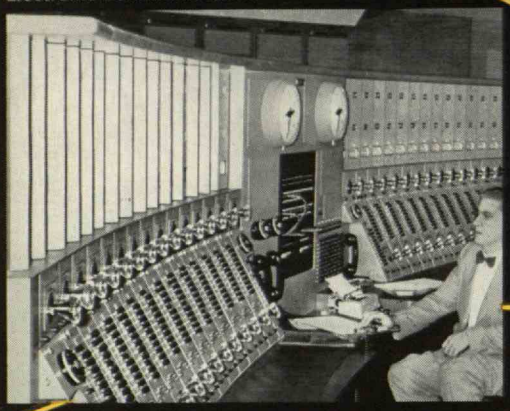
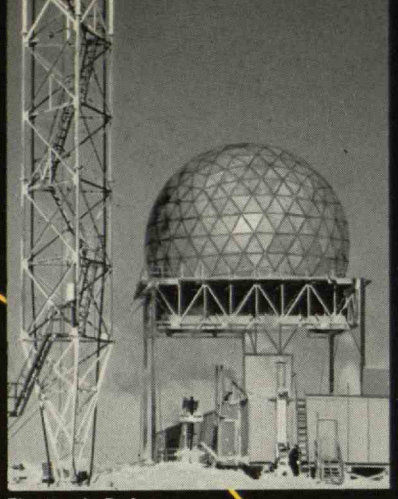
TECHNOLOGY REVIEW

June 1959

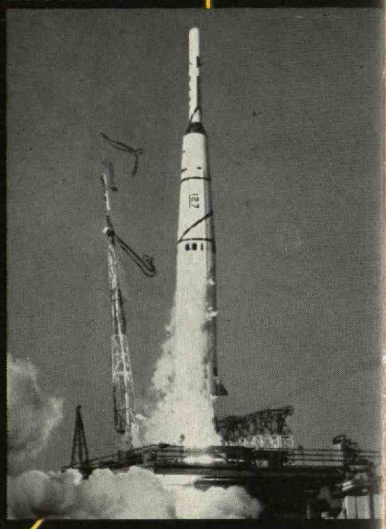
Electronic Communications



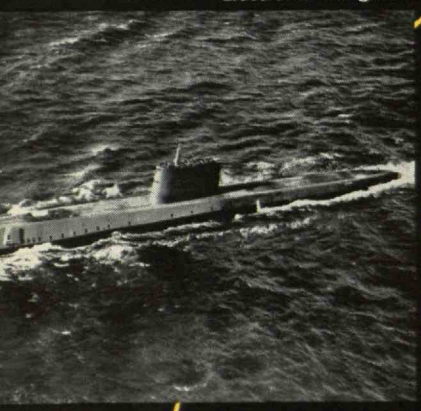


Electronic Defense

Electronic Guidance



Electronic Navigation



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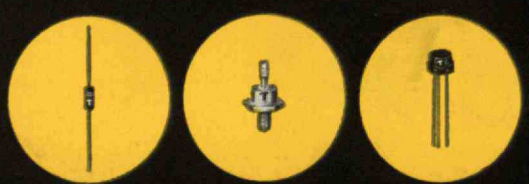

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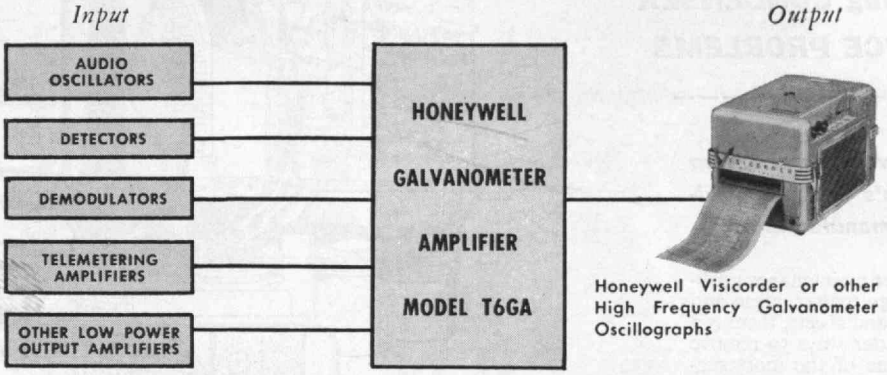
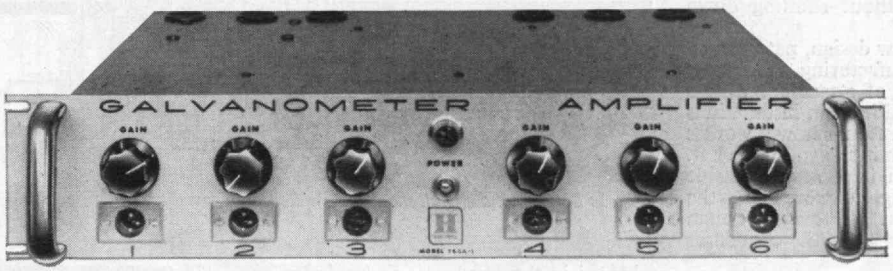
NEW GALVANOMETER AMPLIFIER

Strengthens Low Power Signals to Drive High Frequency Oscillographs



Honeywell Visicorder or other High Frequency Galvanometer Oscillographs



Galvanometer Amplifier, Model T6GA-1, measures 3½" high, 19" wide, 15½" deep.

DESCRIPTIVE DATA

VOLTAGE GAIN:
Adjustable from 0 to 1.0

OUTPUT (37 OHM LOAD):
±2.4 volts at 65 ma d-c to 8 Kc, limits at ±100 ma.

OUTPUT IMPEDANCE:
2 Ohms d-c to 10 Kc

CONTROLS:
6 GAIN controls, 1 Power ON-OFF switch

INPUT IMPEDANCE: 47 K

ISOLATION:
Individually floating channels for use with ungrounded loads

NOISE:
Less than 3 mv peak-to-peak

DRIFT:
Less than 3 mv/°F

POWER REQUIREMENTS:
115 volts ±10 volts, 50 to 440 cps, 45 watts

With Honeywell's new Galvanometer Amplifier, Model T6GA-1, high frequency oscillographs can now be operated directly by low power input sources of 1 volt or more. These inputs, some of which are shown in the diagram above, should have output impedances of 10 K or less although higher source impedances can be tolerated. Noise and drift are indistinguishable on the recorded output when the galvanometer-amplifier combination has a maximum sensitivity of 1 inch per volt.

The Model T6GA-1 is a compact, six channel, three stage transistor d-c amplifier with overload protection to eliminate both danger of transistor damage and galvanometer burnout.

Each of the six amplifier channels is isolated from ground by individual floating power supplies. Write for Bulletin B-ET6 to Minneapolis-Honeywell, Boston Division, Dept. 1, 40 Life Street, Boston, Mass.

Honeywell

H HONEYWELL *First in Control*

THE TECHNOLOGY REVIEW, June, 1959, Vol. LXI, No. 8. Published monthly from November to July inclusive at Emmett Street, Bristol, Conn. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription, $4.00: Canadian and Foreign subscription, $4.50. Entered as second-class matter December 23, 1949, at the Post Office, at Bristol, Conn., under the Act of March 3, 1879.

The contributions C. H. Wheeler's Reverse Flow makes in solving CONDENSER MAINTENANCE PROBLEMS

An informative advertisement from one of the nation's most experienced condenser manufacturers

Since a major condenser maintenance problem is caused by foreign matter, algae and scale which clog tubes and sheets, there is a constant search for better ways to remove this contamination. One of the most successful methods is Reverse Flow (see diagram on right), a system of back-flushing tubes and sheets without shutting down the condenser.

This Reverse Flow design, patented by C. H. Wheeler Manufacturing Company, designer and builder of steam condensers since 1903, has proved itself in installations throughout the world. Here's how it works:

Normal operation is shown on the left. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram above shows Reverse Flow in operation in a C. H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E. Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Other Ways To Keep Tubes Clean

Special slugs are sometimes used to remove algae and foreign matter from the insides of condenser tubes. They're forced through the tubes by high-pressure water; thus scale and other contamination is flushed as it's dislodged. When the slugs are metal, care must be taken to prevent ruining them as they fly from the outlet side of the tubes.

Sometimes a 5% HCl solution is introduced into the tubes to dissolve the scale. While this method is effective, it is often necessary to leave the acid in the tubes for six hours or so—thus prolonging down time. Also, it's necessary to flush the tubes before the condenser can be put back in service.

In general, maintenance becomes more of a problem as water-source pollution increases; also as circulating water temperature rises, because the rate of scale formation increases at higher water temperatures.

Solving Deaeration Problems

Oxygen and other non-condensable vapors in the condensate result from leaks or are introduced through make-up water or heater returns. Most authorities believe that the greatest source of oxygen is make-up water.

Make-up water which is not properly heated in the condenser and agitated sufficiently to release entrained gases results in excessive oxygen and other non-condensables in the condensate. As a consequence, corrosive oxides may be deposited in the boiler, reducing its efficiency.

Proper distribution of normal make-up water is achieved in Wheeler condensers by spraying it over the top of the tube banks at both ends of the tubes, and out of the path of high-velocity steam from the turbine exhaust. Steel bars above tubes protect them from water impingement damage.

Heater returns are sprayed in the steam lanes to permit flashing and distribution of the returns and release of entrained gases.

All condensate draining off the tubes is cascaded over a series of horizontal deaerating bars (1, Fig. 3) in the presence of a moving blanket of steam to provide greater agitation and reheating before condensate is drained into the hotwell.

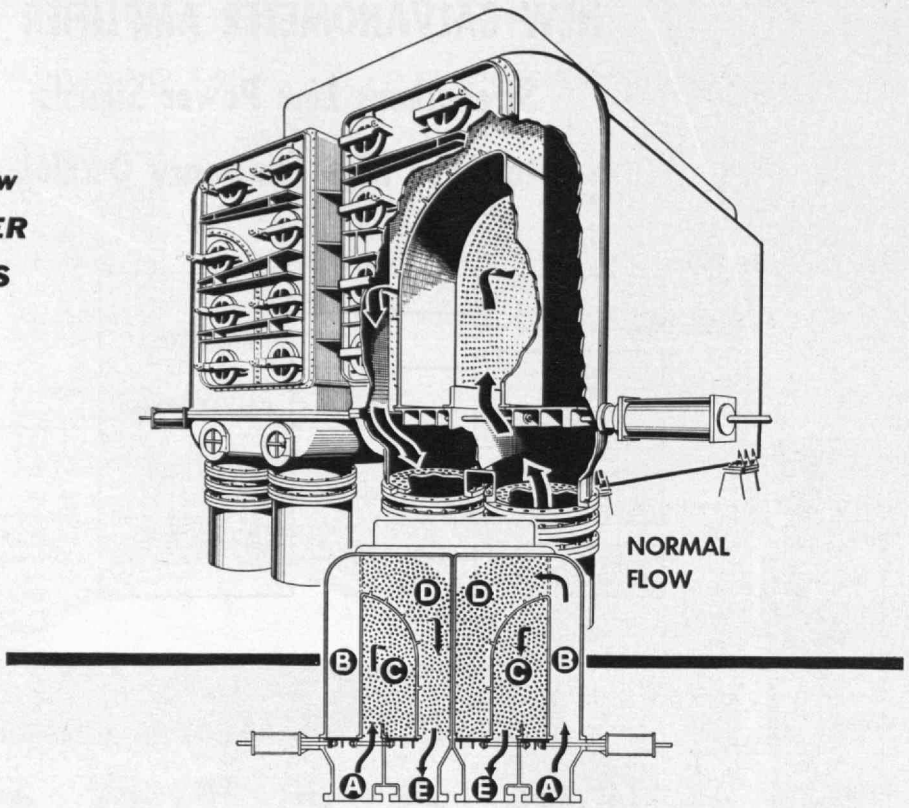


Fig. 1: Simplified diagram showing how Reverse Flow cleans tubes and sheets during full load operation.

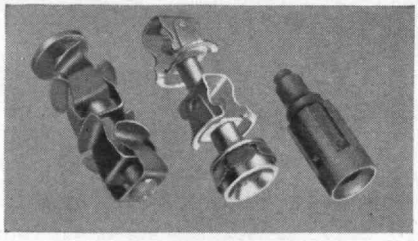


Fig. 2: A few of the types of slugs used to clean the inside of condenser tubes.

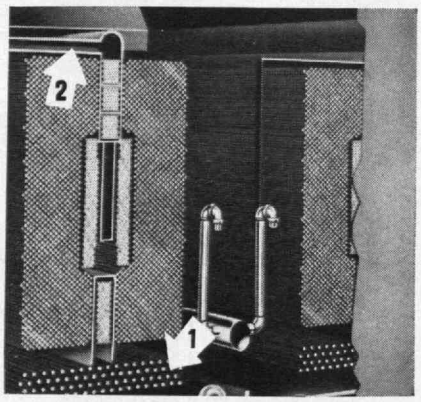


Fig. 3: Drawing of deaerating bars and air-vapor suction line. Tubejet® Air Ejector.

Notice too, location of the air-vapor suction line (2), through which the Tubejet® Ejector draws off non-condensable gases and discharges them to the atmosphere.

In C. H. Wheeler Dual Bank Divided Water Box Condensers the air cooler section is centrally located, so as to reduce depth of steam penetration and consequently resistance to steam passage, achieving a new low in pressure loss in the condenser.

If you have a maintenance problem that doesn't seem to improve no matter what you do, C. H. Wheeler may be able to help. Get in touch with a Wheeler representative or write direct. No obligation.

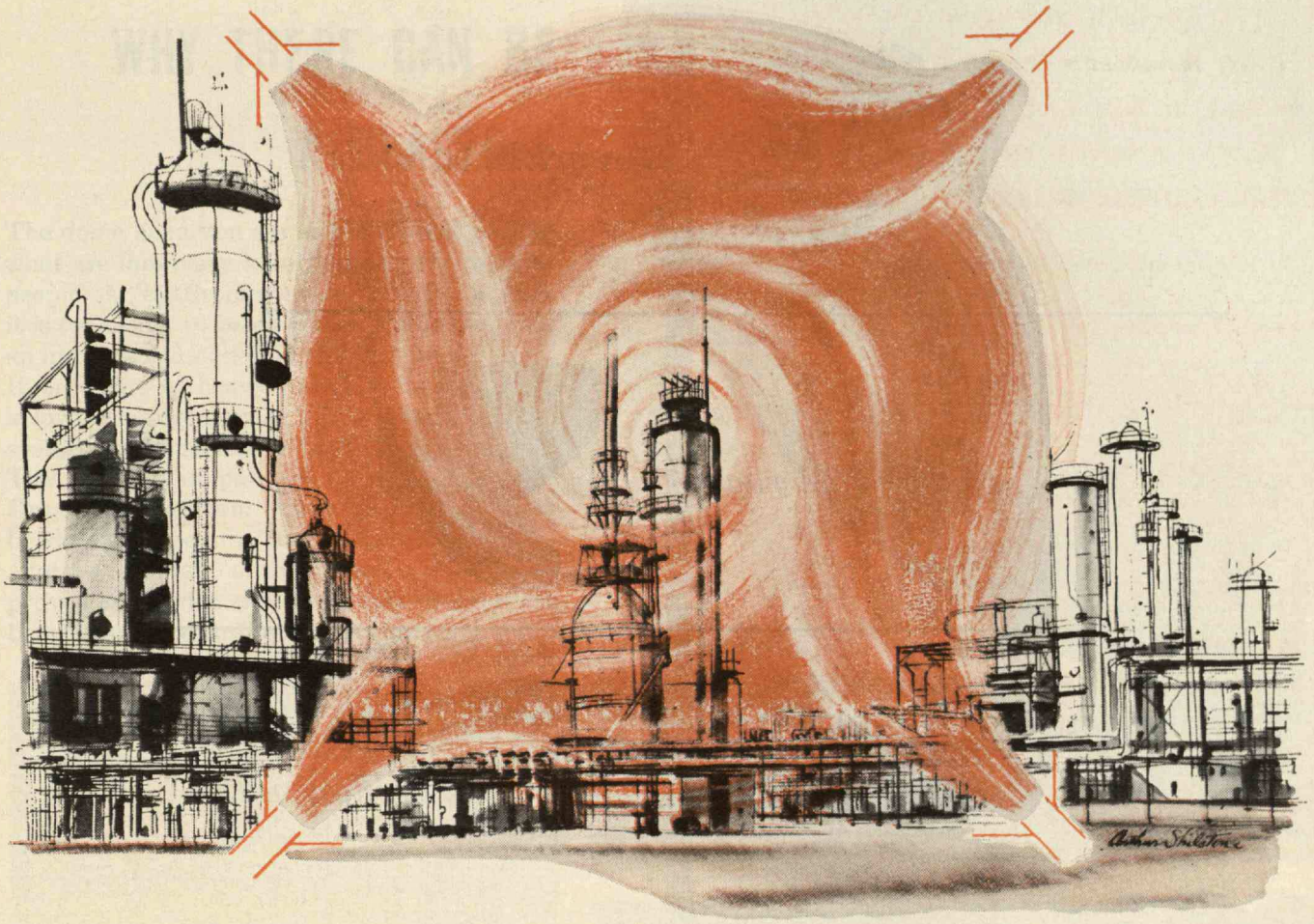
C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

"CREATIVE ENGINEERING" TURNS A TROUBLESOME WASTE INTO A VALUABLE FUEL



Waste carbon monoxide is sentenced to hard labor in the refinery

For years, refinery operators were concerned about the loss of a by-product with an untapped capacity to do work. Produced in volume by their catalyst regenerators, Btu-loaded carbon monoxide was being discharged to the atmosphere for want of a technique to burn it efficiently and productively.

The problem of burning this "lean," moist, toxic gas for the production of steam was not entirely new to Combustion, since the company had designed a large number of boilers to burn a similar fuel – blast furnace gas. Based on this experience, C-E engineers believed that "*tangential firing*"* would be the most effective method of burning carbon monoxide. And so it proved to be. Working in close cooperation with refinery engineers, C-E specialists designed a tangentially-fired boiler which has fully demonstrated its ability to provide the intense turbulence and almost instantaneous combustion needed for the most efficient utilization of this waste product. Today, the C-E "CO" Boiler is providing extra dividends to the refinery industry in the form of steam for power and process.

Here then is another example of Creative Engineering–the C-E approach to providing the most advanced designs of boilers for all fuels and steam requirements–from those of small industrial and institutional plants to the largest utility power stations.

* An exclusive C-E development which has been outstandingly successful in burning pulverized coal, oil and gas in hundreds of installations. Involves firing from the four corners of a furnace to create a tornado of flame as illustrated.

"CREATIVE ENGINEERING" is the reason for the leadership attained by C-E products. The products which bear this mark of leadership include:

all types of steam generating, fuel burning and related equipment • nuclear power systems • paper mill equipment • pulverizers • flash drying systems • pressure vessels • soil pipe

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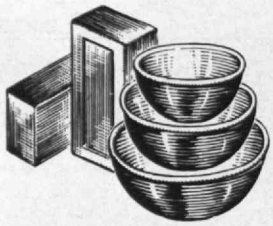
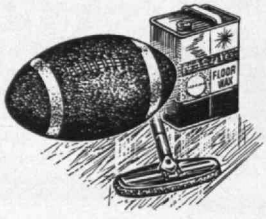


. . . bricks or bowls

. . . rubbers or rugs



. . . footballs or floor waxes

Better Products begin with CABOT!

The items above can only begin to hint at the enormous range of products which contain a pinch or a pound of one Cabot raw material or another.

Put it this way: no matter where you are as you read this, chances are excellent that you are within reaching distance of at least one.

That's why we're reasonably confident that among the readers of this message, there is at least one whose product or process can profit from a perusal of the list below—and a phone call to Cabot.

Perhaps it is you.

WHICH OF THESE CABOT MATERIALS CAN HELP YOUR PRODUCT?

CABOT CARBON BLACKS . . . *more than 50 different grades of channel, furnace and thermal blacks for use by the rubber, printing ink, paint, varnish, lacquer, enamel, plastics, paper, phonograph record, battery and other industries.*

CAB-O-LITE® (wollastonite) . . . *as a paint pigment, this versatile, uniform calcium metasilicate has more desirable properties than other extenders used singly or in combination. Excellent for all types of paint, and for quality improvement of all types of ceramics.*

CAB-O-SIL® . . . *this unique airborne silica, in extremely small quantities, greatly improves a host of products. Remarkable for its unusual combination of properties, it's equally effective as a thixotropic, thickening, gelling, suspending, flatling, reinforcing, anticaking and antislip agent. Used in plastics, lubricating oils, greases, paints, varnishes, lacquers, rubber, sulfur, insecticides, pharmaceuticals, cosmetics, many other products.*

PT® PINE TAR PRODUCTS . . . *these versatile quality controlled materials improve the performance of a wide variety of products, including: rubber, paint, cordage, oakum and insecticides.*

For complete information, phone or write:

GODFREY L. CABOT, INC. CABOT®

77 FRANKLIN ST., BOSTON 10, MASSACHUSETTS

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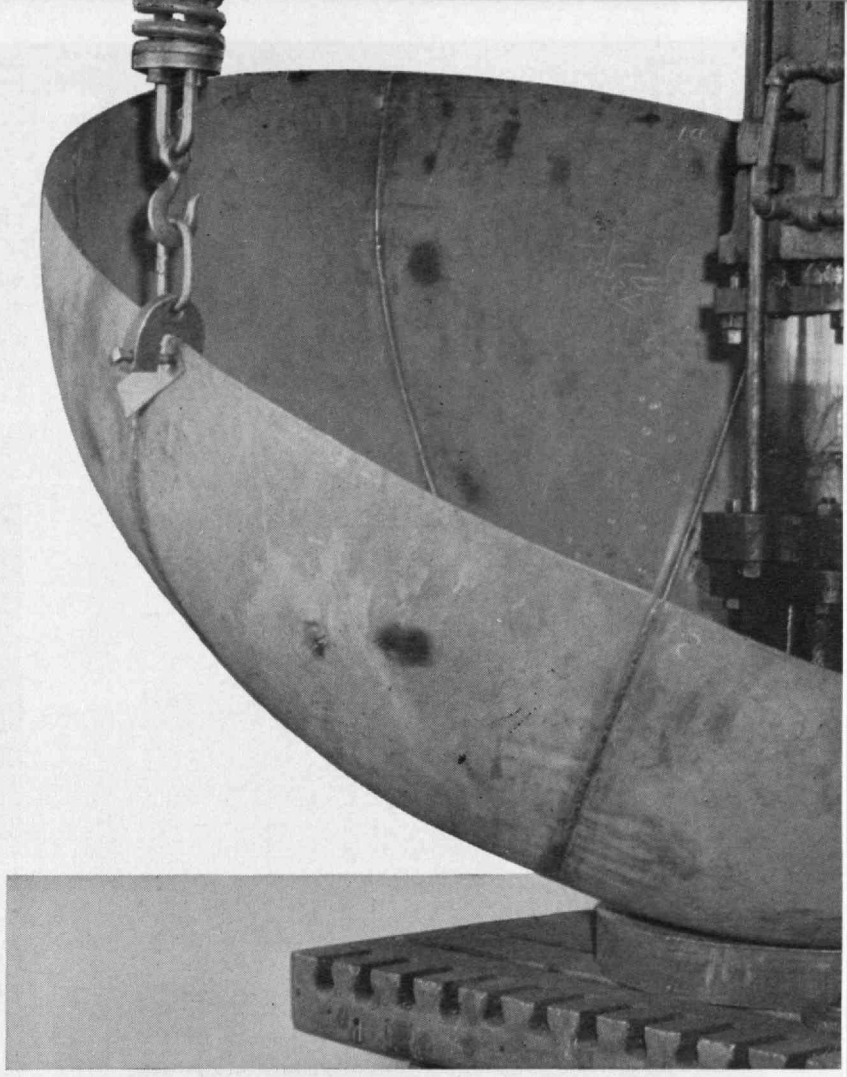
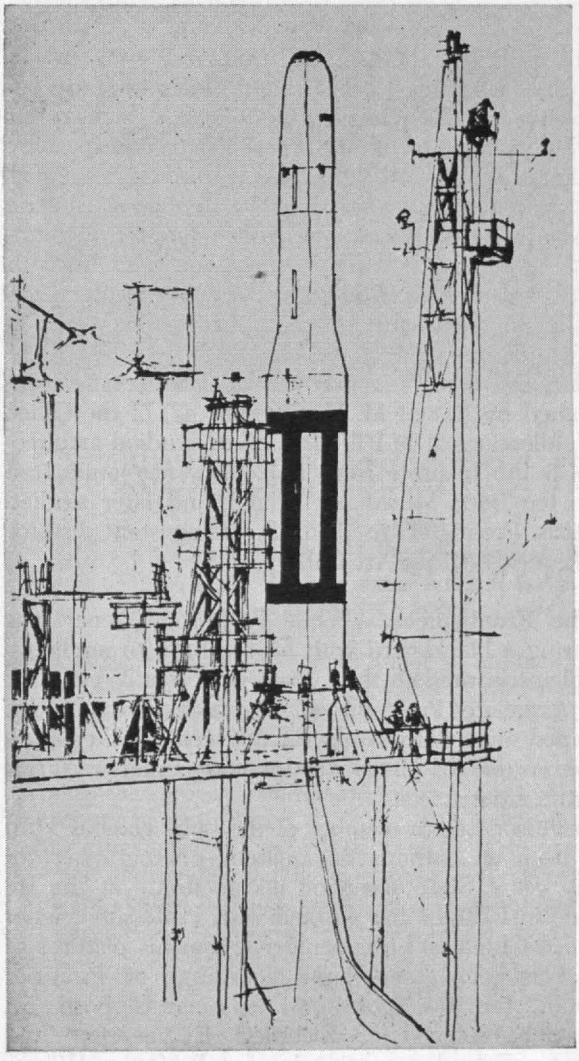
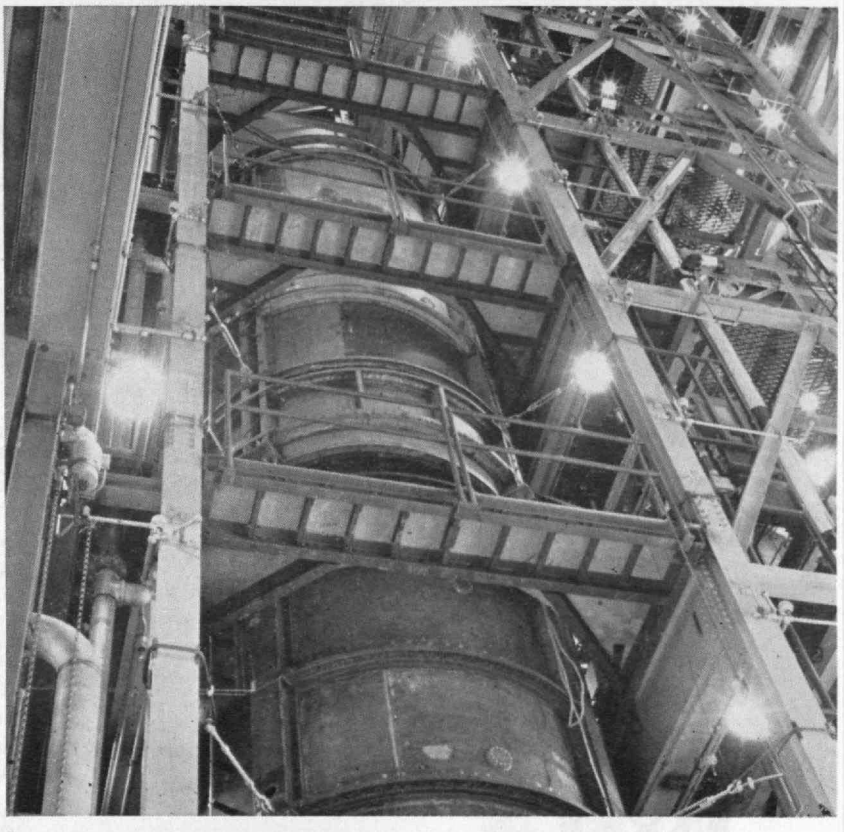
ONE IMPORTANT REASON WHY THERE CAN BE A BLASTOFF

The dome head you see at the right is part of what are familiarly known among the missiles people as "battleship tanks." That's because it is too heavy to be air borne. Yet it performs an important function in the missiles program. It is a part of heavy-walled units like those below which are used to test components, subsystems and systems for the TITAN missile by The Martin Company at its Denver facility. Graver's assignment was a number of dome heads and cones for this testing installation, another example of how Graver's century-proved skills with alloys and special steels are being employed in the missiles program.







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THE PHOTOGRAPHERS

The Cover. – GJON MILI, '27, made the photograph of Professor Gordon S. Brown, '31, that is on the cover of The Review this month. He did this while working on a photographic essay for *Life* magazine. Mr. Mili made many excellent pictures of members of the Faculty and students at that time, some of which were exhibited last year in the Hayden Memorial Library. The Review plans to publish more of them.

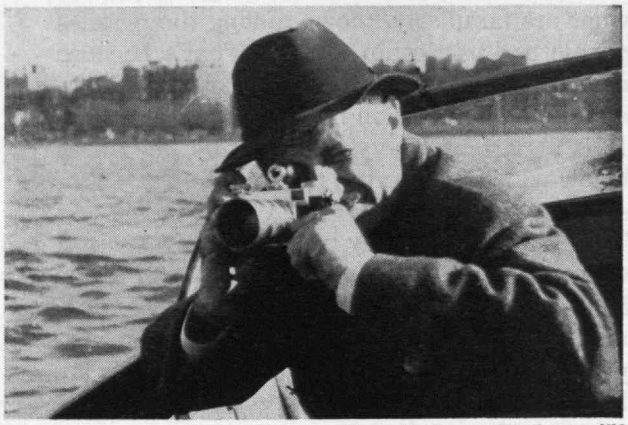


Photo by George W. Brown, '56

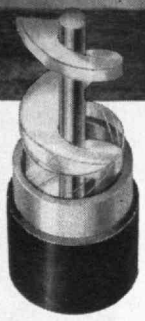
Gjon Mili, '27

Mr. Mili was born in Albania and grew up in Romania. He came to the United States to study engineering in 1923, scarcely able to speak English, but quickly gained Professor Norbert Wiener's respect by the speed with which he solved a third-degree equation. While working for the Westinghouse Electric Company, he became increasingly interested in high-speed photography. He has worked closely with Professor Harold E. Edgerton, '27, who considers him "the leading journalist photographer in the world in the use of the stroboscope."

This and other recent covers of The Review were designed by RALPH M. H. COBURN, '47, of the Office of Publications at M.I.T. Mr. Coburn studied architecture at the Institute from 1942-1945, was graduated from the Boris Mirski Art School, and later studied in Paris. From 1945 to 1955, he was assistant director of the Boris Mirski Art Gallery.

The Frontispiece. – While Professor Wiener was covering a blackboard with his solutions to nonlinear problems in random theory last year, YUK-WING LEE, '27, Associate Professor of Electrical Engineering, snapped some 400 pictures for the record. An enlargement of one of those documentary photos is this month's frontispiece.

Professor Lee (a member of the same class as Mili) has been an enthusiastic amateur photographer for many years. Since receiving his doctorate at the Institute in 1930, he has worked with Professor Wiener both in China and this country. From his pictures of the blackboard, and tape recordings of Professor Wiener's remarks, Professor Lee, Amar G. Bose, '51, Assistant Professor of Electrical Engineering, and others prepared a manuscript for Professor Wiener to edit and The Technology Press to publish.



New space-scanning radio telescope equipped with *Styroflex® Coaxial Cable*

Styroflex® coaxial cable is an important component part of the new radio telescope now in operation at the National Radio Astronomy Observatory, Green Bank, W. Va. This remarkable telescope is designed to probe the universe for radio waves originating in space.

Six "runs" of Styroflex® coaxial cable connect the 85-foot parabolic antenna with the control building. These "runs" are used to relay radio waves picked up from outer space by the telescope.

The job of feeding these low-energy radio waves to the control center calls for a high frequency cable with a low inherent noise level. The low loss and low noise to high signal ratio of Styroflex® cable provide the ideal answer to these operational requirements. An additional advantage is the long operating life of this coaxial cable, regardless of climatic conditions.

The superior properties of Styroflex® cable have earned for it an outstanding reputation in high frequency cable applications of many different kinds. If you have a problem requiring the use of a high frequency cable with exceptional characteristics, perhaps Styroflex® can provide the answer.

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CORPORATION

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How NRC High Vacuum Technology Can Help You Conquer Extreme Altitudes

Under the high vacuum conditions encountered in outer space, familiar products and processes which work at sea level may develop strange and unfamiliar characteristics.

For example, at extreme altitudes metal-to-metal contact may cause parts to gall or stick. Graphite lubricants lose their effectiveness. Grease vaporizes rapidly. Plastics change their properties. Some metals such as zinc evaporate directly. Rocket flame patterns change and fuels behave differently.

COSTLY FAILURES AVOIDED — A superior method of making sure your product or component will work in outer space is to test it in simulated high vacuum conditions encountered at altitudes from 200 to 600 miles. A missile failure can cost over $2,000,000 and all traces of the cause can be lost with it. National Research Corporation can help you predict your product performance in several ways.

Data relating to your product or materials may already be on hand. Much information has been generated in connection with the development of high vacuum processes and equipment over the past 20 years.

Existing facilities are available in our laboratories for doing basic materials research for outer space and missile applications on a contract basis.

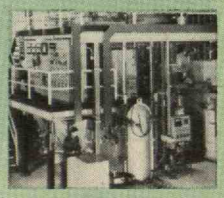
Together with our subsidiary, NRC Equipment Corporation, we can deliver a turn key installation which will simulate high vacuum conditions above 100 miles. If you wish to assemble your own high vacuum facilities, standard gauges, valves, pumps and accessories are in stock for immediate shipment. The services of our field engineers will help you save time, money and trouble.

Call or Write in today for preliminary exploration of how we can help you build products or select materials for outer space components.

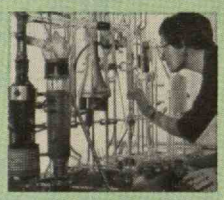
Chart prepared by National Research to indicate vacuum requirements for space simulation. Data taken from International Geophysical Year Reports. Copyright 1958 by National Research Corp.

Almost weightless heat reflective or corrosion resistant metallic coatings from 2 millionths to 2 thousandths thick can be deposited on metals, plastics, fabrics, or paper. NRC can develop the coatings or supply the equipment.

A complete line of vacuum arc, induction and resistance furnaces is available to help you develop or produce new high performance metals. Services of our vacuum metallurgical department are available.



Know gas content in metals with the NRC Gas Analyzer. Hydrogen, oxygen and other gases in metals can cause fatigue or product failure under high temperatures.



Comprehensive information through NRC test facilities is available on effects of low pressures on flexibility, outgassing, slip, chemical stability, etc., of metallic refractories and plastics.

For measuring density at high altitudes the 2-ounce Alphatron® densitometer can be connected directly to telemetering equipment.