-General Corp., Univ. of Calif., Materials Research Corp., Materials Laboratory, WADC (In-house), Air Force (In-house), $3,910,000; Solid propellant research, AOMC, Esso Research & Engineering, Allied Chemical, Olin Mathieson, Army (In-house), Rohm & Haas (In-house), $3,267,000; Solid propellant research, OOR, University of Chicago, Duke Univ., A.D. Little, Vanderbilt Univ., Univ. of Florida, $630,000; Solid propellant research, BuMines (In-house), $215,000.

Civilian Space Programs Transferred to NASA

2 lunar probes; cosmic ray experiment; 12 ft. sphere, AOMC, $18,820,000.

3 lunar probes, ARDC, $7,600,000.

Ground scanning for lunar probes, NOTS, $400,000.

Meteorological payload, ASC, RCA, $6,711,000.

Other announced awards included:

NAVY

The Sperry Gyroscope Co. has been selected as the prime contractor for the development and assembly of navigational equipment for the new version of the *Pol* missile-firing submarine. (Initial con ls for $2 million.)

Sylvania has received $10 million in tracts for the development of munications systems for the *Polaris* gram.

$1,195,386—West Bend Aluminum Co., Bend, Wis., for *Zuni* rocket launcher

AIR FORCE

$63,000,000—General Electric Co., Del Systems Dept., for radio-command g ance systems for the *Atlas*.

$15,326,000—Hercules Powder Co., Wilm ton, Del., for research and develop of a third-stage engine for the *Min man* ICBM.

$12,458,351—Douglas Aircraft Co., Inc., S Monica, for components, ground sup equipment, spare parts and technical engineering data on *MB-1* rocket.

$11,000,000—Westinghouse Electric Aircraft Equipment Dept., for elec power generating system for the AF bomber. (Prime contractor Convair Di General Dynamics.)

$7,000,000—Melpar, Inc., Falls Church, for production of F-101B weapon sy simulators. (Initial amount of this tract $2,500,000, the ultimate value i cess of $7,000,000.)

$5,000,000—General Electric Co., Flight pulsion Div., Cincinnati, for turbojet craft engines, data and bill of mat for German, Lockheed designed F-10 craft.

$3,000,000—Hughes Aircraft, Culver Calif., for aircraft and weapons co systems, engineering services, mat and data.

$1,843,944—General Precision Labor Inc., Pleasantville, N.Y., for addi procurement of components for AN/APN-81 Doppler Navigation syst

$525,000—Lockheed Aircraft Corp., G Div., for research in connection with newly-developed titanium alloys.

$398,944—RCA, Harrison, N.J., for v electron tubes.

$179,069—Bomarc Laboratories, Beve Mass., for various electron tubes.

ARMY

$22,200,000—Martin-Orlando, for addi *Lacrosse* missiles and related g equipment.

$2,961,000—Martin-Orlando, for contin of engineering services for the *La* system.

$1,868,404—Paul Hardeman, Inc., Los les, for missile launch complex "H P.L.S. equipment for ODTF at Va berg AFB.

$1,038,000—Rocketdyne Div., North can Aviation, Inc., Canoga Park, for sified contract.

$977,941—Cubic Corporation, San Die an electronic measuring system for tracking research and development missiles and to assist in further de ment of missile systems at White

$755,000—Douglas Aircraft Co., Santa M for *Nike* adapters and research an velopment (two contracts).

$629,155—Autonetics Div., North Am Aviation, Inc., Downey, Calif., for computers.

$500,000—Olin Mathieson Chemical for exploring uses of an advanced propellant for the *Nike-Zeus* missi

$402,765—Montgomery Ross Fisher, In Angeles, for silo launch test co Phase III, static test facility at E AFB.

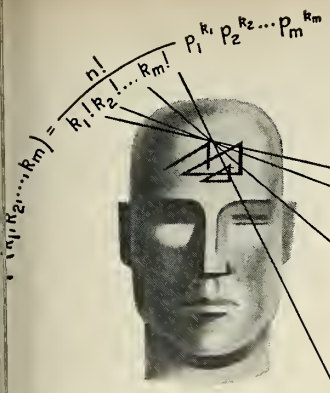
$280,072—Parish Pressed Steel, Div. o Corp., Reading, Pa., for rocket wa

$260,483—Gilfillan Brothers, Inc., Los les, for engineering services.

$165,236—Carrier Corp., Cambridge C Lowell, Mass., for container for sto 28,000 gals. of liquid oxygen or nitrogen.

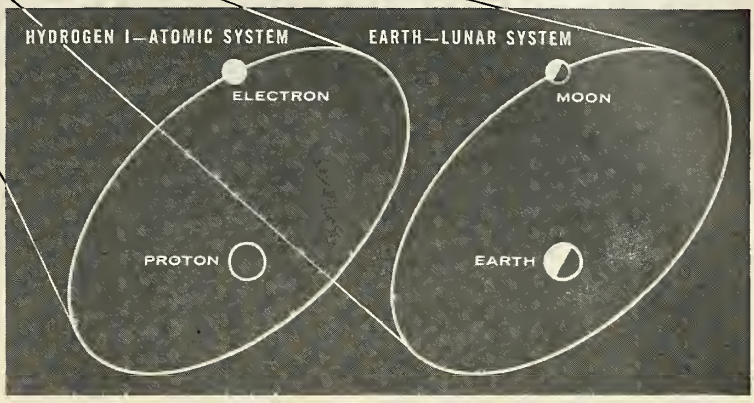
$151,365—Brown Engineering Co., Hun Ala., for additional continuation c with the Army Ballistic Missile

ENGINEERS—SCIENTISTS



Is order and organization in MACROCOSM and MICROCOSM an underlying principle of the universe... or does a fundamental state of randomness prevail in the cosmos, as might be expressed by the multinomial formula at left?

BOLD MINDS



THROUGHOUT HISTORY..... BOLD MINDS have sought to understand the forces at work in the universe, and as they developed working hypotheses, endeavored to turn all knowledge to their own purposes, devising philosophical and mechanical systems of their own.

As old hypotheses become inadequate or untenable, thinking men devise new ones. So the concept of a "flat" world has changed to an oblate orbiting spheroid—mere speck in a vast and expanding universe; so "empty" formless space is regarded as a curved continuum occupied by random knots of turbulence (creating the new branch of mechanics—hydromagnetics).

Today new horizons of discovery and surmise arise before the speculative mind.

ENGINEERS AND SCIENTISTS AT REPUBLIC FEEL KINSHIP WITH ALL BOLD MINDS OF PAST AND PRESENT, AS THEY FACE THE EXHILARATING CHALLENGES OF CREATING VEHICLES TO FLY IN ENVIRONMENTS WHERE NEW APPROACHES IN THERMO/AERODYNAMICS MUST BE MADE...AS WELL AS APPROPRIATE PROPULSION AND ELECTRONIC SYSTEMS TO POWER AND GUIDE TRANSIT IN SPACE

Groups of Research, Development and Experimental Engineers and Scientists at Republic Aviation are now working on projects over the whole range of aeronautics and astronautics—from supersonic and hypersonic weapons systems, both manned and unmanned, to plasma propulsion and space electronics.

Imaginative professional men at many levels of experience are invited to inquire about opportunities indicated below:

ELECTRONICS
- Inertial Guidance & Navigation
- Digital Computer Development
- Systems Engineering
- Information Theory
- Telemetry-SSB Technique
- Doppler Radar
- Countermeasures
- Radome & Antenna Design
- Microwave Circuitry & Components
- Receiver & Transmitter Design
- Airborne Navigational Systems
- Jamming & Anti-Jamming
- Miniaturization-Transistorization
- Ranging Systems
- Propagation Studies
- Ground Support Equipment

THERMO, AERODYNAMICS
- Theoretical Gasdynamics
- Hyper-Velocity Studies
- Astronautics Precision Trajectories
- Airplane/Missile Performance
- Air Load and Aeroelasticity
- Stability and Controls
- Flutter & Vibration
- Vehicle Dynamics & System Designs
- High Altitude Atmosphere Physics
- Re-entry Heat Transfer
- Hydromagnetics
- Ground Support Equipment

PLASMA PROPULSION
- Plasma Physics
- Gaseous Electronics
- Hypersonics and Shock Phenomena
- Hydromagnetics
- Physical Chemistry
- Combustion and Detonation
- Instrumentation
- High Power Pulse Electronics

NUCLEAR PROPULSION & RADIATION PHENOMENA
- Nuclear Weapons Effects
- Radiation Environment in Space
- Nuclear Power & Propulsion Applications
- Nuclear Radiation Laboratories

A new $14,000,000 Research Center—to be completed this year—is part of Republic's far-ranging R&D programs aimed at major state-of-the-art breakthroughs in every flight regime & environment.

Send resume in complete confidence to:
Mr. George R. Hickman, ENGINEERING EMPLOYMENT MANAGER— DEPT. 4F-3

REPUBLIC AVIATION
FARMINGDALE, LONG ISLAND, NEW YORK

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JUNE

United Nations Educational Scientific and Cultural Organization, UNESCO House, Paris, June 15-20.

Michigan Aeronautics and Space Association, Industrial Missile and Space Conference, Sheraton-Cadillac Hotel, Detroit, June 16-17.

Cornell University Industry Engineering Seminars, Ithaca, N.Y., June 16-19.

Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, June 16-19.

Institute for Practical Research on Operations, The University of Connecticut, Storrs, June 21-July 3.

American Institute of Electrical Engineers, Air Transportation Conference, Olympic Hotel, Seattle, June 24-26.

Nuclear Industry Division, Instrument Society of America, Second National Symposium, Idaho Falls, Idaho, June 24-26.

Institute of Radio Engineers' Professional Group on Military Electronics, Third National Convention on Military Electronics, Sheraton-Park Hotel, Washington, D.C., June 29-July 1.

Pennsylvania State University, Summer Seminar on Plastics—Its Mechanical Properties, Design and Applications, University Park, Pa., June 29-July 3.

JULY

Tenth Annual Basic Statistical Quality Institute, University of Connecticut, Storrs, July 12-24.

Radio Technical Commission for Aeronautics and Los Angeles Section of the Institute of Radio Engineers, Third Biennial Joint Meeting, Ambassador Hotel, Los Angeles, July 16-17.

Second Annual Institute on Missile Technology, Chief of Research and Development, U.S. Army, University of Connecticut, Storrs, July 26-Aug. 7.

The Denver Research Institute of the University of Denver, 6th Annual Symposium on Computers and Data Processing, Stanley Hotel, Estes Park, Colo., July 30-31.

AUGUST

Institution of Investigation of Biological Sciences, sponsored by Air Force Office of Scientific Research-Aeromedical Div., World Health Organization and United Nations Educational, Scientific and Cultural Organization, Montevideo, Uruguay, Aug. 2-7.

William Frederick Durand Centen Conference, Problems of Hypersc and Space Flight, Stanford Univers Stanford, Calif., Aug. 5-7.

Institute of Radio Engineers' Professic Group on Ultrasonics Engineering, F National Ultrasonics Symposium, S ford University, Stanford, Calif., A 17.

Institute of Radio Engineers, Wes Electronic Show & Convention, C Palace, San Francisco, Aug. 18-21.

American Rocket Society, Gas Dynar Symposium, Northwestern Univer Evanston, Ill., Aug. 24-26.

International Astronautical Federat 10th Annual Congress, Church Ho Westminster, London, Aug. 31-Sept

SEPTEMBER

Air Force Office of Scientific Research General Electric Company's Missile Space Vehicle Department, Confere on Physical Chemistry in Aerodynar and Space Flight, University of P sylvania, Philadelphia, Sept. 1-2.

Air Force Association and Panora send reservations to AFA Hou Bureau, P.O. Box 1511, Miami Be Sept. 3-6.

Standards Engineering Society, Bo Section, Eighth Annual Meeting, H Somerset, Boston, Sept. 21-22.

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NEW PRODUCT BRIEFS

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FR HOSE. Fluoroflex-T(eflon) se, said to be chemically in- a jet and missile fuels and oxi- h been developed by Resisto- r. The abrasion-resistant rubber is inforced with a spiraled high- w to prevent crush or collapse. e of Fluoroflex-T is carried e hose and over the face of n fluids being transferred can- m in contact with or be con- d y the metal flanged fittings or o ring. The non-adhesive surface te on permits rapid flow of fluids tt or no buildup of corrosive l nonaging characteristic in- on service life. Current produc- f luoroflex-T chemical transfer r round handling equipment use 1½", 2" and 3" diameters to e engths. Larger diameters will il e shortly.

No. 241 on Subscriber Service Card.

NT METER. A 25-turn potenti- r, urnished in a length only y l ger than most 10-turn units, ce y been introduced by Litton rie Potentiometer Division. Desig- th MD20-25, the unit meets or ls l military specifications for ior ters, with .0075% linearity 005 resolution a Litton produc- an rd for this 2-inch model.

No. 242 on Subscriber Service Card.

DE ASSEMBLY. Resolving shaft ons o l part in 10,000 can be wit the CG-701 Geared Encoder bly now available from Datex rat n. Designed for use where um ze and weight are important, sen y uses two Datex shaft posi- nco ers and a gear box. The en- use on the input shaft provides pos ons of the least significant per 0° rotation. Because the disc s e oder is coupled directly to put haft, accuracy is that of the er ed. This input unit is then geared 10:1 to a 10-position encoder. The low-speed encoder utilized double-brush, lead-lag logic to eliminate ambiguities due to gear inaccuracy and backlash. Hence, the accuracy of the CG-701 is determined only by the accuracy of the encoder attached to the input shaft. The CG-701 is 3" in diameter, 3" long (exclusive of shaft), and weighs 19 ounces.

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PRESSURE SWITCH. Now available for use in all types of systems is a ¼ oz. transistor-size pressure switch designed for surge, leak, and variance detection which has been produced by Century Electronics and Instruments Co. Now in use as automatic leak detectors on missile programs, the unit has the following capabilities: setting limits, 1 to 100 psig; proof pressure, 3000 psig; operating range, 1 to 500 psig; burst pressure, 5000 psig; temperature, −65°F to +250°F; vibration, 0 to 2000 cps at 10g.

Circle No. 244 on Subscriber Service Card.

NEW ALLOYS. A new magnesium-rare earth metal alloy for missile applications has been developed by The Dow Chemical Company. Sand castings in the new alloy, designated EK31XA, are being produced by Dow for evaluation by prospective users. EK31XA sand castings combine room-temperature tensile properties with tensile strength at elevated temperatures up to about 600°F and also exhibit creep resistance at these elevated temperatures for times up to 10 hours, according to Dow. In long-term properties, including creep strength up to 1000 hours, EK31XA sand castings are serviceable to about 450°F, Dow said. Composition of the alloy is 3.2% rare-earth metal, 0.6% zirconium, balance magnesium.

Circle No. 245 on Subscriber Service Card.

CERAMIC COATING. An organic-ceramic coating developed by Dyna-Therm Chemical Corp. is reportedly capable of resisting extreme temperatures and adhering to almost any type of metal surface. Termed L-154, the material features gas-erosion characteristics of ceramics while requiring only standard industrial spray equipment for application. No enameling or curing ovens are needed. L-154 offers high dielectric strength, according to the manufacturer, as well as thermal shock resistance as low as −100°F.

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MISSILE LITERATURE

HYDRAULIC TEST CART. A 2-page, technical bulletin, No. 1373, describing a portable, self-contained hydraulic test cart for missile field test procedures is now available from the George L. Nankervis Company. Illustrated with photographs, dimensioned line drawings and a circuit schematic, this bulletin discusses various operational characteristics and specifications of the Nankervis Model 9462 test carts for field use. These carts supply 10-gpm of clean, tempered oil at up to 3000 psi. They are mounted on four-wheel axles with automotive type steering and are easily moved by one person. Oil is filtered to 2-5 microns and system components are of stainless steel to minimize contamination.

Circle No. 200 on Subscriber Service Card.

SWITCHES. A four-page catalog describing eight high-temperature thermal and seven waterproof switches, is available from Control Products Inc. Photographs, dimension drawings, specifications and characteristics are included of these plug, probe, and surface types of thermal controls for governmental and industrial applications and waterproof switches for use in applications requiring conformance to government standards or military specifications.

Circle No. 201 on Subscriber Service Card.

SEQUENCE INDICATIONS. The Opad Electric Company has released a two-page catalog sheet describing their new line of panel mounting Phase Sequence Indicators. Designed for integretion in test stands and panel boards, these instruments permit rapid determination of the order in which the voltage peaks of a three-phase power supply occur. Bulletin 1551 covers seven standard models and includes dimensioned outline drawings of the instruments.

Circle No. 202 on Subscriber Service Card.

ELECTRICAL CONNECTORS. A fully-illustrated catalog describing the complete line of Joy electrical connectors for industry has been issued by the Electrical Products Division of the Joy Manufacturing Company. In addition to orienting the reader by means of an illustrated nomenclature of terms and references used in the description of electrical connectors, the literature also lists electrical current ratings for cable, as based on wire gauges and number of wires.

Circle No. 203 on Subscriber Service Card.

TEST CHAMBER. A new 12-page catalog covering their line of environmental test chambers has been published by the American Research Corp.

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FIELD EMISSION CATHODES. A paper giving results of research conducted by the Linfield Research Institute for the U.S. Air Force on field emission cathodes is available from the Office of Technical Services of the U.S. Department of Commerce. The program was undertaken in two phases, one of which led to improvement of stability of the field emission cathode and the other involving study of the electrochemical behavior of refractory metals used to meke field emitters.

Circle No. 205 on Subscriber Service Card.

RADIO SIGNALS. A paper on the theoretical mathematical considerations of varying strengths of radio signals by H. Bremmer of the National Bure... Standards has been released b... Office of Technical Services of th... Department of Commerce. A stuc... made of a constant signal and a ... ating signal of the same freq... which reached the receiver by a ... ent path. The properties investigat... the composed signal are the di... tion functions of both the am... end phase, as well as the average... ber of crossings for either q... through any given level.

Circle No. 206 on Subscriber Servic...

TECHNICAL LIBRARY INDEX. ... fourth edition of a volume listi... subject headings used in the ... system of the Armed Services Te... Information Agency is available ... the Office of Technical Services, ... ment of Commerce. The listing ... rent to January, 1959. Each h... represents one or more reports ... search actually in the collecti... ASTIA or available to it.

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TITANIUM FORGING. Two ti... studies, one dealing with impact ... and the other with the thermal ... of several alloys, are available fr... Office of Technical Services, U. ... partment of Commerce. Three gr... titanium—commercially pure RC-... RS-55, RC-130A, and Ti-150A, w... pact-forged by researchers fro... U.S. Army Ordnance Corps at t... atures from 1300 to 2100°F. Stu... the effect of temperature indicat... the flow stress of RS-55 de... rapidly up to 1700°F; thereafter, ... crease was very small. In RC-13... Ti-150A, the flow stress was a... mately 20% less for each inc... of temperature above 1700°F. ... behavior of RC-130A and Ti-15... similar.

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RF MASS SPECTROMETER. A re... a new sampling system for the ... spectrometer which permits its ... studying combustion processes a... in batch analysis of gases is a... from the Office of Technical S... U.S. Dept. of Commerce.

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TEMPERATURE EFFECT. The eff... temperature on the magnetic pr... of six well-known end comm... available nickel-iron alloys are gra... illustrated in an Air Force rep... leased through the Office of T... Services, U.S. Department of ... merce. The temperature effects ... a-c magnetic properties of ... Hipernik V, Deltamax, Hymu 80 ... malloy, and 4-79 Mo-Permalloy ... ported for the temperature r... —60 to 250°C. Results of the st... reported in the form of curves ... ing the variation of core loss ... of weight and rms exciting volt... per unit of weight as tem... varies.

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ALUMINUM-IRON ALLOYS. H... minum-iron alloys have magneti... cal, and mechanical propertie... provide the potential for vari... netic applications, according to ... available from the Office of T... Services, U.S. Dept. of Comm...

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