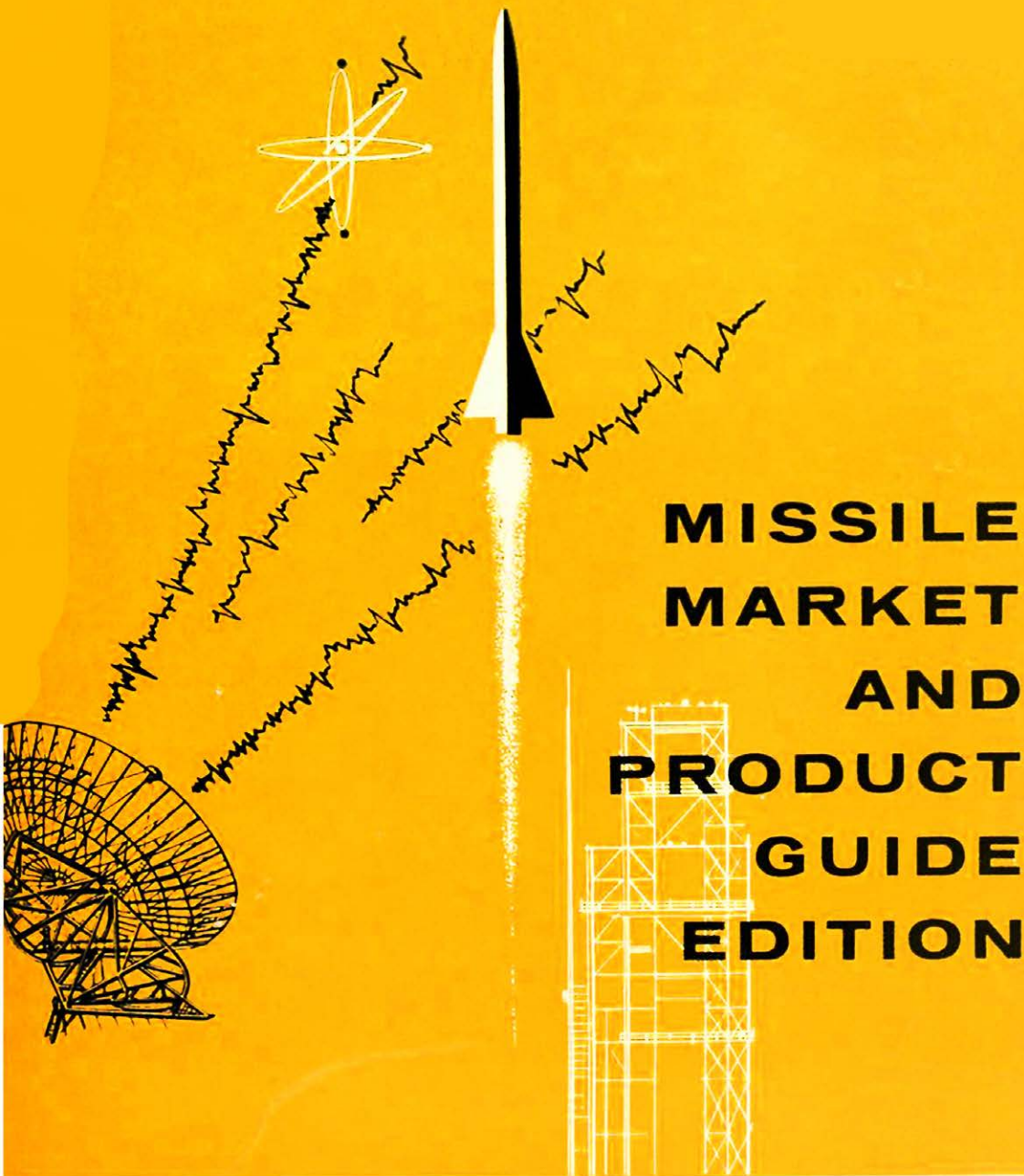




**MISSILE
MARKET
AND
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EDITION**

missiles and rockets

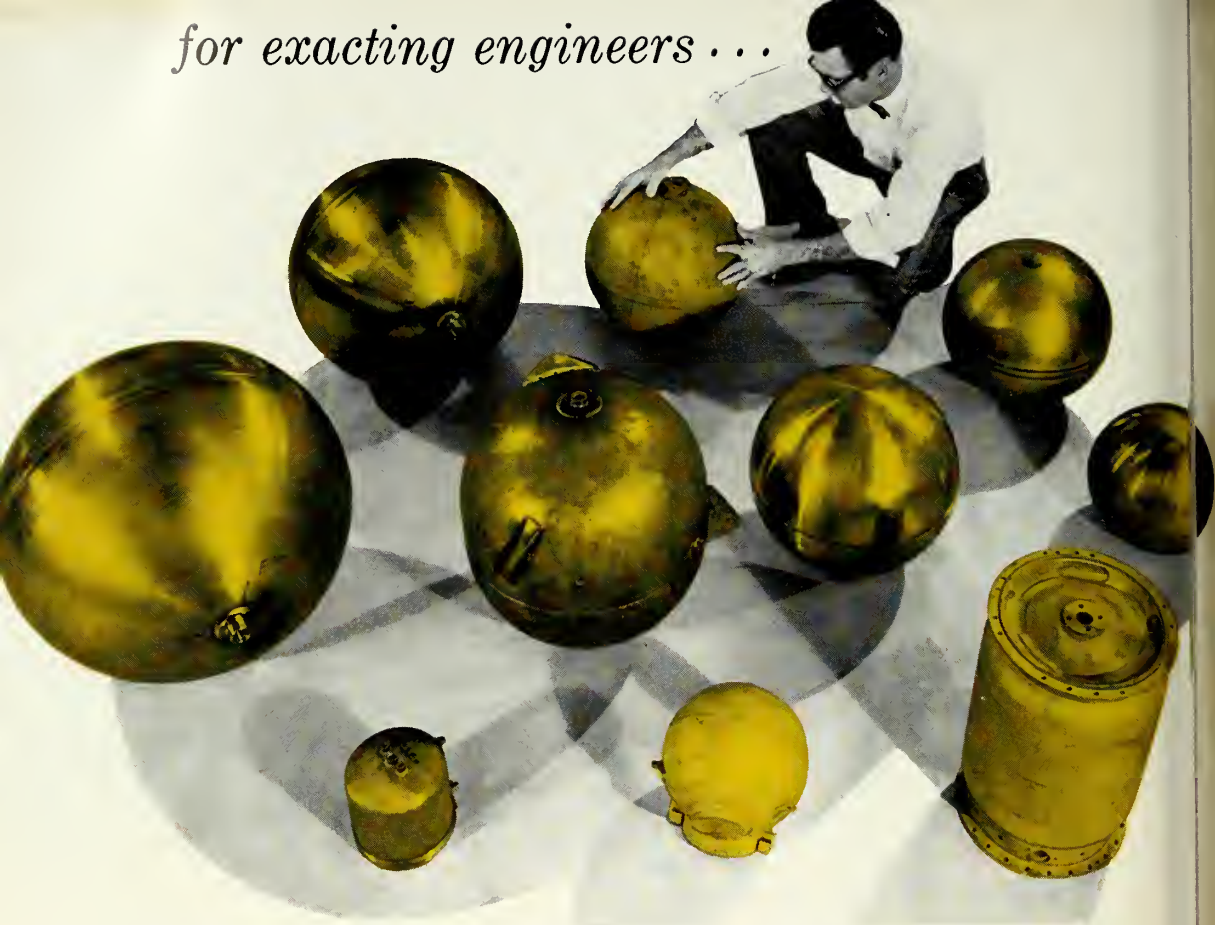
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MID-MAY 1959

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SOME DOWN-TO-EARTH THOUGHTS ABOUT THE SPACE AGE



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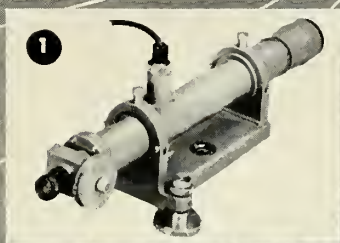
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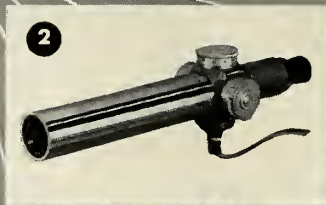
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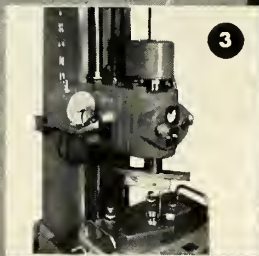
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ANGLES TO .000001"*



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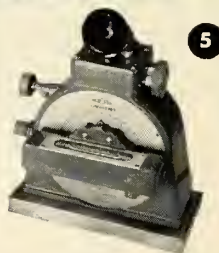
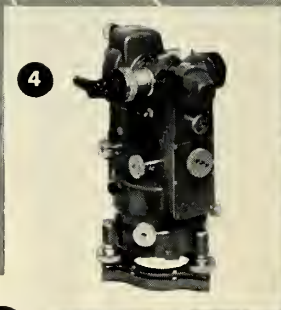


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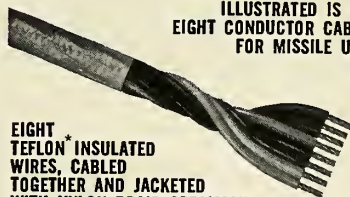


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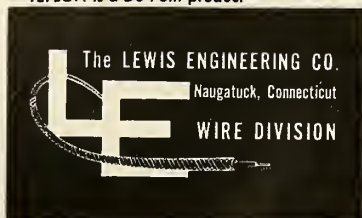
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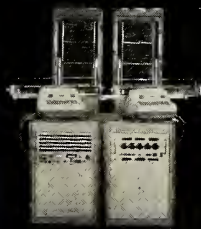


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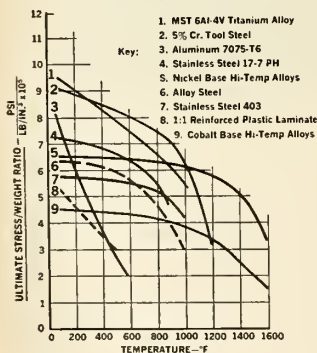
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missile market and product guide

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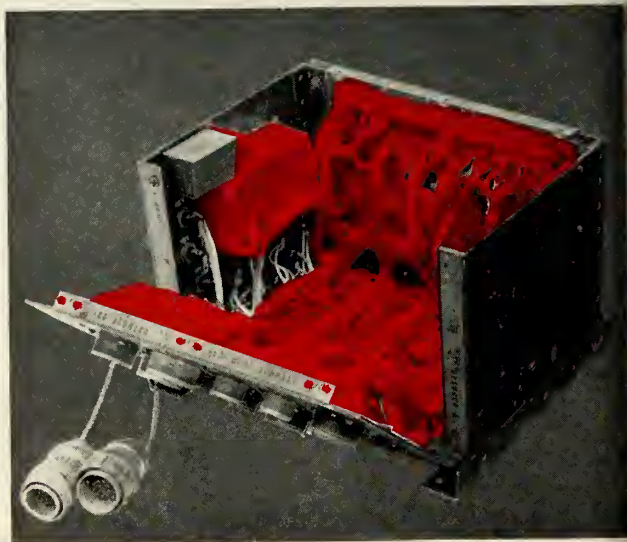


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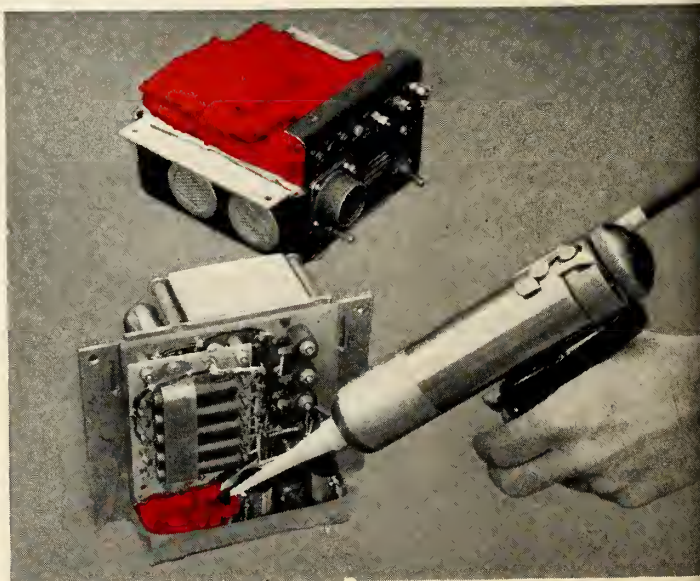
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Missile Support—a New U.S. Industry

Within the months ahead this country will see the development of an almost new segment of industry—one which will eventually run into billions of dollars. It is the construction of ballistic missile bases and the equipping of them with supporting hardware.

Involved to some extent will be the same companies which produce the missiles, the big primes which have traditionally been associated with the spacecraft and/or the aircraft business. But in addition to them, thousands of big and little companies to whom the missile and space industry a few months ago was as foreign, say, as a trip to Mars, will find themselves accidentally or intentionally concerned with producing or installing the thousand and one items which go to support the missiles of the very new future.

For the missile—and while this is intended primarily to treat of the big intercontinental ballistic types it also holds true for the smaller ballistic weapons and the air-breathers as well—is somewhat like the iceberg where cost visibility is concerned. Something like four-fifths is hidden. For example, a *Titan* ICBM may cost \$2 million. The site to contain a squadron of nine *Titans* will cost \$45 million, not including the personnel to man it.

The \$45 million takes in the cost of a concrete blockhouse strong enough to withstand an accidental explosion; the cost of communications cables connecting with each launching pad—many-stranded cables which will snake through conduits at the cost of \$800 a foot. It will include tons of concrete for handstand, miles of pipe for both liquids and gases; scores of pumps, hundreds of valves, generators, tubes and transistors, tons of steel in every form, aluminum and a dozen other metals, scores of chemicals. Heavy earth-moving equipment will be used, trucks, bulldozers, forklifts, lumber, lighting equipment—gauges and computers and every form of checkout equipment.

Some of the big ballistic missile launching pads will be hardened, that is, either sunk in holes or otherwise protected from possible enemy nuclear weapons. Our first ICBM, the *Atlas*, will be partially hardened, at some sites at least, probably to lie in a rough concrete-lined coffin with a sliding cover. From this "coffin" it will be raised and fired. The second liquid fuel ICBM, the *Titan*, will be lowered into holes in the ground, inverted silos,

from which they will be raised to the surface and fired. The third ICBM, the second-generation, solid-fuel *Minuteman*, will also be housed in inverted silos from which it will be fired without elevating to the surface. A solid-fuel vehicle can be fired from the hole because it rises much more quickly in the initial firing stage and thus does not present the heat dissipation problem of the liquid-fuel missile.

The ICBM sites must also include living quarters for personnel, storage facilities for materials and for maintenance equipment. They must include, believe it or not, recreation facilities for crews who will be on constant alert 24 hours of every day.

None of the equipment needed for a missile site—and none of the skill—is new to American industry (with the exception of some of the more esoteric checkout and testing devices), but industry will be faced with a demand from the military services to come up with new techniques for both speed and lower costs.

How do you drill a hole 100 feet deep and 20 feet in diameter for the *Minuteman*? How do you line it with concrete, properly reinforced to withstand the shock of a near-miss nuclear explosion?

The services say: "Give us a new technique which will dig the holes in one day and line them with concrete in another—all at a cost of \$50,000 and not \$500,000." And they are talking about as many as a thousand holes for a thousand *Minutemen*.

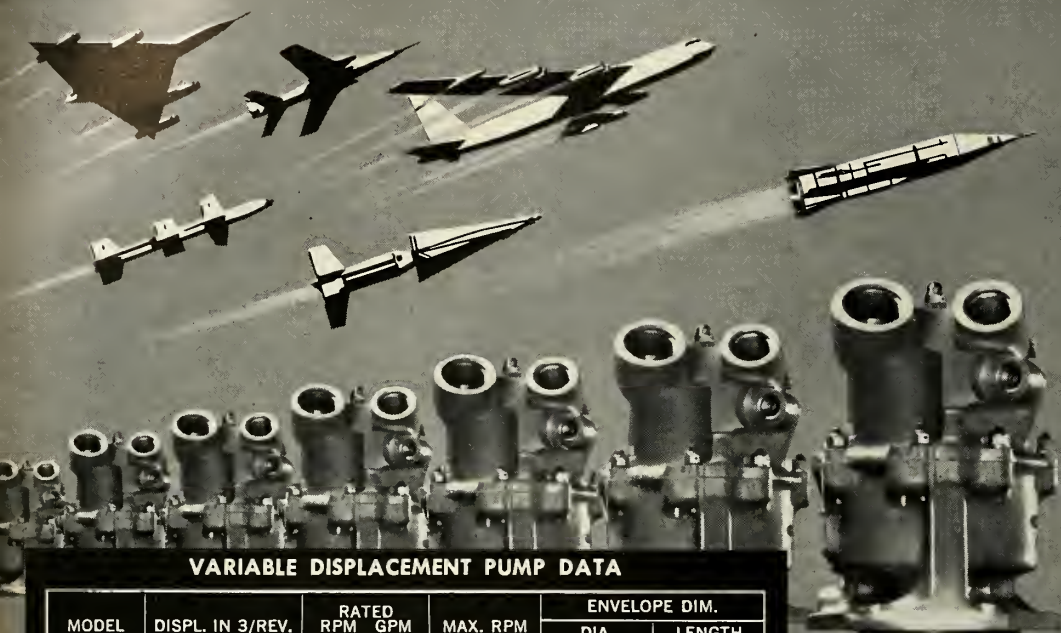
Which will be the companies to come up with new ideas in prefabrication, in miniaturization? Who will provide the shortcuts, the better, the faster and the cheaper way to do it?

There is no royal road to defense contracts and no magic formula for bidding. Uncle Sam is a tough customer and he wants and usually gets a full dollar's worth for every dollar he spends. He is as eager to find the little company with the bright idea or the special skill as he is to deal with the giant primes. Equally true is the fact that the big companies are always searching for the little man who has found a better way to do it. The price of missiles will come down as the skills of spacecraft advance—\$100,000 for the *Minuteman*, for example. In parallel fashion, the cost of missile sites must lower, too, and it will be industry, big or little, which will bring that cost down through ingenuity while reaping a golden harvest as it happens.

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P11	.115	12000 5.5	16000	2.750	3.625
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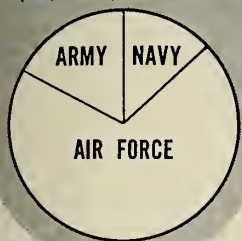
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Procurement & Production
Missiles, FY 1960

How To Do Business With the Defense Department

Outlined here are some helpful pointers for the average business man who wants to sell to the Department of Defense but doesn't know quite where to start . . .

TO THE AVERAGE business man hunting a contract from the Defense Department, the questions of whom to see, where to go and what to take with him are almost insoluble. Difficulties result not only from the complexity of the Defense Department's procurement organization but also from changes which are almost constantly made in the techniques and rules of procurement.

As a starting point, the Defense Department, itself, buys nothing. It has a number of procurement agencies. The biggest, of course, are the Army, Navy and Air Force, with the Defense Department's Advanced Research Projects Agency likely to enter the field later. Each of these agencies themselves are subdivided with procurement responsibility decentralized throughout the country.

DOD's basic role in procurement is one of policymaking. It also decides how many dollars each of the services may spend and, in some cases, actually decides which weapon system may be bought and by whom.

Purchases are made either by formal advertising or by negotiation. For missiles, rockets, ground support equipment, and subsystems, normally a procedure called "competitive negotiation" is used. This means, generally, that contractors thought to be qualified are invited to submit competitive proposals which are evaluated. After evaluation, a contract is negotiated with the contractor whose proposal seems most nearly to meet the military requirement.

Rules governing both formal advertising and competitive negotiation are spelled out in great detail in the Armed Services Procurement Regulation, Army Procurement Procedure, Navy Procurement Directives and, Air Force Procurement Regulations and Instructions.

Most big manufacturers who do business with the agencies of the De-

fense Department on a regular basis maintain Washington organizations to handle the technical problems inherent in the complex procurement structure. It is the company which wants to come in for the first time or the small business firm which needs the most guidance.

All kinds of advice is available, particularly to small business concerns. To qualify, a concern must have less than 500 employees and cannot be dominant in its field of operation. A certificate from the Small Business Administration will be taken at face value by Defense Department procurement officers.

Each of the military departments has an active program to help small business to compete for defense procurement. In addition, some contracts may be set aside in whole or in part for the exclusive benefit of small business.

In the case of equal low bids submitted by a large and a small company, preference would generally be given to the small concern. However, if a big company agrees to perform the work in an area of substantial unemployment, it will receive a preference over a small concern which won't or can't produce in a labor surplus area. To bolster the small business program, Defense officials work with the Small Business Administration to screen procurement that can be set-aside for exclusive small business participation. However, there is more than a little question as to the effectiveness of the program.

Generally, Defense officials have expressed the belief that the most effective role which small business can play is in the subcontract structure. All major contractors maintain an active program which aims at establishing a qualified list or lists of subcontractors and suppliers. Many defense contracts specifically require that a specified per-

centage of a big contract be subcontracted and gradually, the military services are screening the subcontract structure to be sure that conditions are complied with.

For subcontracts, manufacturers are advised to apply directly to prime contractors. Names of the principal contractors can be obtained from a Commerce Department Synopsis of Bids published almost daily and from records maintained by the Defense Department.

In the research and development area, special opportunities are available to small concerns and nonprofit institutions. Here the yardstick is competence, which frequently has little to do with size. Special efforts are made both by the military departments and the Defense Department to find the right man or the right company for the job in the area of research and development. More details will be found in other articles in this section.

In general, a would-be contractor will find the following rules helpful:

(1) Don't come to Washington when you first decide you want military work.

(2) Analyze the capabilities of your company, including facilities know-how, available labor pool, management and finance.

(3) Visit the nearest procurement or contract administration office to your plant, taking with you your analysis of company capabilities.

(4) Visit prime contractors, taking an analysis or proposal with you, picking those prime contractors who are located close to your own plant.

(5) Study or have a competent lawyer study the procurement structure of the military departments to be sure that buying representatives are made aware of your company's capabilities.

(6) Don't sign a contract without competent advice.

\$2,356,000,000



PROCUREMENT & PRODUCTION
MISSILES, FY 1960

How To Do Business With the Air Force

The buying arm of the Air Force carries over one million items in inventory. Here is a rundown on where the would-be contractor should go and what he should do when seeking this business . . .

AIR MATERIEL COMMAND located at Dayton, Ohio, is the Air Force's buying, supply and maintenance arm. Its workload is decentralized to Air Materiel Areas, Centers and Depots. It buys new production weapons for inventory, provides spare parts and material to maintain equipment already in the hands of the troops and makes research and development contracts on orders from the Air Research and Development Command. Some idea of the scope of the job can be obtained from the fact that AMC carries more than 1,300,000 items in inventory.

Knowing that a requirement will exist for better tooling, a new material, or new electronic equipment, it makes manufacturing methods contracts with research organizations and with industry in an effort to assure the availability of equipment in production quantities and at practicable costs.

Air Materiel Command is headed by Lt. Gen. Samuel E. Anderson, Jr. His deputy is Lt. Gen. William F. McKee. It is divided into six directorates which now operate as staff offices. These are: Plans and Programs, Procurement and Production, Supply, Maintenance Engineering, Transportation and Services, and Personnel and Support Operations. There is a separate Quality Control office to improve reliability.

Major responsibility for procurement is vested in the Aeronautical Systems Center at Wright Patterson Air Force Base, Ohio, and the Ballistic Missiles Center, AF Unit Post Office, Los Angeles 45, Calif.

Aeronautical Systems Center is responsible for the purchase of complete missiles, other than ballistic, complete aircraft and aerial targets. In addition, it is responsible for the procurement of fire control systems, launchers, rocket

and pyrotechnic weapons, warheads and explosives, photographic equipment, bombing and gunnery equipment, airborne radio and radar equipment, initial spares and ground support and tools/test equipment except for propulsion systems, research and development and service test of non-stock listed items. It buys, of course, many kinds of aircraft accessories and equipment.

Ballistic Missiles Center buys ballistic missiles, space vehicles and related equipment such as propulsion and guidance systems, ground support equipment, initial spares, tools, test equipment and the like. In the space field, Ballistic Missiles Center lets contracts on instructions from Advanced Research Projects Agency as well as the Air Force.

Electronic Defense Systems Division, 220 Church Street, New York City is responsible for the procurement of engineering management and other services for Air Defense Systems such as SAGE, DEW Line/White Alice (Alaska) and the new Ballistic Missile Early Warning Line.

The Air Materiel Areas have been designated Logistic Support Managers as well as weapon system managers to be sure positive supply support is provided to tactical units of first line weapons. This means:

Middletown Air Materiel Area, at Olmsted Air Force Base, Middletown, Pa. buys guided missile components support and rocket engine parts for the *Falcon* (GAR 1,2,3, and 4); *Side-winder* (GAR 8); fuels, lubricants oils, waxes and corrosion preventative compounds; chemicals and chemical products; gases, compressed and liquefied and gas cylinders; miscellaneous instruments (other than Government-Furnished Aircraft Equipment—GFAE) and laboratory equipment; electrical

meters and maintenance parts; parachutes and aerial pickup and cargo tie-down equipment. It also provides for contractual maintenance and modification services for the support of commodities listed above and missiles and/or engines for which it has prime maintenance responsibility. It also buys structural components and aircraft engine parts for specified training, transport and liaison aircraft.

Mobile Air Materiel Area, Brookley AFB, Mobile, Ala., buys guided missile components for the SA-16 *Jupiter* intermediate range ballistic missile and aircraft components for the F-84 and F-105. It also provides for contractual maintenance and modification services for this missile.

Ogden Air Materiel Area, at Hill AFB, Ogden, Utah buys guided missile components, support and engine parts for the IM 99 *Bomarc*, SM-62 *Snark* and the SM-73 *Goose* (now cancelled). It also buys laboratory equipment biological surveillance and provides contractual maintenance and modification services for the listed missiles and/or engines. It also keeps parts for F-101 and other specified aircraft.

Oklahoma City Air Materiel Area, Tinker AFB, Oklahoma City, buys guided missile components, and support for the *Rascal* (GAM-63, now cancelled); *Hound Dog* (GAM-77) and *BullPup*, and provides maintenance and modification services for these missiles. It also buys parts and support for B-52, B-47, KC-135 and other aircraft.

Rome Air Materiel Area, Griffiss AFB, Rome, N.Y. is responsible for the purchase of the largest part of the Air Force's electronic, radio and radar

equipment procurement. Specifically, it buys ground radio, radar and navigational equipment, meteorological equipment, instruments (except airborne) and supplies; ground communications equipment, miscellaneous electric power and distribution equipment and supplies, lighting fixtures for airports, lighting fixtures and lamps (except airborne), and electric wire and cable.

Rome AMA buys the engineering and installation of ground electronics support equipment, facilities and systems (GEEIA). It also buys systems integration, development, service test and similar functions required for implementation and operation of Electronic Support Systems (ESSPOs).

San Bernardino Air Materiel Area, at Norton AFB, Calif., has been designated the support manager for ballistic missiles. As such, it buys guided missile components and support for the *Atlas*, *Titan* and *Thor* ballistic missiles and will, presumably, take on the job for *Minuteman* at a later date. It is also responsible for the support of the Q-2 target drone built by Ryan and the Q-4 drone built by Radioplane. It also buys parts and support for specified aircraft.

Warner Robins Air Materiel Area, Robins AFB, Macon, Ga., buys guided missile component support for the *Matador* (TM-61) and *Mace* (TM-76) and airframe structural components for the C-130 and B-57. Aircraft launching, landing and ground handling equipment; weapons, except Army Ordnance assigned items; bearings; metal working and woodworking machinery and equipment; maintenance and repair shop equipment (aircraft, motor vehicle and weapons); tires and tubes, except aircraft; gas turbines and jet engines, except aircraft; rescue and safety equipment. The AMA will provide contractual maintenance and modification services for support of commodities listed above and aircraft, bombing, gunnery and fire control systems and equipment and aircraft and missiles and/or engines for which the AMA has primary responsibilities.

Dayton AF Depot, Gentile AF Station, Dayton, Ohio, buys airborne radio, radar and navigational equipment and components, airborne communications equipment; electrical and electronic equipment, components; terminals; terminal boards, connectors, fuses, lightning arrestors, capacitors, resistors, switches, circuit breakers, tubes, relays, contactors, solenoids, insulators, knobs, pointers, dials and piezo electric crystals, laboratory and shop test inspection equipment and maintenance

parts, measuring tools, inspection gages, and combination and miscellaneous instruments. Dayton does not buy any Government Furnished Aircraft Equipment (GFAE) in the way of airborne radio or airborne communications equipment.

There are two other air materiel areas and one depot. **Sacramento AMA** at McClellan AFB specializes in the purchase of airframe structural parts for aircraft including the F-100, F-104 and the upcoming F-108 among others. **San Antonio Air Materiel Area**, at Kelly AFB, Tex., buys airframe structural parts and engine parts for the B-58, the F-102 and has been designated the support manager for the B-70, chemical bomber and the WS-125A, nuclear-powered aircraft.

In outlining the decentralized procurement responsibility, Air Materiel Command notes that there is, in addition, a local purchase or base procurement program. This deals with the purchases of supplies and services required to support a specified installation. Most of the items bought are of a housekeeping nature.

Actually the would-be contractor or subcontractor doesn't have to go to the listed AMAs for help. Middletown AMA is responsible for five procurement districts, located at Boston, Newark, New York, Philadelphia and Rochester. In addition, there are eight Air Procurement offices, located at Hartford, Conn., Hackensack, N.J., and South Orange, N.J.; Stamford, Conn.; two in Pittsburgh, Pa., and one at Buffalo and Syracuse, N.Y. Finally AF has stationed at the plants of principal contractors representatives who can help. These are located at Bell Aircraft, Niagara Falls; Curtiss-Wright Wood-Ridge, N.J.; Fairchild Engine and Airplane at Hagerstown, Md.; General Electric, Syracuse; Sperry Gyroscope, at Great Neck, L.I. and United Aircraft at Stamford, Conn.

How does the Air Force manage its vast buying program? It uses what it calls the Weapon System Integration concept. This means that an AF contract gives a strong prime contractor the basic responsibility to design, develop, produce and manage the total effort under the supervision of the Air Force.

However, this does not mean that subcontractors and suppliers are left out in the cold. AF usually requires that a specific part of the contract be subcontracted. It also wants to approve the subcontract structure.

Purpose is to be sure that the prime contractor does not keep in-house work which can be done more efficiently or economically on the outside.

Most of the prime contractors maintain active organizations which aim at

building up and maintaining a strong subcontract structure. These involve in some cases as many as 23,000 subcontractors and suppliers, with 5,000-6,000 not being in any way unusual. A good point of contact for business is the prime contractors including: Boeing Airplane Co., Seattle, Wash.; North American Aviation, Canoga Park and Downey, Calif.; Lockheed Aircraft, Sunnyvale, Calif.; Aerojet General Corp., Nimbus, Calif.; Convair Division of General Dynamics at San Diego, Calif.; McDonnell Aircraft, St. Louis; Radio Corporation of America, Camden, N.J.; General Electric, Philadelphia, Pa., and Syracuse, N.Y.; Douglas Aircraft, Santa Monica, Calif.; Republic Aircraft, Farmingdale, L.I.; The Martin Company, Denver, Col., and Orlando, Fla.; Hughes Aircraft, Culver City, Calif., and Tucson, Ariz.

In one important area, Air Force does not handle its own work. Construction of missile bases, while planned for by the Air Force is handled by the Corps of Army Engineers acting as agent for the Air Force. Most of the contracts for construction of bases, many of which involve the installation of equipment, are handled on open bids invited by the District Engineer in which the installation will be located.

If you aren't interested in producing hardware but have a new idea, or a new way of doing something important for the AF, the Air Research and Development Command at Andrews AFB, just outside of Washington, D.C., frequently will talk business to private research groups, industrial concerns, regardless of size, and to nonprofit organizations.

ARDC is headed by a lieutenant general. There is a vice commander and an assistant vice commander. The office is divided into five main sections: Resources; Air Defense Systems Integration; Research; Ballistic Missiles, and Weapon Systems. Air Defense Systems Integration is located at Bedford, Mass. and the Ballistic Missiles Division is located at Inglewood, Calif. The other divisions are at Andrews AFB.

The resources office would probably be the first point of contact for a would-be contractor. It consists of: Directorate of Materiel; Directorate of Installations; Directorate of Procurement; Technical Services; Personnel; Operations; and Manpower and Organization. An Assistant Deputy Commander is charged with responsibility for contractual and technical services and would be helpful to the man with an idea.

The research engineering section would be another point of contact. It is the office which places most of the "pure" research contracts.

\$417,000,000



Procurement & Production,
Missiles, FY 1960

How To Do Business With the Navy

Navy will spend over \$6 billion in the next fiscal year. Here is a breakdown of those expenditures and tips to prime and subcontractors on how to obtain contracts . . .

FOR THE FISCAL YEAR 1959-60, the Navy plans procurement obligations totaling more than \$6 billion. These contracts will involve everything the Navy needs from missiles, ships and planes to machined parts, food and clothing.

A breakdown of these planned expenditures shows the following major items:

Aircraft, \$1.86 billion; ships, \$1.7 billion; followed by various categories in the missile and rocket, and support systems areas—missiles, \$716 million; electronics and communications, \$318 million; construction, \$266 million; miscellaneous procurement and production including target drones, machine tools etc., \$96 million; production equipment and facilities, \$26 million; and support vehicles, \$30 million.

As with the Department of Defense and the other services, the two major approaches to selling to the Navy—whether it be hardware, supplies, equipment, missiles or support equipment, or research and development ability—are either as a prime contractor or as a subcontractor to a prime.

To obtain prime contracts, it is necessary to get on the bidders' lists for those items the company is qualified to produce. The Navy recommends reference to the booklet "How to Sell to Agencies Within the Department of Defense" which is available from the field offices of all the services. Major Navy field offices are the Inspectors of Naval Material located in 29 cities in all parts of the nation. The booklet covers both advertised and negotiated contracts.

If the interest is in the subcontract, it is necessary to get on the bidders' lists of the various primes. Lists of these primes also can be obtained from the Inspectors of Naval Material. The Navy recommends another booklet, "Selling to Navy Prime Contractors,"

NaVEXOS P-1030, as a source of information on procurement and production.

The third largest item in procurement obligations is for research and development work. Frequently such R&D contracts lead to production contracts.

These contracts usually are let by the interested bureau or office of the Navy on a competitive basis to the firm best qualified to do the work at the lowest cost. Detailed information may be found in two publications: "The Office of Naval Research Contract Research Program," which is available from the Chief of Naval Research, Department of the Navy, Washington 25, D.C.; and "Inventions Wanted by the Armed Forces," published by the National Inventors Council, Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

Another good source of information, the Navy says, is the Department of Commerce's "Daily Synopsis of U.S. Government Proposed Procurement, Sales and Contract Awards" which is available for a yearly subscription of \$7.00 from the Commerce Department's Field Service, Administration Service Office, 433 West Van Buren St., Chicago 7, Ill.

During the past five years, approximately 20% of the Navy's domestic procurement dollar went directly to small business, with another 20% to small business in subcontracts. The Navy has a vigorous program to encourage small business—some 130 persons are primarily concerned with helping small business and are located in all major naval purchasing activities and in the Offices of the Inspectors of Naval Material.

One effective way to help small business is to set aside total procurements or parts of procurements exclusively for negotiation with small

business. This is done generally when limiting of competition will not result in payment of unreasonable prices by the government.

In addition, the Navy Department in 1954, in cooperation with the Army, Air Force and other Federal agencies, developed the Industrial Assistance Program. Under this program, businessmen are advised of trends and needs of the services by means of procurement conferences, exhibits of items needed, and other activities to stimulate interest.

The coordination and direction of "material matters" in the Navy are the responsibility of the Assistant Secretary of the Navy (Material) assisted by the Chief of Naval Material. Under his guidance, the technical bureaus and offices are responsible for providing the Navy's needs.

Each of these offices or bureaus designs, procures, controls and maintains those segments of equipment coming under its particular cognizance.

This includes some 36,000 major end items such as ships, missiles, planes, communications devices etc., and more than 1,200,000 secondary supply items needed to support, operate and maintain the major equipment. This latter replenishable material includes 800,000 repair parts and 400,000 consumable and general supply items.

The Bureau of Aeronautics is charged with maintenance of superiority of the U.S. Navy in the air. In addition to the procurement of aircraft, BuAer is charged with procurement of the air-to-air and air-to-ground missiles. As with BuOrd, BuAer is interested in research and development work in its own field.

The Bureau of Ships is charged with design, building, conversion and altera-

tion of naval vessels, including the missile launching surface units and the submarines including *Polaris*.

The Bureau of Supplies and Accounts fills many needs throughout the Naval Service. The Bureau, through a network of more than 200 decentralized offices throughout the country, spends annually more than \$2 billion to acquire more than a million items.

This procurement covers almost all categories of consumables, repair parts and technical items including electronics and special parts for guided missiles and support equipment including nuclear powered submarines for the *Polaris* missile system.

The Bureau is interested in expanding its procurement sources and encourages competition from both large and small business alike. It invites all qualified suppliers to have their names placed on the Navy's bidding lists. An information brochure can be obtained from the Bureau of Supplies and Accounts (Code OZ), Navy Department, Washington 25, D.C.

The Bureau of Yards & Docks has the responsibility for the construction and maintenance of the Navy's shore establishments. Also, through the Naval Civil Engineering Laboratory, Port Hueneme, Calif., the Bureau conducts broad research, development, testing and evaluation of methods, procedures, materials and equipment pertinent to its field of endeavor.

Civilian contractors interested in work for the Bureau, or inventors, researchers and others who wish to investigate possibilities or bid on work should contact one of the Naval District Public Works Offices located in various large cities.

The Bureau of Medicine & Surgery procures its supplies through a joint procurement agency—Military Medical Supply Agency, 84 Sands St., Brooklyn 1, N.Y.

The Office of Naval Research is responsible for sponsoring both basic and applied research. Its fields of interest to date include all the basic sciences such as physics, acoustics, chemistry, geophysics, electronics, mathematics, statistics, mechanics, systems analysis and others.

The Marine Corps., which is part of the Naval Establishment, through its Quartermaster General, procures electronics and engineering items, refrigeration and air conditioning equipment. Much of its procurement is carried out through contracting officers at the Marine Corps Supply Activity, 1100 South Broad St., Philadelphia, Pa.

The Navy's overall policy in procurement provides that research and development contracts be awarded on the basis of comparative technical ability in the specific science or technology involved in the work. Because of the exploratory nature of the work, and the uncertainties of successful accomplishment, cost-reimbursement contracts generally are used in this field.

Consequently, the award of such contracts normally is based on the comparative ability of the proposed contractors rather than on comparison of the estimated costs, since in cost-reimbursement contracts advance estimates of cost do provide a valid indication of the actual final costs.

So that there will not be unnecessary waste and cost involved, the Navy usually requests technical proposals only from firms which have been technically evaluated and believed qualified to do the work involved.

When applications are received, the Navy reviews the prospective contractor's management techniques, his compliance with the Department of Defense policies and thoroughly investigates the subcontracting plan.

Navy Purchasing Offices

Inspectors of Naval Material
50 7th St. NE
Atlanta 5, Ga.
Phone TRinity 6-3311 ext. 5593

Inspectors of Naval Material
401 Walter St.
Baltimore 2, Md.
Phone PLaza 2-7900 ext. 2-8460

Inspectors of Naval Material
495 Summer St., Post Office Box 2276
Boston 7, Mass.
Phone LIberty 2-5100

Inspectors of Naval Material
181 Middle St., Jayson Building
Bridgeport, Conn.
Phone FOrest 8-2567

Inspectors of Naval Material
740 Main St.
Buffalo 2, N.Y.
Phone WAshington 4400-4406

Inspectors of Naval Material
RCA Building, Front and Cooper Sts.
Camden, N.J.
Phone WOodlawn 3-8690

Inspectors of Naval Material
800 1st Ave. NE., Box 1510
Cedar Rapids, Iowa
Phone EMpire 4-0165

Inspectors of Naval Material
608 South Dearborn St.
Chicago 5, Ill.
Phone HArrison 7-9300

Inspectors of Naval Material
230 East 9th St.
Cincinnati 2, Ohio
DUbar 1-2200

Inspectors of Naval Material
Ferguson Building, 1783 East 11th St.
Cleveland 14, Ohio
Phone CHerry 1-7900

Inspectors of Naval Material
1114 Commerce St.
Dallas, Texas
Phone RIverside 8-561, ext. 311

Inspectors of Naval Material
310 East Jefferson Ave.
Detroit 26, Mich.
Phone WOodward 5-0714

Inspectors of Naval Material
3802 South Calhoun St.
Fort Wayne 6, Ind.
Phone HArrison 4231

Inspectors of Naval Material
605 Stewart Ave.
Garden City, Long Island, N.Y.

Inspectors of Naval Material
318 East 10th St.
Kansas City 6, Mo.
Phone BAltimore 1-700

Inspectors of Naval Material
1206 South Santee St.
Los Angeles 15, Calif.
Phone RIchmond 2-4711

Inspectors of Naval Material
783 North Water St.
Milwaukee 2, Wis.
Phone BRoadway 3-5901

Inspectors of Naval Material
U.S. Courthouse, 3rd St. and Marquette Ave. South
Minneapolis 1, Minn.
Phone FEderal 2-3244, Ext. 157-159

Inspectors of Naval Material
Naval Industrial Reserve Shipyard
Building 13, Port Newark
Newark 5, N.J.
Phone MIchell 3-5700

Inspectors of Naval Material
207 West 24th St.
New York 11, N.Y.
Phone WAtkins 4-5000

Inspectors of Naval Material
17 Brief Ave., Upper Darby, Pa.
Philadelphia, Pa.
Phone GRanite 4-4840

Inspectors of Naval Material
401 Old Post Office Building
Pittsburgh 19, Pa.
Phone EXpress 1-2560

Inspectors of Naval Material
10 North 8th St.
Reading, Pa.
Phone FRanklin 4-5194

Inspectors of Naval Material
321 U.S. Customhouse (Old), 815 Olive St.
St. Louis 1, Mo.
Phone MAin 1-8100

Inspectors of Naval Material
Building 178, Treasure Island
San Francisco 19, Calif.
Phone EXbrook 2-3931

Inspectors of Naval Material
Post Office Box 1085
Schenectady 1, N.Y.
Phone DIckens 6-8476

Inspectors of Naval Material
2300 11th Ave. SW
Seattle 4, Wash.
Phone ELliott 8800

Inspectors of Naval Material
Post Office Building, Room 310
Springfield, Mass.
Phone REpublic 9-7391

Inspectors of Naval Material
428 South Warren St.
Syracuse 2, N.Y.
Phone GRanite 4-6861

\$587,000,000



PROCUREMENT & PRODUCTION,
MISSILES, FY 1960

How To Do Business With the Army

This article show the businessman how he can get part of the Army missile dollar. Included also is a list of current Army missile and rocket systems and their prime contractors . . .

THERE ARE two basic ways for a businessman to get a part of the Army missile dollar. One way is get a contract to do certain research and development work, or as the prime contractor for a missile or system. The second approach—and the one through which the greater part of the business volume is channeled—is as a subcontractor to a prime or as a supplier of parts, components or services.

The prime contractor who gets a research and development contract, usually for an entire missile system, is responsible for the initial production of all system components including the missile, launching and handling equipment, guidance, documentation and test equipment. While the prime has the overall responsibility, in most cases the dollar volume of the subcontracted components far exceeds the value of the components manufactured directly by the prime contractor. This, naturally, depends on the capabilities of the prime and the scope of the entire system.

Selection of a Contractor

Selection of a contractor for production of a missile system or components is achieved through formal advertising and negotiation. Selection is based on a number of criteria including production capability, reliability, costs, quality of the company's commercial or military products, and specific production requirements for the particular item being considered.

Consequently, it is important that the Army know what each industrial firm can do. The overall responsibility for the Army missile program has been assigned to the U.S. Army Ordnance Missile Command, Redstone Arsenal, Alabama, under the jurisdiction of the Chief of U.S. Army Ord-

nance Corps. The Army Ordnance Missile Command (AOMC) maintains a source file on industrial firms.

Those interested in doing business with the Army should supply the following information: name and type of company; total number of employees including research scientists and development engineers or other technical personnel; plant space and equipment including laboratory equipment and other facilities for research and development work; security clearance if a "facility clearance" is held for Army, Navy or Air Force work; general information on engineering capability and commercial and defense products; financial statement and descriptive brochure or any other information which would help in determining the full capability of the company.

Regional points of contact are provided by the 11 Ordnance Districts (see listing). Each of these districts maintains lists of items to be procured. AOMC normally requests the Ordnance Districts to secure quotations when a supplier of missile items is to be selected. After evaluation and bids, AOMC will request the District to prepare a contract with the selected supplier.

While contract administration always is the responsibility of AOMC, under certain circumstances procurement may be allocated directly to the Districts for selection of suppliers and contractual action.

An interested contractor or supplier is given an opportunity to review such research and development drawings and specifications are obtained before submitting formal proposals or bids. This information can be had from the 11 District Offices. A security clearance may be required to obtain this information and details as to subcon-

tracting possibilities. It is of prime importance that prospective Army contractors and suppliers maintain contact with the Ordnance District Offices.

By its very nature, the procurement of guided missile systems and the replenishment of spares, is different from procurement of other items. Frequently, urgency of the program will not permit normal competitive procedure until late in the program. The more information the District Office and AOMC has on a company, the better its opportunities for selection.

New Army Procedures

The Army welcomes ideas for new weapons and material items voluntarily generated by industry and civilian organizations. However, there have been cases where costly voluntary efforts resulted only in disappointment because the ideas were not sufficiently compatible with the factors which must be considered by the Army.

To assist prospective contractors the Ordnance Corps has published Order 7-58 which establishes some new procedures to aid in the availability of information as to what new items the Army would like to have developed. Any interested U.S. civilian organization which has a suitable R&D capability, has the necessary clearances and has signed the policy agreement form can now obtain information on what the Army wants.

The required Policy Agreement form may be obtained from the district offices. If the company already is working with Ordnance on an R&D type contract, queries may be submitted directly to the Ordnance Commodity Command or the Commodity Arsenal with which it has been dealing. This is because they already are familiar with the company's capability. Where such

work is not in progress, or the company wishes to expand into areas not covered by current contracts, the query should be submitted directly to the nearest Ordnance District Office. The District Office will then advise as to how to become a qualified organization and put the company in touch with the proper Commodity Command or Commodity Arsenal.

Normally, development requirements information will be released only from the Ordnance Commodity Commands and Arsenals. This may be done by means of interviews, group briefings, distribution of written documents, or by correspondence. However, for the present, it is anticipated that group briefings will be the principal method.

Inasmuch as a missile system in its final operation draws on practically every agency and corps of the Army, business opportunities in support of the missile program can be developed through other units, as well as the Ordnance Corps. For information as to the proper agency for R&D work, queries should be submitted to the Office of the Chief, Research and Development, Department of the Army, Washington 25, D.C., Attn.: Technical Liaison Office. This office maintains a list of items and activities with which each of the technical services and commands of the Army is concerned.

Such proposals should be complete and concise with full information on the proposing firm and a discussion of the proposed work in terms of objective and scope.

If the proposal is accepted, a contract may be negotiated between the organization and the appropriate agency. If it is not accepted, the government is not obligated in any way to reimburse the firm for costs it might have incurred in submitting the proposal or seeking the contract. Corps, and their fields of endeavor include:

Corps of Engineers—most of the support equipment for missile systems, rockets and satellite programs. This involves a variety of work such as: construction and maintenance equipment; launching towers; cover and concealment of weapons; electrical equipment such as generators and converters; fire-fighting equipment; industrial engines including turbines; industrial gases and compressors; infrared and night vision equipment; liquid fuels distribution; mapping, geodesy and surveying materials; nuclear power and heating plants; prefabricated buildings and other areas of interest.

Ordnance Corps—in addition to weapons, Ordnance has cognizance of the control equipment and material; fuels and lubricants.

Quartermaster Corps—chemicals and plastics; environmental protection; individual clothing and equipment which should become more important with the development of nuclear power for missiles and the attendant hazards of radiation and decontamination; mechanical equipment; and test materials and techniques.

Signal Corps—avionics; electronic countermeasures; electronic data processing systems; infrared, ultraviolet, meteorological instrumentation; radar; radio and wire communications; radio direction finding; sound, and light and television.

Transportation Corps—air, marine, motor and rail transportation.

Chemical Corps—biological agents; chemical agents; incendiaries; protective equipment; screening agents; smokes, weapons.

Army Medical Service—all basic research in medical sciences.

For research in areas of personnel training, motivation and leadership, the Army has the Human Resources Research Office in Washington.

The current list of Army missile and rocket systems and their prime contractors include:

Corporal—Firestone Tire & Rubber Co. (missile and ground handling equipment), Gilfillan Brothers, Inc. (ground guidance equipment).

Hawk—Raytheon Manufacturing Co.

Jupiter—Army Ballistic Missile Agency (missile system) and Chrysler Corp. (missile fuselage and assembly and ground equipment).

Honest John—procurement responsibility for this rocket, with the exception of the fins and warhead compartments, has been transferred to the Commanding General, U.S. Army Ordnance Ammunition Command, Joliet, Ill. Ground equipment is under the authority of the Commanding General, U.S. Army Ordnance Weapons Command, Rock Island, Ill. Fins and warhead compartments are under Emerson Electric Mfg. Co., one of the prime contractors.

Lacrosse—Cornell Aeronautical Lab., and The Martin Company.

Nike—Western Electric Company; Goodyear Aircraft Company and Borg Warner Corp. (solid sustainer motor booster motor). Procurement of booster motor metal parts is the responsibility of the Commanding General Army Ordnance Ammunition Command, Joliet, Ill.

Pershing—The Martin Company.

Plato—Sylvania Electric Products, Inc.

Redstone—Army Ballistic Missile Agency and Chrysler Corp.

Sergeant—Jet Propulsion Laboratory (missile system) and Sperry Utah Engineering Lab. (all critical R&D components).

The Army has issued a statement which reads:

"It seems quite clear that a company which aspires to become an important factor in the guided missile industry in the role of a prime contractor should strive to attain a position of being able to assume full responsibility for system development and program management. The smaller company would do well to concentrate on superiority of individual components so that their reputation for reliability, superior performance, and better cost will lead prime contractors to their door."

The Ordnance Districts

Birmingham Ord. Dist.
2120 No. Seventh Ave.
Birmingham, Ala.
Birmingham 53-3421

Boston Ord. Dist.
Boston Army Base
Boston 10, Mass.
Liberty 2-6000

Chicago Ord. Dist.
209 W. Jackson Blvd.
Chicago 6, Ill.
Webster 9-6000

Cincinnati Ord. Dist.
Swift Bldg., 230 E. 9th St.
Cincinnati 2, Ohio
Dunbar 1-2200

Cleveland Ord. Dist.
Lincoln Bldg., 1367 E. 6th St.
Cleveland, Ohio
Tower 1-4960

Detroit Ord. Dist.
574 E. Woodbridge
Detroit 31, Mich.
Woodward 5-3720

Los Angeles Ord. Dist.
55 S. Grand Ave.
Pasadena, Calif.
Ryan 1-8471

New York Ord. Dist.
770 Broadway
New York 3, N.Y.
Oregon 7-3030

Philadelphia Ord. Dist.
128 N. Broad St.
Philadelphia 2, Pa.
Locust 8-0400

St. Louis Ord. Dist.
430 Goodfellow Blvd.
St. Louis 20, Mo.
Evergreen 2-8200

San Francisco Ord. Dist.
1515 Clay Street
P.O. Box 1829
Oakland 12, Calif.
Twin Oaks 3-6330



Ernest Brackett

Director of Procurement and Supply

How To Do Business With NASA

National Aeronautics and Space Administration was added this year to the list of contracting agencies in the missile business. Outlined here are some of NASA's procurement procedures . . .

ANOTHER NAME has been added this year to the list of contracting agencies in the rockets and space development field. Under the National Aeronautics and Space Act of 1958, signed into law by the President July 29th last year, the charter and responsibilities of the National Advisory Committee on Aeronautics was expanded. NASA was given the overall responsibility for the nation's space program which the Act stated "should be devoted to peaceful purposes for the benefit of all mankind."

Generally speaking, NASA procurement follows the provisions of the Armed Services Procurement Regulations. This normally is by formal advertising for competitive bids where the supplies, materials, equipment or construction work can clearly be defined in drawings or specifications. However, in the case of research and development and other instances where such specification is not feasible, procurement is through negotiation with qualified firms.

The greater part of the procurement and contracting for services is carried through the field stations. However, any contract in excess of \$25,000 must be countersigned by the NASA headquarters. All contracting negotiation and administration is performed via the field stations except in certain cases when the items or work sought does not fall specifically under the cognizance of one of the field stations.

NASA normally negotiates its own contracts with prime contractors. This is done directly with the contractor by NASA's own staff for contract negotiation and administration. A flexible procedure is employed which permits use of the services of the Department of Defense or other governmental agencies, as NASA sees fit. NASA's own technical direction, including proj-

ect officer supervision, for all prime contracts is used except for standard hardware items more easily obtained by extension of already existing military contracts.

The actual level within the NASA organization responsible for the detailed technical direction and execution of the particular project negotiates with research and development contractors.

To the maximum extent possible, small business is given opportunity to participate in supplying NASA's supplies and services.

For actual procurement, NASA employs a decentralized system. This means that all equipment and supplies needed by a NASA field station are procured by the procurement officer at that station. Each of these procurement activities maintains its own bidders list, and should be contacted by those wishing to participate in NASA's procurement (see listing).

Advertising Procedures

In the case of purchases by formal advertising, strict adherence to a prescribed procedure is followed. At a specified time bids are opened and the bid most advantageous to the government is accepted. Upon award, the accepted bid becomes a legally binding contract.

When formal advertising does not meet the needs of NASA, procurement by negotiation is permitted. This method is when experimental, developmental or research work is involved or the urgency of the situation demands it. However, it is the policy of NASA to assure full and free competition as far as possible. Award in such cases is made in the best interest of the government considering price, delivery, quality of the product and

other factors based on the original proposals or negotiation.

NASA reminds would-be contractors preparing their bids to watch for special conditions relating to material packing, packaging and delivery which may vary from the standard printed instructions. Any bid which does not conform to the requirements of the invitation for bids will be rejected. All bids may be rejected when rejection is in the interest of the government, or when the contracting office does not consider the bids reasonable or arrived at independently, or feel they are collusive or in bad faith.

Generally speaking, NASA employs the fixed-price contract for both advertised and negotiated procurement. Certain variations of the fixed-price contract is used for price redeterminations where the performance of the contract may involve large contingencies or uncertainties in costs.

Cost-reimbursement contracts are reserved for certain situations and may be awarded with or without a fee. In emergencies, or under unusual circumstances requiring maximum reduction of procurement lead time, letter-of-intent contracts enable the contractor to begin work pending negotiation and execution of the actual contract.

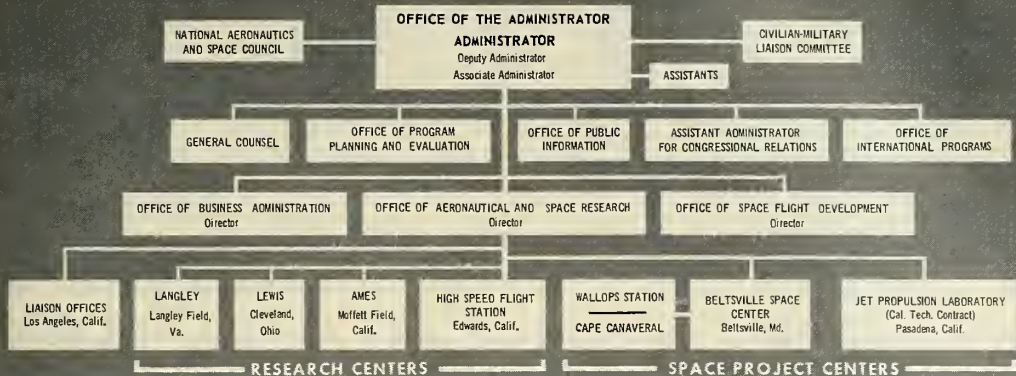
Cost - plus - percentage - of - cost contracts are prohibited by law.

Although contractors are expected to be fully qualified and competent to carry out the contract including the financial requirements, when such work will result in serious drain of the contractor's working funds, the government may provide financial assistance.

In addition, the Small Business Administration can grant loans to small concerns for the financing of plant construction, equipment or for use as working capital.

NASA recognizes the increasing

National Aeronautics and Space Administration



of quality control techniques by industry and emphasizes the importance of quality in all supplies and parts used in the highly complex space vehicles and equipment. Before materials are accepted, they are subject to inspection for compliance with contract specifications.

As with the military services, frequently a facility clearance is required for NASA contracts. This is necessary whenever access to classified matter is required either by the contractor or his employees. Subcontractors on classified projects should obtain a facility security clearance via the prime contractor. Most of the supplies purchased by NASA conform to the federal or military specifications on quality, size, performance etc., available from the Government Printing Office.

As with other government agencies, it is the policy with NASA to include in contracts involving employment of labor, a provision obligating the contractor not to discriminate against any employee or applicant for employment because of race, religion, national origin, or color.

NASA points out that in research and development work especially, the competence of a firm is not always determined by its size. Contracts for R&D are awarded on a basis of highest competence in the specific branch of science or technology required for successful execution of the project.

In addition, NASA each year lets a number of research grants and contracts to educational institutions and non-profit organizations. These contracts involve research of two general types—supporting research and fundamental research. Research proposals should be submitted (10 copies will facilitate evaluation) to the National Aeronautics and Space Administration, 150 H. St., N.W., Washington 25,

D.C. marked for the attention Research Grants and Contracts Office. All such contracts are handled by the NASA headquarters and not by any of the field stations.

While bona fide representatives are permissible, the "Covenant Against Contingent Fees" clause included in all NASA contracts is warranty by the contractor that he has not retained other parties in soliciting or securing the contract. Breach of this warranty may result in an annulment of the contract or recovery by the government of the amount of fee already paid. Employees or established commercial or selling agencies maintained by the contractor to secure new business can represent the firm.

List of products—A representative list of items and supplies procured by NASA follows:

Abrasives; Air Conditioning Equipment and Supplies; Aircraft Maintenance Equipment and Supplies; Building Materials; Castings; Chemicals; Chemical Laboratory Equipment and Supplies; Clothing, protective; Communications Equipment; Data Recording and Processing Equipment; Drafting and Illustrating Equipment and Supplies; Electrical Maintenance Shop Equipment and Supplies; Electrical Power Distribution Equipment and Supplies; Electronics Hardware and Supplies; Electronic Instrumentation Equipment; Electronic Test Equipment; Forgings; Foundry Supplies; Gases, compressed; Gases, liquefied; Hardware, all kinds; Janitorial Supplies; Lumber; Machine-shop Services; Materials Handling Equipment; Materials Testing Equipment; Mechanical Power Transmission Equipment; Metal Fabrication Services; Metal Finishing Equipment and Supplies; Metal Heat Treating Equipment and Supplies; Metals, ferrous; Metals, non-ferrous; Metals, precious; Metalworking Equipment and Supplies; Missile Structural Components; Office Equipment and Supplies; Offset Printing Equipment and Supplies; Oils and Greases; Paints; Painting Equipment and Supplies; Photographic Equipment and Supplies; Plastics Materials; Plastics-

working Equipment and Supplies; Plumbing Supplies; Pressure Systems and Equipment; Pressure Vessels; Reproduction Equipment and Supplies; Safety Equipment and Supplies; Shop Furniture; Telemetry Equipment; Vacuum Systems and Equipment; Welding Equipment and Supplies; Weldments; Wind Tunnel Instrumentation Equipment and Supplies; Woodworking Equipment and Supplies.

Representatives of the Contracting Officer on Construction Projects

Mr. J. Cabell Messick
Chief, Engineering Services Division
Langley Research Center
Langley Field, Virginia

Mr. Charles A. Herrmann
Chief, Technical Services Division
Lewis Research Center
21000 Brookpark Road
Cleveland 35, Ohio

Mr. Charles H. Harvey
Representative of the Contracting Officer
Ames Research Center
Moffett Field, California

Officials in Charge of Procurement of Supplies and Equipment

Mr. Sherwood L. Butler
Procurement Officer
Langley Research Center
Langley Field, Virginia

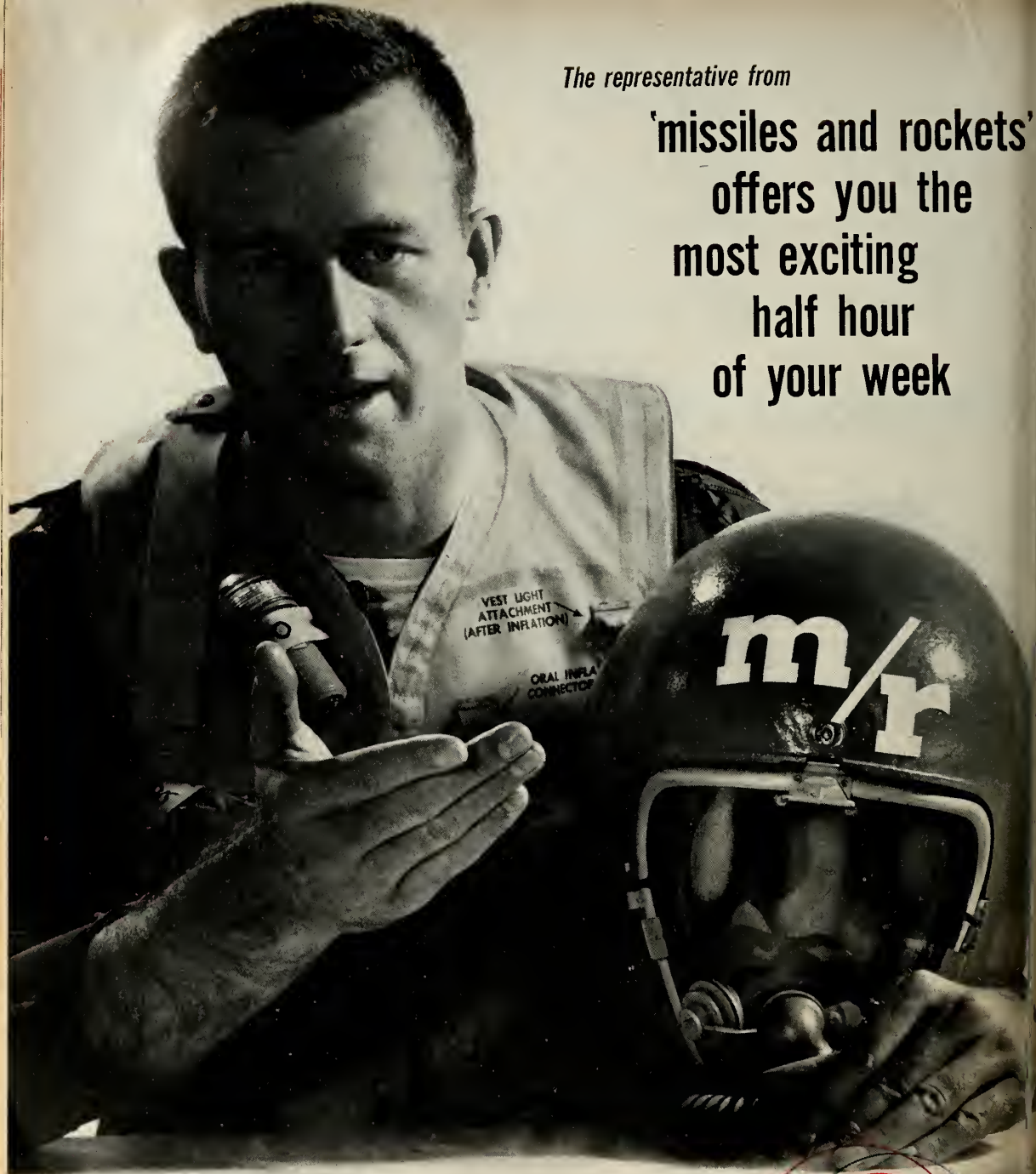
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Mr. Alvin S. Hertzog
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What a Prime Seeks from a Sub

A prime contractor official describes the weapon system concept and explains what a weapon system contractor expects from the suppliers . . .

by Rulon Nagely

*Corporate Director, Material
North American Aviation, Inc.*

THE RELATIONSHIP between a weapon system contractor, and his suppliers and subcontractors is perhaps one of the most important elements in today's defense picture.

A well-established, smooth working relationship can lead to increased production efficiency and can save the government thousands upon thousands of dollars. On the other hand, poor coordination between the key organizations can only result in wasted time and effort, financial loss and, in extreme cases, perhaps could lead to the elimination of the particular weapon system involved.

To fully understand the problems involved, it is important to first understand the method of procurement which is described as "the weapon system concept." Historically, the various military contractors, particularly those doing business with the Air Force or the Navy, were responsible only for the design and production of the primary piece of equipment. In the case of aircraft manufacturers, this was the aircraft itself; the Government furnished such items as engines, wheels, brakes, instruments, radar equipment, and so on.

Only occasionally was the contrac-

tor involved in the selection of these items.

The concerned government agency, in effect, acted as weapon system contractor, utilizing a number of subcontractors to furnish the necessary components which when assembled, became a finished, flyable airplane.

The system had certain advantages, not the least of which was that the prime manufacturer was absolved of the thousands of details—and the resultant headaches—that go with the procurement of the many pieces that make the whole.

Time for a Change

However, there were many more, and overriding, disadvantages. All too often the airplane manufacturer found that a vital equipment item would not work properly, or was incompatible with the balance of the system; making the necessary adjustments often delayed the whole program. Delivery schedules were not always as well planned as they should have been. Making major design changes while in the middle of a contract was very difficult and was often expensive because some completed hardware was no longer usable, but had to be paid for.

Where did the fault lie? In few instances could the responsibility be pinpointed to any one group, company or agency. Since there was no clear-cut line of responsibility, confusion and difficulties were unavoidable.

With the advent of the space age, it became increasingly obvious that the problems encountered through this procedure must be eliminated. The newer weapons then envisaged demanded the most exacting coordination and cooperation throughout the defense industry, and required a pooling of the most advanced scientific knowledge, the most specialized technologies, and the newest industrial skills.

The result: the so-called "weapon system concept."

Under this procedure, the prime contractor is held fully responsible for the success of the program, with only a very few, if any, items being furnished by the contracting agency. It is up to the contractor to find the proper equipment item for a given task, to see that delivery schedules are met, and that a high standard of quality, engineering and reliability is maintained. It is up to the contractor, also, to make certain that costs are held within prescribed limits and a very close cost control is



Rulon Nagely, Director of Material for North American Aviation, Inc., was promoted to his present position in 1951 from Purchasing Agent. He joined North American as Purchasing Agent in 1941.

Nagely first entered the aircraft industry in 1937 as purchasing agent for Vultee Aircraft Co., where he remained until 1941.

Nagely is Chairman of the Aerospace Industries Association's Materials Committee and is a member of the U.S. Air Force Advisory Group-Small Business.

maintained by the weapon system contractor.

In the case of today's complex weapons, these procedures involve far more than just selection and purchase; in many, if not most, instances the needed systems and subsystems are nonexistent. The contractor must first determine exactly what is required, he then must not only find the proper company to develop the item, but must also expend considerable effort of his own in assuring that the development process results in getting the right item on schedule and at a minimum expense.

North American Aviation is now weapon system contractor for two major weapon systems, the B-70 Valkyrie, intercontinental jet bomber, and the F-108 long-range jet interceptor. Both are designed for high altitude performance in the Mach-3 range. Under the latter two programs, the only items furnished by the Government are the engines; all other items, including fire-control flight control, mission and traffic control, electronic countermeasure and bombing-navigation systems, as well as other equipment that formerly would have been government-furnished equipment, are now North American's responsibility. We are charged with selecting, ordering and coordinating the manufacture of all the various components and subsystems which will go in to the B-70 and F-108. Moreover, we are also responsible for the ground-handling equipment, servicing equipment and everything else necessary to make the complete weapon system operate properly.

There should be no misunderstanding: the government is still deeply concerned with these programs and through the concerned weapon systems project offices keeps a close and constant watch over what we are doing. However, the responsibility is North American's.

Criticism of Procedure

There has been some criticism of the weapon system procedure, most of it on the basis that costs will increase and that small business will be squeezed out of the picture.

As to the first charge, we fully believe that is an unfounded fear. It is true that some of today's projects are staggeringly expensive as compared with World War II weapons; this is due to the increased complexity of the systems, not to the change in procurement procedures. Additionally, costs under the weapon systems concept can actually be determined and controlled because they are in one spot; pre-

viously, these costs were scattered over so many areas, and through so many agencies and companies, that it was almost impossible to determine and control the true and absolute cost of any single completed aircraft.

As to the second fear, we know that there is no basis for its existence. The small businessman will continue to play a vital role in the procurement picture and indeed, may even have increased opportunities for business. The business is still there, and the small businessman will get his share.

Changes in the System

The only basic change is that he will be dealing at a different level; in most instances, he will contact, or be contacted by, a prime contractor rather than a weapon system contractor.

The latter—whether one company or as in the case of some weapon systems, a group of related companies—will simply have moved up a rung on the ladder. The weapon system contractor will be handling most of the duties heretofore handled by the services, the major subcontractors will have replaced the prime contractors in certain procurement situations, and so on.

This means, of course, that the weapon system contractor will not have as much direct contact with the small business firm as has been customary in the past.

The size and scope of today's weapon systems demands that a greater portion of the business be subcontracted with major manufacturing concerns than in the past. It is doubtful that any one company in this country could handle as much as one-half the work involved in the design, development and production of a major modern weapon system.

For example, in the case of the B-70, we have named Boeing Airplane Co. as the subcontract for a wing section. This particular subcontract involves considerable engineering and design effort, as well as actual manufacture. It could not have been handled by a small concern and still have met design requirements and delivery schedules.

Boeing, in turn, will subcontract many of the items that will make up this section—and this is where small business will get its share of the program.

Other major subsystems are being handled in the same manner.

North American has taken several steps to insure that small business does, in fact, participate.

We require our suppliers, on every purchase order or subcontract of \$100,000 or more, to supply us with a quarterly report on his small business subcontracting; he in turn must insure a similar requirement in all of his purchase orders and subcontracts in the amount.

We notify the regional office of the Small Business Administration, as well as the Small Business Specialist of the appropriate branch of the Armed Services whenever a purchase order or subcontract is let that appears to offer opportunities for small business participation.

Each of our buyers is required to make a "small business checklist" on each purchase, showing whether the order went to large or small business and if the former, whether small businesses were solicited and why they did not get the order.

Through these and other procedures, we are confident small business will get its fair share of the work on these weapon systems.

Approximately 80 per cent of the work on the B-70 and F-108 will go to other companies, most of whom would be prime contractors to the government in a different situation. These companies will continue to let at least the same amount of work to small concerns as they did in the past.

These procedures, while established by North American for specific programs, are essentially the same as will be followed by other weapon system contractors. The details may differ, but the basic philosophy will be the same if for no other reason than the complexity and size of the programs now being conducted.

Position of Contractor

It is readily apparent that the weapon system contractor is placed in a peculiarly vulnerable position. Holding a tremendous responsibility for success of an expensive program of great importance to our defense picture, he is at the same time cut off from direct contact with many of the people who could increase costs or otherwise cripple the program.

The weapon system contractor must therefore, be very demanding in his relationships with the immediate subcontractors and suppliers. He must establish firm ground rules for operation, must make certain that all requirements are met, and must be ready to insist on competent performance on the part of both his own subcontractors and those companies on the third an-

fourth tiers of effort.

The weapon system contractor must supervise and control the cost and the progress of all work, and periodic reports on these items from subcontractors are a necessity.

Examination of these reports might indicate inefficiencies or schedule slippage. In such a case, the contractor must be prepared to take any steps necessary to correct the situation.

Quality Control

Quality control is extremely important, and here, too, the controller must be vigilant. The subcontractor is, by virtue of his role, primarily responsible for high standards of workmanship. Where quality is not up to par, the weapon system contractor must reserve the right to be arbitrary in demanding rework or, if necessary, rejection. Within the limits of sound working

relationships, he must have the right to supervise the quality control procedures established by the other company.

And finally, the weapon system contractor must make certain that there is fast, clear, and accurate communication, not only with the subcontractor, but also between that organization and the others participating in the program. Red tape must be kept to a minimum, and decision-making must be prompt. This is a two-way street, and the weapon system manager has an equal responsibility to his subcontractors to provide fast and accurate information regarding changes of any kind.

The objectives of a particular weapon system program can only be met if this pattern is established at the beginning of the program and maintained to its completion. There must, naturally, be a certain amount of give-and-take on both sides, but essentially, the subcontractor must recognize that

ultimate responsibility rests with the weapon system contractor, and that his demands must be met if the program is to succeed.

Working Relationship

This is the same businesslike relationship that should exist between two companies under any procurement system. The difference lies only in the size and complexity of today's weapon systems, and the increased responsibility that falls upon the weapon system contractor.

If these requirements are understood by all parties, and followed from the initial steps in contract negotiation, then there can be assurance that the government and the citizen will receive what is justifiably their due: a reliable, high-performance weapon system, delivered on time and at a minimum of cost.



What a Sub Seeks from a Prime

Profit is not the only thing the subcontractor seeks when he does business with a prime. Recognition of quality, courtesy, and fairness are major needs, says this defense industry expert . . .

by John Marschalk

THE NUMBER ONE thing a sub seeks from a prime is a chance to make a profit on quality work. Most primes recognize that a subcontractor has to make a profit to deliver a quality product and stay in business.

This means that *recognition of quality* is next to the top of the list of what a competent subcontractor wants. Years of operation with minimum rejection rates and prompt deliveries ought to mean more than just initial price, most qualified sup-

pliers believe. And experienced buyers usually agree. With the heavy emphasis on reliability of supersonic weapons, this would seem to be the only way to buy. Even so, there are many dog-good-to-small-business people who keep insisting that award to the lowest bidder (regardless of relative quality) is the "American way" to buy.

Competitive bidding on price alone may be completely satisfactory on common supply items like rope, nails and paper clips—where specifications can

be fixed for a period of years. But the firms who work on the technical components of weapons think a low-price award is the certain way of assuring either default or poor quality.

I can think of no better word than "courtesy" for another want expressed time and again by small subcontractors with whom I've talked. They tell me that too many buyers take on a "power-of-God" attitude when dealing with representatives of smaller firms. It is human, I guess, to think of one's



John Marschalk, a public relations consultant, has specialized for the past fifteen years in the problems of industry dealing with Government. Until recently, he was executive director of Strategic Industries Association, a national trade group of small and independent firms in the defense supporting industry.

self as being pretty important when the control over several millions of dollars worth of purchasing is involved. The fellow from the small firm who wants to talk about an order for \$3,000 is likely to seem relatively unimportant in the midst of such grandiose activities.

Here, again, the experienced buyer knows that the fellow from the small firm may have something to offer which can save both the prime and the Government millions of dollars and maybe thousands of lives. As the Director of Material for one large company told me recently, "A buyer has to know a little bit about a lot of things. The people he spends from need to know a great deal about just a few things. We try to teach our buyers to listen. They buy better that way."

The most common and costly discourtesy to a small firm representative is to keep him waiting for an hour or more after an appointment time. Frequently the small firm caller is either head of his company or close to it. Every hour he spends away from his plant is a costly deduction from management time. Yet it is his personal know-how which the buyer needs most.

He is the one person who can readily interpret buyer needs in terms of his shop's capacity.

To make the small firm representative drive for an hour to the prime plant, park in a lot a half mile from the buying office, and then cool his heels for an hour-and-a-half before getting a three-minute brush-off from a self-important buyer, is about the poorest way to treat a fellow human being, let alone the waste involved.

Fair Return for Design

Finally, among the things small subcontractors want is a fair return for design effort. A common practice with some prime buying departments is to put out an "envelope" specification, asking several subs to submit a design for a component to do a certain job with size and weight limitations. Each sub is expected to submit his design for evaluation, plus a price proposal for doing the work.

When the engineers at the prime choose what they think is the best approach you expect them to negotiate with the firm that submitted the best design. Most companies do handle it

that way. Some of them don't. Some take the winning design, copy it and send it out for bids from other companies. If the company that submitted the best design isn't low bidder, he gets not a dime for his work. Worse than that, we know of a couple of classic cases in which the prime people said in effect, "Thanks for the idea; now we know enough to make this our selves."

The top managements of even prime we know have no patience with that kind of practice. It can almost always be traced to that rare small-minded individual who congratulated himself on pulling a fast one. To get such practices stopped is one of the main hopes of thousands of small suppliers.

Adding it up, there are four major needs on the part of most small subcontractors:

- 1) A chance to make a fair profit
- 2) Recognition of quality over price
- 3) Courtesy in handling contacts
- 4) Integrity in dealing

This is not much different from what the large firms want for themselves.

Why Subcontractors Go Gray...

"We have lost money on our subcontracting for the past two years in a row. If it were not for our coupling sales, we would be out of business."

The man who told me this two months ago heads one of the most experienced and reliable small subcontract firms in New York State. As an individual, he has spent more than twenty-five years in defense manufacture. He normally employs about 125 people; his shop is rated A-1 on quality and reliability by many major prime contractors for whom he has been a supplier since World War II. Yet he has kept "alive" only through his sales—mostly commercial—of a small proprietary item.

Why has he taken orders at loss figures for the past two years? His answer is simple: "You owe something to your people; if it isn't too much of a loss, we'd rather keep them working."

Losses are less than fun for any businessman. But what really gets under this particular subcontractor's skin is the conviction that more than a few buyers with whom he deals enjoy the

situation. He described the method used by one large company not far from his plant.

"They have a bidding system. When a job comes up, they send out bids. They claim all their bidders have been qualified to do the job, one no better than another. My company has the lowest rejection rate you can find, but we start out bidding against other outfits who have nowhere near our quality record. So we know we're going to have to shave to the bone to get close.

"So our engineers spend a couple of days analyzing the prints, working out production methods, preparing our bid. This costs a lot of money, in itself. Sometimes it can pay off, though. Sometimes we find a real good way to cut production cost, so the bid we send in is lower than we expected we could do. Maybe it even turns out we're the low bidder.

"But there's a hitch. They don't take the low bid. First thing they do is send it to their Cost Analysis boys. They try to find some holes in it. Maybe they call me on the phone and argue

I figured too much for machine set-time or some other thing. Finally, I get a call from the buyer. Say I bid \$2 apiece for each of twenty items. He tells me if I'll knock off \$50 on each piece, they will give me the job.

"I tell them to go hang. But you know what? They'll start calling the other bidders with the same pitch until they find a sucker who will go along."

Although I heard the same story from two other New York subcontractors with whom I visited, I'm personally convinced that this squeeze system isn't common practice. I have run into it in other parts of the country and it may well be confined to the single prime about whom it was told. In the only other case I know of personally, a contracting officer for one of the military services bragged that he had saved over a million dollars for Uncle Sam in a single year by using this sort of system. When he was asked how many small companies had gone broke as the result, he just shrugged his shoulders.

—John Marsch

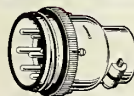
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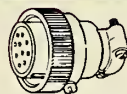
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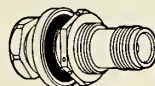
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The Cannon Electric Company also has available a wide variety of plugs for Battery-Power, Fire-wall, Watertight, Printed Circuit, and other applications, as well as "Kwik-Term" Terminals and DC Solenoids.

FOR ADDITIONAL INFORMATION on the typical designs illustrated... other configurations for your specific applications... or the design, engineering and manufacture to your special needs... write to Cannon Electric Company—3208 Humboldt Street, Los Angeles 31, California. Please refer to Dept. 0000.



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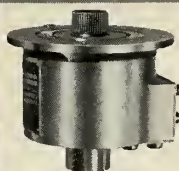
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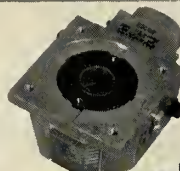
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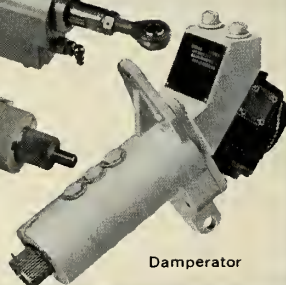
Direct rotary torque output from 200 to 600,000 inch-pounds. Optional vibration damping may be incorporated. Broad range of designs and sizes, for hinge-line mounting.



Linear Flutter Damper



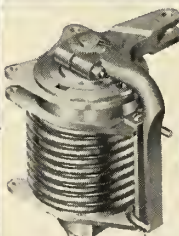
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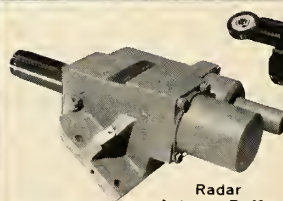
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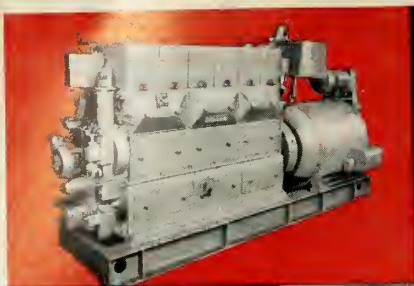
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MISSILE FRAME, WARHEAD AND NOSE CONE

The frame is the skin and structure of the missile, including fins, if any. The warhead and nose cone contain the payload (nuclear, high explosive, or instruments in the case of research missiles) and the shell or cone that encases.





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The warhead carries a missile's big punch, but its fighter instinct is developed by earth-bound electric power. Without reliable ground power, there could be no missile launching, guidance and control, or communication . . . and no knock-out blow!

Already in the U. S. defense ring are dependable White Superior diesel engine generator sets at BOMARC, NIKE and other missile installations. At every round, they are ready with quick, easy starting and continuous, reliable operation. Precision construction takes Superior the limit, too, with trouble-free performance, low maintenance and maximum fuel economy.

In the battle for space, Superiors are veterans, being installed on sections of SAGE, "DEW" line and the "Texas Towers." They will soon find important civilian sky duty also at many of the Federal Aviation Agency new air-traffic control stations. White can custom-engineer engines to meet your exact needs . . . offers experience with automatic, unattended and remotely controlled operation. If your requirements range from 215 to 2150 HP, or 150 to 1500 KW, get complete information now!

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White Diesel



New Products

• missile frame, warhead and nose cone

NEW FASTENERS MEET MISSILE PROGRAM DEMANDS

Huckbolt fasteners fabricated from high alloy die steels and a variety of stainless steels are now available from Huck Manufacturing Co.

The new fastener specifications have been developed primarily to meet recent demands for miniaturized fastener designs for use in new missile programs. The new materials permit use of smaller, lighter components with no sacrifice in strength. They are recommended for use in elevated temperature applications where unusually high strength is required.

Among the new Huckbolt pin materials that may now be specified are AISI Types 321 and 431 stainless steels, A286 and 17-4 PH stainless steels, Vasco Jet 1000 alloy steel and Thermold J alloy steel. Huckbolt colors for these applications are of AISI type 430 stainless steel, annealed.

Fastener strengths formerly achieved only at room temperature are provided up to 900°F by some of these materials. In addition, fastener performance has



been satisfactory in certain applications at temperatures well beyond 900°F.

Huckbolt fasteners of both shear and tension types as well as Huckbolt stumps can now be obtained in the new materials for the full range of nominal pin diameters (5/32-in., 3/16-in., 1/4-in., 5/16-in. and 3/8-in.) Alloy steel fasteners are available with diffused cadmium-nickel alloy plate where required in accordance with A.M.S. 2416.

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Gloss-Cote Designed for Air-Space Usage

Hi-Brite Gloss-Cote is specifically designed for use in military applications and on private and commercial aircraft. The high-visibility colors are used extensively on missiles for visual and photographic tracking, on drone aircraft and tow targets, on drogue chutes for in-flight re-fueling operations, and on private and commercial airplanes for improvement in the visibility of the aircraft against backgrounds of hazy sky, or dull green and brown earth.

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New Weldable Alloy Solves Joining Problem

A new air-hardening, weldable and fully martensitic alloy has been developed by The Carpenter Steel Co., to meet the need for a metal that can be used for highly stressed parts at temperatures up to 1050°F where joining is a problem.

The steel, known as Carpenter 404 alloy, is designed to be free from weld cracking without preheating or post-welding. Weldments can be readily cold worked after stress relieving or annealing.

The new alloy is recommended especially for applications such as steam turbine buckets, blades and bucket covers, as well as for "casting in" assemblies such as turbine diaphragms.

The new metal is essentially a 12%-chromium 1½% nickel composition having relatively high tensile strength and good ductility. It shows a marked improvement in weldability over stainless Type 410, and a more uniform structure and higher hardness than Type 405.

In the annealed condition, the steel is said to be easily blanked, drawn, formed or cold headed. Another advantage is its easy machineability in both the treated and annealed conditions.

Carpenter 404 alloy is made by the company's Mel-Trol process, a new quality control system with patented ingot design. Mel-Trol is used to minimize the causes of inconsistent centerline quality which so often causes erratic service in alloys of this type made by conventional methods.

The alloy offers resistance against a wide range of corrosives, including the atmosphere, fresh water, mine water, steam, carbonic acid, crude oil, gasoline, blood, perspiration, alcohol, ammonia, mercury, soap, sugar solutions and other reagents. It also has good resistance to scaling at elevated

temperatures and can be used for continuous service up to about 1200°F.

Forms now available include forging billets; hot rolled bars and forgings, either annealed or heat treated; cold drawn and ground bars; wire and wire rods; and strip, both annealed and tempered.

Fill in No. 102 on Subscriber Service Card.

Subminiature Devices May Be Smallest Power Units

The engineering laboratories of Ferrotran Electronics Co. have recently developed a new subminiature series of their "Powertran" power supply units which may be the smallest power supply package ever developed. They are manufactured in a molded or in an encased form.

The molded unit which is made for mounting on a printed circuit board is approximately the size of a flashlight battery. A typical unit measures 1 3/8" x 1 3/4" x 1 1/4". (Photo shows relative size of unit compared to a power transistor.)



Four stock units which will give any fixed d-c output voltage in the range from 10-30 volts are available. The 10 volt unit, for example, operating from 115 volts, 60 cycles will supply 25 ma. of current. It is well-regulated, ripple-free, and short-circuit protected.

The device is ideal for transistor supply purposes, bias purposes, or reference voltage purposes.

This series of power supply units is the smallest in the "Powertran" series.

Stock units are as follows:

Model No.	D.C. Output Volts	D.C. Output Current	% Reg.	% Ripple
SM-10-A	10	25 ma.	2.3	0.5
SM-15-A	15	20	2.3	0.5
SM-20-A	20	20	2.5	0.5
SM-30-A	30	15	3.0	0.5

Encased units are 1 5/8" x 1 3/4" x 1 1/2" and are available with transformer type terminals, multiple pin headers, or as plug-ins. (7-pins or 8-pins)

Molded units are 1 3/8" x 1 3/4" x 1 1/4" and are furnished with short pins for mounting into printed circuit boards. The units may be solder-dipped.

A far greater current than shown above can be drawn from the unit, without overheating, at a somewhat reduced output voltage.

Temporary short circuits may be placed across the output without damaging the unit.

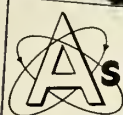
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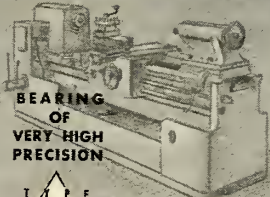
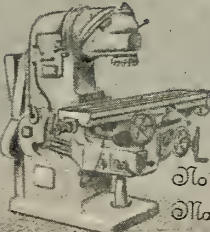
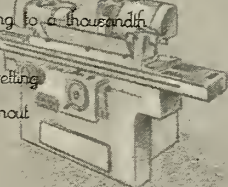
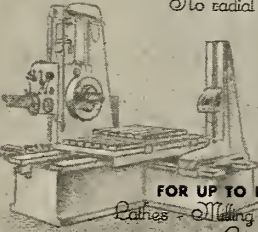
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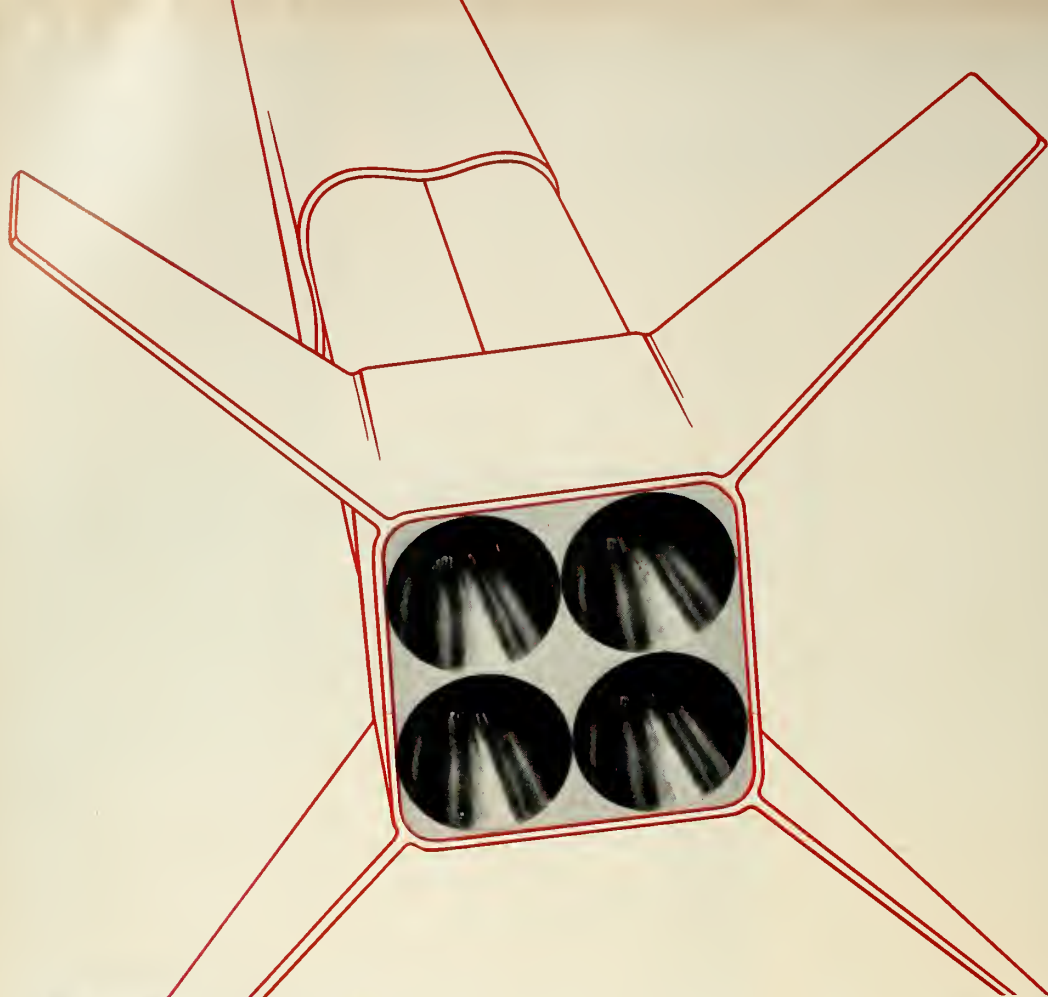
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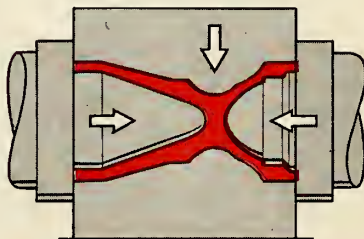


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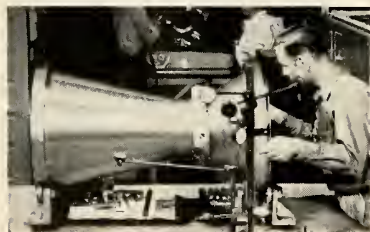
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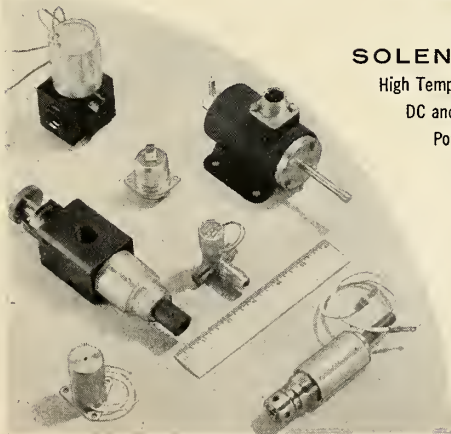
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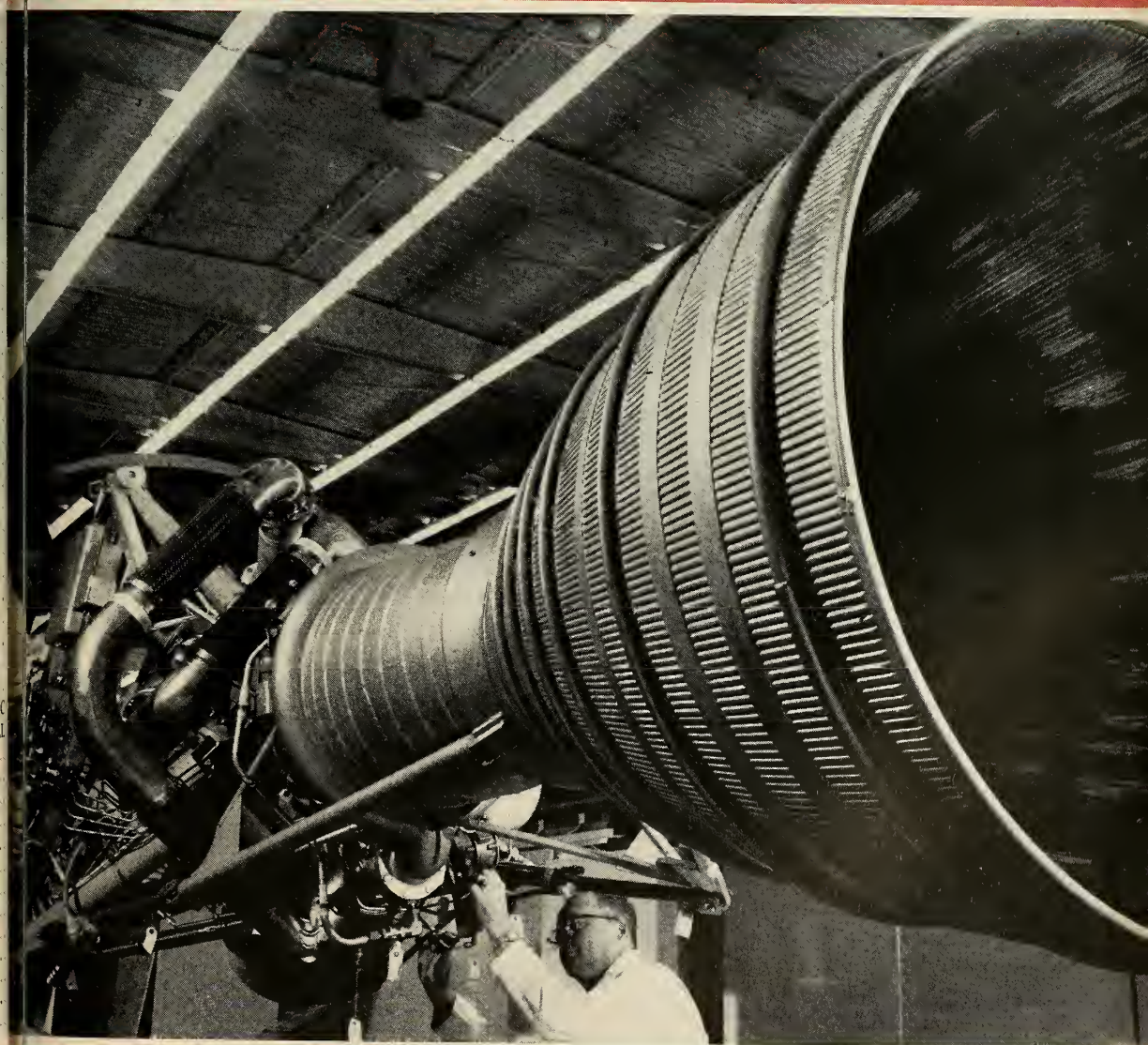
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PROPULSION SYSTEMS AND AUXILIARY POWER UNITS

These units include the power plant and its associated equipment; such as, tanks, pumps, blast chambers, nozzles, resonance rods and fuel. Propulsion systems are simple in solid rockets, complex in liquid rockets. Auxiliary power units consist either of hot gas turbines driving hydraulic pumps and generators, or of batteries supplying power for missile guidance and control systems.





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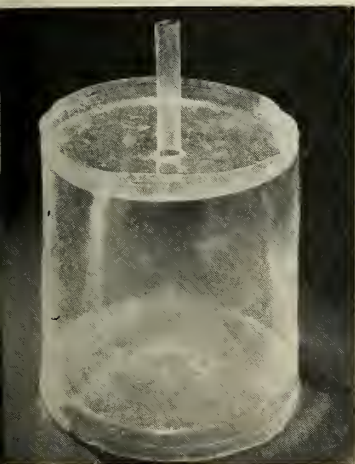
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New Products

• propulsion systems

KEL-F PLASTICS HAVE MISSILE APPLICATIONS



"Kel-F" polymers produced by Minnesota Mining and Mfg. Co. are noted for chemical inertness, low-temperature range, low "cold-flow" characteristics, all-round moldability, and easy machining.

Another useful property, especially for missiles and rockets, is the polymers' flexibility. Lip seals for rotating and reciprocating shaft seals and propellant gate-valve seals must be flexible at temperatures from about -450 to 165°F. They also require spring-back and dimensional stability to seal against low and high pressure, from 5 to 600 psi.

These qualities can be achieved by special heat treatment of "Kel-F" plastics to control physical properties. Tensile strength of the plastics remains high (up to 5800 psi at -300°F.), while flexibility is maintained at these temperatures to withstand impulses and cycling as a seal from pressures of up to 1000 psi.

Missile applications include:

Coil forms—Zero moisture absorption, good dielectric strength, and excellent dimensional stability make "Kel-F" plastics an exceptional coil form material for missiles. Biggest problem solved is that it shows no effects from the extremely high temperatures reached by the wire wrapped around the coil form—temperatures that tend to often warp coil forms made of other materials.

Expellant bladders—Function of these bladders is to store such highly corrosive liquids as LOX, WFNA, FNA, and 90% hydrogen peroxide in the fuel chambers of missiles. Fabricated from plastic tubing and heat-sealed after loading, the bladders are usually employed as liners in stainless steel tanks. They range in diameter and length from 1/4" to 150".

Gasket seals—Transfer-molded gasket seals, made of an elastomer O-ring mechanically-bonded to a square of anodized aluminum, are now being produced for nitric acid contacts in missiles. "Kel-F" polymers provide the only applicable elastomer that will withstand such contacts.

LOX lip seals—Chemical inertness and flexibility at the extremely low temperature of LOX are responsible for the wide use of "Kel-F" plastics in LOX lip seal applications. The material is first compression-molded, then post-formed and machined into seals of the desired shapes and sizes, with tolerances as close as plus or minus 1.5 mils with a 7 micro finish.

O-rings in rocket engines—Successful operation of a liquid rocket depends almost entirely on the proper functioning of its elastomeric parts. O-rings are used as shaft seals, gaskets, and valve seats. "Kel-F" elastomer was early applied in this area, mainly because of its resistance to WFNA.

Self-locking nuts—Inserts of "Kel-F" plastic prevent seepage of such strongly reactive missile fuel liquids as RFNA and WFNA past the internal bolt threads of self-locking nuts.

Sprays—"Kel-F" dispersion film, the most flexible of the polymers, is being used in many missile applications, chiefly diaphragms, as follows: the dispersion is sprayed on a metal form (which may be of any convolution or configuration); after baking, it is removed, yielding a component that is non-porous, tough and flexible.

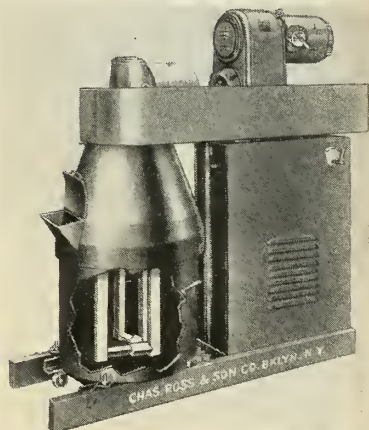
Structural-thermal use—Because of high compressive strength and wide temperature utility, "Kel-F" plastics are the main structural support and thermal barrier between the outer shell and the "internal package" in Vanguard satellites. Major concentrated load of the package is carried directly through a "Kel-F" plastic support to the main hub at the base of the structure.

Vent seals—A small device injection-molded from "Kel-F" plastics is used to prevent moisture or foreign material from entering small bleed holes in rocket engine components. The seal also acts as a low-pressure, small-volume relief valve.

Fill in No. 104 on Subscriber Service Card.

Machines Developed for Mixing Propellants

A complete new line of heavy duty double planetary change can mixers has been developed by Charles Ross & Son Co., Inc. for mixing solid propellants. The company, which also manufactures a line of horizontal type kneading machines for mixing propellants, has improved on the design of the vertical type changeable can mixer to incorporate many features designed specifically for propellant mixing.



The double planetary change can mixers are available in many sizes from 1 gallon Laboratory size to 200 gallon large production size, and all mixers are furnished with variable speed motor drives. Nonsparking materials are utilized, and, aside from versatility in operation and ease of clean out of the changeable can type mixers, mixers of this type eliminate stuffing boxes and bearing in the product zone.

The double planetary changeable can mixers are furnished with stainless steel stirrers and can, jacketed cans, and vacuum covers when required.

Fill in No. 105 on Subscriber Service Card.

Propellant Valve Has Dual Flow Control

For simultaneous flow control of liquid Oxygen and Fuel, Hydromatics Inc.'s provides zero leakage control of a 5/8" LOX line and 1/2" fuel line at pressure up to 100 psi and temperatures as low as -350°F.

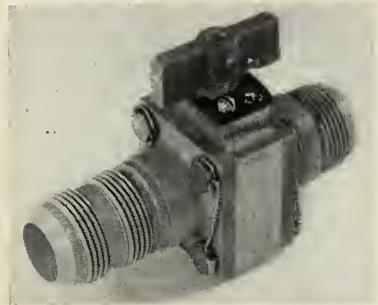
A single-acting, spring-return pressure actuator drives a precision mechanical linkage which controls both valves, thus insuring constant timing. The valves are extremely fast acting, with response times as short as 10 milliseconds. All dynamic sealing is double with a vent between seals for maximum safety. A sealed, rotary action snap switch permits remote observation of valve position. Valve flanges, available in standard or special styles, are removable and interchangeable.

Fill in No. 106 on Subscriber Service Card.

... new products

Koehler Ball Valves Have Missile Applications

An extensive line of KOEHLER/Dayton Ball Valves, Koehler Aircraft Products Co., is now available for missile in-flight and ground support applications.



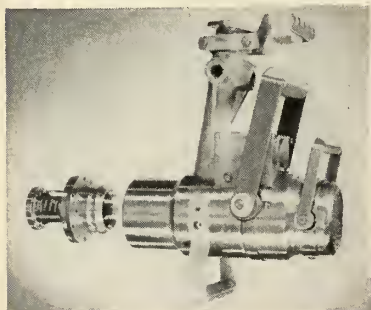
KOEHLER/Dayton Ball Valves are ideal for use with standard fuels and oils, high energy fuels, oxidizers coolants and cryogenics. They combine simple design and rugged construction and as a result are among the lightest and smallest available.

When functioning as drain, selector, fill and flushing valves, this ball type design can be actuated by manual, mechanical or electrical means.

Fill in No. 107 on Subscriber Service Card.

Fuel Oxidizer Servicing Nozzle Designed

Missiles and ground servicing equipment require specially designed nozzles and adapters for fueling operations prior to countdown. Lear-Romec Division of Lear, Inc. has developed such a device for missiles embodying special design and materials, standardizing the equipment for filling oxidizer reservoirs and fuel tanks at missile bases.



Developed for dependability and safety in handling oxidants, the nozzle is fully capable of transferring any of the exotic fuels and oxidants except those requiring stoneware transmission equipment.

For "closed circuit" fueling opera-

tion, two nozzles are required to transfer propellant or oxidant from the supply source to missile and overflow venting from missile to source. Thru the three way locking action between the nozzle and its companion adapter (permanently mounted on supply source and missile) absolute leak and hazard-proof seal is effected.

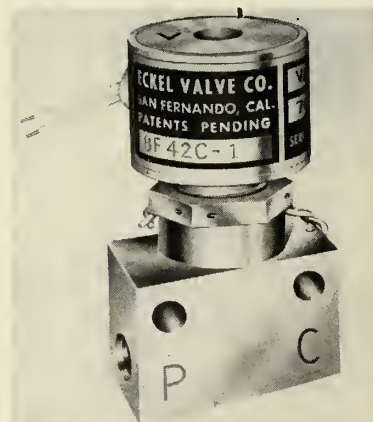
Operation is satisfactory at temperatures ranging from -65 degrees to plus 140 degrees Fahrenheit, in accordance with the requirements of Military Test Specifications Mil-N-25556 (nozzle RR13110) and MIL-N-25555 (adapter RD13040).

Originally designed to accommodate fuming red nitric acid (HNO_3), only the purer and more advanced aluminum and stainless steels are used for their overall resistance qualities to the corrosive action of oxidants.

Fill in No. 108 on Subscriber Service Card.

Eckel Offers Miniature Three-Way Valve

Eckel Valve Co.'s Series BF42C is a miniature 3-way valve for small actuators and instrumentation systems. It operates to 70 psi—gases or liquids—with inherent minimum leakage. The current consumption is just 9 watts at 28V DC, and the valve is available either with electrical connectors or lead wires.



Because of the Eckel coaxial configuration, this new BF42C valve is only one-third the weight of previous "smallest" 3-way valves.

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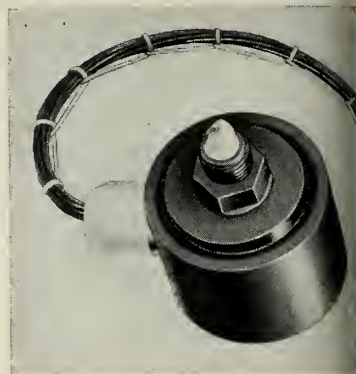
Lox Pump Motor Delivers 60 gal/min.

Recently developed by the J. C. Carter Co. for pumping liquid oxygen of liquid nitrogen is an electric motor driven two stage centrifugal pump. Designed to deliver 60 gallons per minute against a 550 ft. head, this pump is particularly suited for installations where light-weight, compact design is important.

Fill in No. 110 on Subscriber Service Card.

New Concept Featured in Liquid Sensing

A new Liquid Sensor featuring simplicity and greater reliability is now being produced by the Pioneer-Central Division of Bendix. The new Sensor which was developed to supplement the fuel measurement and control systems and the airborne liquid and gaseous oxygen systems with which Bendix has been identified is expected to have wide application in many related and unrelated fields.



The Sensor provides a new means of sensing the existence or level of liquids even in the presence of gas or vapor. It is adaptable to a wide range of applications—from sensing the presence of liquid at a given level in tanks to the critical measurement and control of missile propellants. It will function in fluids with widely divergent characteristics including the liquefied gases, hydrocarbon fuels, red fuming nitric acid, fluorides, hydrazine, water ink and viscous fluids such as molasses.

The Sensor is currently available in the form of a probe with built-in transistorized amplifier and relay or, for other applications, with the probe separated from the amplifier and relay. Both designs are adaptable to different configuration and to dimensional changes to conform to specific requirements.

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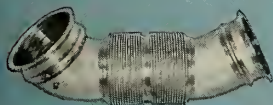
New Hydrogen Peroxide Nozzle Is Non-Corrosive

A new self-sealing, high flow rate hydrogen peroxide nozzle and adapter for servicing aircraft or missiles using hydrogen peroxide as an oxidizer has been announced by Flight Refueling Inc.

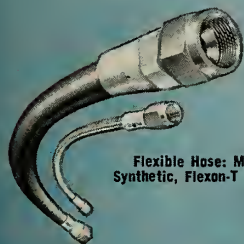
Safety requires the nozzle to be manually locked to the adapter before the internal valves can be actuated and collaterally, the internal valves must be completely closed before disengagement.

Another important feature is the working parts are fitted externally and do not come in contact with the fluid eliminating the possibility of corrosion.

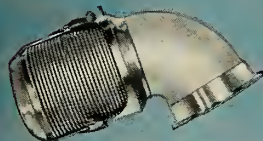
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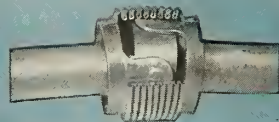
Missile Turbine
Exhaust Duct



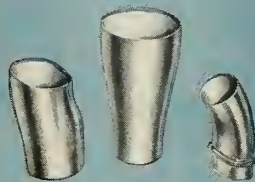
Flexible Hose: Metal,
Synthetic, Flexon-T (Teflon)



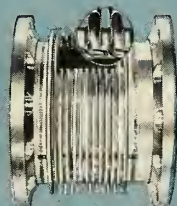
Turbine Exhaust
Anti-Roll Nozzle



Gimbal Joints



Special Forming —
Thin-Wall Stainless Steel



LOX Expansion Joint
with Flexible Liner



Electrically Heated Fuel Line

Propulsion piping system or individual components . . .

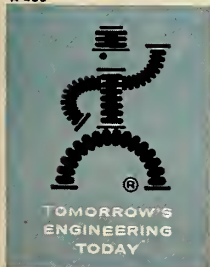
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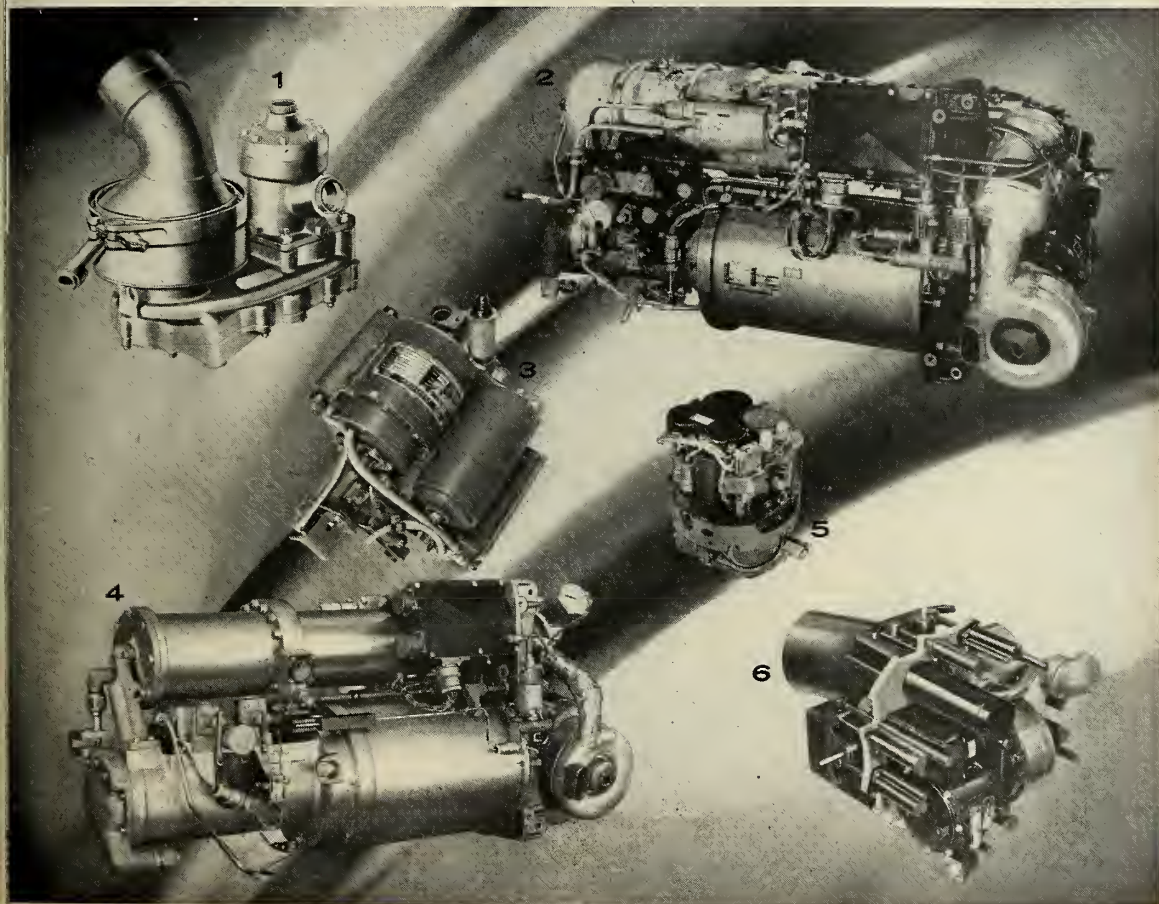
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To assist specialists working in the field of rocket and missile propulsion, General Chemical now offers a valuable set of product information bulletins packed with physical and chemical data, tables and graphs. This information is based on General Chemical's extensive experience with these products as America's leading producer of fluorine and fluorine-based chemicals, and one of the nation's primary producers of nitric and other mineral acids. The questions our customers ask most often about these products are answered here.

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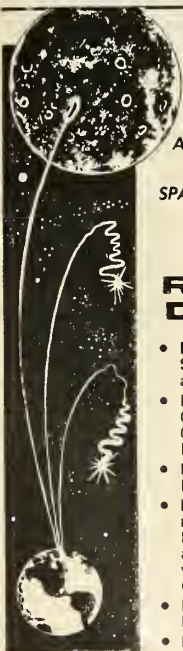
Assemblies and sub-
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HMS

HARTFORD MACHINE SCREW CO.

Division of Standard Screw Co.
HARTFORD 2, CONNECTICUT

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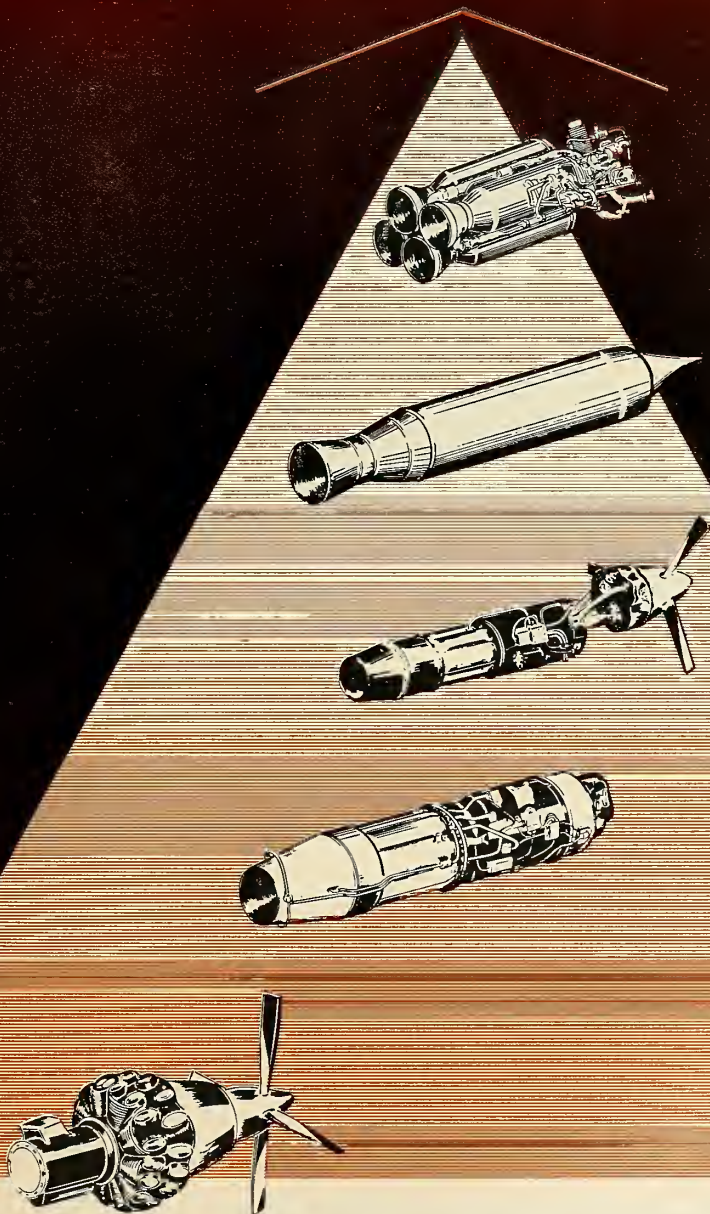
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CONTROLS

FOR THE FULL SPECTRUM OF PROPULSION SYSTEMS



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

*REG. U.S. PAT. OFF.

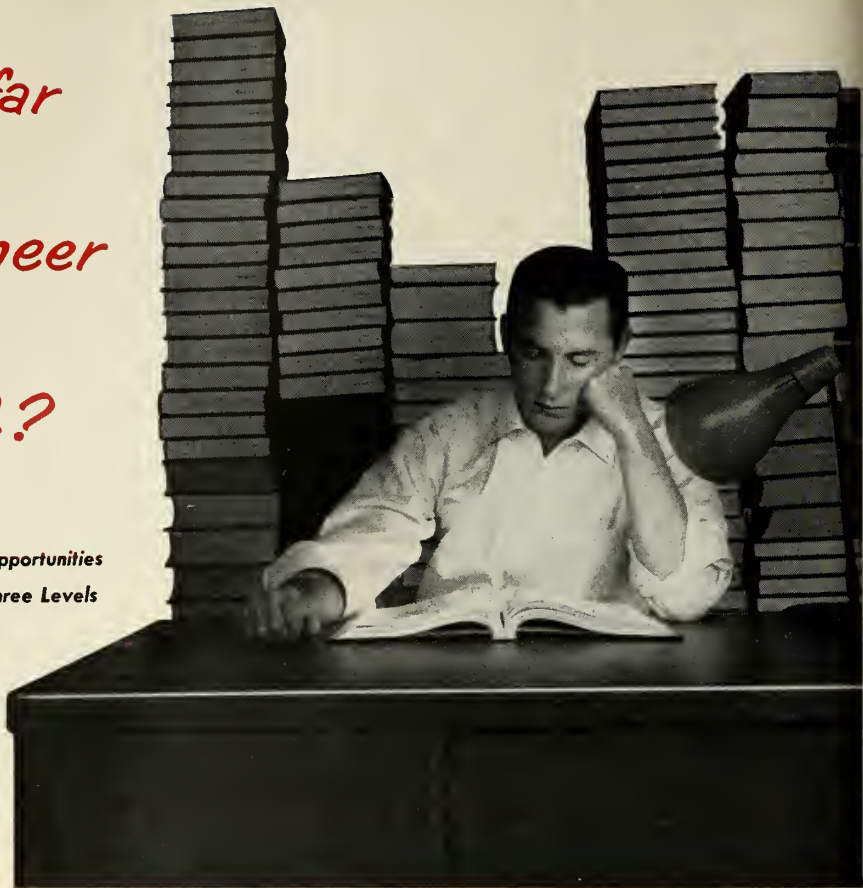
BENDIX PRODUCTS DIVISION **SOUTH BEND, IND.**

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**Special Advanced Education Opportunities
Develop Career Potential on Three Levels**



If you are a graduate engineer in the electronics, electrical or mechanical fields, or if you have an advanced degree in mathematics or physics, you can work on AC's famous AChiever inertial guidance system or a wide variety of other electro-mechanical, optical and infra-red devices. You can also prepare for promotion and enhance your professional status through AC's free comprehensive training programs—the finest "in house" programs available.

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These thoroughly practical courses—taught by university professors or recognized AC specialists—constitute AC educational "extras." AC offers them in addition to their educational assistance programs for men who wish to study for advanced degrees in nearby universities.

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AC SPARK PLUG 
THE ELECTRONICS DIVISION
OF GENERAL MOTORS

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REGULATED DC POWER SUPPLIES

SERIES



Model 250 S 025

Designed for powering airborne electronics equipment under the most adverse environmental conditions, Arnoux High Voltage DC Power Supplies assure the utmost in reliability. These magnetic-amplifier regulated supplies are available in the range of 108 to 450 volts DC, with current ratings from 50 ma to 800 ma. Other ratings are also available on special order.

ARNOUX

Input Power: 115 volts, 400 cps
Regulation: Input (Variation) Output (% Rated)
Line Voltage: $\pm 10\%$ $\pm 0.25\%$
Line Frequency: ± 20 cps ± 0.1
Load Current: 20-100% ± 0.1
0-100% ± 0.2

Ripple: Less than 0.05% rms at full load.

Output Adjustment: 5% adjustment available on request of slightly higher price.

Environmental: Meets specification MIL-E-5272 A for acceleration, vibration, altitude, humidity and temperature operating at 20% to 100% rated load.
Also meets MIL-I-6181 B.

Connector: AN-type connector.

Mounting: Stud-mounted.

(Write for Bulletin 200)

SERIES



Model 5 S 10

Intended for use in precision airborne instrumentation systems, Arnoux Low-Voltage DC Power Supplies are available in both single and dual output. Ranging from 5 to 50 volts at currents up to 10 amperes, these rugged units are hermetically sealed.

ARNOUX

Input Power: 115 volts, 400 cps
Regulation: Input (Variation) Output (% Rated)
Line Voltage: ± 15 volts ± 0.10
Line Frequency: ± 20 cps ± 0.15
Output Load: 20-100% ± 0.05
0-100% ± 0.10

Temperature Stability: 0.5% per 100°F.
(-60°F. to +160°F.)

Ripple: Less than 0.1% rms at full load.

Output Adjustment: Screwdriver adjustment provides ± 0.5 volt change. Wider range of adjustment available on request.

Connector: Standard AN-type connector, or hermetically sealed header on request.

Mounting: Stud-mounted.

Environmental: Meets specification MIL-E-5272 A for acceleration, vibration, altitude, temperature and humidity.

(Write for Bulletin 100)

Designers and Manufacturers of
PRECISION INSTRUMENTATION

ARNOUX

ARNOUX CORPORATION

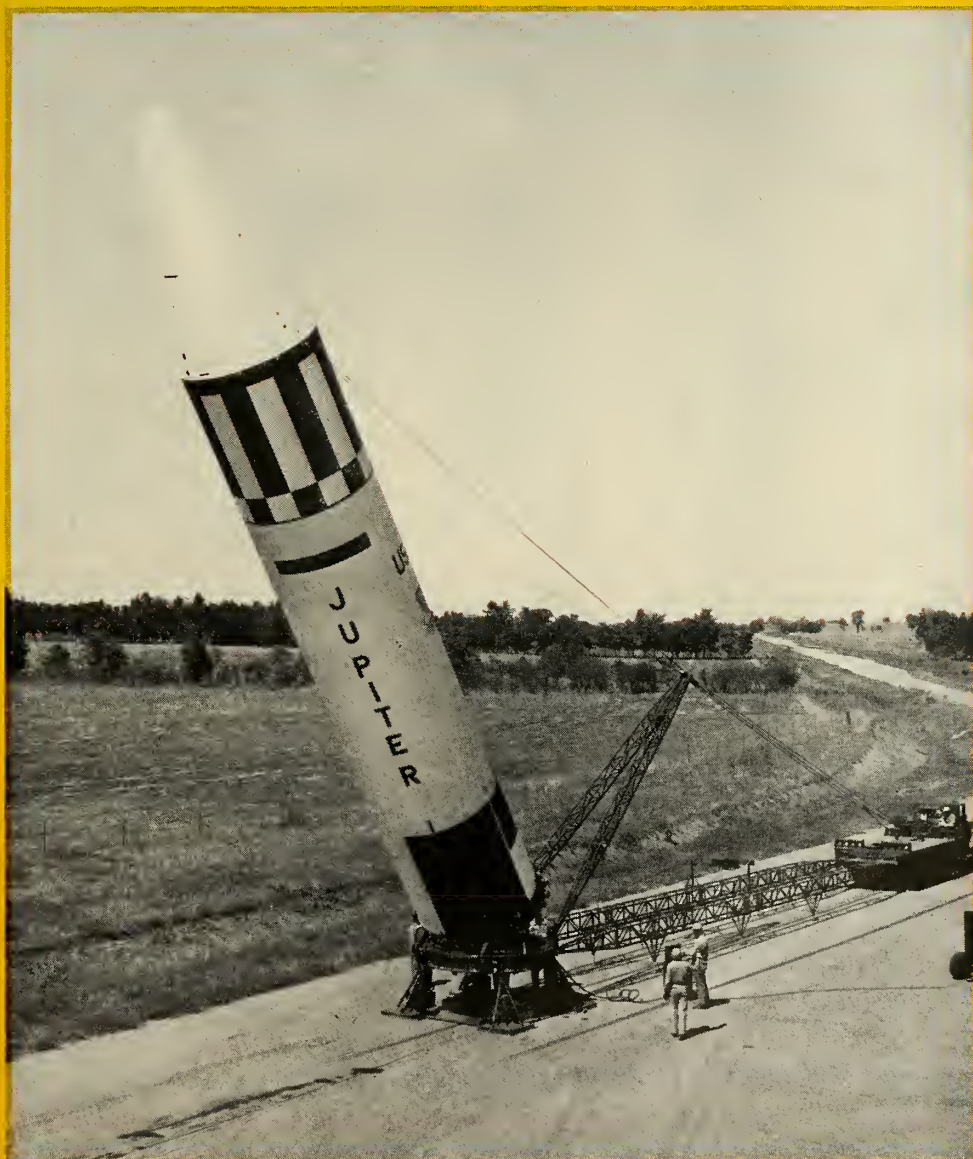
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GROUND SUPPORT EQUIPMENT

This is the equipment that supports the missiles; such as, "go, no-go" boxes and other electronic checkout gear, liquid oxygen generators, fuel trucks, fire trucks, portable generators, launching pads and block-houses.



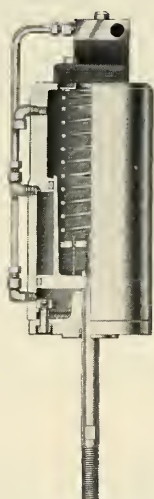
Annin OFFERS YOU MORE IN ACTUATORS

Your choice OF ADVANCED DESIGNS
WITH MORE PRECISE POSITIONING AND
DYNAMIC RESPONSE CHARACTERISTICS



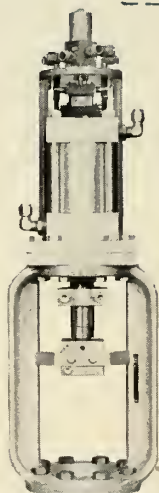
**1542 & 1544 SERIES
DOMOTOR POWERED
ACTUATORS**

Two types, "Direct Thrust" (illustrated) or "Lever" units are available for any application requiring accurate positioning in response to a pneumatic signal, such as butterfly valves, dampers, turbines and engine governors. Guaranteed positioning accuracy of better than 0.001" per inch of stroke over the complete range of piston travel is combined with a smooth operating action that provides an accurate, stable output force.



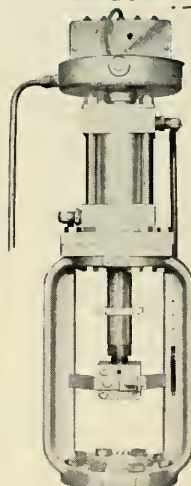
**600 SERIES
STROKE POSITIONING
ACTUATORS**

Offered primarily for the control of variable speed drives, rheostats, pumps and cams, as well as control valves, with strokes up to 6 inches and forces up to 2510 pounds of thrust. Compact and rugged, for easy mounting on existing equipment. May be operated from a standard 3-15 psi instrument signal, with a positional accuracy within 0.001" per inch of stroke.



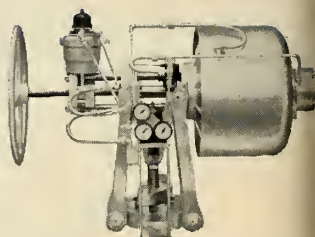
**10,000 SERIES
PNEUMATIC-HYDRAULIC
ACTUATORS**

For valves requiring strokes to 6 inches and thrusts to 100,000 lbs. Furnished on body assemblies where process conditions require very fine valve response, hi-speed and stability. Operate on 1500 psi oil supply system from any common instrument air signal.



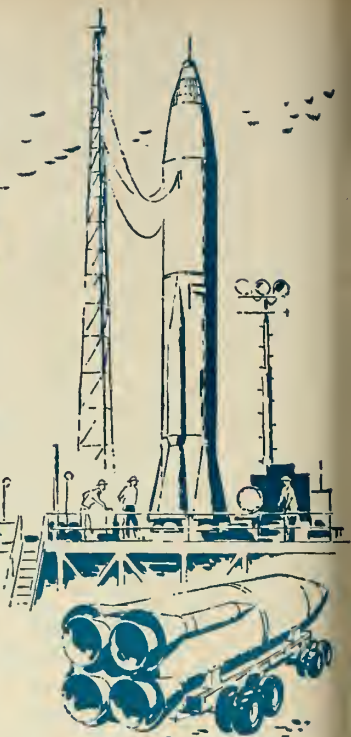
**20,000 SERIES
ELECTRO-HYDRAULIC
ACTUATORS**

Provide a means of converting an electrical signal to a powerful hydraulic positioning force, where high speed of response and stable operation are required under extreme conditions of pressure differentials, high velocities and large volume loads.



TOGGLE ACTUATORS

For process requirements where the unbalanced forces are extremely high, or where large through-puts are required. Three types are offered: pneumatic positioning, pneumatic on-off, and manual control, all embodying the toggle actuator; or a manual control arrangement can be combined with the pneumatic positioning or on-off toggle actuator.



Annin VALVES

THE ANNIN COMPANY

1040 S. Vail Avenue, Montebello, California

Write for Bulletin 1236-ST

New Products

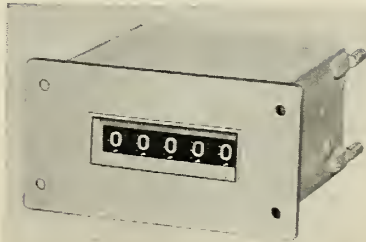
• ground support

SEALED ELECTRIC COUNTER HAS ELECTRIC RESET

Durant Mfg. Co.'s new Model 5-YE-9156-ER is a hermetically sealed electric counter with electric reset, designed specifically for use on military and other applications where adverse operating conditions are a factor. It is manufactured to meet MIL specifications 5272-A and similar rugged specifications.

Although especially designed for such military applications as missile ground support equipment and aircraft instrumentation, Model YE-9156-ER may also be used on industrial installations where severe atmospheric conditions prevail, or where an explosion-proof unit is required.

Provision is made for mounting the counter to the front panel through four 32 threaded holes on the face of the counter. It is also equipped with four mounting lugs at the base for applications where additional support is needed, or for base installation. Compact in size and sturdy in construction, Model 5-YE-9156-ER is complete with Winchester hermetic seal connector



on the bottom for quick connection to the power source.

Case size—3½" wide x 1-7/8" deep x 3-7/16" high. Figures—3/16" high x 9/64" wide. White on black background, with wide window opening for maximum readability. Speeds—1500 CPM or 25 CPS standard, with maximum resetting time of 105 milliseconds. Voltage—28 V. DC—Other voltages available on special order. Finish—Gray color 36492 per federal standard 596 for military panels.

Fill in No. 113 on Subscriber Service Card.

Hose is designed for the more severe requirements of missile pneumatic charging systems. The 4 to 1 safety factor of the hose provides greater safety to crews handling very high pressure air, helium, nitrogen, and other gases.



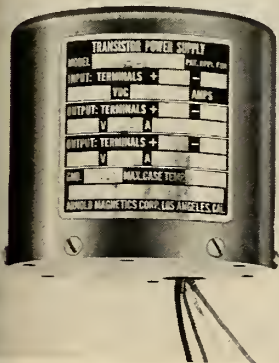
The hose has a Teflon tube with zero moisture absorption and an anti-adhesive surface to permit fast, easy purging and dehydration of hose lines and equipment. Spirally-wound stainless steel wire overlaying a stainless inner braid reinforces the hose, which has a stainless braided cover. Though constructed for use under rough handling, it retains flexibility making it easy to coil on reels. It is available in in -6 (3/8") and in -8 (½") sizes.

New segmented fittings for 678 Hose are reusable and incorporate a proven lip-seal for permanent leakproof performance. Designed concurrently with the 678 Hose is a lighter weight pneumatic hose for 3500 psi pneumatic systems. Designated 675 Hose, it features a Teflon tube and two-ply stainless steel wire braid reinforcement. With the exception of pressure requirements, it has the same characteristics of the 678 Hose and other Aeroquip Hoses of Teflon. It is available in sizes -4 (¼") to -12 (¾"), and fittings are of the reusable "super gem" type.

Fill in No. 115 on Subscriber Service Card.

Power Supply Produces IC to Square Wave

Arnold Magnetics Corp. has announced a transistorized power supply that will produce 400 cps single-phase, square wave power from a 28 volt DC line.



Unit delivers 50 VA of output power with a frequency and voltage regulation of ±1% for variations of input voltage of 5 volts. An output power of 115 volts, 400 cycles is stand-

ard, but any voltage between 6 or 1200 VRMS, and any frequency between 400 and 2000 cps, is available on request.

Protection against internal damage is provided by the use of an added circuit, which has the effect of rendering the power supply non-operative when the polarity is inadvertently reversed. Unit can withstand short circuit indefinitely, input voltage transients of 60 volts for 0.01 seconds, and 50 volts indefinitely at reduced power. Voltage drift is ±3% across a temperature range of from -55°C to +71°C.

Designated Model 591AC, unit is fully encapsulated and hermetically sealed, and meets the test specifications of MIL-E-5272B. Size is 3" OD x 3-3/16" high, and weight is 22 ounces.

Three standard terminations are available—A/N connector, wire-lead pigtail, and solder-lug terminals.

Fill in No. 114 on Subscriber Service Card.

Pneumatic Hose Has 24,000 Psi Burst Pressure

Aeroquip's Development-Engineering Center offers 678 Hose of Teflon for 6000 psi pneumatic systems and with a 24,000 psi burst pressure. 678

FRI Float Switch To Close Circuits

The Flight Refueling, Inc. Model FS-2 Float Switch is ideal for use in any system where it is required to operate electrically actuated valves and



indicator light systems. It can be used for closing a circuit either by the rise or fall of a fluid level. Switches of this type can be used for both ground, aircraft and missile installations with the highest degree of reliability. A variety of float arm configurations are available to suit alternate requirements. Other float switches of this general type are available on special order for varying fluids and for special applications.

Fill in No. 116 on Subscriber Service Card.

I INSTRUMENTATION WIRING

C COMPLETE INSTALLATION

B BASE COMMUNICATION SYSTEM

M MISSILE GROUND SUPPORT SYSTEMS

BY
AMERICA'S
MOST COMPLETE
ELECTRICAL SERVICE

ETS-HOKIN & GALVAN

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HIGH STRENGTH FASTENERS

Hex head cap screws—
low carbon, high carbon,
stainless 304 or 316 in stock

Specials made to order
in any alloy

Hardened and ground
components to aircraft
standards

31 years of aircraft
engine experience and
quality

HMS

HARTFORD MACHINE SCREW CO.

Division of Standard Screw Co.

HARTFORD 2, CONNECTICUT

Fill in No. 2 on Subscriber Service Card.

... new products

Monitoring Equipment Tracks Interference

The Mobile Interference Analysis Station assembled by Missileonics, Inc. of Melbourne, Fla., locate, track down, and record interference; and are able to eliminate any interfering radio signals by coordination with area frequency users. These signals may affect radio control of missile firings, or the telemetry signals from the missile.



The stations monitor radio signals in the frequencies from 1500 kilocycles to 10,000 megacycles. Advanced direction finding and field intensity equipment coupled with the ability of the stations to traverse cross-country roads, afford a quick means of locating the origin of any interfering radio signal. The stations are installed in specially designed truck vans constructed by Gramm Trailer Corp., Lima, O., and mounted on a heavy-duty Ford chassis, fitted with power steering and power brakes. Complete air conditioning and heating equipment are furnished, and independent gasoline-driven generators supply up to 7 KVA for operation of the electronic equipment.

Fill in No. 117 on Subscriber Service Card.

Pipe and Tube Connectors Offer Advantages

Meeting the high pressure, temperature and minimum weight requirements of the aircraft and missiles industry, Flight Refueling Inc.'s complete line of pipe and tube connectors offers many additional advantages. Positive grip and seal under conditions of angular misalignment, parallel axial offset and tube gaps assure a constant connection on beaded or flange type tubing.

One family of connectors provides for easy hand installation in hard-to-get-to places, where wrench movements are prohibited. Connectors are available in sizes from $\frac{3}{4}$ " to $4\frac{1}{2}$ ".

Fill in No. 118 on Subscriber Service Card.

Low-Cost Standards Used For Ground Support

New low-cost frequency standards which perform well in uncontrolled environments such as found in the operation of military ground support equipment and industrial applications, have been developed by The Gyrex Corp.

Resonant elements of the new Model TQ 60C units operate at their fundamental frequencies. This feature eliminates the need for auxiliary step-down circuitry, giving the instrument exceptionally high reliability. They can be operated or stored over a wide temperature range. Shock, vibration and atmospheric conditions normally found in connection with the operation of ground support equipment will not affect their operation. All units are hermetically sealed and qualify to MIL environment test specifications for ground support equipment.

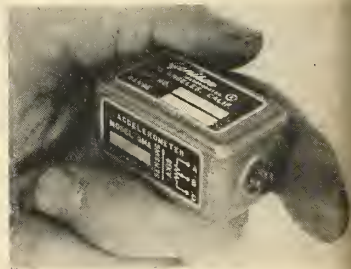
Other advantages of the new Model TQ 60C units include simple transistorized circuitry and compact size.

Fill in No. 119 on Subscriber Service Card.

Miniature Accelerometer Is Developed

A new accelerometer measuring only $1" \times 1" \times 1\frac{1}{4}"$ and weighing just three ounces, has been developed by Genisco, Inc., Los Angeles. A potentiometer-type pickoff is used.

The small size and light weight of the new instrument, designated Model GMA, makes it particularly suited for aircraft and missile fire and flight control systems and telemetering applications.



Range of the Model GMA is $\pm 0.5g$ to $\pm 100g$'s with natural frequencies of from 12 cps to 75 cps. Linearity is $\pm 1\%$ of full scale for balanced range instruments. Damping nominally 0.7 of critical at $+75^\circ F$, provided by the shearing of silicon fluid between closely spaced moving surfaces. The instrument is temperature compensated and will operate to specifications between $-20^\circ F$ and $+250^\circ F$.

It is able to withstand vibration accelerations of 10g's, 10 to 20,00 cps. on any axis, and shock accelerations of 50g's for 7 ms duration on an axis.

Fill in No. 120 on Subscriber Service Card.

... new products

Versatile Missile Check Valve Is Lightweight

Flight Refueling Inc.'s Model CV-1 missile and aircraft check valves are lightweight, reliable and extremely versatile. Standard beaded AND-10060 (Type A) ends permit rapid in-line installation by using two pipe connectors. The interest of weight reduction,



These check valves may be incorporated into any long tube merely by expanding a small end section of the tube, thereby eliminating one pipe connector.

These operationally proved valves are positive sealing and feature low "backing" pressure and low pressure drop. Design makes it practical for use with most fluids and gases. The CV-1 is also available with threaded ends for special applications.

Fill in No. 121 on Subscriber Service Card.

Aluminum Shelter Is Air Transportable

Gramm Trailer Corp. offers shelter of continuous ribs of extruded aluminum, located between end panels so equipment can be supported properly in any area. Longitudinal members are welded to rib sections at the four corners. Equipment can also be fastened to these members for support. The skid is integral with the bottom longitudinal members for strength as well as simplicity of design. All inside dimensions are square so equipment may be mounted flush against the wall. The inside may be lined with plywood, sheet aluminum, perforated metal to suit individual requirements. Hardware is flush mounted to minimize damage. Dutch door comes equipped with flush frost blocking hardware as standard equipment.

This shelter is air transportable and can be transported by C-119, or C124, helicopter and M-35 truck.

Fill in No. 122 on Subscriber Service Card.

HARCO

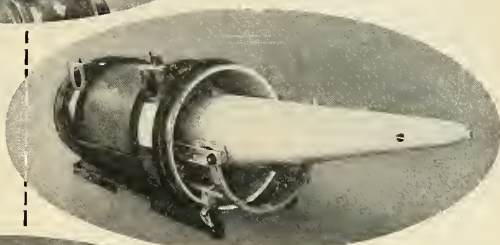
a **PROVEN** source
OF FIBERGLASS CONTAINERS AND
INTEGRAL GROUND HANDLING TRAILERS



LOADED CONTAINERS
Measuring 18 1/2' long, 4 1/2' diameter and weighing up to 4800-pounds when loaded with in-flight refueling stores and integral trailer, can be stacked 3 high to conserve storage space.

FAST UNLOADING OF REFUELING STORES

Less than 60-seconds required to remove end sections, through use of unique Vee-band clamps, greatly speeds unloading of stores on integral ground handling Harco trailer.

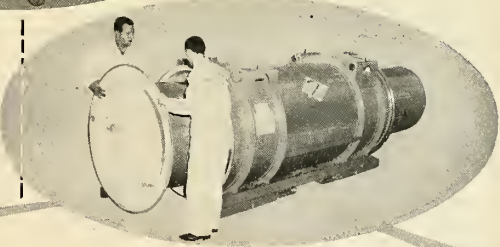


TRAILER IN PLACE FOR RETURN TO BASE

Harco Containers are a complete system for storage, transport and ground handling of critical stores; important part of system is Harco developed trailer which is returnable within container for re-loading.

END SECTIONS REVERSED FOR RETURN SHIPMENT

Overall length is reduced by half for empty-return shipment, conserving valuable shipping space. Use of fiberglass reduces container weight by 60%; is impervious to rust or corrosion; easily repaired in the field.



Harco Containers are the only fiberglass containers for storage, transport and handling of in-flight refueling stores approved by BuAer. Features include 60% reduction in weight, reversible end sections to cut return shipping size by 1/2, integral ground handling trailers for stores, 60-second availability of stores through use of quick release Vee-bands on end sections. Two years of field service prove their superiority. Other Harco Containers available for missiles, jet engines, re-fueling system components, electronic equipment.



write for literature and quotations on your container and ground handling equipment requirements.

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Harco Containers

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Missile Refuelers
Air-Borne Trailers
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Air Suspension Systems

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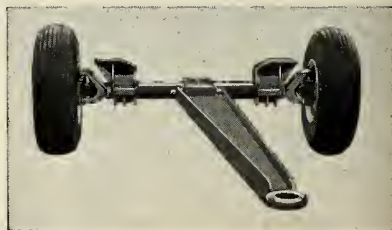
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• ground support

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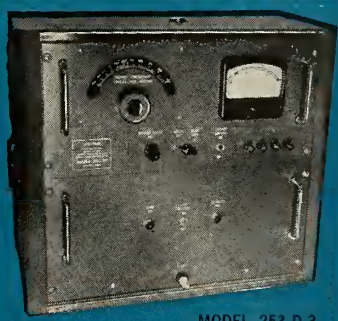
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PHASE 3

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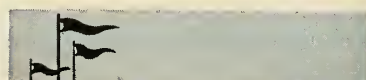
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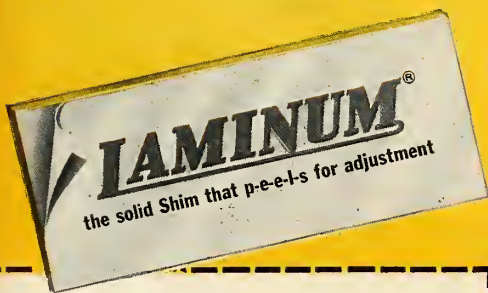
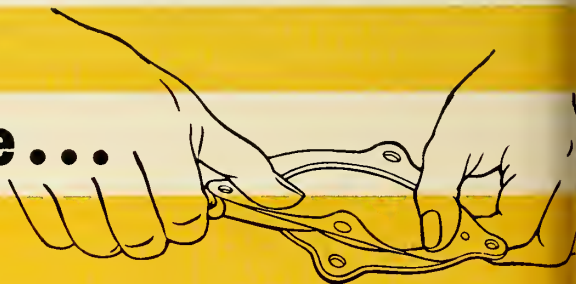
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Actually, our famous Shims of LAMINUM are perfect precision STAMPINGS. Consequently, we have perfected our own special equipment and tooling, our own skills and techniques, unknown to ordinary stampings producers. Result: the unique ability to quickly produce precision STAMPINGS...in any contour, in any size...in any quantity "one to a million"...at the lowest possible unit cost. We have 3 exclusive Methods—pick the one that fits *you* best...

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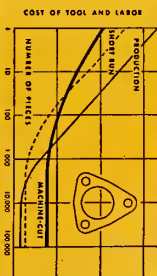
Experimental Pilot Stage
We use our MACHINE CUT METHOD. No dies needed. Our special equipment, us our unique techniques, are applied to produce small quantities at very low cost.

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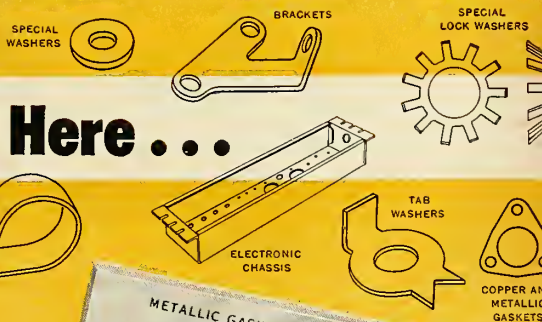
—we use our *low-cost*, SHORT RUN TOOLING METHOD. Our low cost tooling and simple dies, plus special presses, go to work to produce something more than "just a few." Quality is high—costs stay low.

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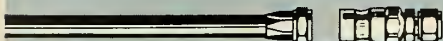
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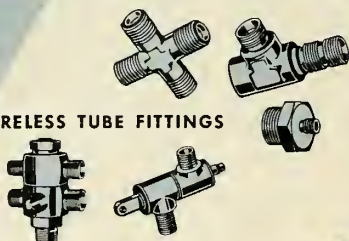


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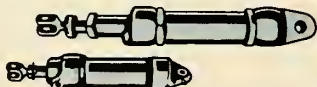
MS, ER FLARELESS TUBE FITTINGS



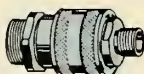
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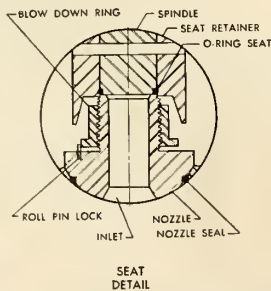
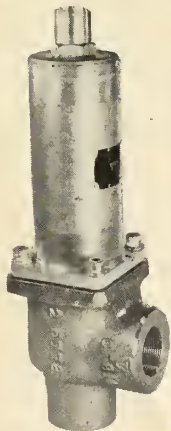
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Relief valve with replaceable O-ring seat

Bubble-tight operation up to set pressure is now possible with Anderson, Greenwood & Co.'s Type 3 Relief Valves. This new design uses replaceable O-ring seats to give perfect sealing and reseating qualities over a long dependable life — even on helium at 7000 psi. Write for catalog 151.

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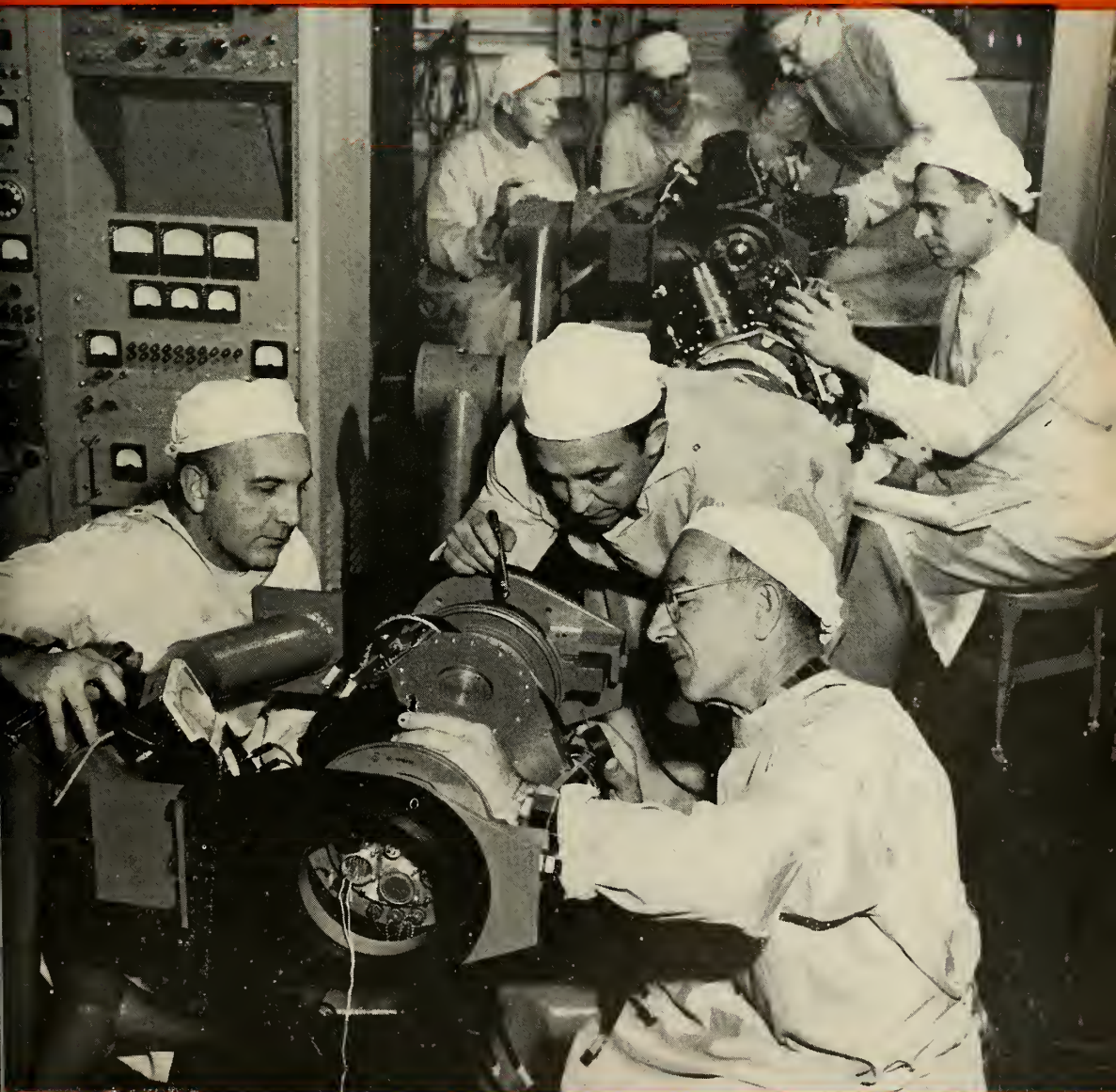
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New Products

• checkout equipment

CHART RECORDERS USE ADVANCED COMPONENTS

New circular chart recorder-controllers, with either electric or pneumatic controls, have been introduced by the Daystrom-Weston Industrial Division of Daystrom, Inc.

The new circular chart recorders employ advanced components, such as the division's recently developed D-Pak unit, and other improved mechanisms to provide greater instrument reliability and service in process industries," according to the company.

All models of the new recorder-controllers feature the revolutionary D-Pak constant voltage supply unit which eliminates batteries, standard cells, and standardizing mechanisms in potentiometers; interchangeable slide-wires, easy replaceable range standards, plug-in amplifiers, universal mountings, recessed indicator pointers to facilitate chart replacements; and rigidly supported scales on back of the plate assembly to permit easy calibration and indicator readings with the door open.

Pneumatic controls—in models 6836 potentiometer and 6856 Wheatstone bridge—are available as universal controller, proportional plus automatic reset, or proportional with automatic reset and derivative; proportional band adjustability—2 to 300 per cent. The proportional controller with reset, or reset and derivative, is recommended for more complex processes with high capacity or where appreciable transfer lag and/or dead-time is present.

Optional 4-position pneumatic transfer switch—automatic, manual, test, and service—provides complete control loop flexibility (supply air at 20 psig; controlled air at three to 15 psig). Tripping of the "flip switch" also provides bumpless transfer since gage accuracy is not a governing factor.

Electric controls—in models 6833 potentiometer and 6853 Wheatstone bridge—are available as contact type two-position or three-position) and



proportioning control with 5, 10, or 20 per cent proportional band.

The control mechanism is directly coupled to the slidewire shaft, eliminating lag and backlash inherent with linkage and cams. According to division engineers, the unusual design of the control mechanism eliminates chatter due to vibration with even the narrowest differential and, being completely enclosed, insures long trouble-free performance under adverse atmospheric conditions.

The new null-balancing type circular chart recorders are designed for a-c operation only; 115 volts, 60 cycles; or 115 volts, 50 cycles as specified; accuracy of plus or minus 0.25 per cent of span, or .025 mv. Design features include 12-inch chart with full scale pen travel of 4-5/8 inches; 33.86-inch long, 320° concentric scale; large easily read numerals; many standard calibration ranges for potentiometer or Wheatstone bridge; full-scale response time of 5, 10, and 20 seconds; enclosed connection terminals; and standard chart speeds.

Fill in No. 123 on Subscriber Service Card.

Theta Instrument Makes System Error Bridge

With the Theta-Bridge the angular position of any synchro or resolver inaccessibly located within a complex system can be directly measured without any mechanical coupling. The only connection is via the electrical leads of the synchro or resolver. Loading of the system is avoided through use of very high impedance elements in Theta Instrument Corp.'s new device. It is

also used to simulate a perfect synchro or resolver input to a system. Three dials display angular position digitally to three decimal places over a 360° range. The initial calibration to a particular system is accomplished without the necessity for mechanical rotation of any part of the system, and without the necessity for adjusting the system voltage excitation to an accurate level. Specifications: Accuracy, 10 sec. of arc. Readability, .001°. Size, 19 in. wide by 10 1/2 in. high by 8 in. deep.

Fill in No. 124 on Subscriber Service Card.

New Five-Channel Timer Has Low Contact Bounce

An extremely accurate, fixed position Interval Timer which limits contact bounce to within a range of 50 to 300 microseconds has been developed by Western Design & Manufacturing Corp., Santa Barbara, California, a division of U. S. Industries, Inc.

Currently utilized by two major aircraft companies in aircraft and missile systems checkout under severe environmental conditions, this compact electromechanical device is designed to provide highly accurate switching operations at precise time intervals for electrical circuits. Timing cycles may be as short as a second or as long as several hours.

With up to five independent channels available in the standard unit, events may be sequenced simultaneously or in a series, or in a combination of both. On special order, the number of channels may be increased to 10 as the synchronous motor has ample torque to handle the increased operating load.

The Western Design Timer, in addition to the synchronous motor, consists of a unique cam and positive action contact arrangement in which one set of contacts makes the circuit and the other set breaks the circuit. This action sharply defines the start or finish of any pulse and is accomplished by the use of abrupt discontinuities on the cam surfaces which permit the tripping points to be set precisely. The speed of contact operation is independent of the speed of rotation of the cams.

This unique design reduces duration of contact bounce to an absolute minimum. Total contact bounce on the circuit make and break is so slight it can be measured in microseconds, less than 300 microseconds on make, and less than 50 microseconds on break in production line units.

Contacts are designed for a load current of at least 0.5 amperes and are capable of operating satisfactorily with higher currents depending on the type of circuits and duty cycle required.

Because of the synchronous drive motors, the tolerance of the timing pulses is held to $\pm 1/5$ of one percent or ± 10 milliseconds whichever is greater. These tolerances are relative to a 60 cycle or 400 cycle time base accuracy.

A variable speed drive may be used so that one channel of the output pulses of the timer may be fed back into a closed loop servo system which will automatically synchronize the timer function with an external process.

The Interval Timer is supplied to operate at various input voltages on 60 cps and 400 cps alternating current lines or on direct current. Diminutive in size, the units are 5 inches long, with a 2.2 inch diameter and weigh as little as 1.5 lbs.

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... new products

Transistorized Tachometer Goes on Market

To fill the need in industry for a moderately priced indicating instrument suitable for numerous applications, Kahn and Co. has developed and put on the market their Transi-Tach Transistorized Tachometer.

The Transi-Tach is available in three basic models—for 19" rack panel mounting, as a portable unit, or with remote indicator. All models are self-powered by a 9-volt battery, but can also be used with 115 volts, 60 cycle AC.

The Transi-Tach indicates the speed of rotating shafts through the use of a magnetic or other speed pickup. RPM is read directly on a large meter scale which can be calibrated in any speed range desired with as many as 120 linear scale divisions. Speeds up to 60,000 rpm can be accurately measured. Zero suppression can be built into the scale to enable scale expansion within a desired speed range.

Since it is essentially a frequency meter, the Transi-Tach can be supplied as such for the measurement of audio or ultrasonic frequencies. It may also be adapted for use in conjunction with any transducer which converts flows, pressures or other physical forces into electrical signals of variable frequencies. Accuracy is plus or minus 2% of full scale of the meter reading. The proper transducer for each application can be supplied by Kahn and Company. Complete information is contained in illustrated bulletin which is available from Kahn and Company, Inc.

Fill in No. 126 on Subscriber Service Card.

Manometer Model TA Has 25 Tubes

Dynametrics Model TA Tiltable Manometer, Dynametrics Corp., is designed for operation as either a standard vertical manometer or a slant tube manometer at any selected angle from 11° to 90°. This mobile, backlit unit has 25 tubes mounted in a rigid box frame. The frame is balanced in precision line-bored pivots on the mobile stand, and has a manual-locking adjustment to fix the frame at any desired angle between vertical and 11° of horizontal. Slanting the bank increases the sensitivity of fluid height indication over smaller ranges and permits a more accurate pressure measurement. Zero register is accurate on all tubes even at the greatest tilt angle. When used as a standard vertical unit, the Model TA retains all the favorable characteristics of the Dynametrics multibank and multitube manometers.

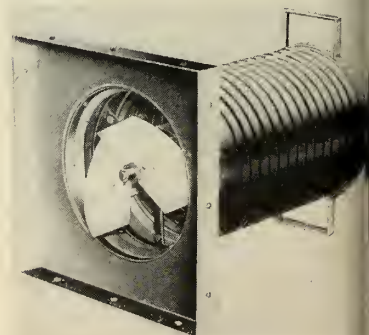
All tubes are manifolded to a single, manually adjustable reservoir. A vernier is provided for fine adjustment at angles near the horizontal. To reduce the quantity of fluid necessary, the pyrex tubes have a smaller than standard bore. The accurate co-planar scale sheet is backlit for photography and is graduated in inches and tenths of inches. The stand is mounted on 4 swivel casters for mobility and has built-in leveling jacks and level indicator for precise set up after locating.

As in all other Dynametrics manometers, the Model TA can be equipped, at slight extra cost, with a metric scale, check valves, or other standard accessories. One model of this unit is standard: TA-25-60 (25 tubes 60" scale height).

Fill in No. 127 on Subscriber Service Card.

Sun Electric Improves Electric Power Absorber

An improved version of their versatile Electric Power Absorber is announced by Sun Electric Corporation. The unit is used extensively in aircraft and missile testing systems applications. It is compact and has a low weight factor in relation to power absorption and heat dissipation. 10 to 15 KV capacity is claimed for AC use and up to 450 amperes at 30 volts DC.



New features include a front mounting panel for stacking units to conserve space. Mounting panel is on 13 inches square, overall length approximately 18 inches and weight 1 to 20 pounds depending on capacity.

A low temperature coefficient resistance ribbon within a slotted housing is cooled by ambient air drawn through a cooling tube by an internal mounted fan and motor. The motor may be operated as a part of the load or from an independent power source.

The unit is easily wired and is fully protected against overload. Infinite variable loading within the range of each unit can be achieved by the addition of a carbon pile or similar variable resistor.

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Creators of over 6,000 Precision Switches and Controls

presents . . . A new panel concept that promises to revolutionize monitoring or control of Missiles and Rockets

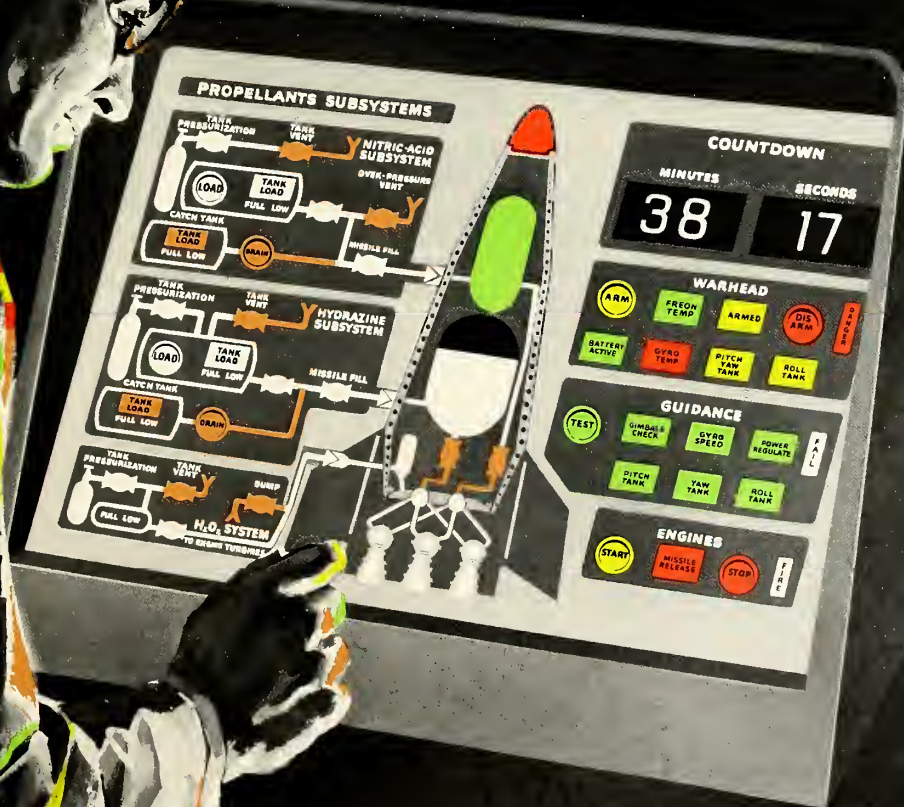
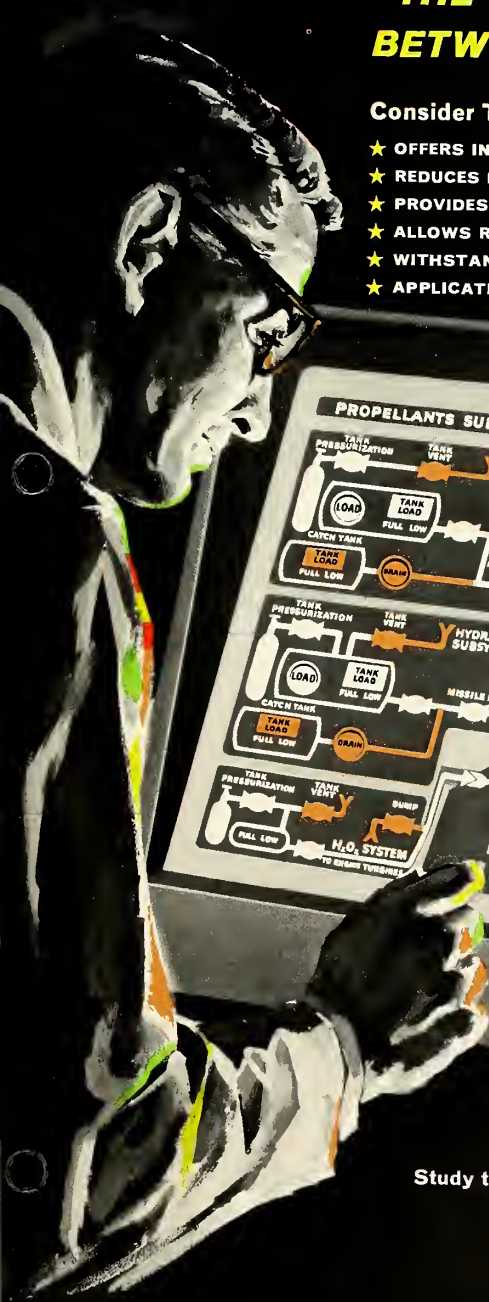


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LASTING LEGIBILITY ... Exclusive process imbues color into Fiberglas ... resists wear-off of legend and diagramming. Vivid colors actually photoprinted—will not chip or scratch off. Meets all requirements of MIL-P-7788 for Aircraft Cockpit Panel.



QUICK LAMP REPLACEMENT ... Front panel hinged for quick access to components below, permitting 10-second bulb change if necessary.

EASY TO ALTER ... During prototyping legend and schematic diagramming can be easily changed to visualize any new findings. Components under panel may be relocated.

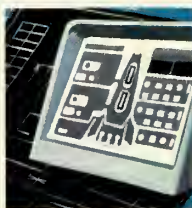
VERSATILITY OF DESIGN ... The module concept of construction makes the Astromatic panel technique extremely versatile. **WHATEVER ACTION YOU DESIRE TO VISUALIZE, ASTROMATIC CAN SUBMIT A PANEL DESIGN TO SURPASS YOUR EXPECTATIONS.**



100% FLUSH PANEL ... Eliminates protruding hardware ... unless specified by human engineering requirements. Switching functions may be recessed, flush, or over-flush.



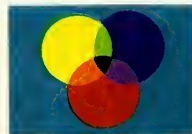
TRI-COLOR LIGHTS ... Each light module contains 3 separate bulbs and circuits to permit triple indications such as GO, NO-GO and CAUTION signalling.



CONCENTRATED GROUPING OF CONTROLS ... Multiple function of TRI-LITE controls permits high component density, saving from two to four times space required by ordinary panel. Permits instant visual recognition and action by operator, minimizing time-loss found in larger panels.



VERSATILE SWITCHING ... The switching and indicating techniques are specifically designed for maximum compatibility with this advanced panel. Momentary, positive feel and alternate action switching is available.



LIMITLESS COLOR COMBINATIONS ... The unique combination of TRILITES plus multi-color photo printing of panel allows unlimited color guidance, distinctly identifiable even by color blind.



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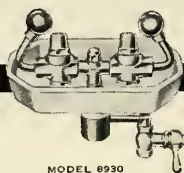
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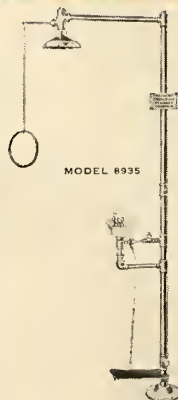
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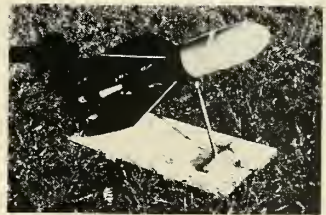
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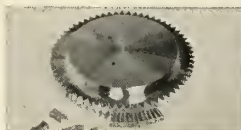
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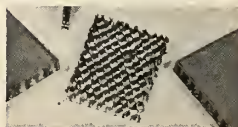
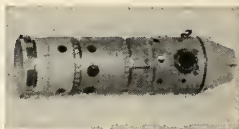
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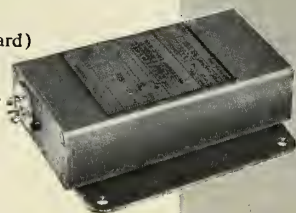


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New Products

• guidance equipment

MAGNETIC AMPLIFIER IS SMALL UNIT

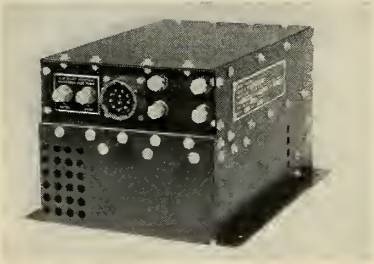
A new Variable Output Magnetic Amplifier for aircraft and missile use has been developed by the Vap-Aireronautical Products Division of Vapor Heating Corporation, Chicago, Ill. It is said to be the smallest in size and weight of any unit of this type available. It has an output of from 10 to 2000 watts.

The Variable Output Magnetic Amplifier can be used in many aircraft and missile systems including wind-tunnel temperature control, heater control, and motor speed control.

The advantage of the Variable Output Magnetic Amplifier over the on-off type is the modulating output, eliminating power surges in the aircraft or missile electrical system.

It also replaces three units normally used in a system; the temperature controller, power contactor, and the transformer.

Combining the functions of these units into a single control eliminates the extra AN Connectors and harness tie them together, 2) moving electrical contacts in the control box and contactor, and 3) installing three units.



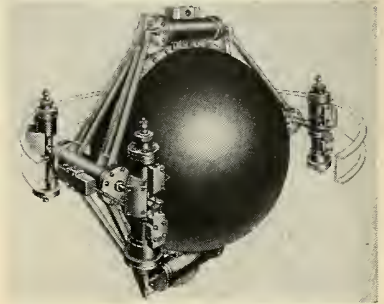
The controller also offers fail-safe features which will shut the controller off in the event of loss of power, pickup short, or pickup open.

In addition, the Variable Output Magnetic Amplifier has the ruggedness which is characteristic of mag-amps. The unit meets the requirements of MIL-E-5272A, is adjustable over a wide range, has the built-in reliability which mag-amps offer, and features extreme accuracy and repeatability of operation in ambients of minus 65° to 200°F.

Fill in No. 129 on Subscriber Service Card.

Isolation System Protects Delicate Units

Walter Kidde & Co., Inc.'s pneumatic vibration isolation system protects delicate units such as missile controls, aircraft components, and sled test instrumentation subjected to large and rapid "g" load changes. The isolation system accomplishes this by maintain-



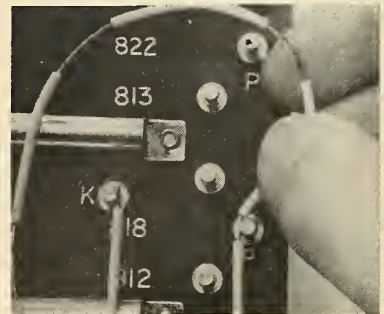
ing its desired low natural frequency while limiting relative displacement at various load conditions. The system consists of three independent sets of servo-controlled gas springs, each set absorbing a component of the vibrational and acceleration loadings along one of three mutually perpendicular axes.

Fill in No. 132 on Subscriber Service Card.

Centerstripped Leads Permit Fast Assembly

Manger Electric Co. offers centerstripping as one of its custom wire processing services. The firm has developed equipment which removes the insulation from stranded or solid conductors of any gauge.

The stripped portion may be any length from a minimum of 1/8" and may be located at either regular or irregular intervals throughout the length of the wire. Leads can be cut, end-stripped, and counter-stripped as required, or they can be supplied in a continuous coil.

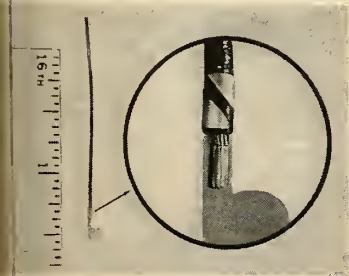


Centerstripping is of particular interest to manufacturers of products where multiple banks of electrical components have common terminating points. One continuous centerstripped wire can be used in place of two or more single leads.

Fill in No. 133 on Subscriber Service Card.

Miniature Terminals Are Resistant Welded

A new process has been developed by Manger Electric Co. to meet the terminating requirements of subminiature electronic assemblies. No longer limited to ready made terminals, terminations can now be designed to fit assembly. These terminals can be securely welded to wire as small as AW.G. #32.



Close tolerances are maintained and flex life is assured. Engineering service is available to assist with any special terminating problems relating to all types of electrical terminations.

Fill in No. 130 on Subscriber Service Card.

Mouse Tails Eliminate Clamps

The electronic package for Boeing Airplane Co.'s IM-99 Bomarc interceptor missile utilizes a recently-developed "mouse tail" for securing wire bundles to the chassis. These "mouse tails" produced by Rubber Teck, Inc., are made of a tough rubber compound. They are available in lengths from 1 to 4 inches, and are tapered at each end. They are installed easily by passing one tapered end through a hole in the chassis, looping the shank over the wire bundle and inserting the other tapered end through an adjacent hole. When clinked up tight and the tension relieved, expansion of the rubber holds the "mouse tail" firmly in place.

A series of laboratory shake tests has proved that these "mouse tails" will hold firm under all environmental conditions expected during the missile's flight. Use of mouse tails eliminates the need for clamps or waxed string ties. As a result, both weight and a considerable amount of manufacturing time are saved. Rubber Teck has been chosen to be the licensee for their manufacture.

Fill in No. 131 on Subscriber Service Card.

... new products

Circuit Breaker Weighs Only 2.1 Oz.

A hermetically-sealed circuit breaker of less than matchbox size has been developed by Heinemann Electric Co. of Trenton, New Jersey.

Called Model SM3, it is the first of Heinemann's SM series of sub-miniature breakers to go into production. The SM series is aimed at applications where small size and light weight are demanded, and where stable performance under varying conditions of shock, vibration, and ambient temperature is vital.

A series-overload breaker, the SM3 is designed for operation at 110 volts at either 60 or 400 cycles, or for 50 volts DC. It is available in ratings from 50 milliamps to 10 amperes. A choice of two time delay curves is offered, for fast or slow overload response, and the breaker is also available with instantaneous-trip response.

Since the SM3 combines magnetic actuation with hydraulic time delay, its current capacity and must-trip points are free from ambient temperature



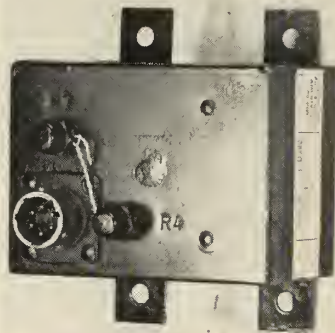
effects. The breaker will maintain its 125-percent must-trip point from -65° to $+125^{\circ}$ Centigrade. No de-rating is necessary for temperature or vibration. The rugged, hermetically sealed construction assures dependable operation under severe environmental conditions.

Fill in No. 134 on Subscriber Service Card.

Magnetic Amplifier Is New On-Off Type

Vap-Air Division, Vapor Heating Corp., offers a new On-Off Type Magnetic Amplifier Controller that is claimed to be the smallest and lightest unit of its type on the market today. Encapsulated in epoxy, it can stand extreme shock and vibration, yet is smaller than a pack of cigarettes.

The controller has many applications in the aircraft and missile field, among them: windshield temperature control, heater control and overheat warning.



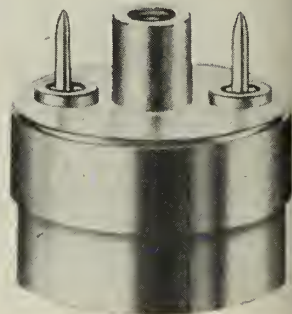
Ruggedness and reliability are characteristics of magnetic amplifiers. Other features of this unit are adjustability $\pm 25^{\circ}\text{F}$. of control point, accuracy, and repeatability of operation in ambient temperatures of minus 65° to 200°F . The amplifier meets requirements of MIL-E-5272A.

There are several built-in-fail-safe features which will shut the unit off in case of 1) loss of power, 2) partial or full pickup short, and 3) pickup open.

Fill in No. 135 on Subscriber Service Card.

Bimetal Thermal Switch Weighs $\frac{1}{2}$ Ounce

Weighing $\frac{1}{2}$ ounce, Control Products, Inc.'s "Button" switch is a high-temperature bimetal thermal switch which can be supplied with contacts for either close-on-rise or close-on-fall in temperature. The switch can be supplied calibrated at a maximum of 600°F or down to a minimum of -20°F with a possible close temperature tolerance of 2°F under laboratory conditions. Temperature differential and repeat ability for a given switch is about 1°F . An overshoot to 800°F or undershoot to -100°F can be tolerated.



The switch can be mounted by lugs soft soldered directly to, or recessed into the surface to be controlled, thus giving precise surface temperature measurement for applications such as aircraft and airborne electric equipment. It is available with single-wire or two-wire construction.

Hermetically sealed (metal-to-glass), it will meet the shock and vibration requirements of MIL-E-5272A Procedure I. The lower portion of the switch is $\frac{3}{4}$ " in diameter and the upper portion is $\frac{25}{32}$ " to permit seating the unit in a recessed mounting. The overall height is $\frac{3}{4}$ " including the glass seals and bushing.

Fill in No. 136 on Subscriber Service Card.

Price Electric Improves Crystal-Can Style Relay

Price Electric Corp., Frederick, Md. has announced a design improvement in its Style 6 Crystal-Can-size relay to improve reliability. An internal bracket has been added to support the relay mechanism and position it relative to the header, reinforcing the can in this function.

This design change has not affected the basic simplicity of the design, which does not require an armature hinging pin and thus eliminates the need for precision fitting of the armature hinging pin. The new bracket is said to improve uniformity and reliability of performance in vibration, shock, contact life and other environmental exposures.

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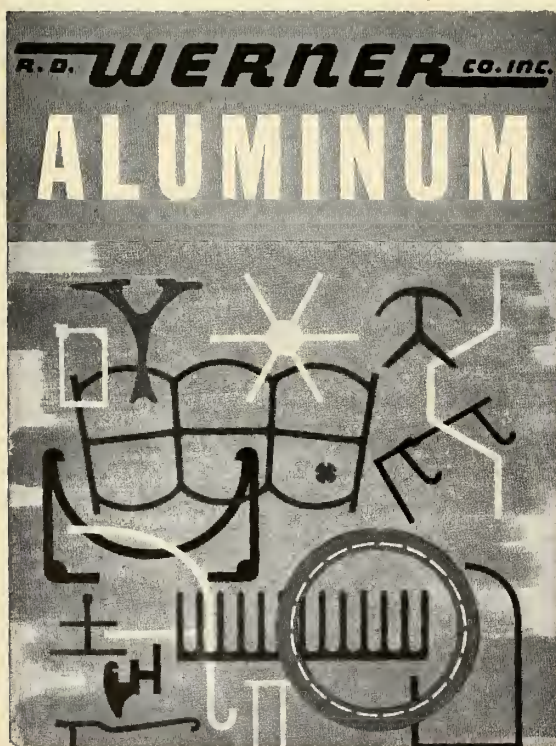
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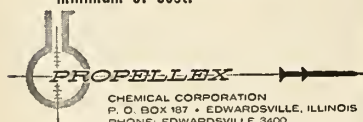
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