ELECTRONIC INDUSTRIES

★ Electronic Instruments as an Aid in Weather Forecasting
★ Coil Design for UHF ★ Using Tubes in Industrial Controls
★ Radio Organization of the Navy ★ Factory Short Cuts

AUGUST

Caldwell-Clements, Inc.

Mallory Distributors Can Save You Time When Time is Important

Quick, complete information and prices for your purchasing department.

Application data for your engineering and design departments.

Service from stock.

A copy of the Mallory catalog for ready reference.

Lack of a few parts can wreck almost any production schedule. But when the needed parts are Mallory electronic products, the Mallory distributor is the man to turn to for help.

For example—one manufacturer discovered, just the day before scheduled use, that a number of selector switches required for the launching apparatus of a new aircraft carrier were missing. Something had gone wrong somewhere. But a wire to a Mallory distributor found him with the exact circuit arrangement in stock. The switches went out via air express and the carrier was launched on time.

Example Number Two—Navy Code Schools in two universities urgently needed a number of electronic products, among them Mallory switches and jacks, in order to inaugurate training of code operators on schedule. Something inexplicable had gone wrong and the parts were missing. Again, a Mallory distributor stepped into the breach to save the day in jig time.

Nothing very dramatic about this, it is true. But it demonstrates how Mallory distributors are geared to save time in furnishing essential electronic parts for essential uses . . . especially where small orders are concerned.

Where essential electronic parts are required—for maintenance, laboratory and testing devices, pre-production models—in short, where small quantities are involved, the Mallory distributor stands by to help. We are doing our level best to keep his stocks adequate. Proper ratings are needed? Certainly!

But make his acquaintance. He can be of service in many ways. If you do not know the name of the Mallory distributor nearest you, we will be glad to tell you.

P. R. MALLORY & CO., Inc. **INDIANAPOLIS, INDIANA** • *Cable Address*—PELMALLO

Long, uninterrupted service is called for in a capacitor and to fulfill that requirement three things are necessary:—intensive experience . . . advanced engineering . . . rigid production standards. This combination has given Tobe Capacitors a proud record, with almost complete absence of "returns."

The Tobe Oil-Mite Capacitor, shown here, has consistently lived up to an established reputation for long life. This capacitor, impregnated and filled with mineral oil, is most carefully made and most conservatively rated. It is performing day-in, day-out duty as a filter condenser in war equipment. Inquiries in connection with your condenser problems will receive our prompt attention.

LONG LIFE ASSURED

CHARACTERISTICS OF TOBE OIL-MITE CAPACITORS

STANDARD CAPACITY TOLERANCE.	= 10%
TEST VOLTAGE	Twice D.C. rating
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms. .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms
RATINGS	.05 mfd. to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
GROUND TEST	2,500 Volts D.C.
POWER FACTOR	At 1,000 cycles—.002 to .005

TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

A SMALL PART IN VICTORY TODAY
A BIG PART IN INDUSTRY TOMORROW

EDITORIAL CONTENTS AND ARTICLES LISTED ON PAGE 4

REMEMBER . . .

When most electrical connections looked like this?

solder was piled on, *hoping* for a sound, efficient connection

A few of the many types of Burndy HYLINE connectors (indent type).

Pat. No. 2,109,837

Burndy

EDITORIAL CONTENTS AND ARTICLES LISTED ON PAGE 4

ELECTRONIC INDUSTRIES

AUGUST, 1943

In this Issue

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Electronic Industries, August, 1943, Vol. II, No. 8. 35 cents a copy. Published monthly by Caldwell-Clements, Inc., 480 Lexington Avenue, New York 17, N. Y. M. Clements, President; Orestes H. Caldwell, Treasurer.

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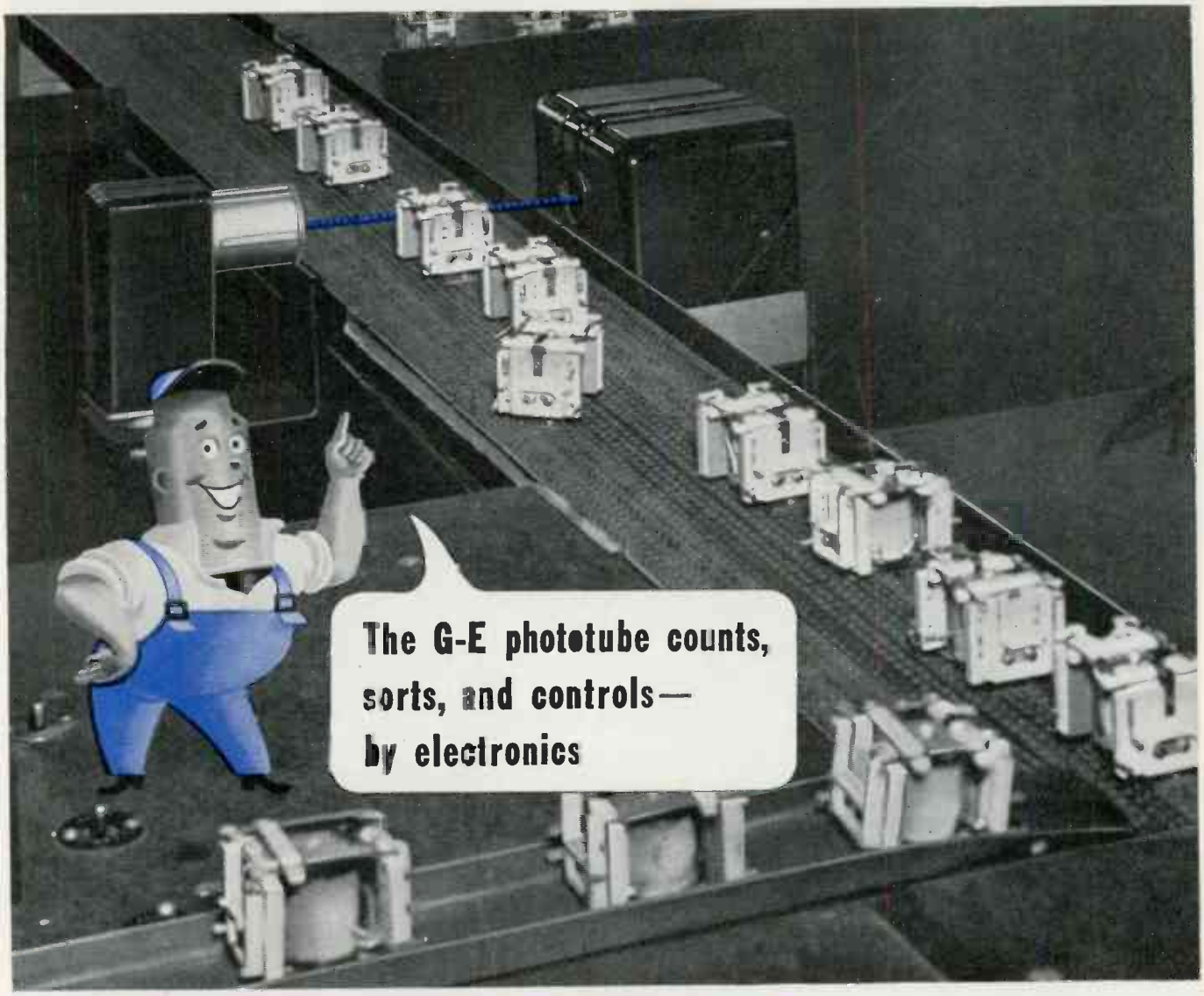


The General Electric phototube, a light-sensitive electronic tube with hundreds of applications, is one of the most useful tubes in modern industry.

ONE phototube counts the relays speeding down a war production line.

Another rejects imperfect ball-bearings by automatically sizing each one to perfect dimensions. A third, responsive to radiant energy, controls temperature in an electric furnace.

A fourth watches the smoke density in a plant chimney and sounds an alarm to warn of wasteful combustion.

In its many industrial applications the phototube is primarily a signaling device, actuated by the breaking or modulation of its beam of light. It tells other tubes what to do and when to do it.

Working with the thyratron, a precision "timer," the phototube transmits a low-power impulse which is amplified by the thyratron to such proportions that it can start or stop, accelerate or decelerate the equipment.

Thus in hundreds of ways does the phototube increase the efficiency of industry. New uses are discovered daily.

It is the purpose of G-E electronic engineers to aid *any* manufacturer of electronic devices in the application of electronic tubes. General Electric, through its nation-wide distribution system, is also prepared to supply *users* with replacement tubes.

Free booklet on electronic tubes. Send us the names of interested men in your plant and we will keep them informed of electronic developments. For example, we will mail without charge an illustrated book entitled "How Electronic Tubes Work," written in easy and understandable language, and showing typical electronic tubes and applications. *Electronics Department, General Electric, Schenectady, N. Y.*

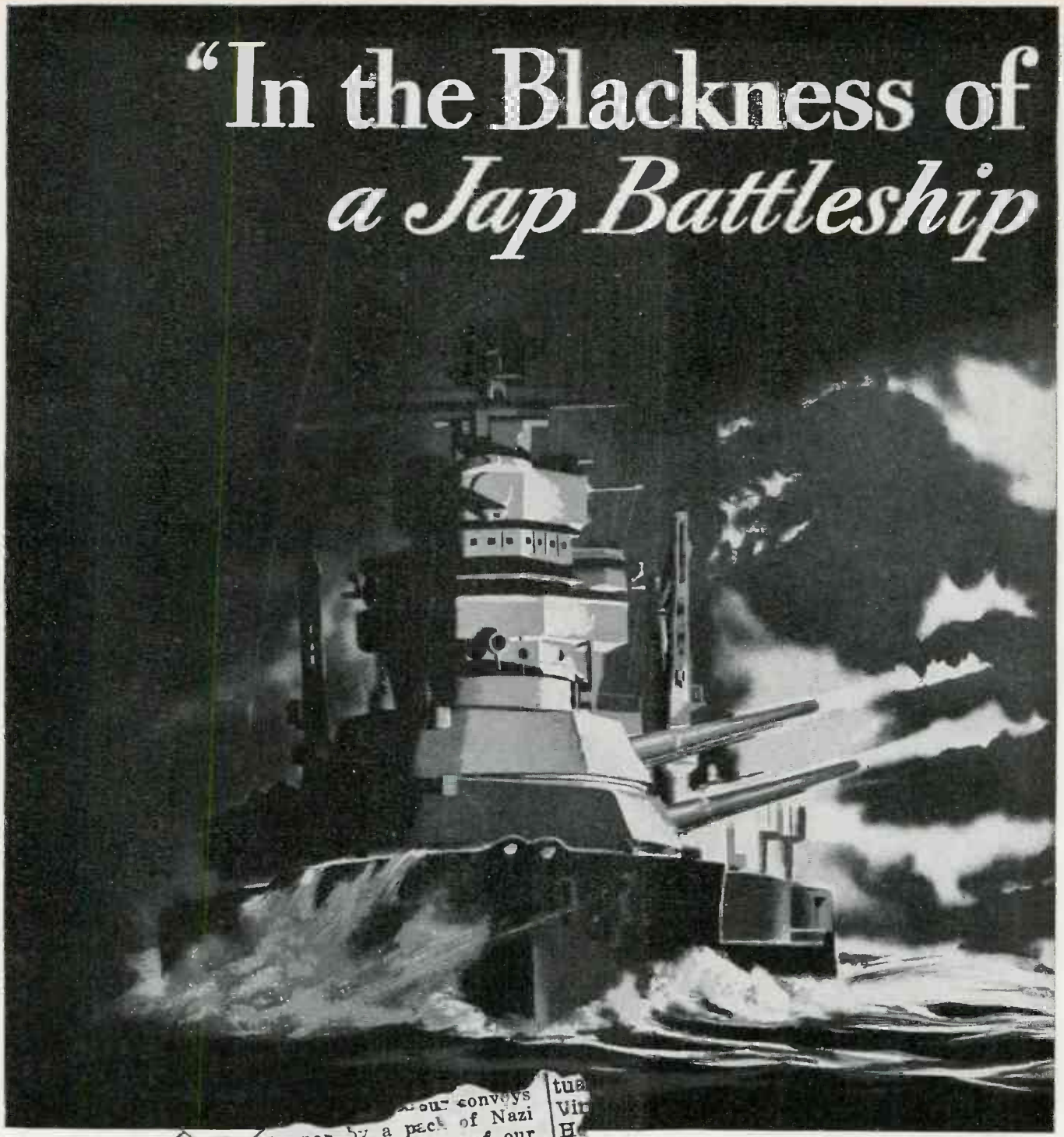
Tune in "THE WORLD TODAY" and hear the news direct from the men who see it happen, every evening except Sunday at 6:45 E. W. T. over CBS. On Sunday listen to "The Hour of Charm" at 10 P. M. E. W. T. over NBC.

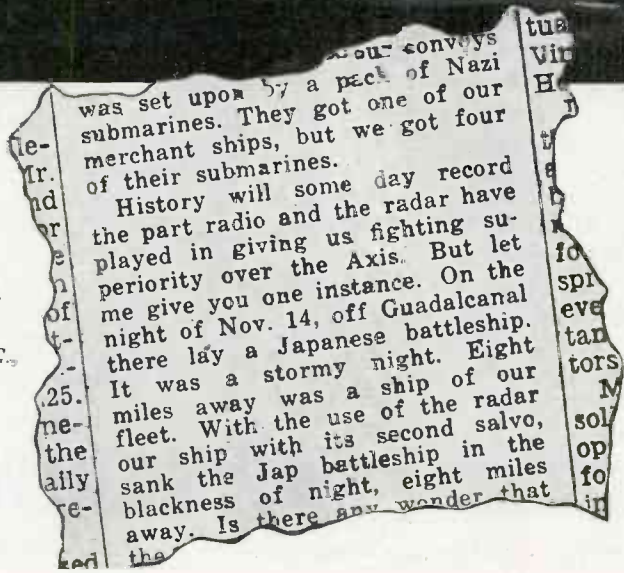
GENERAL ELECTRIC

102-88-8850

General Electric employees are now purchasing over $1,000,000 in War Bonds weekly

"In the Blackness of *a Jap Battleship*





was set upon by a pack of Nazi submarines. They got one of our merchant ships, but we got four of their submarines.

History will some day record the part radio and the radar have played in giving us fighting superiority over the Axis. But let me give you one instance. On the night of Nov. 14, off Guadalcanal there lay a Japanese battleship. It was a stormy night. Eight miles away was a ship of our fleet. With the use of the radar our ship with its second salvo, sank the Jap battleship in the blackness of night, eight miles away. Is there any wonder that

EXTRACT *from address by James F. Byrnes, Director of War Mobilization, at Spartanburg, S. C., May 31, 1943, broadcast over the Blue Network.*

Radar principles were first applied to aviation by RCA through equipment built and installed in its own plane in 1937, in connection with a study of collision prevention.

In 1938, RCA built an experimental Radar installation for the U. S. Navy. As the result of tests, in October, 1939 the Navy placed with RCA its first order for service Radar equipment. Since then, vast strides in the development of Radar in RCA Laboratories

RADIO

Night, Eight Miles Away" *is sunk by RADAR*

HOW RADAR WORKS—Traveling with the speed of light—186,000 miles per second—ultra-high frequency waves strike the invisible enemy vessel, bounce back, automatically establish range and distance of the target!

For the full, fascinating story of Radar, write today for free booklet, "Radar—Wartime Miracle of Radio." Address your request to: Department AX, Radio Corporation of America, 30 Rockefeller Plaza, New York.

have been made available to all branches of the industry producing Radar.

Radar is another achievement of the radio-electron tube and the use of ultra-high frequency waves, pioneered by RCA Laboratories. RCA looks forward to the time when its services as world headquarters for radio-electronic research can again be devoted to making the peacetime world a better place in which to live.

CORPORATION OF AMERICA RCA

RCA BUILDING • NEW YORK CITY

TESTED ON AN ATOLL

ON a tiny strip of coral . . . an observation post pierces the dawn with cryptic messages that may spell the difference between victory and defeat. Duty on this speck on your map calls for iron men and dependable equipment.

Under the toughest of conditions . . . under the roughest of handling . . . far from sources of replacement . . . parts must work—for men's lives hang in the balance. Utah Parts are passing this final test on tiny atolls, in steaming jungles, on burning sands in all parts of the world—from pole to pole.

A shooting war is also a talking war. The weapons of communications must have the same dependability and non-failing action as weapons of destruction. These qualities are built into Utah Parts at the factory where soldiers of production are working 100% for Victory. In Utah laboratories, engineers and technicians are working far into the night developing new answers to communication problems—making improvements on devices now in action.

But "tomorrow" all this activity, all this research, all this experience learned in the hard school of war, will be devoted to the pursuits of peace. Thanks to the things now going on at Utah—there will be greater convenience and enjoyment in American homes . . . greater efficiency in the nation's factories. UTAH RADIO PRODUCTS COMPANY, 50 Orleans Street, Chicago, Ill. Canadian Office: 560 King Street West, Toronto. In Argentine: UCOA Radio Products Co., SRL, Buenos Aires. Cable Address: UTARADIO, Chicago.

PARTS FOR RADIO, ELECTRICAL AND ELECTRONIC DEVICES, INCLUDING SPEAKERS, TRANSFORMERS, VIBRATORS, VITREOUS ENAMELED RESISTORS, WIREWOUND CONTROLS, PLUGS, JACKS, SWITCHES, ELECTRIC MOTORS

Utah

"CONSTANT AS THE PLANETS IN THEIR ORBITS"

If you are a manufacturer of controls . . . or, if you are giving consideration to the manufacturing opportunities in this field, here is an announcement of importance to you.

The successful application of electronic principles to the problem of control, as exemplified by the Thordarson Flashtron, has resulted in lightning-fast action (and hence extreme accuracy) giving new meaning to the word control itself.

The Thordarson Flashtron is not a complete control "system". But it is literally the electronic "heart", around which may be designed a control set-up making full use of several years of intensive research pointed towards one objective . . . ±O tolerance in regulating temperature, pressure, flow, speed, frequency, light, and a host of other factors involved in almost every field of human endeavor.

The Thordarson Flashtron is not "new" in the sense of being merely a unit fresh from the laboratory, without practical usage to back up its claims. On the contrary, the Thordarson Flashtron has served as the heart of control systems operating in widely diversified fields, for a number of years. It has not only proved its uncanny precision characteristics, but it has also demonstrated its ability to achieve results heretofore thought impossible, with continuous dollar and cents savings to the user over a long period of time.

We invite interested manufacturers to write for descriptive folder today.

ARMY (E) NAVY

THORDARSON

ELECTRIC MFG. COMPANY
500 WEST HURON STREET, CHICAGO, ILL.

"Transformer Specialists Since 1895"

Flying blind . . . but not deaf

HIGH over obscuring clouds, through the murk of fog and the black of night, the "blind" pilot speeds to his mission . . . and returns . . . almost completely dependent upon what he hears through his headphones. A tremendous responsibility for any piece of equipment.

Making headphones to the exacting standards of the Army and Navy Air Force is one of the wartime tasks of Rola. A pioneer in Radio and later in Electronics, the technical knowledge and the manufacturing skill of this seasoned organization now is devoted exclusively to giving our Fighters in the Air the best, most effective equipment of any in the world. THE ROLA COMPANY, INC., 2530 Superior Avenue, Cleveland, Ohio.

* * *

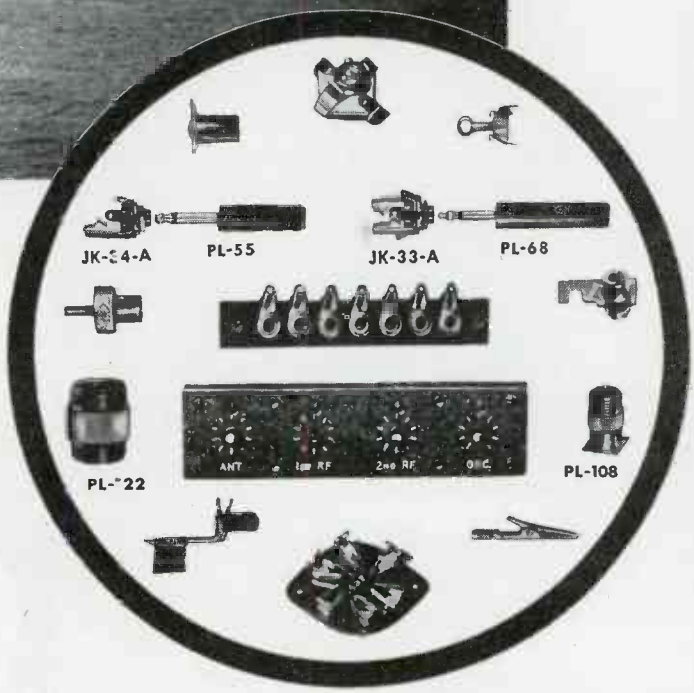
In addition to complete headsets, Rola manufactures transformers and coils of all kinds for aerial communications. If your problem involves Electronics . . . and is important to the war effort . . . why not discuss it with a Rola engineer.

★ ROLA ★

MAKERS OF THE FINEST IN SOUND REPRODUCING AND ELECTRONIC EQUIPMENT

ELECTRONICS... A MIGHTY WEAPON

This is ELECTRONICS in operation . . . but not until the full facts are released will you be able to see all the technical developments.



ELECTRONIC equipment is comprised of many individual components . . . plugs, jacks, insulators, etc.

ELECTRONIC DEVICES physically, are assemblies of components, each one contributing its share toward making the instrument function. Among the many activities of American Radio Hardware is the manufacture of over one hundred parts used in ELECTRONIC equipment and applications. That our components are used in the production of this mighty weapon is in itself a fine tribute to our skill and our facilities.

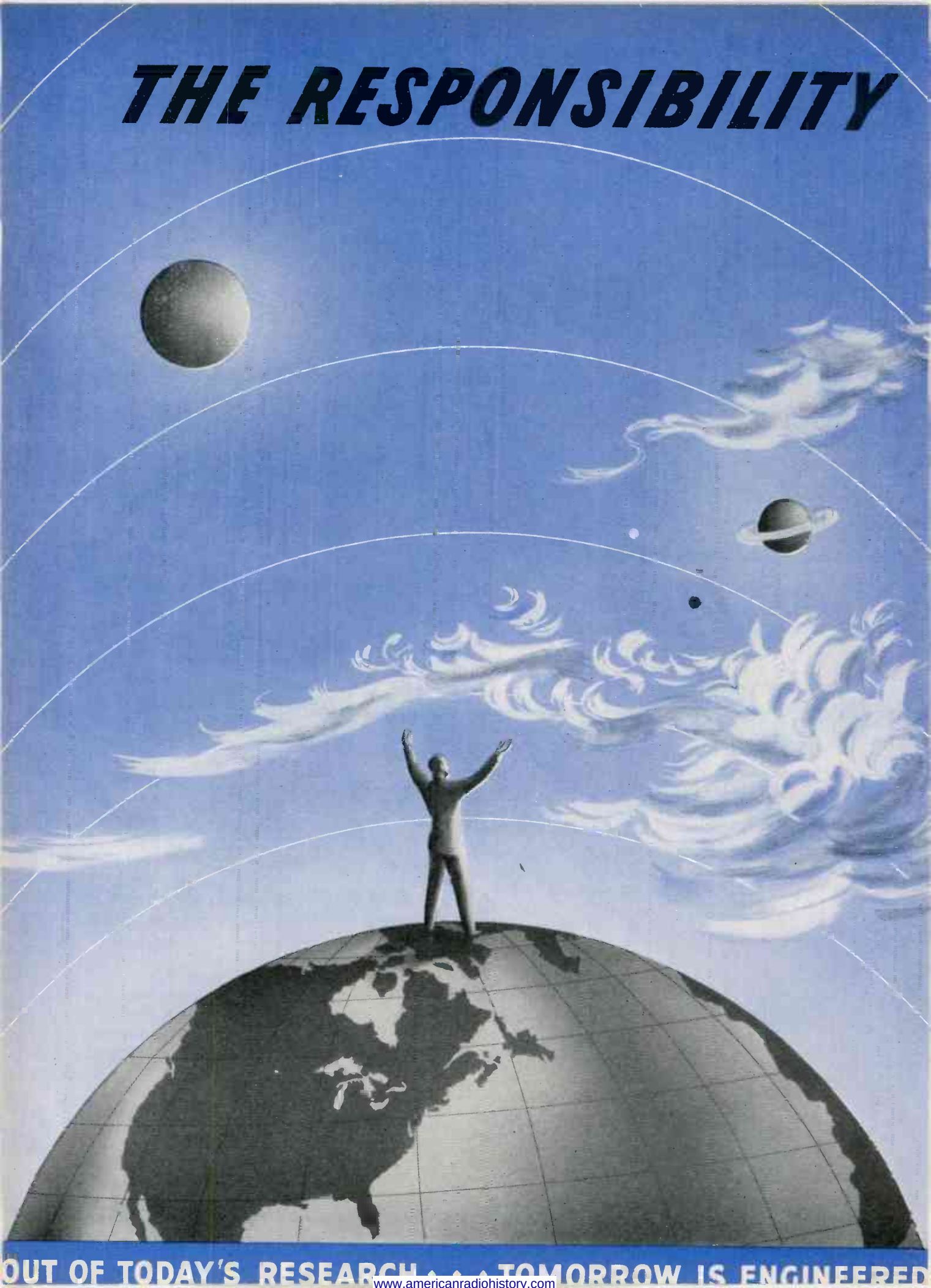
With electrical and mechanical tolerances as critical as they are nowadays, all of our components have been improved to a commanding degree. When they are released for general use, they will be able to serve you better than ever before. Your inquiries regarding the entire ARHCO line are welcomed.

ARHCO RADIO PRODUCTS

American Radio Hardware Co., Inc.

476 BROADWAY • NEW YORK 13, N. Y.

MANUFACTURERS OF SHORT WAVE • RADIO • TELEVISION • SOUND EQUIPMENT



OF LEADERSHIP

CONSTANT PIONEERING . . . the unceasing search beyond present horizons for a Better Way . . . this is the responsibility of Leadership.

As man reaches for the stars, through the science of electricity . . . the miracles of Radio and Television . . . the amazing new world of Electronics, we at American Lava Corporation have paced each new achievement with insulation engineered to the new requirements.

When war came upon us with its demands for tremendously expanded production . . . its requirements for higher performance in Communications . . . we were ready with the KNOW HOW gained from 40 years' experience in pioneering, developing and perfecting steatite ceramic insulation.

Our research and engineering staffs will gladly cooperate on today's blue print . . . tomorrow's production.

AMERICAN LAVA CORPORATION

CHATTANOOGA, TENNESSEE

ARMY NAVY AWARDED JULY 27, 1942

Where stability is an important requirement, ALSIMAG Steatite ceramics are unsurpassed for lending rigidity and permanence of alignment to electronic circuits.

ALSIMAG

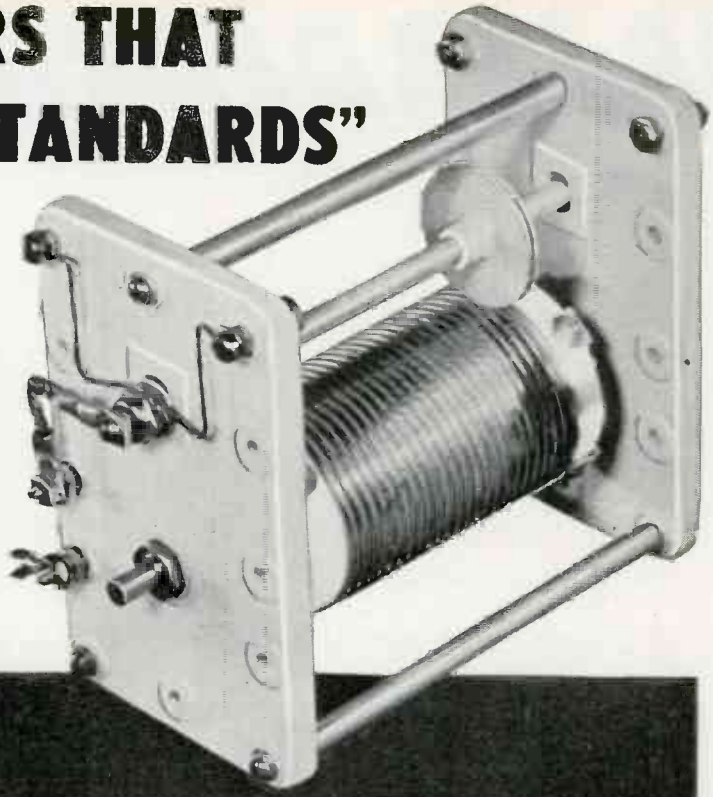
TRADE MARK REGISTERED U. S. PATENT OFFICE

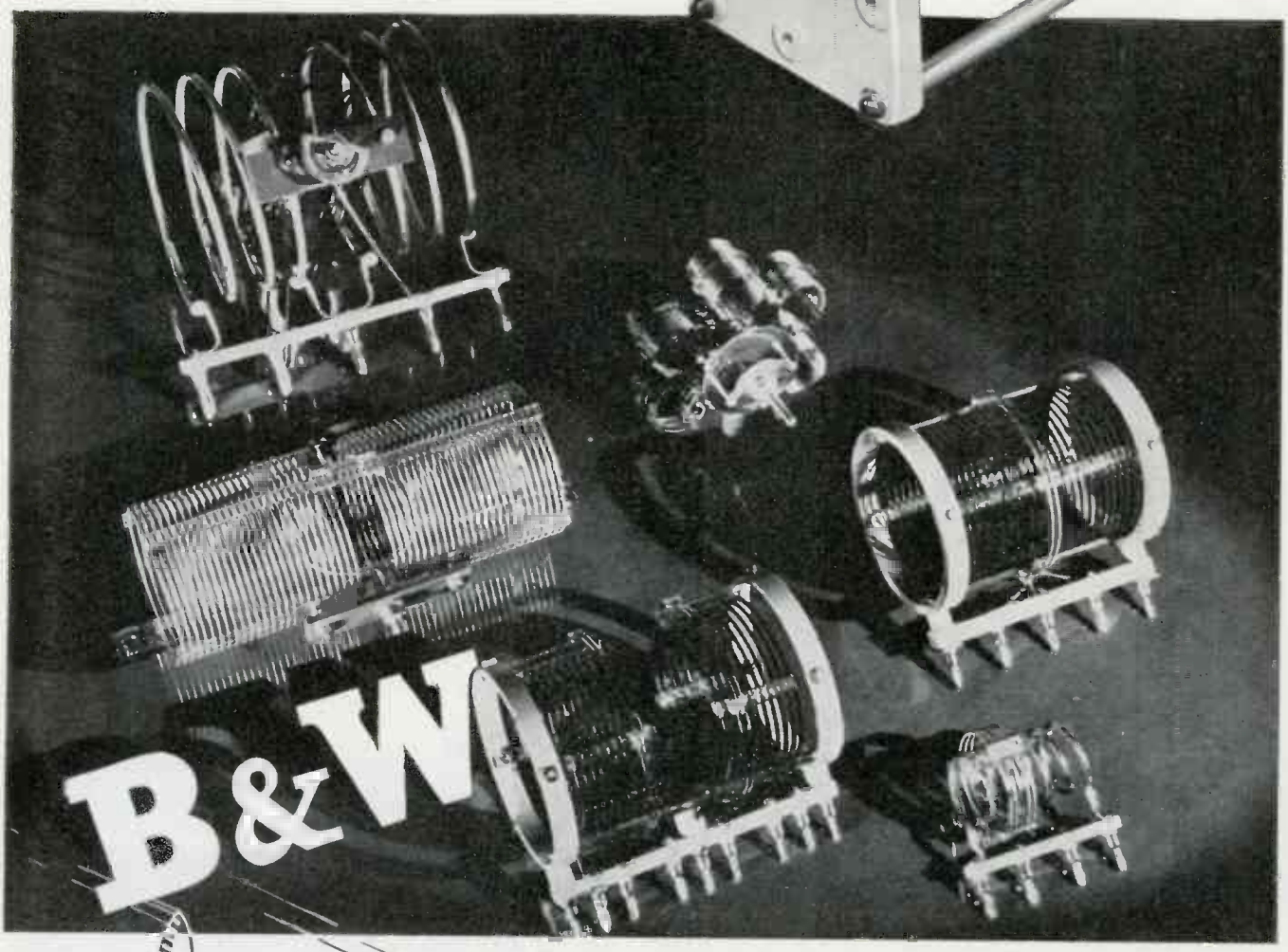
STEATITE CERAMIC INSULATORS

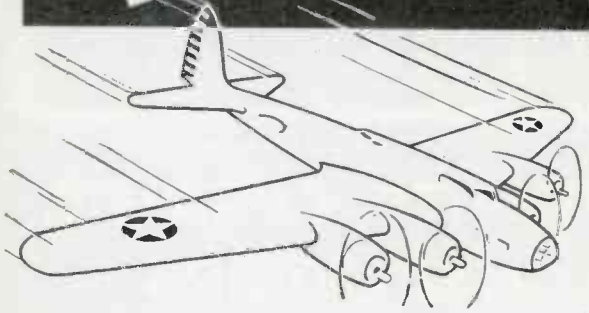
CHARACTERISTICS TAILORED TO YOUR REQUIREMENTS

"THE AIR INDUCTORS THAT SET THE QUALITY STANDARDS"

PERHAPS no radio components have seen greater engineering advances in recent years than Air Inductor coils—and B&W engineering has consistently led the field at every turn. Built to exacting tolerances, durably constructed for the most strenuous wartime uses, and available in a wide variety of types and assemblies, B&W Air Inductors have established new, higher standards of quality wherever coils are used. That's because they're produced by men to whom quality coil-making is not only a specialized business, but a matter of intense personal pride as well.







In the group photo, are shown five standard B&W "fixed for fightin'" Air Inductors and one of the famous B&W turret assemblies. At top is a special rotary coil unit.

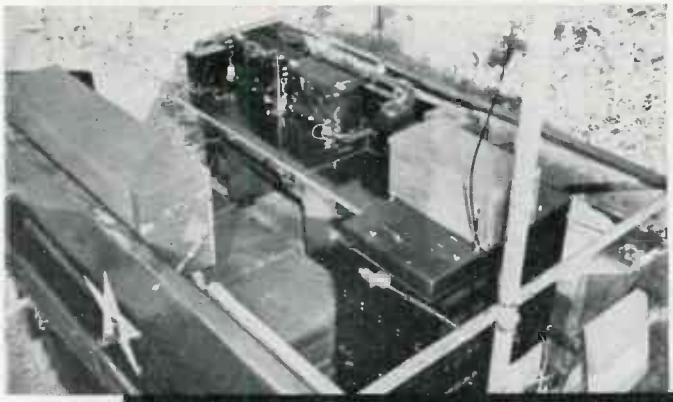
Bring your problems to Air Inductor headquarters! Fast deliveries on both standard models and wartime adaptations!

BARKER & WILLIAMSON

Manufacturers of Quality Electronic Components for 10 Years

235 Fairfield Avenue, Upper Darby, Pa.

WINNING THE BATTLE OF COMMUNICATIONS!



Mobile communications units assembled by Hallicrafters are helping to win the battle of communications on every fighting front. They are built to endure the rigors of modern warfare . . . The consistent performance of SCR-299 has been highly praised by leading members of our armed forces for its adaptability in meeting all the requirements of combat duty . . . A phrase best describing the SCR-299 was given when a leading military authority said "It is to communications what the jeep is to transportation."

hallicrafters

CHICAGO, U.S.A.

ARMY NAVY E

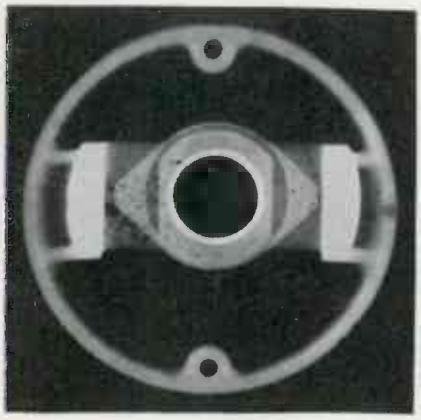
BUY MORE BONDS

THE WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE COMMUNICATIONS EQUIPMENT

Which is the "Dud"?

X-ray tells *instantly*

LOOKING INSIDE WITH X-RAY ASSURES 100% PERFECT DIE CASTINGS



X-ray reveals porosity in die casting—a typical example of how x-ray inspection helps control quality by detecting subsurface faults.

Critical jobs like bomb and shell fuses needed in huge volumes are a "natural" for the die casting process. It provides advantages held at high premium for war production: (1) high-speed, precision production (2) little or no finishing (3) conservation of critical materials.

Each part, however, must be perfect. Faults undetectable by ordinary inspection may cause premature explosions or other ammunition failures. But with x-ray on the job—faulty castings are detected easily—nondestructively—and without penalizing the high production speeds possible with die casting.

Quality control of die castings is only one of hundreds of production jobs that can be done faster, better and cheaper with x-ray. Others include inspection of welds, packages, assemblies, and countless other jobs.

Learn more about x-ray. Write for our new 38-page book on x-ray inspection . . . it explains x-ray . . . how to set up an x-ray department . . . how to select the right equipment. Ask for B-3159.

Or to discuss your problem with an Industrial X-ray Specialist, call your nearest Westinghouse office. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

J-02020

LOOK INSIDE WITH WESTINGHOUSE X-RAY

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

X-RAY

My Mom Won That!

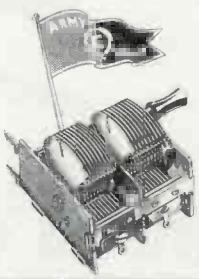
OF course, Son, you've a right to be proud of your Mom! And Uncle Sam is proud of her, too. He's proud of all the mothers, wives, sweethearts—even many a grandma—who have donned the uniform of industry and enlisted in the battle ranks of war production here at G. I.

Perhaps your dad is "over there" somewhere—exact whereabouts a military secret—along with millions of others fighting on land and sea and in the air. Do you realize, Son, that their very lives, and, yes, your future happiness and that of other kids like you all over the world, depend on what this certificate of merit—the Army-Navy "E"—stands for?

The men and women of General Instrument are deeply appreciative of the honor of the Army-Navy "E" award. They respect it not only as recognition of a record of high accomplishment, but as an inspiration for future achievement in production for Victory.

* * * * *

G. I. is 100% in war production now, but after Victory, as in peacetime before the war, we will concentrate on the volume manufacture of precision products in the electrical, mechanical and electronic fields for the betterment of the commercial, industrial and home life of America.



General Instrument
CORPORATION

Executive Offices: 829 Newark Avenue, Elizabeth, New Jersey

Voice communications on every front...

Whether by radio or land wire telephone, a voice command gets the job done with clarity and speed.

Available from stock, 1700U series microphone. Single button carbon type, push-to-talk switch, etc. For trainers, intercommunication and general transmitter service.

UNIVERSAL microphones are playing a vital part in voice communications of all the Armed Forces . . . being the first instrument through which a command is given. Care must be taken that the electronic patterns of the voice are held true for the many electrical circuits through which they must later pass. UNIVERSAL microphones with their precise workmanship are carrying the message through in all forms of voice communication whether from a tank, ship or aeroplane. UNIVERSAL products meet all U. S. Army Signal Corps Laboratory tests. Standardization of parts, inspection, and workmanship of high order combined with the best of material, make UNIVERSAL'S microphones and accessories outstanding in every application.

U. S. Army Signal Corps and U. S. Navy plugs and jacks are offered as voice communication components to manufacturers of transmitters and sound equipment for the Armed Forces. Catalog No. 830 contains complete details.

UNIVERSAL MICROPHONE CO. LTD.

INGLEWOOD, CALIFORNIA

FOREIGN DIVISION, 301 CLAY ST., SAN FRANCISCO 11, CALIF. • CANADIAN DIVISION, 560 KING ST. W., TORONTO 2, ONTARIO

YET FOUND STILL OPERATIVE WHEN CHECKED UP

Quite by accident, three DuMont Type 164E 3-inch oscillographs were submerged in salt water. Duly recovered, they were returned for salvage—repair, if at all possible; otherwise, replacement.

Our service engineers were frankly disconcerted by the mud, silt and even seaweed found amidst the multitudinous components. Finally cleaned up, the instruments were checked for necessary repairs and replacements. And then the surprise: Two instruments were found still operative! The third required only a potentiometer replacement for restoration to full operative condition!

While we do not recommend dunking as a regular thing, we submit this case as still another proof of the ruggedness of Dumont equipment. It is certainly reassuring when you face extra-severe service conditions. Likewise indicative of years of trouble-free life.

DuMont cathode-ray tubes and oscillographs in both standard and special types are found in many branches of the armed forces; in many industries engaged in war and civilian production; in engineering and research activities.

Be sure you have our new catalog and manual just off the press, in your working library. Otherwise write for your copy. And submit any unusual problems for our engineering collaboration, recommendations, specifications, quotations.

DUMONT

ALLEN B. DU MONT LABORATORIES, Inc.
Passaic • New Jersey
Cable Address: Wespexlin, New York

WILCOX EQUIPMENT
Proves Dependable for Eastern Air Lines

Photo, Courtesy Eastern Air Lines

Communication Receivers
Aircraft Radio
Transmitting Equipment
Airline Radio Equipment

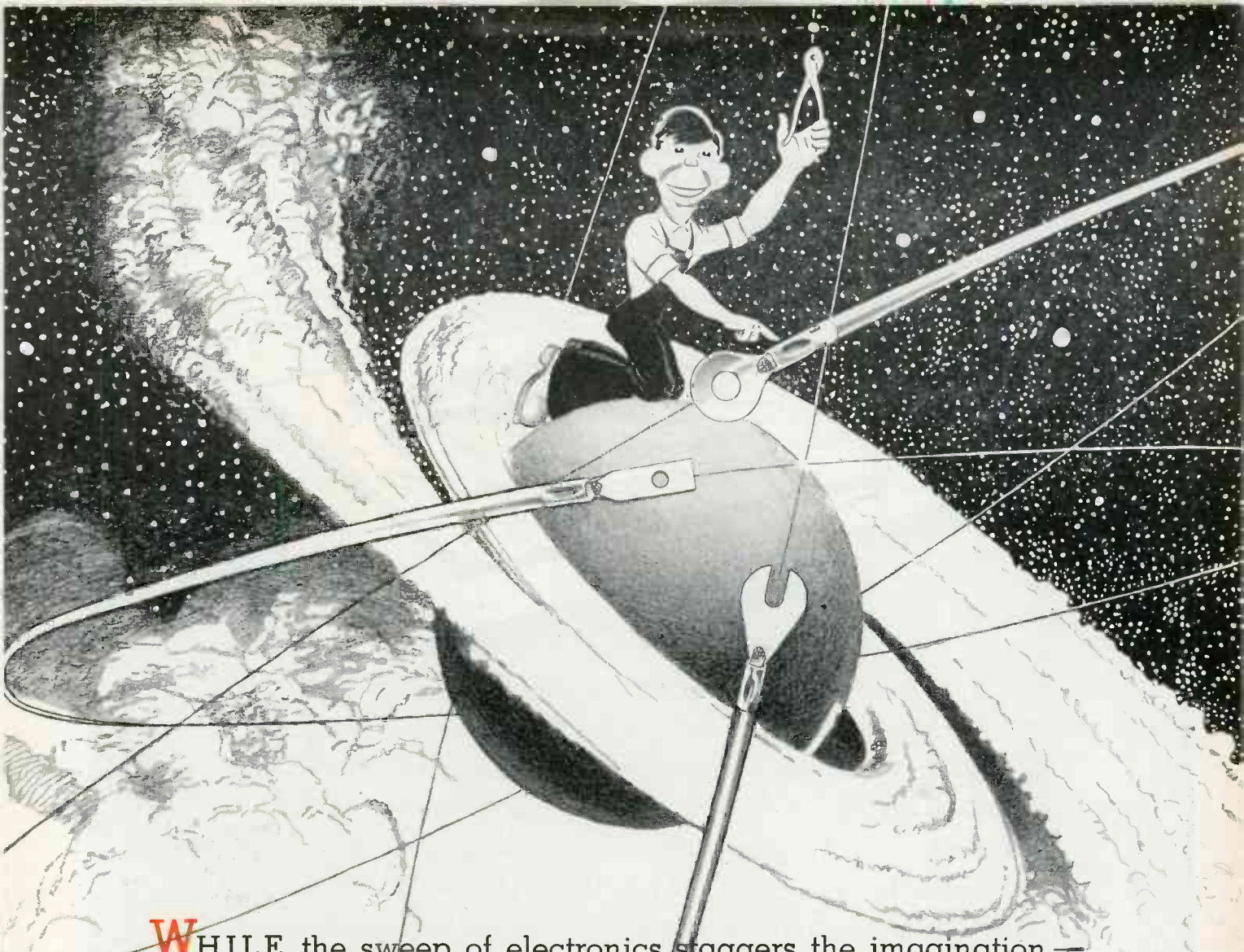
Today, the experience of years in manufacturing flight control radio equipment is turned to production for military needs. Tomorrow, this added experience with present developments will be reflected in greater radio advantages for a peacetime world.

WILCOX ELECTRIC COMPANY

Quality Manufacturing of Radio Equipment

14th & CHESTNUT **KANSAS CITY, MO.**

THERE MUST BE DEPENDABLE COMMUNICATIONS



WHILE the sweep of electronics staggers the imagination — the proper way to hook-up the essential wiring is an established engineering proceedure. • T&B Sta-Kons — Pressure (Solderless) Wire Terminals — make permanent, metal-to-metal connections. They resist corrosion. They withstand high frequency vibrations. They install fast with any of the various T&B Power Tools. They are made in a great variety of designs and wire capacities. • Approved. Patented. • Send for Sta-Kon Catalog Bulletin No. 500. Write to us on your special problems. • Under the T&B Plan, Sta-Kons, like all other T&B products, are sold only through T&B Distributors who reduce the manufacturer's selling costs, thereby reducing the cost of all electrical equipment to the user.

ORDER SMALL BUT ESSENTIAL PRODUCTION PARTS AT LEAST FOUR MONTHS IN ADVANCE

THE THOMAS & BETTS CO.

INCORPORATED

MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH 1, NEW JERSEY

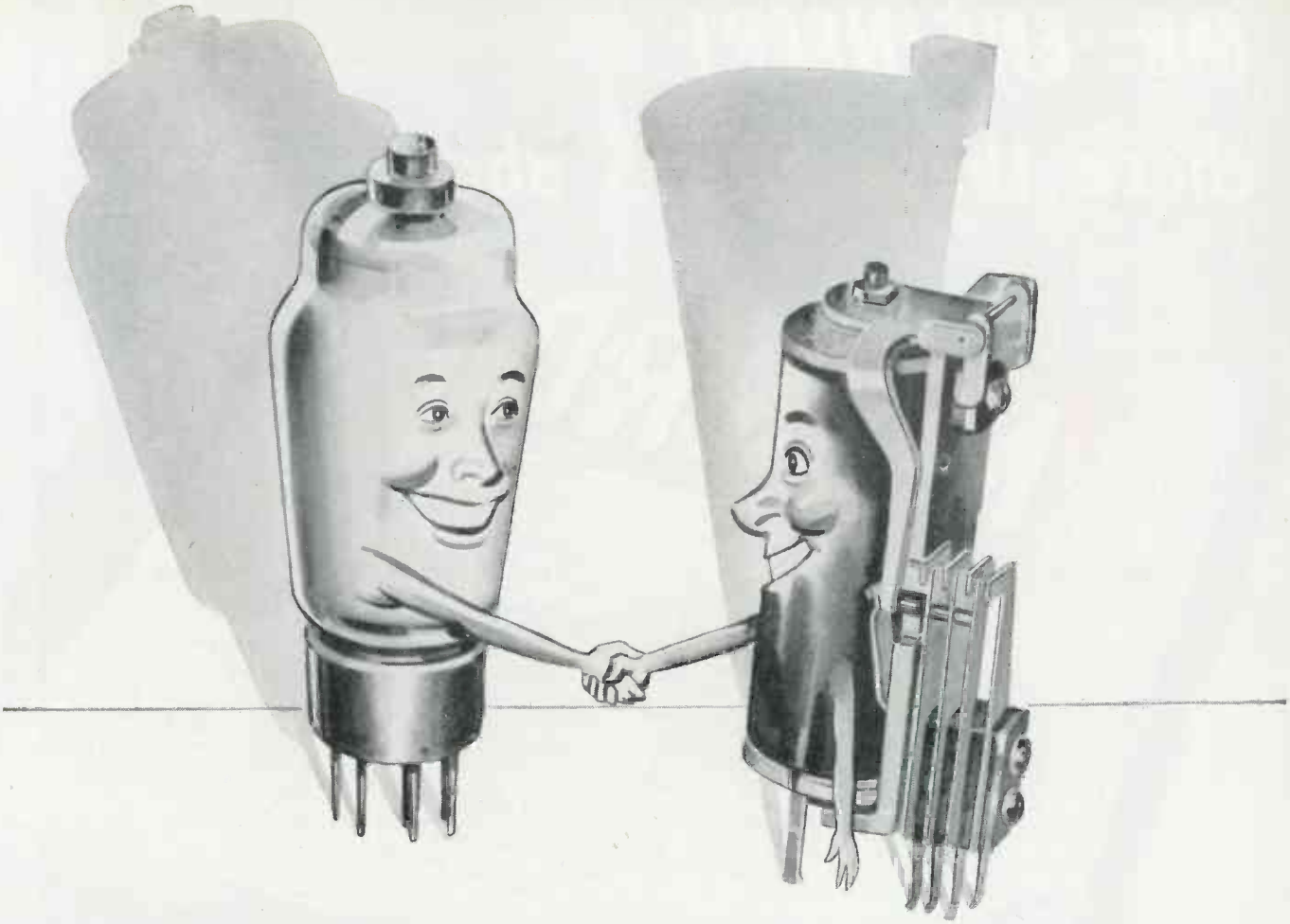
In Canada: Thomas & Betts Ltd. Montreal

Perhaps you fail to recognize us under this new name — Electronic Corporation of America . . . but a name really means very little. It's the knowledge and skill of an organization that count. We've been manufacturing sound systems, test equipment and numerous electronic devices, and the roots of our experience are almost as old as radio itself. The principals and most of the personnel of ECA have functioned as a unit for many years. New employees, added to our force because of the important war work we are doing, have become imbued with our cooperative spirit. Consequently, internal harmony is at its highest pitch . . . and we're able to produce just a little bit better, a little bit faster. Such a combination of experience and teamwork can't be beat. If you're in need of a dependable supplier we may, as our schedules permit, be able to help you.

THIS WAR CAN BE SHORTENED. Although engaged 100% in war work, we find time to seriously consider the home front. Surely the news from the battle front is good . . . but the war hasn't been won yet. In fact, we can lose it if we fail to adjust our domestic problems. Labor-management difficulties, race riots, personalities, vicious rumors . . . hurt rather than help. Let's cut them out . . . let's work together . . . let's shorten this war.

ELECTRONIC CORP. OF AMERICA

45 WEST 18TH STREET • NEW YORK 11, N.Y. • WATKINS 9-1870



LET'S POOL OUR KNOWLEDGE

WORKING with electronic engineers in scores of industries has taught us a lot about electronic science—what it is doing to increase the effectiveness of our tools of war—how it is speeding up war production—about the miracles it promises for our postwar world.

We have learned, for example, how much this "new-old" science depends on the right electrical controls—the important part that relays, stepping switches, solenoids and other control devices play in putting electrons to work.

And that's *our* strong point. We know electrical control because that has been our sole business for over fifty years. So why not pool our resources? Let's apply *our* experience in electrical control to *your* problems in making electronic developments do a better job at lower cost.

First step in this direction is to make sure you have the Automatic Electric catalog of control apparatus. Then, if you need help on any specific electronic problem, call in our field engineer. Behind him are Automatic Electric's fifty years of experience in control engineering. His recommendations may save you time and money.

AUTOMATIC ELECTRIC SALES CORPORATION
1033 W. Van Buren St. Chicago
In Canada: Canadian Telephones & Supplies, Ltd., Toronto

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

MUSCLES FOR THE MIRACLES OF ELECTRONICS

MR. ENGINEER!
check these FACTS about

TYPICAL EXAMPLES OF MYKROY APPLICATIONS

Stand-off Insulators — Variable condensers
Tube and Crystal Sockets — Mounting strips
Structural supports for radio circuits
Plug-in bases — Antenna reel insulators
Insulated couplings — Relay bases and arms
Motor generator brush holders
Padding condenser supports
High voltage arc shields — Oscillator circuits
Fixed condensers — Impregnated resistors
Radio frequency coil forms
Radio frequency panel assemblies
Radio frequency switches — Lead-in insulators

Ignore mere claims and evaluate the demonstrable FACTS. Then you will understand why equipment insulated with MYKROY is rendering an extra margin of dependable performance . . . on land, on sea and in the air.

On blazing desert sands, in humid, dripping jungles, amid Grand Banks fog or arctic frost, MYKROY steadfastly retains its fixed electrical and mechanical properties.

With each new advancement in electronics engineering, the standards and requirements for insulating materials become more exacting. MYKROY meets and anticipates these needs. For more efficient insulation today and in the post-war progress of electronics, investigate MYKROY. Write or phone us for detailed information.

MYKROY IS SUPPLIED IN SHEETS AND RODS . . . MACHINED OR MOLDED TO SPECIFICATIONS

MADE EXCLUSIVELY BY ELECTRONIC MECHANICS INC.

70 CLIFTON BOULEVARD • CLIFTON, NEW JERSEY
Chicago: 1917 NO. SPRINGFIELD AVENUE . . . TEL. Albany 4310

CANNON *Visual Aids*

TO HELP YOU LICK THE MANPOWER SHORTAGE BY MAKING YOUR WORKERS MORE EFFICIENT

TRAINING FILM—Ready now! A slide film with sound, produced to aid the men servicing fighting aircraft in the field, or the men and women building all types of electrical equipment where AN Connectors are used. Clears up confusing terminology. Explains assembly techniques. Shows how AN part numbers are established and facilitates ordering of replacements.

CATALOGS—Your engineering department, production executives and service men need the basic information clearly presented in the new catalogs covering many types of Cannon Connectors used in any industry employing electrically operated devices.

WALL CHARTS—One chart gives insert arrangements and shell sizes on AN specification connectors at a glance. The other gives catalog numbers of all AN fittings. Both charts aid the designer, and the man in the field who is servicing any type of equipment on which AN electrical connectors are used.

MAIL COUPON TODAY

Short-Circuit Sammy is a genius at getting into trouble, but he raises some pretty good questions in the Cannon Plug training film. His pedagogical characteristics are confined to showing how not to do certain operations

CANNON ELECTRIC

Cannon Electric Development Company
Dept. A-122, 3209 Humboldt St. • Los Angeles, California

If any or all of these visual aids will help your employees to become more efficient, attach this coupon to your firm letterhead.

Please send us more information on the visual aids checked below:

TRAINING FILM ☐ CATALOGS ☐ WALL CHART ☐

There's No Escape!

This is another of the series of cartoon advertisements appearing in the national magazines depicting the might of industrial America. It tells the story of Philco at war and the peacetime promise of Philco war research and production for the homes and industries of America.

RADAR, the fabulous radio device that *"sees through"* fog, clouds and darkness, that searches out enemy targets and warns against the approach of hostile forces, has given us a thrilling story of American ingenuity. Long before Hitler screamed his ominous threats of secret weapons, the scientific branches of our Army, Navy and government were quietly developing this miracle of radio.

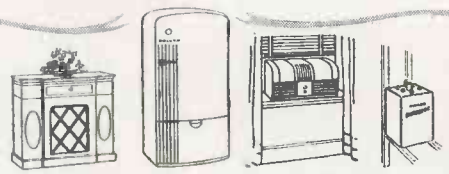
The time came when the radio industry of America was called upon to produce Radar quickly and in decisive quantities to turn the tide of Axis conquest. That's when Philco, with the facilities of the world's largest radio manufacturer and with vast research experience in the field of ultra-high frequency radio waves, was able to render its vital service to the might of our fighting forces.

Today, Radar is one of Philco's most important war production activities. Tomorrow, the advance of science in the Philco laboratories will appear as peacetime miracles of radio, television, refrigeration, air conditioning and electronics for the homes and industries of America—under the famous Philco name.

PHILCO CORPORATION

BUY WAR BONDS AND STAMPS

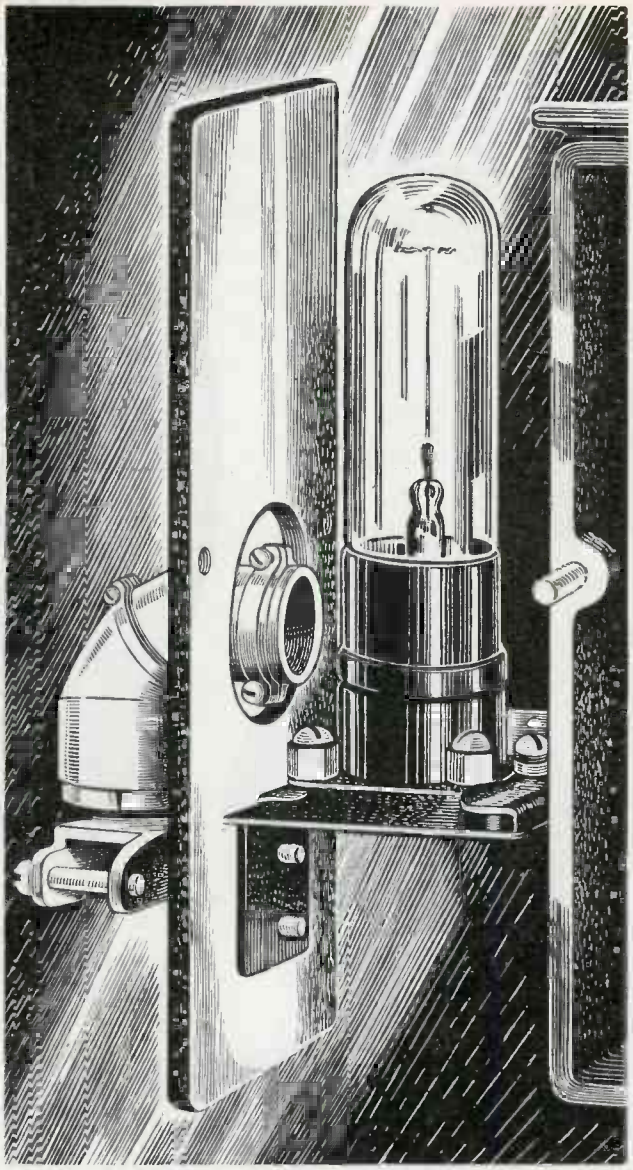
Hasten Victory . . Build for tomorrow . . Invest a part of your income in War Bonds.



PHILCO—the Quality Name in Millions of American Homes.

LISTEN TO
"OUR SECRET WEAPON"

Hear Rex Stout expose Axis lies and propaganda. Every Friday evening, CBS stations.



WE REMEMBER!

. . . it seemed an impossible job, but it was our country asking for help! Raytheon laboratories went on an "all out" basis . . . time went on and there were no "clock watchers." Power tubes for intricate new electronic applications had to be developed immediately and there was no pattern, no precedent to follow. The results depended solely upon the skill of Raytheon's corps of specially trained engineers.

Just how well Raytheon's power tube division has succeeded in delivering these intricately designed tubes in quantities heretofore unknown, is evidenced by the production increases that have enabled Raytheon to be an important factor in the successful operations of our military forces. *Look to Raytheon for your postwar power-tube requirements.*

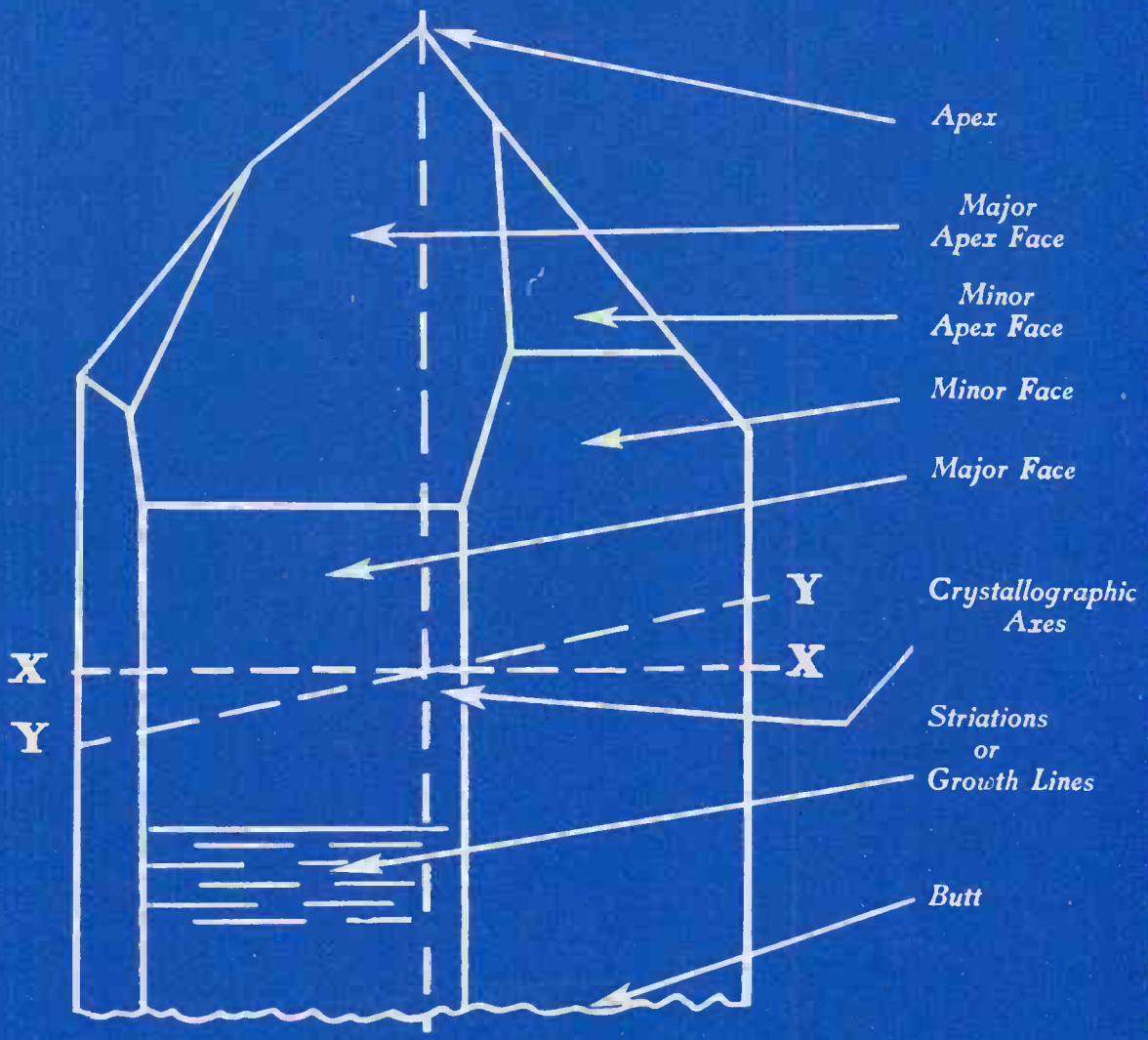
DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES AND EQUIPMENT FOR THE NEW ERA OF ELECTRONICS

RAYTHEON

Raytheon Manufacturing Company
WALTHAM AND NEWTON, MASSACHUSETTS

CRYSTALS IN THE MAKING

. . . AS DIAGRAMMED BY CRYSTAL PRODUCTS



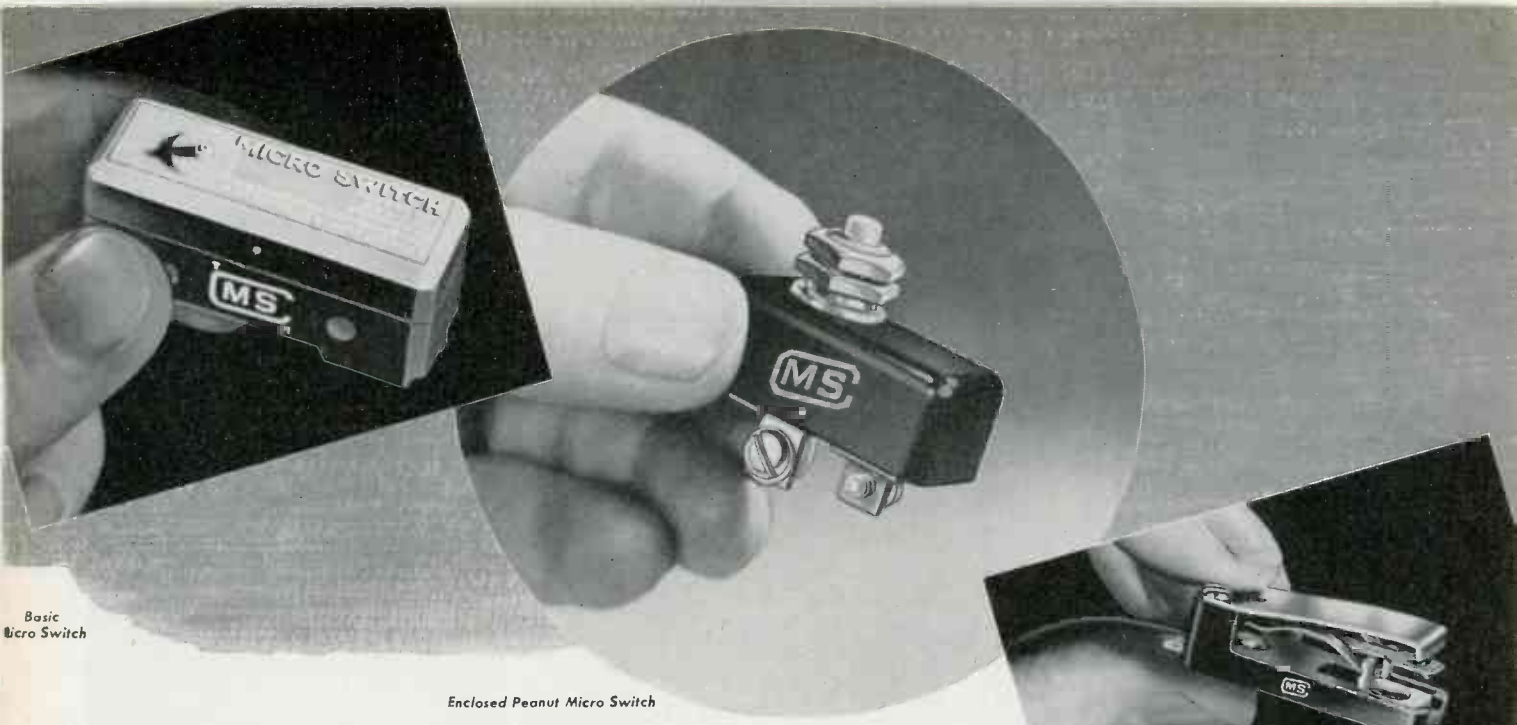
After being expertly inspected for impurities and the direction of cut determined . . . each of these painstaking operations must be absolutely accurate . . . the crystal is mounted for sawing. For precision crystals the mother is mounted with the optic axis running parallel to the plate and the electric axis perpendicular to it. This operation can become exceedingly difficult with a lack of an apex and well-defined faces.

When neither faces nor apex are present, the axis must be located by another method before it can be mounted for cutting.

Precision cutting is an all important factor in the production of crystals for radio frequency control.

Crystal
PRODUCTS COMPANY
1519 McGEE STREET, KANSAS CITY, MO.

Producers of Approved Precision Crystals for Radio Frequency Control



Basic Micro Switch

Enclosed Peanut Micro Switch

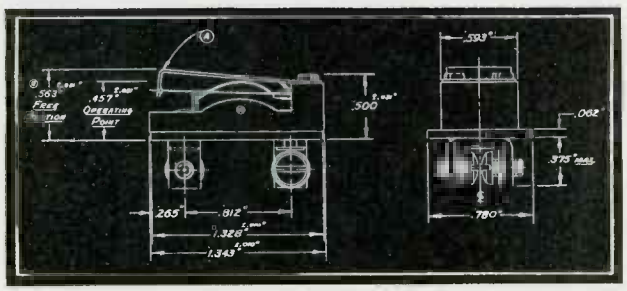
Skeleton Peanut Micro Switch

Built for Tomorrow ...YOURS today

Designed for post war use, the Peanut Micro Switch so filled the bill for a number of military requirements that we are now making them in large scale production.

This diminutive switch is smaller than the basic Micro Switch, more robust, more resistant to vibration, is lighter, lower in cost and has a higher electrical rating.

The Peanut Micro Switch is so designed that it can be used without an enclosing case, allowing the actuating movement to be applied anywhere over a large portion of the upper spring. Used with a Bakelite case, a convenient stem mounting is provided. The construction allows inherent overtravel beyond the point of operation sufficient for most uses.



The unenclosed Peanut Micro Switch weighs .019 lb., encased in Bakelite housing the weight is .048 lb. This switch resists vibration and acceleration up to 300 times gravity. Operating force is 32 ounces maximum and the movement differential is .036" maximum.

Contact separation up to .085" can be varied in manufacture to meet requirements. This wide gap is particularly valuable on DC loads. To provide the high unit contact pressure for low voltage applications, contacts of 99.95% pure silver are formed with a knurled surface.

Experience and skill of Micro Switch engineers is at your service. Send for information.

Micro Switch Corporation, Freeport, Illinois
Branches: 43 E. Ohio St., Chicago (11) • 11 Park Place, New York City (7)
Sales and Engineering Offices: Boston • Hartford • Los Angeles

Peanut Micro Switch Ratings

DIRECT CURRENT

VOLTS D.C.	HEATERS		LAMPS		MOTORS—RELAYS & SOLENOIDS	
	Sea level amp.	45,000 ft. amp.	Sea level amp.	45,000 ft. amp.	Sea level amp.	45,000 ft. amp.
†) 24-28	40	40	7	7	30	25
*) 110-115	1.5	1.2	1.5	1.2	1.2	0.75
*) 220-230	0.6	0.6	0.6	0.6	0.5	0.3

†) *Aircraft use of 25,000 operations* *) *Not less than 100,000 operations*

ALTERNATING CURRENT

Volts A.C. 60 cycle	Heater amp.	Lamp amp.	Inductive 75% P.F. Amperes
110	20	10	15
220	10	5	8

Not less than 100,000 operations

MOTORS 110-220 V. A.C. motor rating ¼ h.p.

MICRO SWITCH

Made Only By Micro Switch Corporation . . . Freeport, Illinois

THURSDAY, JUNE 24, 1943

The Story of Radar---Early Steps in the Making Of the War's 'Greatest New Tactical Weapon'

By JOHN M. HIGHTOWER

One type of equipment for which they had gone to the outside world all along, and continued to go, was the vacuum tube. Early in the game they tried out a variety of tubes and quickly found that only two were suitable for their hard use. Both of those were manufactured for radio amateurs, "hams." Taylor and Page give the anonymous thousands of old-time hams great credit for their unwitting contribution to radar.

"A ham," said Taylor, "was a tough fellow to please when it came to tubes. If he was trying to talk with Des Moines and he couldn't reach it, he would merely turn up the power. It didn't bother him if he put 150 watts on a 50-watt tube. If the tube burned out, he just thought it wasn't any good. So he'd raise hell and get a new one.

"Those tubes we used were built to meet the demands of the ham. Anything less rugged was not suitable for our purposes."

Page and Guthrie were using those ham tubes in their first experiments, and it was not until several years later that funds became available for adequate purchases of tubes specially designed for radar requirements.

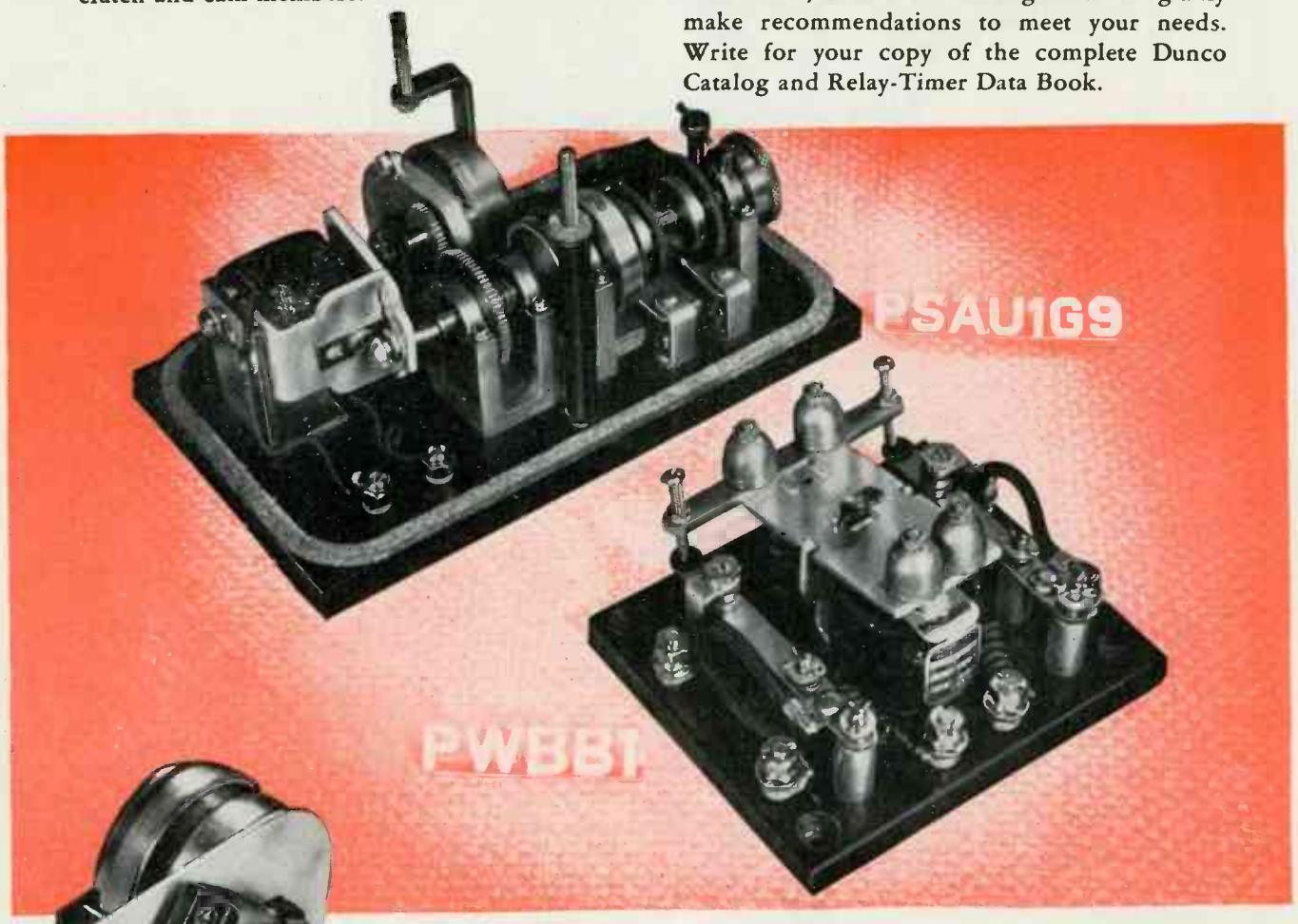
Dunco Recycling Time-Delay

RELAYS FOR CONTROLLING AUTOMATIC OPERATIONS

THERMAL • INERTIA • MAGNETIC • MOTOR-DRIVEN

New developments in Struthers-Dunn motor-driven Type PS Recycling Time-Delay Relays have resulted in units ⅓ the size of previous compact timers, and having 100% ball-bearing clutch and cam members.

Other Dunco Time-Delay Relays of inertia, thermal, or magnetic construction afford a complete assortment for modern engineering requirements. Based on broad, specialized experience in this field, Struthers-Dunn engineers will gladly make recommendations to meet your needs. Write for your copy of the complete Dunco Catalog and Relay-Timer Data Book.



◀ SMALLER — CONTINUOUSLY ADJUSTABLE

Another important Dunco Timer development is the Type PSY1 shown at left. Exceptionally compact, its contact closure time is continuously adjustable from 0 to 100% of the cycle time. It operates continuously at 1 cycle per minute.

STRUTHERS-DUNN, Inc.

1321 ARCH STREET, PHILADELPHIA, PA.

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • HARTFORD INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL • NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO • WASHINGTON

SH-H-H-H! THE ENEMY IS LISTENING!

● Sailors at sea couldn't listen to their favorite radio programs until one of our foremost radio manufacturers was commissioned to build a special seagoing receiver. It was found that ordinary radios "rebroadcast" and tipped off the ship's location. And without any radio, morale suffered.

Now, it's different! Sailors around the world are listening to radio programs from home through this low-radiation receiving set. The speed with which it was produced and put in service is a tribute, in part, to the *E·L* engineers asked to provide a suitable power supply. They did it—fast, and well.

This is just one of the many contributions to America's war effort which *E·L* research and specialized knowledge of vibrator power supplies and electronic circuits has made possible. You'll find *E·L* Vibrator Power Supplies on the job in all types of service, and on every front where the United Nations are fighting.

Wherever electric current must be changed, in voltage, frequency or type, *E·L* Vibrator Power Supplies and Converters offer a wide range of advantages, for peace, as well as for war.

For Operating Radio Transmitters in Lifeboats—E·L Model S-1229-B Power Supply. Input Voltage, 12 Volts DC; Output Voltage, 500 Volts DC; Output Current, 175 MA; Dimensions, 7½″ x 5½″ x 6¼″.

For Operating AC Radio Receivers from DC Current—E·L Model 262 Marine Power Supply. Input Voltage, 110 Volts DC; Output Voltage, 110 Volts AC; Output Power, 250 Volt-Amperes; Output Frequency, 60 Cycles; Dimensions, 10½″ x 7⅝″ x 8¼″.

Electronic
LABORATORIES, INC.
INDIANAPOLIS

E·L ELECTRICAL PRODUCTS—Vibrator Power Supplies for Communications . . . Lighting . . . Electric Motor Operation . . . Electric, Electronic and other Equipment . . . on Land, Sea or in the Air.

"If she undervalue me,
What care I how fair she be?"

WHAT CAN ELECTRONICS DO FOR *YOUR* BUSINESS?

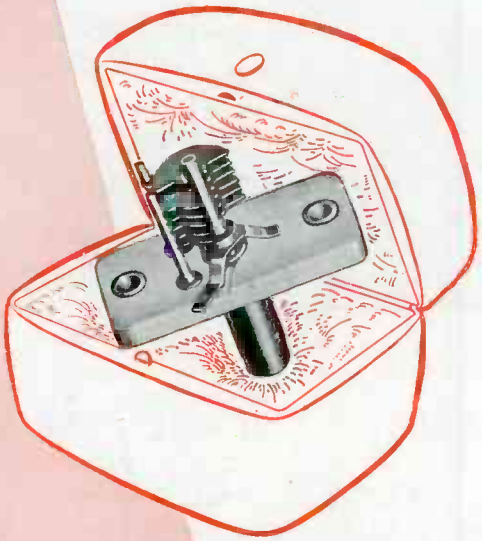
● The use of Electronics is performing miracles in a rapidly increasing number of applications. The way it is speeding production, cutting costs, producing better precision-made goods and generally knocking the spots out of once-tough jobs . . . sounds like a beautiful dream.

But, from the practical viewpoint of your own business, you may logically inquire: "What good is Electronics to me?"

That is a question General Electronic Industries would like an opportunity to answer.

Our research engineering department has come through with flying colors on every war task assigned to it. Present conditions do not permit a full recounting of these achievements in *Electronics, Hydraulics* and *Electromechanics*. Even so—the story of most interest to *you* is how this specialized skill and experience may be applied to help solve *your* engineering and production problems.

Would you like to hear it? We're ready whenever you are! Write to *Engineering Department, General Electronic Industries, 342 West Putnam Avenue, Greenwich, Connecticut.*



A Precision Gem
(Reproduced actual size)

Ultra-compact, temperature-compensated *Variable Condenser*. Available in quantity on high priority only.

Other products manufactured include
ELECTRONIC CONTROLS • VACUUM TUBES
HYDRAULIC SERVOS
ELECTROMECHANICAL DEVICES

Army-Navy "E" awarded to Auto-Ordnance Corporation for excellence in production of "Tommy" Guns.

GENERAL *Electronic* INDUSTRIES

Division of Auto-Ordnance Corporation

GREENWICH • STAMFORD • BRIDGEPORT • NEW YORK

NEW G-E RADIO-NOISE FILTERS for Aircraft

Available in ratings of 25, 50, 100, and 200 amp, d-c, at 50 volts

They provide excellent noise suppression —especially from 200 to 20,000 kc

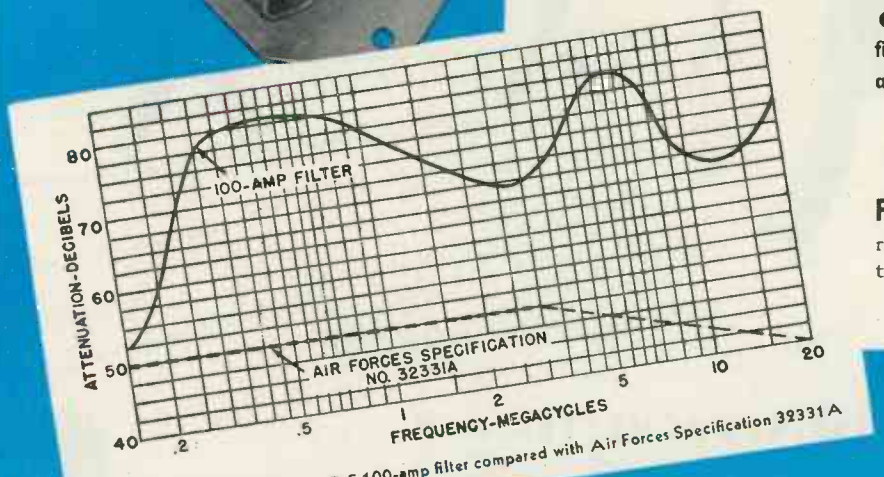
THESE filters help immeasurably in providing the high-fidelity radio reception so important in aerial warfare. They attenuate radio-noise voltage on aircraft electric systems (on circuits with such equipment as generators, amplidynes, inverters, and dynamotors). They are particularly helpful in systems where open wiring is used to save weight.

FEATURES

- High attenuation characteristic results in excellent noise reduction
- Compact and lightweight (For 100-amp rating, shown at left, approx 2 1/5 lb, measuring approx 5 by 4 by 2 1/2 in.)
- Can be mounted readily in any position
- Operate efficiently over a wide temperature range (— 50 C to 50 C)
- Comply with U.S. Army Air Forces specifications, including the stringent requirements as to vibration and acceleration

★ ★ ★

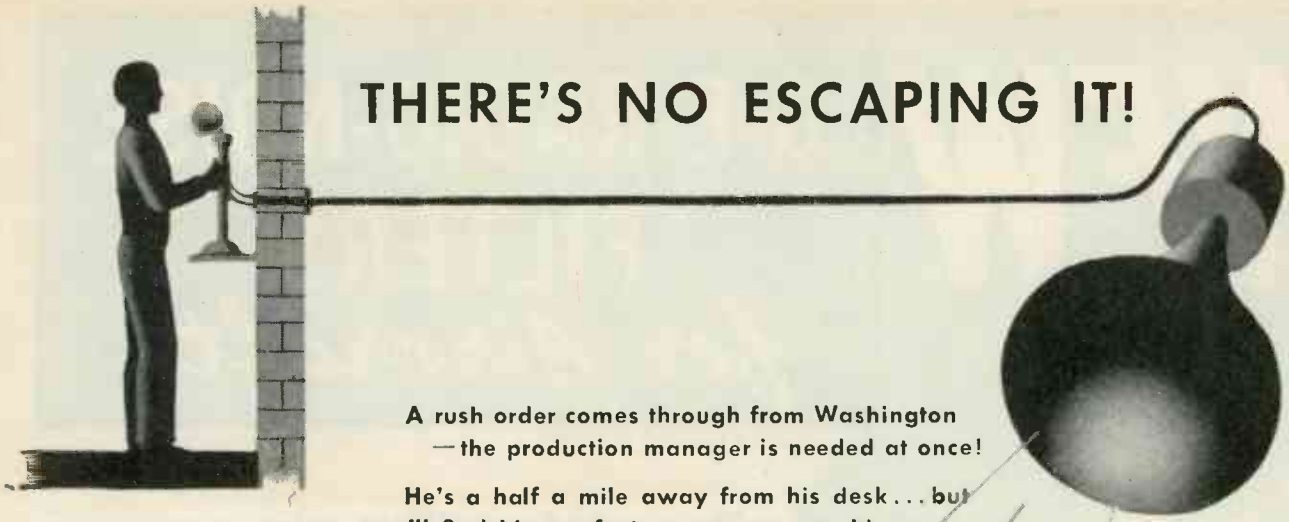
FOR FURTHER DATA Ask your G-E representative for Bulletin GEA-4098, or write to General Electric, Schenectady, New York.



Attenuation characteristic of G-E 100-amp filter compared with Air Forces Specification 32331A

GENERAL ELECTRIC

407-62-5760



THERE'S NO ESCAPING IT!

A rush order comes through from Washington —the production manager is needed at once!

He's a half a mile away from his desk . . . but you'll find him as fast as you can say his name . . . thanks to Stromberg-Carlson Straight-line Communication.

It does the job QUICKER and BETTER than by any other means!

Think of the savings in critical manpower. Think of how it makes your telephone system more effective . . . by not tying up limited lines.

It's the fastest way of giving instructions to prevent accidents . . . to help in emergencies. It's the most efficient way of broadcasting warning signals . . . fire alarms, air raid alerts, all clear.

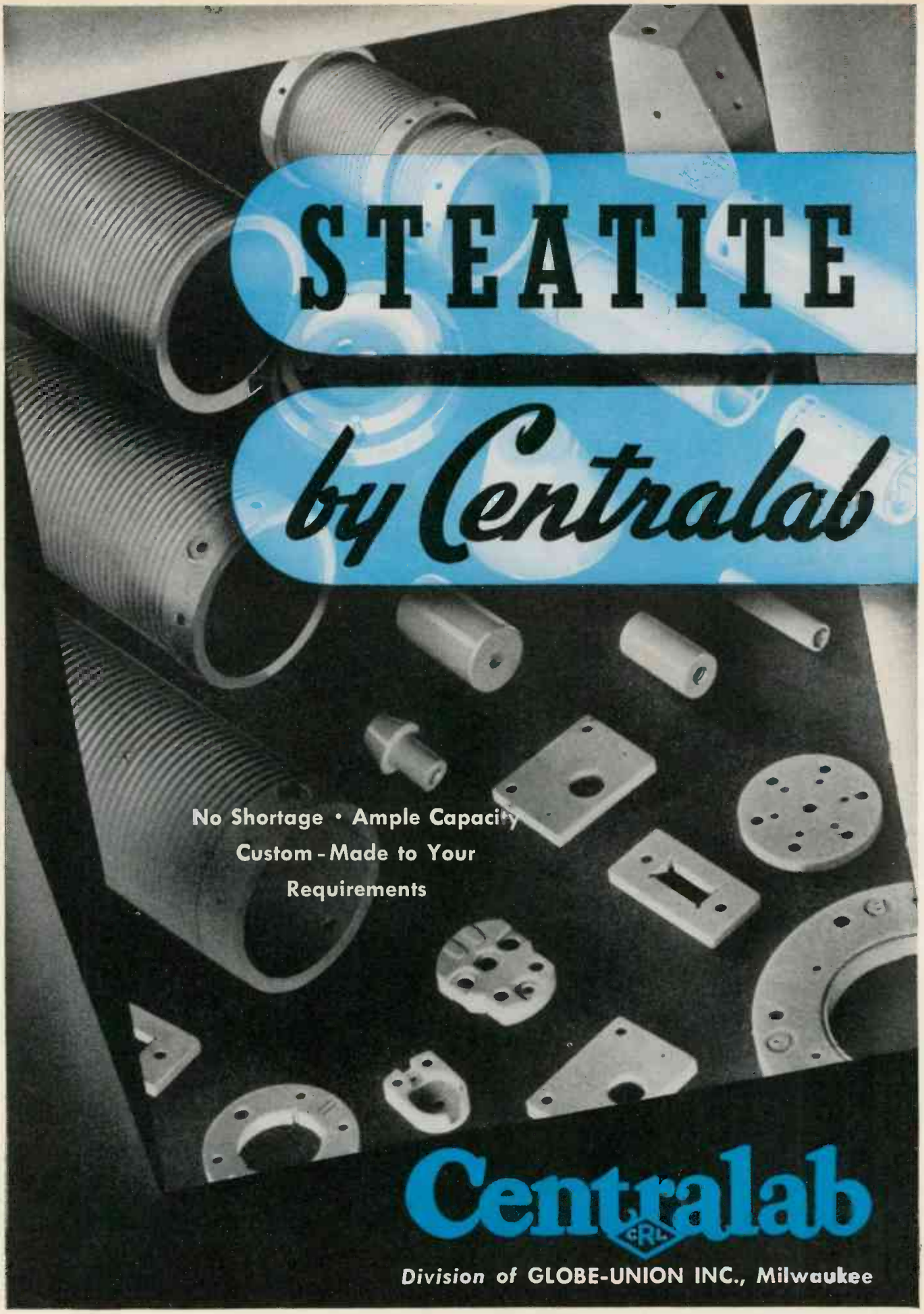
Think it over, and remember . . . Stromberg-Carlson has been manufacturing sound reproducing equipment of the highest reliability, the utmost durability for nearly half a century.

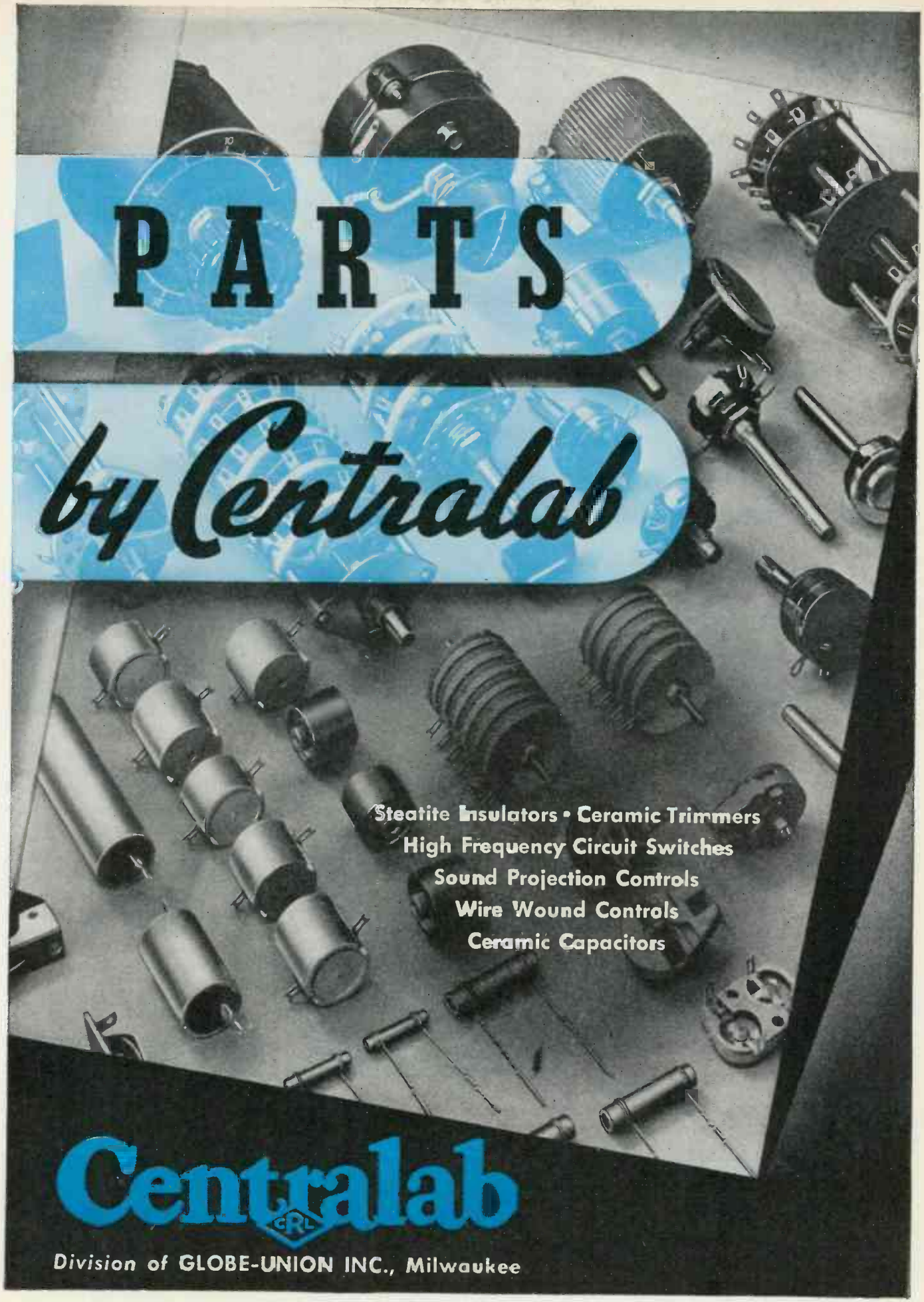
Today our installations are helping speed production, promote safety in war plants throughout the nation.

For these reasons, we believe we're specially fitted to solve your own communication problem. Before you decide on any particular sound system, get in touch with the Sound Systems Division of the Stromberg-Carlson Company, 100 Carlson Road, Rochester, New York. Write for free Booklet No. 1934.

STROMBERG-CARLSON, ROCHESTER, N. Y.

STRAIGHT-LINE COMMUNICATION SAVES MANPOWER • SPEEDS THE WORK TO VICTORY





AMERTRAN

★

Pioneer Manufacturer of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

"Devise scouts that will travel 186,284 miles per second—pierce fog, gloom, and clouds—and report accurately the location of our enemies." Such, in effect, was a pre-war assignment given to those associated with ultra high frequency radio. Among the concerns honored by this task that culminated in RADAR, was the American Transformer Company.

We have every reason to believe that we fulfilled this assignment capably, because AmerTran equipment was not only accepted under the original specifications, but has been retained as improvements have been accomplished progressively.

Our work in RADAR has been a source of gratification to us as our contribution to an epoch-making development in the field of electronics.

☆

AMERICAN TRANSFORMER COMPANY

173 EMMET STREET, NEWARK, N. J.

AMERTRAN

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

A TYPICAL 'MULTI-SWAGE' JOB

Most of the radio tube contacts used today are made by the BEAD CHAIN MULTI-SWAGE PROCESS.

The radio tube contacts shown above typify the precise, high-speed, volume production of small metal parts possible by the BEAD CHAIN MULTI-SWAGE PROCESS. These parts are formed from flat stock, practically without waste . . . a feature of all MULTI-SWAGE jobs which results in substantial economy in the cost of the finished product.

A great variety of similar parts, solid or hollow, can be produced advantageously by MULTI-SWAGE. Large quantities can be turned out quickly. Most metals can be processed by MULTI-SWAGE.

Right now, our MULTI-SWAGE facilities are running full-time on war work. But, if you are planning post-war products using hollow, or solid round, cylindrical or angular parts, our Research and Development Division will gladly show you the advantages of making them by MULTI-SWAGE.

BEAD CHAIN
multi·swage
PROCESS

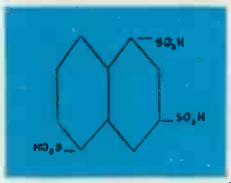
THE MOST ECONOMICAL METHOD OF PRODUCING SMALL METAL PARTS TO CLOSE TOLERANCES WITHOUT WASTE

THE BEAD CHAIN MANUFACTURING COMPANY

MOUNTAIN GROVE AND STATE STS., BRIDGEPORT 5, CONN.

THE FORMULA FOR A BETTER PRODUCT . . .

Cornell-Dubilier Capacitors



In chemistry, the key to the qualities of a compound lie in the molecular structure of its components. In radio, too, the formula for a better product is in the quality of the components used. That is why many of the leading manufacturers of radio equipment specify C-D Capacitors. These manufacturers know and recognize the importance of reliable capacitors. You too, can insure the dependable performance of your equipment by specifying C-D capacitors for your manufacturing requirements. Our engineers will be glad to cooperate with you on applications involving the use of capacitors. Cornell Dubilier Electric Corporation. South Plainfield, N. J.

Moulded Mica Transmitter Capacitors

Used in power amplifiers and low-power transmitters principally for r.f. by-passing, grid and plate blocking applications, the Cornell-Dubilier Type 9 Moulded Mica Capacitor offers these features'—typical of all C-D Molded Mica Capacitors:

Special C-D impregnation process, resulting in a capacitor of extreme stability and high insulation resistance. These capacitors are unaffected by variations in temperature and humidity conditions.

Careful selection of gauged mica, providing a unit of higher breakdown voltage and low power-factor.

No magnetic materials used in construction, reducing losses at all frequencies.

Moulded in Bakelite, producing a mechanically-strong well-insulated capacitor of increased moisture resistance.

Short, heavy terminals result in reduced r.f. and contact resistance

These capacitors as well as others in the complete C-D line are described in Catalog 160T. Free on request.

Cornell-Dubilier

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

FELKER DI-MET

UNDER TENSION *for* Dynamic Flatness

QUARTZ SHORTAGES are effecting important improvements in cutting methods and equipment. DI-MET's contribution in this direction is DYNAMIC FLATNESS, a method for keeping diamond abrasive wheels flat under high speed rotation. This new perfection aids in obtaining a greater number of usable quartz blocks per pound of raw material by reducing runouts, chipping, wafer breakage, and other defects caused by rim wobble.

Experiments prove that all blades which test flat do not always operate flat. This variation is due to unequalized strains within the blade which are released during operation and reassert themselves to cause blade warpage and rim wobble.

DI-MET engineers have overcome rim wobble by a new process for obtaining dynamic flatness! Strains are first equalized throughout the blade — and the rim then placed under a balanced, radial tension. The tension is uniform throughout the circumference and prevents run-out due to normal temperature rise and nominal pressure variation during cutting.

With proper care, DI-MET dynamically flattened blades *stay* flat for the life of the blade — not only reduce the number of blades required — but produce more crystals per pound of quartz! Try dynamically flattened DI-MET Rimlocks. You pay no premium for this BETTER cutting tool!

New catalog illustrating DI-MET Quartz Cutting Machines is now available. Have you received your copy? Write for it!

Look for this symbol (A) of dynamic flatness

FELKER MANUFACTURING COMPANY

1114 BORDER AVENUE • TORRANCE, CALIFORNIA

MANUFACTURERS OF DIAMOND ABRASIVE TOOLS

Serving on all our fighting fronts
. . . the SUPER-PRO "SERIES ◆ 200"

IT REQUIRES STAMINA to withstand the steaming wet climate of the Pacific Islands, or the frigid temperature of the far North. Our boys and our equipment are proving a match for the elements as well as our enemies. We of HAMMARLUND are proud to have aided in the successful battles of Guadalcanal.

THE HAMMARLUND MFG. CO., INC.
460 West 34th Street, New York, N. Y.

THE SIGN OF QUALITY IN RADIO

HAMMARLUND

INCHES AWAY—YET MILES APART

Linked by Interphone Equipment

Pilot and crew, separated by deafening flak and engine throb, explosions and noisy ack-ack fire, are *linked together* completely by interphone communication equipment. Where split-second timing depends on perfect intra-plane communication, Trav-Ler Karenola equipment fights right along with front-line American Air Forces . . . relaying orders and messages to every man aloft with maximum clarity and dependability . . . forging a link that strengthens the fighting airship.

TRAV-LER

TRAVLER KARENOLA

RADIO AND TELEVISION CORPORATION

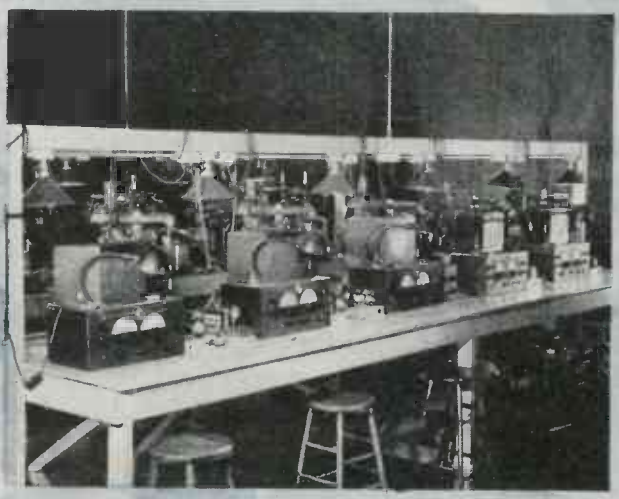
1032 WEST VAN BUREN STREET • CHICAGO 7, ILLINOIS

MANUFACTURERS OF QUALITY RADIO AND COMMUNICATION EQUIPMENT

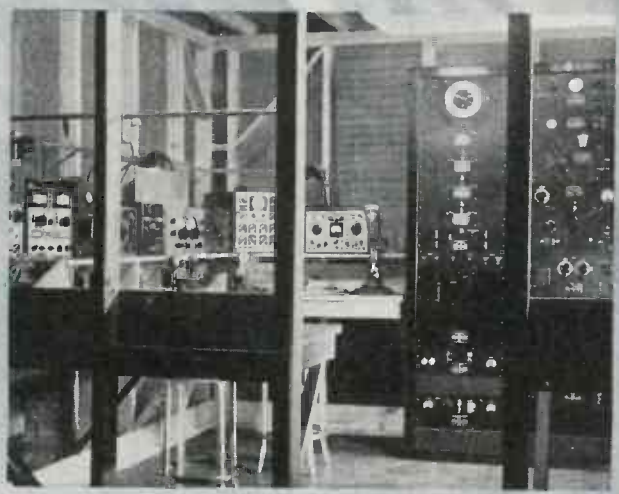
JAMES . . . Crystals KNIGHTS

There's History Behind Every JAMES KNIGHTS CRYSTAL

For many years, key men of our carefully built organization have pioneered, "researched", and developed the manufacture and application of precision cut quartz crystals. As engineers, physicists and operators from American, Foreign and U.S. Government technical schools, they have consistently contributed history making graphs, inventions and methods to the Crystal industry in general and to James Knights Crystals in particular. With such a practical achievement background, it is understandable that James Knights Crystals meet and satisfy the most intricate specifications.



There's efficiency in concentration. We manufacture but one product—precision cut quartz crystals. All of the skill, experience and output of our staff is concentrated on crystals exclusively. Above is a corner of the lapping and calibrating department.



A section of the experimental and testing laboratory. Here is an important reason why we were one of the first manufacturers after Pearl Harbor in actual quantity production of quartz crystals meeting Governmental specifications. What are your requirements?

The JAMES KNIGHTS Company

SANDWICH, ILLINOIS PHONE 65

The devil rode that night . . .

"Driven by an angry wind, rain beat down with the fury of bullets, and waves swept across the deck like a frenzied mob. As orders went out clearly over the microphone, I remembered a night back in 1932 when a similar storm swallowed words even as I spoke them, and lack of proper communications resulted in tragedy for some of my men."

Purely hypothetical is the case above . . . but you may be sure that after the war, when entirely new Electro-Voice Communication Microphones are released for general use, they will fill a definite need aboard ships. Fitting easily into the hand or attached snugly to the face, weighing barely more than a whisper, Electro-Voice Microphones are incomparable from the standpoint of stability, articulation and reduction of background noise.

Builders of war equipment may secure information concerning new Electro-Voice developments from us. However, if limited quantity needs can be filled by any of our Standard Model Microphones, with or without minor modifications, contact your local radio parts distributor.

In order to maintain existing civilian equipment at maximum efficiency, we suggest that you submit your Electro-Voice Microphone to your supplier for TEST and REPAIR at our factory.

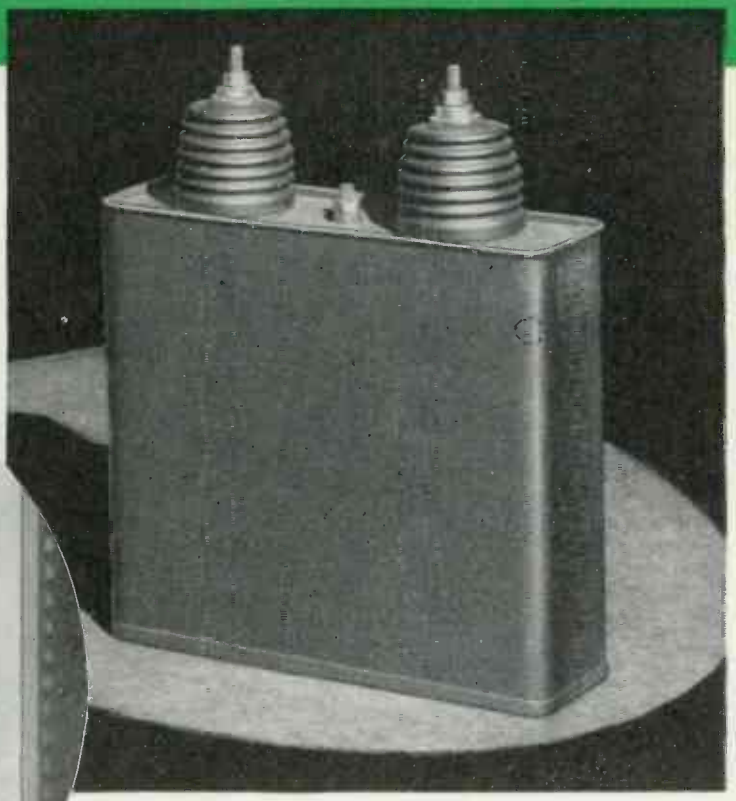
Electro-Voice MICROPHONES

ELECTRO-VOICE MANUFACTURING CO., INC. • 1239 SOUTH BEND AVENUE • SOUTH BEND, INDIANA

Export Division: 13 East 40th Street, New York 16, N. Y. — U. S. A. *Cables: ARLAB*

Quick Delivery PYRANOL CAPACITORS

for High-voltage D-c Service



Used as a filter in a 10-kw FM transmitter. This is one of many applications.

30 *Standard Ratings* (5–75 kv) *to choose from*

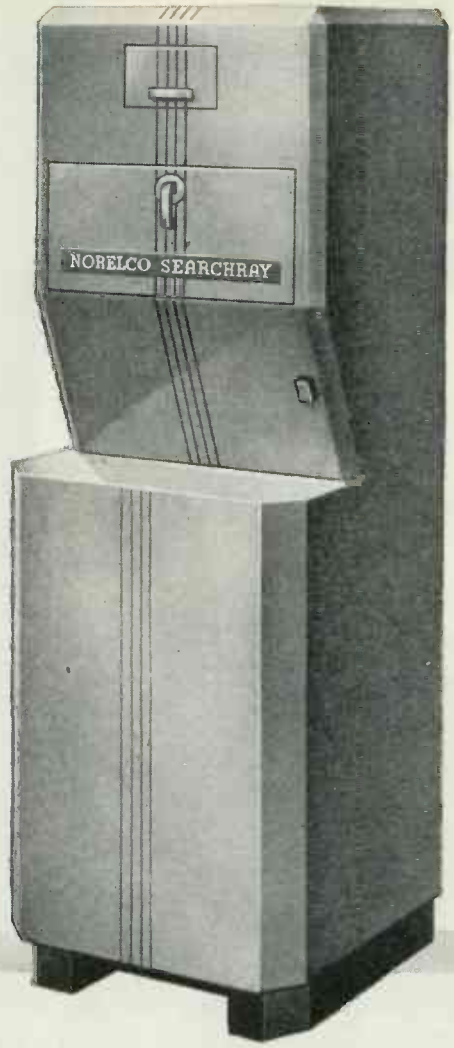
FILTER problems take a beating when you install Pyranol* capacitors for high-voltage d-c service. Here are other useful facts to remember about Pyranol capacitors:

- They can be mounted in any position.
- Reliable performance is ensured by superior materials and individual testing.
- Substantially increased manufacturing facilities now enable us to make prompt deliveries.

**Pyranol is the G-E trade mark for capacitors and for askarel, the synthetic, noninflammable liquid used in treating G-E capacitors.*

GENERAL ELECTRIC

407-49-5700



Meet SEARCHRAY
INDUSTRY'S X-RAY HANDY MAN

Flaws you never suspected—defects that cause failures later on—show up in a flash when you put your product into the new "Norelco" Searchray.

Shockproof, rayproof, foolproof and readily mobile, Searchray is so simply devised that anyone can operate it. Yet it discloses in fluoroscopic and radiographic views the internal structure of parts, sub-assemblies and finished products and many other units made of light alloys, rubber, ceramics, plastics and other light materials. It can be as useful in the laboratory as it is on the production line.

By its detection of imperfections in manufacture, the new "Norelco" Searchray can save you thousands of dollars and man-hours of production. Searchray also has a definite place in plant protection by means of its rapid inspection of incoming and outgoing packages, etc. It is truly Industry's X-ray HANDY MAN. Safe—simple—inexpensive.

The new Searchray is only one of the "Norelco" industrial electronic products created for helping industry. If you want to know whether Searchray can help solve your problems, write today to North American Philips and get the benefit of our wide experience.

NORELCO ELECTRONIC PRODUCTS BY

NORTH AMERICAN PHILIPS COMPANY, INC.

Industrial Electronics Division, 419 Fourth Ave., New York 16, N. Y.

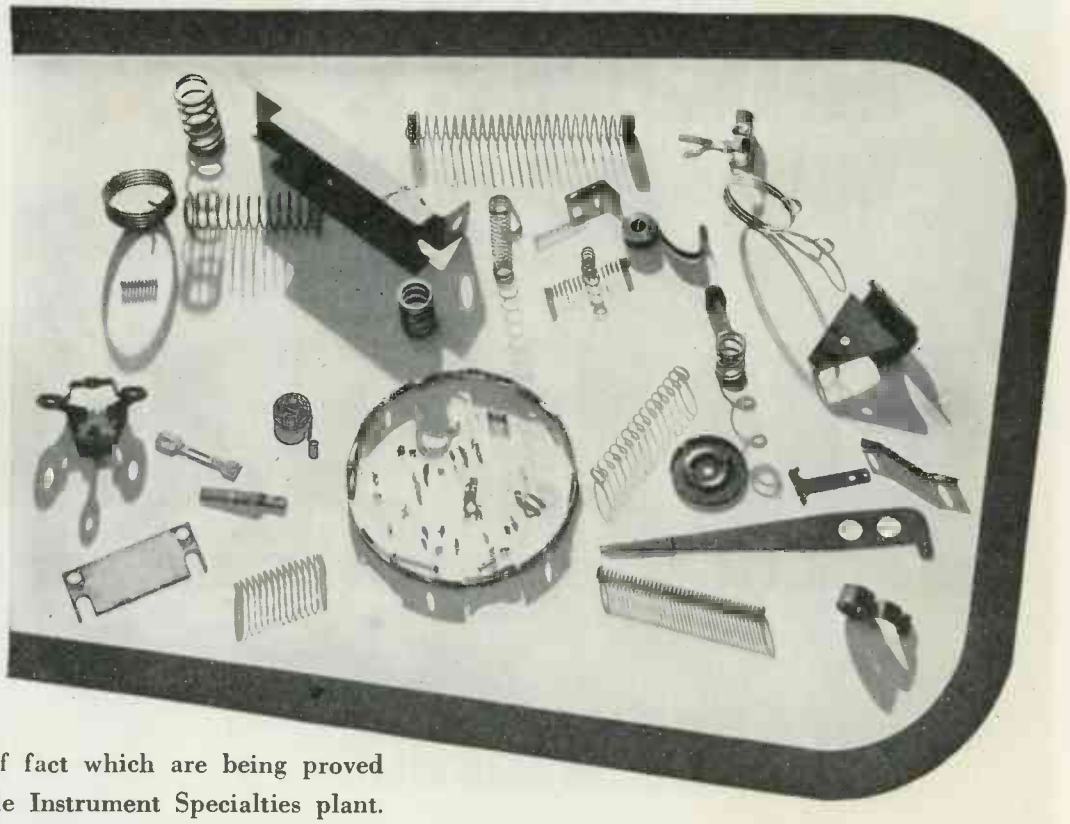
Products For Victory include Cathode Ray Tubes; Amplifier Tubes; Rectifier Tubes; Transmitting Tubes; Oscillator Plates; Tungsten and Molybdenum in powder, rod, wire and sheet form; Tungsten Alloys; Fine Wire of all drawable metals: bare, plated and enameled; Diamond Dies; Searchray (X-ray) Apparatus for industrial and research applications; X-Ray Diffraction Apparatus; Electronic Temperature Indicators; Direct Reading Frequency Meters.

Factories in Dobbs Ferry, N. Y.; Mount Vernon, N. Y. (Philips Metalix Corp.); Lewiston, Maine (Elmet Division).

MICRO-PROCESSING takes the "WONDER" out of Beryllium Copper Springs

It has taken us eight years to prove to industry that the use of a potentially superior spring material is no guarantee of consistently finer springs.

At the risk of seeming boastful, there are springs illustrated below — taken from long runs in our plant, which have not been duplicated in quantity by any other method than by "Micro-processing." And every one of these beryllium copper springs is serving a highly critical wartime purpose.



It has taken eight hard years of research and production for us to sift the essential fact from the non-essential; to take the "wonder" out of every run and replace it with "assurance." It has taken some of the toughest problems a war could pose for us to prove that beryllium copper springs in the ultimate require a special technique to make them behave as they should.

These are statements of fact which are being proved around the clock in the Instrument Specialties plant. These statements are made to you who, for one reason or another, have found beryllium copper inadequate as the spring material for your needs — and to you who have yet to take advantage of the extreme versatility of beryllium copper.

We have grown from a small spring manufacturer to a relatively large producer — not alone because of war conditions, but because we have devloped a technique which has stood every comparative test ever put to it. By so doing, we have converted many disbelievers, and have found many new users. Beryllium copper *can* be the wonder metal for coil or flat springs when it is treated correctly. That fact Instrument Specialties will prove to you on your own springs. "Micro-processing" makes the difference between uncertainty and assurance of outstanding service performance of beryllium copper springs.

THREE SUGGESTIONS for BETTER SPRINGS!

1. If you are now using coil or flat springs which are or could be of beryllium copper, get in touch with Instrument Specialties to see what Micro-processing can do to improve necessary physical and electrical characteristics.
2. Start planning now to use the exceptional long life and dependability of micro-processed beryllium copper springs. We will be glad to discuss present or postwar spring requirements with your design and engineering departments.
3. Write today for your copy of I-S Bulletins 4 and 5 which summarize micro-processing in terms of increased spring performance.

INSTRUMENT SPECIALTIES CO., INC.

Dept. E-2 — Little Falls, N. J.

A HELPING HAND

for your electronic problems

The N-Y-T Service Department!

The multitude of highly specialized assignments now being undertaken by the N-Y-T Sample Department is indicative of the trend of electronics toward consumer applications.

After months of uninterrupted research, design and production of transformers for every branch of the Armed Forces, N-Y-T engineers and technicians are again formulating plans for postwar achievements. Advantages for richer, more healthful living that will make all previous efforts incongruous in comparison.

Our clients—leaders in their respective fields—utilize the N-Y-T Sample Department facilities as an integral part of their own companies. It is available to you, too. Inquiries are invited.

NEW YORK TRANSFORMER COMPANY

22-26 WAVERLY PLACE, NEW YORK, N. Y.

Savings in DESIGN

A

B

PREVIOUS UTC ads have illustrated the importance of engineering design in the saving of critical materials, machine time and man hours. The engineer's responsibility in our war effort is tremendous. We can win or lose the war because the winner will be that group of nations which gets there first with the most. We illustrate the functioning of this viewpoint at UTC by a highlight design for the month, as below.

A . . . *Contemporary transformer as brought to UTC for duplication.*

B . . . *UTC final design, illustrating design savings.*

VOLUME REDUCTION 80% . . . This represents a vital reduction in critical material.

WEIGHT REDUCTION 78% . . . Used in portable apparatus, weight reduction is important.

PRICE REDUCTION 84% . . . This means more war units for the same cost . . . Quicker.

DEPENDABILITY --% . . . Considerably more efficient electrically and *submersion proof.*

May we design a war unit to your application?

UNITED TRANSFORMER CO.

150 VARICK STREET ★ NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

ELECTRONIC INDUSTRIES

O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17), N. Y.

Postwar Conversion

By next month nearly half the population of the country will be dependent for its living on wages earned in war industries. And the radio field is in the first rank of these, in importance and number. When the fighting stops—and the end is apt to come suddenly and just as unexpectedly as it did in 1918—this gigantic radio war production will grind to a dead stop. What then is to be done? What's to happen to the thousands now employed in electronic and radio plants?

It is to be hoped that each of the stars now pasted on the service flags displayed in all radio factories, will be replaced by the boy himself whom that star represents. He too must be considered and taken care of when the conversion back to peacetime operations shall have arrived.

A great deal will depend upon how factory management and the government faces this gigantic task. No one wants work relief or the creating of jobs on public works to tide over the period of readjustment which is sure to come. It will be no time to expect much assistance from the government other than encouragement in the speedy conversion of private industry back to peacetime production.

Thinking That Pays Out

Sometimes the obvious seems too easy. Tackling the problem in a straight-forward manner and doing the obvious thing, surprisingly enough, may be just the right way to do it! The fact that rule-of-thumb often works, and works well, is no disparagement.

Take the case of an engineer submerged under the problem of keeping particles of iron out of the lubricating system of an engine because of their harmful effect on wearing surfaces. Filters might do it. So might many other methods. But the obvious thing to do was to introduce somewhere in the lubricating system a magnet that would attract, catch and hold all such abrasive particles. Which is what he did. Doing the obvious thing may require a new kind of thinking, but it is the kind of thinking that pays out.

Engineer and Scientist

An electronic engineer we know, once wondered in school why on earth he should be obliged to memorize relativistic formulas, when the biggest design problem he would have was designing a good-sized transmitter. By an ironic twist of fate this man is now engaged in building an electron-microscope and wishes he had paid better attention to the formula giving the increase in mass of an electron.

Such happenings are not uncommon nowadays. They show how necessary the connection between pure and applied science is for the progress of both. For this reason it is to be regretted that there often exists a somewhat deprecating attitude on the part of the practical man towards the pure scientist. Let it be remembered that the highly abstract formulation of the Maxwell equations opened the way for the extension of the useful frequency range to higher and higher frequencies by means of wave guides, etc., when the engineers "were stuck" with the usual transmission line equations.

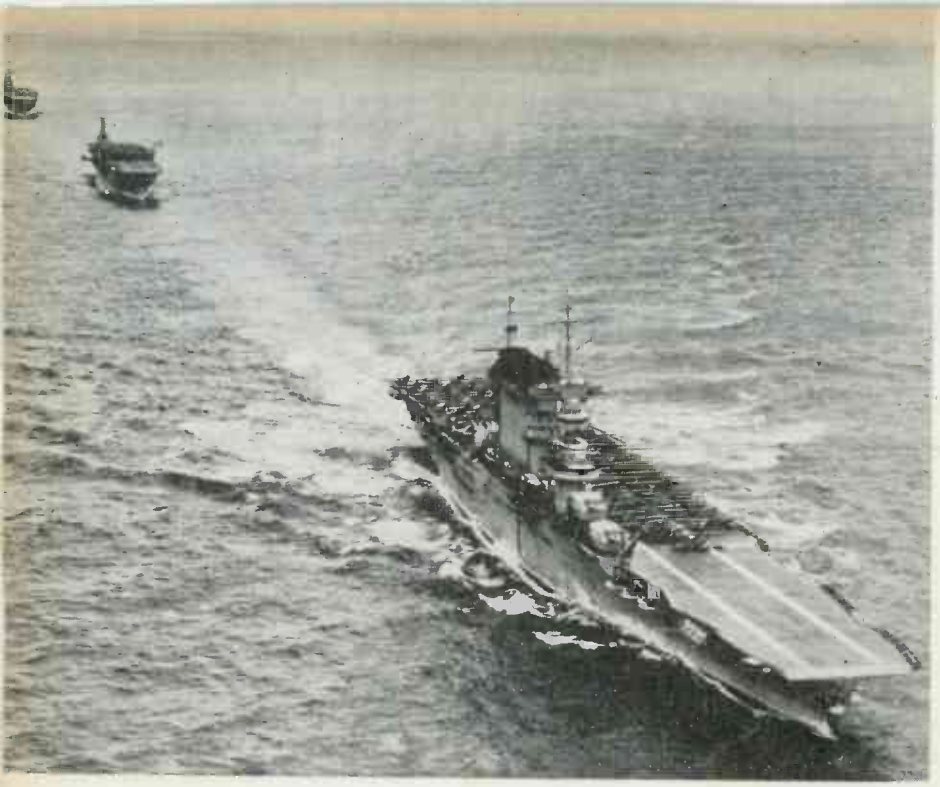
Presented to You—
On a large, folded color chart in this issue you will find—

THE ELECTRON TUBE
As an Element
IN INDUSTRIAL CONTROL

pointing out the ways of putting vacuum tubes to work in industry. See pages 65-72.

This Chart shows basic circuit diagrams, illustrating how any control function or any regulation problem that is part of some industrial process can be handled by electronic means.

NAVY



AIRCRAFT AND CARRIERS require vast amounts of electronic equipment

The Navy Department designs, specifies, purchases and installs something like an average of one hundred and fifty million dollars worth of radio, and other electronic equipment each month. The work entailed by this huge program is divided among numerous agencies which in some cases must work closely with one another. Chief factor here is Captain J. B. Dow of the Bureau of Ships, whose activity is coordinated with Naval Communications.

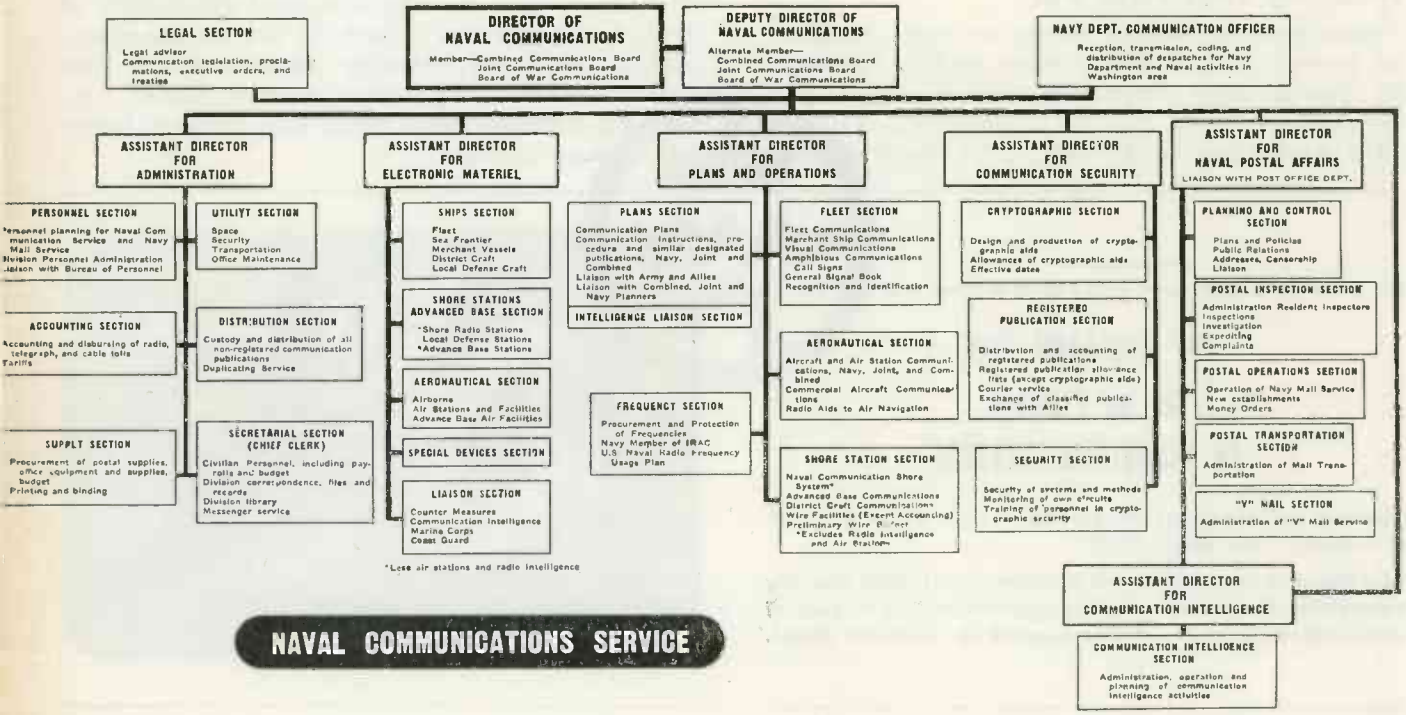
The Director of Naval Communications is charged with the administration, organization and operation of the entire radio, telegraph, telephone, and cable systems of communications within the naval service, as shown in the accompanying organization chart. This includes operation of the Navy overseas radio system, all communications between merchant ships and naval shore stations in the United States and its possessions, services rendered by shore direction-finder stations, and accounting for commercial messages. The Director of Naval Communications handles all matters pertaining to naval communications except those relating solely to purchase, supply, test, and installation of apparatus.

The Communication Office of the Navy Department (a section of the Communication Division) is responsible for the handling of all telegraphic and radio communications to and from the Navy Department.

Rear Admiral Redman

One of the best known figures in Naval Communications, Rear Admiral Joseph Reasor Redman, U.S.N., has been Director of Naval Communications since February, 1942, except for a six months' period when he commanded a cruiser in the war zone.

As Director of Naval Communications shortly after America was plunged into war, Captain (now Rear Admiral) Redman was largely responsible for the vast expansion of the naval communications services. He assisted in the formation of two major wartime com-



RADIO ORGANIZATION

Chief radio-electronic men in Naval Communications, Bureaus of Ships and of Aeronautics, Marine Corps, and Coast Guard

Rear Admiral
Joseph R. Redman, USN

Captain
Jennings B. Dow, USN

Captain
Edward M. Webster, USCG

Lt. Frank Akers, USN

Lt. Colonel
George C. Ruffin, USMC

munication agencies—the Combined Communications Board, which is the communications planning agency for the Combined Chiefs of Staff, and the Joint United States Communications Board, which is responsible for coordinating operations and procedures of Army and Navy communications. He is also a member of the Board of War Communications, a planning agency on which non-military agencies of the United States Government are represented.

Throughout his naval career Admiral Redman has specialized in communications. He also qualified in submarines and commanded one in the last war. He was Division Radio Officer from 1921 to 1925, Fleet Radio Officer for the Commander-in-Chief from 1927 to 1929, and thereafter served tours of duty in the Office of Naval Communications from 1930 to 1933 and from 1936 to 1939. As Assistant Director in 1941 and Director during 1942, he represented the Navy in communications conferences with government agencies and in its relations with commercial communications enterprises.

Chief engineer on the staff of the Director of Naval Communications is Captain Thomas Browning Inglis, U.S.N. Captain Inglis has done work in radio engineering at the Naval Academy and at Harvard University and has served in the Radio Division of the Bureau of Engineering, now the Bureau of Ships. His assistants include Commanders August J. Dexter and Earl Stone.

Radio engineering set-up

The accompanying chart of the Radio Division of the Bureau of Ships shows the organization required to handle the Navy's huge wartime radio and electronics program. This Division, headed by Captain Jennings B. Dow, U.S.N. is responsible for the research, design, procurement, installation and maintenance of all radio, and underwater sound materiel used by the Navy, excepting only certain equipment specifically placed under the cognizance of other bureaus.

Captain Dow is well fitted for his task of carrying on the radio engineering work of Rear Admiral Hooper and other predecessors. He graduated from the Naval Academy in 1920, received an M.S. degree in communication engineering from Harvard University in 1926, and has served as Asiatic Fleet Radio Officer and Radio Materiel Officer. He was attached to the Radio Division of the Bureau of Engineering during 1930-32, and acted as the head of the division in 1938 and '39. For five months during the winter of 1940-41, Captain Dow acted as special radio observer in England.

Captain Dow's assistants

The work of the Head of the Radio Division is expedited by two Assistant Heads, Commander Daniel F. J. Shea, U.S.N., and Lieut. Commander Ralph T. Brengle, formerly chief of the Procurement Section, Procurement and Production Branch. In civilian life, Commander Brengle was head of the Ralph T. Brengle Sales Company of Chicago and is, therefore, well known in the radio-electronic industries.

Commander Shea has seen considerable active duty in radio and sound with the fleet. This experience, coupled with his engineering background of Naval and special university study, make him well fitted to handle the duties of Assistant Head of the Radio Division.

Division of responsibilities

The work of the Radio Division is handled by three major branches: Design; Procurement and Production; Installation and Maintenance.

The Design Branch is charged with basic research and the development of new apparatus. It assumes the responsibility of insuring that the equipment built will withstand the severe conditions of service use. The various engineering groups have always followed the policy of working closely with Naval, college and university, and independent research laboratories, as well as with the engineering departments of the private manufacturers in all parts of the country. The excellent results achieved by this policy are now well known.

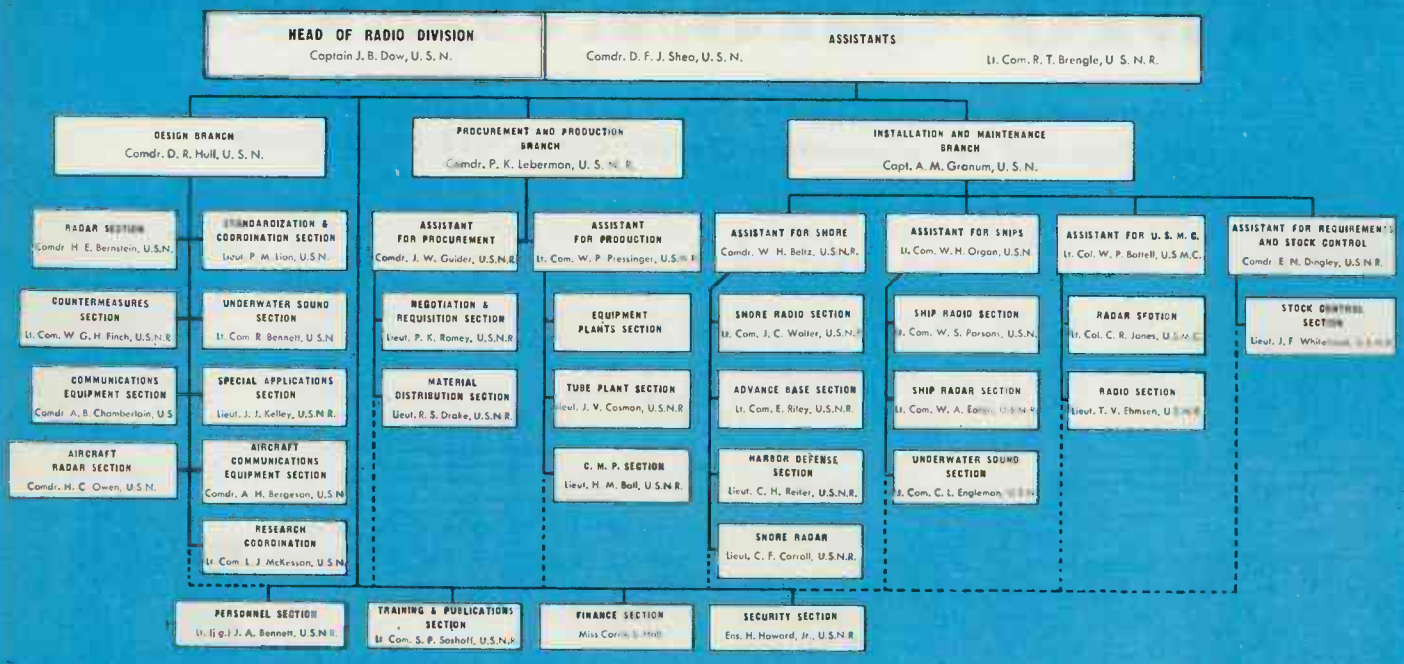
Captain
Thomas B. Inglis, US

Commander
Daniel F. J. Shea, US

Lt. Commander
Ralph T. Brengle, US

Commander
D. R. Hull, USN

Captain
Alfred M. Granum, U



RADIO DIVISION of the Bureau of Ships, showing heads of the various branches and sections

Commander Davis R. Hull

One of the ablest Naval officers in the fields of radio research and underwater sound experimentation, Commander Davis R. Hull, U.S.N., heads this Design Branch of the Radio Division. Commander Hull, a 1925 graduate of the Naval Academy, later took postgraduate work at Cruft's Laboratory, Harvard University. He came to the Radio Division after three years of experimental and developmental work in radio, radar, and sound at the Naval Research Laboratory, Anacostia Station, Washington, D. C. Commander Hull supervised the first installation of modern underwater sound equipment while he headed the Underwater Sound Section of the Radio Division. He has had a wealth of experience in radio duties at sea as communications officer of battleships, destroyers, and a destroyer fleet.

Production and Procurement

The Production and Procurement Branch handles the orders and keeps stock records and all incidental correspondence. It cooperates with the manufacturers, WPB, OPM, and other priority boards on priorities and allocations, and acts to expedite the delivery of equipment. This branch is headed by Commander P. K. Leberman, with assistants for procurement and for production matters as shown on the Radio Division chart.

Installation and Maintenance

The Installation and Maintenance Branch initiates procurement in line with established allowance. It has also the important responsibility of seeing to it that the equipment is properly installed by the various Navy Yards and construction activities, and that facilities are available afloat and at shore bases for keeping it in good working order.

The branch is headed by Captain Alfred Marcellus Granum, U.S.N., a graduate in radio and communications engineering courses at the Naval Academy and at Harvard. He has had considerable experience on sea duty and in the old Bureau of Engineering as well as in his present position. Captain Granum makes occasional tours of inspection in combat zones to survey the performance of radio, and other electronic equipment installations.

Bureau of Aeronautics

On aircraft radio, the Navy's Bureau of Aeronautics decides on requirements and sets up general specifications covering such characteristics as size, weight, mounting, number and location of controls, etc.

(*Continued on page* 210)

Commander
August J. Detzer, Jr., USN

Commander
Earl E. Stone, USN

Radio in Plane and Tank

VITAL PART played by radio communication facilities in all phases of the war are emphasized in these two views showing typical installations behind the side gunner in an American bombing plane and in an M3 light tank

AMPHIBIOUS Warfare

Hypothetical amphibious attack is used to illustrate applications of various Signal Corps radio and telephone services

The importance of adequate and proper communications in modern amphibious warfare with radio and telephone playing key roles in directing the forces and maintaining the liaison of command was again demonstrated in the landings of the Allied forces on Sicily. To coordinate the invading forces—the Americans at Gela, Canadians at Pachino and the British at Augusta — communications constitute a vital element of the attack.

The exact part of the U.S. Army Signal Corps in the Sicilian invasion obviously cannot be told. But a broad picture of the Signal troops' activities and functions as to what can be expected in a waterborne invasion can be described only by using a purely hypothetical case. Such plans, too, can be used only as guides because the "fortunes of war" make any plan subject to the exigencies of specific operations.

Division Signal Company

X Division, part of the United States Army Task Force, will have been assigned the establishment of a beachhead in one particular sector of the shores toward which the invasion is pointed. In addition to the usual complement of infantry, artillery and other special troops, X Division includes a Division Signal Company. In that company are a radio section, a telephone and telegraph section, an intercept section, a direction-finding section and construction, service, repair and maintenance sections—all assigned the job of insuring proper communications for the troops ashore. During the first phase of amphibious Task Force approaching its objective with the bombardment of the shoreline by the Navy and concentration of bombers and strafing fighters concentrating on the same spot, the rangers and commandos make the initial landing with army assault troops following up.

During this first phase communications would be short and direct. The Handie-Talkie and Walkie-Talkie radio sets, both carried by single soldiers, would enable shock troops to keep in contact with each other and with divisional headquarters aboard a ship. The Handie-Talkie, a small compact radio-sending and receiving instrument which can be carried by a single soldier in one hand, has a range of several miles. The Walkie-

COMMUNICATIONS in the first phase of amphibious warfare are short and direct with Handie-Talkie and Walkie-Talkie radio sets carrying the brunt of the load

BEACHHEAD establishment calls for the use of portable equipment more powerful than individual soldiers carry

PORTABLE-mobile radio equipment carried in the ubiquitous jeep provides emergency headquarters for landing operations

Talkie is similarly a small, compact radio sending and receiving instrument that is carried on the back of a single soldier just as a haversack is, and its range is somewhat greater. Visual signalling, such as flag hoists, lamps, and pyrotechnics would be used by the Navy during the early phases to control landing traffic and gunfire.

Short-range radio

Short-range radio would also be used to maintain communications for air support. Air-support units would be in constant contact with Air Force headquarters and would enable ground troops to call for and receive tactical air support.

Depending on the tactical situation, it might be several hours or even several days before the battle enters the second phase. When this does occur, signal communications would begin to expand with telephone as well as radio. Assault wire which is a thin, light line would be laid to connect up the command posts of the various assault battalions.

As depth is gained by the forces, use would be made of more powerful radio. One sample of this type is the vehicular radio set, which can be mounted in reconnaissance cars, half-tracks, etc. For use in conjunction with jeeps and other vehicles, the cavalry guidon radio set, originally made to fit into the guidon boot, would be used. By this time, tanks, each of which has a radio, also would be ashore and probably operating.

Combat communications

At the end of the second phase, with success, sufficient depth would have been established to allow regular combat operational communications to be established. The long-range mobile headquarters set would be set up for divisional and corps headquarters communications. This set has a range of several hundred miles. The light, fragile assault wire would be superseded by regular field wire. A message center would be established, together with comprehensive radio and wire systems.

Assuming, as the invasion continues, that the objective, in addition to establishing a beachhead, is a town some miles inland, Signal Corps troops would have their part to play. Special combat teams would be racing for the nerve centers of the town as soon as it was entered by our troops. Included among them would be two groups of Signal Corps soldiers: a telephone team and a radio team.

Take local radio transmitters

The telephone team would have as its assignment the taking over of the local telephone plant, its rehabilitation if necessary, and its operation for our own use if possible. The Signal Corps telephone men would have the job of utilizing existing telephone and telegraph communications, and should they not find such facilities, of puting up rapid pole-line construction for overhead wire, or of laying the special spiral 4 field cable. In most cases these wire men would find it necessary to "bridge," for some of the telephone lines would run out into enemy territory. In that case special wire crews would go out and tap the line within the farthest boundaries of our own advance and connect the two taps with field wire.

The radio team would have as its objective the local radio station or stations. Its job would be to take the radio station over, repair it if it is damaged, and put it back on the air for the use of American forces. The radio station would be used for long distance military communications, announcements to the local populace, and for our own propaganda. It might be mentioned that the establishment of powerful radio broadcasting and receiving stations for military purposes would also be a part of the Signal Corps' responsibility. Ultimately our forces would have a broadcasting and receiving station for military communications powerful enough to reach the United States, London, or any of the headquarters of the United Nations.

The work of the Signal Corps radio interception and direction

(*Continued on page* 208)

HANDIE-TALKIES provide quick, sure contact with landing forces

UHF COIL DESIGN

Calculating dimensions of inductances for the highest frequency ranges at which ordinary triode is effective

The design of ultra-high-frequency circuit components frequently calls for the computation of inductances that are outside of the rules, tables and charts that have been found useful for coils for use at lower frequencies.

The following analysis deals with inductances of a size useful in the highest frequency ranges at which the usual negative-grid triode oscillator will work. In other words, the coils described are about as small as a coil can be, in practical design and still be called a "coil."

The problem has two parts—the first, to determine the dimensions to give a certain inductance—and second, to compute the resulting inductance from a given set of dimensions. At first it might seem that these problems are identical, but unlike computations of many-turn single layer coils, the inductance formula that takes into consideration the wire size and turn-spacing so complicates the design that a rigid method that will give a predetermined inductance is not always practicable. The easiest way out is that suggested in the following analysis: use a system that will give the nearest approximation and still is simple enough to permit several dimensional variations to be determined by comparison, to be followed by a more rigorous determination when the rough set of values has been indicated.

Chart I is first referred to, if it is not known just how much inductance is needed in a certain set-up for a given frequency. This is the well-known LC relation but is extended to the particular inductance range useful at 30-3000 megacycles. While this chart is arranged to cover the usual values of L and C, many unusual values of L/C are found in modern circuits, so in case it does not fit, multiply or divide the L scale by 10 and do the reverse to the C scale.

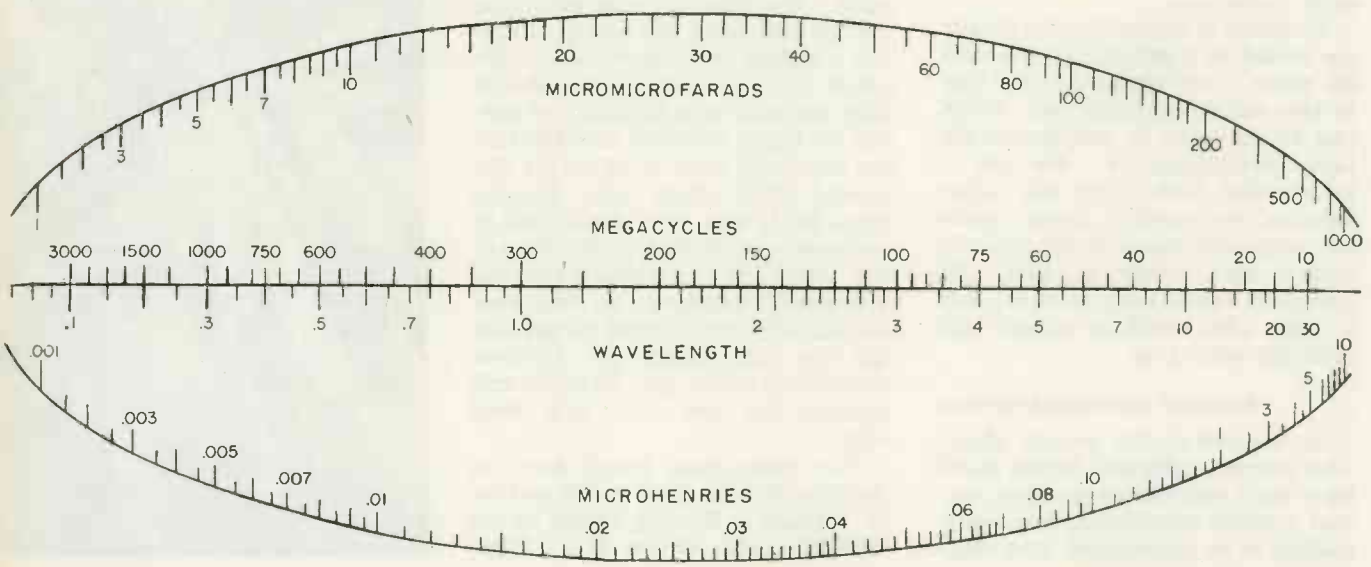
Of course, both L and C refer to the total values present, and not those of the coil and condenser alone.

Coil dimension factors

Chart II provides an easy method of finding out constructional details when a given inductance is needed. It is based on a "current sheet" formula, as is usual in such charts, and while it may be in error 5-10 per cent in some remote cases, it does give an easy way of determining how big a certain coil should be. The method of using this chart is illustrated by an example on the chart itself. At the left is a scale which takes care of the factor of winding pitch, or "turns per inch" in practical units. The family of curves at the right end of Chart II determines the "shape factor." It is to be noted that coils with small diameters have a considerable inductance shift with a slight change of that diameter, as evidenced by the steepness of the curves. In using these curves, take note that the diameter of a coil is equal to the diameter of the winding form plus the diameter of one wire. The length of a coil is equal to number of turns times the distance between centers of adjacent turns. In selecting the shape values for a proposed coil, it is suggested that the wire size and pitch be selected first, so that the "turns-per-inch" value can be indicated on the left scale. A straight line from this point through the inductance value on center scale is extended to the Shape Factor scale at extreme right. It will be noted that several different diameter-to-length ratios can be used to give a certain inductance, giving considerable leeway in design. Pairs of values that can be used are on the same horizontal line extending toward the left from the required Shape Factor point.

Opinions differ somewhat as to the best shape ratio and there is no single universal rule that cov-

CHART I—Nomographic chart of LC values in the short wave range



ers all cases. A value of D/l equals 2.46, has been suggested by Bull. No. 74 of the Bureau of Standards as giving the maximum inductance with a given length of wire. The locus of points bearing this relation is shown as the broken line (R).

Some designs will be based on purely physical details—the winding form must have a certain diameter, so that it will fit into a given shield. Other designs must be based on obtaining the highest possible Q. Still again, the design might be based on temperature drift considerations.

In the latter case, it will be seen that if all dimensions of a coil change linearly due to temperature, a first order change is noted in the inductance—the greater the expansion, the greater the inductance. However, few coils follow this simple rule in practice: sometimes the diameter changes according to the expansion coefficient of copper, and the length according to the expansion of the material in the winding form. A material that expands twice as far as copper would seem to offer the best solution.

However, in the range of frequencies under discussion, many other effects enter into the problem, and when all is said and done, it is probable that very few uses for a zero-coefficient coil are found anyway, since the usual tuned circuit requires the coil shift to partially make up for the capacitance shift as well if it is at all possible.

Chart II is not complete inasmuch as it gives no indication of the inductance of a single turn. Rather than to complicate the basic chart, Chart III takes care of this special case. While the inductance of a single turn is mainly dependent on the turn diameter, the wire size also has some effect. The central scale of Chart III takes care of this, based on factor (turn diameter/wire diameter).

Other factors of importance that alter the inductance are: the change in the resistance of the coil with both frequency and temperature shifts, and the change in the amount of inductance in the circuit as the variable condenser is rotated, caused by a shift of the physical point where the center of capacitance is located as the plates become more or less enmeshed.

This brings up the question of how much the length of the leads from the coil to the rest of the circuit increases the inductance. This is a simple factor to figure, according to the rules, but actually, the shorter the leads the closer the coil is to other metallic objects that alter the field pattern and therefore the inductance. Tests have shown that it is hardly possible to improve the accuracy of the inductance computations as determined by the chart, in practical cases, and in fact it is just as difficult to predetermine the circuit capacitance when all factors are considered. It is possible, however, to strike pretty close to what is wanted and it will be found that these circuits are easy to trim to the desired frequency.—R. R. B.

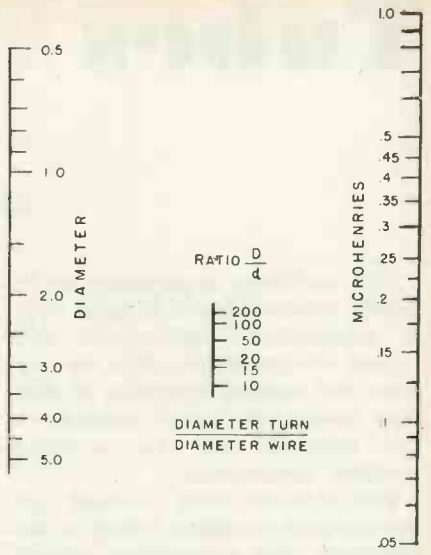
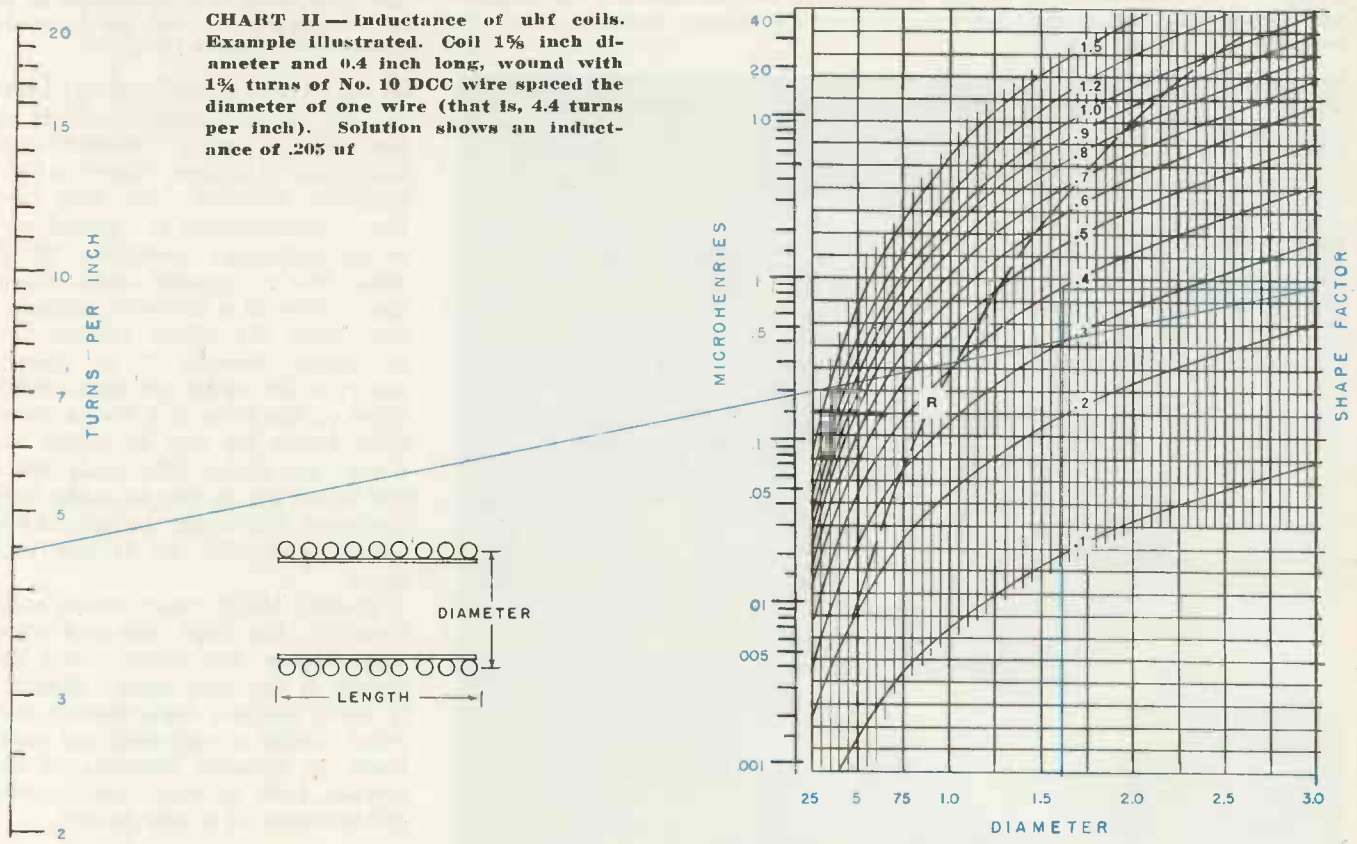


CHART III—Nomographic charts showing inductance of single turn loops

CHART II — Inductance of uhf coils. Example illustrated. Coil 1⅝ inch diameter and 0.4 inch long, wound with 1¾ turns of No. 10 DCC wire spaced the diameter of one wire (that is, 4.4 turns per inch). Solution shows an inductance of .205 uf



Tubes in Meteorology

by GILBERT SONBERGH

Electronic aids for the weatherman

The economic importance of accurate weather forecasting is firmly established, particularly with regard to agriculture. Now, in wartime, the success or failure of military operations often depends on the accuracy of the available weather information.

Few sciences must contend with the complex variables found in meteorology. For generations, investigators have sought formulas for long range forecasting and methods for predicting variations in the observed weather cycles. In these efforts, attempts are made to measure and record every known phenomenon pertaining to the "state of the weather," which phrase includes pressure, temperature, humidity, wind speed and direction, visibility, and other factors.

During the past few years, a number of electronic devices have been employed to detect, measure, and record such observed and invisible factors of the total meteorological picture. Lately considerable attention has been devoted to the possibilities inherent in electronic methods, by the U. S. Weather Bureau and others.

ILLUMINATION measuring unit. Weather Bureau mounts phototube, trigger tube, condensers and resistors inside frosted bulb filled with dry air

Theories of prediction

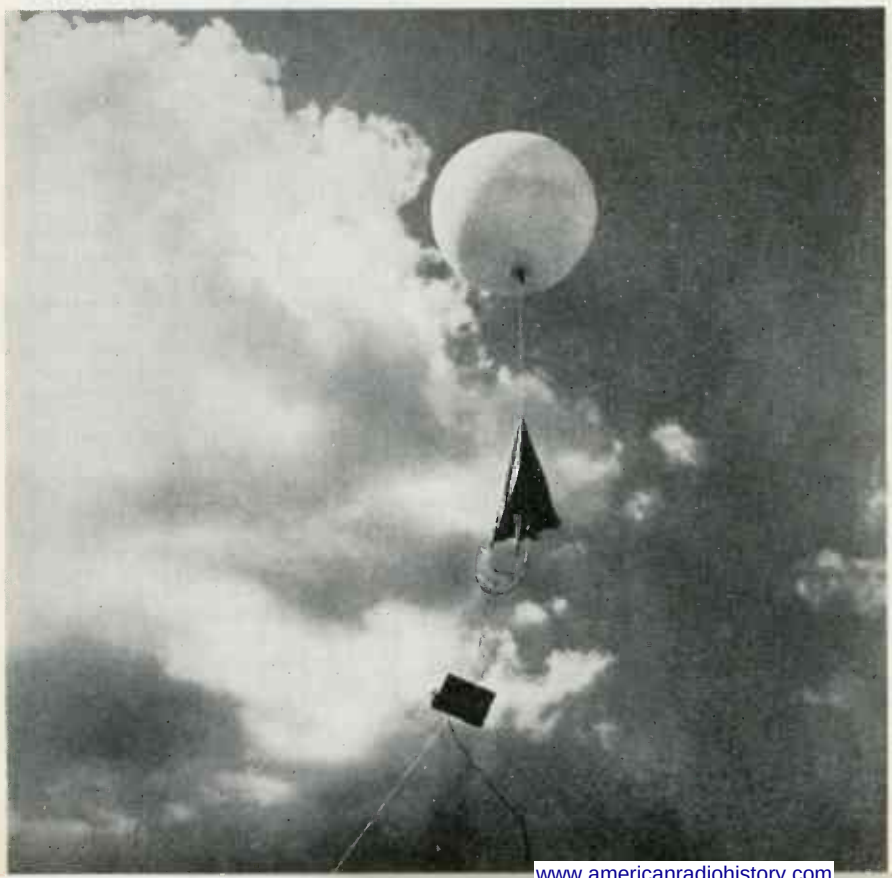
Two basic theories of weather phenomena of paramount importance are the air mass theory and the polar front theory. The widespread use of the radiosonde for upper air analysis is a direct result of the popularity of the air mass theory and is by now firmly established in this country. A successful consolidation of the air mass and cold front theories into a workable weather forecasting system is the air mass and frontal analysis technique.

Basic principles are as follows: First, that a stationary mass of air on the earth's surface quickly takes on the climatic characteristics of the area it covers. Second, that this mass of air may travel a considerable distance and still keep the characteristics it "picked up" in its stationary location. Third, when two air masses meet, one is likely to be of a different temperature from the other; the warmer air mass, because it is lighter, overruns the colder air mass, which takes on the form of a wedge whose apex forces its way in under the warm air mass. This may force the warm air to rise to quite high altitudes. The upper surface of the "wedge" of cold air is the cold front.

Fourth, clouds, rain, snow, haze, humidity, fog, frost, dew and other disturbances will occur along the length of the cold front. Similarly, such weather disturbances may occur inside a traveling air mass itself, if unusual features of the terrain, such as mountains, create disturbances of a like nature.

IMPULSE COUNTER constructed by R. J. Cashman for use with the Coblentz-Cashman-Rentschler phototube

RADIOSONDE, parachute, and balloon ascending on routine upper-air exploration. Balloon bursts at high altitude, parachute lowers transmitter; many are returned, reconditioned, and used again



Accurate weather forecasting depends to a considerable extent on the coordination of information pertaining to local conditions of temperature, pressure, humidity, wind speed and direction, etc., with similar information gathered at other near and distant points. A number of electronic devices are used both in gathering and transmitting such information.

Determining "state of the weather"

Probably one of the earliest applications of electronics to short-range forecasting was the use of a directional antenna on a radio receiver to determine the type and direction of "static" noise. Continuous records are being kept at many laboratory observatories in all parts of the world. A scheme

TUBES MOUNTED horizontally on reverse side of anemometer panel which is shown below at the right

making use of the principle is understood to be in operation at the present time on the Indo-Burma front. Discharges associated with different types of thunderstorms in various layers of the atmosphere can be detected at distances up to 800 miles and can be differentiated from each other. Selective direction finding equipment makes it possible to follow the low pressure areas preceding the Indian "monsoon," or rainy season, and to detect rotational and other movements of the low pressure air mass.

Applications in industry

A continuous record of the "ambient static level" in a given location, without regard to direction, is an important tool in certain types of process control. In manufacturing and processing photographic film, the presence of static charges above a certain level cause characteristic spark patterns — minute corona or brush discharges —to register in the sensitized emulsion. Installation of static level recorders, coupled with an automatic air-conditioning system to maintain the humidity at a level which inhibits such effects, constitutes an entirely satisfactory solution.

In powder and other explosives plants demanding unusual precautions against accidental spark discharges, static level recorders are widely used in conjunction with direction finding equipment to give enough warning to allow time for necessary safety measures.

Electronic anemometers

The conventional method of measuring wind speed entails the use of the familiar rotating cups, which are designed so that the number of contacts per minute represents wind speed in miles per hour. As each contact is made, a signal device such as a buzzer or lamp is energized. To determine wind speed, the operator holds a stop watch and notes the count.

Two types of electronic instruments to obtain a direct reading of the wind speed are being tested at the present time. The simpler of these makes use of the time constant of a resistance-capacitance combination for integration of the impulses from the anemometer. A constant voltage power pack supplies current to the capac-

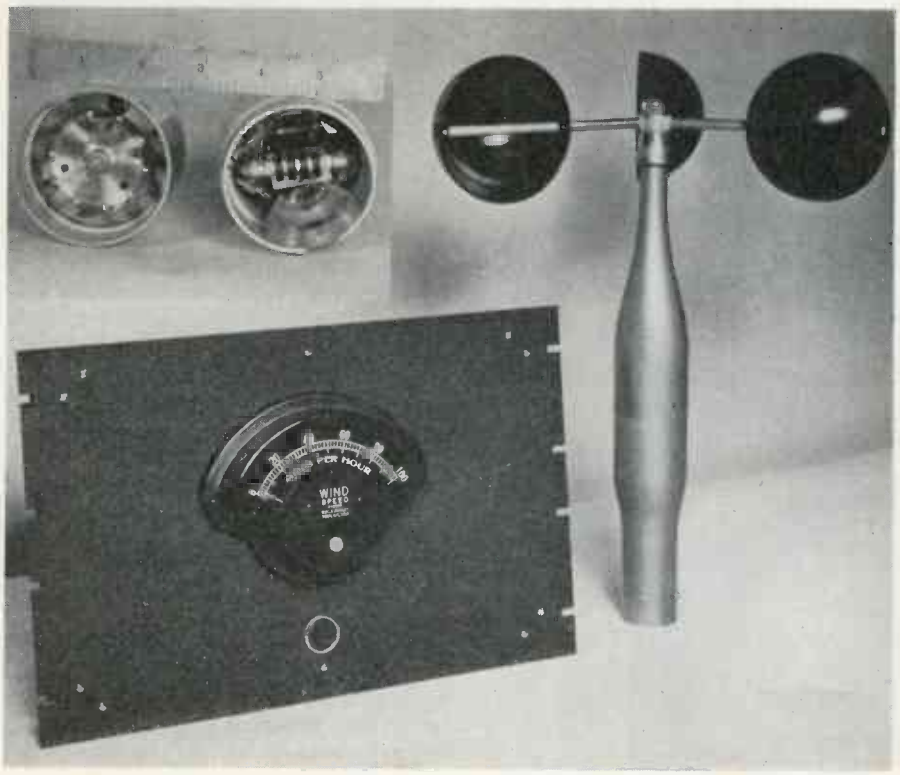
ULTRA - VIOLET Mg phototubes constructed for Bureau of Standards' W. W. Coblentz by R. J. Cashman, Northwestern University

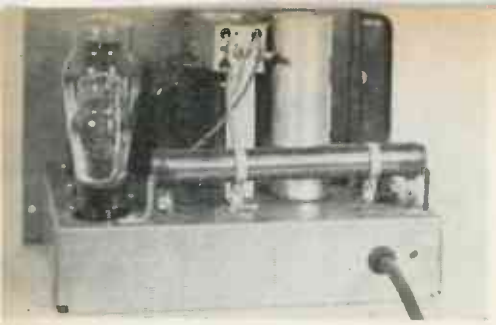
itor through the resistor once each revolution of the wind-driven shaft. Through an R-C filter network, the accumulated current is fed to a microammeter calibrated in miles per hour of wind speed. Thus the faster the wind, the more charging impulses received by the capacitor. Such an instrument is not of much value for wind speeds below four or five miles per hour and it is extremely difficult to achieve stability in the rather high values of capacitance needed.

Frequency type anemometer

At somewhat higher cost, these shortcomings can be obviated by the use of the frequency type of instrument. The model illustrated has a triode oscillator in the housing which supports the anemometer cups. Plate and grid coils of this circuit are embedded in Lucite with a small airspace between the

FREQUENCY TYPE wind-speed meter made for Weather Bureau by Gurley, Troy, N. Y. Inset, staff taken apart, showing triode oscillator components and 10-pole metal armature





WEATHER BUREAU'S experimental unit for registering and counting impulses received from condenser charged through radiation-measuring phototube

two. Vanes or teeth of a rotor driven by the cups pass between the coils, so that the oscillator output is pulse-modulated at a frequency, varying in proportion to the wind speed. The output of this oscillator is fed to circuits ending in a visual frequency indicator calibrated in miles per hour.

Solar and sky radiation

The total amount of solar and sky radiation of light of all wavelengths is of considerable interest to meteorology, agriculture, and biology alike. Measuring ultra-violet radiation, in particular, has been the subject of experimental work by the U. S. Bureau of Standards, the Weather Bureau, Dr. Harvey Rentschler of Westinghouse and others.

The only convenient instrument for the measurement of ultra-violet available in the early 'thirties was the Rentschler device, consisting of a titanium photoelectric cell

RADIOSONDE ground receiving-recording equipment made by Friez, Baltimore, Md.

and recording apparatus, used commercially to measure the output of mercury-vapor lamps for sterilization, irradiation, and photochemical processes.

The device was suited only to measurement of the radiation of the sun itself and a very small portion of the adjacent sky. However, the area of the sky is some 92,300 times the apparent area of the sun. It has long been known that ultra-violet radiation received from the sky constitutes from 30 to 50 per cent or more of the total received on a clear day. On hazy or cloudy days the percentage is higher.

Effectively to measure the total called for a light-sensitive cathode

CLOUD-HEIGHT indicator made by U. S. Weather Bureau detects reflection of vertical beam of light at night or in full daylight. Triangulation gives height (full details September issue)

in a horizontal plane, with an anode of two fine wires curved to form a hemispherical dome above the cathode. Very little shadowing of the cathode results. Several experimental tubes answering this description were produced by Professor R. J. Cashman, of Northwestern University, for Dr. W. W. Coblentz of the Bureau of Standards. Dr. Coblentz used this type of tube with the familiar integrating device in which the phototube charges a condenser to a critical voltage, at which point it discharges through a gaseous tube to operate a counting mechanism.

Since February 1, 1941, this equipment has been in operation at the Bureau of Standards in conjunction with a "traffic counter" recorder, which at quarter-hour intervals records on paper tape the

RESISTANCE - CAPACITANCE type of wind meter depends on frequency of charging condenser. Charge bleeds off into microammeter on front of panel

accumulated discharge impulse received from the condenser, the day, the hour, and the quarter hour. As a test of the action of the entire equipment, it was operated throughout two nights of bright moonlight; no ultra-violet was recorded.

Spectral response of cathode materials

The erythemal, antirachitic, and tanning wavelengths in the region from 2800 to 3200 Angstrom units, with a peak at about 2967, make up the spectral region it is desired to measure. No phototube has yet been produced which responds exactly to this band. Cathodes of titanium, cadmium, and magnesium were the most successful first used, with the magnesium type representing a fairly close approach to the desired sensitivity. In use, a correction factor was applied to

(*Continued on page* 208)

U-V PHOTOTUBE of 1942, made by Rentschler. Note two fine wires crossed to form anode. Zirconium-cathode tube, condenser, and trigger tube all enclosed in glass envelope

ELECTRON TUBES as Elements of CONTROL

by RALPH R. BATCHER

Fundamental tube circuits that will help establish more efficient manufacturing process control

In recent years the spirit of competition in the radio industry has taxed the ingenuity of its engineers in developing many radio set features that provide convenience and satisfaction to the user.

Contrasting the present day methods with those of a decade or so back, one finds that electron tubes are now the cheapest component of importance in a receiver and the most versatile, whereas before, all matters pertaining to quality had to be obtained by utilization of expensive electrical components with highest efficiency, greatly adding to the weight, bulk and cost.

Many types available

The unwritten rule of design was, "when some unusual effect has to be provided, find some way to make an electron tube do it." The tube manufacturing companies contributed immensely by developing tube types with rabbit farm abundance, and radio development engineers never had to wait long when tubes with special characteristics were needed. Not all of the types developed proved of great value but from the list there came a standard group of useful styles and much research knowledge that has contributed greatly to tube performance. Industrial production processes, research measurements and control have already benefited by having this wealth of specific information on electron tubes made available with the expenses already absorbed by the broadcasting industry as a whole.*

The electronic applications can be studied from many angles, but possibly the most useful introduction is a resume of the basic problems that have been solved with electron tubes. The tubes do not know or care whether they are plugged into measuring circuits or process controls, so the accompanying "Electronic Industries" chart is planned to cover the general conditions met with in all such fields.

A tube itself is a controlled instrument; some sort of driving potential must be applied and some other kind of effect is delivered. In either case there is a wide variety of functions that can be tied up with a tube's characteristics.

Eight basic sections

In all sections of the chart many symbolic representations are made and the actual circuits may contain other necessary equipment, such as operating power supplies, etc., and the general circuits which go to heat the tube filaments are omitted. This system of abbreviation is common in electronic circuits inasmuch as it permits the circuit features to be emphasized without introducing extra complexity in the diagrams. One symbol however may be new to some; the inclusion of a small dot within the tube symbol indicates a gas filled tube.

Those in the left half are dependent on AMPLITUDE characteristics; that is, some effect which deals with displacement, either electrical, magnetic, physical or in any other field of technical activity, is called upon to control another amplitude effect of a different magnitude and possibly at a different rate.

In section (I) at the upper left, basic methods for securing linear conversion are listed, (II) methods of selective control where the control transfer occurs only when some condition of margin, threshold level, rate of change, frequency, etc., is reached. In (III) are shown basic methods where tubes are used to introduce non-linear factors for stabilization or other control functions. (IV) shows how tubes are used to produce outputs following definite non-linear expansion or contraction laws.

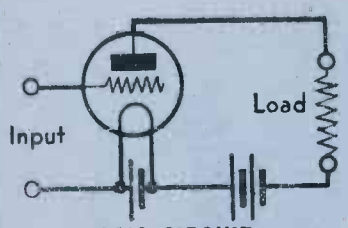
In the right half of the chart are numerous conversion systems using tubes wherein some TIME factor is involved. The sections take up (V) timing circuits which initiate single or a series of pulses having specific characteristics (VI) methods whereby the controlled function depends upon the

*Certain applications shown may have patent restrictions, however.

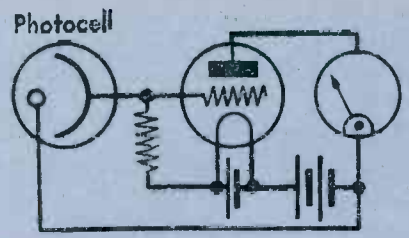
Look Inside for Large Chart (In Colors) of

THE ELECTRON TUBE AS AN ELEMENT IN INDUSTRIAL CONTROL

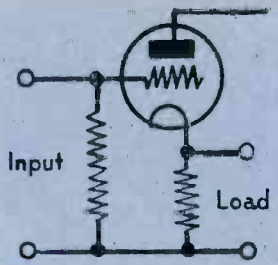
Unfold chart carefully



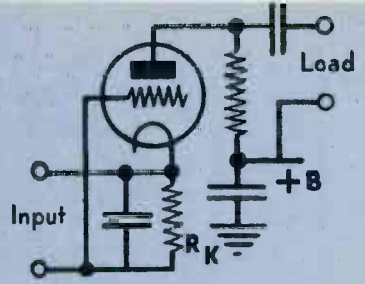
1 BASIC CIRCUIT OF TUBE AMPLIFIER



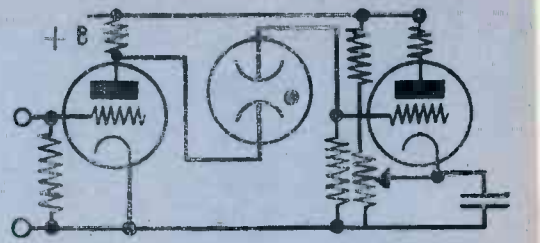
2 PHOTOELECTRIC MEASUREMENTS
TYPICAL APPLICATION



3 CATHODE-COUPLING IMPEDANCE CONVERTER

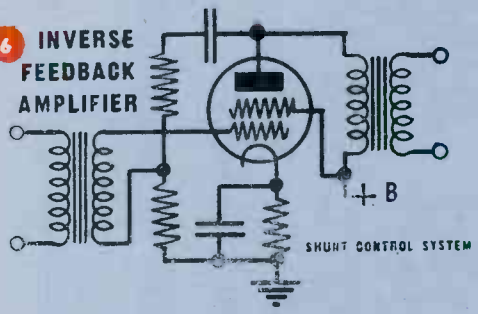


4 INVERSE CATHODE-COUPLED CONVERTER

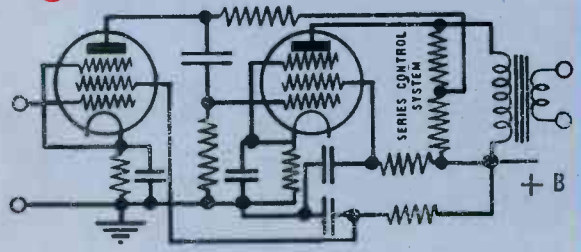


5 LOW FREQUENCY RESPONSE AMPLIFIER USES GASEOUS-TUBE COUPLING

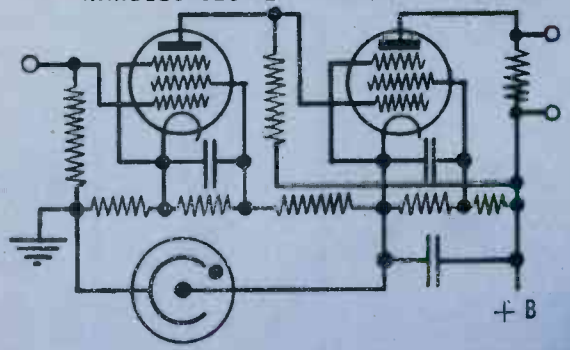
6 INVERSE FEEDBACK AMPLIFIER

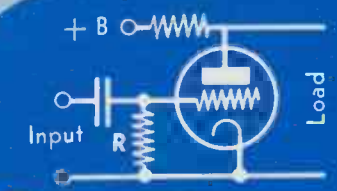


7 INVERSE FEEDBACK AMPLIFIER



8 DIRECT COUPLED AMPLIFIER HANDLES SLOWLY VARYING POTENTIALS

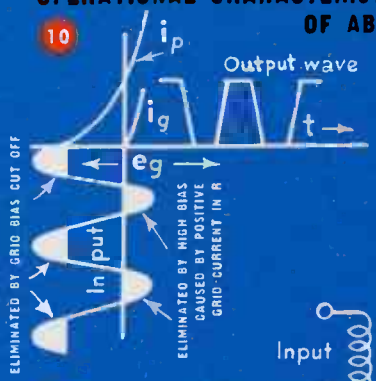


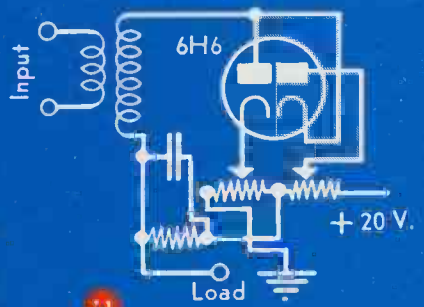


9 SIGNAL LIMITER USING LOW PLATE VOLTAGE

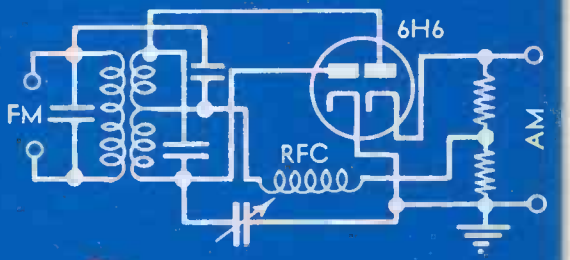
OPERATIONAL CHARACTERISTICS OF ABOVE

10



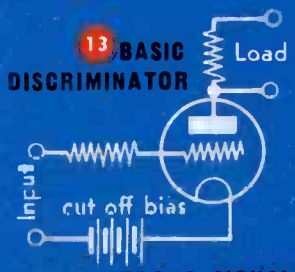


11 BALANCED DIODE LIMITER



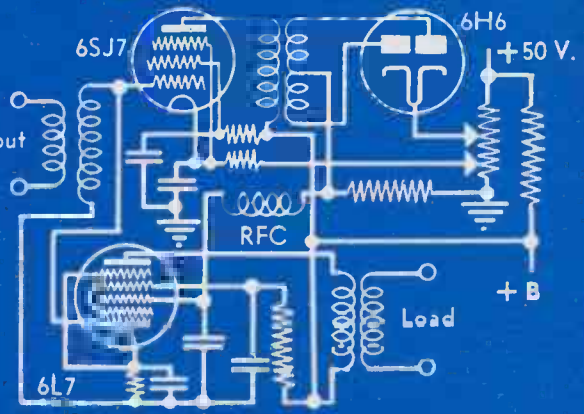
12 DISCRIMINATOR CIRCUIT FOR FREQUENCY MODULATION

13 BASIC DISCRIMINATOR



PASSES STRONG SIGNALS BUT NOT WEAK ONES

14 INTERFERENCE LIMITING CIRCUIT



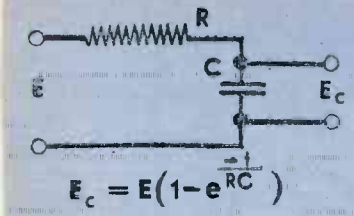
PASSES WEAK SIGNALS AND SUBDUES STRONG ONES

THE ELEC
AS AN
IN INDUSTRI

LINEAR AMPLITUDE EXPANSION

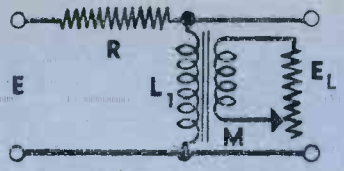
DISCRIMINATING AND LIMITING

AMPLITUDE



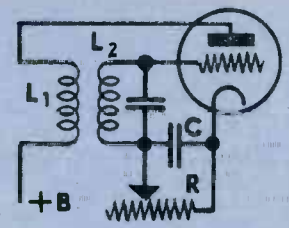
$E_c = E(1-e^{\frac{-t}{RC}})$

TIME DELAY
28 USING RC CIRCUIT

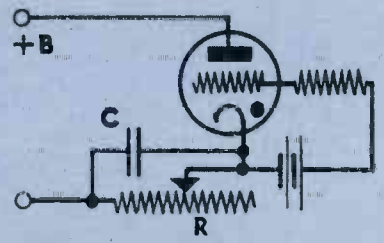


$E_L = Ee^{\frac{-R}{Lt}}$ where $L = L_1 - Mi_2/I_1$

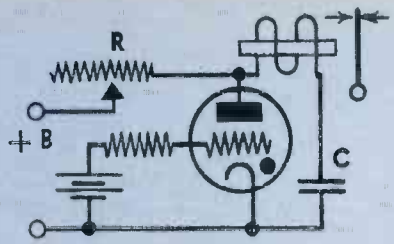
TIME DELAY
29 USING MUTUAL INDUCTANCE



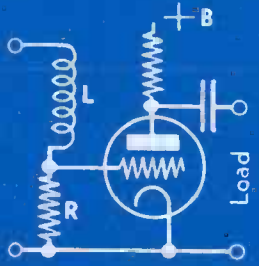
30 ELECTRONIC TIMER



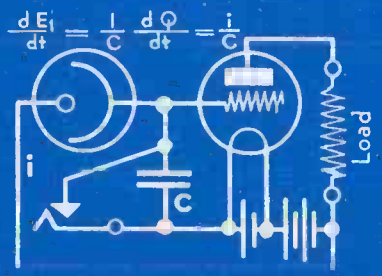
31 TIMING CIRCUIT
USING THYRATRON



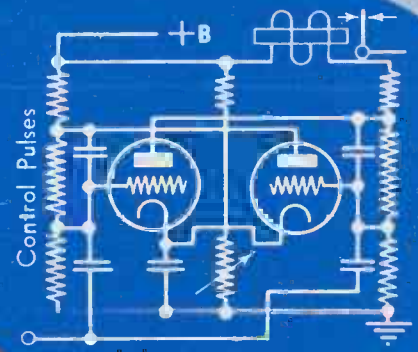
32 TIMING CIRCUIT
USING THYRATRON



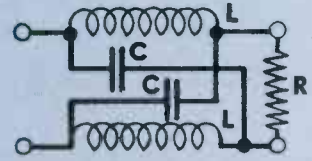
30 INTEGRATING CIRCUIT
USING L AND R



37 ELECTROMETER CONNECTION

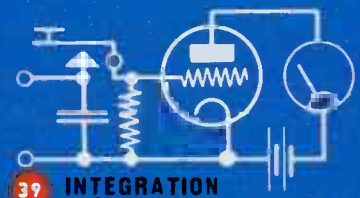


38 ELECTRONIC TOGGLE
OR FLIP-FLOP CIRCUIT

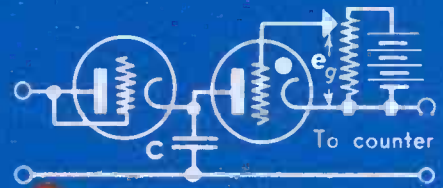


FOR CONSTANT ATTENUATION
$\sqrt{L/C} = R$
33 LATTICE TYPE PHASE SHIFT NETWORK

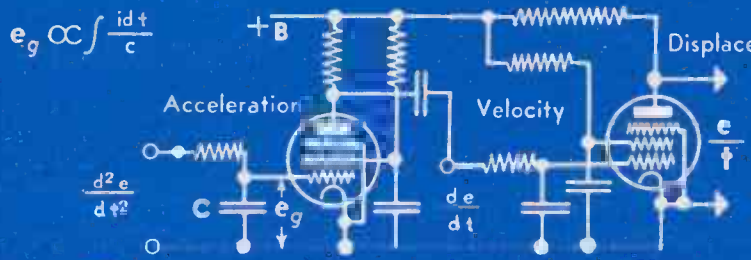
RON TUBE
LEMENT
AL CONTROL



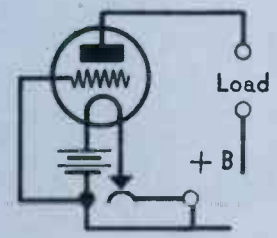
39 INTEGRATION
USING BALLISTIC CONNECTION



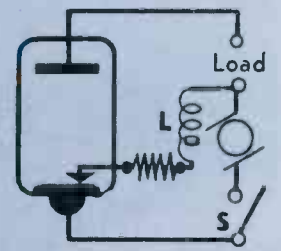
40 ELECTRONIC INTEGRATION
USING COUNTING



41 TYPICAL APPLICATION OF INTEGRATING CIRCUIT



34 DELAY USING
FILAMENT HEATING TIME



35 INDUCTIVE DELAY CIRCUIT
IN IGNITRON CONTROL LEAD

TIME

ELECTRICAL INTEGRATION

TIME INTERVAL CONTROL

integration of the varying controlling effects, (VII) or the converse where the output is proportional to the rate-of-change of the controlling effect, or (VIII) dealing with either delay or phase conditions.

These circuits are all based on the use of commonplace radio tubes. No reference is made to any of the special-purpose electron tubes that use beams of electrons controlled as to their direction as distinguished from the control of their density.

What is industrial electronics?

In a majority of industrial problems electronics deals with the correlation of vacuum gaseous, or photoelectric tubes with many types of presently used controls. Due to the nature of an electronic device itself such correlation is first concerned with electrical control appliances: relays, electric switches, motors, solenoid magnets, etc. The mechanics of physical movements in all other fields is but little different, from a basic viewpoint, and it is but a step further to bring into the picture such matters of temperature, color, magnetism, acoustics, noises, humidity, pressure and dozens of other physical phenomena. It can be pointed out that electron tubes are used both to instigate these effects and to investigate the results.

Linear amplitude magnification

This application uses a thermionic tube in its most elementary form—as an amplifier. Industrial usage generally deals with problems of handling large amounts of power and of selecting a tube and its operating conditions to match a given load. In common with most other electrical circuit operations, the impedance of the load should match that of the tube, and for a first approximation, the value of the anode circuit loading listed in standard tube characteristic tables can be used.

Item 1 shows the basic tube circuit (a triode) with a load connected in the anode. The anode battery may be from a few volts up, and in the chart is designated simply as a lead marked +B, with its negative terminal assumed to be tied in with the common or ground potential connection. The impedance of the grid circuit can be either low or high, as required by the set-up, since a grid is a voltage-operated electrode. Generally speaking input impedances of more than one megohm are avoided unless special precautions are taken to eliminate the flow of positive grid current.

Item 2 shows an example of a high impedance input, a photocell and a low impedance output, such as a milliammeter.

A vacuum tube is sometimes used as an impedance converter, Item 3, when an extremely low impedance load is to be supplied. There is no voltage amplification with this connection, although there is a "current" amplification.

Item 4 is a system of connecting a low impedance source to a higher impedance load. Here, if the impedance of the applied source is designated R_k, the input impedance is—

$$Z_i = R_k/(R_k G_m + 1) \text{ where } G_m \text{ is in mhos.}$$

When a multistage amplifier is used at low frequencies, a two-electrode gaseous tube such as a neon lamp is frequently used as an interstage coupling link, Item 5. A higher bias voltage on the second tube makes up for the current passed by the lighted lamp.

Although, unlike the communication problem, amplifiers in industrial applications may not have to handle a wide range of frequencies, certain conditions may exist where improved operating characteristics or a wide band of frequencies may have to be covered. Inverse feedback amplifier connections, of which there are numerous types, may be used. One plan, Item 6, uses a shunting connection to feed back a signal from the output of a tube to its input circuit. Item 7 indicates a series feedback connection permitting a potential due to the anode current in the last stage to be fed back to a previous stage with correct phasing to improve the amplifier characteristics.

A multistage amplifier wherein the successive tubes are coupled through condensers will not successfully amplify frequencies below a few cycles per second. Item 8 shows a two stage amplifier without coupling condensers that will amplify direct-currents of a slowly varying nature as well as higher frequencies. A VR-150 regulating tube prevents the current through the final tube from adding degeneration to the first stage.

Electron tubes as discriminators

In Section II certain useful arrangements are shown wherein tubes function only when certain conditions are met. Item 9 shows a basic limiter circuit where the pulse level output remains constant no matter how much the input exceeds a predetermined level. Here the input operates with a very low anode potential, no bias and with a high input grid resistance. As shown in the curve relation 10, negative swings are clipped when the signal exceeds the grid cutoff point, while positive swings are clipped due to a high bias appearing in the grid circuit as soon as the grid "goes positive."

Another arrangement which will produce similar effects (Item 11) uses a double-diode rectifier arrangement. This is a very early system for reducing radio interference in communication receivers. The two diodes are connected in parallel but series opposing. If both tubes had identical characteristics they would balance each other's signals out. However, one diode is biased for high sensitivity and the other so that it will function only on strong signals. There is, therefore, a certain operating range over which the balancing effect is ineffective.

A circuit, frequently used in communication receivers and which may find some use in telemetering and remote control installations, is a frequency-modulation converter (Item 12). This arrangement changes a frequency modulated signal to an amplitude modulated one. There are many simple methods whereby an electron tube oscillator can be made to shift its output frequency in accordance with some applied physical effect. This circuit (12) is used to convert the signals at the receiving position into a variation in amplitude level—for instrument recording, etc.

A basic discrimination circuit of value, which makes a recording position immune to minor variations in control signal (interference, etc.) is that in Item 13. Here a tube is biased so that it will act

only when a strong signal is received.

Another circuit which has the reverse effect, Item 14, passes weak signals but is more or less immune to strong ones. This action is due to an auxiliary pair of tubes (6SJ7 and 6H6) which take note of the incoming signal levels and produce a bias potential that chokes off amplifier action in the 6L7 tube when the signal gets too strong. The level at which this occurs is adjustable. The resultant output can even show "voids" when strong overloads occur. This must be considered when the use of this circuit is contemplated. It is a common form of "static" reducer in communication receivers.

As a circuit element

In Section III are listed a few basic applications of electron tubes as circuit varying and stabilizing elements. A pentode has the very interesting characteristic that the anode current passing through the tube is independent of the voltage applied (at least when the latter is greater than about 50 volts). Item 15 calls attention to this property where de/di = infinity. Tube characteristic curves for any pentode show the conditions where this is true and those whereby the current level can be preselected.

The use of a tube as a variable resistance is also common (Item 16). It can be used as a negative resistance, negative inductance, or a negative capacitance. Item 18 shows a system of connections where a negative resistance element can be applied to another circuit, using a feedback connection. Here E_c must be several times as large as E_p and E_s is about $0.1E_c$. There are many variations of this effect and many applications of value in industrial control. Item 19 shows the peculiar curvature of the characteristic curve of the tube wherein a decrease in voltage at X, results in an increased current. Negative resistance effects occur in this region.

In Item 17 is shown a practical application of a tube as a resistor. Here a triode is connected in series with the load. Its control grid is coupled to a voltage regulator VR-105 and an amplifier tube (6SJ7) is such a way that any change in the input voltage or any change in the load factor is immediately noted and the resulting voltage change in the output corrected. These stabilizers for power supplies are in wide use in many fields of activity.

A simpler voltage stabilizer for small changes in applied voltages or load currents can be provided by the simple regulator tube circuit, Item 20. Tubes are available to hold voltages constant at either 75, 105, or 150 volts (VR-75, VR-105 and VR-150).

The use of a vacuum tube as a variable impedance is shown in Item 21 where modulator tubes T_1 and T_2 alter the operating characteristics of the self-excited oscillator T_3, to produce a current whose frequency shifts in unison (and if desired over quite wide ranges) with potential variations applied to the input circuit of the modulator tubes.

In section I arrangements were shown wherein a linear relation exists between the input and output levels of a tube. In many control functions it may be necessary to alter this proportionality factor in accordance with some other law. Section IV lists a few electronic possibilities along this line. A general circuit, Item 22 which permits the magnification factor to increase as the input increases (expansion) or to decrease as the input increases (compression) at will, by using the switch, and according to an adjustable incremental rate.

Other circuit elements having non-linear characteristics can be combined with tubes to produce similar effects. Item 23 shows copper oxide or selenium barrier-layer cells (which have a non-linear input-output characteristic) connected as a cathode load (see Item 3). This circuit is useful in making a single instrument scale cover large ranges in the applied control level. Item 24 shows a similar effect using vacuum tubes of the double-diode type.

Items 25 and 26 show typical circuits using tubes of the remote cutoff type, which have been purposely designed to have non-linear input-output characteristics. There are numerous styles of tubes with such characteristics available. In order to function in this way, a separate rectifier is provided on each stage, to provide a bias which becomes more negative as the signal increases. These tubes can be adjusted to show logarithmic characteristics over a certain range, but several stages can be connected in tandem to produce logarithmic action over wide ranges (Item 25).

A tube can be connected (Item 27) so that any input signal is amplified and rectified and the rectifier output connected so that it will block off the amplifier action if the signal gets stronger than a certain value. In 27, the relay releases when an appreciable signal is applied. The variable resistance R which can be of the order of one megohm can be used to adjust the threshold of this effect.

Circuit functions involving time

The circuits on the left half of the chart were concerned with amplitude relations. Now effects involving Time will be considered. In section V numerous arrangements are listed by which a delay function can be introduced. Simple RC (Item 28) and RL (Item 29) networks are common in all kinds of electrical circuits. They are quite effective in connection with vacuum tube arrangements since the latter are usually high impedance devices and substantial delay action can be obtained with high R values even if the C value is small. Inexpensive combinations are therefore available.

There are numerous low-frequency oscillator arrangements where a series of pulses having prearranged intervals can be generated for timing purposes, or if desired a single pulse can be produced after a given delay for process control.

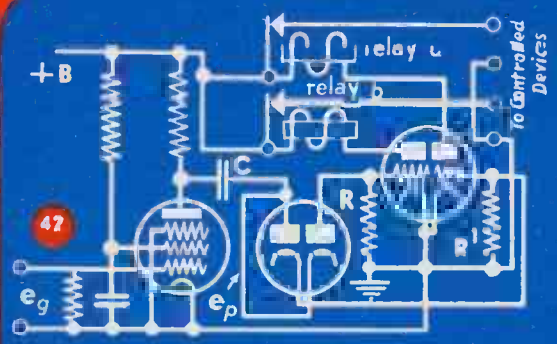
Such circuits are used in weld timing, cathode ray time-base generators, inverter devices, and other applications. Item 30 shows a self-excited oscillator that generates a few cycles of energy charging up the condenser C by grid rectification. This charge has to leak off through a high resistance R before oscillations can start again. This intermittent recurring action is controllable by the adjustment of RC combination. In 31 the condenser C is quickly charged by thyratron and slowly discharges through R. In 32 it slowly charges through R and rapidly discharges. In either case a relay in series with the condenser will operate each time the thyratron fires.

In communication circuits a delay can be introduced by a lattice

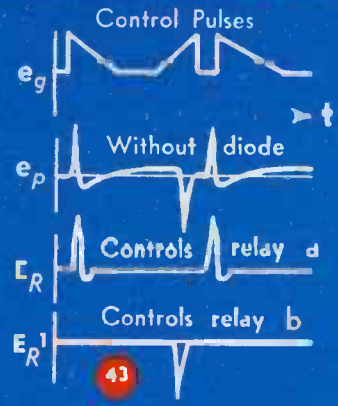
it, neutralize or magnify physi-
s, in connection with valves,
mes, electrical energy, chem-
r other tools of precise control.

R. BATCHER
INDUSTRIES

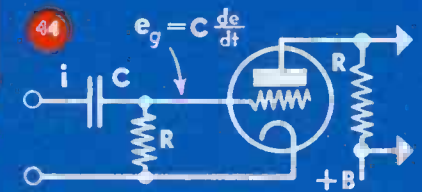
ELECTRICAL DIFFERENTIATING



42 SEPARATION OF SIGNALS BY WAVEFORM

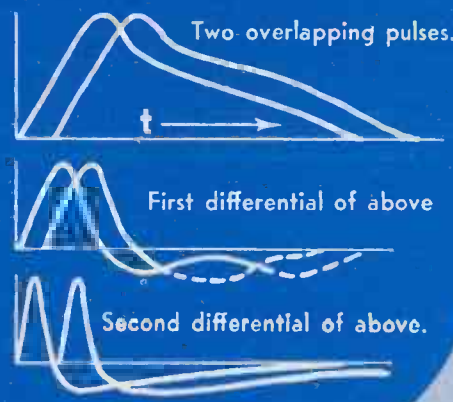


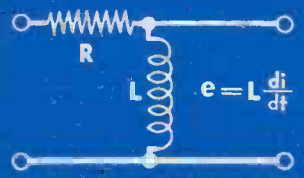
43



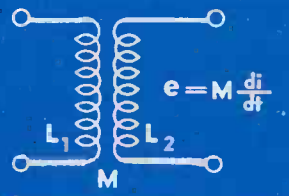
44 DIFFERENTIATING WITH RC CIRCUIT

45 PULSE SEPARATION USING DOUBLE DIFFERENTIATION.



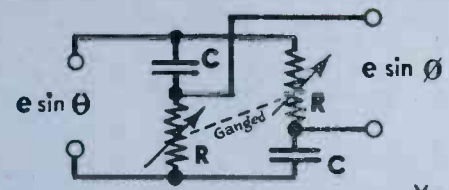


46 DIFFERENTIATION WITH L·R NETWORK



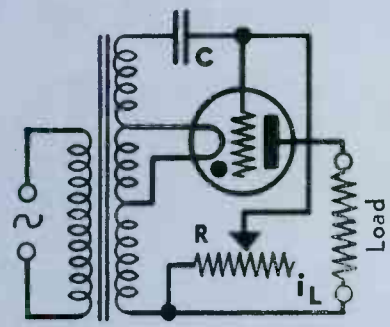
47 DIFFERENTIATING WITH MUTUAL INDUCTANCE

CONTROL BY PHASE SHIFTING



40 $e \sin \phi - \left(e \sin \theta - 2 \arctan \frac{X_C}{R}\right)$

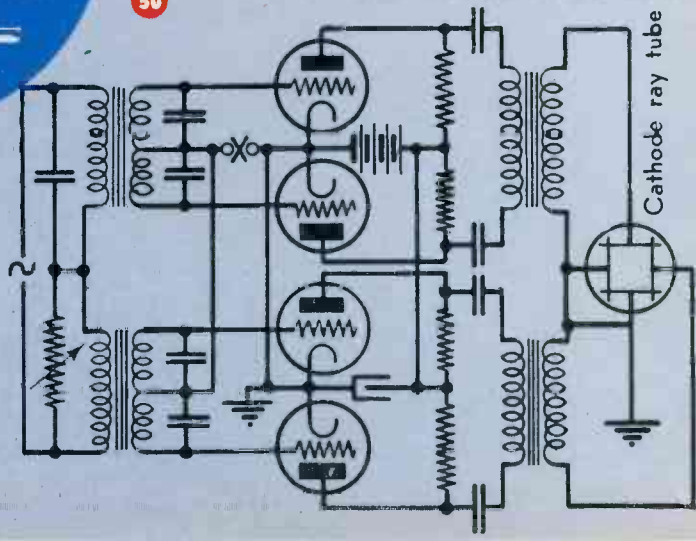
PHASE SHIFT USING GANGED RESISTOR.



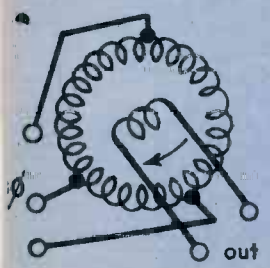
49 PHASE CONTROL OF THYRATRON FOR LOAD CONTROL

AMPLIFIED PHASE ROTATING CIRCUIT FOR CIRCULAR TIME BASE

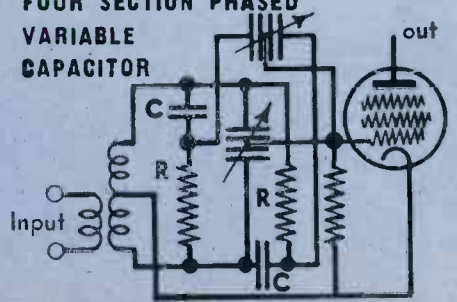
50



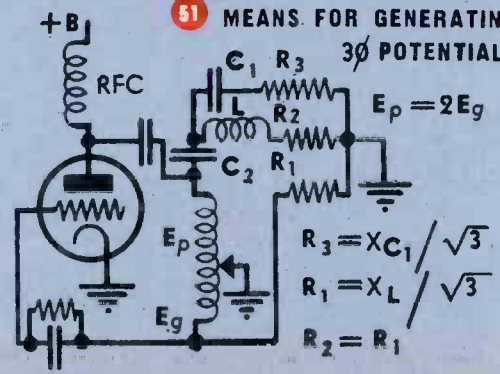
53 PHASE SHIFT USING SELSYN TYPE MOTOR



52 PHASE SHIFT NETWORK USING FOUR SECTION PHASED VARIABLE CAPACITOR



51 MEANS FOR GENERATING 3Ø POTENTIALS



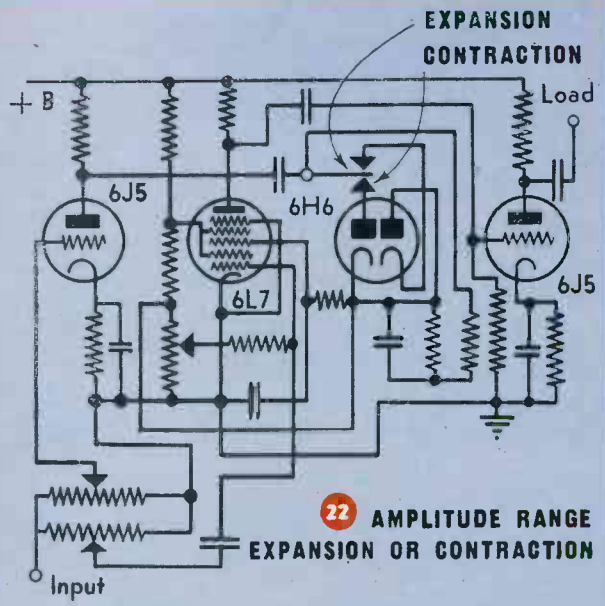
AMPLITUDE

NON-LINEAR AMPLIFIER EFFECTS

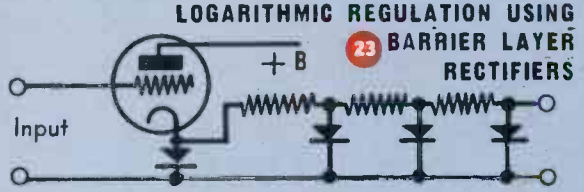
USED AS CIRCUIT ELEMENTS

How tubes can be used to tran
cal actions in industrial proce
motors, solenoid magnets, gas
ical equipment, timing device

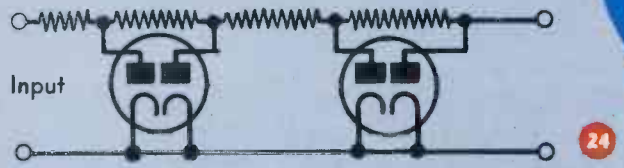
COMPILED B
ELECTRONIC



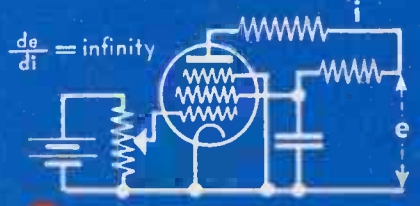
22 AMPLITUDE RANGE EXPANSION OR CONTRACTION



LOGARITHMIC REGULATION USING
23 BARRIER LAYER RECTIFIERS

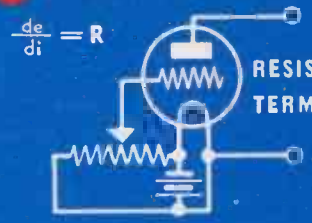


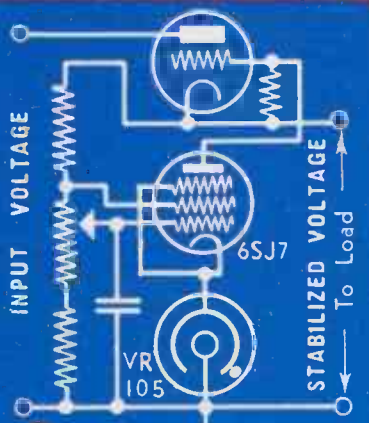
24 LOGARITHMIC REGULATION USING DIODES



15 CONSTANT CURRENT DEVICE

16 VARIABLE RESISTANCE DEVICE

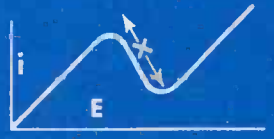




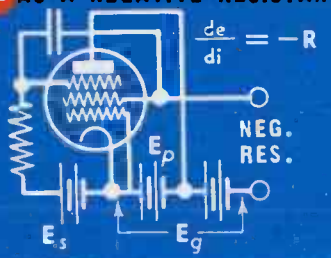
17 VOLTAGE STABILIZER

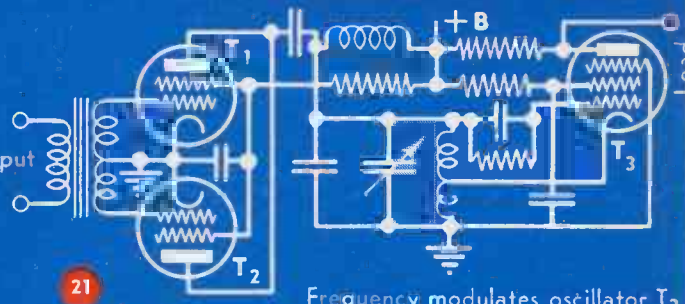
VOLTAGE STABILIZER 20

19 CHARACTERISTICS OF NEGATIVE RESISTANCE



18 AS A NEGATIVE RESISTANCE



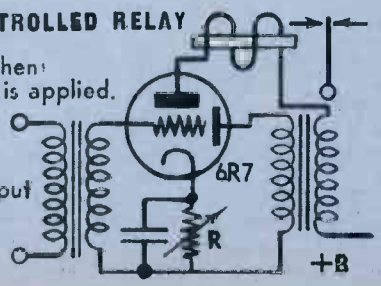


21 BALANCED REACTANCE TUBE MODULATOR

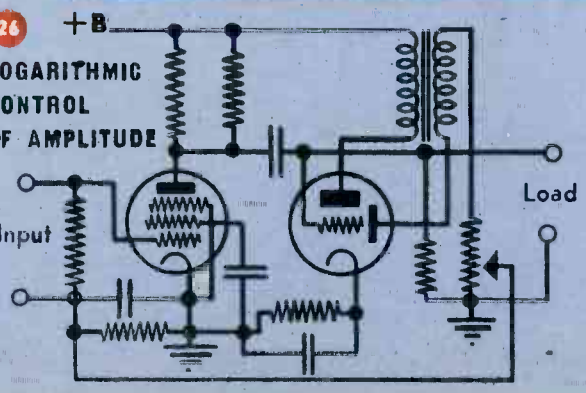
Frequency modulates oscillator T_3

27 TONE CONTROLLED RELAY

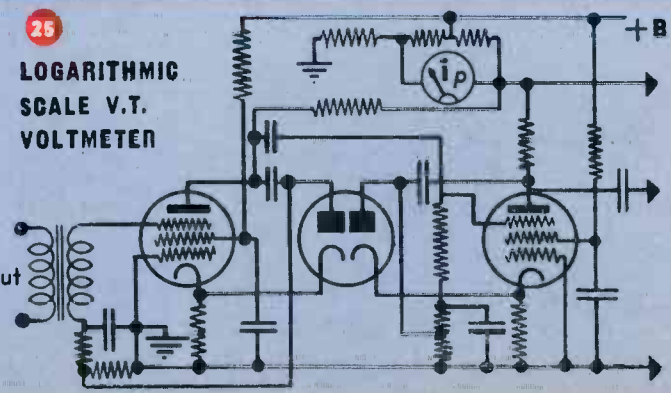
Releases when any signal is applied.



26 LOGARITHMIC CONTROL OF AMPLITUDE



25 LOGARITHMIC SCALE V.T. VOLTMETER



To other stages to expand range.

network, 33, without frequency attenuation if $R=\sqrt{L/C}$. Then $\theta=\text{arc tan } 2\div(f/fo-fo/f)$ where $2\pi fo=1/\sqrt{LC}$.

A simple, although somewhat indefinite time delay is accomplished by using the heating time of the tube to delay the anode current flow. This system is not safe when high voltages are involved owing to cathode surface deterioration when some tubes are used at low filament temperatures. A pure tungsten filament is not thus affected however.

In high power service, an ignitron tube with some type of delay network, such as a large inductance (Item 35) can be used to delay operation for a short interval. Many variations of this principle are in use.

Electrical integration

The effect of taking note of the cumulative or resultant value of a varying effect can be accomplished electrically in several ways. A simple LC filter changes a rapidly pulsating potential into a more or less smooth one. Integration circuits can also be based on L and R values (Item 36) or RC values. In Item 37 an electrometer tube (one arranged to have no appreciable grid current when used at low anode potentials, say six volts, so that no grid leak need be used) connection is shown. In this application, light, as from a star permits a photocell to slowly charge a condenser. The tube shows the rate of accumulation of charge on C by rate of change of anode current as indicated by the relation shown at Item 37. At frequent intervals it is necessary to discharge C using a key or switch.

A similar use, Item 38, permits the charge to accumulate on C for a definite interval whereupon it is discharged through the tube input circuit. The tube and its attached load are ballistically operated.

A curious circuit, used at times in electronic counting of discharge rates (as of alpha-particle ionization effects) is the flip-flop circuit in which one or the other of the tubes is always operated. A suitable pulse applied to the input circuit will cause the operation to jump to the other tube. One complete cycle of events takes place after each pair of pulses, so that each set-up as shown will divide the pulse rate by 2.

In 40, another counting circuit is shown. The rectified input signal charges the condenser C. Each time the charge exceeds a predetermined value the thyratron operates and clicks up the counter one unit.

Many commercial vibration pickup devices, such as piezoelectric units give an output proportional to acceleration. Therefore velocity and/or displacement studies can be made with integrating circuits, such as in 41.

Differentiation

The reverse action to integration consists of differentiation. This function also can be accomplished by electrical circuits as shown in section VII. These circuits are often used to discriminate between pulse varieties as to wave shape. For example, circuit Item 31 gives a pulse with a sharp front, while 32 gives a gradual wave front and an abrupt falling off. A combination of these pulses which might be used in some remote control system, is shown in the oscillogram, Item 43.

The first derivative of this waveform is shown below as sharp positive and negative pulses, which can be separated by the use of diodes so as to operate the respective relays, as shown in Item 42. The method can be used to provide greater discrimination in counting random effects, when two pulses may take place close together so as to overlap as in the oscillogram 45.

The first derivative of this wave, shown here, has a somewhat greater separation, while the second derivative shows distinct separation. A simple RC circuit that can accomplish this differentiation is shown in 44. Other combinations of R and L and mutual inductance are shown in 46 and 47, which give similar effects.

Timing by phase effects

In section VIII of the chart numerous methods of producing and using phase effects are listed.

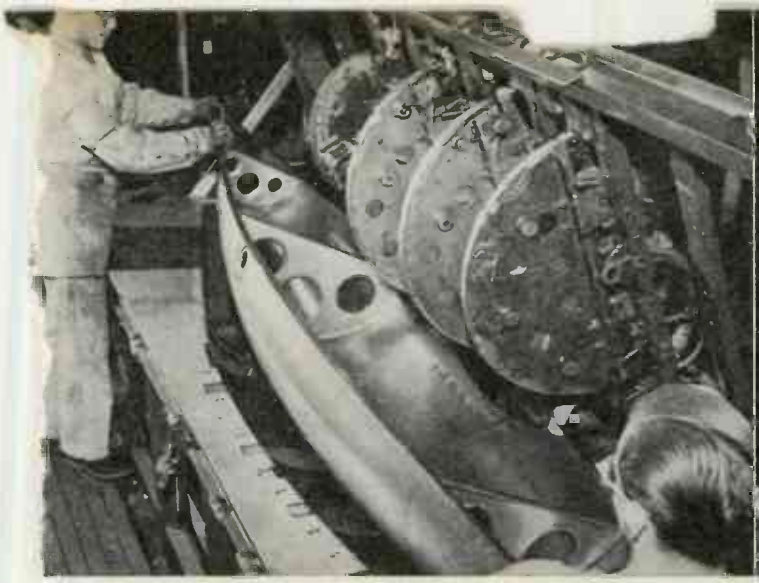
A simple phase-shift network using a two gang variable resistor is given in 48. The values of R and C depend on the frequency involved. Approximately 180° shift can be accomplished by the adjustment of the resistors. In 52 a similar network is shown using fixed resistors having values equivalent to the impedance of the condensers at the operating frequency. A special condenser with four stator sections and two rotor sections (the latter 90° apart physically on the shaft is connected to the RC network so that any phase angle over a 360° shift can be obtained. Each rotor section is mounted so that it has entered one section of stator by the approximate amount it has left the mating stator.

If the plate shape is of a proper contour (approximately a cardioid) the electrical shift can be made to coincide with the physical rotational shift, making the scale linear and direct reading. A mechanical arrangement giving full 360° shift uses a Selsyn type motor as a generator (Item 53). This requires that a three phase power source be available.

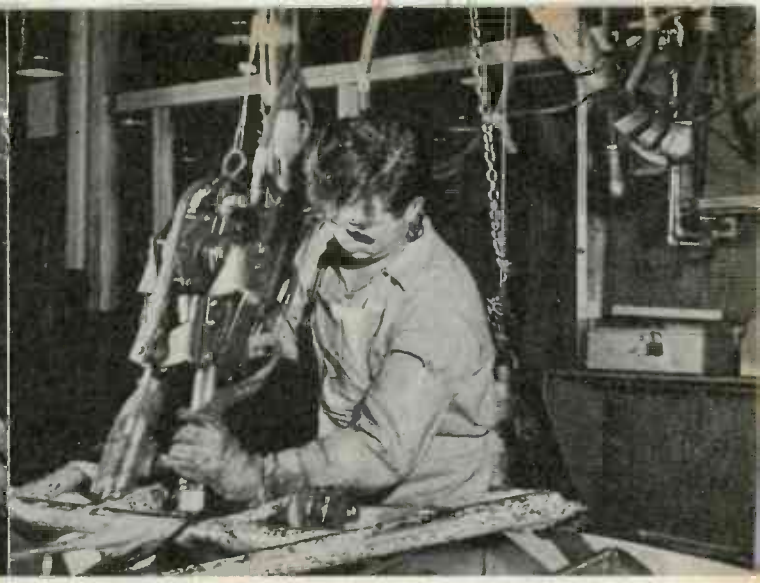
With a little care, a single tube oscillator can be adjusted to give a three phase output as shown in Item 51. Here if the load is divided according to the rules listed on the chart, the voltages across R_1, R_2 and R_3 will be equal and 120° out-of-phase with each other. This provides a source of 3 phase power.

Item 49 illustrates an example of a whole series of methods whereby a load current control is accomplished in a smooth and efficient manner, using thyratrons or ignitrons. The control is accomplished by delaying the grid control potential to the thyratron so that it fires later during each cycle so that only a part of the current is allowed to flow into the load. The delay interval is dependent on the R and C values. Item 50 shows a balanced amplifier providing a two-phase current from a single phase source, used to provide a rotating time base in oscillographic work. A modulating signal can be applied at terminals X to provide radial movements from the base circle shown on the oscillograph screen.

Industrial Control Chart
Reference Bibliography
See page 216



INGENIOUS FIXTURE with motor driven spot welders automatically completes four bulkhead welds in less than 1 minute



STRUCTURE SIMILAR to the keel of a boat is here spot welded to the tank while it is carried on a moving conveyor

RESISTANCE WELDING

Tear-Drop Tanks

PORTABLE SEAM welder operated in direction counter to movement of conveyor holding tank cuts welding time in half

HALVES of the tank, spot welded together are supported in cradle as seam welder is run completely around to join them

Electronically controlled ac resistance welding equipment, used with jigs and fixtures especially designed for the purpose, is helping Lockheed Aircraft Corp., Los Angeles, to speed the production of tear-drop fuel tanks. Replacing units previously made of aluminum this newer type of dropable tank is now made of .024 inch thick steel in two halves. After various internal braces are welded in place, the halves are run through a National seam welder that completes the mating operation. The substitution of light gage steel for aluminum of which these tanks previously were made, coupled with the use of resistance welding in their fabrication has greatly speeded production.

TWO WELDS are made simultaneously in this operation on one of the halves of a tear-drop shape dropable fuel tank

FREQUENCY CONCERNS

E. K. COHAN

DR. ALFRED N. GOLDSMITH

JOHN V. L. HOGAN

● Four points stand out in any early attempt at analysis of the spectrum situation:

1—Postwar production cannot go ahead until reallocation problems are solved.

2—There must be a certain amount of reshuffling to care adequately for existing service and to provide for new services, many of them tied up directly with matters still of a necessarily secret nature.

3—It is essential that there be an amicable meeting of minds looking to equitable division of the spectrum along sound engineering lines with due regard to military, commercial and purely scientific requirements.

4—The problem is one that must be looked upon from a global rather than a national or even an international viewpoint.

What view is taken of the matter as a whole, quite obviously will be tempered by the interests of the viewer. There can be no doubt regarding both the complexity and the importance of the subject. It is paramount, therefore, that those

Military FM Experience

by E. K. COHAN

Director of engineering,
Columbia Broadcasting System

Frankly, I have been much concerned over what I believe to be premature recommendations on this subject. While I recognize the desirability of setting up committees to study the most effective methods to be employed in the tremendously expanded communications fields of the future, so much progress of a confidential nature has been made since the beginning of the present war that I don't feel that we, civilians, have the qualifications to decide such matters without the advice and recommendation of those men, who in the field and in laboratories are gaining practical experience with methods and devices unknown in the commercial field prior to the war.

To limit the future growth of radio communications and the electronics field by decisions prematurely arrived at would be a calamity, and I think our job is to get the stage set so that, without too much loss of time, such discussions can take place in earnest by all interested parties as soon after the cessation of hostilities as possible.

I, for one, would like more intimate knowledge of what military experience has been with FM before I could decide how the present band compares with some other band. In view of the wide channels necessary for FM, I have always felt that it might be better to place it all above 100 megacycles and give it room where it can grow for the next 50 years, and not be subject to the restrictions which have limited the domestic broadcasting band where, to get a sufficient number of stations to serve the country, much unfortunate duplication has had to take place.

Evolving Ideal Plan

by DR. ALFRED N. GOLDSMITH

Consulting engineer

I really have no concrete suggestions on the best utilization of frequencies. I do, however, strongly urge the most detailed study of the problem by Army, Navy and civilian government experts as well as the research and development engineers and radio physicists. I think that the viewpoint of any one man in this matter might well prove incomplete or unintentionally biased.

The number of data necessary for a really analytic and constructive study of the situation is very great. We should draw on all the major laboratories and engineering groups; assemble the available information which they can offer; digest and coordinate such information; and endeavor to determine trends and specific details in relation to future spectrum utilization.

The first plan thus produced might well be an "ideal" plan. It would almost certainly be found that numerous changes or concessions would be necessary to adapt such a plan to practical and existing conditions. The more novel and less used any frequency domain, the easier it is to allocate its use on a theoretically correct basis.

ALLOCATION ENGINEERS

JAMES LAWRENCE FLY

K. B. WARNER

O. B. HANSON

who do the viewing be truly representative of all interests and thus able to do a job of collective viewing that will focus attention on every facet of the jewel.

With the termination of hostilities, it is a foregone conclusion that practically all services will want to expand to such extent as room can be found, or made for them. FM is certainly going to need more space; television, looked upon by many as possessing potentialities capable of making it the next big boom on the electronics horizon, will have to have more; expansion of point-to-point, police, aviation both public and private, photo and facsimile, and a host of services other than those having to do with the military and communications will be limited only by what frequencies may be found available for them.

Some relief will come presently from very closely guarded industrial, military and purely scientific research; multi-channeling of frequencies, for example, may have an important bearing.

In the meantime, these leaders make these comments.

It is my belief that only by such a process could we hope to lay some foundation for the future use of the radio frequencies. Any individual suggestions today, while helpful in detail, would require integration with the thoughts of many other persons before serving as a safe guide for the future.

How Not to Do It

by L. C. F. HORLE
Consulting engineer

I strongly suspect that I'm one of the few men in the radio industry who don't know the proper allocations for all services. I do, however, know how to find out these proper allocations. The method does not comprise battling between IRE, FCC and RMA.

Careful Planning

by JAMES LAWRENCE FLY
Chairman Federal Communications Commission

I am afraid that it would be a bit dangerous to comment at this time on the proposals for postwar radio spectrum allocation. As you know, the industry and the government are cooperating with a view to establishing postwar planning groups which will cover allocation problems. The demand for frequencies will be very great, not only for television and FM, but also for aviation, police, and other miscellaneous services, including, of course, many government services which operate throughout the spectrum. This work will involve very careful planning on the part of all the interested groups and I doubt if the results will be known for some time to come.

Expand FM Frequencies

by JOHN V. L. HOGAN
President Interstate Broadcasting Co.

I am not yet prepared to recommend a complete spectrum distribution for postwar use, but I can suggest the following points that I think should be considered:

1. The existing FM broadcasting frequencies should be continued, because (a) of transmitter and receiver investment involved, (b) there has been no proof that long-distance "burst" interference will offer serious difficulty within the established fifty - microvolt service contour, and (c) because an increase in frequency would probably reduce service in the area beyond the first horizon which is so important.

2. The total band allocated to FM broadcasting should be increased to allow for service needs in densely populated areas.

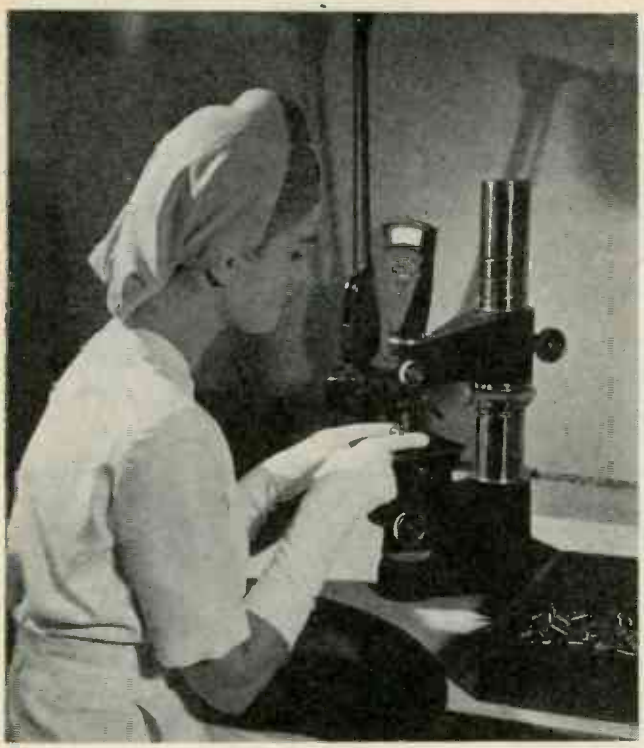
3. The FM broadcasting band should be continuous throughout a range not greater than approximately 2.5 to 1.

4. Provision within the FM broadcasting band should be made for both simplex and multiplex facsimile operation.

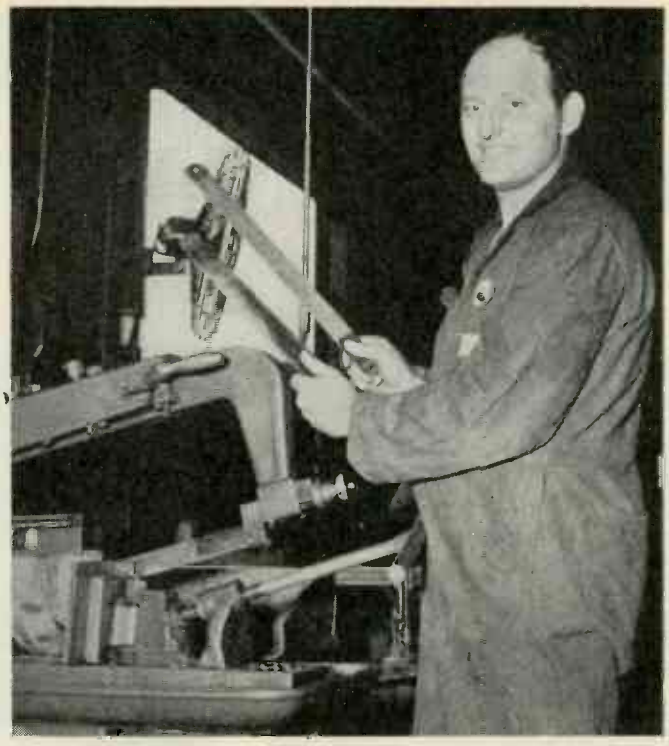
5. A few specific and relatively narrow bands should be assigned for industrial heating, diathermy, etc. These bands need be only as wide as required by good oscillator stability, since there is no reason why very large numbers of industrial instruments cannot be operated in a single band.

6. Full use should be made of the newly available super high-

(*Continued on page* 192)

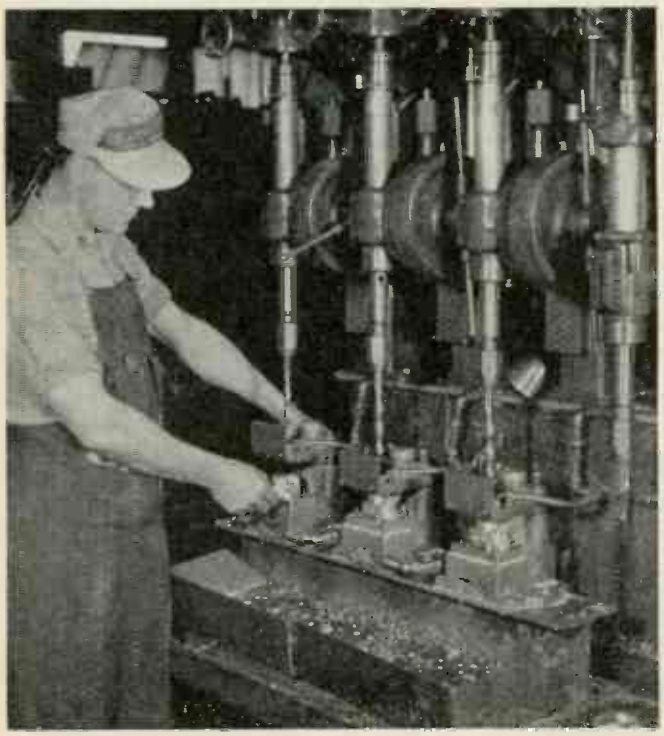


1. *Eliminating Lint*
in plant of Photo Utilities, Inc., New York, manufacturers of electronic test equipment. Precision measurement worker wears white gloves, dress, and cap of a lint-free rayon fabric developed by Celanese Corp. of America



2. *40% Saving*
in 18-inch hack-saw blades is obtained in method suggested by Leonard Yates of Tube Turns, Inc., Louisville, Ky. Most-used portion of blade is discarded. End is annealed and drilled fitting blade for 14-inch saw

10 FACTORY Short Cuts

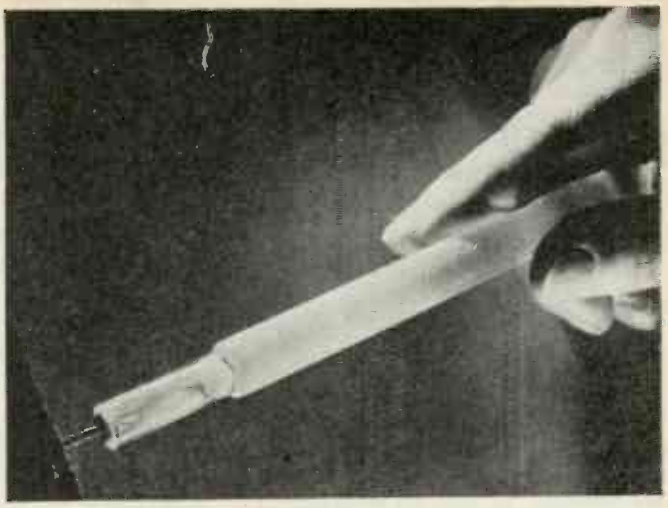


3. *Permanent Drill Jigs*
bolted to table of four-spindle drill press, obviate necessity of centering fixtures under spindles, speeds production at Westinghouse switchgear plant. Spindles lift automatically after drilling to pre-set depth

4. *Woman's Hair Dryer*
becomes a pre-heating unit at this test position in crystal shop of Western Electric Hawthorne Works, Chicago. In controlled-temperature oven, crystals are checked for activity over a wide range

5. *Uncooked Spaghetti*

broke a filament assembly bottleneck at Westinghouse Lamp Division. Short lengths of spaghetti (yes, the edible kind!) support coiled filaments during welding, then are burned away, upping production 75 per cent

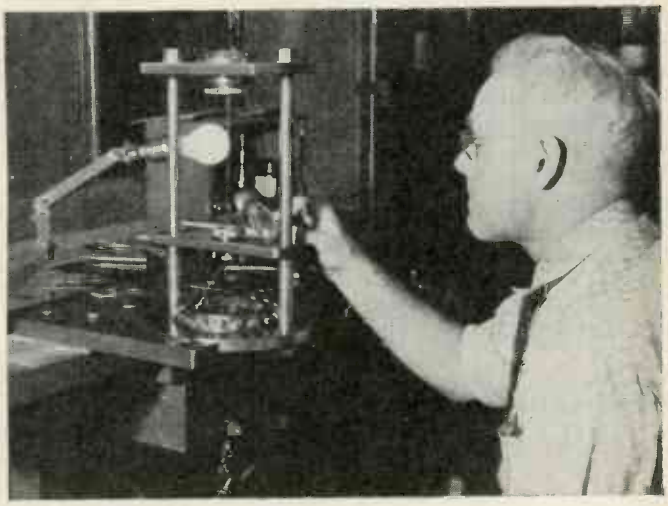


6. *Aligning Wrench*

used by Wells-Gardner Co., Chicago, on intermediate frequency transformers of Navy receivers, is made of Plexiglas. Because it "conducts" light, such wrenches could be combined with pencil-type flashlights for hard-to-see locations

7. *Basic Training*

for familiarity with the various types of nuts, bolts, and washers is given learners at Federal Telephone and Radio Corp., Newark, N. J., by having them sort and compare floor-sweepings with board of mounted sample parts

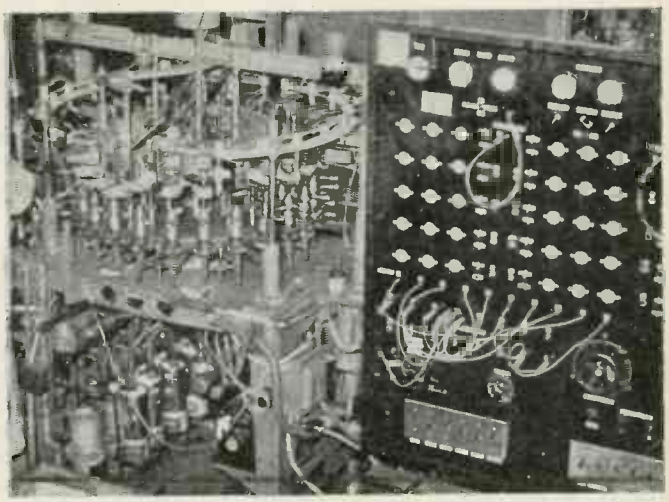


8. *Precision Assembly*

simplified with special fixture. Stranded cable for suspension of Sperry Gyro-compass rotor is about one foot long, and must consist of 18 equally stressed .009-inch steel wires forming perfect circle around air core

9. *Soldering Proficiency*

is developed in Federal's Chinese learners at Newark, by demonstrating various types of soldering jobs on this sample board. Here, trainee compares own work with mounted example of perfect soldering he tried to duplicate



10. *Mass Production*

of low-power transmitting tubes was achieved by applying receiving-tube production methods. Developed by National Union Radio Corp., Newark, this automatic machine exhausts, bombards and seals off. Control panel at right warns of trouble

REACTANCE CALCULATOR for TRANSMISSION Lines

by WILLIAM MOULIC
UHF Department, N. Y. State Signal Corps Training School

A nomograph for determining inductive and capacitive reactances of open and shorted transmission line sections

The problem of finding suitable high Q reactances and "tank" elements at ultra-high frequencies has one solution in the application of the properties of fractional wavelength long transmission line sections either open-circuited or short-circuited at the far end. The transmission line may, of course, be either coaxial, or of parallel rod construction. The accompanying nomograph serves as a calculator of the reactance values for either the open- or short-circuited termination.

The general expression for the impedance at any point along a transmission line for any termination is given by,

$$Z_X = Z_K \left[\frac{Z_L \operatorname{Cosh} \gamma l + Z_K \operatorname{Sinh} \gamma l}{Z_L \operatorname{Sinh} \gamma l + Z_K \operatorname{Cosh} \gamma l}\right] \quad (1)$$

and for the lossless case, the impedance reduces to,

$$Z_X = Z_K \left[\frac{Z_L \operatorname{Cos} \beta l + j Z_K \operatorname{Sin} \beta l}{j Z_L \operatorname{Sin} \beta l + Z_K \operatorname{Cos} \beta l}\right] \quad (2)$$

In these formulas, Z_X is the impedance at any point x measured from the receiving end of the line. Z_L is the load impedance on the receiving end of the line. γ is the propagation constant of the line equal to $\alpha + j\beta$. Where the resistance and conductance of the line are negligible (true for well designed uhf lines), α is zero and $\gamma = j\beta$, where β is the phase shift factor and is equal to $\frac{2\pi}{\lambda}$ radians per unit length (the units in which λ is expressed, centimeters, meters, etc.). The symbol l is the distance from the receiving end to point X and must also be expressed in the same units as λ (centimeters, meters, etc.). Z_K is the characteristic impedance of the transmission line. Formulas for Z_K are given at the bottom of the nomograph.

In the case of the shorted transmission line, Z_L is O and (2) reduces to, in the lossless case,

$$Z_x = jZ_K \operatorname{Tan} \beta l \quad (3)$$

If l is considered as $X\lambda$, (3) becomes

$$Z_x = jZ_K \operatorname{Tan} 2\pi X \quad (4)$$

By similar analysis, the open circuited line in which Z_L is ∞, the impedance of any section $X\lambda$ long, can be expressed in the lossless case, by,

$$Z_x = -jZ_K \operatorname{Cot} 2\pi X \quad (5)$$

Inspection of (4) and (5) show that the impedance is pure reactance. The shorted line will produce inductive reactance when its length is less than a quarter wavelength, capacitive reactance when the length is between a quarter and a half wavelength, inductive in the next quarter, etc. The open line will have capacitive reactance in the first quarter wavelength, inductive reactance if the length is between a quarter and a half wavelength, etc.

While a shorted line that is an exact quarter wavelength long will be parallel resonant (as will also a half wavelength line that is open circuited) the inevitable tube capacities and lead inductances usually require the transmission line section to be slightly shorter than the exact parallel or series resonant value. For example, if the transmission line section is being used as a tank circuit in an amplifier or oscillator, the interelectrode and stray reactance of the tube circuit must be equal in magnitude and opposite in kind to the reactance of the transmission line at the desired resonant frequency.

Using the chart

The nomograph can be used to find quickly the length of line to produce a desired kind and magnitude of reactance or, given the length, the reactance can be determined. The chart also permits the characteristic impedance to be found if the length and reactance are known factors.

To find the length required to produce a desired reactance, lay a straight-edge from the value of the characteristic impedance (Z_K) to the desired reactance value on Z_{DP} scale. The straight-edge will cross the tangent-cotangent scale at some point; from this intersection extend a line horizontally to the function curve; read vertically up to X scale if reactance is to be inductive, and downward if reactance is to be capacitive.

If the length X is given, extend perpendicular to intersection with function curve; extend a line horizontally to tangent-cotangent scale. Lay straight-edge through Z_K value and point found on tangent-cotangent scale to Z_{DP} scale. If line was shorted, Z_{DP} will be inductive reactance; if open circuited the impedance is capacitive reactance.

Example 1. $Z_K = 200$ ohms, desired reactance $Z_{DP} = +j\ 1000$. Find length of line at 500 mc. Straight edge crosses tangent scale at 5. Project line from 5 horizontally in to function curve. Project line vertically up and read $X = 0.218\ \lambda$. At 500 mc $\lambda = 60$ cm, therefore $X = 13.1$ cm.

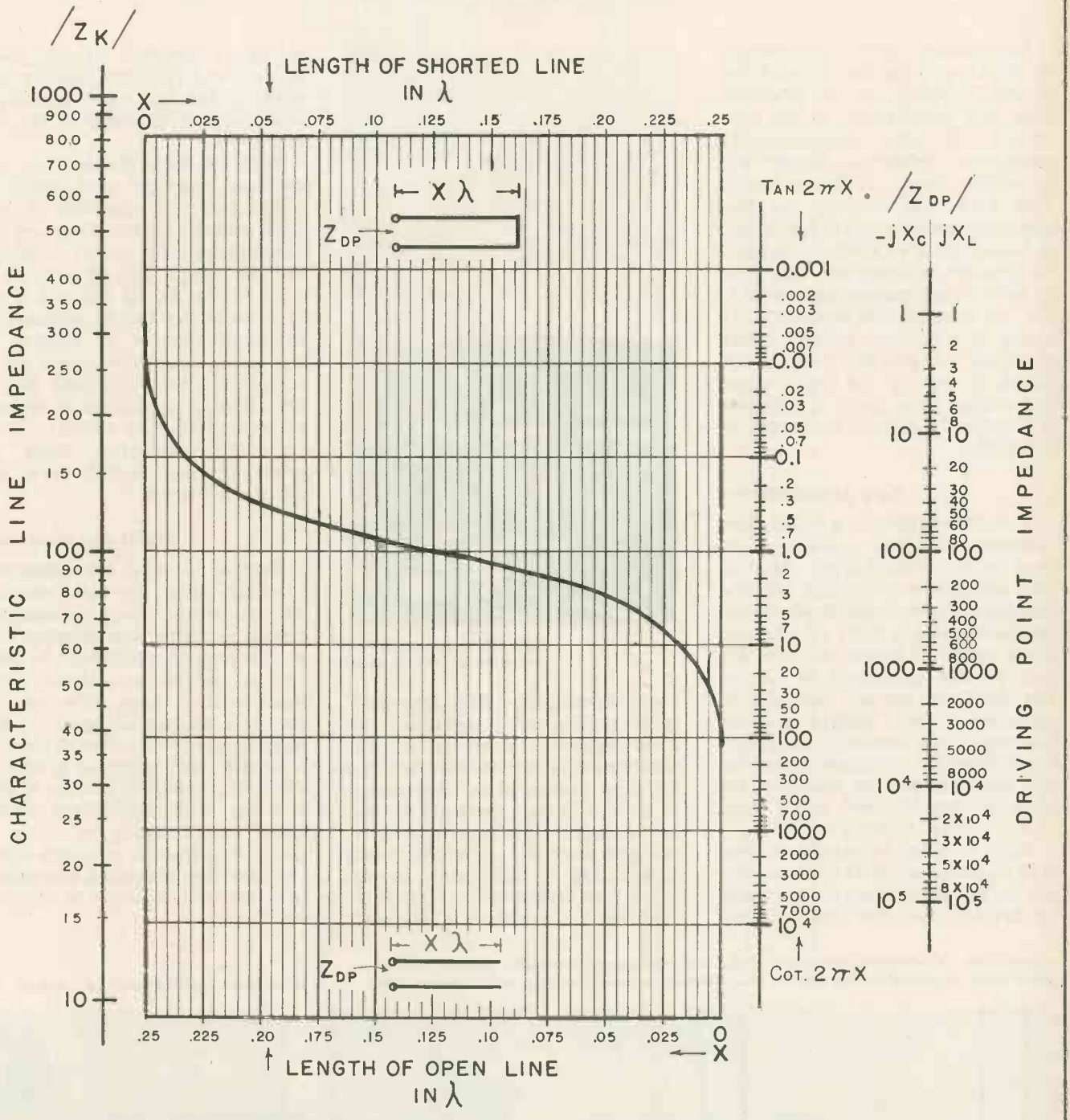
Example 2. Inductive reactance of a circuit is +j 300. Find length of line with $Z_K = 100$ to give —j300 capacitive reactance.

Line will be open circuited for lengths under quarter wavelength. Line from $Z_K = 100$ to —j300 crosses cotangent scale at 3. Project line in to curve and read vertically down to $X = 0.047\ \lambda$. If frequency is 1000 mc, $X = 1.41$ cm.

Note that 0.5 λ may be added to any value of X without altering the reactance value or sign.

If 0.25 λ is added to any value of X read reactance as if line were shorted instead of open or vice-versa and had its original length. Thus in example 1, if .25 λ is added to 0.218 λ the shorted line 0.468 λ long will act the same as 0.218 λ open line. The reactance in this case will be —j39 ohms. (Read up from 0.218 λ on "open line" scale to function curve and horizontally across to cotangent function 0.195.) Line from $Z_K = 200$ through 0.195 gives —j39.

REACTANCE OF SHORTED AND OPEN TRANSMISSION LINES



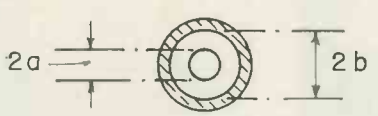
FOR PARALLEL WIRE LINES;

$$Z_K = 276 \log_{10} \frac{d}{a}$$

a = RADIUS

FOR COAXIAL LINES;

$$Z_K = 138 \log_{10} \frac{b}{a}$$



MODERN CONTROL

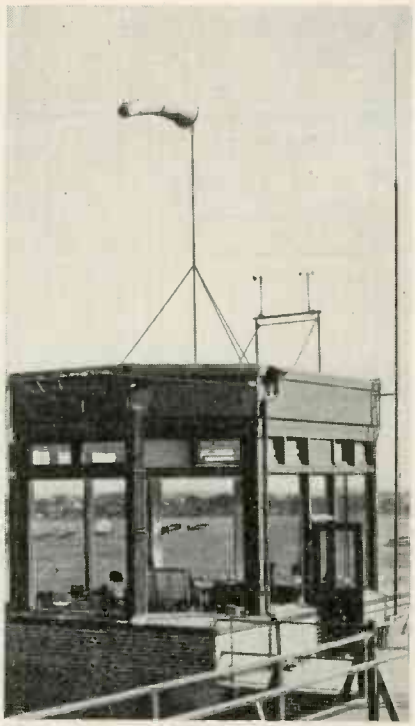
Providing effective and reliable facilities for continual ground checks of aircraft radio and for dispatching several hundred daily flights

Split-second control of aircraft in flight and on the ground depends, obviously, on the effectiveness, and particularly on the reliability, of tower communication equipment. Grumman Aircraft Engineering Corp., on Long Island, New York, has recently put into operation a new control tower that is looked upon by Civil Aeronautics authorities as being the last word in both completeness and reliability. Its effectiveness represents the result of experience gained during a period of growth from a few flights a day to the point where ships from three fields in well over a hundred flights a day must be controlled.

Two transmitters

The tower itself is a multi-floor building with the operations offices on the ground level. Most of the equipment including all the transmitters with associated control equipment and a block of receivers are a couple of flights up. The actual control equipment is on the top deck, of course, enclosed in polarized glass. Relays are the muscles of the system, with everything remotely controlled under the apt handling of L. E. Salvante, his assistant Ray Thurber, and a corps of six women operators.

Main reliance is placed on two transmitters, one of 15 watts capacity on the regular tower frequency of 323 kc, and the other of 250 watts capacity on a Navy frequency. Both transmitters, together with fixed frequency receivers covering these two frequencies, were designed by Erco Laboratories, Hempstead, N. Y. In addition, there are a number of standard Hallicrafters receivers used for continuous monitoring of a string of important, though lesser used frequencies. Emergency equipment consists of a complete set-up of standard aircraft transmitters and receivers, battery powered, on the two main frequencies and instantly available in the control tower.



TOWER is spacious, enclosed in polarized glass

Both the main transmitters were designed and built with simplicity, ruggedness and reliability as principal considerations. They are both straight-forward crystal controlled designs with a pair of 807's in the final of the 323 kc job and a pair of 812's in the higher-powered rig. Although capable of putting out 250 watts, maximum power of the larger transmitter is used only as atmospheric conditions or distance to be covered may require. Relay controlled switching keeps the power at a considerably lower level for routine work.

Multi-purpose units

Control of both transmitters is through press-to-talk switches, which operate relays in combined speech amplifier and monitor units at the operating position. In addition to speech amplifying equipment each of these units functions also as a modulation monitor, as a modulation level indicator, and as a carrier level indicator giving the operator a complete picture of what goes on. Additional relays in these units also function to open the plate circuits of all receivers during the time the associated microphone is in use, as a measure to eliminate feedback.

ESSENTIAL CONTROL facilities in the new Grumman air traffic control tower have been arranged for maximum accessibility and convenience of the operators

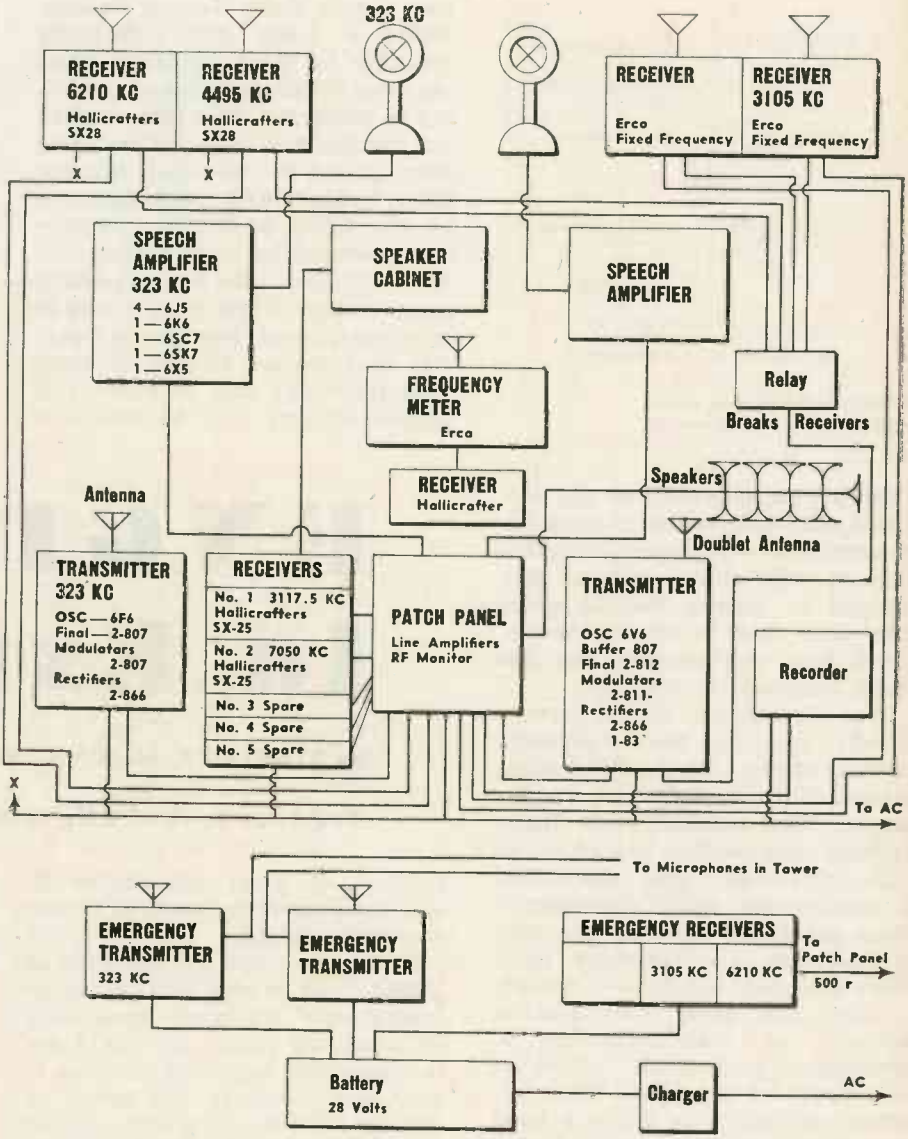
TOWER DESIGN

The two Erco fixed frequency receivers upon which main reliance is placed are used to monitor the Navy test frequency and 3105 kc. These two units, together with all other receivers are fed into an ingenious patch panel which contains four low-level line amplifiers and an rf monitor, the latter serving continuously for both transmitters. There are quite a number of speakers located in various parts of the operations office and in other parts of the building and the patch panel makes it possible to feed any receiver to any speaker or group of speakers in the building. T-pad attenuators are provided to adjust the level on all lines and amplifiers. Also, in case of necessity, one of the line amplifiers can be patched in to temporarily replace a defective speech amplifier feeding either transmitter. For frequency checks on all transmitters, there is an Erco frequency meter operated in conjunction with a Hallicrafters SX28 receiver.

An important piece of equipment made automatically available through remote control is a recording machine with which a record can be made of both sides of dispatching orders and responses, or any other conversation between the tower operators and pilots of ships on the ground or in flight. Such records are made as required, and serve as a check on take-off and landing instructions.

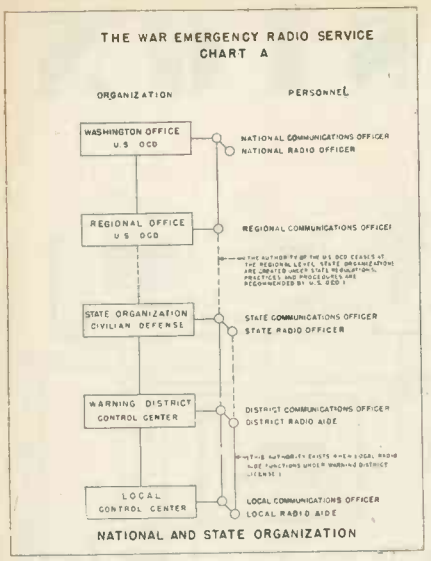
Design of the tower and development of its equipment has proceeded over a number of years from the time when ship radios were all

(*Continued on page* 176)



BLOCK SCHEMATIC showing intercommunication of all transmitters, receivers and remote speaker installation centralized in the new Grumman tower

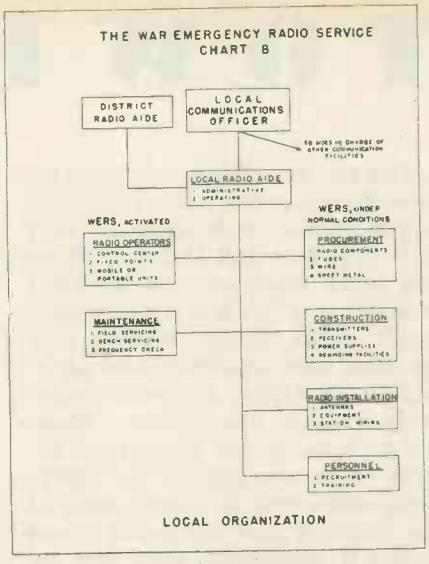
TRANSMITTER ROOM with low power, low frequency rig, monitor speakers, emergency equipment, high power transmitter and patch panel. Right, frequency meters



WERS national and state organization arrangement

coming from public-spirited radio engineers and others having organizational ability. There remain many engineering problems to lick.

Originally conceived by amateurs banded together under the American Radio Relay League banner, WERS is today quite efficiently operated by them, although their amateur status, in so far as operating is concerned, has been washed out for the duration, and has long since passed the so-called amateur stage. Today WERS is administered by the Office of Civilian Defense and operated by local civilian defense officials in the names of their communities. Thus from a strictly amateur concept, has sprung a service organization already of great potential value and destined with proper support soon to occupy a



LOCAL organization of WERS facilities follows this pattern

ENGINEERS In Expanding

by STANLEY P. McMINN (W2WD)

Need for technically trained executive personnel in grow-

During rapid growth of any service a solid foundation of good engineering is of paramount importance in order that expansion may proceed in orderly fashion along lines that lead to all the advantages that can accrue from the latest technical knowledge.

War Emergency Radio Service, rapidly becoming more familiarly known among other alphabetical organizations as WERS, is an example. For although this Home Defense organization has grown in little more than a year into almost a nation-wide radio communications net, it has done so with only a modicum of engineering help; more such help is earnestly needed.

There has been practically no attempt at standardization of equipment particularly suited to this work, for example. While existing equipment is doing a good job, that fact is a tribute to the persistence of WERS personnel rather than to planned engineering. That there is a very definite need for engineering help, or rather for the help of individual engineers, particularly those endowed with some measure of executive ability, becomes plain from study of what has been done—and even plainer when growth is considered.

In 174 communities

Like Topsy, WERS "just growed" until it now represents a well-knit organization spread over 34 states and the District of Columbia, with accredited representatives in 174 communities. Further desirable expansion will depend in considerable measure on the help, guidance and support that may be forthposition of great importance in any national emergency, be it war or natural forces.

Until very recently, facilities of WERS could be used only during or immediately following impending or actual air raids. Late in June, however, FCC amended its rules to very much enlarge the scope of civilian defense operations. Under the amended rules, WERS licensees may now use their stations to provide essential communications over limited distances in the event of other emergencies such as floods, explosions in munitions plants, hurricanes, fires and any situation affecting civic security.

Civil emergency test

In fact, WERS already has had its first test in civil emergency. During recent floods at Anderson, Indiana, the radio units of Anderson's WERS station WJWH were put into service at one-thirty of the afternoon of May 18, and remained on duty until two-thirty the following morning.

During that time they directed trucks, men, sand, and equipment to points of urgent need along the levee, four WERS units actually being set up on the levee. Two other radio units kept the auxiliary police, road repair, and the Red Cross canteen and evacuation forces in

TYPICAL warden post with portable equipment set up

touch with the control center. A final unit, in addition to the unit in the control center, was set up in the city engineer's office, giving this office uninterrupted contact with the whole flood situation. Close to 300 radio calls were handled through eight WERS units operating during the emergency.

J. W. Barber, head of the Madison County Defense Council, said, "Without the facilities of the radio units and their personnel, Anderson would have sustained a loss of several hundred thousand dollars from the flood. This emergency has demonstrated the value of WERS as one of the most important of all services." The use of WERS for these purposes obviously serves to emphasize the need for engineers interesting themselves in the work.

are for communication between control center and local fixed points such as hospitals, fire stations, wardens' posts, etc., the control center being the coordinating agency for the various services over these channels; channels between 114 and 115.1 mc are for communication between control center and mobile units of the various services at the scene of an "incident"; channels between 115.2 and 116 mc have been set aside for the use of the Civilian Air Patrol to eliminate interference which might otherwise occur between air and ground stations.

The manner in which WERS is organized, the extent to which the plan already has spread, and the possibility for further expansion with 14 states and many thousands

MOBILE WERS stations report direct to local control center

CAN HELP WERS Plan

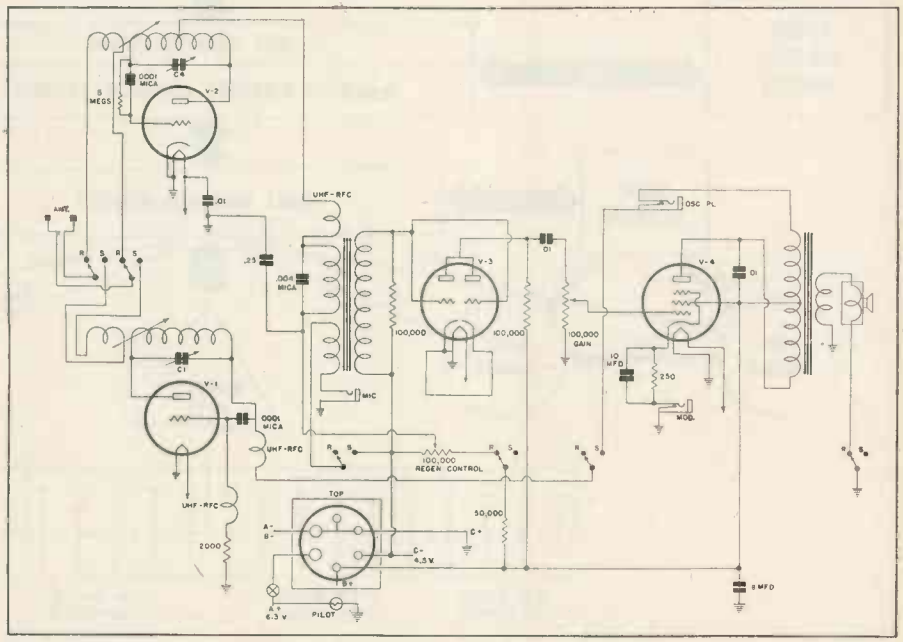
ing home defense organization already covering 34 states

More than a year ago, OCD, inspired by the remarkable results obtained by ARRL members in taking over during numbers of local emergencies when other means of communication had failed, presented to the Federal Communications Commission and the Defense Communications Board (now Board of War Communications) the problem of again utilizing such existing, and tried, facilities during the present national emergency. As a result, FCC in May 1942 allocated channels for the joint use of OCD and State Guard Stations.

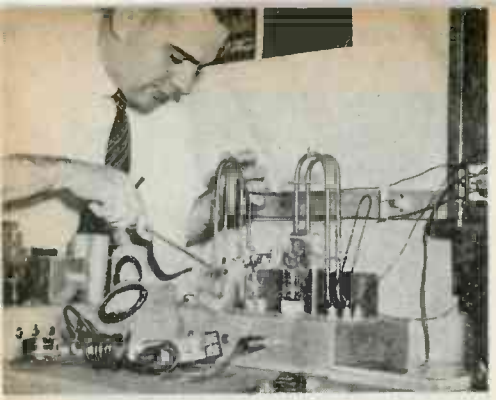
These channels, between 112 and 116 mc, are designated for specific purposes in accordance with the general plan laid down by OCD. The arrangement makes possible a non-interfering network of CD stations interconnecting all communities with each district warning center. Thus, frequencies between 112 and 112.8 mc are used for communications between control centers and warning district control centers and represent the supplemental circuit between a community and an outside point; between 112.9 and 113.9 mc channels

of communities not yet represented, leaves no room for doubt regarding the need for a continuing interest in and the active support and guidance of both engineers and other citizens who may have available the small amount of time required for this worthwhile work.

WERS is headed up by a National Communications Officer, located in Washington, under whom are nine regional communications officers each responsible for an area comprising one of the nine Army Service Commands (formerly known as Corps Areas). Authority of the US OCD ceases at the regional level. State organizations, headed by State Communications Officers, are created under state regulations in accordance with practices and procedures recommended by US OCD. State organizations are further divided into warning districts each with its district communications officer, and



COMBINATION transmitter-receiver designs such as the Abbott are used quite extensively in WERS work and have become popular because of their simplicity



EQUIPMENT in most cases is home designed and built

WHERE WERS OPERATES

STATE	STATIONS	STATE	STATIONS
Alabama	1	Montana	1
Arizona	1	Nebraska	3
California	9	New Hampshire	2
Colorado	1	New Jersey	19
Connecticut	8	New York	15
District of Columbia	1	North Carolina	4
Florida	3	Ohio	13
Georgia	2	Oregon	2
Illinois	5	Pennsylvania	13
Indiana	8	Rhode Island	10
Kentucky	1	South Dakota	2
Louisiana	2	Tennessee	1
Maine	2	Texas	3
Maryland	6	Vermont	1
Massachusetts	21	Virginia	2
Michigan	4	Washington	4
Missouri	2	West Virginia	1
		Wisconsin	1

then into local control centers which have their local communications officers. Such local organizations are further subdivided in accordance with the chart herewith. There is thus a tight organization of the whole effort with definite duties assigned to all the personnel.

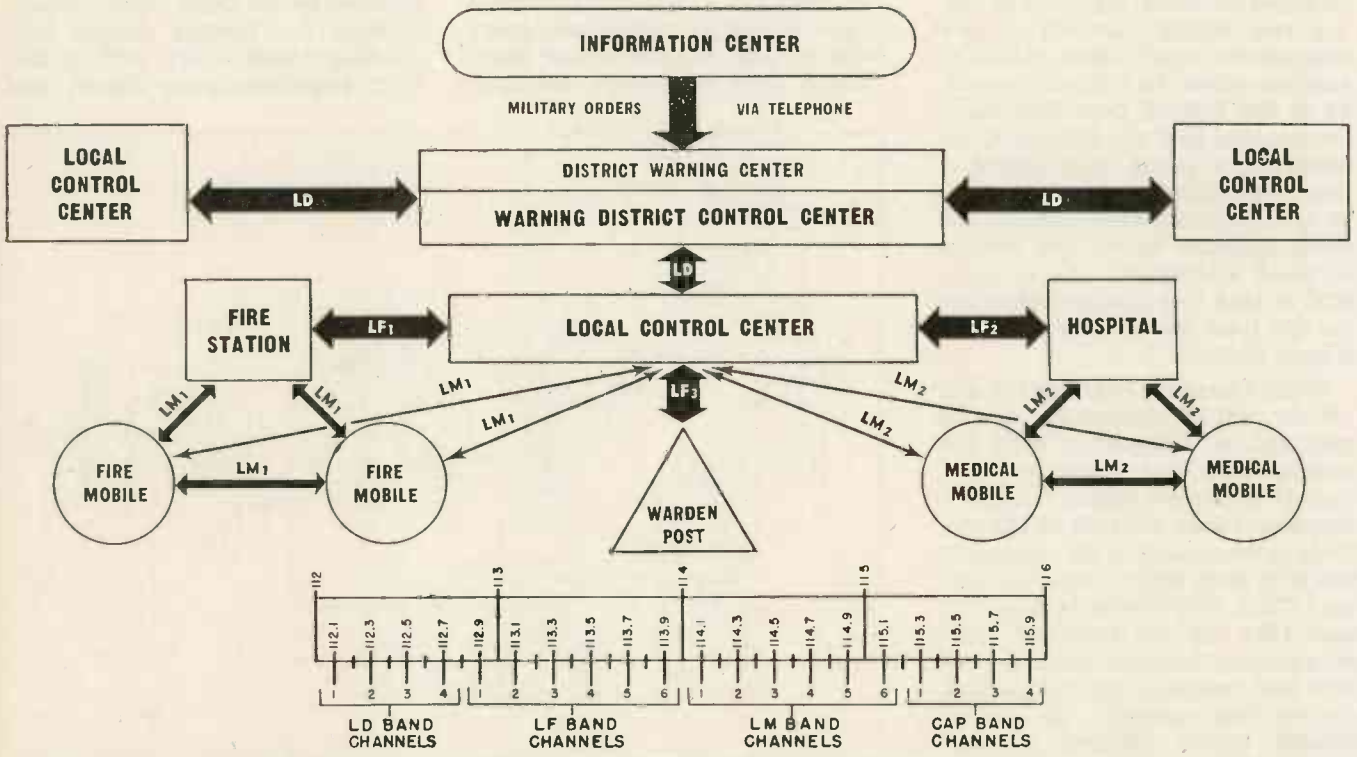
Responsible heads of the various organizations are clothed with considerable authority and their qualifications are in the higher brackets. State Radio Aides, for example, must have demonstrated executive ability and have operational experience; a radio manufacturing executive, an engineering member of a local broadcast station staff or commercial radio station, or a leading local amateur could qualify. District and Local Aides are required to be capable radio technicians preferably with previous engineering, executive, operational and constructional experience. On these men will fall responsibility for the establishment of district and local networks, the training of operators and of construction, installation and maintenance groups. They must hold an FCC license of a grade higher than the restricted radiotelephone operator's permit.

Actual operating personnel is chosen on the basis of ability to carry on calmly and efficiently under stress of emergency. Permits to carry on this work are issued by FCC only to those who already hold valid operators' licenses or permits.

Equipment requirements

Equipment is essentially prewar amateur. WERS has made no attempt to specify or to standardize. It is recommended that fixed stations have sufficient power adequately to cover their service areas

(*Continued on page* 176)



ORGANIZATION of War Emergency Radio Service, which functions under the Office of Civilian Defense, is laid out along these lines, with four principle bands of frequencies, designated by FCC, divided into channels for specific communication purposes

When RADIO ENGINEER IS In Command

by **WALTER EVANS**
Vice-president Westinghouse Electric & Mfg. Co., Baltimore, Md.

How the technical man must revise his thinking when he is himself the big boss, responsible for results

The increasing trend towards the technological aspect in American industry, particularly as stimulated by the war, has made desirable, and even necessary, the selection of executives from engineering personnel. The average engineer is likely to have certain characteristics which must undergo some degree of modification with the assumption of executive or administrative duties.

Industrial relations is vital problem

The engineer's entire technical training has been to produce the best possible results with the best available materials, so that through the years of his cumulative engineering experience, it is likely that he has become something of a perfectionist. In his executive duties he must learn to make a fair and rational compromise between perfection and the practical requirements of time, manufacturing considerations, markets, and the competition with which he is faced.

ENGINEERS ARE TRAINED TO BE PERFECTIONISTS

But in executive duties the engineer must learn to make a fair and rational compromise between perfection and the practical requirements of time, manufacturing considerations, markets, and the competition with which he is faced.

One of his new and interesting problems will be the handling of industrial relations, which has become one of the most important activities in modern industry. This requires fairness of viewpoint, the ability to determine labor policies and resolve the questions raised by labor organizations. These need to be handled with considerable promptness and courage to stand his ground when necessary even under unpleasant pressure.

Industrial activities

Engineers as a rule flock together because of mutual interests which center around scientific societies and similar activities. New administrative responsibilities require participation in general affairs and meetings of their industry, with their employees, and in community activities.

"Don't try to do it all yourself"

The usual engineer is in his chosen field because of his love for that work which frequently results in the tendency on his part to do as much of the work as possible himself rather than undertake the temporary inconvenience of explaining or showing another how it could be done for him. From this point on his success depends in no small measure on his ability to distribute everything possible to others who can handle the details for him in a satisfactory manner. There will be plenty left that others can not do.

And if the engineer can acquire the knack of wisely choosing capable subordinates, there will be little doubt about his success.

WALTER EVANS, a thoroughly qualified radio engineer, has been active in the radio operations of the Westinghouse company from the time Westinghouse laid the foundations for modern broadcasting with its pioneer KDKA and WJZ, coupled with the pioneer manufacture and sale of radio receivers. Mr. Evans' rise to executive responsibility has been logical and continuous, until he is now vice-president of the vast Westinghouse company, in charge of its radio, X-ray and broadcasting

ELECTRONIC BIOLOGICAL

PART II

GENERAL ELECTRIC X-RAY in use aboard U. S. Naval Hospital ship

There is a very close relation between human emotions, mental activity, certain physical conditions and body reactions. Instruments have been designed that will detect changes in the emotions by direct measurements of the electrical resistance of the body. This condition can be illustrated by a description of a pathometer, popularly known as a lie detector.

The emotional condition of a person differs considerably when he knowingly tells a falsehood and when he is truthful, for this emotion alters the resistance of the skin. Numerous explanations of this phenomenon have been given: an increase of the adrenalin in the blood stream, an increase in the output of the sweat glands, or a flush of blood to the skin. Maybe all of these effects are interrelated.

The test consists of a low voltage bridge circuit, one arm serving as a path between two electrodes pressed against the skin. A voltage (1 to 20 volts) is used in the bridge circuit, which is adjusted to balance. The detector of the unbalance is the two-stage direct-coupled tube amplifier, illustrated. This circuit can be used to conduct many related experiments in physiology and psychology, and is rather simple to construct and operate. Two high-gain pentodes are used, with a voltage stabilizer in part of the circuit to reduce degeneration. This pathometer has sufficient sensitivity to produce changes of .010 ampere in the output circuit caused by changes in the emotional state.

The secret of successful lie detection is in the selection of the questions and in analyzing the surges accompanying the responses by comparing them with other innocuous questions interspersed with the key questions. Both electrodes can be placed on one palm, or can be separated in different locations without affecting the results, since the resistance drop is mainly at the skin layer.

The contacts must be kept perfectly still or the resistance changes due to an imperfect contact will obscure the normal variations. In many tests it is desirable to use saline moistened pads, or to have the electrodes coated with electrode jelly—which is a conductive "Musterole-like" paste developed for electrocardiographic work.

ELECTRO SHOCK therapy with self-contained recording surge current meter. Rahm Instruments, Inc., New York

Brain waves

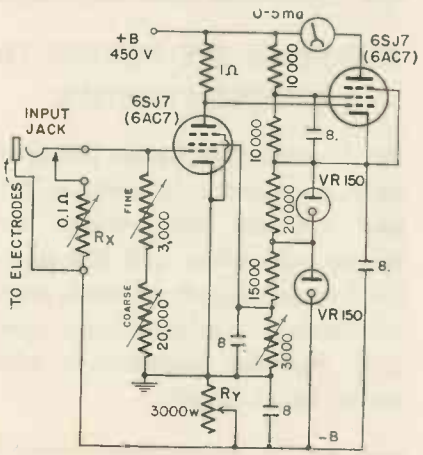
As soon as electronic tube amplifiers that would amplify extremely small potentials became available, it was discovered that a somewhat irregular electrical potential wave was given off from the brain at all times. The early tests consisted of making electrode contacts to the brain itself, but it was discovered that contact with the head, even through the hair, would give measurable voltages.

The brain has such a complicated structure that it is surprising that a brain wave is so simple. What is more surprising is that when the mental process is most active the brain wave amplitude is often at a minimum. The activity of the waves is reduced when the subject's eyes are closed but it immediately resumes when reopened. On the other hand it may have less amplitude during sleep.

The waves are not all one type, but several types having different amplitudes and frequencies are superposed. This makes the job of analyzing the pattern tedious and at times impracticable, if an exact study is needed. However, certain characteristics produced by specific disorders, such as epilepsy are often outstanding, which simplifies the manner of deriving results. A change in waveform may be noted several hours before an attack.

For convenience, the predominating waves, found to be within a range of 8-12 cycles, are called the alpha waves. Other series of waves have been noted superposed on the alpha pattern. Beta waves have a frequency of 30-40 cycles per

PSYCHOGALVANOMETRIC CIRCUIT. Here Rx is a comparison resistor to simulate external electrode circuit. Ry is used to adjust voltage applied to electrodes. The screen voltage of first tube should be adjusted so that meter current goes to zero when input circuit is open



AIDS in the SCIENCES

Continuing a broad review of a few of the problems associated with medical diagnosis, the solutions of which have been tackled with electronic devices

second or more, but are of a lower amplitude and at present contribute less information to the analysis. Another important series of sharper pulses termed the delta pattern has a frequency of about 3 cycles per second or less. In general their waveform is complicated by body action currents, such as eyeball movements, blinking, etc.

The utility of encephalograms in the study of mental conditions consists of comparing the predominating frequency and amplitude changes when various stimuli are applied, and in noting the outputs at various points on the cranium.

The procedure is to press against the scalp pairs of small disc electrodes covered with a conducting paste, and to compare the output of each pair with that from another. In general an electroencephalograph has four or more sets of amplifiers and recorders. Records from each appear in parallel columns on a tape. Several recording systems have been developed, including the photographic process on bromide paper, ink writing pens using electromagnetic or piezoelectric driving units using plain paper or in other designs electrosensitive paper where a chemical coating is blackened by current flowing through the paper from the tip of the pointer, or wax-coated recording paper where a heated stylus draws a fine line in a white wax film on a colored paper roll.

In a multiple channel electroencephalograph system, all amplifiers must have no inter-coupling, minimum hum pickup, and must be able to drive the pen units at a frequency range of possibly 1-100 cycles, giving an appreciable deflection with an input potential of a few microvolts, since the beta waves have a nominal potential of about 10 microvolts, alpha waves 50 microvolts.

GARCEAU ELECTROENCEPHALOGRAPH with two direct writing pens. Electro-Medical Laboratories, Holliston, Mass., produce this unit

Analyzing wave form

Brain wave study value in the future will depend on a simplified solution to an old engineering problem (incidentally the same one that is inherent in many other biological studies) a rapid means of analyzing wave forms. One method that has shown promise utilizes a series of tuned-reed filters as a coupling means between amplifier stages. Those frequencies that are not resonant with the reed frequency are not transferred to the recording mechanism. Some twenty reeds within the range 2 to 22 cycles per second are connected into the circuit during a 9 second interval. This scheme transforms a non-recognizable pattern into one that directly answers the question as to what frequencies are present in the brain wave.

Another system of analysis is based on a curious discovery that the alpha waves can be synchronized by applied stimulation, as by a light flicker. A ten cycle flicker will cause the alpha waves (if present) to change from a frequency of approximately ten cycles to one that is exactly ten cycles. Their analysis can then be simplified by the utilization of a ten-cycle bandpass filter.

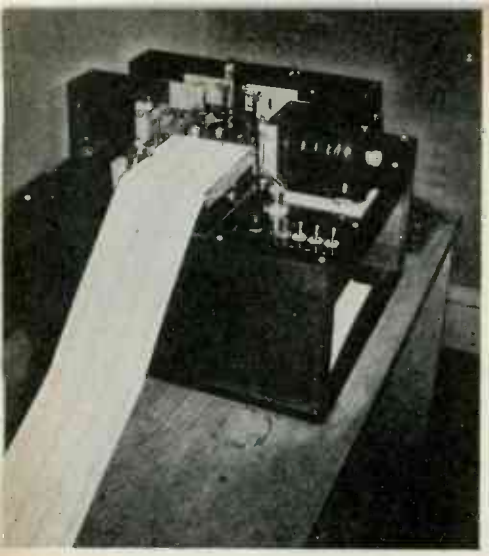
WESTINGHOUSE X-RAY fluoroscopic equipment with miniature turntable to permit patient to be moved at will during delicate operations to remove foreign bodies accidentally in esophagus or lungs

Another approach to the problem of brain wave analysis consists of utilizing the brain wave potentials to frequency-modulate one of two beating rf oscillators. The resulting beat note is a series of chirps and trills, produced by the higher brain wave potentials, superposed on slower sweeps of tone corresponding to the delta waves.

Electroencephalophone

These tones bear no relation to any system of analysis now being used, but it seems that the method does afford an alternate system of frequency analysis. As long as the various frequency ranges in a brain wave produce distinguishable difference in the record, whether it be visual or aural, experience and practice will permit its utilization. After all, a spoken tone is more easily analyzed by ear than an oscillogram of that tone handled visually, although, time permitting, a more complete analysis is afforded by the oscillogram.

Many important facts concerning mental activity have been discovered by research groups using brain wave equipment. One factor is the effect of brain shocks, as by administering insulin in a certain manner. This shock to the mental process has produced beneficial changes in certain disorders, such as in the case of epilepsy. The duration of the shock must be care-



FOUR-PEN recorder with Grass encephalograph used by U.S. Army

fully timed and here the continuous recording of brain waves becomes a necessity.

Furthermore, the coma-producing insulin treatment has been largely replaced by an electrical shock method, whereby a definite voltage (possibly of the order of a hundred volts ac at say 50-60 mils) is applied to the brain for a tenth of a second or more as prescribed. Here the "dosage" must be definitely controlled for safety to the patient and for judging the results. One particular design makes its own record of the duration of the shock on a small disc chart with a simple type of recording voltmeter. Since the applied potential is at power line frequency, the duration of the shock is exactly recorded by a direct recorded oscillogram of the number of cycles on a chart.

Another form of electrical therapy used in nerve work is the electronic stimulator, which furnishes a series of sharp pulses having an adjustable amplitude and frequency. A typical device of this kind contains a thyratron circuit, not unlike that used as a time base oscillator in a cathode ray oscillograph. A condenser, when charged to a preset voltage, discharges through a thyratron tube. For an instant, the voltage across the cathode resistor in this tube is practically the whole voltage of the condenser. The frequency of the discharges for a fixed set of voltage conditions depends upon the condenser charging rate. The leads to the output electrodes are connected across the cathode resistor. Besides its use in stimulation of the cortex in neuro-surgery, it is useful in the localization of nervous system functions.

Electrotherapy

While time may prove that the therapeutic value of electrical currents of one type may be equivalent to those of another type, when due regard to wave-form, voltage, etc., is taken, numerous views are held, resulting from personal experience of particular users. Steady dc, interrupted dc, sinusoidal ac (low voltage), static electricity, and the above mentioned stimulators all cause muscular activity by stimulating the nervous system at the affected area. The use of definite polarities with dc applications (the so-called galvanic current) to produce "ionization" effects will be passed over, however, without engineering comment!

The use of high-frequency currents, or diathermy, is a method whereby a controlled temperature rise can be produced by the utilization of dielectric and eddy current losses. It is the more common form of electrotherapy and has advantages over lower frequency therapy in that there is no direct application of current-carrying electrodes to the skin.

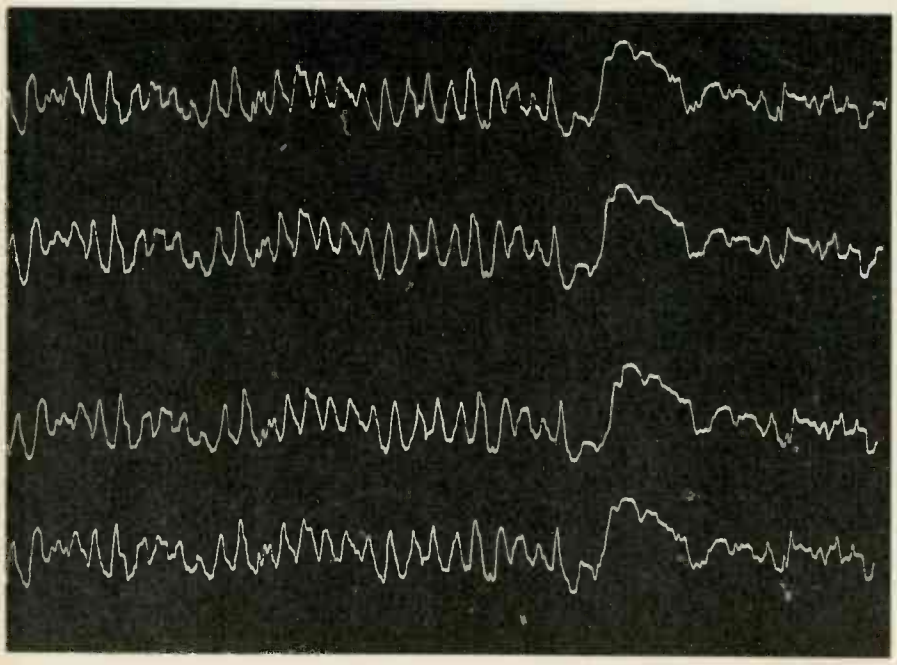
High-frequency currents

Einthoven pointed out almost a century ago that heart muscles produced rhythmic electrical potentials. Curiously, it was another galvanometer inventor, d'Arsonval who pointed out that alternating currents having high frequencies produced less muscular contraction than similar currents at low frequencies and then showed that the high frequencies produced greater heat in the body. There are many claims that certain frequencies produced selective effects and bring about cures that cannot be traced to heat alone. However, there are no acceptable proofs that this view is, or is not, true.

It seems that any "magic" therapeutical frequencies, if found, will be in a higher range than present exploration has covered. The therapy value of those in the range of 60 megacycles or less seems to lie solely in two more-or-less interrelated effects: temperature rise due to radio frequency losses, and increased blood circulation in the field of excitation. Under similar conditions of energy distribution, there does not seem to be a noticeable difference whether the high frequency field is applied by the use of a dielectric field or by an inductive field. The heating is more or less evenly distributed through that part of the body in the field.

The electronic engineer is far more conversant with this principle and what it does than he is with the "galvanic" and "faradic" therapy systems, although he may wonder somewhat about certain modalities (or methods, in the language of an engineer), such as the practice of spacing the electrodes away from the body with a towel so as to produce deep heating. This frequently practiced rule seems to have resulted by extrapolation of the observed results: early diathermy equipment used lower radio frequencies (around one megacycle) with bare electrodes in con-

BRAIN WAVE record. Taken with four channel equipment developed by Rahm



tact with the skin, and the observed heating was confined largely to the surface. In short wave diathermy, insulated (and therefore spaced) electrodes were used and deep-seated heating was the rule. Therefore the greater the spacing the deeper the heating.

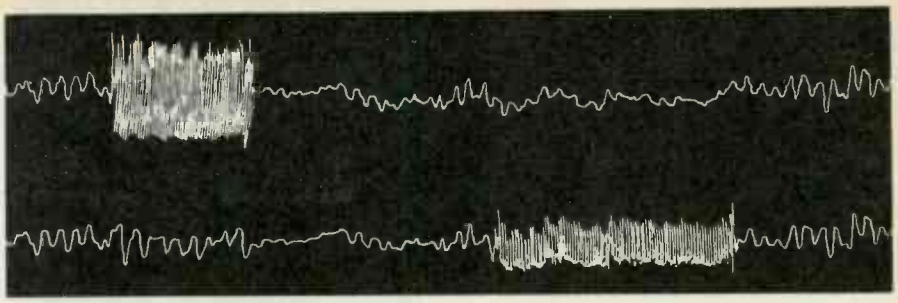
Much of the electrotherapy equipment that is now in use has been designed without due regard either for frequency stability or ability to accurately reproduce the applied power. The rf energy delivered by any equipment is not indicated in terms of power so that the results from various investigations cannot be compared directly, since the power, frequency and other factors shift frequently, even during a single test.

Variety of tissues

The wide variety of tissues in the body—cartilage, muscular, fatty tissue, bone, etc.—all respond differently to high frequency fields. Some of these tissues are dielectrics, others in effect are conductors, while most of them have an intermediate characteristic — that of a "leaky" dielectric. It is in such tissues that the heat is most intense. The actual energy dissipation, therefore, takes place as a dielectric loss, with some eddy current loss, on account of the electromagnetic field added.

Since a highly complicated electron tube oscillator must be operated by non-technical users, the engineering design problem is made more complicated since it becomes necessary to compensate exactly and automatically for all circuit variations, leaving only those external controls that are to be a part of standard prescribed treatments. The correct "dosage" for a particular treatment can be prescribed in terms of "frequency," "power" and "length of treatment." Other factors are the selection of a useful size and shape of the electrodes and their placement.

The FCC has proposed a frequency of 13.7 megacycles for electrotherapy use, with its second and third harmonics also reserved or kept open. To the engineer the oscillator itself does not present unusual difficulties; still there are a large variety of unusual conditions that must be met. The output load impedance into which the oscillator must work varies over wide limits, due to the changes in the size of the applicator pads and their location on the body, to the frequency and also to variations in the spacing between the applicator pads and the skin (such spacing being due to the rubber insulation on the electrodes, to the patient's clothing and to inserted spacing mats).



TWO-CHANNEL brain wave record showing need for elaborate hum and room interference elimination. Filter was momentarily disconnected in each channel

The frequency stability is usually exceedingly low, not only because of this load variation but also to power line regulation changes, and to the general use of self-rectification in the tube plate circuits, to keep costs low.

When a self-rectified oscillator circuit is used, the tubes carry large values of power for less than half of each power cycle, so that they are generally overloaded during the operating intervals. This factor contributes to the high harmonic content of the output power. This does not affect the therapy value, but does contribute to the radio interference problem. When large amounts of power (hundreds of watts) are drawn from the power line during a portion of each cycle, the power line regulation factor comes in, so that the line voltage waveform is altered.

Still another factor, which at this time prevents much hope for greater frequency stability is that all equipment uses a self-excited oscillating circuit. Keeping this equipment on the assigned frequencies, or others which may be substituted later, is thus a major engineering problem. From the medical viewpoint it is necessary to supply an output conversion circuit that will deliver energy into the load with minimum fluctuation. Movement of the electrode pads, leads, or changes in resonance are factors that sometimes change the output delivered over a ten to one range.

Surgical knife

The "radio" knife has become a widely used tool of the surgeon with its features of sterilizing as it cuts, coagulating the blood, sealing the capillaries immediately to prevent bleeding, and reducing chances of bacteria implantation.

In this process the subject is "grounded" to one terminal of a

(*Continued on page* 178)

FORDHAM UNIVERSITY Pathometer used in many emotional studies and lie detection. Uses Esterline Angus recorder

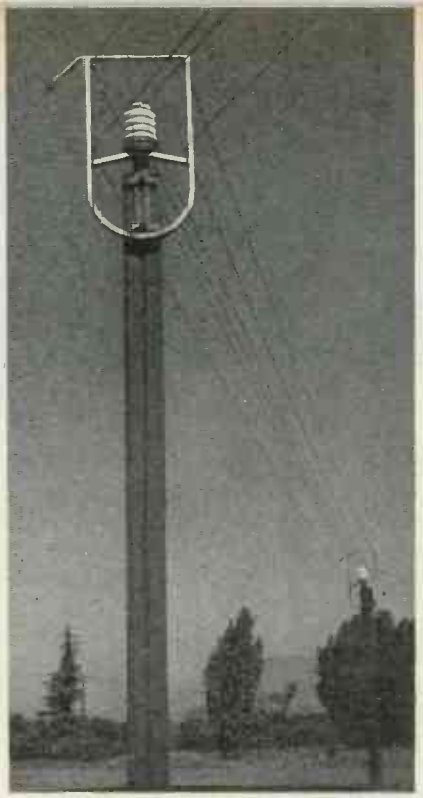
KWKW One-KW

To start construction of a modern radio transmitter, even of moderate power, requires the solution of many problems that are not of a technical character. In the case of KWKW near Pasadena, California, one unusual factor was the replanting of acres of strawberries with many miles of copper ground wire, acres that were reclaimed from Japanese squatters with much difficulty. The engineering problems included one which is common in many locations —that of guiding the signal output so that it will do the most good.

Directional coverage

In the past few years the directional antenna has become more important in the broadcast frequencies. The main purpose of any directional array is to protect stations on the same or adjacent channels from jamming, or to direct the radiated power into metropolitan areas instead of into waste lands or large bodies of water.

A directional array uses more than one antenna, and the phase of the current in each tower is accurately maintained with respect to the phase of the currents in the other towers. The antenna phasing and coupling equipment used to maintain the desired directional pattern is simply a network made up of the proper components so that the energy coming out of the transmitter divides in the correct proportions for each antenna, and arrives at the antennas at the correct instant of time.



FIVE WIRE transmission line

In granting permission to the Southern California Broadcasting Company to erect a station for daytime operation with a power of 1000 watts on 1430 kilocycles, it was a necessary proviso of the FCC that directional operation be provided to protect KPRO, Riverside, California, 40 miles away and operating on 1440 kilocycles. Considerable difficulty was experienced in finding a suitable transmitter site that would also put a maximum signal in downtown Pasadena, and in Los Angeles. A site of nine acres in the San Gabriel Valley was finally decided upon, which gives a maximum signal in Pasadena, five miles away, with a minimum signal of 23 millivolts at a mile in the direction of KPRO. The desired directivity was obtained by using a composite branching and power dividing network to divide the output power in a particular proportion. The customary technique of balancing the loads may be of interest.

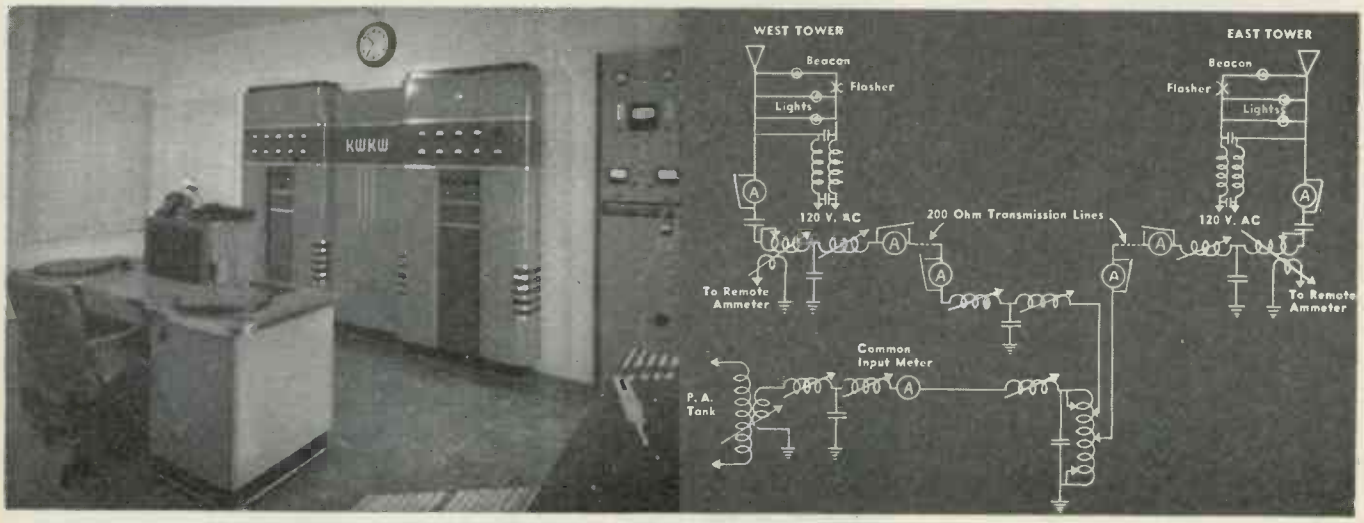
Antenna phasing and coupling

Such a problem is tackled by first measuring with an rf bridge the resistance and reactance of each element alone. Then the elements were adjusted and the mutual impedance determined. From the figures obtained from this adjustment, the terminating networks for each tower were computed. Energy was fed to the towers and the phasing network in the transmitter building was adjusted so that the desired phase shift was indicated on a Western Electric phase monitoring panel. Then the currents in each antenna were balanced with a phase shift of 60 degrees. The resistance at the point of common input was determined and tuned to zero reactance.

The power in the west tower was 776 watts, the power in the east tower was 224 watts. Nine radials were plotted and followed over a 20 mile range, wherever possible, measuring the inverse fields so as to determine the shape of the pattern. A fixed monitoring point was then established on the null radial 1.1 miles from the antenna system of KWKW. This monitoring point is

CONTROL ROOM and 1 kw transmitter

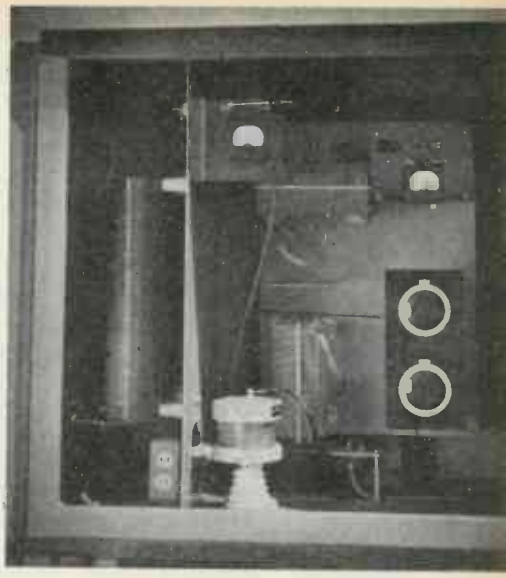
DIRECTIONAL ANTENNA tuning and phasing equipment



at PASADENA

by PAUL W. SPARGO
Chief Engineer

Sharply directional effect obtained through use of composite branching and power dividing network



ANTENNA TUNING BOX
and tower lighting chokes

free from overhead wires and nearby buildings.

KWKW's directional array consists of two guyed, insulated towers of uniform cross-section, each 195 feet in height and spaced 172 feet (one-quarter wave) apart, and in a line 102 degrees from true north. The ground system consists of two sets of 120 radials of No. 10 copper wire, spaced three degrees apart, centered at the base of each tower. These radials are 200 feet in length and are buried 12 to 15 inches in the ground. All radials between the towers are connected by a 3 inch copper strip. The tower bases are tied together with a 6 inch copper strip. To avoid the necessity of using copper ground screen (which was impossible to obtain) the first 25 feet of the ground radials next to the towers was left on top of the ground to reduce dielectric losses at the base of the towers, thereby increasing their radiating efficiency.

Transmission line

The transmission lines are the five wire, overhead type, 265 feet in length, with an impedance of 200 ohms. They are of No. 6 hard-drawn copper wire, mounted on "U" type brackets, 12 feet above the ground. Each "U" bracket is grounded to the ground system by means of a 4 inch copper strip. The outside wires are located at the corners of a 15 inch square. The antenna tuning and phasing equipment are of composite construction and are housed in heavy gage sheet iron houses. The power dividing and phasing network is mounted back of the transmitter on the wall where the transmission lines enter.

Transmitter

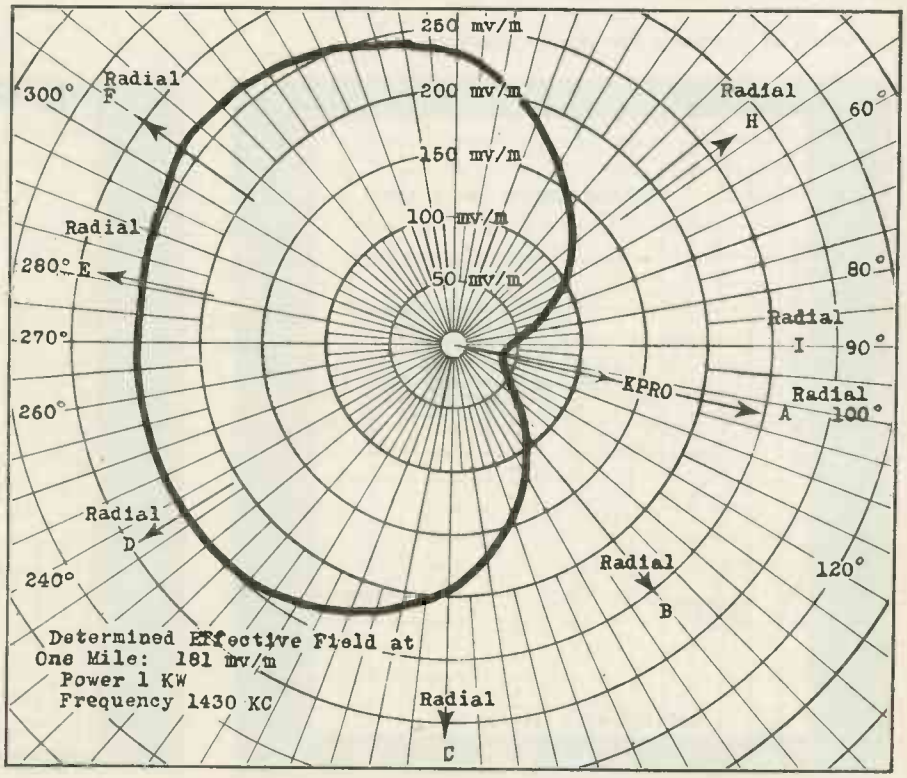
The transmitter building of KWKW is 24 by 35 feet and built of stucco with a tile roof. It is so designed that it can be enlarged should the station receive an increase in power. The RCA 1K transmitter, usually installed in the middle of the room, was placed in the wall as a partition, because of earth movements in this vicinity, leaving plenty of room at the rear to perform maintenance work. Fans installed in the base provide extra ventilation in each unit to prolong the life of the tubes and other components. All controls, conveniently grouped on illuminated panels, serve to provide convenient operation and protection to the tubes and other components. All transmitter components are mounted on vertical type chassis, each of which is readily accessible from the rear through five full-length doors equipped with interlock switches.

The transmitter employs high level modulation of the Class C amplifier with negative feedback around the three audio frequency stages, which produces an extremely low order of distortion, less than 4 per cent rms from 50 to 7,500 cycles. The measured frequency response was within plus or minus 2 db between 30 and 10,000 cycles.

Alongside the control console desk in the transmitter room, two auxiliary turntables and a microphone are available for emergency use. All other equipment such as speech input amplifier, limiting amplifier, modulation monitor, frequency monitor, remote reading antenna meters, etc., are installed in a rack adjoining the transmitter.

Much credit is due Norman Webster of Columbia University, formerly of the McClatchy Broadcasting Co., who designed the directional array, and to Jay Tapp of KGER, Long Beach, who conducted the final field measurements for the proof of performance.

RADIALS from KWKW with directional antenna in final adjustment. Determining the effective field at 1 mile



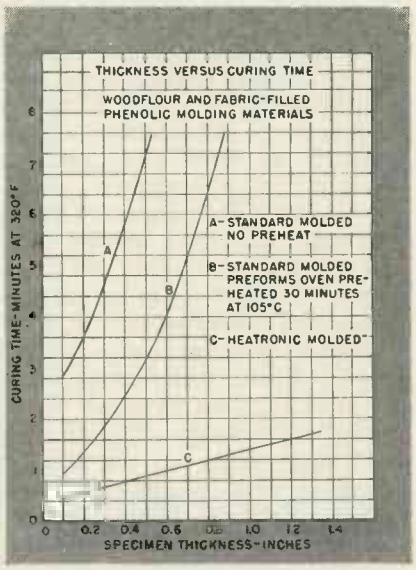
HEATRONIC MOLDING

Electronic heat introduces new technique for rapid molding of plastics and a saving in molds and man-hours

The Heatronic Molding process utilizing a high-frequency dielectric heating source of energy has given the plastics industry a new principle of operation, according to V. E. Meharg, Bakelite Corp., during a meeting of the Society of the Plastics Industry, one that gives promise of a saving in molds, presses, and labor man-hours. Installations that are now being made show ample justification of its practicability to many phases of the forming or molding of plastics. The process refers to the method of heating a plastic to a temperature at which it possesses sufficient fluidity for the desired flow by the application of high-frequency fields to the molds.

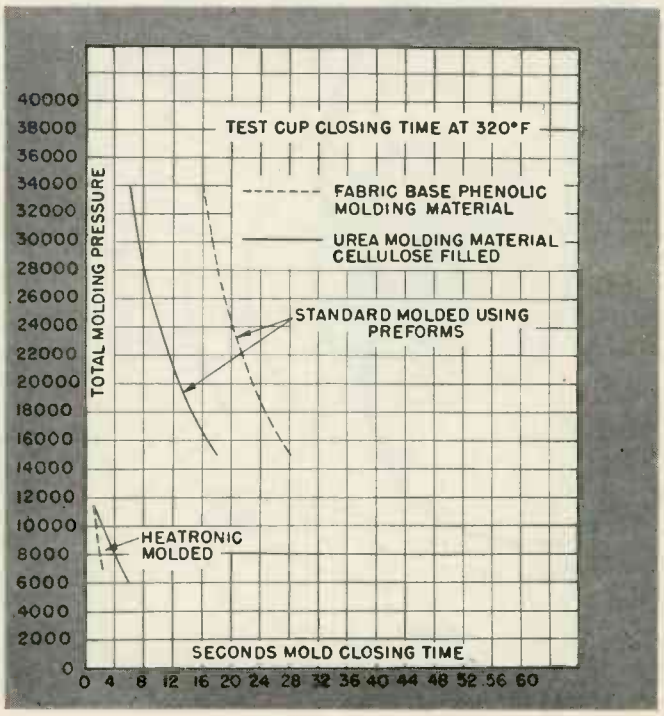
It is particularly applicable to the thermosetting resins which, by virtue of a chemical reaction, soften under heat but harden with time. The other general class, thermoplastics, also soften under heat but harden by cooling, no substantial chemical reaction occurring during the cycle.

Since the molding industry generally has to handle large quantities of individual items, it is greatly concerned with the speed at which they can be formed. The variables of temperature and pressure have been used to the utmost in shortening cycles as much as possible. Today jobs are gained or lost by time cycle differences of only a few seconds. The heating and cooling cycles in the molding operation and the rate of heat transfer have been the most severely limiting factor, especially in cases in which thick sections are concerned. The restriction has been more severe, however, in the case of the thermosetting materials because the complete operation of heating and hardening had to take place in the molding die whereas in the case of thermoplastics, the heating of material for one or more charges takes place in a separate heating cylinder and concurrent with the cooling in the die of the parts being molded. The Heatronic method handles this problem by generating the heat within the material and, if desirable, outside the die. A high-frequency current is used to bring the material to or near its molding temperature in a relatively short period of time by making the material the dielectric between two plates in the high-frequency field. If the material was a perfect dielectric, no heating would occur. However, all present

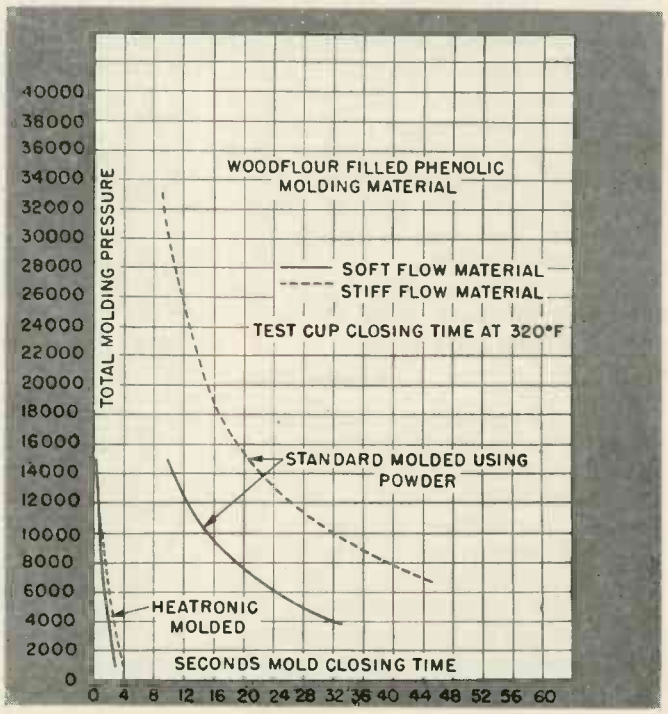


OPTIMUM TIME of molding specimens of different thicknesses

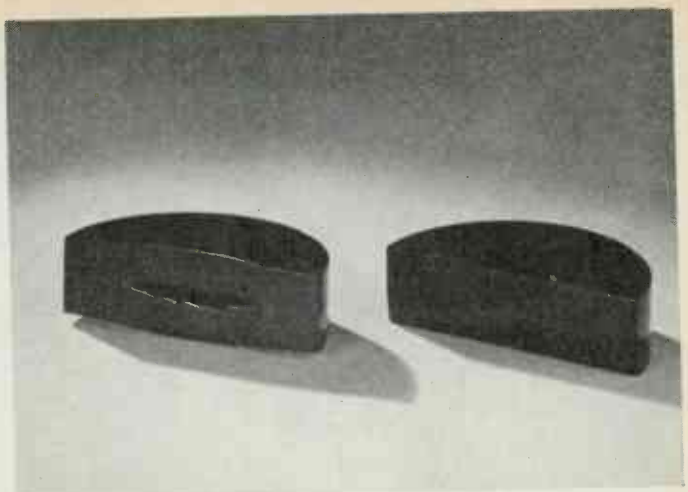
EFFECT of Heatronic Molding on plasticity



EFFECT of Heatronic Molding on plasticity



TEST CUPS molded of high impact-resistant phenolic material. Total pressure 16,000 lbs. Left: Standard Molded cup not filled. Right: Heatronic Molded 14 seconds close



CROSS-SECTION of discs 3 in. diameter, ⅞ in. thick. Molded of Bakelite at 320 deg. F. Left: Standard Molded 10 minute cure. Right: Heatronic Molded, 1¼ minute cure

day thermosetting materials are sufficiently far from being perfect that the dielectric field quickly generates enough heat in the material to raise it to molding temperature within a matter of fifteen to sixty seconds.

The present simplest procedure of Heatronic application to thermosetting plastics consists of heating the material to or near its molding temperature within 15-60 seconds. The hot material is quickly transferred to the mold which is closed to permit plastic flow prior to any substantial hardening of the material. The time available for this operation will vary somewhat for different materials. The basic formula for heating by this means is:

$$H = Kf\ (L.F.)\ \frac{(E)^2}{t}$$

Where H = heat per unit volume
K = constant
f = frequency
L.F. = loss factor
E = voltage
t = thickness of sample

The rate of heating must bear a relationship to the speed at which the plastic hardens. Thus, if heating requires too long a time, the material will commence to harden before flow is finished in the die. For the present general-purpose phenolic, it is desirable to have a machine of about 5 kva input per pound of material. If 50 per cent conversion of electrical energy to heat is obtained, as may be expected, this means 2.5 kva per pound, which should heat the material to molding temperature in 45 seconds or less. Other methods of combining the Heatronic process as an integral part of the die have been carried out experimentally and with further work may prove practical. Entirely automatic methods give promise of early use.

It is advisable to have the molding material in a preformed state if best uniformity and heating efficiency are to be obtained. While the powder will heat, it will be at a lower rate than with preforms and there is more danger of differences in temperature developing within the material being heated.

Advantages in Setting Thermosetting Materials

1. **Increased speed of hardening especially for thick sections.**
2. **Increased plasticity which enables greater production from the same press and die or a smaller press and die for the same production.**
3. **Less wear on dies.**
4. **Less danger of pin and insert breakage or displacement. In addition to these we also point out the possibility that due to the lower pressures and less abrasive nature of the plastic another advantage, i.e.,**
5. **Probable use of lower cost dies of cast or plates, types where only limited production is desired and cost is a considerable factor.**
6. **Feasibility of molding large parts on a fast cycle.**

Shape of part

A point not usually appreciated by those unfamiliar with the technique is that uniformity is greatly influenced by the shape of the part to be heated. Although odd, uneven shapes can be heated, it is much simpler if uniformly thick flat preforms can be used.

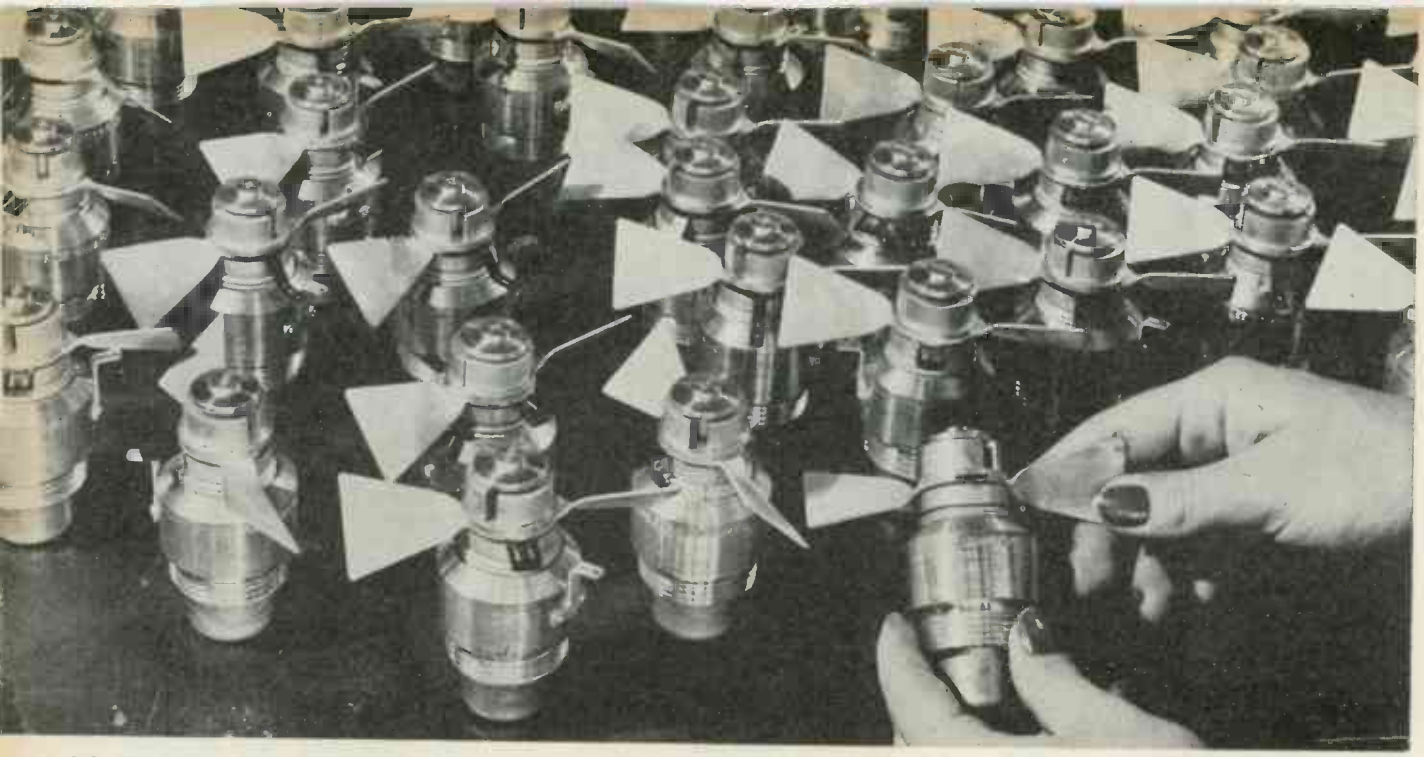
If the best principles of this new process are followed, certain definite and distinct advantages are obtained. The first of these is shown on the chart "Thickness Versus Cure Time." It will be noted that cure time is almost independent of thickness of section.

A second great advantage is increased plasticity. This data is presented in the form of "Closing Time" of a standard cup mold as

(*Continued on page* 184)

TABLE I
EFFECT OF HEATRONIC MOLDING ON PLASTICITY

Molding Material	Type Molding	Total Pressure Pounds	Mold Closing Time
Phenolic General Purpose	Standard	17,000 (min.)	25 sec.
	Heatronic	17,000	6 sec.
	Standard	8,000	Not filled
	Heatronic	8,000 (min.)	6 sec.
Phenolic Improved Impact-Resistant	Standard	14,000 (min.)	35 sec.
	Heatronic	14,000	4 sec.
	Standard	6,000	Not filled
	Heatronic	6,000 (min.)	4 sec.
Phenolic High Impact-Resistant	Standard	30,000 (min.)	32 sec.
	Heatronic	30,000	11 sec.
	Standard	6,000	Not filled
	Heatronic	6,000 (min.)	12 sec.
Phenolic High Heat-Resistant	Standard	16,000 (min.)	25 sec.
	Heatronic	16,000	13 sec.
	Standard	8,000	Not filled
	Heatronic	8,000 (min.)	13 sec.



TO PERMIT SAFE HANDLING on the ground, bombs are armed in flight by electronically tested propellers which release safety mechanism

ELECTRONIC TIMER CHECKS BOMB FUSES

by H. C. BATES
Quality Control Engineer, Westinghouse Electric & Manufacturing Co.

Photoelectric means accurately determines "arming time" required to remove safety block-exposing striker plate

With the tendency toward increased plane speeds, it has become essential to test fuses at air velocities of 600 miles per hour or more. Since the "arming time" at these velocities is normally only a fraction of a second, it is imperative to have a timing device of suitable accuracy. The use of a light beam and photoelectric cell has proven to be the most accurate and practical method of securing the results required.

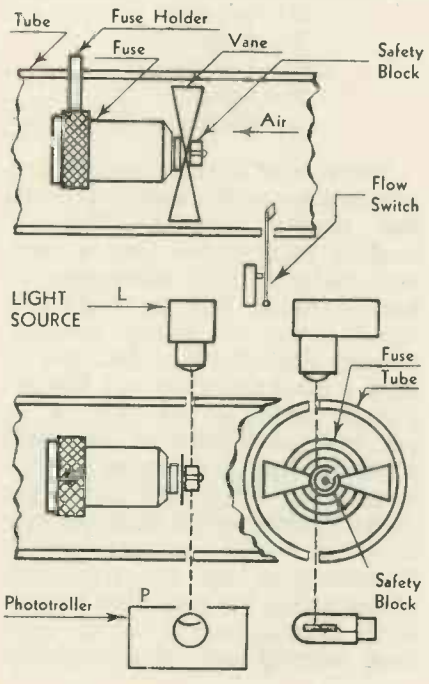
Prevent detonation

The nose type bomb fuse such as manufactured at an eastern Westinghouse plant, contains a safety device to prevent detonation of the bomb except when intended. This device consists of a "safety block," interposed between the striker plate and fuse body, which until removed prevents detonation even upon normal impact. The removal of the safety block, or "arming" of the bomb, occurs when the propeller, or vane, of the fuse is exposed to a high velocity air stream upon being dropped from the plane. The rotating propeller turns a gear train, which withdraws a sleeve by means of a screw thread, leaving the safety block free to be thrown clear of the fuse by centrifugal force and gravity.

In conducting performance tests on the nose type bomb fuse one of the important requirements is to determine how long a time it takes the safety block to be released after exposure of the fuse to an air stream of a certain velocity. This is called "arming time."

A brief description of the whole test set-up will make the action of the timer more easily understood. Compressed air at a certain pressure, up to 110 lbs./square inch, is stored in tank "T" from the shop line. This air is allowed to pass through nozzle "N" when electromagnetic valve "V" is opened by closing the key switch "S." The nozzle allows expansion, changing the pressure into velocity in tube

SECTIONAL VIEW of fuse mounted inside wind tunnel. Below, sketch shows how safety block intercepts light beam



"W" where the fuse to be tested is located. The vane or propeller of the fuse is rotated at a high speed, causing the fuse to "arm" and the safety block to fly out after a fraction of a second, striking the circumference of the tube. In most cases the vane will strike the block shortly after this, resulting in considerable bending and distortion of the blade. The safety block is discharged, through the silencer "Q" to a receptacle "Y."

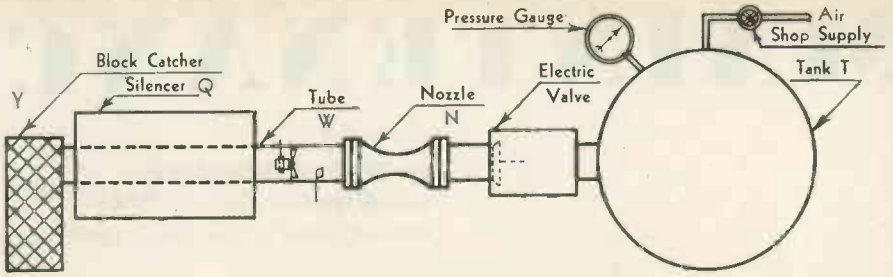
Timer's action

The action of the electronic timer is as follows:

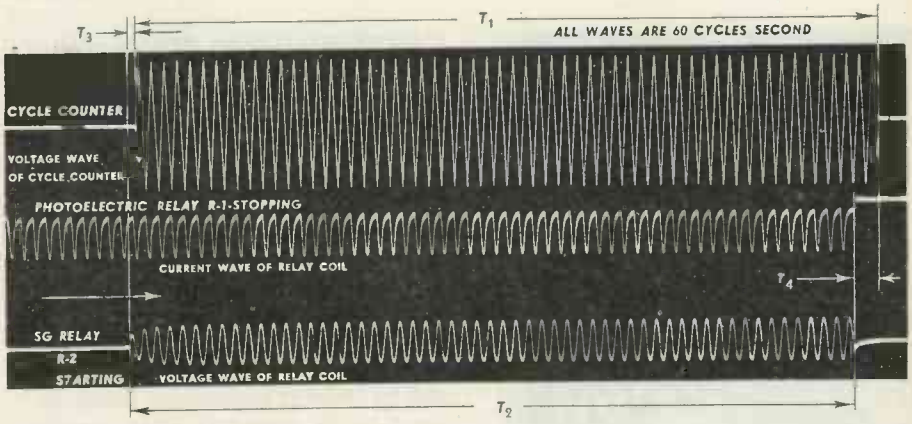
Light from source "L" passes through a hole in the tube "W" and with no fuse in place, passes across the tube, out through another hole, where it strikes the plate at the phototube "P." When the test fuse is in the holder, however, this light beam is interrupted by the safety block of the fuse. When the block flies out, the light passes through, just above the striker pin and spring assembly.

An electric clock "C" (cycle-counter or milli-second timer) is connected in such a way that it is started by the action of the flow switch "M" which is actuated by a very small paddle, projecting into the wind stream. This switch

(*Continued on page* 198)



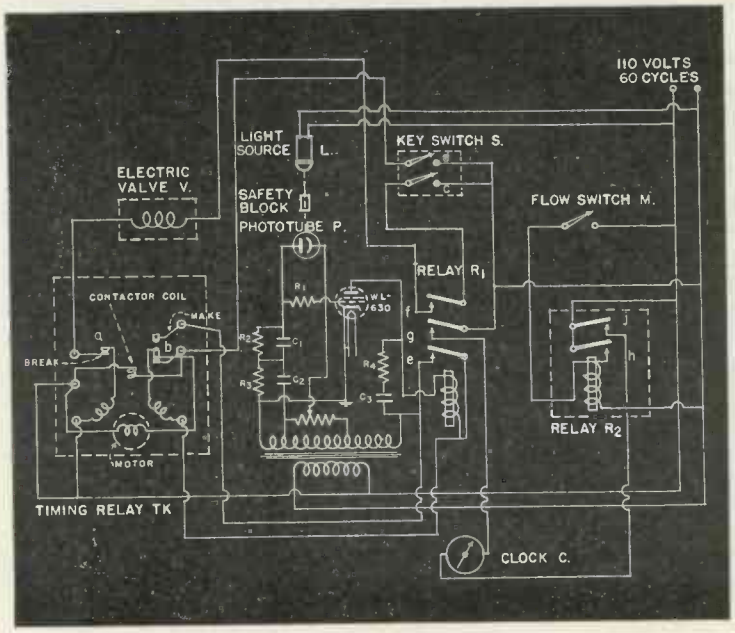
PNEUMATIC SYSTEM used in testing bomb arming fuses

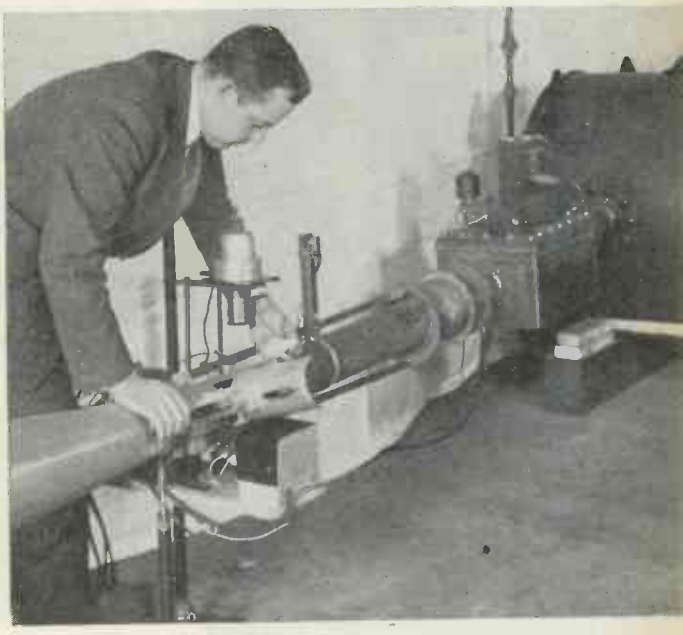


OSCILLOGRAPH test of timer, with elements of recorder connected across cycle counter supply voltage, across starting relay R-2, and in series with stopping relay R-1. T_1 is time as recorded by cycle counter, 57½ cycles or .958 seconds. T_2 is actual time between impact of wind stream and release of safety block, 56½ cycles or .942 seconds. Error in timer due to relay lag is therefore .016 seconds, or 1.67%. T_3 is lag of de relay taking 2 cycles to open. T_3 is lag of sg relay taking 1 cycle to close. If relays lagged equally T_3 would equal T_4 and errors would cancel, but since error is known and constant it is subtracted from the reading obtained from the cycle counter

SCHEMATIC DIAGRAM of bomb fuse test set-up, at left. With safety block to be timed in position, operator closes key switch S, energizing timing relay TK through contacts d. Relay R_1 closes through contacts b on TK and conducting thyratron, and locks up through its own contacts e. The TK delay-motor starts and after an interval of about one second causes TK to open, closing contacts a and energizing electrically operated air valve V, which admits air to the test tunnel. Air strikes vane of flow switch M, closing relay R_2 which locks up through its contacts h. Timing clock starts through contacts j. The bomb fuse vane begins to revolve and after the interval to be measured, the safety block flies out. Light strikes the phototube, causing the thyratron to cease firing, which allows R_1 to open. Clock stops through contacts g, and electric air valve shuts off air through contacts f. Switch S is opened and a new bomb fuse positioned for test

COMPRESSED AIR, operates wind tunnel, below, to give average velocity of 500 mph, for laboratory study of action of bomb fuses. Air in the tunnel is controlled by a reducing nozzle and the electric valve to start and stop flow. While electronic timer measures duration of air flow, pressure gage indicates air used.

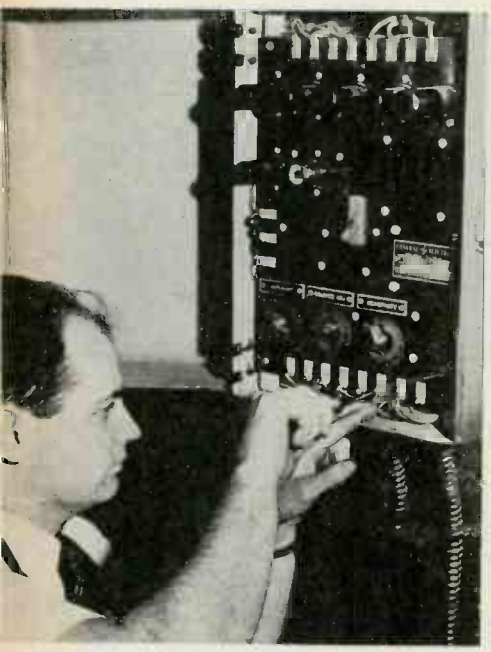




MAINTENANCE AND

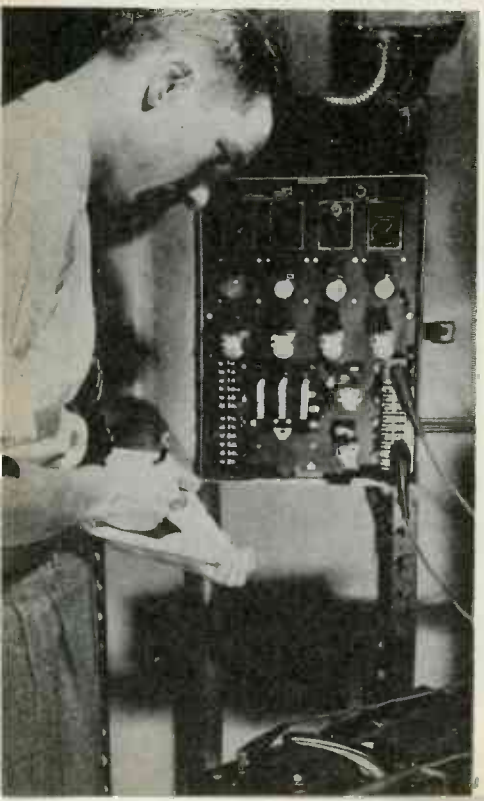
by W. D. COCKERELL
Engineer, Electronics Section
Industrial Control Division, General Electric Company

Causes of failure in service generally can be traced to excessive vibration, accumulations of dirt, and long neglect



PERIODIC CHECKS should be made on equipment subject to slight vibrations to be sure that all fastenings are tight

LINE VOLTAGE should correspond to panel nameplate rating, or within variation of plus or minus 5% of marked value



Electronic control devices—ranging from specialized resistance welding controls used in metal-working industries to standard photoelectric relays used for hundreds of jobs in all industries—are being worked hard in today's production battle. Electronic equipment, generally, requires less maintenance than other electric equipment since it has no moving or wearing parts. Nevertheless, to keep it in top-notch operating condition and to prevent production interruptions, it is essential that certain maintenance procedures and checks be followed and that troubles be located and remedied as quickly as possible.

This article is not intended to be an exhaustive step-by-step treatment of the maintenance of particular electronic controls but rather a "high-light" discussion of good maintenance, trouble-finding, and trouble-correcting practices on electronic controls generally.

Most of the components of electronic controls—resistors, reactors, transformers, and capacitors — are of a semipermanent nature and are conservatively rated to give many years of service with very little maintenance. Even the electron tubes themselves require inspection and test only at comparatively long intervals.

In view of these facts and the fact that electronic control sometimes will continue to function under extreme conditions of moisture, temperature, and dirt, there is frequently a tendency to neglect the simple rules of good maintenance.

First, it must be remembered that many parts of electronic controls are similar to those used in magnetic controls. Enclosing cases, bases, terminals, and wiring and conduit devices are frequently identical. Standard magnetic control devices — such as fuses, switches, and overload relays of both the instantaneous and the time-delay types—are found on many electronic panels. These devices usually perform starting or protective functions and operate infrequently. As in the case of standard magnetic control panels, this infrequent operation itself sometimes results in special maintenance problems. Detailed instructions as to the inspection and maintenance of these standard devices may be found in manuals covering this equipment.

Preventive maintenance

Particular emphasis should be placed on inspection for cleanliness and the effects of vibration. Because of the high impedances used in some electronic circuits, an excessive accumulation of dust or processed material will, particularly when damp, provide parasite circuits which may interfere with proper operation. Lenses and other parts of optical systems should be wiped off frequently with a clean, soft rag.

Since many electronic panels are interconnected extensively with other apparatus, the loosening of connections or the breakage of leads through the effects of vibration may cause serious shutdowns, entailing intensive and sometimes aggravating trouble shooting before the fault is located. Vibration also tends to shorten tube life. If severe vibration is found to exist at the installation location, shock mounting of the control panels, as well as the use of stranded or extraflexible leads, may be justified.

Photoelectric and other electronic controls involving mechanical components should be checked frequently to assure that the mechanical adjustments have not been disturbed. Common causes of such disturbances are bolts loosening under vibration or chain hoists and other shop equipment hitting against the equipment.

Very rarely does a modern electronic tube fail suddenly. Usually the failure is the result of a gradual loss of emission that takes place

TROUBLE-SHOOTING

as the active cathode material is used up or flakes off. Overloading, mechanical abuse, operation at high or low filament or cathode heater voltage, and operation outside of required temperature limits all tend to shorten tube life.

Among the most prevalent causes of poor operation and short tube life are the operation of electronic panels on line voltages differing too greatly from the panel nameplate voltage, and the use of the wrong tap when a tapped-input transformer is provided. Panels are usually designed to operate satisfactorily on line voltages varying plus or minus five per cent of the panel rating. If the voltage at the installation point is consistently high or low, a small auto- or booster-transformer may be used. If the line voltage fluctuates widely, a special voltage-regulating transformer may be justified. Faulty heater transformers, loose connections, and corroded socket connections also may limit the low-voltage, high-current power required for the tube cathode heater.

High-vacuum tubes and tubes filled with true gases, such as argon and xenon, may be operated without difficulty over a wide ambient temperature range, but tubes using mercury vapor operate best in a more restricted ambient range. Enclosing case ventilation and other temperature-regulating means are provided for the usual industrial indoor ambient temperatures of 60 to 100 deg. F. For low ambient temperatures, manually or thermostatically controlled strip heaters may be mounted in the case. For temperatures from 100 to 120 deg. F, fan or forced-air cooling may be sufficient. Above this temperature, components other than the tubes may be affected also and it may be that standard equipment will be unsuitable for the installation.

Set protective timer

Panels which use gas- or mercury-filled tubes are normally equipped with a cathode protective timer. This timer should be set for the heating period designated by the instructions accompanying each new tube. This time has been found by experience to be the minimum time permissible for reasonable tube life.

During the shipment or handling of mercury-vapor-type tubes, the liquid mercury may be splashed on the elements. Therefore, when the tube is first placed in service, it is necessary to heat the tube cathode for a time with the anode lead disconnected, distilling off the splashed mercury before the anode power is applied. This requires a longer period than the usual cathode heating time; the tube instructions give the proper time.

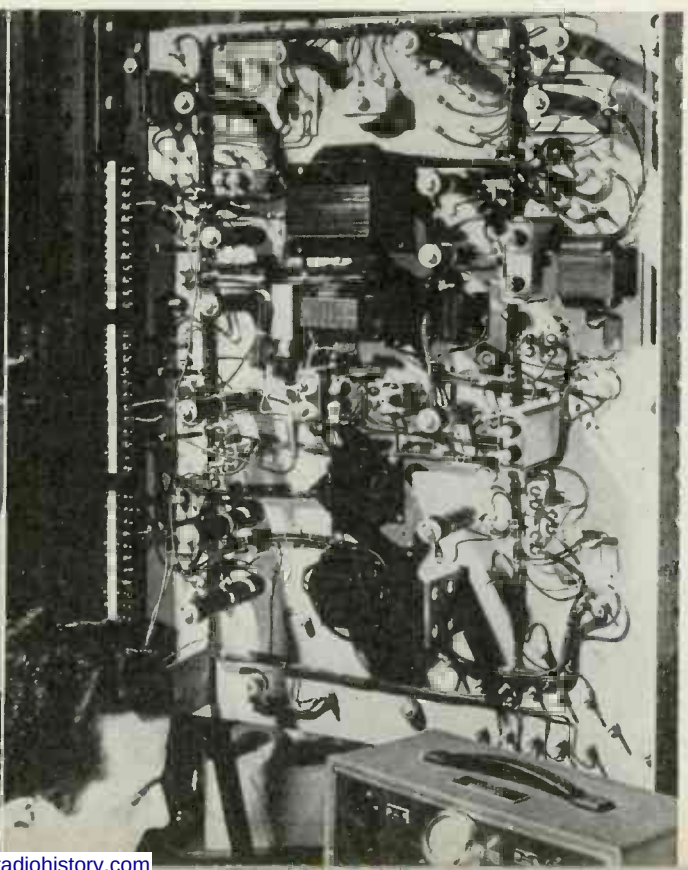
Some electronic panels are designed to use tubes on external loads. It is essential that these loads not be greater than either the average or peak rating of the tubes. Sometimes an operator will increase the anode voltage, replace coils, or alter motor pulleys or gearing to obtain a greater output, thus overloading the tubes. Since they seriously reduce tube life, such practices should be avoided.

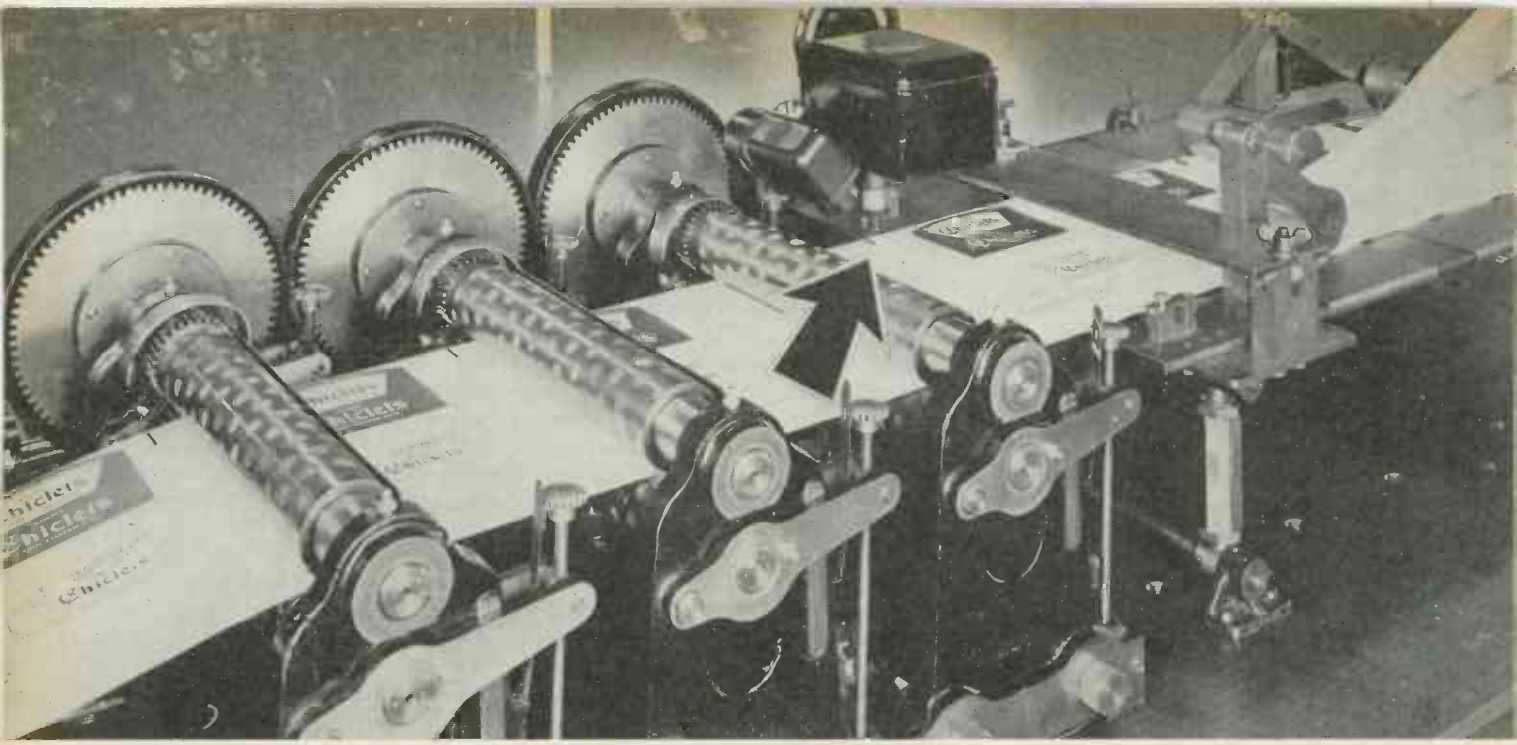
The effects of vibration on tube life have already been considered, but shocks and jars in handling tubes, particularly when they are old, can be quite detrimental. Sharp shocks, such as caused by

(*Continued on page* 186)

LENSES AND PHOTOELECTRIC optical systems should be wiped off regularly with clean, soft rag

CATHODE RAY OSCILLOSCOPE is useful instrument for checking wave shapes when searching for faults





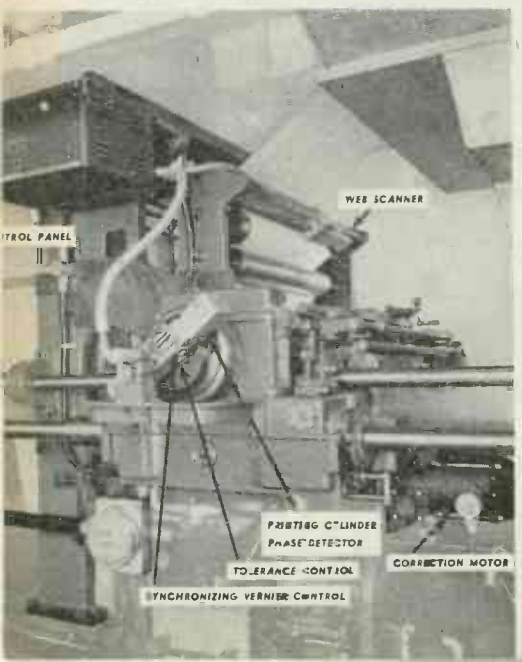
PHOTOELECTRIC control in printing operations, here shown in a precision die-cutting operation, relies upon a scanning mark printed on one of the margins

PRECISION REGISTER WITH PHOTOTUBES

How wastage in fine color printing on high-speed web presses has been cut down from 10 per cent to less than 2 per cent

With printing speeds increasing to the point where several hundred feet of paper pass in a minute between the impression rollers of modern high speed presses, the problem of getting precision register of three, four or five colors becomes a difficult one and one that is directly tied up with press room profits.

CORRECTION MOTOR, controlled by synchronized photoelectric tubes, maintains color register



The only practical method of insuring hairline precision register automatically is through the use of photoelectric control; and so accurately does such equipment operate that wastage resulting from misregister in multi-color printing has been reduced from as much as 10 per cent to less than 2 per cent. Electronic control, such as that developed by the Champlain Division of Interchemical Corporation, New York, is applicable with equal effectiveness to letterpress printing, to gravure, to lithography and to analine processes, as well as to other printing operations requiring a high degree of precision, such, for example, as die-cutting.

Perfect register

In its simplest aspect, as applied to a single cylinder of a multi-color press for the control of the second of several colors which will be printed on subsequent rollers each of which carries similar control equipment, the device consists of photocells which, through synchronization, operate thyratron tubes controlling a dc motor which advances or retards the impression cylinder by the exact amount necessary for perfect register. The equipment automatically detects and corrects misregister.

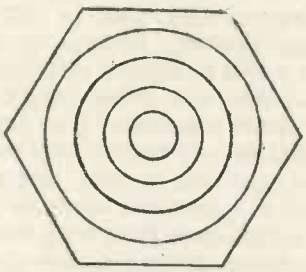
The manner in which this result is achieved is relatively simple. A reference mark 1/32 inch x 5/16 inch is printed on the web or roll of paper by the first color. This mark acts as a target for determining the relative position of other colors printed by subsequent rollers. Focused on the mark, a photocell scans the target and as it flashes past, the feeble voltage generated is amplified and passed to a control panel. Sensitivity adjustments are provided so that even faint colors, such as process yellow on white paper, will affect the photocell.

The second photocell is mounted to focus on slots in a disc mounted

(*Continued on page* 199)

LABORATORY KINKS

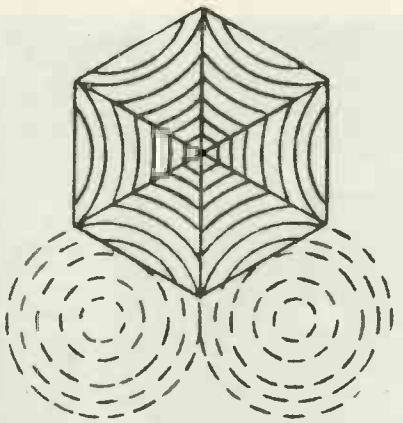
A notable example of how American industry has gotten together in close cooperation in the free exchange of ideas that speed up production schedules is that typified by the Crystal Round Table, operated by the Galvin Mfg. Co., Chicago. Started originally in order to circulate crystal production ideas between the various groups interested in crystals in that organization and its crystal sub-contractors, it now has included other organizations in its plan.



APPEARANCE of the rings in unterminated quartz, forming complete circles

Since its start last October under the responsibility of Elmer H. Wavering of the Galvin company, more than fifty bulletins have been issued showing ideas to speed up crystal production and to conserve vital materials. The following material is typical of the service rendered by this Round Table and the concerns that have contributed their best ideas.

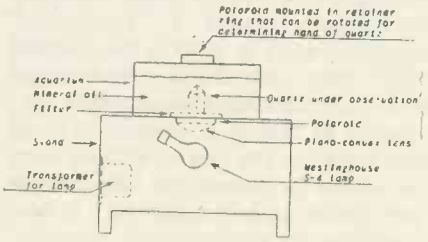
A precise and rapid method for determining the hand, usability and polarity of mother quartz was contributed by the Precise Developments Co., Chicago. Cutters of small mother quartz (3 oz. to 1 lb.) are usually confronted with the problem of determining these facts in order to cut correctly.



APPEARANCE of the rings in terminated quartz; curves form circles outside the quartz

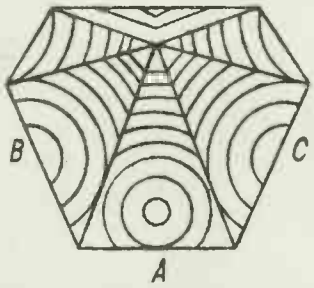
Electrical twinning plays a serious part in these small rocks and grave mistakes can be readily made (particularly in the polarity determination) if conventional methods are used. For the process about to be described, very simple and non-critical equipment is used and if the instructions are followed, no chance of error will exist.

RED CELLULOID filter is used in the Precise polariscope to reduce lamp intensity on quartz in which the transparency is high



Equipment needed

The equipment is as follows: rubber lined deep tank and a rubber lined wire basket, a pair of rubber gloves, an electrometer and a polariscope (monochromatic light.)



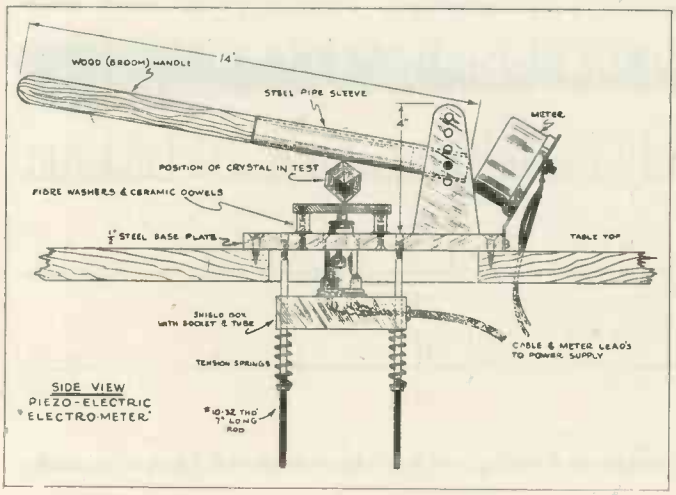
APPEARANCE of the rings in terminated quartz having three very prominent faces

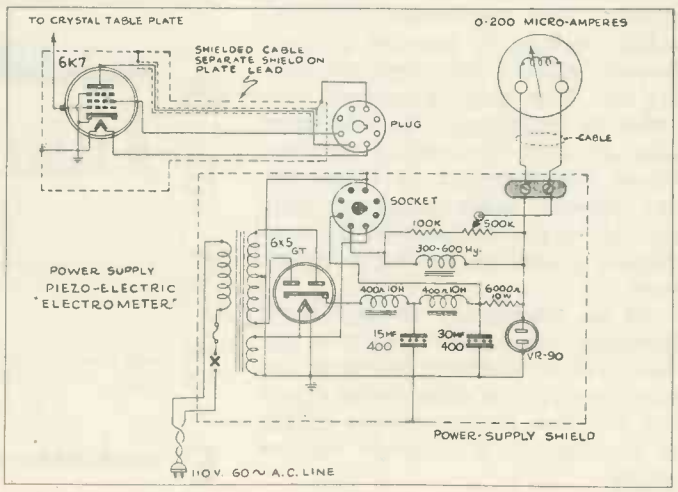
The mother quartz is first sandblasted. The sandblasted quartz is then placed in the rubber lined baskets and immersed in a 60 per cent solution of hydrofluoric acid. After three hours the quartz is removed from the acid and washed in clear running water.

The quartz is then examined for optical and electrical twinning and the electrical twinned areas are painted out. The quartz is now

(*Continued on page* 200)

THIS ELECTROMETER WAS DEVELOPED by the Crystal Engineering Department of the Galvin Mfg. Co., Chicago, and is suitable for determining the polarity of mother quartz—the magnitude and polarity of the emf generated in a crystal with pressure applied successively to the various axes





Electronic Tubes ON THE JOB

CONTROL PANEL for the PA system in the factory buildings of North American Aviation

A 2,100-Watt Industrial-Music System

Set up to cover North American Aviation's Inglewood, Calif. plant, this up-to-date PA system excites more than three hundred speakers, wired in six main "districts" in the several plants. Twenty-six channels in the main factory provide the maximum of flexibility for paging, music, special announcements, or off-the-air programs.

The main control room, pictured here, is a specially constructed sound-deadened "studio," an unusual refinement for a plant PA system. Two turntables are provided, making it possible to play records without interruptions during the four daily programs provided to employees. In this room also, an RCA commercial recorder allows the operator to transcribe any special radio program, talk, etc., to be played back to the employees at another more convenient time.

In an emergency of any kind, throwing one master switch in the main factory building brings in the entire plant on a microphone channel. Another, similar, master switch is provided in a separate control center.

Predicting Rock "Bursts"

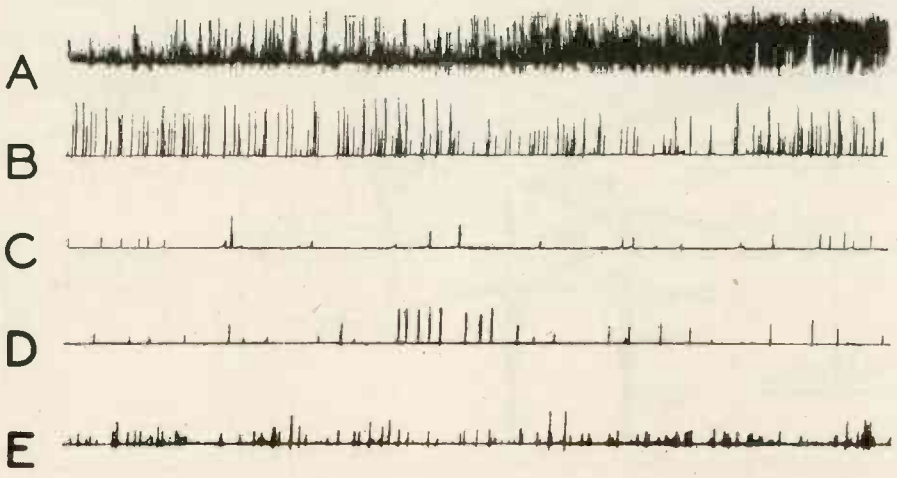
Using electronic apparatus consisting of a type of piezo-electric microphone styled a "geophone," together with a resistance-coupled high gain amplifier, headphones and tape recording equipment, geologists of the U. S. Department of the Interior, Bureau of Mines, have succeeded in measuring sub-audible rock noises and in using such measurements to predict rock "bursts." These sub-audible noises, it has been determined, result from pressure, and inasmuch as it is pressure that causes the rock to "burst," a record of noises can be made to predict "bursts" with accuracy.

Tests in mines

The tests from which conclusions were drawn were carried on over a period of several months in a number of different mines. One difficulty encountered was in differentiating between natural noises, such as would be caused by drilling, for example, and other noises of much smaller magnitude that might be related to rock bursts. This trouble was overcome in part, and under certain conditions, through the use of a high-pass filter with which characteristic drilling noises could be sufficiently attenuated to permit examining and recording sub-audible noises.

The geophone, used to generate a feeble current for transmission to the amplifier through a concentric cable sometimes as long as 1000 feet, consisted of a bimorphic piezo-electric crystal 2½ in. long, ¾ in. wide and ¼ in. thick mounted as a cantilever in a steel tube 1¼ in. in diameter and approximately 8 in. long. It was thus about the dimensions of a stick of powder and was so designed that it would fit nicely in a rock drill hole. Between the geophone and the transmission line, a transformer reduced the line impedance to 30 ohms, permitting the use of long cables without serious

ELECTRONIC RECORD of mine noises showing A, drilling noise; B, distant sounds; C, subaudible rock noises (comparatively quiet); D, subaudible rock noises showing a series of remote disturbances of considerable magnitude; E, subaudible rock noises (comparatively noisy) showing a predominence of small noises



attenuation or frequency discrimination.

The amplifier was a conventional three-stage resistance coupled unit having a voltage gain of approximately 100,000 and was equipped with a series of high-pass and low-pass filters having cut-off frequencies of 500, 1000, 2500, 5000 and 7500 cycles. Following this amplifier there were a logarithmic and peak limiting amplifier with power supply and then a graphic recorder.

Records made

Following a series of tests during which a record of drilling and other noises was made as a basis for future comparisons, tests were run to determine the magnitude and frequency of sub-audible noises generated within the rock as a result of pressure. Traces reproduced here indicate the nature of the records obtained under various conditions. In a subsequent test extended over a period of 42 days, sub-audible noises were charted in conjunction with actual rock bursts, indicating the possibility of quite definitely predicting bursts which invariably are preceded by considerable increase in sub-audible noise.

Cleaned Air For Blast Furnace

For the first time, electrically cleaned air is being used in a steel mill blast furnace. The mill is one of those operated by the Kaiser Co., near Fontana, Calif., and 90,000 cubic feet of air a minute passes through 120 Westinghouse Precipitron cells to the turbo-blower that feeds the furnace. Purpose of cleaning the air is to keep sludge out of the blower case, increasing the efficiency of the unit and decreasing maintenance expense.

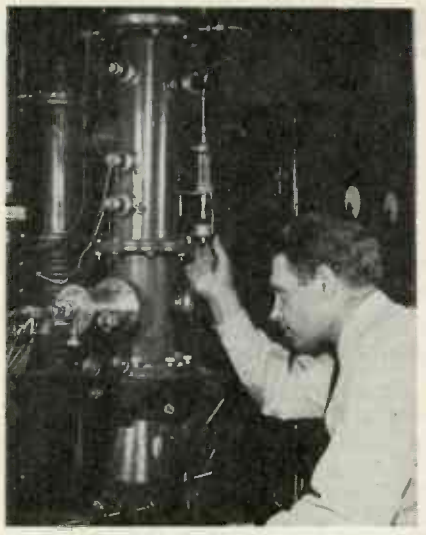
STEEL MILL furnace breathes through this Precipitron air cleaner

Precipitron lures oil

Pretty well known are the capabilities of the Westinghouse Precipitron which makes use of an electronic lure to trap air-borne dust. "Now," points out A. C. Monteith, manager of the industry engineering department of Westinghouse Electric & Mfg. Co., "prospects of the equipment are expanding to the point where it can be used to cleanse machine shop air of oil mist. On a trial installation, the Precipitron collected four gallons of oil in 24 hours from one machine."

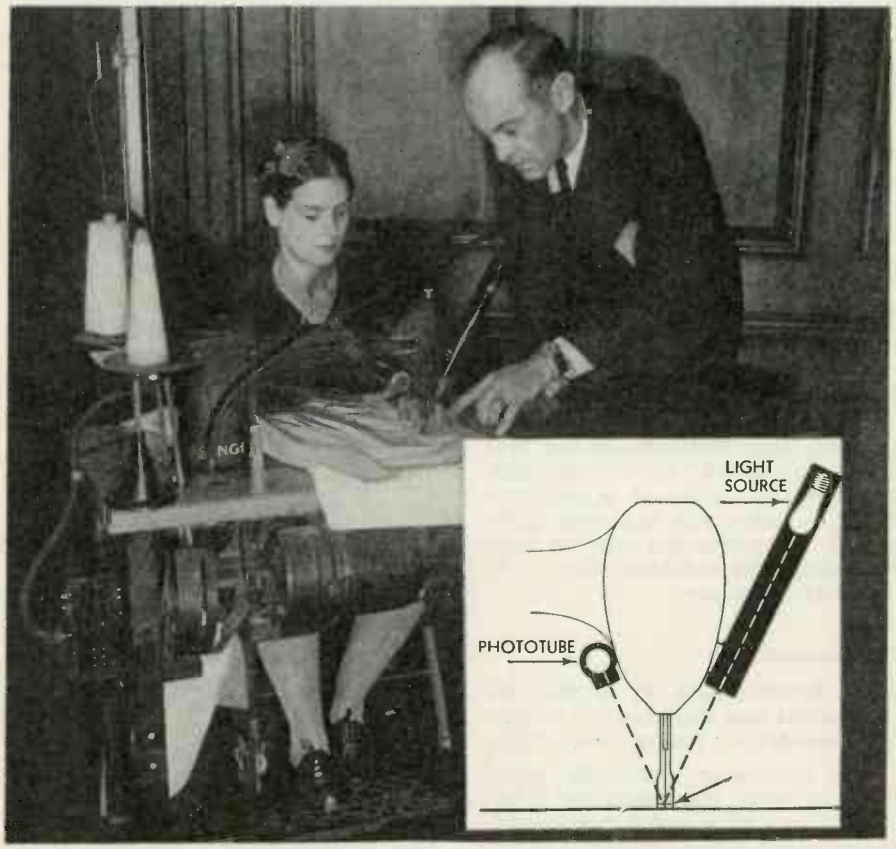
Combatting Corrosion

Investigating the atomic structure of rust and other coatings that form on steel, aluminum and copper, Dr. Earl A. Gulbranson of Westinghouse Research Laboratories, uses an electron gun and an electronic diffraction camera. The gun bounces electrons off a small button of the material being investigated. As electrons ricochet off the faces of the molecules that form the coating they strike a photographic plate, thereby registering a pattern which reveals the molecular structure of the film. Purpose of the investigation is to find ways to combat corrosion.



ELECTRON GUN under the guiding hand of Dr. Earl A. Gulbranson, Westinghouse Research Laboratories

Safeguarding Blind Seamstresses



PHOTOELECTRIC GUARD, which automatically and instantly stops sewing machine when blind operator's fingers enter danger zone, is demonstrated by J. O. Kleber, who developed the equipment for the American Foundation for the Blind. Light beam, reflected from chromium plated sewing machine foot, is interrupted by worker's fingers, cutting off motor current and operating magnetic brake

SURVEY of WIDE READING

Electronic news in the world's press. Review of engineering, scientific and industrial journals, here and abroad

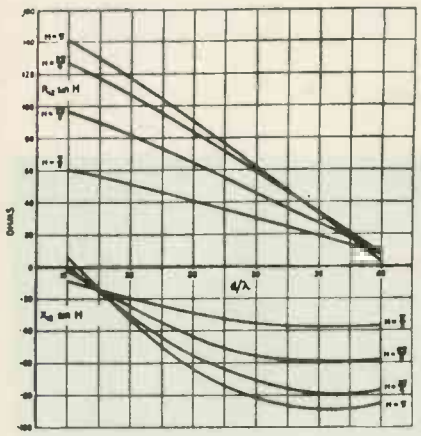
On Mutual Antenna Impedance

C. W. Harrison, Jr. (Journal of Applied Physics, June 1943)

An expression is derived for the mutual impedance between a symmetrical, center-driven antenna and an untuned parasitic element, when the wires are parallel, and are not displaced in length. To evaluate the formula, the integral of the retarded potential

$$\int e^{-2\pi j(x^2+r^2)^{\frac{1}{2}}/\lambda}/(x^2+r^2)^{\frac{1}{2}}\,dx$$

—which is frequently encountered in antenna problems—had to be solved. This was done by numerical integration and the results are shown in diagrams.



MUTUAL antenna impedance

The figure gives the mutual impedance between the driven antenna and the untuned parasitic antenna as a function of the distance measured in wavelength, for constant values of H equal to $2\pi h/\lambda$, h being the antenna half-length. The diagram may be used to compute the radiation pattern of the antenna array.

Titrometer

C. J. Penther and F. B. Rolfson (Industrial and Engineering Chemistry, Analytical Edition, May 1943)

The titrometer described comprises a step potentiometer connected to a tube voltmeter circuit of the single-stage, balanced-input type. The instrument covers the range from —1.65 to +1.65 volts readable to 0.5 millivolts. It has a grid current of the order of 10^{-12} amperes.

Machine for Calculating Polar Diagrams

H. P. Williams (Electrical Communication, Vol. 21, No. 2, 1943)

This device permits calculation of the polar diagram of antenna arrays for any relative magnitude and phase of antenna currents and any arrangement of antennas. Though the present model is designed for five antennas, the principle of operation will allow for its extension to any number of antennas. Provisions for automatic tracing of the polar curves can be added, instead of voltmeter readings for the various angles of interest.

In a "Selsyn" motor the phase of the emf in the rotor is proportional to the angular position of the rotor. Several such motors are used and, by means of mechanical couplings, the angular position of each of them, as it rotates, is made to correspond to the relative phase of one of the antenna fields for a rotation of 360° in the horizontal plane. Each rotor output is adjusted to be proportional to the correlated antenna current, and all output voltages are connected in series. The resulting voltage is indicative of the field strength.

On Spectral Calibration of Phototubes

R. Stair and W. O. Smith (Journal of Research of the National Bureau of Standards, June 1943)

Phototubes have a selective response with respect to wavelength, which varies from tube to tube and also from point to point on the surface of the same electrode, both as to absolute intensity and wavelength range of sensitivity, even in tubes of the same type and process of manufacture.

In precision photoelectric radiometry, knowledge of the spectral response of either defined portions or the whole of the tube surface must be secured by careful calibration. This requires light of known and constant spectral distribution and of uniform intensity over a minimum area. To provide a suitable light source, a tungsten-filament lamp, enclosed by a fused-quartz envelope, was designed, the spectral energy distribution of which depends upon filament temperature, the emissivity of tungsten and the transmission characteristic of the envelope.

Construction of the lamp, its performance in connection with color filters, and the calibration procedure are discussed in detail.

On the Johnson Effect

N. R. Campbell and V. J. Francis (Philosophical Magazine, London, April 1943)

The Johnson effect is the generation of voltage by the random movement of electrons in a resistor. In the article, a mathematical proof of Johnson's formula

$$\overline{I^2} = 2kT/\pi \int R(_w) \mid Y(_{jw}) \mid^2 dw$$

is given, based on the principles of Brownian or random motion of the electrons. In the formula, R_w is the real part of the impedance connected across the input of an amplifier tube whose transfer admittance is $Y(_{jw})$, T is the absolute temperature, k Boltzmann's constant, I the fluctuation current in the output circuit, and $\overline{I^2}$ its mean square deviation from its mean, which is zero. The relation between the Johnson effect and the shot effect (voltage fluctuations in a temperature-limited electron tube caused by the random velocity distribution of electrons leaving the cathode), is established.

Geological Structure and Radio Waves

B. F. Howell, Jr. (Geophysics, April, 1943)

Some considerations on the influence of the geological structure of the earth on the propagation of radio waves are given and experiments at places of known geological irregularities reported. However, no conclusions are reached and further investigation is suggested.

Mechanical-Electrical Analogy

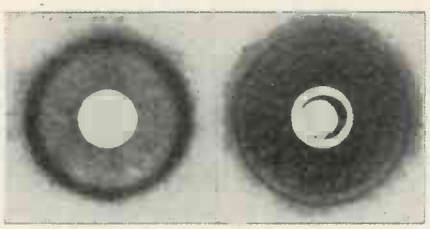
John Miles (Journal of the Acoustical Society of America, Jan. 1943)

The two possible coordinations between electrical and mechanical systems, based on the identity of the corresponding differential equations, are compared as to their relative simplicity and applicability. Likely errors are pointed out and examples given.

On X-ray Investigation of Metals

W. A. Wood (Nature, London, May 22, 1943)

The article describes an X-ray method to distinguish structural changes in cold-worked metals. The observed diffusion of X-ray reflections from a metal which has been subjected to plastic deformation may be due either to the breakdown of the metallic grains to crystallites characterized by a lower limiting size, or to permanent overall changes in dimensions of the atomic lattice to an extent related to the external deformation of the metal. Both effects are usually present, but it was decided to try to develop a reliable criterion to distinguish the predominant factor.



FINE GRAIN diffraction patterns

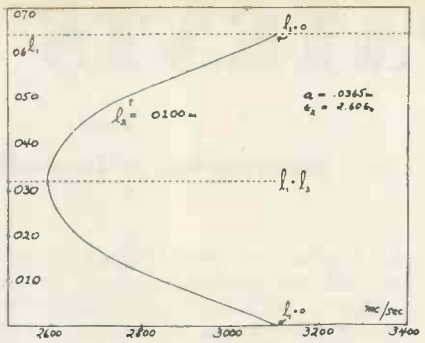
The present method utilizes the fact that at a given reflection angle the broadening due to fine grain is proportional to the X-ray wavelength used to obtain the diffraction pattern, but broadening due to variability of lattice spacing is independent of wavelength. A technique has been developed to employ molybdenum radiation (0.7 A.), which was used in the right-hand picture obtained from heavily deformed steel. The two doublet rings at the circumference are clearly visible.

The left-hand picture was taken with cobalt radiation (1.8 A.); due to line broadening, the doublet rings can no longer be distinguished. It can be concluded that fine grain caused the diffusion effect, which can be seen to depend on the X-ray wavelength used.

Avoiding Crosstalk

H. Stanesby and E. W. Ayers (Post Office Electrical Engineers' Journal, London, April 1943)

Some aspects of crosstalk between unbalanced circuits in communication practice are discussed. The importance of avoiding or suitably arranging ground returns or other ground connections is explained. Several methods to minimize crosstalk are indicated. Particular attention is given to the problem of grounding coaxial cables.



RESONANT AIR-LENGTH as function of frequency

Cylindrical Resonator Containing Two or Three Dielectric Media

D. Middleton (Physical Review, May 1943)

The paper is concerned with the relation between the various natural frequencies and resonant lengths of cylindrical cavity resonators provided with a movable slab of dielectric material. If the slab is fixedly mounted at one end of the cylinder, the problem reduces to that of two dielectric media.

Solutions for the electromagnetic field are obtained in terms of the Hertzian vector potentials. Application of the boundary conditions leads to an expression involving the natural frequencies and the lengths of the resonator sections containing the different dielectrics.

Mathematical investigation of this expression shows that a three-dielectric resonator may be used as tunable circuit element for a particular mode by varying the length of one or more of the dielectric sections, for instance, by shifting the dielectric slab. In the figure, a is the radius of the cylinder, ϵ_2 the dielectric constant of the slab and l_2 its thickness; l_1 and l_3 are the lengths of the two air-filled resonator sections. The two-dielectric resonator has the properties of a band transmission filter whose band width is adjustable by varying the dielectric thickness.

Some experiments were carried out, and the theoretical and experimental results are given and illustrated by a number of diagrams. A method of measuring dielectric constants at about 10 cm is suggested.

Ultrashort Wave Propagation

S. A. Schelkunoff (Electrical Engineering, June 1943)

A nonmathematical presentation of the propagation of electromagnetic waves in wave guides and resonant cavities is given. The behaviour of the waves under various circumstances is stated and illustrated.

Electron Diffraction by Large Molecules

K. H. Storks (Bell Laboratories Record, July 1943)

Polyethylene sebacate, a substance similar to cotton fiber but simpler in structure, has been studied. By the electron diffraction method this material can be examined in the form of films thinner than the total length of one of its molecules which have a chain arrangement of atoms and are extremely long as compared with their other two dimensions. Diffraction patterns are shown in the article and the consequent arrangement of the molecules in the substance as well as the arrangement of the atoms in the molecule are stated.

Diffraction of X-Rays by Liquid Elements

N. S. Gingrich (Reviews of Modern Physics, January 1943)

Theoretical considerations are given correlating X-ray diffraction patterns from liquid elements with the distribution function of the atoms in the liquid; experimental results are reported. The distribution function indicates how many atoms are contained in the spherical shells surrounding any particular atom as a center, and depends on interatomic forces. This function is characteristic for the liquid structure, which is neither permanent as in a crystal nor random as in a gas but has a definite arrangement including preferred distances or shells with a comparatively great atom density.

A particular structure may be correlated with or used to predict physical properties of the liquid.

Start of Arc Discharge

M. Pirani (Proceedings of the Physical Society, London, Jan. 1943)

The conditions for starting arc discharge in mains-operated low-pressure fluorescent lamps were investigated by experiments. The process may be split up in two stages, the glow discharge with high voltage and low current, and the arc discharge proper with low voltage and high current. It was found that surface chemistry of the electrodes and surface physics of the walls play an important part in the start of the arc.

For long tubes and distant electrodes, the negative charge of the wall prevents discharge, and an arrangement to remove these charges by almost continuous glow discharge between two auxiliary wires is described.

(*Continued on page* 201)

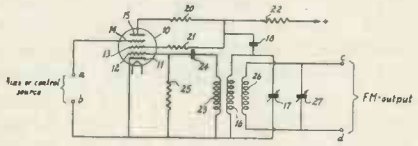
NEW PATENTS ISSUED

Summaries of inventions relating to electronic uses

Note: Date application was Filed shown by (F). Date patent Issued, (I). For the reader's convenience, patents most recently issued are presented first within their specific classifications.

FM AND PHASE MODULATION

FM Oscillator—The resonant frequency of an oscillator is determined by the characteristics of its resonant circuit and by the phase shift in the feed-back current. Thus, frequency modulation is obtained by varying the phase shift of the feed-back current which can be accomplished by changing the relative amount of energy fed back through paths having different electric lengths. Alternatively, the difference in phase shift between the two feed-back currents may be caused by a considerable difference in amplification factor for two out-

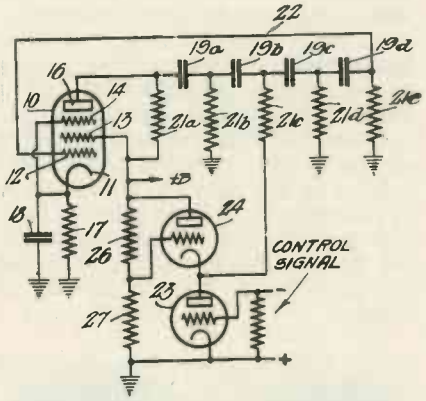


put electrodes of the oscillator tube, the plate current being substantially in phase with the grid voltage and independent of plate voltage and tank circuit for high amplification factors, while the plate current is dependent on plate voltage and, consequently, on the phase angle of the plate load, for small amplification factors. To keep the amplitude reasonably constant, the sum of energy fed back should be maintained constant. In one embodiment, a pentode 10 is used as the oscillator tube, the two feed-back paths being resistor 20 or 21, respectively, condenser 20 and tank circuit 16, 17 coupled to inductance 23. In the pentode, the amplification factor between screen grid 13 and control grid 12 is very low, the amplification factor between plate 15 and control grid 12 is very high. The modulating potential applied to grid 14 changes the amount of current flowing to electrodes 13 and 15, thus regulating the ratio of energy fed back over the two paths. D. A. Bell and O. H. Davie, Radio Patents Corp., (F) March 20, 1942, (I) June 8, 1943, No. 2,321,354.

FM Monitor—The peak depth of modulation of frequency-modulated oscillators of the reactance tube type is determined by measuring the maximum radio-frequency current of the reactance tube. Under certain circumstances changes in this plate current are stated to be proportional to a fractional change in oscillation frequency. Two embodiments for one and two reactance tube circuits, respectively, are described. If the voltage across the tuned resonant circuit providing the carrier frequency, or its reactances, are not constant, this has to be taken into account by computation or an additional apparatus. Voltages proportional to the currents through the reactance tube and through one branch of the resonant circuit may be applied to the two plate pairs of a cathode ray tube. Then the angle of inclination of the resulting lines on the screen, which is a measure for the ratio of the two currents, indicates the modulation depth. D. A. Bell, Radio Patents Corp., (F) March 18, 1942, (I) June 8, 1943, No. 2,321,353.

FM Oscillator—The control frequency of a piezo-electric crystal can be modulated by varying the air gap between the crystal element and one electrode. According to the original patent, a substantially inflexible electrode is mounted on an electromagnetic or electrodynamic mechanism moving it toward and away from the crystal. The present divisional patent covers an embodiment of this invention in which the driving mechanism for the spaced electrode is another piezo-electric element. R. J. Ehret and J. L. Barnes, RCA, (F) Dec. 10, 1941, (I) June 8, 1943, No. 2,321,285.

Frequency Modulation — Modulation is obtained by varying the cathode-plate impedance of tube 23 which is connected in series with resistor 21c and thus constitutes part of the resistor-capacitor delay network 19a, b, c, d and 21a, b, c, d, e, controlling the oscillator frequency. Voltage divider 26, 27 and tube 24 are included so as to maintain a constant voltage drop across tube 23. Upon an increase in the cathode-plate impedance of tube 23 due to the modulating potentials, the current through this tube as well as through tube 24 decreases, causing the cathode of tube 24 to become slightly more positive with respect to the grid of the tube, whereby the plate-cathode impedance of tube 24 also increases. In this way the potential at plate of

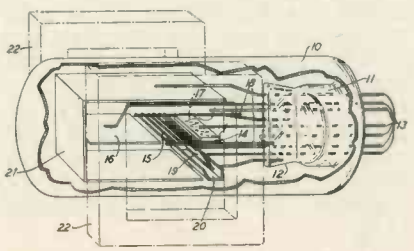


tube 23 and cathode of tube 24 is maintained substantially constant; it may be made the same as the potential at the junction point of resistors 26 and 27. More than one combination of modulating tubes 23, 24 may be employed. A cathode follower can be substituted for resistance 21a. M. Artzt, RCA, (F) Nov. 21, 1941, (I) June 8, 1943, No. 2,321,269.

Frequency Modulation Measurement—The mean frequency of a frequency-modulated wave is indicated by a cathode ray tube. The modulated wave potentials are applied to one pair of deflecting plates, the modulating potentials to the other pair, and the output of an auxiliary oscillator is applied to either deflecting plate pair. The pattern obtained is a square showing a pair of diametrically opposed peaks indicative of the mean frequency of the modulated wave. Obviously, the frequency of any unmodulated wave may be determined, in which case the auxiliary oscillator energy would be modulated. H. M. Crosby, General Electric Co., (F) Sept. 12, 1942, (I) June 1, 1943, Re. 22,328.

HIGH FREQUENCY DEVICES

HF Electron Tube—Under the influence of the electrostatic field between cathode 14 and accelerating anode 21 and of the magnetic field produced by coils 22 the electrons



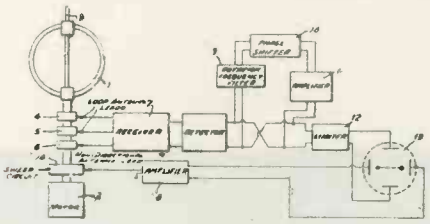
traverse cycloidal paths having cusps in the vicinity of grid 15. If grid 15 is at positive potential, some of the electrons, depending in number upon the magnitude of this potential, pass through the grid and flow to target electrode 19. If grid 15 is at negative potential, the electrons cannot pass through and are collected by accelerating electrode 21. Target electrode 19 may be either an output electrode or a secondary emission electrode. In the latter case, collector electrode 20 must be provided. The slowly moving electrons in the immediate vicinity of grid 15 form a virtual cathode resulting in a sensitive control and high transconductance, and reducing the effective transit time to such an extent that the tube may be operated with cm waves. Another embodiment is shown, the cathode of which has both sides covered with a photoemissive material; it includes two grids, two target electrodes and two accelerating electrodes. C. A. Hedberg, Bell Telephone Laboratories, (F) Feb. 24, 1941, (I) June 15, 1943, No. 2,321,912.

PICTURE REPRODUCTION

Telephoto Scanning System — The conventional reflected-light method is used for scanning, but a luminescent backing is provided for the negative. The scanning light spot will excite the luminescent backing which will act as a separate light source the intensity of which is a function of the negative density at the particular point. If a phosphorescent material of considerable lag is employed, the entire backing may be exposed at the same time, the negative removed, and the luminescent record scanned. The luminescent material may be applied as a coating or as a separate web. P. D. Zurian, Press Wireless, Inc., (F) Aug. 27, 1941, (I) May 25, 1943, No. 2,319,898.

DIRECTION FINDERS

Radio Compass—The outputs of rotated directional antenna 1 and non-directional antenna 3 are combined, detected, inverted, limited and applied to the vertical deflecting plates of cathode ray tube 13. Rotation frequency is filtered out, shifted in phase, amplified by arrangement 9, 10 and 11, and re-

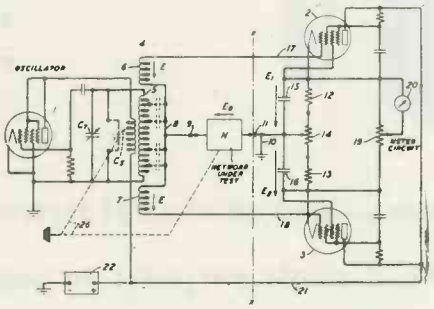


introduced into the main circuit. Sweep circuit 14, synchronized with rotating loop antenna 1, provides the horizontally deflecting potentials. The resultant pattern on the screen of the cathode ray tube will be an inverted V-shaped mark as an indication of the receiving direction and a straight line for all other directions. Other embodiments are described. H. G. Busignies, International Standard Electric Corp., (F) March 5, 1941, (I) June 1, 1943, No. 2,320,908.

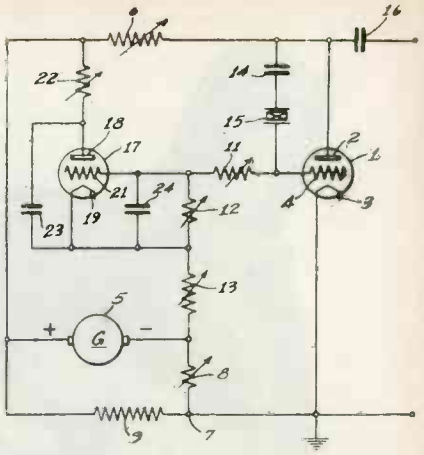
MISCELLANEOUS

Band Width Control—Band width control is effected by varying the input resistance of a feed-back amplifier connected in shunt with the load resistance of the audio amplifier. The input resistance of the control tube depends on the amount of feed-back applied which is made a function of frequency by using a resonant circuit as tube load. According to the invention, the dc plate current is decoupled from the ac circuit in which the tube acts as a shunt. The grid potential of the control tube is adjustable. H. Boucke, Alien Property Custodian, (F) April 3, 1941, (I) June 1, 1943, No. 2,320,558.

Testing Resonant Networks—Besides voltages E, there is a voltage E_0 induced in the input circuit of the tubes due to stray admittances. Voltage E_0 produces a voltage drop

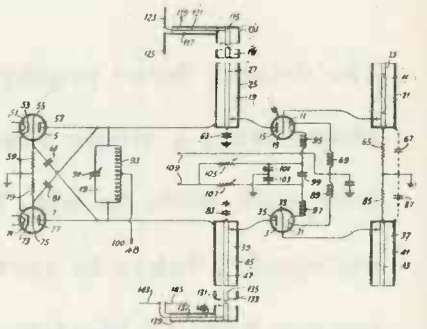


across network N which is in quadrature with the induced voltages E if network N is tuned to resonance with the oscillator frequency. It will then add equal amounts to both input circuits. Upon detuning, one of the input voltages will increase, the other decrease and a resulting current flow in the differentially connected output circuit of tubes 2 and 3. Meter 20 may be calibrated to indicate the amount of detuning in percentage of resonant frequency or the actual inductance or capacitance deviation from resonance. C. E. Dennis and A. Heinz, Western Electric Company, (F) May 16, 1942, (I) May 25, 1943, No. 2,320,175.



Oscillator Amplitude Control—Current through auxiliary tube 17 and its accessory circuit elements provides a voltage drop across resistor 13 and thereby regulates the potential at control grid 4 of oscillator tube 1. Current through tube 17 is in turn controlled by the voltage drop across resistor 12 resulting from rectification of the electric oscillations on grid 4. It will be seen that these two controlling actions if properly adjusted tend to keep the oscillator amplitude constant. F. S. Mabry, Westinghouse Electric and Manufacturing Co., (F) Dec. 30, 1941, (I) June 1, 1943, No. 2,320,876.

UHF Transmitter—Push-pull oscillator 5, 7 modulates transmitters 1, 3 by alternately raising their plate potential to such a value that oscillations take place. For this purpose, the plate potentials are supplied through tank circuit 19 of the push-pull oscillator. High stability is obtained by the use of high Q resonant circuits in the



form of quarter wavelength transmission lines 17 and 37 in the grid circuits and of quarter wavelength transmission lines 19 and 39 in the plate circuits of the uhf oscillator tubes 1, 3 respectively. Stability without the use of an additional stabilizer and high operational efficiency at 400 megacycles are characteristics of this arrangement. R. H. George, RCA, (F) Oct. 7, 1939, (I) June 1, 1943, No. 2,320,518.

with but a

Gertrude Fontaine, mount operator at Hytron's Salem plant, and soldier in the Army of Production.

Miss Fontaine concentrates her nimble fingers and keen young eyes upon spot-welding and assembling the minute parts of a 954. On another floor, a Hytron engineer is giving lavishly, night and day, of his long training and experience as he designs and develops a new War tube in record time.

The driving force urging them — and all of us at Hytron — on to superhuman effort, stems from a single thought, a single purpose: to supply our courageous fighting men with tools to win. Hytron employees have but one goal — a mounting flood of top-quality tubes to serve as the "hearts" of electronic and radio equipments helping our boys to blast the way to speedy and permanent Victory.

Since 1921 Manufacturers of Radio Tubes

Hytron

HYTRON RADIO TUBES

ELECTRONIC AND RADIO TUBES

Single thought

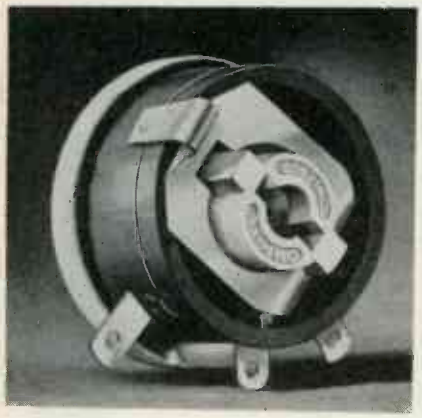
Consult the May issue of ELECTRONIC INDUSTRIES for a listing of new and other popular Hytron tubes.

Corporation

SALEM AND NEWBURYPORT • MASSACHUSETTS

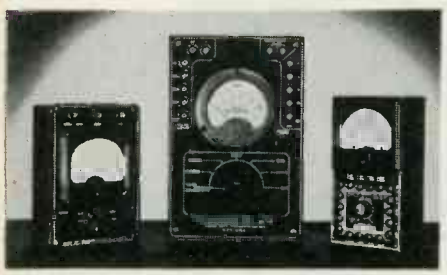
WHAT'S NEW

Devices, products and materials the manufacturers offer



Ohmite Rheostat

Designed especially for low resistance, low wattage applications, this rheostat-potentiometer is made by the Ohmite Mfg. Co., 4835 Flournoy St., Chicago. A length of resistance wire is stretched tightly around the outside of a cylindrical core which is bonded to a ceramic base and is anchored to two terminals. Contact to the wire is made by a phosphor-bronze spring arm which is connected to a third terminal. Provision of three terminals allows the unit to be used as a potentiometer or voltage divider. Maximum resistance is approximately 1 ohm while minimum total resistance can be made approximately 0.1 ohm. Since the contact arm travels along the wire from end to end, the resistance variation is stepless.

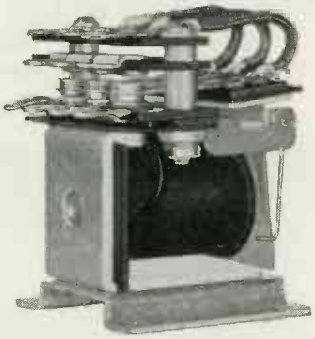


New Test Instruments

Radio City Products, Inc., 127 W. 26th St., New York City, has introduced three new test instruments: a pocket-sized multimeter, No. 442, output meter, No. 471, and volt-ohmmeter, No. 481. The multimeter is a compact multitester with a 200-microampere movement and a sensitivity of 5000 ohms per volt. The output meter has a constant impedance of 4000 ohms. All resistors are precision wound, and are accurate within 1 per cent. The test meter has a meter sensitivity of 50 microamperes, dc voltmeter readings from 0.1 to 1000 volts. Dc milliammeter readings from 0-100 milliamperes. Energy for resistance measurements is supplied from self-contained batteries.

Aircraft Radio Relay

A general purpose radio relay, series 345, designed by Guardian Electric, 1622 W. Walnut Street, Chicago, for use in aircraft, is available in contact combinations from single pole, single throw, up



to three pole double throw. Dimensions are 2⅜ by 2$\frac{1}{32}$ by 1$\frac{11}{16}$ inches. Contacts, rated 12 amps. at 24 volts, dc, are arranged to resist over 10 G acceleration and vibration in all positions.

Coil resistances range from .01 ohm to 15,000 ohms in a varnish impregnated and baked coil. Standard voltages are 16 to 32; however, other values are available. Bearing is pin type, of hardened, non-magnetic, stainless steel and staked to the armature hinge. Armature return spring is torsion type to maintain an even spring pressure.

Metal Plating of Plastics

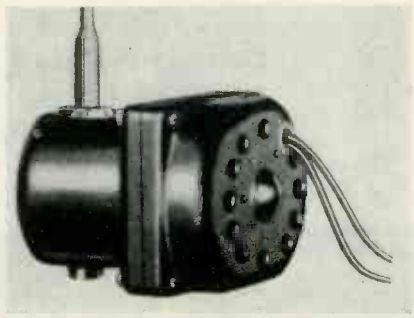
A new process by which plastics, glass, or any non-conductor may be plated with any of the plating metals has been developed by Precision Paper Tube Co., 2023 West Charleston St., Chicago. The new process can be used for plating magnetic and electric shielding of all kinds —radio shielding, electrostatic and magnetic shielding, applications as coil shields, condensers, etc. Conductor and insulator can be combined in one unit. Both rigid and pliable types of plastic tubing and pipe fittings can be plated. The uses of the process extend into all electrical and mechanical manufacture.

Rotatable Transformer

A lightweight, precision construction for use in electronic devices is a recent development of Kollsman Instrument Division of Square D Company, Elmhurst, N. Y. Operating with either 32 volt 60 cycle or 110 volt 400 cycle ac current, the transformer may be continuously rotated at speeds up to 1800 rpm. With a 110 volt input the voltage varies from 0 to 193 volts, according to the position of the rotor. With a weight of 10 ounces and an overall length of less than 3 inches, the transformer may be incorporated into many types of units where compactness and light weight are an important consideration.

Constant Speed Motor

A small, self-starting, constant speed motor that maintains superior speed regulation under wide variations of voltage, load and temperature, is being made by the Rotom Mfg. Co., Alhambra, Calif. Measuring only 4⅜ x 3⅛ x 3¼ in., the motor is available for operation on 110 or 220 volt, 50 or 60 cycle source at 14 watts input. Gears are of a helical-cut laminated bakelite. Forced ventilation assures cool operation. The motor has large bearings and ample oil reserves and is precision-assembled for uniform production.



Clutch Head Screws

In this recessed head screw, available in very wide variety including thread cutting types, the recess is of such shape that the screw may be driven with an ordinary screwdriver or with a bit designed especially for the purpose. With either bit, a slight left turn locks screw and bit together, facilitating one-hand operation. Shape of the head recess provides relatively large bearing for the driver, providing quick and easy access and eliminating much of the possibility of slippage with consequent damage to finished surfaces. Three sizes of center pivot bits cover the popular range of standard machine screws and thread-cutting types. Made by United Screw & Bolt Corp., Chicago, Cleveland and New York.

Thermostatic Delay Relay

Delays from 1-100 seconds can be obtained with the new Amperite relay manufactured by the Amperite Co., 561 Broadway, New York. The relay is compensated for ambient changes of —40 to +100 deg. F. and can be furnished in single pole—either normally open or normally closed. Contacts are capable of handling up to 12 amps—115 volts ac or dc. Being hermetically sealed in an inert gas assures clean contacts at all times. When necessary, replacements can be made as easily as changing an electric lamp. Fits standard radio octal base.

Pre-Tuned Coaxial Antenna

Type 899 vertical coaxial antenna provides an efficient, easy-to-install, and inexpensive half-wave radiator in the frequency range from 30 to 200 mc. The upper half of the antenna is a whip of conventional design. The lower half or skirt is a 2½ in. tube. The entire assembly is rigidly supported by a 1 5/16 in. support pipe 12 feet long, which is attached to a mast with a clamp. Overall length including support pipe is about 20 feet and the weight is 48 pounds. No impedance matching devices are required. The whip and skirt are cut to length and are pre-tuned for the operating frequency. The unit is designed to be fed from a 70 ohm coaxial transmission line. Fourteen feet of ⅞ in. coaxial cable are provided with the antenna. Made by Victor J. Andrew Co., 363 East 75th St., Chicago.

Sealed Transformers

A new moisture- and dust-proof transformer that meets Navy specifications for hermetic sealing is being manufactured by Peerless Electrical Products Co., Los Angeles, Calif. The new transformers use glass or porcelain insulators with metal bands which are soldered into the transformer case of cold, drawn, copper-plated steel and thus become an integral part of the case. The Vac - sealing impregnation process is used, insuring impregnation without solvents or other deleterious material present inside coils. This is accomplished through the use of a special type of impregnant that cures under heat. The new transformers may be quickly produced in any desired size or capacity to specification.

Altitude Test Chamber

An advanced model of a high-altitude test cabinet is being manufactured by American Coils Co., 27 Lexington Ave., Newark, N. J. The Amcoil unit consists of a well-built vapor proof automatic mechanical refrigeration cabinet and an enclosed vacuum chamber with air space completely surrounding it. Above the vacuum chamber, a coil is mounted to take care of complete pull-down including mass, load, heat-leakage, etc., of the cabinet itself. Therefore, the ambient temperature of the altitude chamber will be as low as is necessary. Heat dissipation may be carried away in the refrigerating system, making it possible to obtain low temperatures quickly and under actual temperature conditions.

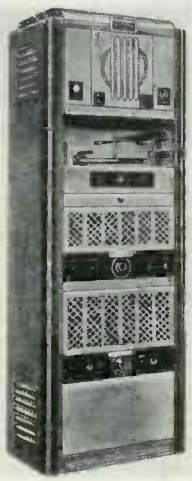
An innovation in vacuum chamber design is the floating glass seal, a heavy glass on the cabinet door, pivoted at the center and floating on spring bolts which maintains perfect alignment in closing and gives freely under vacuum pressure. There are no heavy latching mechanisms or tricky fasteners.

Non-Rubber, Sealing Tape

A waterproof, pressure-sensitive cloth tape, which is manufactured without the use of rubber by Mystik Tape Division, Chicago Show Printing Co., Chicago, is non-toxic and therefore available for sealing packages of medicine, foods, ordnance equipment, etc. Handling and application difficulties are reduced to a minimum. The cloth stock is so woven that it tears evenly at right angles to either edge and is packed in rolls of any width up to 36 inches — standard rolls are 60 yards in length.

Music and Voice in a "Package"

A simplified low-cost unit for voice-paging and music broadcasting factories has been developed by Operadio Mfg. Co., St. Charles, Ill. Standardized and "packaged" to include in a single unit the most popular features of more elaborate installations, the plant broadcaster operates 20-40 loudspeakers, covers an area of up to 100,000 square feet and requires only 22 inches of floor space. It can be used to provide plant - protection alarm and air-raid warning. It enables management to talk directly to employees and to furnish them with news broadcasts, inspirational material, etc. Paging calls may be sent over the system while music is being played by means of an automatic control which decreases the music volume.



HERE'S A VOLTAGE STABILIZER THAT'S INSENSITIVE TO LOAD POWER FACTOR

Provides Constant Output Voltage from Variable Input

THIS new G-E voltage stabilizer provides a constant 115-volt supply on circuits varying from 95 to 130 volts, ensuring better performance and greater reliability of a wide variety of electric equipment. On such circuits, wherever close voltage regulation is requisite to good operation, these stabilizers fill the bill.

Maintenance costs are negligible. This voltage stabilizer is completely automatic, and because there are no moving parts, practically no maintenance is necessary. It is not affected by variations in load from no load to full load or by changes in power factor from unity to 0.8 lagging. Moreover, it will operate continuously throughout the range from open circuit to short circuit without damage.

Wide range of ratings. Ratings from 50 to 5000 va are available; "specials" will be built to order.

For details on this stabilizer's unique circuit, write for Bulletin GEA-3634. *General Electric Co., Schenectady, N. Y.*

A Few of Its Many Applications:

- Radio transmitters and testing equipment
- Photoelectric equipment and other electronic-tube apparatus
- Motion-picture projectors and sound equipment
- Telephone apparatus
- X-ray machines
- Precision photographic equipment and photometers
- Color comparators
- Calibration of meters, instruments, relays
- Laboratory precision processes and testing equipment

GENERAL ELECTRIC

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ASSOCIATION NEWS

AIEE Discusses Industrial Electronics

Industrial power applications of electronic principles occupied a good bit of the time of the national technical meeting of the American Institute of Electrical Engineers, held in Cleveland, latter part of June. One whole session was devoted to resistance welding and considerable time was given over to induction heating, the principal paper in the latter field being given by J. P. Jordan of the General Electric Co.

In the field of communications, F. M. Rives (GE) discussing "Application of Carrier to Power Lines," pointed out the great strides that have been made, adding that at present there are some 1,300 terminals of power line carrier in operation in the U.S. with 40,000 channel miles used for telephone circuits, pilot relaying, telemetering, load control, supervising, etc., over transmission lines of all voltages. Along similar lines, E. W. Kenefake (GE) presented the result of experiments using frequencies below 200 kc for frequency modulation of power line communication where it was found that FM realizes important advantages over AM in the reduction of noise interference.

New types of aircraft power supplies using ac generators and special light weight transformers were described by John E. Yarmack, Federal Telephone & Radio Corp., Newark, N. J., who brought out that use of such equipment combined with selenium rectifiers is a reliable trouble-free method of obtaining the larger power requirements of modern aircraft. Selenium rectifier cells, themselves, were described by Edgar A. Harty (GE) who gave design formulas for various types of rectifiers.

Conventions and Meetings Ahead

Associated Police Communication Officers (J. M. Wherritt, Police Department, Jefferson City, Mo.), Aug. 31 to Sept. 2, Madison, Wis.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York City), National Technical Meeting, Sept. 2-4, Salt Lake City, Utah.

American Mathematical Society, Sept. 12-13, New Brunswick, N. J.

Optical Society of America (A. C. Hardy, Massachusetts Inst. of Technology), Oct. 7-9, Pittsburgh.

Electrochemical Society (C. G. Fink, Columbia University, New York), Oct. 13-16, New York, Hotel Pennsylvania.

American Welding Society (Miss M. M. Kelly, 29 West 39th Street, New York), Oct. 18-21, Chicago.

Society of Motion Picture Engineers (Sylvan Harris, Hotel Pennsylvania, New York), Oct. 18-22, Hollywood.

National Electrical Manufacturers Association (W. J. Donald, 155 East 44th Street, New York), Annual Meeting, Oct. 25-29, Waldorf-Astoria Hotel, New York.

Society of Rheology (R. B. Dow, Aberdeen Proving Ground, Maryland), Oct. 29-30, New York.

New York Electrical Society (29 West 39th Street, New York), Nov. 4, 29 West 39th Street, New York.

American Institute of Chemical Engineers (50 East 41st Street, New York), Nov. 15-16. Pittsburgh.

New Signal Officer

Major General Harry C. Ingles, who late last month was appointed Chief Signal Officer of the U. S. Army, succeeding Major General Dawson Olmstead, retired. During the past four months General Ingles has been Deputy Commander in the U. S. Theater of Operations and before that was Signal Officer and later Chief of Staff of the Carribean Command

Steel as a Design Material

At the American Designers Institute dinner meeting in New York, July 14, the full color movie "Steel —Man's Servant" was shown by Robert J. Ritchey of The Carnegie-Illinois Steel Corporation.

Of interest to postwar electronic development and design was the statement by Mr. Ritchey that much laboratory research is now going on in the integral coloring of steel and that recent successes have been had in rolling steel to sheets as thin as 0.004 inch.

Mr. Ritchey admitted the lack of imaginative progress of steel in many consumer fields, stating that in the past 85 per cent of steel production had gone to four major industries: railroads, shipping, construction, and machine-tool services. Now that steel expects the pressure of competition in postwar period from new materials such as plastics, molded plywoods, and other metal alloys, the steel people are devoting their laboratory time to experiments which should be useful in postwar design. In fact, said the speaker, steel looks forward to the birth of "The Second Steel Age."

Ingles Streamlines Signal Corps

By way of facilitating the work of development, procurement, maintenance and distribution of communications equipment, newly appointed chief signal officer Major General Harry C. Ingles has streamlined the Signal Corps organization and given it five services, replacing the two it has had.

A major change is the creation of a procurement and distribution service under Major General William H. Harrison, for the past year in charge of procurement of army service forces. All personnel, military and civilian, will be under Brigadier General J. V. Matejka in a new Personnel and Training service. Major General Roger B. Colton, who has been in charge of signal supply services, will head an engineering and technical service. The signal operating services become the Army communications service, including the new personnel and training service, and the Army pictorial service.

ELECTRONIC PRECISION PARTS

MACHINED FOR ACCURACY

HAYDU BROTHERS are playing a vital part in the important and strenuous war efforts of the Electronic Industries . . . supplying this field with over twenty-two million precision parts daily.

No matter how large the quantity, how close the tolerance, how impossible the problem, we have always arrived at a solution that saves time, money and materials . . . and waste of time, money or materials is criminal in these war times.

Additional space, extra equipment permits us to serve more clients . . . faster, better, at greater economy. We have the experience, engineering staff, the men and the machines to undertake your difficult problems. Consult us at once.

HAYDU Bros.

A MEMBER OF THE RADIO MANUFACTURERS ASSOCIATION

Mt. Bethel Road, Plainfield, N.J.

SPECIALISTS IN BURNER TIPS

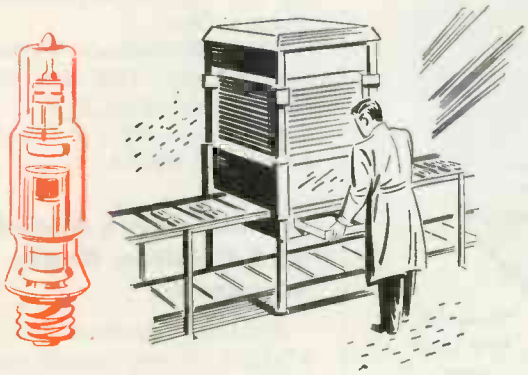
TUBE PARTS, WIRE FORMS, METAL STAMPING FOR RADIO, ELECTRICAL, AVIATION AND INSTRUMENT MANUFACTURERS

Electronics

The Westinghouse Weld-o-trol, a single-pole Ignitron tube contactor, is used to make and break resistance welding currents as high as 10,000 amperes—with no arc, no noise, no moving parts. Because it can be timed more accurately than mechanical devices, the Weld-o-trol enables an operator to produce stronger, more uniform welds, at greatly increased production rates.

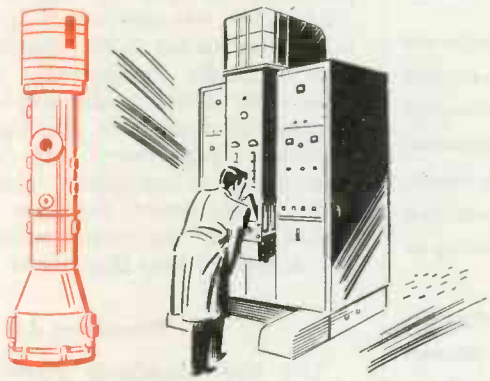
. . at Work

Through the new and improved industrial techniques it makes possible, electronic science is helping America to win its wartime production battles. Here are some of the scores of important ways Westinghouse electronic devices are being used to improve products, speed production, cut costs.

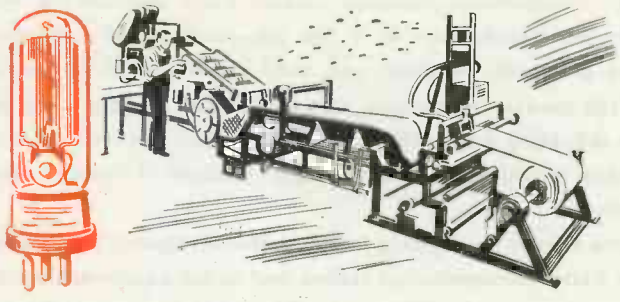


Automatic X-ray Units, built into a conveyor line, speed inspection of vital aircraft castings in a midwest plant. Controls for the units are interlocked with the conveyor drive. When the parts are positioned beneath the x-ray unit, a protective hood lowers, exposure is made, the hood rises and parts pass on. Operation is continuous and largely automatic.

The Stroboglow Lamp makes rapidly rotating objects appear to "stand still". Electronic tubes deliver a light flash each time the object reaches a given point in its motion cycle. Through "persistence of vision", the image is carried over to the next flash, making the rapidly rotating object appear as though standing still—so its operating characteristics may be studied.



Faster Than Lightning is no exaggeration in describing the Westinghouse Electronic Oscillograph. By means of cathode ray tubes, it records electrical phenomena at speeds of *1/100 of one-millionth of a second*. Widely used in studying methods of power line protection, it is now being used to provide important data on internal combustion engine performance.



Electronic Register Regulators accurately control the register in the cutting of paper. A beam of light from a phototube, directed at the paper web, detects even the slightest out-of-register condition, causing the regulator to operate, bringing the paper back into perfect register with respect to the printed material. Thus waste due to improper printing is eliminated.

J-91032-A

For further information on Westinghouse "Electronics At Work", write for Booklet B-3264. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Westinghouse ELECTRONICS

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electrical Jobbers' Electronic Committee

The National Electrical Wholesalers Association, with headquarters at 500 Fifth Avenue, New York, formerly had a radio and tubes committee which is now known as the "Electronics Committee." The chairman and members of this committee are as follows:

Percy Stern, Chairman, Interstate Electric Co., Magazine & Girod Sts., New Orleans, La.

W. S. Blue, Columbian Elec'l. Co., 2603 Grand Ave., Kansas City, Mo.

J. T. Morgan, Charleston Elec'l. Supply Co., 914 Kanawha Blvd., Charleston, W. Va.

G. M. Nutter, The Moock Elec. Supply Co., 5th St. & Cleveland, N.W., Canton, Ohio.

W. B. Stringham, General Elec. Supply Corp., 1330 New York Ave., N.W., Washington, D. C.

Charles G. Pyle is the managing director of NEWA.

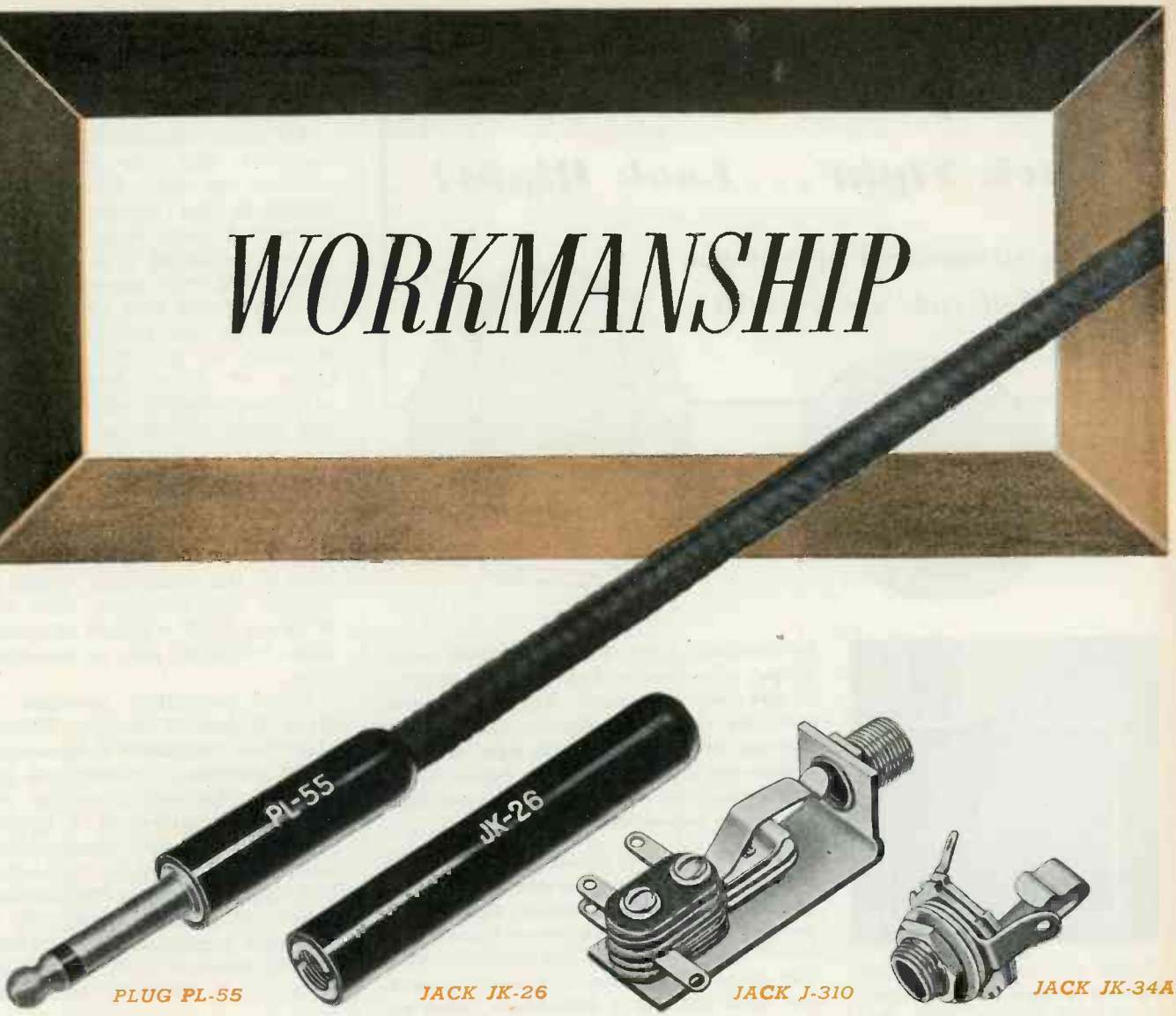
Transformers Added to ASA Civilian Radio Standards

Another standard, the fourth of a series of war standards to provide replacement parts for civilian radio, has been completed by the American Standards Association, with the cooperation of all branches of the radio industry, the War Production Board, and the Office of Price Administration. This standard, as well as two of the other three, are referred to in WPB Limitation Order L-293, Simplification of Radio Replacement Parts. This order limits production of dry electrolytic capacitors, fixed paper-dielectric capacitors, and power and audio transformers used as radio replacement parts to those which meet the requirements of the American War Standards.

Provides 14 units

The new standard, Power and Audio Transformers and reactors, Home Receiver Replacement Type (C16.9-1943) covers the performance and quality requirements for a simplified list of 14 such units which, it is estimated, will be sufficient to service about 90 per cent of the radio sets now in operation. Use of the new standard will also assure that such critical materials as copper and transformer steel, allocated to the production of radio replacement parts, will be stretched as far as possible with a minimum

WORKMANSHIP



PLUG PL-55 JACK JK-26 JACK J-310 JACK JK-34A

For more than 46 years the products of the Chicago Telephone Supply Company have been the standard for high quality workmanship. From their inception in the engineering laboratories to the craftsmanship of the finished article, Chicago Telephone Supply products are planned for maximum performance and trouble-free long life. If you are a manufacturer of electronic equipment—all of the engineering skill and great production facilities of Chicago Telephone Supply Company are at your service.

Plugs, Jacks, Switches, Variable Resistors — *Telephone Generators and Ringers*

CHICAGO TELEPHONE SUPPLY Company

ELKHART ★ INDIANA

Manufacturers of Quality Electro-Mechanical Components Since 1896

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C. C. Meredith & Co.
Streetsville, Ontario

amount of material being used in each unit. The simplified list of units will also mean fewer production lines and smaller dealer inventories.

All items manufactured in accordance with the specifications outlined in the American War Standards for civilian radio replacement parts bear the special symbol consisting of a V with the Morse Code "V"—three dots and a dash—enclosed in a circle.

Work on this standard was undertaken at the request of the Office of Price Administration, after consultation with the Radio and Radar Division of the WPB.

Committee membership

Dr. O. H. Caldwell, editor of "Electronic Industries," is chairman of the committee which developed this standard, with John M. Borst, chief engineer of John F. Rider Publisher, Inc., as vice-chairman.

Other committee members include George D. Barbey, National Electronic Distributors Association; M. M. Brandon, Underwriters' Laboratories; Gerrard Mountjoy, RCA License Laboratory; M. J. Schinke, chairman, Radio Manufacturers Association's Service Committee; P. R. Butler, General Electric Company, (alternate); George F. Du Val, past president, Radio Servicemen of America (A. E. Rhine, alternate); S. L. Chertok, ASA, secretary.

Government liaison men on the committee include Frank H. McIntosh, Chief of the Domestic and Foreign Radio Section of the WPB (Samuel Weisbroth, alternate): Karl S. Geiges, Simplification Branch, WPB; and Earl A. Graham, Chief, Consumer Durable Goods Section, Standards Division, OPA.

Wire Recorders For the Navy

After experimenting quite a bit with various types of recorders, cylinder, disc, film and wire, the Navy is preparing to use a considerable number of magnetic wire recorders. Already 350 portable instruments are in use in battleships, carriers and cruisers for monitoring radio circuits and ship conferences, telephone battle conversations, etc., and more are on order for ship and shore installations. Armour Foundation made the first of them; GE will produce them on a mass production basis.

Signal Corps Extends Radio Telephoto Coverage

As the result of many months of Signal Corps planning, designing and testing, radiotelephoto service has been launched between North Africa and the War Department Message Center which is producing the transmission of battlefront news-pictures in seven minutes and their reproduction in newspapers within 24 hours or less. Now it is planned to extend this service to other theatres of war.

The military need for radiotelephoto equipment and transmission to reproduce facsimile diagrams and photographs, which are vital for tactical purposes, was foreseen in December, 1941, by Brigadier General Frank E. Stoner, then Signal Officer of the Third Army at San Antonio, and his executive officer, Lt. Col. Carl H. Hatch. An electrical engineer of wide experience, L. A. Thompson of Cleveland volunteered without personal compensation to convert existing wirephoto equipment to radio use. Mr. Thompson carried on with General Stoner and Col. Hatch a project to develop the equipment at that time also for military landline transmission under the direction of Major General Dawson Ohmstead, who was Chief Signal Officer at that time.

The adaptation of the equipment for transatlantic radio transmission took 2½ months of intensive laboratory research by Mr. Thompson, who not only designed but built the initial Signal Corps apparatus. At the same time, Signal Corps noncommissioned and commissioned officers who were experienced in newsphoto syndicate work in civilian life had to be trained in the special problems of operating the radiophoto apparatus.

Captain Lawrence B. Prehn of the Signal Corps flew to North Africa to install and test the equipment there. Three weeks of steady testing was needed to get the desired quality of the transmitted pictures for the Army Pictorial Service of the Signal Corps. A test picture of "Jinx" Falkenburg playing tennis was sent over the circuit hundreds of times to eliminate the distortions and other transmission obstacles.

Photographs of the capture of Gafsa in Tunisia were sent by courier to the radio station and 7 minutes later a negative was being stripped off the machine in the War Department.

THIS IS WHAT COUNTS!

There's a difference between working on "gadgets" and being an integral part in the manufacture of quality products that are a matter of intense pride throughout the community in which you live. That difference represents the extra "plus" factor of goodness you find in Sprague Capacitors.

North Adams is not a large city. It doesn't produce a great deal by big-city standards—but what it does produce it believes in producing right. And Sprague Capacitors and Koolohm Resistors by the hundreds of thousands are among its chief products.

SPRAGUE SPECIALTIES COMPANY, North Adams, Mass.

WORKING TOGETHER FOR VICTORY

Sprague Army-Navy "E" presentation day was a holiday in North Adams—but a holiday on which everyone still worked. At right is one of many congratulatory window displays made by North Adams merchants. At left is the day's North Adams Transcript with a 16-page section devoted to the event.

SPRAGUE
CAPACITORS
& KOOLOHM RESISTORS

Quality Products—Expertly Engineered—Competently Produced

Laboratory Supply Agency Ready

The Electronic Research Supply Agency, formed to supply critical materials and components not readily available from commercial sources, to laboratories engaged in radio and radar research and development for the Armed Services, is now ready to operate, the War Production Board has just revealed.

Maurice S. Despres, managing director of the agency, 460 Fourth Ave., New York City, has sent a letter explaining its operations to laboratories approved by the Services.

Set up by the Defense Supplies Corporation at the request of the armed services, the Office of Scientific Research and Development and the War Production Board, the new agency carries inventories purchased with the assistance of preference ratings assigned by WPB or extended by its customers. Operating profits or losses accrue to the Defense Supplies Corporation.

In placing orders with the agency, laboratories must certify (1) that requested items are needed for research projects or for preproduction models for the services or OSRD, (2) that the items are not ordered for inventory and (3) that no part of the order has been placed with another source of supply.

Wholesale distributors, buying for account of approved laboratories, must certify that they have not in inventory the items being sought and that they have not placed purchase orders for them elsewhere. Orders are accepted with or without priority ratings.

Radio Warning Net Protects U. S. Bases in India

Returning to the United States for the first time in three years, Col. Emmett O'Donnell, assistant chief of staff for the Tenth Air Force, told Army officers that a radio-operated air-raid warning system is protecting India from aerial attack by the Japanese.

Col. O'Donnell said that team units of the Army Air Forces, maintaining 24-hour vigils atop mountain peaks, are using radio, including undoubtedly some radio locators, to notify American air bases of the approach of enemy planes. He pointed out that the radio warnings insure American fliers

FROM HUNDREDS OF MILES AT SEA CAME

THE ALARM THAT SAVED MIDWAY!

Midway was ready when the Jap attempt to capture this strategic U. S. outpost came June 4 to 7, last year. Long before the Jap fleet of battleships, carriers, cruisers, destroyers and transports could bring their big guns into range—vigilant patrol planes with modern radio communications equipment had sounded the alarm. Many miles from Midway's shores American planes blasted their fleet . . . drove their survivors into a frantic homeward retreat.

REPEATEDLY it has been said—"this war is different". Yes, different because, on land, at sea and in the air, battles are being planned and fought with weapons never before available to our fighting men. Among these is the electronic tube. It is reassuring to know that no nation is making wider or better use of this great weapon of modern warfare than the U. S. A. To help serve the vast requirements of our Army and Navy National Union, for example, is producing electronic tubes on a scale far exceeding its pre-war peak. Yet, dramatic as are the achievements of electronics in war, there will be even more miraculous peace-time tasks for tubes to perform. National Union will be prepared to aid engineers and production men in applying the power of electronics to their special needs. To producers of war goods, this industrial electronics service of National Union engineers is now available.

NATIONAL UNION RADIO CORPORATION • NEWARK, NEW JERSEY • LANSDALE, PENNSYLVANIA

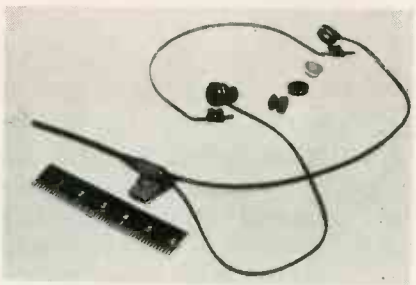
NATIONAL UNION
RADIO AND ELECTRONIC TUBES

Transmitting Tubes • Cathode Ray Tubes • Receiving Tubes • Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Exciter Lamps • Panel Lamps • Flashlight Bulbs

sufficient time to get into the air before enemy planes have neared the American bases, and said the signal teams are composed of radio operators, repairmen and observers, and are completely on their own with a medical attendant and cook assigned to each unit.

New Headsets for Signal Corps Operators

Students at Signal Corps schools for radio operators aren't wearing "hearing aids" as some elderly visitors might suspect—no, they are the latest headphones. Signal Corps engineers at the laboratories at Fort Monmouth, N. J., in cooperation with industrial electrical engineers, have designed a new mili-



Signal Corps headset of new type, which resembles a "hearing aid", shown disassembled and in use

tary headset for both telephone and radio operation which is now in use throughout Signal Corps units.

The new headset, designed as a direct outgrowth of the new American helmet that protects the sides of the soldier's head and the back of his neck from missiles, provides more dependable communication than any headset previously used, for one part of it is a small, soft plug which fits into the orifice of the outer ear and is a more effective seal against outside noises than the older-type rubber caps.

The new device is far more sanitary than the older types, for a

When the Blueprint Calls for Quick, Accurate SELECTIVITY Consider the Many Advantages of FREQ KC CHANNEL CRYSTAL UNITS

On the fighting fronts, FREQ-KC crystal units are selecting the right channels for vital communications instantly and reliably.

QUICK

Precision — ground — to — specified — frequencies, FREQ-KC units are eliminating the need for time-wasting tuning.

DURABLE

Unusual protection against heat, cold or shock is helping FREQ-KC crystals guard against communication failure

ACCURATE

Adherence to absolute frequency specifications is enabling FREQ-KC units to narrow communication channels and thus avoid miscarriage of confidential messages.

RESEARCH

FREQ-KC engineers have made their marks on the blue-prints of war by developing crystal units that are serving reliably and well under the most exacting and difficult combat conditions.

AVAILABLE

Our electronic engineers are at the service of manufacturers to help design and specify crystal-controlled applications for essential products or ahead-of-competition post-war models.

Gentleman Products Division of

HENNEY MOTOR COMPANY

Home Office at FREEPORT, ILLINOIS — Factory at Omaha, Nebraska

new pair of plug inserts is issued to each new wearer, whereas the older phones might be reissued to several different wearers. And because the insert focuses the sound from the diaphragm directly into the ear canal, the new receivers have a higher sensitivity and a higher fidelity of response than those in former military headsets. Using inserts made of neoprene instead of rubber, the new design has vital industrial advantages in that it uses far less material than any previous headset, and almost no strategic material. And finally it answers that good old question: Why use two when one will do the trick? For, where formerly the Signal Corps required several types of headsets to operate successfully with the various communications sets employed, the new earphones can now be used interchangeably with all ground signal equipment.

Air-Force Radio Men Get Markers

The Army Air Forces have authorized a distinctive sleeve patch for wear by enlisted technical specialists in Communications, together with four specialist classifications. The Communications symbol is a pyramid-shaped radio tower with flashes emanating from the top—the patches, a 2½ inch equilateral triangle, are on a background of ultramarine blue with the distinguishing design in gold.

General Code Lauds Signal Supply Officers

The importance of the work done by Signal Corps supply officers in maintaining the "life-line of combat" was stressed by Major General James A. Code, Jr., Assistant Chief Signal Officer, in an address before the officer students at the Supply Depot at Lexington, Ky.

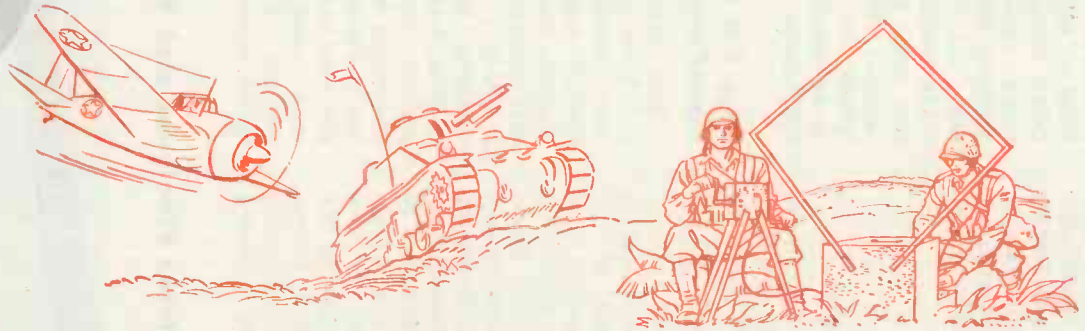
The war consists essentially of three problems — transportation, fire power and communications—General Code told the officer students. As a result, he declared, men charged with even the smallest aspect of maintaining this life-line carry the responsibility for the outcome of every battle, every clash of arms and the very war itself.

The importance of proper supply was illustrated by General Code by relating several incidents to stress the necessity for the use of ingenuity, complete and accu-

Purdue Teaching Them to Be Junior Radio Engineers

Here are two of the sixty young women recently sent to Purdue at the expense of RCA which after their graduation plans to give them assignments as junior radio engineers. The girls are now taking courses in electronics and radio, coupled with actual laboratory experiments. Here Jacqueline Beldon and Betty Woldkoetter are measuring tube characteristics by means of a vacuum-tube bridge

Where size is important!



Hipersil* Cores save space

More from less... lighter weight... smaller size... but *more* flux-carrying capacity. That's why Hipersil Cores are being specified for a steadily increasing variety of communication applications... in radio transformers, chokes, relays, reactors and loading coils.

Hipersil Cores release designers from the limitations of ordinary steel cores. They are the only commercial cores that combine these advantages:

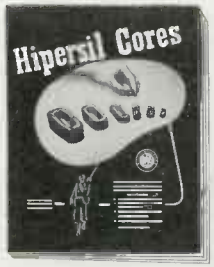
- 30 to 50% lighter weight
- 33⅓% more flux-carrying capacity
- Very high, high-density permeability
- High, low-density permeability
- High incremental permeability
- Very low losses in direction of rolling
- Space factor as high as 95% ... thin glass films insulate adjacent laminations

SIMPLIFIED TRANSFORMER ASSEMBLY

Hipersil Cores eliminate hard-to-handle tiny transformer laminations. Wound from one strip and then cut in two pieces, they save valuable man-hours because there are only 2 pieces per loop.

For better, more efficient, lighter and smaller communication equipment — QUICKER... ask your Westinghouse representative about... and use in your equipment ... *standard* Hipersil Core sizes.

J-7040



GET THE FACTS ABOUT HIPERSIL

Write for B-3223, the new data book filled with application and performance facts about Hipersil. Address: Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., Dept. 7-N.

* Registered Trade-mark, Westinghouse Electric & Mfg. Co., for HIgh PERmeability SILicon steel.

Westinghouse

PLANTS IN 25 CITIES ... OFFICES EVERYWHERE

HIPERSIL

rate records, follow-up, shipment check and pursuit of all checks possible to push supplies speedily. Accompanying General Code were Col. Carroll O. Bickelhaupt, Deputy Signal Officer, and Major John A. Aldridge of the Control Division of the Army Service Forces Headquarters.

S. I. Cole on RMA Executive Committee

S. I. Cole, president of Aerovox Corporation, was elected a member of the executive committee of the Radio Manufacturer's Association at its annual convention in Chicago.

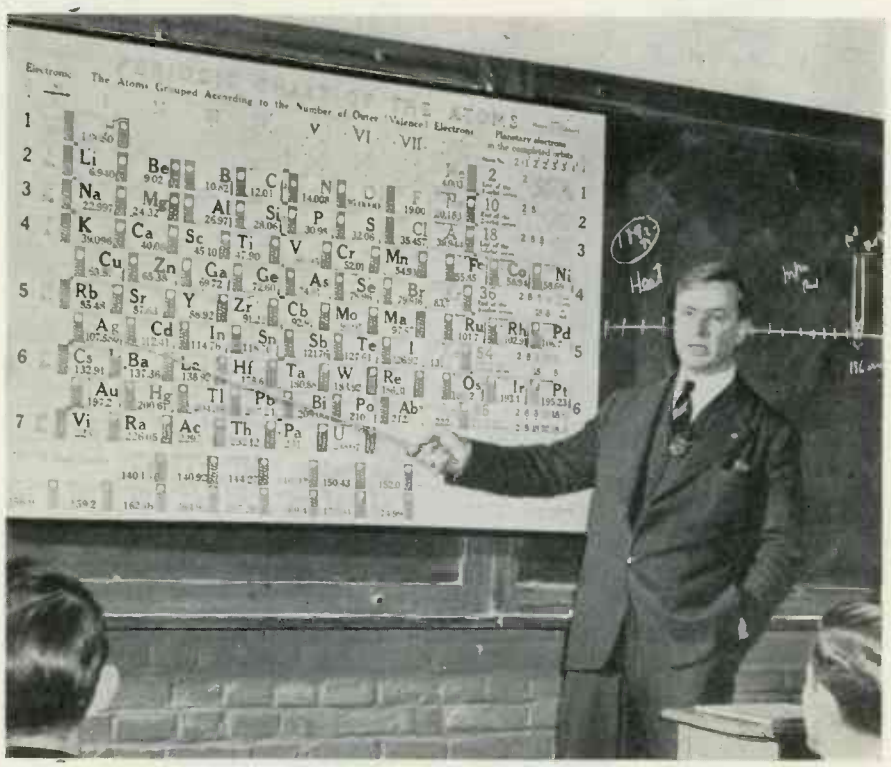
With a radio manufacturing background dating back to the earliest days of broadcasting, and preceded by extensive production and sales activities in other fields, Mr. Cole brings a wealth of experience to the executive deliberations of RMA. Under his personal guidance the Aerovox Corporation of New Bedford, Mass., has grown from modest beginnings in New York and later in Brooklyn, to one of the world's outstanding manufacturers of radio and electronic components, with several thousand workers at New Bedford and Taunton, and in the Canadian plant at Hamilton, Ontario, producing millions of capacitors a month. Mr. Cole's organization has pioneered many capacitor developments, a company statement points out—notably the "dry" electrolytic which made feasible the satisfactory low-cost radio receiver, and the high-capacity intermittent-service electrolytic for motor-starting, which made possible the low-cost electric refrigerator.

Sees FM Replacing Low-Power AM

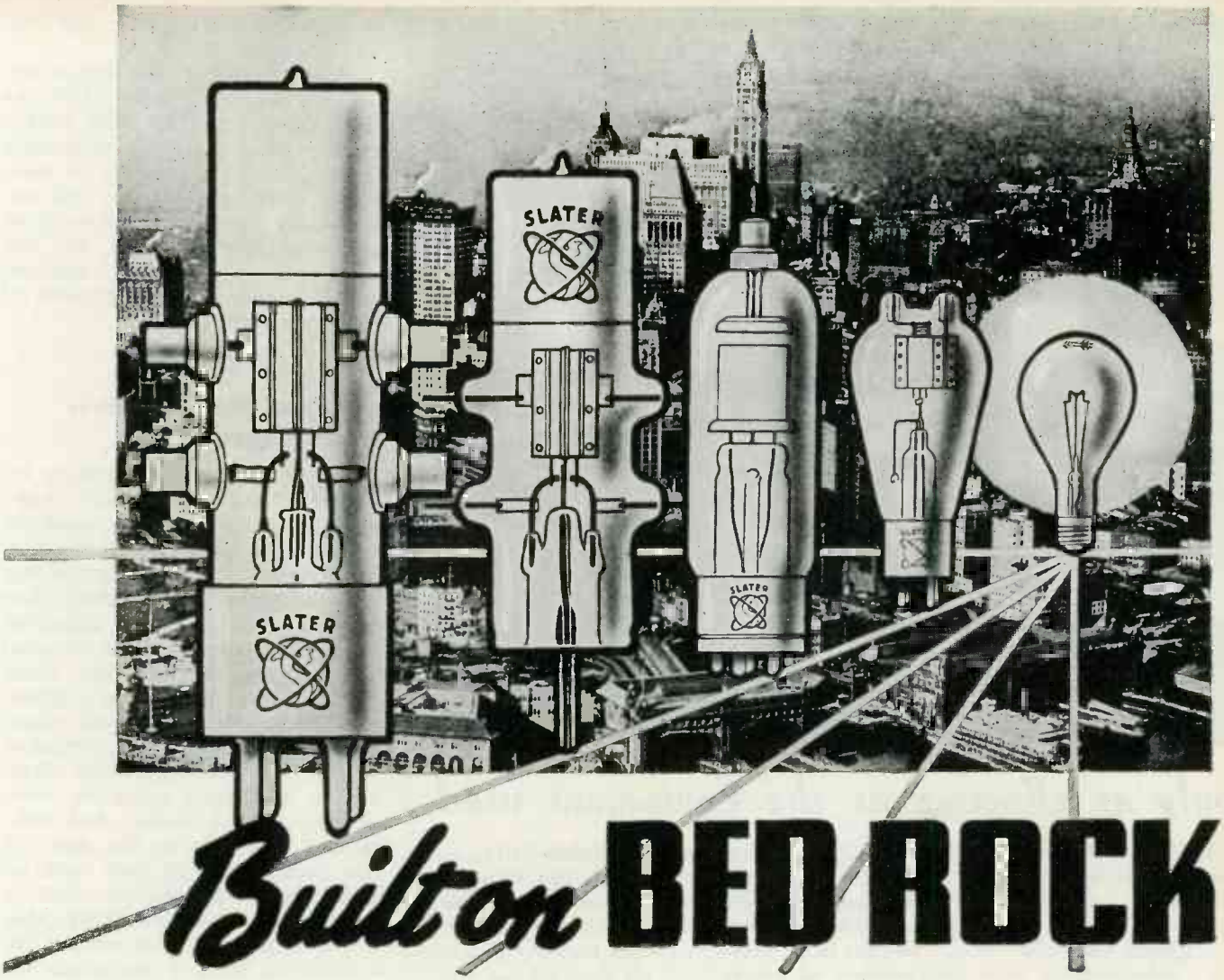
War developments undoubtedly will bring improvement in broadcast transmitters, but General Electric engineers see no radical changes that will prematurely discard present equipment, according to Paul L. Chamberlain of the company's electronic department.

"What we do expect in the field of postwar broadcasting is the replacement by FM statons of many low-powered AM stations which are now handicapped by interference and inadequate signal strength. This probably will mean higher power and more clear chan-

Dave Grimes Explains Electrons and Waves



David Grimes, Philco vice-president in charge of engineering, whose delightful platform presence has nlivened many a gathering, delivers a lecture to students of the advanced division, Philco Training School, which is operated for the United States Army Signal Corps



Built on BED ROCK

In the links in the chain of electronic research . . . the study by scientists of tungsten for lamp filaments, and other discoveries related to the lamp, such as the "Edison Effect," were among the milestones of progress toward the electron-tube development. It was, therefore, only natural that Slater's long experience in the manufacture of *incandescent lamps provided a *firm foundation* for making electronic tubes. With engineers versed in the science of vacuum tube manufacture . . . with one of the most modernly equipped plants and laboratories . . . with expert craftsmen skilled in the building of vacuum tubes . . . the Slater organization was ready to keep pace with electronics progress. How well we have done this is evidenced by the broad acceptance of Slater Electronic Tubes by the intra-industries and their use by our Government.

**Used throughout New York City exclusively, and many other municipalities.*

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

SLATER ELECTRIC & MFG. CO.

BROOKLYN, NEW YORK

MANUFACTURERS OF PRECISION ELECTRONIC TUBES AND INCANDESCENT STREET LIGHTING LAMPS

nels for the remaining AM stations," he explains.

"We expect television broadcasting to develop rapidly after the war, along with FM radio broadcasting. Manufacturing experience gained in the production of electronic equipment for war will undoubtedly result in lower-priced television receivers after the war and this, plus public demand, should accelerate the expansion of television service."

Suggests Material Men Band Together

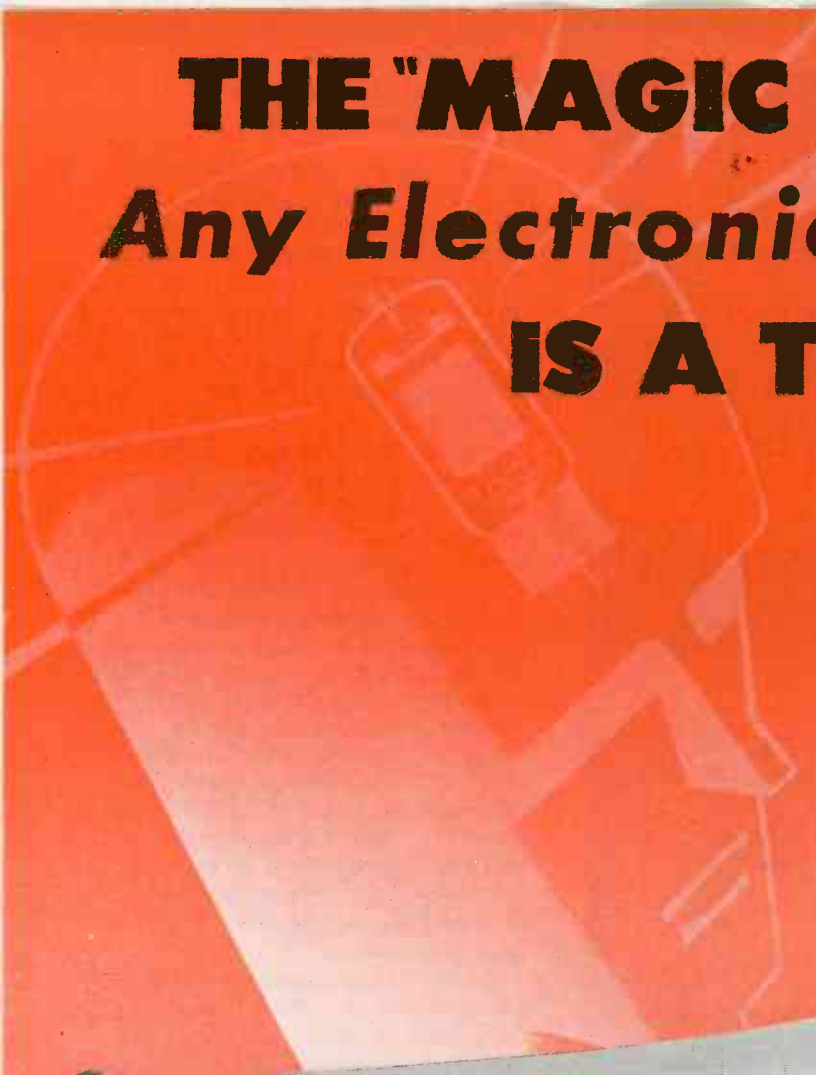
The possibility of a banding together of material control managers—those men in each company whose job it is to control the flow of material into an organization and out onto the assembly lines when needed—has been suggested by J. H. Scheinman, who occupies such a position with the Freed Radio Corp., 200 Hudson Street, New York. Mr. Scheinman states that the matter has been broached to the Radio Manufacturers Association and that executive vice-president Bond Geddes has commented favorably on the idea. It has been suggested that such an organization be started with a group from the New York area which might form the nucleus for a national body if sentiment favored it. Mr. Scheinman will be glad to have words from interested material control managers with an expression of their opinion on the feasibility of the plan.

Pioneers Pledge Safety

David Bright, president of Pioneer Gen-E-Motor, Chicago, and Admiral Alexander Charlton, at Pioneer's rally in which the company's 1500 employees pledged to reduce absenteeism and accidents

THE "MAGIC BRAIN" OF *Any Electronic Equipment* IS A TUBE . . .

and the fountainhead of modern tube production is RCA



LET'S LOOK AT THE RECORD!

To a greater degree than any other manufacturer, RCA has solved the problem of turning out in quantity, high quality Tubes expertly engineered to the requirements of the practical user.

In the field of "Receiving" Tubes, RCA is looked to by the government as well as many other critical customers as producing an eminently satisfactory product—and doing it in tremendous quantities.

In Cathode-Ray Tubes, RCA was the first to produce well-engineered units at low cost, thus making them available to industry generally.

RCA has long led in Phototube development, meeting one newer and more exacting application after another. Included here as RCA "firsts" are such outstanding developments as the RCA-931 Multiplier Tube, and other Phototubes utilizing the famous S4 surface which is highly responsive to daylight and blue light.

RCA first developed the Beam Power Tube in the "Receiving" field, subsequently carrying this important development into the field of Transmitting Tubes.

In the field of Ultra-High-Frequency Tubes, RCA was the first to bring out Acorn Tubes—and, later, many others, among them such important Tubes as the RCA-1628 (and its successor, -8012), -825, -827 and RCA-832.

In Power and Transmitting Tubes, RCA was the first to design a successful air-radiator for cooling heavy-duty units.

Time and again, RCA has anticipated the need for new or improved Tube types, often pioneering them far ahead of any commercial demand.

And always RCA has led the way with Application Engineers in the field. These practical men apply their specialized talents to the dual objective of developing better tubes for the job at hand, and finding ways to use tubes already available to better advantage.

BUY U. S. WAR BONDS AND STAMPS

RCA RADIO-ELECTRONIC TUBES

RCA Victor Division, **RADIO CORPORATION OF AMERICA**, Camden, N. J.

Du Mont Applies for Television License

Allen B. Du Mont Laboratories, Inc., with offices, laboratories and plants in Passaic, N. J., have just filed with the Federal Communications Commission a request for the reinstatement of a commercial television station application for Washington, D. C. The station would operate on Channel 1 or 50,000 to 56,000 kilocycles.

Already the Du Mont organization is operating a New York television station, W2XWV, at 515 Madison Avenue, on a scheduled program basis. Each Sunday evening, from 8:30 until almost 10:00, this station is on the air with a program of entertainment and enlightenment. In addition and more recently, W2XWV on Wednesday evenings is on the air with strictly experimental programs aimed at developing the sponsored program or telecast advertising technique for future commercialized television. Leading advertisers, advertising agencies and broadcasters interested in postwar telecasting, are taking part in these experimental activities.

Du Mont-built equipment will be available for the Washington station, just as such equipment was built and installed in the New York Station.

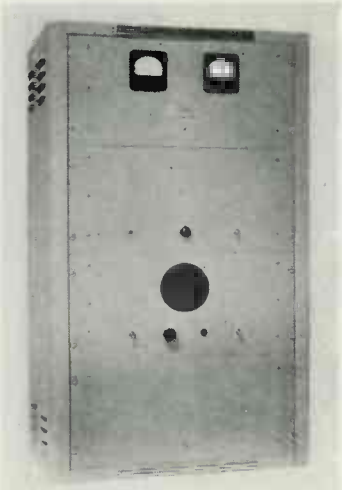
100 Degrees Below

No, not visitors from Mars — just a couple of General Electric engineers about to enter a test chamber where war radio equipment is put through its paces at temperatures as low as 100 degrees below zero

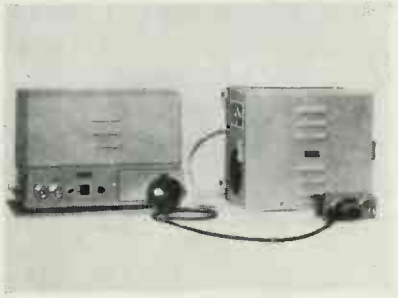
RADIOTELEPHONE EQUIPMENT

FOR *Your* APPLICATION

Complete 22 Watt High Frequency Mobile Installation

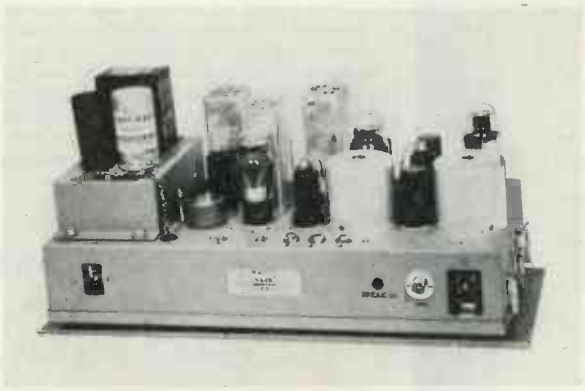


Complete 50 Watt Central Station Installation.



Type 11X Receiver and PTL-10X Transmitter for Mobile Applications.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★



Type PRS-9X, 30-40 MC Mobile Receiver with Dust Cover Removed.

Type PTS-22X, 30-40 MC Mobile Transmitter with Dust Cover Removed.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

PARTIAL LIST OF TYPICAL PRODUCTION MODELS

SERIES 17	10 Watt Multi-Channel Transmitter, Receiver and Power Supply in 8¾" x 15" x 11" Cabinet. 6 and 12 Volt DC and 117 Volt AC Models available.
SERIES 26	20 Watt Multi-Channel Transmitter and Receiver available for operation from 6, 12, 32 and 110 Volts DC or 117 Volts AC.
SERIES 56	50 Watt Multi-Channel Transmitter and Receiver available for operation from 12, 32 and 110 Volts DC or 117 Volts AC.
SERIES 6	Includes Tunable and Multi-Channel Fixed Tuned Receivers for Mobile, Marine or Central Station application.
TYPE 11A	Single Frequency Crystal Controlled Station Receiver for frequency ranges up to 8,000 KC.
TYPE 11X	Crystal Controlled Mobile Receiver, for frequency ranges up to 8,000 KC.
TYPE PTL-10X	Instant Heating 10 Watt Mobile Transmitter, for frequency ranges up to 8,000 KC.
TYPE PTL-22X	Instant Heating 22 Watt Mobile Transmitter for frequency ranges up to 8,000 KC.
TYPE PTS-22X	Instant Heating 22 Watt Mobile Transmitter, range 30-40 MC.
TYPE PR-9X	Crystal Controlled Mobile Receiver, range 30-40 MC.
TYPE PRS-9A	Crystal Controlled Station Receiver, range 30-40 MC.

WRITE FOR QUOTATION ON STANDARD OR SPECIAL EQUIPMENT YOU REQUIRE!

KAAR ENGINEERING CO.

PALO ALTO, CALIFORNIA

Manufacturers of High Grade Mobile and Central Station Radiotelephone Equipment

Tom White and Heroes

Employees of Jensen Radio Mfg. Co., headed by Thomas A. White, vice-president and sales manager (center) heard two heroes of Guadalcanal, the Lexington and the Yorktown, tell of the fighting man's daily hardships. Both Sergeant Barry and Fireman Ambler were awarded Purple Hearts for outstanding bravery

Corderman Leaves OWI, Joins Western Electric

Roy C. Corderman left OWI's bureau of communications facilities July 15 to join the radio division of Western Electric. He will handle war work in WE's government contracts section. Mr. Corderman has been with OWI since December, 1941, on leave from American Telephone & Telegraph Co.

Sylvania Opens New Quarters in Atlanta

Improved service to the mushrooming war industries of the south will be afforded by the opening of a new office and warehouse in Atlanta, Ga., it was announced by the New York office of Sylvania Electric Products Inc., at 500 Fifth Avenue. Atlanta becomes the 26th American city to acquire a major plant of this manufacturer of radio tubes, secret electronic devices and both fluorescent and incandescent lighting equipment. Don G. Mitchell, vice-president in charge of sales, told several hundred dis-

DOING OUR JOB WELL...
Welcoming more jobs to do

Majestic
Mighty Monarch of the air

To meet the demands of our armed forces, American Industry was forced to step up its production and manufacturing standards.

Majestic was among the first to adopt the new tempo. Walkie-Talkies, Marker Beacons and Electronic Equipment of several kinds leave the assembly lines in a never ending stream. Crystals, with their requirements of infinite precision, are being produced by the thousands.

Majestic has done its job well — and in doing it has become a stronger organization; stronger in personnel—stronger in resources and facilities. Guided by veterans of the radio industry, it has not yet reached its peak in production capacity — its new strength has not yet been fully taxed.

Majestic welcomes more jobs to do.

MAJESTIC RADIO AND TELEVISION CORPORATION

2600 West 50th Street • Chicago, Illinois

Builders of the WALKIE-TALKIE, "Radio of the Firing Line"

$1000 PRIZES IN WAR BONDS

FOR MOST HELPFUL ANSWERS TO THESE THREE QUESTIONS

1st Prize, $500 maturity value; 2nd Prize, $250 maturity value; 3rd to 13th, $25 maturity values.

Every one is eligible. Contest ends December 31, 1943.

To stimulate YOUR post-war thinking, and to check OUR post-war plans, Majestic offers prizes for the most helpful answers to these questions:

(1) What types of radios will be in large demand in YOUR locality immediately following Victory?

(2) In what new features or new merchandising policies are you most interested at present?

(3) What kind of advertising support do you believe will be most helpful to you?

Competent judges will read your answers. It's facts and ideas, not rhetoric, that will count. If any two prize winning letters are considered by the judges to have equal merit, duplicate awards will be made. Write your answers to these three questions—mail them to me personally, today!

E. A. TRACEY, *President*

tributors and war industrialists in brief opening ceremonies that the new plant will speed deliveries to southern manufacturers.

Richard Hume Joins Universal Microphone Co.

Formerly associated with the North American Aviation Corp., Inglewood, Calif., Richard Hume has joined the Universal Microphone Co. in the same city as stores manager and supervisor of Department 7. Ken Arms, daytime assistant supervisor of Department 3, has been promoted to night supervisor of the same department.

"Electronics at Work," Westinghouse Movie

"Electronics at Work," an educational motion picture released by Westinghouse, explains the six basic functions of electronic tubes and shows how each type of tube is used in some of the latest industrial and military applications.

Animated drawings showing tube construction are used to explain how the cathode, anode and grid elements rectify, amplify, generate, control, transform light into electric current and transform electric current into light. Precipitron, radio and radio-telephony, high-frequency induction heating, resistance welding control, television, industrial and medical X-ray are a few of the electronic devices which are shown.

This 20-minute sound film is available in 16 mm print and is loaned free for showing at war plants and engineering and technical societies. Write to Department 7-N, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Jefferson Electric Elects New Officers

At the meeting of the board of directors of the Jefferson Electric Co., Bellwood, Ill., on June 3rd, the following officers were elected: John A. Bennan, Chairman of the Board; J. C. Daley, president and treasurer; A. E. Tregenza, executive vice-president. At the same meeting Mr. Bennan was made vice-president and general sales manager; A. A. Flick, Jr., vice-president in charge of manufacturing; and R. A. Hoagland, vice-president in charge of war contracts.

Along with these changes in officers, four executive engineers were appointed: R. J. Horstmann, in charge of radio and electronic products; L. Mauerer in charge of design and development; and E. W. Rickmeyer, in charge of mechanical products.

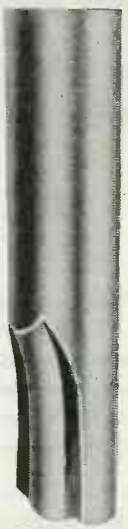
The Jefferson Electric Co., founded in 1915, was a pioneer in the fuse and outlet box field. Their chief products today include transformers for radio, television, radar, electronics, etc.

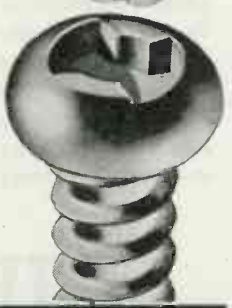
Sylvania's International Division

As the first step toward preparation for increased world-wide operation, Sylvania Electric Products, Inc., announces the formation of an International Division with Walter A. Coogan as director, to provide engineering counsel, prompt delivery, and more frequent and personal contact with the market in each country,

In addition to being prepared for an increased demand for Sylvania incandescent lamps, fluorescent lamps and fixtures, radio and electronic tubes, the new International Division will be geared to the coming age of electronics. There will be new products, many of which are at this time carefully guarded secrets.

We Engineers realize that *performance in the field* must rank in equal importance with quantity and quality in production schedules. The fact that CLUTCH HEAD SCREWS may be removed and replaced with a standard type screwdriver is accepted by us as the first definite answer to a hitherto serious handicap in field work. While thus simplifying and quickening field service, CLUTCH HEAD SCREWS have everything that makes for safe, speedy, and economical production. The deep clutch provides an easy-to-hit bull's-eye on the assembly line... into which the Center Pivot bit self-centers for elimination of "slippage"... conserving operator energy for the drive home with less effort... all for a smoother, faster tempo of factory production that is vitally important to both efficiency and lowered costs. So, we Engineers who plan and produce can join issue with you men in the field who "keep 'em rolling."





CLUTCH HEADS, the *only* modern screws that may be operated with a standard type screwdriver or an Assembly Bit, are performing today an important wartime service. They are available in Standard and Thread-forming types for every purpose.

CLUTCH HEAD SCREWS

ECONOMY is an important feature of this Center Pivot Assembly Bit. No "back-to-the-factory" shipment is necessary for reconditioning. A brief application of the end surface to a grinding wheel fully restores original maximum efficiency.

UNITED SCREW AND BOLT CORPORATION

CHICAGO CLEVELAND NEW YORK

Aircraft Accessories Acquires Phonette

Randolph C. Walker, president of Aircraft Accessories Corp., announces the acquisition by his company of a controlling interest in The Phonette Co. of America, a Los Angeles organization engaged in the manufacture of radio components. Phonette will be operated as a subsidiary, under the supervision and direction of the Electronics Division of Aircraft Accessories Corp., which already operates nine plants in Kansas City, Kan., and four in Slater, Mo., producing transmitters and other radio equipment for aviation and other uses. The Phonette Co. of America was formerly engaged in the development, manufacture and sale of the "Phonette," a music vending device invented by W. S. Farrell, its president.

Brown Advances Two

George M. Muschamp and Paul L. Goldstrohm have been elected vice-presidents of the Brown Instrument Co., Philadelphia, subsidiary of the Minneapolis-Honeywell Regulator Co. Mr. Muschamp will continue in charge of engineering; Mr. Goldstrohm of production. Both posts are new.

N. A. Philips' Trademarks

North American Philips Company, Inc.—with main office and factory at Dobbs Ferry, N. Y.—has adopted a new trademark "Norelco," which will now be applied to products handled by its Industrial Electronics Division at 419 Fourth Avenue, New York. These products will include electronic temperature indicators; direct reading frequency meters; Searchray (industrial and research X-ray) apparatus; X-ray quartz crystal analysis apparatus and other electronic applications. The trademark will also cover cathode-ray tubes; transmitter, amplifier and rectifier tubes; quartz oscillator plates; fine wire of all drawable metals: bare, plated and enameled, and diamond dies, all of which will continue to be handled direct from the Dobbs Ferry plant.

The "Elmet" trademark will continue to be used in connection with tungsten and molybdenum in powder, rod, wire and sheet form as well as tungsten alloys made by the company in its factory at Lewiston, Maine. An associated company—Philips Metalix Corp., Mount Vernon, N. Y.—is handling Philips X-ray medical apparatus through its New York office, 419 Fourth Avenue. The productive capacity of North American Philips Co., Inc., is still concentrated on war work.

Shangri-La Transformation

There won't be many who would guess that these two photographs show the same man. But it is a fact. They are both Pierre Boucheron, one as general sales manager of Farnsworth Television and Radio Corp., the other as Commander Boucheron, USNR. The be-whiskered picture was made while he was in charge of a mission at a Shangri-La base with reverse English—the temperature was in the neighborhood of minus forty Fahrenheit. Past the draft age, "Pete" nevertheless returned to naval duty as a Lt. Commander, was subsequently promoted Commander

Nylon Emerges As A Plastic

Nylon, du Pont synthetic textile, now used for a great many war purposes, will after the war emerge as a new type plastic. It is of the thermoplastic type which means that under heat and pressure it can be re-shaped and re-formed any number of times. It is said to have good electrical properties, burns slowly, undergoes little or no deterioration with age, resists oil, grease, solvents, alkalis and weak acids. A feature of the new plastic is that it has the highest softening point (450 degrees Fahr.) and greatest toughness of any plastic of its type.

Recent Army-Navy "E" Awards

D. W. Onan & Sons, 39 Royalston Ave., Minneapolis, Minn.

Simplex Radio Division, Philco Corp., Sandusky, Ohio (white star added).

Federal Mfg. and Eng. Corp., 211 Steuben St., Brooklyn, N. Y. (white star added).

Philco Promotes Craig

Palmer M. Craig has been appointed chief engineer of the radio division of Philco Corp., Philadelphia. He has been chief engineer in charge of radar and radio communications equipment.

"Electronic Mfrs. Assn." Sec. Now Navy Lt.

Kenneth C. Prince, Chicago attorney, who has been active for many years in the radio and electronic industry, has been commissioned Lieutenant (j.g.) in the United States Naval Reserve.

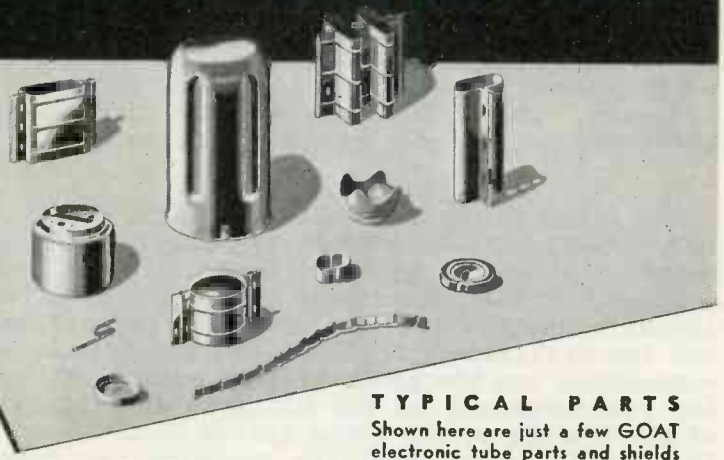
Mr. Prince has for nine years served as executive secretary of the Sales Managers Club, Western Group (now Association of Electronic Parts and Equipment Manufacturers). He has also served as general counsel for the Radio Parts Manufacturers National Trade Show, Inc., and Radio Servicemen of America, Inc., and acted as the legal consultant for the Priorities Committee of the Radio Parts and Associated Industries. He represented many of the leading manufacturers of radio and electronic parts and equipment.

EXPERIENCE?

THIS IS GOAT ELECTRONIC TUBE PART . . .

TYPE G1224

G1224 is just one of the thousands of parts made by GOAT since the days of radio infancy. GOAT is continually called upon to handle tough jobs requiring skill, precision and efficiency. Because of experience gained throughout the years, GOAT has been able to meet the demands of this industry for greater quality, durability and quantity production. Today, GOAT serves almost every electronic tube manufacturer with a tremendous variety of stock and special parts made of any metal to any required degree of accuracy.



TYPICAL PARTS
Shown here are just a few GOAT electronic tube parts and shields that have been stamped, drawn and formed on GOAT machines, dies and presses.

GOAT METAL STAMPINGS, INC.

A DIVISION OF THE FRED GOAT CO. INC. EST. 1893

314 DEAN STREET • BROOKLYN, N. Y.

WASHINGTON

★ ★ ★ ★ *Latest News Concerning the Electronic Industry* ★ ★ ★ ★

SIGNAL CORPS PROCUREMENT'S NEW ORGANIZATION AND CHIEF—With the creation of a new Procurement and Distribution Service and the Engineering and Technical Services separated into another unit, the new Chief Signal Officer, Major General Harry C. Ingles has streamlined the Signal Corps equipment production functions so as to meet in high gear the push of the coming warfare program of the American Army. With the selection of Major General William H. Harrison, who had been Director of Procurement for the Army Service Forces, the Signal Corps has designated one of the ablest and outstanding administrators in the Army to take over its procurement work. It was understood that Lieutenant General Somervell, commanding the Army Service Forces, had expressly desired that General Harrison take over this important function to speed up and remedy any defects in the communications procurement program.

GENERAL COLTON HEADS ENGINEERING SERVICES—The Engineering and Technical Services which embrace all the Signal Corps laboratories and research work, is headed by Major General Roger B. Colton, former chief of the Signal Supply Services. Under General Harrison will be all the Signal Corps Depots and Procurement Districts and Inspection Agencies and Signal Distribution and Supply Sections scattered throughout the country. General Harrison, who has been vice-president and Chief Engineer of the American Telephone and Telegraph Co. on leave since July, 1940, for his war work in Washington with OPM, WPB and the Army, has resigned from the A. T. & T., completely severing all connections.

MAJOR AIDES FOR GENERAL HARRISON—Colonel Eugene V. Elder remained under General Harrison in charge of the Procurement Division as he had proved his ability exceptionally well in handling the requirements program for electronic, radio and wire equipment during the past 1½ years. Now he has to distribute more than 50 per cent of the contracts in terms of money during the current fiscal year, started July 1, than the Corps did during the past fiscal year. Colonel George I. Back takes over direction of the highly important Distribution Division of which he had been Executive Officer. Special emphasis is being laid now on distribution of communications and electronic equipment to all branches of the Army and to the United Nations' forces, while proper and speedy maintenance is the goal upon which particular stress is directed. Under Col. Back are the hundreds of warehouses and distribution points, maintenance personnel guidance, stock and inventory controls.

WPB RADIO AND RADAR DIVISION SHIFTS TO MEET NEW TASKS—Despite rumors, there really has been NO reorganization per se in Ray Ellis' WPB Radio and Radar Division. What has happened is that under the natural course of events, with the changing problems of war production (such as the shift from plant expansion, conversion of industry and facilities, materials' shortages) the emphasis is now upon components and the problems of their production to meet up together for the final assembly. The components run the gamut of test equipment, tubes, meters, capacitors, etc. Besides the rearrangement of the Division staff functions in Washington, the field offices of the WPB agency are being geared up to carry on the WPB tasks as much as possible in the field. A new Division organization chart is now being issued.

NOTES OF INTEREST—General Harrison has replaced General Colton as the Army's Associate Director on ANEPA. Important for the components manufacturers, in filing replacement manning schedules with the local draft boards the WPB Radio and Radar Division will step in to intervene with Selective Service Headquarters in case requests for deferment of skilled workers are not given full consideration; Signal Corps, too, wants to maintain skilled key employees .... WPB Radio and Radar Division is going to issue every few weeks a "restricted" bulletin to laboratories to guide them on the status of components, critical materials' situation and equipment needs to be considered for design development and research work.

To dream and plan realistically for the future is both good and necessary. However, to indulge in Star-Gazing through the wrong end of the telescope is an extravagance which no industry can afford. RADIO can point with pride to its achievements and its miraculous progress made under the impetus and emergency of war. But to promise that the miracles of Radar and other Electronic development will be ready for delivery on V-Day . . . is to damage an otherwise glorious record.

THE FUTURE IS BRIGHT . . .

BUT LET'S KEEP OUR EYE ON THE BALL!

Our number one job right now is the production of Radio Communications Equipment and Radar for the armed services. These are weapons which will help win the war. The application of new Electronic knowledge to peacetime radio production will, of necessity, be a gradual and evolutionary process. We know too that Electronic research and development now entirely serving our war effort can and will elevate every phase of human living.

ARMY E NAVY

For the development and production of Radio Communications Equipment for our armed forces, the Motorola organization was awarded the Army-Navy "E" with added Star for continued excellence of performance. Motorola is proud of the part it has been privileged to play in the speeding of Victory.

You May Expect Big Things from Motorola. We can't say when but we *can* say . . . *no one will be ready sooner!*

Motorola RADIO
FOR CAR & HOME
GALVIN MANUFACTURING CORPORATION · CHICAGO

Signal Corps Completing 1944 Contract Planning

Will cover requirements of Army, Navy and lend-lease; June contracts top $638 million

The electronic and radio manufacturing industry must not falter in its production functioning for the Army Signal Corps because of the false waves of optimism of an early ending of the war.

The industry has a big task cut out for the latter portion of 1943 and for 1944—by Jan. 1, 1944, the Signal Corps is planning to complete the placing of contracts as far as possible for next year to meet the requirements of the Army and the United Nations' Forces (lend-lease.) (This gives manufacturers a gage on their Army production for the year.)

The Signal Corps procurement leadership is emphasizing that there must be no let-down in production because with the coming intensity of offensives the communications "weapons" must not be "too little or too late." At the same time, the Signal Corps is closely cooperating with the WPB Smaller War Plants Corporation to spread the load to the smaller companies and likewise is trying to level off the contracting to avoid peaks. The Signal Corps is also bending every effort to clean up terminations of contracts due to changing requirements so the producers' facilities will be cleared for other production.

From March through June the Signal Corps procurement was the heaviest of the past government fiscal year. June, during which $638,000,000 contracts were placed, was the largest procurement month in Signal Corps history.

Jett Appoints FCC Allocation Committee

The postwar problem of planning the allocation of frequencies is being tackled by another agency, the FCC, with the appointment of an allocation committee in the Commission's Engineering Department by FCC Chief Engineer E. K. Jett. The committee is composed of Philip F. Siling, Chief of the FCC International Division as chairman; William N. Krebs, Chief of the Special Safety and Services Division which covers police, aviation and maritime radio; Assistant Chief Engineer George P. Adair in charge of broadcasting; and Dr.

We are busy, busy, busy producing these recorders for our Armed Forces and our Allies . . . amazing devices that translate high-speed radio code signals into ink marks on paper tape. Considerable research by our laboratory was required for this important contribution to the electronics-communication field . . . a valued factor in the war that will have important after-use in peacetime.

Waters Conley COMPANY

• No one can tell today what the peacetime needs of the world will be, but some of the Waters Conley research and engineering developments are sure to open important new civilian markets for you.

Phonola

WATERS CONLEY COMPANY

In peacetime, America's oldest and largest manufacturers of portable phonographs

ROCHESTER, MINNESOTA

17 E. 42nd Street, New York — 224 S. Michigan Avenue, Chicago

L. P. Wheeler, Chief of the Technical Information Division and this year's IRE president, who will aid the committee in regard to propagation data, channel widths and new developments and improvements in the electronic and radio industries.

The committee will make its recommendations on allocation matters to the Commission itself. It will also coordinate its activities which will cover non-Federal frequency allocation planning with the IRAC which is the technical agency for Federal Government frequency requirements. Commissioner T. A. M. Craven is the FCC member on IRAC. Mr. Siling is secretary of IRAC and also maintains the master frequency records for the Commission and handles all point-to-point international communications matters.

Navy Electronic Appointments

Two Lieutenant Commanders, Rawson Bennett II and William S. Parsons, who have important posts in the Radio Division of the Navy's Bureau of Ships, have just been promoted to the rank of Commander. Commander Bennett is in charge of underwater sound design and Commander Parsons handles communications ship equipment.

Correction

The research amplifier pictured on page 66 of the July issue of "Electronic Industries" was wrongly credited to Rahm Instruments, Inc.; the manufacturer is the Electrophysical Laboratories, Inc., 45 West 18th Street, New York. In the article by Arthur Palme describing a high-speed electronic photo light, it was stated on page 184 that "any condenser, suitable to operate with about 200 volt dc, etc."; this should have read 2000 volt dc.

Emerson Reports on War Radio Production

In a report of its war-production accomplishments during the past year, Emerson Radio & Phonograph Corp. lists radar developments, transceivers, aircraft and tank transmitters and receivers, officers' pocket receivers, aircraft beacon receivers and motorized equipment apparatus as Emerson's

If you believe in the future of America as we do, then we're asking for an appointment immediately after the victory has been won . . . when a bright new era awaits us all.

Perhaps we can talk about a coil problem . . . how thoroughly we're organized to help you on such a problem only military censorship forbids telling now. Or it may be that you manufacture your own coils and will be interested in discussing magnet wire—any shape—any insulation that your operations require.

As a matter of fact, perhaps we can get together now, but if it happens we can't, remember we have a date in and for the future. When we both can keep it, you can again take advantage of Anaconda's service and the benefits derived from the single product control "from mine to consumer" backed by years of continuous metallurgical experience.

43236

ANACONDA WIRE & CABLE COMPANY
General Offices: 25 Broadway, New York 4
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Subsidiary of Anaconda Copper Mining Co.
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ANACONDA
from mine to consumer

This familiar trade-mark symbolizes the best efforts of modern research and production.

Magnet wire and coils

ANACONDA WIRE & CABLE COMPANY

contribution to victory. The report, in brochure form, carries a trend chart of the company's shipments to the armed forces.

"In Emerson's expanded engineering laboratories and in the field with government experts, many new research and developmental techniques have been brought to perfection," explains Ben Abrams, president. "In production, in getting the goods made and delivered—in most instances ahead of schedule—we have surpassed all former civilian records. New materials, new processes, new training methods and stepped-up efficiency throughout the entire organization have enabled us to manufacture and ship in unprecedented volume.

Visions new products

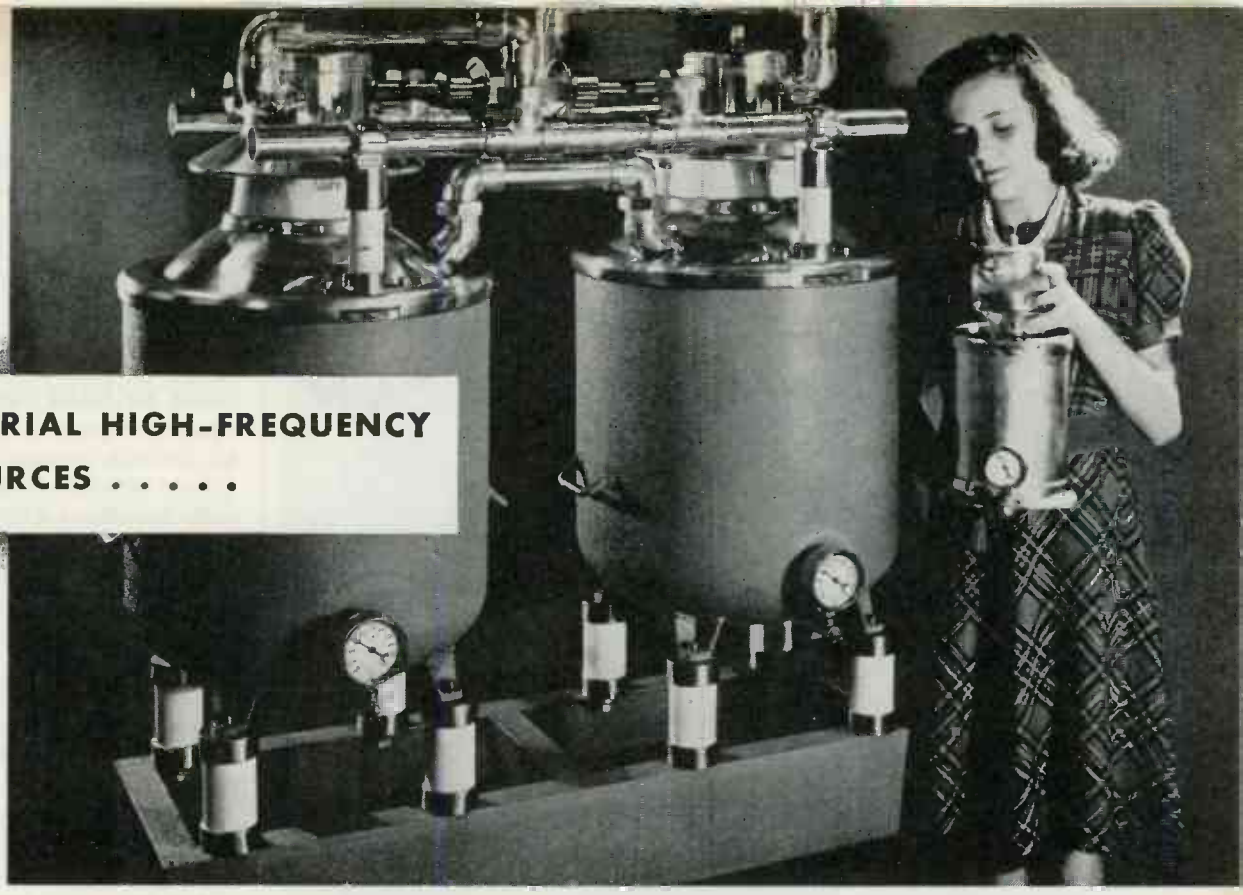
"As new types of sets are designed, as broadcasting changes, as television and FM evolve, all of the 55,000,000 sets now in use will gradually obsolesce and be replaced. When two-way transmitting and receiving instruments are brought to commercial proportions, when pocket radio becomes more efficient and as countless other methods of sound recording and communication are developed, the various branches of manufacturing, distributing and retailing will expand.

"In the wider field of electronics —where miracles of sight, sound, detection, calculation, healing, welding, purifying, magnifying and a thousand other hitherto impossible feats are now being performed —there will be vast production, distribution and selling opportunities. Radar, radio, electronics are destined for growth and expansion and ever-increasing roles in our lives and affairs which will dwarf the past of any other development which has come out of America."

Dorman Israel is Emerson vice-president in charge of engineering.

Radiosondes and High-Voltage Lines

The U. S. Weather Bureau reports that a fatal accident occurred recently when a lineman attempted to disengage one of the Bureau's radiosonde balloons from high-tension wires in which it had been entangled in flight. The Edison Electric Institute has been asked by the Weather Bureau to publish a de-



FOR INDUSTRIAL HIGH-FREQUENCY POWER SOURCES . . . . .

LAPP GAS-FILLED CONDENSERS

In any high-frequency high-power circuit, lump capacitance can most efficiently be provided by Lapp gas-filled condensers. They are ruggedly built to maintain their electrical characteristics under all conditions. Fixed and variable-capacitance models are available over a wide range of power and capacitance ratings. *Above is Unit No. 26541, consisting of two No. 25934 units. The assembly provides pivoting bus conductors, arranged so that the units may be used singly, in series, or in parallel, providing capacitance continuously variable from .0022 mf. to .022 mf. Each unit is rated at 200 amp., 6500 volts, capacitance variable .0043 mf. to .011 mf.; the combination in series, 200 amp., 13,000 volts, .0022 to .0055 mf.; in parallel, 400 amp., 6500 volts, .0086 to .022 mf. The small unit in the girl's hands is No. 23722, rated at 50 amp., 7500 volts, capacitance .000045 mf. to .000075 mf.*

ANY REQUIRED WATTAGE AND CAPACITANCE

ZERO LOSS

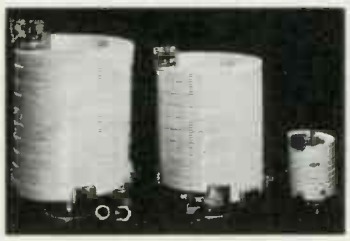
NO CHANGE WITH TEMPERATURE

COMPACT

PUNCTURE PROOF

SOUND, TROUBLE-FREE CONSTRUCTION

Standoff, entrance, bowl, and other special-purpose insulators are available in many types. Lapp is equipped also for production of many special assemblies, incorporating porcelain or steatite and associated metal parts.

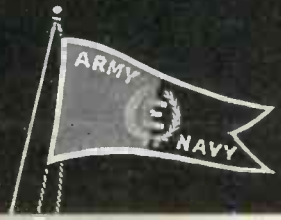


Lapp porcelain water coils, porcelain pipe and fittings provide a highly efficient means for cooling high frequency tubes. Sludging is eliminated and, with it, need for water changing and periodic cleaning of the cooling system.

Lapp

INSULATOR CO., INC.

LEROY, N. Y.



scription of the accident as a future safeguard against the risk that proved fatal in this case.

The radiosonde consists of a silvered cardboard box 9 inches square and 4 inches deep, containing apparatus for the automatic radio-transmission of atmospheric pressure, temperature, and humidity. Attached to 6-foot helium-filled balloons, these instruments are released for flight into the upper atmosphere twice a day from about 60 stations located throughout the United States. During flight the radio transmits a continuous record of the temperatures, humidities, and pressures of the air through which the instrument passes; and the signals, recorded by ground receivers, provide the weather forecaster with very valuable information upon the structure and movements of upper-air currents to heights frequently exceeding 10 miles. At these altitudes the balloon bursts and the instrument returns to earth by parachute.

The radiosonde carries an antenna of No. 18 stranded rubber-covered wire extending 3 feet above and below the box. The upper portion is held fairly straight by the pull of the balloon cord to which it is attached; the lower portion bearing a light lead anchor, swings somewhat in the wind. In the accident reported by the Weather Bureau, the balloon became entangled in the wires a few feet from the cross-arms of a high-tension pole, leaving the radiosonde box swinging free. When the lineman climbed the pole to free the balloon, he apparently touched the lower portion of the antenna while the upper portion was in contact with the power line at the same moment his foot touched a piece of pipe attached to the pole, completing the contact with the ground.

Sees New Science of "Opti-onics"

"Out of the greatly accelerated technical and research developments of this war period is coming a new science," says J. H. McNabb, president of Bell & Howell Company, Chicago. "This science of Opti-onics is not optics; it isn't electronics; but it is a combination of both, combined with precision mechanical design. Actually, in the physical world, we reach a poin

where ultra-high frequency radio waves take on many of the characteristics of light rays. We have learned that optical science can bring much to the development of electronics. Likewise, electronics enhances and supplements the work of optical science.

"It would be inaccurate to describe the work our company is doing in this overlapping region as either electronics or optics. Hence, the new term, Opti-onics.

"A good example of the necessity for combining certain portions of these two sciences into one is furnished in television. The electronics engineer can devise a system electronically which transmits and receives a visual image on the fluorescent surface of a cathode ray tube. But here the optical engineer must take over and devise an optical system which will enlarge and reproduce this image to a usable size and form. The work in the two fields must be coordinated. This coordination and combined work on the part of our research staff, to be truly descriptive, must be called Opti-onics."

WPB Intensifies Salvage

WPB Radio and Radar division has moved to intensify salvage efforts throughout the industry. As a means to this end it has just issued an amendment to order L-265. The new ruling provides that: No manufacturer, wholesaler, distributor or dealer shall retain in his "inventory, possession or control for more than 60 days any used, defective, exhausted or condemned parts of electronic equipment such as vacuum or gaseous tubes, or associated apparatus which cannot be reconditioned, but must dispose of them for salvage where practical, or destroy such parts as have no practical salvage value."

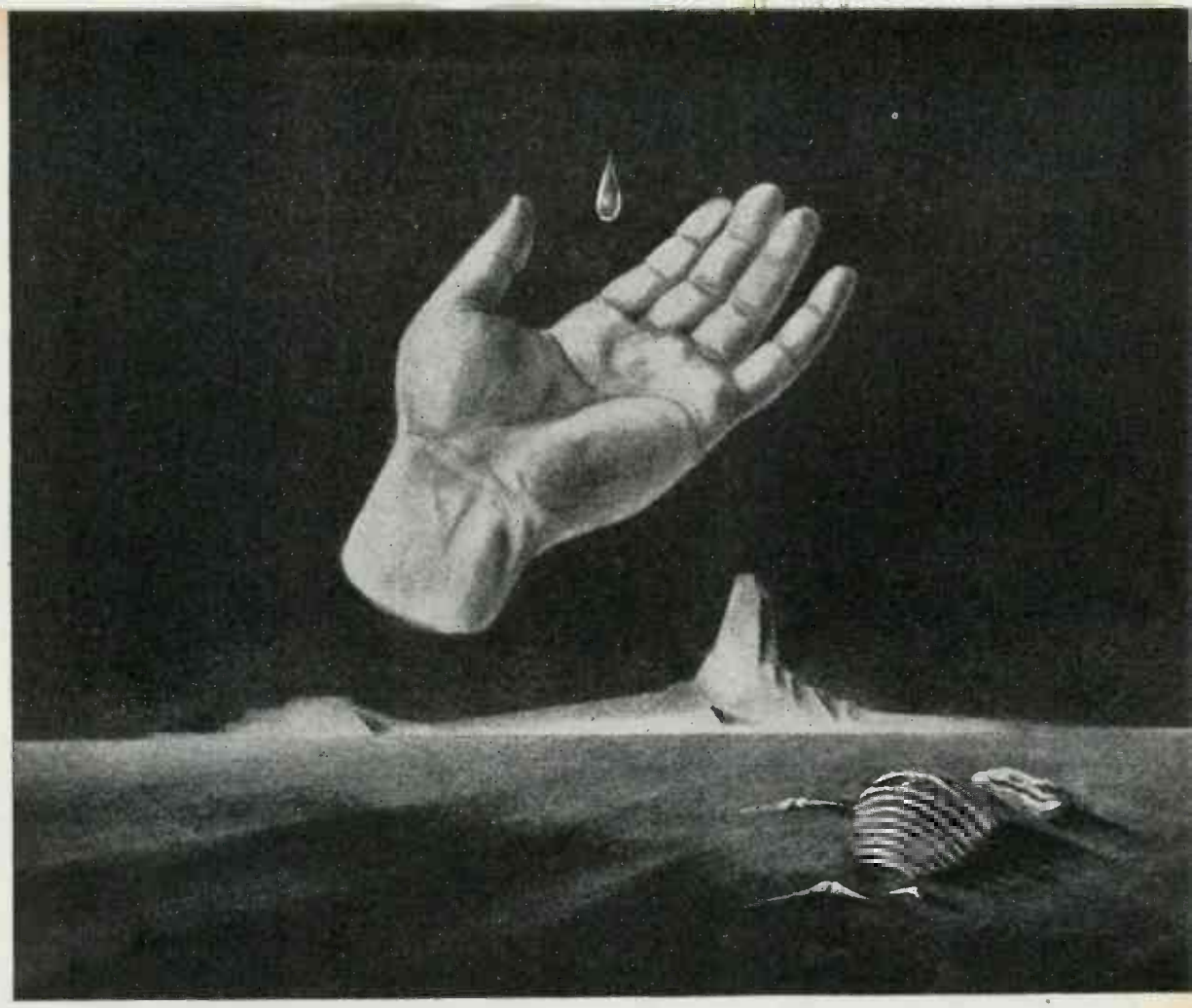
Electronic Control of Atomic Hydrogen Welding

Atomic-hydrogen arc welding is used by the Chambers Corp., Shelbyville, Ind., to speed the fabrication of oxygen cylinders for the armed forces. For this work, GE 75-amp atomic-hydrogen units furnish power to electronically controlled automatic welding equipment, while a 35-amp machine, for hand operation, is used for occasional touch-up welding and also to weld a bushing in the ends of the cylinders.

These cylinders, which are made from sheets of alloy steel approximately 0.043 in. thick, are formed by being first rolled into tubes

INSTRUMENTS AVAILABLE AT WAUGH Laboratories ON A RENTAL BASIS

- Analyzers, Sound
- Amplifiers
- Balancing Equipment
- Ultra High Speed Cameras
  Movie (128 to 2000 frames per sec.)
- Engine Indicators
- Load Maintainer
- Metal Locator, Berman
- Magnetometer
  Materials Insp. Type
- Magnetometer
  Compass Adjuster Type
- Microscope
- Micro-Ammeter
- Oscillators
  Electrical
- Oscillators
  Mechanical
- Oscillographs
  Pen & Ink
- Oscillographs
  String Type
- Projectors
- Recorders, Ride
- Sound Level Meters
- Strain Gages
  Electro Magnetic, Carbon Resistor Types and Scratch
- Strobotac
- Switching Units
- Vibration Machines
  Horizontal, Vertical & Circular Motion
- Vibration Pickup
- Vibration Velocity Meter



THE IRREPLACEABLE IS PRICELESS

RENTAL LIST

Waugh Laboratories INSTRUMENTS RENTAL LIST provides complete information regarding instruments, machines and equipments that are for rent, rates, and conditions of rental.

Our service manual describes these various instruments and their applications in detail.

Write for RENTAL LIST and service manual . . .

"ENGINEERING THINGS TO COME"

. . . yet at Waugh Laboratories, many instruments, irreplace able for months to come, are promptly available on a *renta* basis. Machines which, due to War conditions, cannot now b duplicated are at your immediate service on telegraphic orde

Waugh Laboratories RENTAL LIST of more than *one hun dred* instruments, and machines, for *inducing* and *measurin* vibrations and for analyzing strains and stresses sent on reques

Write today on your business letterhead.

Waugh Laboratories field service, if desired, also is available o a per diem *basis.*

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U.S. NAVY OFFICIAL PHOTO

THERE IS ONLY ONE MYCALEX

. . . but, to say that there is only one MYCALEX is not sufficient without the backing of fact. Whatever claims are made have been proved in actual "firing line" application throughout the far corners of the globe. Through intense heat and cold . . . in days before the war, and in these critical times, MYCALEX has emerged predominant in its field and, as leading engineers in industry, radio and television have told us, *"is the most nearly perfect electrical insulator known today."*

These engineers specify MYCALEX because they *prefer* MYCALEX. Extremely versatile in its application, it may be cut, drilled, tapped, machined, milled, ground, polished and moulded. It meets requirements for close tolerances. Moreover, MYCALEX is leadless. This, combined with low loss at all frequencies, gives it advantages over any other types of glass bound mica insulation.

MYCALEX is not the name of a class of materials, but the registered trade-name for low-loss insulation manufactured in the Western Hemisphere only by the *Mycalex Corporation of America*. Be sure to specify MYCALEX if you are looking for low power factor, low loss, negligible moisture absorption and high dielectric strength. *Sheets and rods immediately available for fabrication by us or in your own plant.*

MYCALEX THE INSULATOR

Trade Mark Reg. U. S. Pat. Off.

MYCALEX CORPORATION OF AMERICA

Exclusive Licensee under all patents of MYCALEX (PARENT) CO. Ltd.

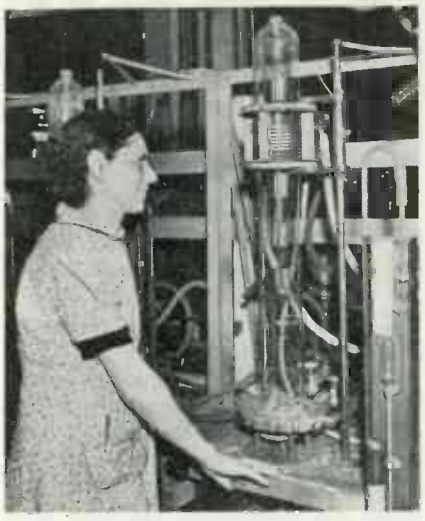
60 CLIFTON BOULEVARD ☆ CLIFTON, NEW JERSEY

much like stove pipe. The butting edges are turned up in a slight burr and are then automatically fused together, without the use of filler rod, by being passed under the head of a 75-amp atomic-hydrogen seam welder. This slight burr facilitates the welding process and improves the finished product.

Hemispherical ends are welded into the cylinders by the same 75-amp machines. In this operation, once the ends are fastened in the cylinders the work automatically revolves under the welding head.

The finished cylinders are then tested under hydrostatic pressure up to 1000 pounds per square inch, and checked for leaks with air under high pressure. Selected units are further checked by machine-gun fire.

Induction Treating



Induction treating bottle used to drive gas particles out of metal parts for radio transmitting tubes manufactured at the Westinghouse Lamp Division, Bloomfield, N. J. High frequency current passing through the water-cooled coil near the top of the bottle induces heat in tube parts being treated, as air and gases are pumped from the container. In treating control grids, temperatures are as high as 3272 deg. F., 300 degrees hotter than molten iron

Electronic Future for Telegraphy Envisioned

The future of telegraph service lies in electronic "Telefax"—facsimile telegraphy—with its unlimited possibilities of service to the public and its potential application to all sorts of automatic operation, including the dialing of telegrams, F. E. d'Humy, Western Union vice-president in charge of engineering, told the FCC hearing on the tele-

graph merger. Envisioning the postwar possibilities of the telegraph industry under the merger, he predicted that "the bulk of overhead communication wires criss-crossing the continent are destined to come down" with radio beams or light beams as an ultimate goal of telegraphic communications, and carrier systems and coaxial cables offering channels which will lower the cost of the telegraph plant.

Telefax like slow television

Mr. d'Humy in his lengthy exposition of the future possibilities of telegraph service aroused the greatest interest in his discussion of the potential uses of ultra-high radio and light beams and in his belief in the future of Telefax. In regard to the possibilities of use of radio and light beams projected within the optical range, he said that this offers a most economical and dependable future telegraphic service. "No longer will there be a need of physical conductors of any kind except for distribution purposes," Mr. d'Humy stated. "This is no idle prophecy. We need only a little more research and to whittle at the economics. It surely will be ready in no far distant future for replacements of plant which will have expended its economic life."

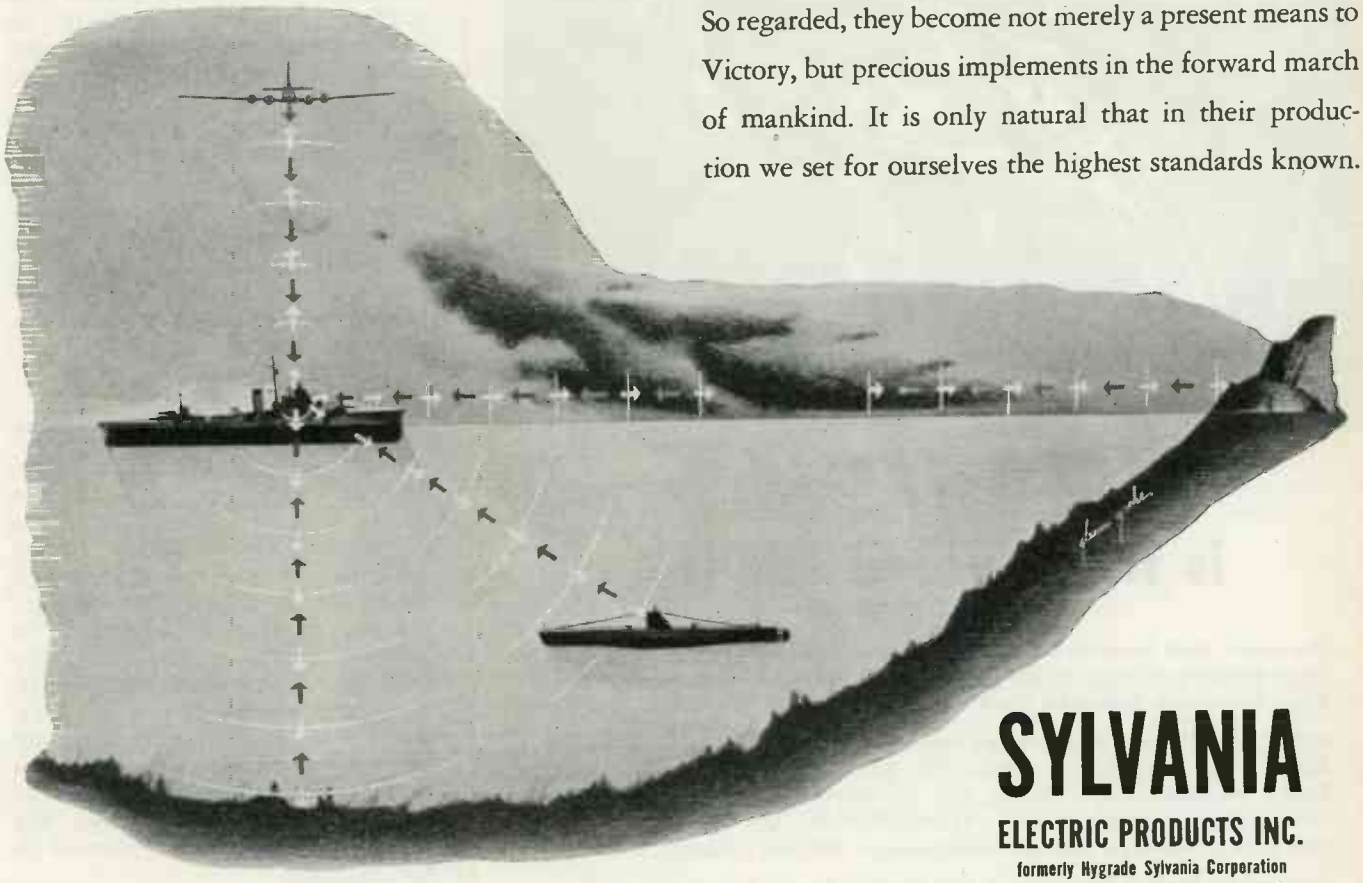
The Western Union official told Chairman Fly that the higher frequencies with their narrower beams can be directed so that eavesdroppers cannot pick up information from the messages. He said that light beams also give the element of privacy. In discussing light beams, he related that this method is old but never has been used to any great extent, but one of the present difficulties of light beams or waves is their inability to penetrate fog.

Commissioner Craven humorously commented that Western Union might have to come to the FCC for authorization in using light beams, but Mr. d'Humy quipped that the company was trying to avoid that.

Mr. d'Humy pointed out that radio beams penetrate fog so that in this future service the telegraph industry will have to lean more heavily on the ultra-high waves and micro waves. He noted that there was need to improve the tubes for photoelectric cells and when such a tube and cell are found an answer will be provided for the transmission of telegrams

Beyond Sight and Transcending Hearing

● Two of the simplest words in the English language make up the phrase, "I see." Yet in that phrase is wrapped up most of the progress man has made. It spells understanding – which, whether gained through eye or ear, is the key to all things good. It is the beginning of knowledge, the source of progress, the interpreter of beauty, the keystone of civilization. That is why the everyday things we build – radio and electronic tubes, incandescent lamps, fluorescent lamps and equipment – are to our mind more than they physically seem. They might be called the Means to the Future, since they enter areas beyond sight and transcending hearing. So regarded, they become not merely a present means to Victory, but precious implements in the forward march of mankind. It is only natural that in their production we set for ourselves the highest standards known.



SYLVANIA

ELECTRIC PRODUCTS INC.

formerly Hygrade Sylvania Corporation

Emporium, Pa.

Established 1901 . . . Makers of Incandescent Lamps, Fluorescent Lamps, Fixtures and Accessories, Radio Tubes and Electronic Devices

GOOD WARES DESERVE GOOD CARE. Sylvania Radio Tubes, Sylvania Incandescent Lamps and Sylvania Fluorescent Lamps and Equipment are all made to serve you well. But the first need of wartime is to save and conserve, both to free men and material for necessary wartime purposes and because of inescapable shortages. So take good care of your Sylvania products, not because they need coddling, but because they are good tubes and lamps, and deserve good handling. And also because you may find it less easy to lay hands on these top-quality products when replacement finally does become necessary.

by light beams, which then may penetrate fogs. The transmitters for light beams are fairly well developed.

Mr. d'Humy declared that Telefax is far more versatile than the teleprinter; its service can be produced at low cost and does not lend itself to errors. He added that telegraph facsimile is almost as immune to electrical interference as the telephone.

"It is economically within reach to link business firms and industry throughout the country with a Telefax system by which one patron may dial with any other patron and directly send a facsimile telegram in less than four minutes' time for the entire operation.

"When this Telefax system has attained substantial volume," he continued, "the rates charged should be substantially lower than present methods permit."

It is not difficult to imagine Telefax sending machines in hotel lobbies, railroad stations, drug stores, office building lobbies, etc., where the public may drop penciled or typewritten telegrams in a slot with a coin in another slot and off the message would go to its destination, Mr. d'Humy noted.

Telefax in homes

"It is also not difficult to imagine," he continued, "a better use of our telegraph lanes during the all night hours. Under normal conditions the plant is virtually asleep during the night." By furnishing an overnight service to business houses where the more important correspondence will be Telefaxed during the night, Mr. d'Humy stated, the messages would be received by the business firms in their own offices and would be ready for distribution when the door of the business is opened in the morning.

"We can again mildly exercise our imagination by visualizing how a single nation-wide telegraph service would be made much easier through the fullest cooperation between the telephone and telegraph industries," the Western Union official stated. "Under the circumstances of an all-inclusive telegraph service it would not be difficult to evolve working arrangements which would benefit both services." Chairman Fly pointed out that telegraph facsimile is more reliable than printers in the case of tabulations and Mr. d'Humy agreed it was infinitely more reliable and easier to

PRESS WIRELESS Inc. AND *Post-War* PLANS

Awarded to our Hicksville, L. I. plant for outstanding achievement in war production.

★ COMMUNICATIONS
★ RESEARCH
★ DEVELOPMENT ENGINEERING
★ MANUFACTURING

In the formulation of plans for the post-war world, extensive use already is being made of Press Wireless and its international network of radio communications.

Execution of these plans will require still further employment of Press Wireless facilities.

We are gratified to have this opportunity to serve. For over twenty years we have been planning, installing, and operating large-scale radio communications systems and manufacturing the equipment their functioning requires.

Today the manufacturing, design, and engineering resources of Press Wireless are devoted entirely to supplying our armed forces with vital radio units. The work we are doing now, added to our more than two decades of communications and manufacturing experience will, we believe, further fit Press Wireless for public service when the war ends.

PRESS WIRELESS Inc.

Executive Offices
435 N. MICHIGAN AVE., CHICAGO

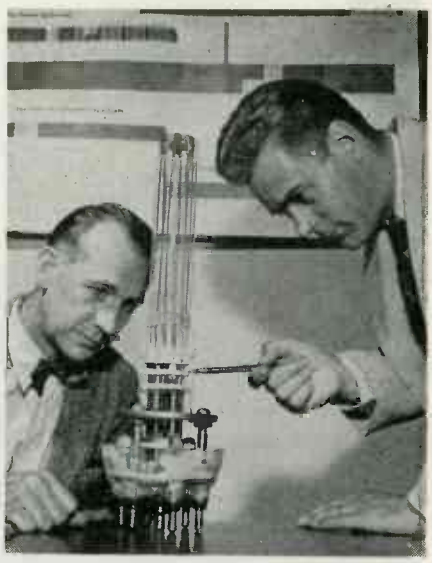
Sales Offices, Manufacturing Division
1475 BROADWAY, NEW YORK CITY, 18

DIVERS TY RECEIVERS ● AIRCRAFT AND AIRFIELD RADIO EQUIPMENT ● MODUPLEX UNITS ● FACSIMILE MACHINES
HIGH POWER TRANSMITTERS ● RADIO PRINTER SYSTEMS ● CHANNELING DEVICES ● RADIO PHOTO TERMINALS

read. He said there were tremendous possibilities which had been demonstrated by his company's cablephoto service with London with business concerns wanting to send facsimilies of contracts and the British Purchasing Commission desiring to have drawings of claims and other war products sent by this method.

"It is within present day possibilities," he continued, "to provide the smaller telegraph clients with inexpensive receiving Telefax machines so designed that a Western Union main office may deliver its telegram to the Telefax machine via the regular subscriber's telephone connection. The telephone company would receive compensation for such deliveries."

Senior Engineers



Heading up the new Westinghouse organization dealing with electronic applications to industry, two senior engineers have been appointed: Gordon F. Jones, left, consultant on conversion problems, and Carl J. Madsen, right, consultant on applications, processes and speed control

Phase Modulation by Easily Saturated Coil

The voltage wave obtained across a magnetic coil when current (many times the saturation current) passes through it, takes the form of a train of very short and very sharp impulses, alternately positive and negative, occurring at zero current amplitudes. This effect may be used to phase-modulate a carrier voltage as described by Leishman R. Wrathall in his U. S. Patent No. 2,320,963.

"If the current impressed on magnetic coil 13 consists of a sinu-

PHOTO BY U. S. ARMY SIGNAL CORPS

PRACTICE MAKES PERFECT

How many sacks of flour does an attack Bomber drop on friendly tanks? How often does a Tank Commander draw a bead on a friendly plane? How long must Air and Armored Forces flex their muscles together in practice before they become welded in a coordinated striking force?

Know-how takes time to acquire. We are thankful that National had years of radio communications know-how all ready.

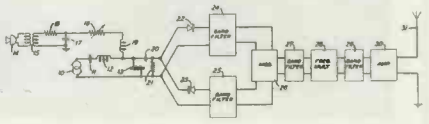
NATIONAL COMPANY, INC., MALDEN, MASS.

soidal frequency saturating current upon which is superimposed a relatively weak low frequency signaling current, the instants of zero value of the resulting complex current will be displaced in time from the zeroes of the high frequency component taken by itself and the timing of the impulses will be correspondingly altered.

"The two trains of impulses, positive and negative, are modulated in opposite senses with respect to the times of their occurrence. It may be shown that each train is equivalent to a multiplicity of harmonically related carrier waves, all modulated in phase by the superimposed low frequency current in degrees proportional to their respective frequencies. The fundamental frequency of the train is the same as that of the carrier current from source 10 and the amplitude, θ, of its phase modulation has substantially the value

$$\theta = \sin^{-1} S/C$$

where S and C denote the amplitudes of the signal and carrier waves, respectively. The rectifiers 22 and 23 provide for the separation of the two trains of modulated impulses. The harmonic components



selected by filters 24 and 25 will therefore be phase modulated in opposite senses and the frequency deviations corresponding to the phase modulations will likewise take place simultaneously in opposite senses. Since the selected waves are modulated in opposite senses the modulation of the difference frequency component will exhibit an increased modulation equal to the sum of the modulations of the two waves. The net result is the production of a wave in which the phase and frequency modulation is greatly multiplied without a corresponding increase in its mean frequency. If the mth and nth harmonics be selected by the filters, it may be shown that the mean frequency of the wave selected by bandpass filter 27 has the value

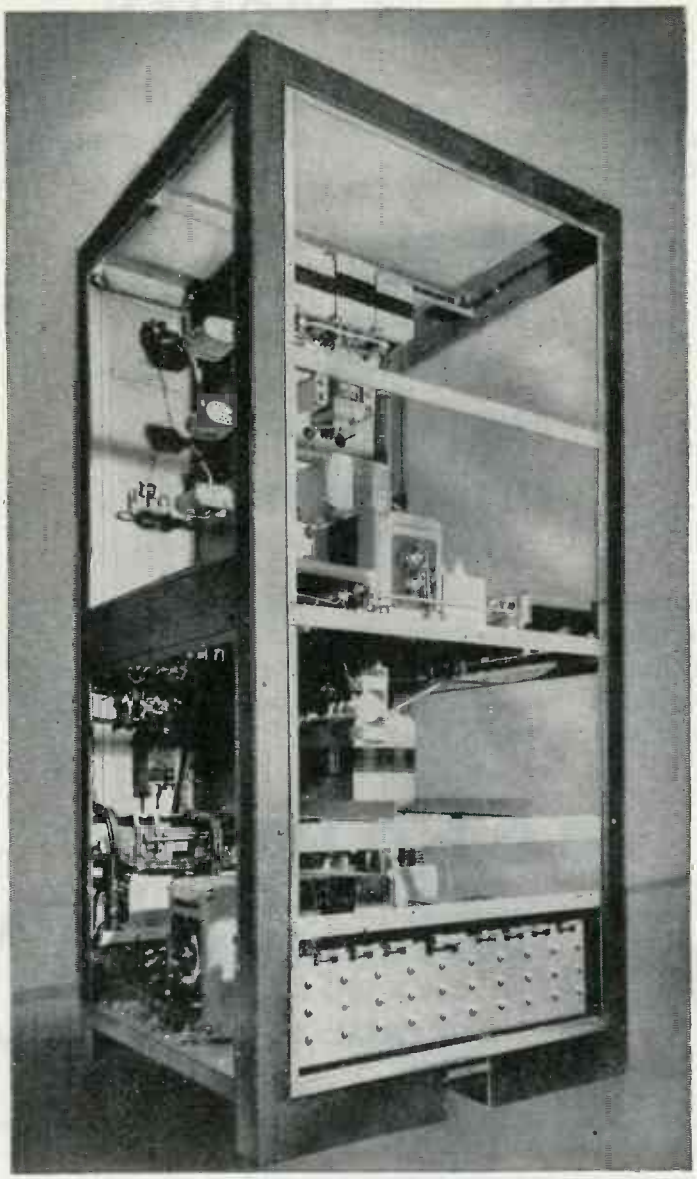
$$(m-n) f_c$$

and its phase deviation has the amplitude

$$(m+n)\theta$$

where f_c denotes the frequency of the original carrier current and θ is the phase modulation of the fundamental component of the impulse trains."

A UNIQUE ENGINEERING GROUP IS READY TO ROLL UP ITS SLEEVES FOR YOU!



FOR wartime production or postwar planning... in the application of existing devices or the development of new designs... we are ready to help you harness the miracle of electronics to your specific needs. We have the background: 65 years of constant cooperation with the communications industry in all its phases. We have the facilities: military and government agencies may tell you some of the story. And we are neither too big to bother with small problems . . . nor too small to succeed with big ones. Can we get together?

JB SINCE 1878

J. H. BUNNELL & Co.

GENERAL OFFICES: 215 Fulton St., New York City · FACTORIES at Brooklyn, N. Y.

Designing Engineers and Manufacturers of:

ELECTRONIC INDUSTRIAL DEVICES ★ INDUSTRIAL RECTIFIERS
HIGH POWER RADIO FREQUENCY GENERATORS ★ TRANSMITTERS
RECEIVERS ★ AUTOMATIC TELEGRAPH EQUIPMENT

MILESTONES TOWARD THE ELECTRONIC ERA

"Talking for the First Time from Ship to Shore"

Within six months after Dr. Lee deForest had invented the first three-element vacuum tube, during the winter of 1906-7, he turned his attention to the development of wireless telephony, practically abandoning wireless telegraphy. His method of transmission was through the medium of an arc immersed in an alcohol flame. After a series of preliminary tests in his attic laboratory atop the Parker Building then located at the corner of Fourth Avenue and Nineteenth Street, New York City, two complete sending and receiving sets were made and shipped to Sandusky, Ohio, on the shores of Lake Erie.

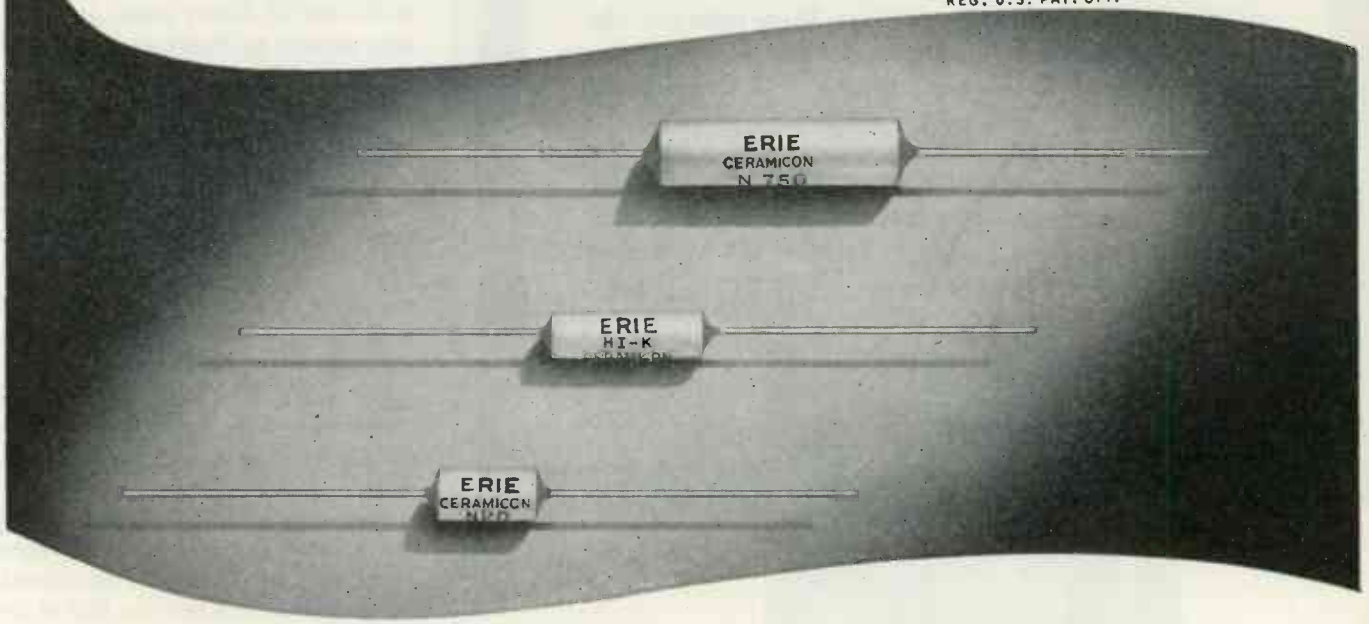
Dr. Lee deForest today

The Thelma

Commodore W. R. Huntington of Elyria, Ohio, was president of The Sandusky Yacht Club and also the owner of a beautiful yacht, "Thelma," so named after his only daughter. This club was sponsoring the Interstate Lake Regatta races scheduled to be held at Put-in-Bay nearby, during the week of July 15th to 20th, 1907. The plan evolved by Dr. deForest and Commodore Huntington was to equip the

Erie INSULATED Ceramicons

REG. U.S. PAT. OFF.



Have 5 Inherent Advantages

1. **COMPLETELY ENCLOSED**
2. **GREATER MECHANICAL STRENGTH**
3. **MORE DIRECT AND UNIFORM ELECTRICAL PATH**
4. **CAN BE LOCATED ANYWHERE IN CHASSIS**
5. **BETTER PROTECTION AGAINST HUMIDITY**

★ INVEST TODAY IN ★
BONDS FOR VICTORY

WHAT do the five advantages of Insulated Ceramicons listed here mean to you? From the standpoint of design, they mean a more compact, efficient lay-out. Insulated Ceramicons can be located *anywhere* in the chassis without regard to the proximity of other components. They make possible shorter leads which are *musts* in higher frequency circuits. They mean greater protection against humidity . . . so important in today's military equipment. They provide extra insurance against breakage in handling on the assembly lines or damage from shock and vibration in actual service. The method of attaching wire leads to the silver electrodes provides a more uniform and direct electrical path.

Erie Insulated Ceramicons, for temperature compensating applications, are made in three sizes and in capacities up to 375 mmf. Erie "Hi-K" Insulated Ceramicons, for by-pass and blocking condensers, are available up to 5,000 mmf.

Where your specifications call for capacities within the above ranges, specify Erie Insulated Ceramicons.

For complete information covering operating characteristics of Erie Insulated Ceramicons, write for data sheet.

ERIE RESISTOR CORP., ERIE, PA. LONDON, ENGLAND · TORONTO, CANADA.

"Thelma" with this wireless telephone equipment and attempt to "talk via wireless" to a station ashore, reporting the progress of each race, and thus establish a two-way communication. A temporary, duplicate installation was established at Ladd's Dock, at Put-in-Bay, manned by Frank E. Butler (Ex-associate Editor of Electronic Industries.)

72 foot cruiser

The "Thelma" was a trim little cruiser yacht with an overall length of 72 feet, with ten-foot eight-inch beam and five-foot draught. She carried two 20-horse power Lacy engines and was schooner-rigged, with a wooden hull. The aerial wires led through the roof of the wheel house to a small cross-arm on top of the foremast and thence parallel to a small arm on the main mast.

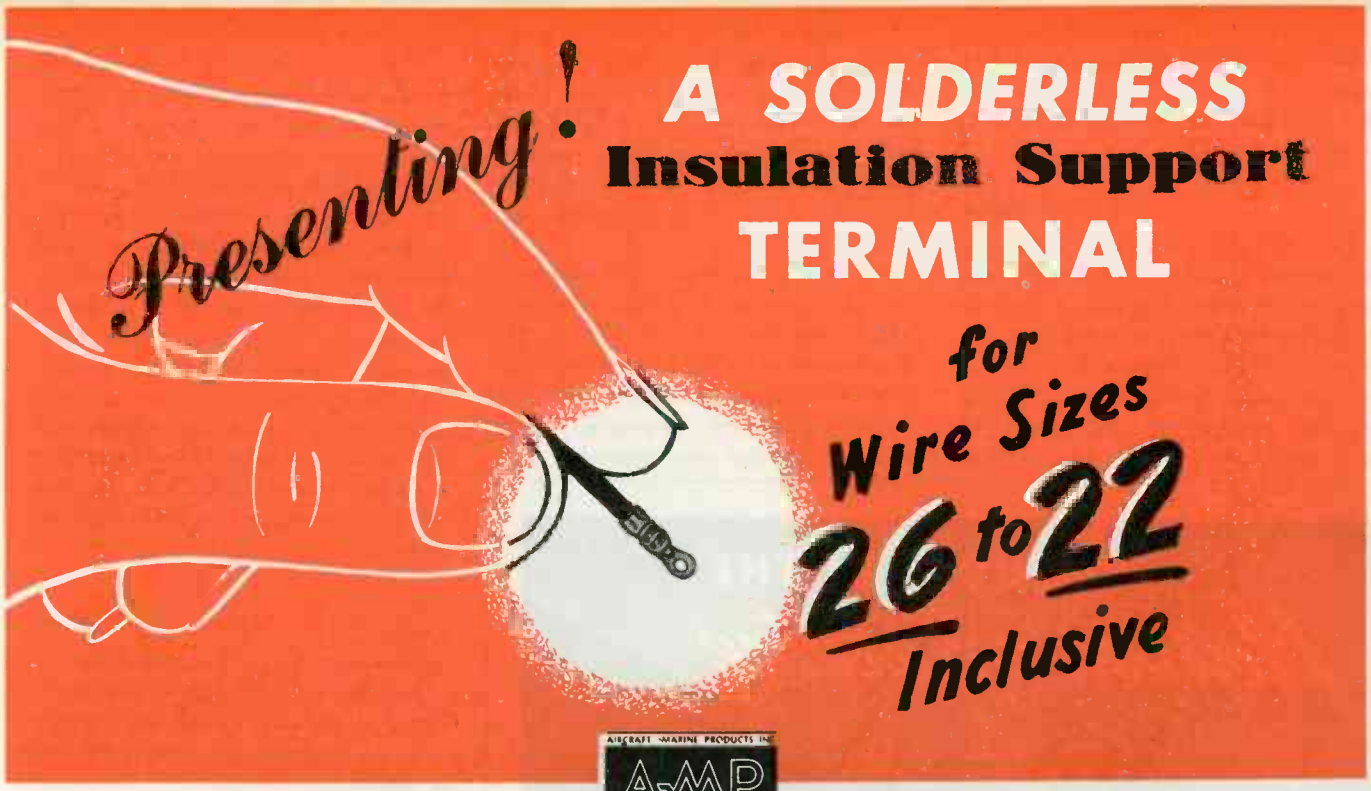
Ground connection was first made to the propeller shafts of the yacht's twin screws, but this was found insufficient. In view of the fact that the hull of the "Thelma" was entirely of wood, deForest and Butler were at a loss to know how to obtain a good and satisfactory "ground" without which the wireless apparatus would not function.

A ground is made

Without further ado the pair went uptown to a hardware store and bought two large sheets of copper and a supply of large-head nails which they brought back to the yacht and hid, awaiting the opportunity of nailing these sheets to the hull at such time when none of the crew or the owner of the yacht were present, since it seemed certain permission to do this on the mahogany hull would not be granted, if asked. A bright moon... and midnight... after all had gone home, provided the time for the two wireless men to go overboard and nail the plates to the hull below the water line. A slight wind caused a choppy beach wash, making the holding of the large metal sheets almost impossible to keep in place for nailing, but by daylight the job was finished.

Must succeed

DeForest and Butler were the Commodore's guests, not only aboard his yacht, but at his hotel—The Beebe House at Put-in-Bay, which he also owned. His hospitality was overflowing and nothing was too good for his



"PRECISION ENGINEERING AMP APPLIED TO THE END OF A WIRE"

Now you can eliminate the inherent difficulties encountered in soldered small wired connections by using the newest addition to the line of *Solderless* AMP "Diamond Grip" Insulation Support Terminals, designed specifically for electronics use on wire sizes 26 to 22 inclusive.

CHECK THESE ADVANTAGES AGAINST YOUR PRESENT METHODS

1. Eliminates skilled labor by providing self-gauging hand, foot and power installation tools which assure uniform application.
2. Terminal is crimped to both the conductor and the insulation in one single operation — three perfect crimps at one time.
3. Minimum voltage drop through terminal — the result of one-piece construction of current carrying member.
4. Tensile strength of Diamond Grip crimped joint greater than strength of wire itself.
5. Eliminates solder joint failures and speeds up production.
6. Insulation support protects against danger of grounds or shorts.
7. Visual inspection of every connection — wire extends through terminal barrel.
8. Assured uniformity of performance through uniformity of installation.

Take advantage of this new solderless terminal — engineered in every detail by AMP — for use on wire sizes 26 to 22. Write, phone or wire for prices and complete details.

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OTHER AMP PRODUCTS FOR ELECTRONICS

DIAMOND GRIP INSULATION SUPPORT TERMINALS
A complete line of Diamond Grip Insulation Support Terminals for wires sizes down to #14 (Comm.) in various tongue shapes and stud hole sizes.

Also available are AMP Spade Terminals, Flag-Type Terminals, Hook-Type Terminals, Lighting Contacts, and others for specific electronic usage.

"QUICK DISCONNECT" BONDING JUMPERS
For aircraft radio transmission and receiving equipment. Vibration-proof, yet easy, positive disconnection. Also for use on precipitron equipment.

guests. He and his daughter took just pride in their beautiful yacht for it was a winner of trophies, but the success of this wireless test was paramount to all else.

A sportsman

The following morning when the Commodore appeared and beheld the ugly row of large nails driven into the hull of his boat, his jaws dropped in surprise as he also dropped to the deck the bundle he was carrying. He was stunned momentarily, but being the true sportsman that he was, instead of kicking deForest and Butler bodily from his yacht, he quickly gathered his composure and complimented them for their ingenuity and determination not to be stumped by any obstacle, merely remarking: "Holes can be calked up again. Paint and varnish are cheap."

Put-in-Bay is a landlocked harbor of only a few miles in diameter, with a narrow entrance, the shoreline of the bay forming a letter C. The yacht races were held outside the bay at some distance in Lake Erie. The racing course was a triangular one, measured to a seven mile stretch to each leg of the triangle. At each of the turning points of this triangle was stationed a "judge's boat" where the time of passing of each racing yacht was noted and officially timed. It was planned that Dr. deForest, aboard the "Thelma" with the wireless telephone apparatus installed would follow a wide circle, well outside the racing route and report to Butler by spoken word when each boat rounded a stake. Among those present for this occasion were several newspaper reporters including Frank Skeldon then representing "The Toledo Bee" (now the Toledo Blade"—Mr. Skeldon being still employed on their editorial staff).

Recording

The exact words as recorded and received by Butler, as spoken and transmitted by deForest during the morning races of Friday, July 18th, 1907, are as follows:

"9:57½ . . . I will tell you when the first boat crosses the line."

"First boat about crossing the line at 9:59.

"Spray crossed the line about 25 seconds after 9:59."

(Note: A checkup later with the Judge's log showed the exact time as being 9:59, 5."

The voice was then interspersed with a few strains of music on the gramophone from two records brought from the laboratory. Every few moments it was necessary for deForest to tap the casing of the old Blake transmitter to dislodge the carbon granules which quickly fused owing to the heat in the tertiary circuit of the voice circuit.

"Second boat just crossed at 10:01½."

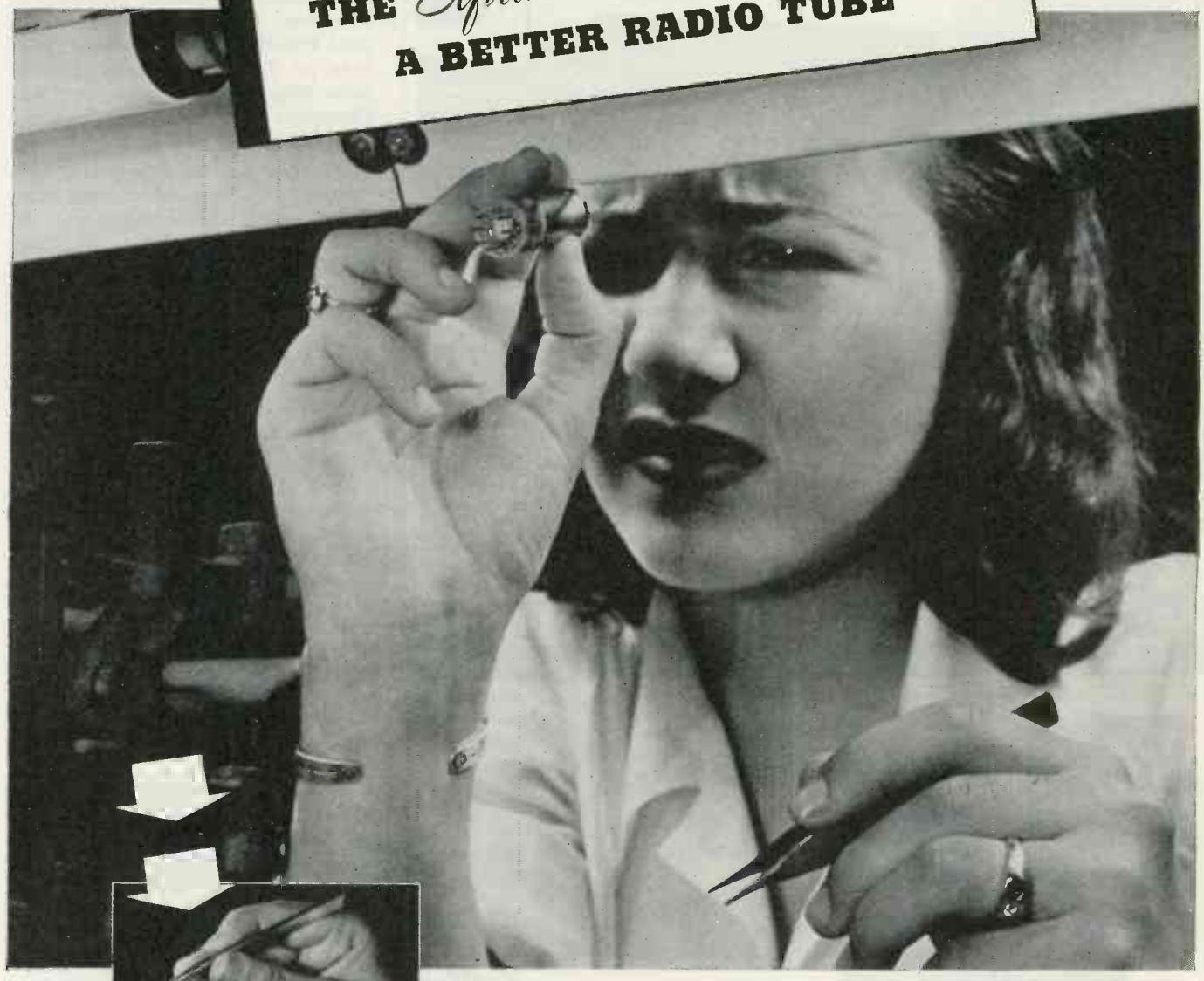
"First in the cat-boat race crossed at 10:02."

"Cleveland finished second at 10:03½."

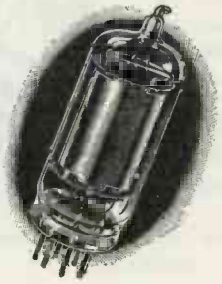
"Borealis . . . 10:04½."

"Here comes the Oseketa . . . you spell it . . . I can't."

THE *Squint* THAT PRODUCED A BETTER RADIO TUBE



You'd squint too if you tried to worry a hair-like wire through an almost microscopic hole and direct it down through a ladder of cross wires and bring it through the corresponding hole at the bottom. But that was common practice in the entire tube industry in making this tube for "walkie-talkies." The nerve strain was terrific. Girls cracked up under it. Labor turnover on this bottle-neck operation actually jeopardized the production of this vital tube. TUNG-SOL factory men solved the problem with the "lilly-jig" which directs the tiny filament into the top hole from where it is vibrated into place. Production immediately stepped up. Rejects went down. Critical materials were saved. Now every filament is positioned automatically. The result of this tired girl's squint is . . . . better TUNG-SOL Radio Tubes.



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vibration-tested
RADIO TUBES

TUNG-SOL LAMP WORKS INC., NEWARK, N. J., *Sales Offices:* ATLANTA, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK
ALSO MANUFACTURERS OF MINIATURE INCANDESCENT LAMPS, ALL-GLASS SEALED BEAM HEADLIGHT LAMPS AND CURRENT INTERMITTERS

NEW BOOKS

Basic Electricity for Communications

By William H. Timbie, Professor of Electrical Engineering and Industrial Practice, Massachusetts Institute of Technology, published by John Wiley & Sons, New York, and Chapman and Hall, Ltd., London, 1943, 603 pages, $3.50.

Basic laws of electricity and electronics are presented in elementary form. Forty-three pages are devoted to explain and illustrate Ohm's law—so essential to electrical circuits—problems and examples included. Other chapters deal with conductors, measurement of resistance, Kirchhoff's laws, magnets, alternating currents, vacuum tubes and gaseous conduction, and electrical communication systems.

No previous knowledge is assumed, and mathematical expressions are avoided. The text is obviously intended as an introductory textbook or for somebody who wants to get an idea "what electricity is all about," as is frequently the case with people whose job is connected in one way or another with electrical or electronic devices.

Electromagnetic Waves

By S. A. Schelkunoff, Bell Telephone Laboratories, Inc., published by D. Van Nostrand Co., Inc., New York City, 1943, 530 pages, $7.50.

Written by an authority on the subject, the text may be considered a standard presentation of the applied theory of electromagnetic waves, including recent developments. It is an outgrowth of research and consulting activities in Bell Telephone Laboratories and a course given at Brown University, and, consequently, the aspects of the teacher as well as the problems of the research engineer have been given thorough consideration. The book is, therefore, equally well suited as a reference and textbook; there is enough material for an intensive six-hour course.

An introduction covering some of the mathematics used in the text is given—a clear and precise treatment of electrical circuits, transmission lines, wave guides, resonators, and antennas.

The book will be of importance to anybody interested in the theoretical background of modern electronics or working on mathe-

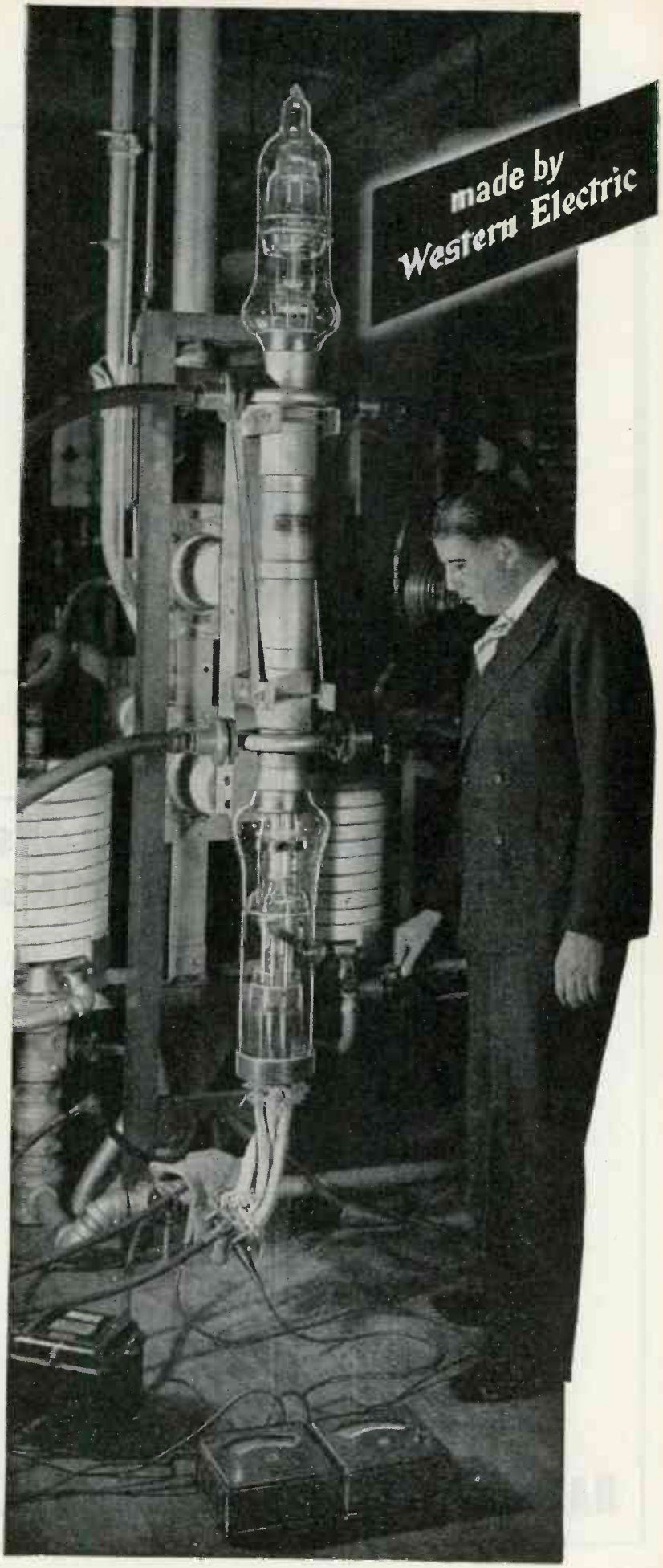
SIX YEARS OLD

—but still the whopper of them all!

HERE you see the first commercial 250 KW power amplifier tube being put through its paces in 1937. It was the world's biggest sealed off vacuum tube then—and it still is today.

While its giant proportions and power are striking, the really significant thing is not the tube itself—but *what's back of it!* And that is the unique "know how" of Bell Telephone Laboratories and Western Electric, which made possible this tube—and which has brought forth so many other developments that have speeded the growth of electronics.

Today Bell Labs and Western Electric are adding steadily to their specialized knowledge—are applying all they know to devices to help win this war. In the years of peace to come this pair of pioneers will continue their leadership.



matical formulation and solution of electronic problems either for engineering purposes, as a basis for further research, or as a teacher.

Dictionary of Science and Technology in English-French-German-Spanish

By Maxim Newmark, Ph.D., Department of Modern Languages, Brooklyn Technical High School, published by the Philosophical Library, New York, 1943, 386 pages, $6.00.

The dictionary contains a list of some 10,000 English terms currently used in the polytechnical and scientific fields, and is so arranged as to permit two-way use of any language with the English. It is the outgrowth of some ten years of experience in teaching the reading and translation of scientific and technical material in foreign languages and of professional translations.

"In the field of radio, both radio monitors and short-wave broadcasters will find this dictionary useful for its complete coverage of the terms of modern warfare on land, sea, and in the air."

Industrial Radiology

By Ancel St. John and H. R. Isenburger, published by John Wiley and Sons, Inc., second edition, 1943, 298 pages, $4.00.

Since the original edition, in 1934, the industrial use of X-ray equipments has increased five-fold. This thoroughly revised edition presents a fairly complete up-to-date picture of gamma and X-ray radiology. While understandable, for the most part, to the layman, the book takes up in some detail the actual procedures involved and should serve as an invaluable handbook for practical X-ray inspection of materials and workmanship in industry.

The first third of the text presents the history and theory of X-radiation and discusses the various types of equipment and circuits used. Chapters on the various operating details of the various techniques follow. The book contains 151 photographs, sketches, diagrams, and radiographs.

In appendices, more than twenty working tables and charts useful to the practical X-ray worker are presented. An extensive bibliography corresponds to foot-notes throughout the text.

Collectors' Items Now!
thanks to Modern Hearing Aids...

Using...IRC Resistor Elements

ANOTHER IRC DEVELOPMENT

For millions with impaired hearing a new avenue of hope was opened when scientists applied to this field the amplification of sound by means of the vacuum tube. From that point on, manufacturers directed their efforts toward instruments combining increased effectiveness with reduction in both size and weight.... Because volume and tone control plays an extremely important role in these small amplifying sets, it is only natural that I R C should have been consulted in the design of this sensitive part. The tiny Volume Control units used by many manufacturers not only employ special Resistance Elements as developed by I R C but also utilize the multi-finger contact and spiral clock-spring connector ideas originated and perfected by I R C. Marvels of compactness and efficiency, these midget controls constitute still another tribute to the ingenuity of I R C's engineering staff.... Perhaps you, too, are faced with a problem requiring expert resistance counsel. If so, we welcome your inquiry and will be glad to apply our research facilities toward its solution.

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NEW BULLETINS

Charts for Wall Hanging

The Ohmite Mfg. Co., 4835 Flournoy St., Chicago, has produced Ohm's Law and Parallel Resistor charts in 26 x 36 in. wall size, ready for hanging. The Ohm's Law chart is used for graphical determination of wattage, voltage, current and resistance. The Parallel Resistor chart is used for graphical determination of the resistance of resistors in parallel. Explanatory examples are given on the face of each chart. Available to schools, training centers, engineers, procurement officers and plant executives without charge.

Plug Bulletin

Under the title Universal U. S. Army and Navy Specification Plugs and Jacks, Universal Microphone Co., Inglewood, Calif., has issued a 9 x 11 loose-leaf four-page edition of its catalog No. 830. Besides plugs and jacks, the illustrated catalog includes descriptions of prongs, cord clamps, jack inserts and shells for both jacks and plugs. Universal shortly will publish a new issue of its general microphone catalog.

Electronic Applications

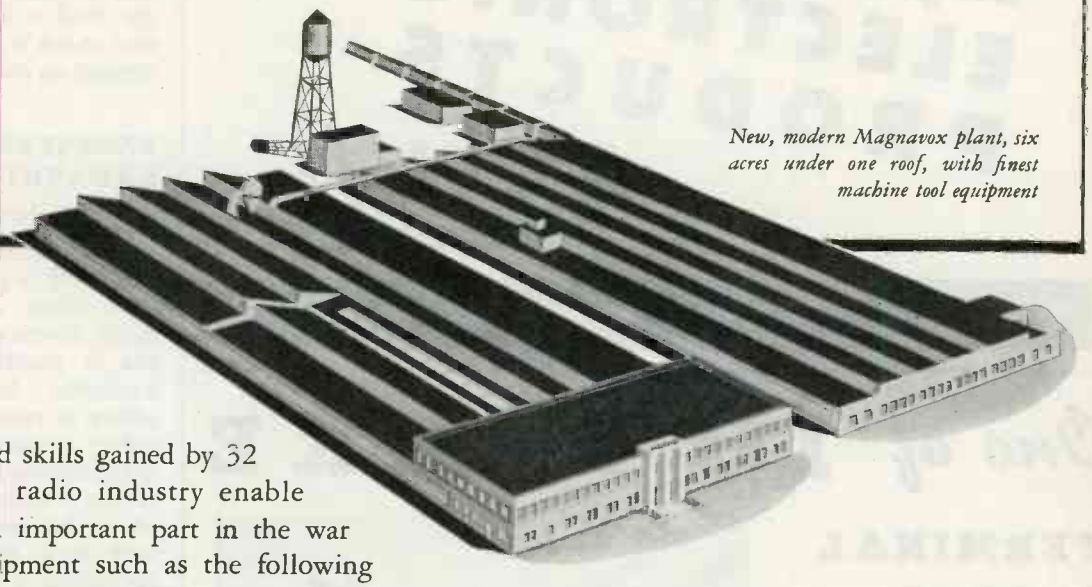
Electronic applications in industry, in the war, in medicine and in the home are illustrated and described in a new 44-page booklet published by Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Typical applications cover resistance welding control for sewing plane parts together at 1,800 stitches per minute; cathode ray oscillograph for electrical circuit and lightning phenomena analysis at speeds of 1/100 of a millionth of a second; high-frequency induction heating units for plastic molding; tin reflowing and surface hardening; ignitron rectifiers for converting alternating to direct current in aluminum and magnesium production; industrial X-ray units for "inside" inspection of vital metal parts; precipitron for removing air-borne dust particles as small as 1/250,000 of an inch.

Various types of electronic tubes, key units of every electronic device, for such applications as industrial control, diathermy, power conversion, X-ray and radio are illustrated and the primary use of each identified.

MAGNAVOX TRAINED

32 YEARS FOR THIS WAR



New, modern Magnavox plant, six acres under one roof, with finest machine tool equipment

THE EXPERIENCE and skills gained by 32 years' service to the radio industry enable Magnavox to take an important part in the war effort, producing equipment such as the following for all branches of the Armed Forces:

Communication Receivers for the Army and Navy. Radio Direction Finders. Radio Control Receivers. Interphone Systems . . . for Aircraft . . . for Tanks. Warship Announcing & Music Distribution Equipment. Carbon Microphones. Electric Gunfiring Solenoids. Bomb Arming Solenoids. Powered Antenna Reels. Dynamic Microphones. Dynamic Head Sets. Loud Speakers for various Military Applications. Electrolytic Condensers for Military Applications. Radio Phonographs for Military Applications. Sound Slide Film Military Training Equipment.

This wide variety of military products reflects, besides experience and diversified skills, the splendid facilities of Magnavox . . . the new, modern six acre plant, the excellent machine tool equipment and the production economies of efficient management. The Magnavox Company, Fort Wayne, Indiana.

Magnavox skill and craftsmanship won the Navy "E" in 1941, among the first awarded . . . now with 3 White Star Renewal Citations.

Magnavox

LOUD SPEAKERS • CAPACITORS • SOLENOIDS COMMUNICATION & ELECTRONIC EQUIPMENT

MODERN CONTROL TOWER DESIGN

(*Continued from page* 81)

that were required for dispatching purposes, under the guidance of Louis E. Salvante who has had much experience, first as an amateur, then as a marine operator, later on the engineering staff of WORL and still later with WLAW.

In its present state of development the responsibility of the tower and its staff of operators is considerable. In addition to dispatching ships of its own, and assisting another large manufacturer of war aircraft, and handling traffic on an adjacent field, much routine testing of ship radio is called for. All ship radio is tested before flight and no ship is permitted to leave the field without a complete two-way check so pilots may be able to depend on constant communication.

ENGINEERS CAN HELP EXPANDING NERS PLAN

(*Continued from page* 84)

and that where main dependence for power is placed on local electric light lines, supplementary equipment operating from batteries or gas or gasoline-operated units be available. In any case final input power is restricted to 25 watts. In order to minimize interference, it is recommended that use of circuits of the transceiver type be restricted as far as possible to low-powered pack units with dry battery operation. It is expected that super-regenerative receivers will be used almost exclusively because of advantages resulting from their simplicity and minimum tube requirements. It is suggested that some effort be made to standardize socket and plug connections between the various pieces of equipment so that interchange of units can be made as rapidly as possible in case of emergency.

It is in these respects, having to do with the practical design and construction of fixed and mobile equipment, station arrangement, the design and erection of suitable antennas, etc., that the service of engineering talent is most desirable and will be most valuable. That those who have built the organization to its present high plane of efficiency have done a good job admits of no question. But as the complexity of the system increases with its undoubted growth, so will the need for engineering advice and help.

Now – to users of battery charging equipment – we present a complete line of Federal battery chargers, of wide voltage and practically unlimited current range, covering every need and purpose.

And – to the manufacturer requiring battery chargers of special design – we offer our complete Federal design and manufacture service, geared to handle your requirements promptly.

All Federal battery charging equipment is powered by long-life, trouble-free I. T. & T. Selenium Rectifiers – accepted as standard by the electrical industry.

For powering production lines and for use in military devices, Federal also manufactures a complete series of general purpose power supply equipment. Consulting Engineering service available. For descriptive bulletins write *Department F.*

SELENIUM RECTIFIER DIVISION

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

1000 Passaic Ave.
East Newark, New Jersey

Authorizations for Civilian Defense stations are issued only to municipal governments, such as cities, towns, counties, townships, boroughs, etc. Organizations such as police departments and civilian defense groups are not eligible. Applications must be filed by the chief executive of the municipality such as the mayor, city manager, chairman of the board of county commissioners. From this it is apparent that WERS is not something into which just any one can jump, no matter how public-spirited he may be. It is a seriously organized service with a serious executive and operating personnel dedicated to devoting time and a whole lot of effort to a worthwhile work that is very much part of the war emergency.

ELECTRONIC AIDS IN THE BIOLOGICAL SCIENCES

(*Continued from page* 89)

low power high frequency source of energy. The cutting electrode, either a needle or rod of other shapes, is connected to the other terminal. The shape and area of this electrode is selected for the job to be done, and the current density is adjusted for cutting currents to give the required amount of coagulation — the latter taking a larger current density than simple flesh cutting.

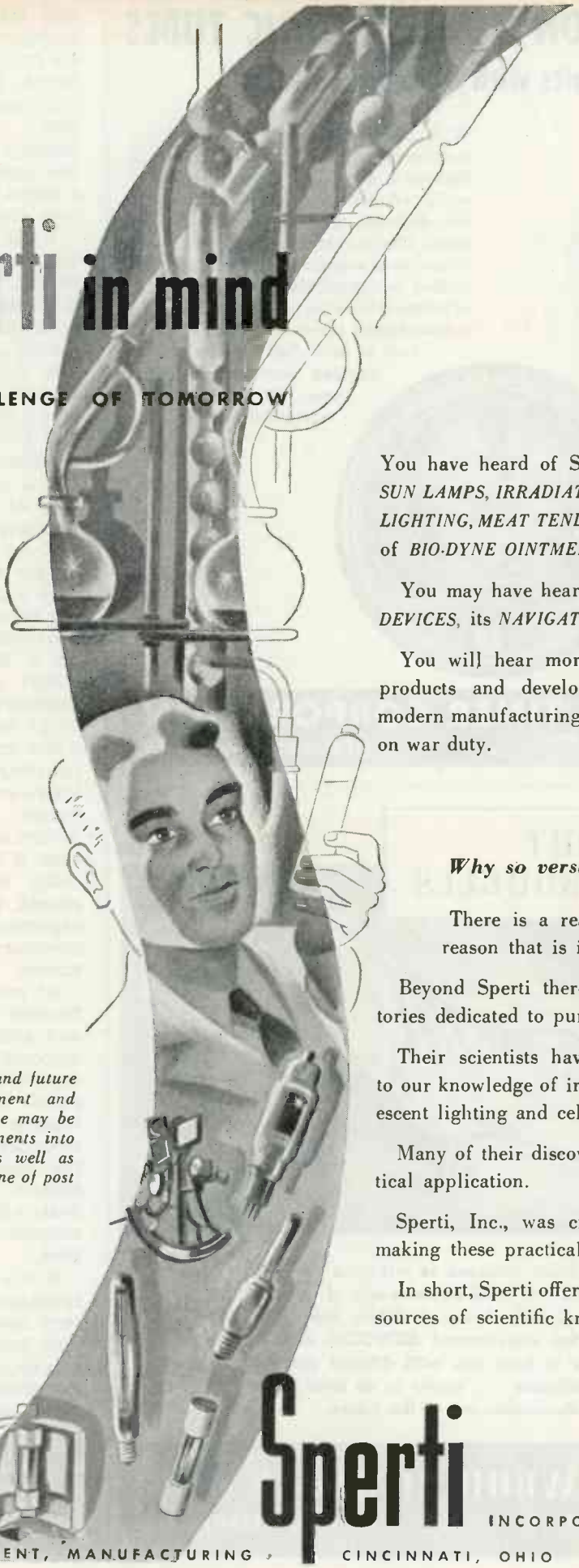
The frequency used in these applications is lower than that in short wave diathermy. It should be high enough to eliminate the muscular contraction caused by the electrical current flowing into sensitive tissues, and low enough so that excessive current does not leak off into the surgeon's hand through capacitive effects. A frequency of the order of one megacycle is often used. Many of the less expensive outfits use a quenched gap oscillator giving a damped wave, but tube oscillators with rectified power source are preferable. Electrotherapy equipment (except those for hospitals and clinics) generally have terminals to which surgical electrodes can be connected.

Radiography

The X-ray tube, one of the earliest electronic devices that received industrial acceptance, was actually a by-product of research on cathode rays. X-rays are a form of light rays produced in highly evacuated tubes by the impact of high speed electrons on heavy metal targets. Since they are light rays,

Keep Sperti in mind

TO MEET THE CHALLENGE OF TOMORROW



You have heard of Sperti as a manufacturer of *SUN LAMPS, IRRADIATION LAMPS, FLUORESCENT LIGHTING, MEAT TENDERIZERS* and more recently of *BIO-DYNE OINTMENT.*

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they travel at the speed of light, obeying all the laws of light, but are invisible. Having a short wavelength, 0.05 to 500 Angstrom units, inter-molecular spaces are relatively open and the rays pass through with ease. This prevents the application of what would be a useful idea, that of refocusing the rays after they leave the tube!

While traversing matter, a certain amount of the radiation is reflected, absorbed, refracted and diffracted, depending on the characteristics of that matter. Reflected X-rays, however, have a new wavelength longer than the original. This principle produces useful features in some applications and troublesome effects in others. A diffraction pattern of rays striking a metallic sample has been used to determine the atomic arrangement in that metal.

X-ray equipment was first used by the medical profession to produce a projected shadow image of the bones and denser parts of the body, the rays being made visible by a fluorescent screen (fluoroscopy) or by a photographic film (radiography). Tubes operating at 10 kv to 100 kv with a current of a few milliamps produce a ray satisfactory for fluoroscopic work, where greater exposure time is necessary for visual observation. X-rays are destructive to body tissues if prolonged exposure, especially in the higher frequency ranges, is maintained, and earlier experimenters suffered because the necessary precautions were not known.

In radiographic work a sharply focused beam, at high potentials and greater current densities (0.5 amperes) permit extremely short exposure and clear, distinct pictures. The limit depends upon the fogging brought by reflections of secondary X-rays generated within the body, also striking the film. Modern radiographic equipment deals with the elimination of these secondary rays in every way possible.

X-ray equipment is an old story fundamentally and represents a very specialized field. An important improvement is the control of film exposure time by an electronic exposure meter. The exposure is a factor that depends upon an exponential relation that contains the fourth power of the atomic number of the material in the path of the ray.

In view of the desirability of minimizing the time that any tis-

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sue is exposed these electronic timers are quite important. In one method a part of the beam impinges on a fluorescent plate that is in line with a photocell.

Thyratron control

The current through the latter accumulates to build up the charge on the grid of a thyratron until it breaks down and turns off the power. The feature of this method is that it can be arranged to open the circuit only when the current passes through zero during a cycle. Design factors are such that the charging time bears a direct relation to the necessary exposure time.

High voltage tube rectifiers provide a simplicity and safety of the high voltage equipment that cannot be obtained with other dc supply systems of other types. It is necessary to provide automatic control of the filament voltages, since small changes here cause large variations in the anode current.

The destructive character of X-ray radiation on body tissues becomes the important feature of X-ray therapy or radiology. The features of the equipment developed for this field are the same as for radiography: accuracy in controlling the ray's focus, presetting its timing and safety to personal welfare.

Electron microscope

The microscope has for centuries been one of the most useful tools of biological and medical research, for the study of bacteria, blood cells, nerves, and all types of tissues and fibers. The limit to which an object can be enlarged with an ordinary microscope using white light depends upon the wavelength of the waves of the light itself. The problem is the same as trying to paint a picture the size of a postage stamp with a one-inch brush! The electron microscope gets around this problem by using a beam of electrons. This microscope is somewhat the same as a cathode ray tube.

In order to make use of the cathode ray principle it is necessary that the object be placed in the vacuum, since it must be traversed by the electrons in the ray which can be formed and focused properly only in the highest possible vacuum. While cathode rays are invisible, nevertheless, they will blacken a photographic film, and their presence can be made ap-

parent with a fluorescent screen. In its present state of perfection, an electron microscope will disclose objects 1/100 as large as can be seen with the best light microscope, permitting many things to be viewed that were beyond the realm of investigation before. The electron microscope is as greatly superior to the best light microscope as the latter is better than a strong reading glass. These tubes comprise one of the newest major developments of the electron art, and in the few years of their existence many fundamental discoveries have been made in biology, chemistry, metallurgy, and other sciences.

HEATRONIC MOLDING

(*Continued from page* 93)

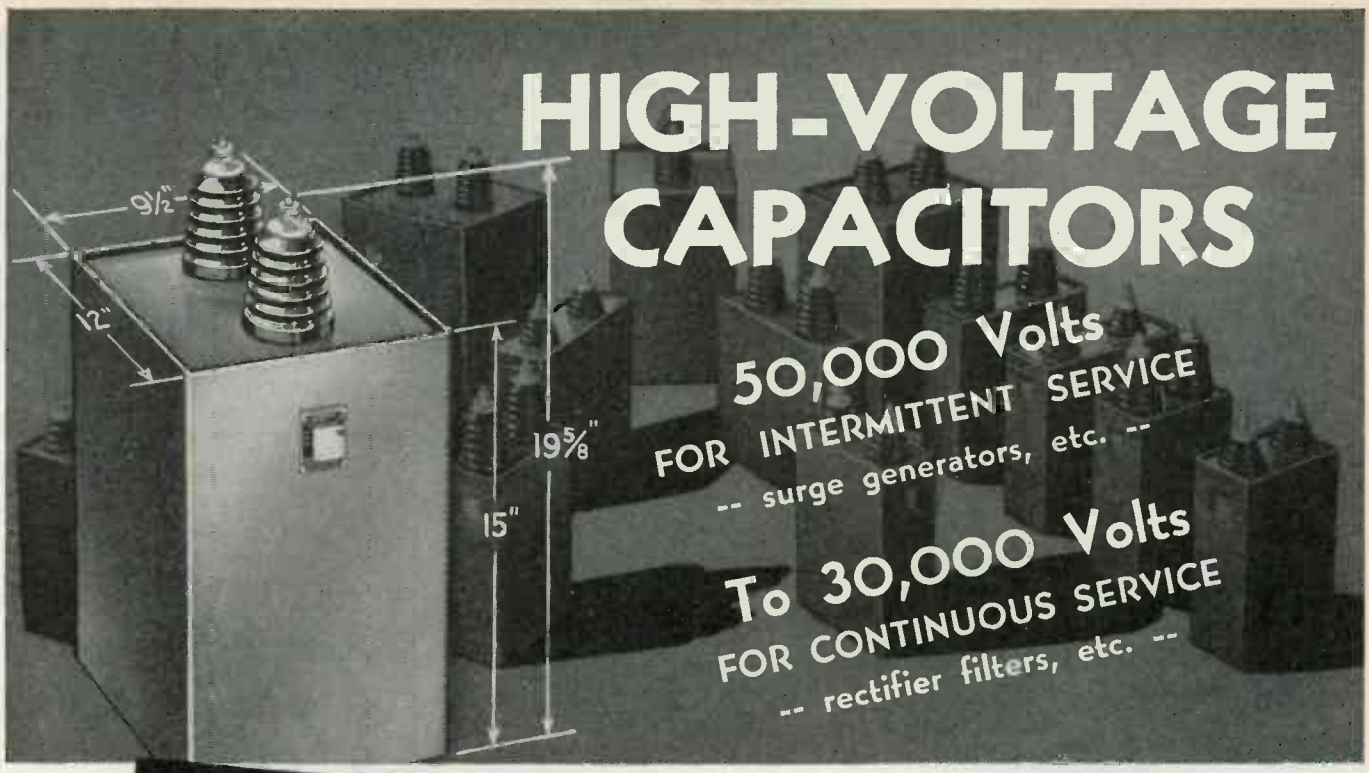
shown in Table I. That is, the time to close the die under definite conditions of temperature and pressure is a practical measure of the plastic properties of the material. The shorter the time the more fluid the plastic. An interesting comparison shows the work and power requirements with ordinary methods as listed here:

	Type Material	Type Molding	Work in Molding Ft. Lbs.	Power Required H.P.
(1)	General purpose phenolic	Standard	254	.0156
		Heatronic	120	.0439
(2)	High impact phenolic	Standard	627	.0407
		Heatronic	121	.011
(3)	Phenolic Heat Resistant	Standard	245	.0178
		Heatronic	120	.109
(4)	Phenolic Improved Impact	Standard	584	.030
		Heatronic	250	.114
(5)	Urea Cellulose Filled	Standard	627	.063
		Heatronic	245	.074

In this table it is shown that the work done is in all cases substantially less using Heatronic Molding. In most cases, however, the work is done in so much shorter time, the power requirements are usually higher with this process.

Other materials adaptable

The data thus far have dealt with phenolic thermosetting materials with occasional references to the urea types. The phenolics appear unusually well adapted to this process. However, it has been been found that other varieties such as urea, melamine, alkyds and various types of rubber can be heated quite readily and reductions both in molding pressure and time of molding are obtained. We therefore anticipate that general use



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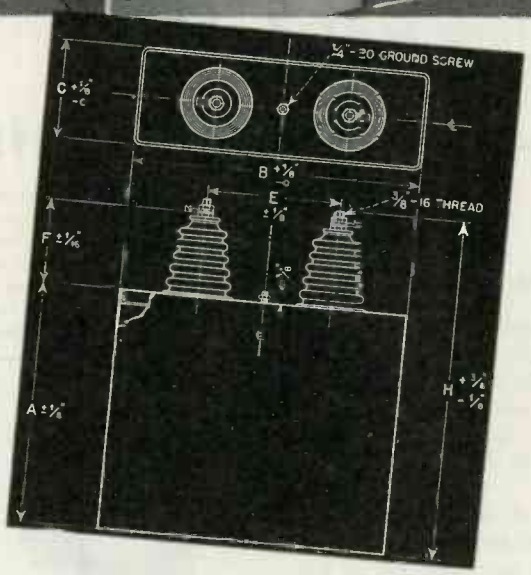

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0.2 mfd. to 1.0 mfd.
TYPE 37520—37,500 v. D.C. Work
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will be found for the process in those fields.

Electronic equipment is now available of sufficient size to allow heating fifty pounds of material at one charge and within the time limit necessary for fast thermosetting type. This charge will be uniformly heated and is capable of molding in thick or thin sections on a fast cycle.

While no particular mention has been made of the strength of molded parts, exhaustive data by well-controlled comparative tests have shown Heatronic molded specimens equal or better than those obtained by present conventional methods. There are good reasons to believe this will also be found true in commercial practice.

MAINTENANCE AND TROUBLE SHOOTING

(*Continued from page 97*)

dropping or striking the tube, if they do not actually rupture the envelope, may jar the elements out of position or even break welds or leads.

Mercury-vapor tubes must be kept upright as much as possible to keep the mercury off the elements.

Trouble-shooting

The best trouble-shooting tool is a clear knowledge of the operation of the panel and each part of it. If partial operation is obtained but other actions fail to occur, the trouble may be isolated to a part of the circuit.

Since many circuits on electronic panels have a very high impedance, meters having high impedances, 1,000 ohms per volt or higher, are very desirable in servicing the equipment. For some circuits, however, an electronic meter, such as a vacuum-tube voltmeter of the dc reading type or a cathode ray oscilloscope, is essential. The cathode ray oscilloscope, particularly when modified to read direct-current potentials, is an extremely useful device since it combines a very high impedance voltmeter with a time axis, thus making visible voltage changes much too rapid for the ordinary meter to follow. Instantaneous thyratron grid and plate potentials and other voltage waveforms may be observed easily on the oscilloscope and any incorrect operation quickly detected.

In trouble-shooting on electronic control, one should first make sure

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that the trouble lies in the electronic equipment. Is power available at the control panel terminals? Can the motor or other device be operated by alternate means (such as from a dc bus by drum switch or magnetic control) if provided? Are all protective devices and interlocks outside of the panel operating properly? Has the cathode protective timer relay completed its timing cycle and applied anode power? Have mechanical adjustments been disturbed where items such as scanning heads or other mechanical components are used?

The times at which the failure occurs may be divided roughly into three: (1) when first starting a new equipment; (2) when starting after a normal shutdown; and (3) during operation.

New equipment fails to start

When new electronic equipment fails to start, the cause may be a lack of correct power, incorrect or missing connections, tubes in wrong sockets, use of wrong or defective tubes, no fuses or wrong size fuse, or damage done to panel leads or parts in shipment.

Incoming power should be checked against panel nameplate. The remedy for no power, missing wires, and fuses is obvious. The position and type of tubes can be checked by referring to the wiring diagram and the panel stamping. Defective tubes and (sometimes) tubes in the wrong socket may not heat up. The glow of the hot cathode may usually be seen in glass tubes; in metal tubes, of course, the envelope becomes hot to the touch. The envelope of metal thyratrons and ignitrons is at cathode potential and should not be touched while power is on the panel.

When electronic equipment does not operate after a normal shutdown, first check power, interlocks, and safety switches. The cathode heating timer relay may have failed or the anode contactor may be defective. An old tube often fails due to expansion and contraction as power is switched off and on. Filament or heater burnouts may be detected quickly by inspecting glass tubes or by feeling metal tubes for heating. Sometimes an overloaded transformer or reactor will fail due to the expansion cycle as power is removed and applied. Here, however, warning of failure is usually

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given by excessive heating, the odor of the hot material, melting of the sealing compound, or smoking or charring of the insulating paper.

Equipment fails during operation

If after a period of satisfactory operation, the equipment's operation quickly becomes unsatisfactory or ceases altogether, it is often possible to isolate the trouble to a specific cause by noting the exact symptoms of the failure. Power failure or a blown fuse result in an instantaneous change in the equipment's operation. An overloaded transformer, resistor, or wire is usually indicated by heat and smoke before total failure occurs. The cause of overload — whether short-circuit, load coil burnout, or motor-bearing failure — must be found and corrected before the equipment is again placed in service.

A failure in a tube cathode circuit permits the cathode to cool gradually over a period of seconds or even minutes. Therefore, the loss of operation may be gradual rather than sudden as in the case of power failure. However, small rectifier- and battery-operated tubes cool quickly.

If none of the above causes for failure are evident it will be necessary to go carefully through the operation of the circuit and to analyze each step. An instruction book for the particular panel or at least an elementary diagram of the circuit should be available. If the circuit is at all extensive, it is usually possible to divide it into two parts, for example, the control and power circuits of a welding control. Then it may be possible to use a meter, electronic voltmeter, cathode ray oscilloscope, or some other means to determine whether or not the control section is operating correctly as the input is varied over the normal range. Likewise, a simulated control signal may be applied to the power circuit to test that half.

In a similar manner, each part of the circuit can be further subdivided until the faulty circuit or part is found. With a clear knowledge of each part of the circuit, this procedure can be carried out quite rapidly. It is a good idea to check the operation of panels while they are operating correctly and to record voltages found and cathode ray traces seen between specific points. In this way, the

differences found in a defective panel will be immediately evident, and the trouble-shooting will take much less time.

If trouble is recurring in certain parts of the circuit, the manufacturer should be notified. Quite often a more permanent solution may be offered or the assistance of the manufacturer's design engineers may be obtained to suggest a cure. Sometimes, slight modifications in the equipment may be proposed to provide more desirable characteristics for the particular installation. In every case, complete information from the panel nameplate as well as a description of the part and the trouble found should be given to the manufacturer so that assistance may be rendered quickly and effectively.

FREQUENCY ALLOCATION CONCERNS ENGINEERS

(*Continued from page* 75)

frequency bands, recognizing the power and distance limitations involved, to relieve pressure on the lower frequency operation of the spectrum.

7. Local and regional (shared-channel) standard broadcasting stations should gradually be transferred to FM, in order to provide a better interference-free coverage day and night.

8. The removal of shared-channel broadcasting from the present standard band should be used to provide improved urban and rural broadcasting service on cleared channels, and to relieve the international situation, by assigning United States stations to cleared channels extending from 550 to 1600 kilocycles at 20-kilocycle intervals, and assigning Canadian, Mexican, Cuban, etc., broadcasting stations to similar cleared channels separated by 20 kilocycles and staggered between the United States channels.

So far as my present information goes, all of the foregoing principles are sound and should have serious consideration. I hope you will find them interesting.

Need Propagation Data

by DR. L. P. WHEELER
President, Institute of Radio Engineers

I do not think that any reallocation of channels for television, FM, aircraft radio, industrial diathermy, etc., can be made wisely at the present time. In the first place, we need more knowledge of

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tropospheric propagation effects in the very high region of the spectrum, and in the second place, we are lacking sufficient information as to what is feasible in the present state of the art in that spectral region as to frequency stability, practicable channel widths and power required.

While steps are being taken to obtain the necessary propagation data they will not be available this year, and although a number of engineers undoubtedly have sufficient information on the other matters, so long as it is held in a confidential status by the armed forces (as it is at present) it is not available for civilian purposes.

Postwar planning

Preliminary studies on some phases of the general problem can, however, be profitably undertaken now, and whatever postwar planning organization is finally agreed upon will undoubtedly put these matters on its agenda. Until such studies have been completed and we are in a position to utilize the engineering developments of the war effort, it seems to me futile to discuss the matter further.

It is understood, of course, that these are my personal opinions and are not officially representative of the views of the engineering department of the commission.

Amateurs Deserve Space

by K. B. WARNER
Managing secretary,
American Radio Relay League

We don't want any improved amateur bands, or allocations located at some other places in the spectrum. But we simply want the return of the amateur frequencies. By means of a temporary order of FCC, they have been temporarily withdrawn, although our licenses are still in effect. Our board of directors declared itself on this subject at a meeting last month, stating that its position, as concerns the frequencies below 300 mc, was for the return of the amateur bands as they existed before the war.

Having committed ourselves to the principle of "test slices" an octave apart, it is our wish to secure for the amateur similar exclusive allocations on this basis, in extension of the present harmonic family, to as high a figure as definitive allocations to services is made. That is to say, we are quite content to rest where we are so long as there is no general allocation above

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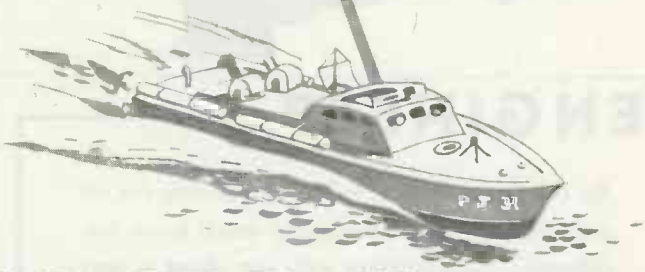

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300 mc. But when the higher reaches of the spectrum are parceled out, we shall want our little piece of each octave also, commencing at 448 mc, 996 mc, etc. You will agree that this is logical, since the amateur's work requires that he have available a little of "each kind" of frequency, and the system was long ago established on the basis of octaves.

Amateur radio

One of the beauties of amateur radio is that it is a mechanism whereby people train themselves in the complexities of a technical art, learning by doing, and do this at their own expense, so that without cost to the state there grows up a considerable body of trained people available for the needs of the art and industry—and the military services! I think that much of America's greatness in communications must have flowed from the national policy of fostering amateur radio, since so many of the key figures in the art in this country have had amateur careers. It is the great training school. Our fellows were the ones who uncovered the value of the short waves, and many a contribution to the technique has come from amateur sources. The present war caught our military services unprepared and we have been told in many places that the day was saved only by the amateur jumping right in at Pearl Harbor and carrying the major part of the load until the training schools could grind out their new products.

I am entirely persuaded that it is wise national policy for any government to maintain adequate frequency assignments at the disposal of its amateurs, for they contribute much to national leadership in communications and electronics.

More Television Room

by O. B. HANSON
Vice-president and chief engineer,
National Broadcasting Co.

At this particular stage of postwar planning I think it is very difficult for any engineer associated with a particular type of radio service to make any constructive proposals without having a full knowledge of the requirements of other industries and of the new services anticipated by those industries for postwar operations. As you know, I am on several postwar planning committees in which allocations are a serious consideration, and it is generally felt that the lack of

quantitative information on frequencies between 100 and 300 megacycles makes one hesitate at this time to make any specific recommendations for the allocation of the ultra-high frequency spectrum. It is generally felt that as the higher frequencies are used more trouble will be experienced with multipath effects. Furthermore, as one goes up the frequency scale, it becomes more and more difficult to generate adequate amounts of power to render satisfactory public service, particularly for television.

I think it is generally recognized that present television assignments are spread over too wide a band of frequencies, making it extremely difficult to design and produce television receivers economically. It would therefore be desirable to reduce the spread of television channels in the spectrum and to bring them adjacent to one another, although I have some reservations on this score. I think it is also desirable to have broadcasting services blocked out together, as is shown in your proposed plans X and Z ("Electronic Industries," July, page 53), as it must be assumed that broadcast receivers of the future will be both television and FM sound receivers as well as including the standard band.

Favors proposed plan

My present thinking, without the consideration or knowledge of the problems of other industries, would tend to favor your proposed plan X, except that I might point out that in a broad band service such as television, the problem of getting adequate power is more difficult than obtaining adequate power for a narrower band service such as FM sound broadcasting.

Bearing in mind these power tube limitations, it would be better to place the FM band above the television band in your proposed plan X. It might be pointed out that multipath transmission produces multiple images in the received television picture, and it is generally thought that the higher frequencies would be more troublesome because as the waves get shorter, more and smaller objects become reflectors of these waves, whereas multipath transmission can produce a form of audible distortion in FM reception that is somewhat militated against by limiters in the receiver which are not present in picture receivers.

If television is to go ahead immediately after the war to provide

employment for hundreds of thousands of people, I feel that television should stay in the present band from 50 megacycles up, more or less as shown in your plan X. If this part of the spectrum is not available to television and television is forced to the higher frequencies, some time will elapse before high-powered vacuum tubes can be developed for such a service; and the limited power which might be available shortly after the termination of the war would probably militate against a rapid expansion of service.

Multipath transmission

We are, at the present time, planning some propagation tests in the present FM and television channel No. 1 frequency as well as in the frequencies between 100 and 300 megacycles in an attempt to gather some quantitative data relative to the effect of multipath transmission upon reception of both FM and television, as well as to observe other propagation characteristics.

Again, if television should be the great new radio service, it will be necessary to provide more channels than you have shown on your charts; and if there were twice as many as you have shown, they would probably be insufficient. I think you agree that probably other industries have some claim upon the frequencies between 100 and 500 megacycles. Therefore, I think it is a little early to make any specific recommendations until some of the other facts governing allocations are known.

ELECTRONIC TIMER CHECKS BOMB FUSES

(*Continued from page 95*)

closes immediately upon being struck by the air, starting the clock. Relay R2 is used to interlock the switch, so that any possible chattering caused by turbulent flow cannot allow the clock to stop and start again.

The clock is stopped by the passing of light through the tube striking the plate of the phototube "P" as soon as the safety block has been released. An interlock, consisting of relays TK and R, is used so that once the clock has been stopped, it cannot be started again, in the event that the safety block, or the bent vane, re-enters the light beam, interrupting it again.

The interlocking relays were found by experience to be neces-

sary for accurate timing. Any delay in the closing of the starting relay will be compensated for by a similar delay in the opening of the stopping relay. It is, however, desirable that these relays act as quickly as possible. If stopping relay "R" acts too slowly, the vane or safety block may re-enter the light beam when it is only partially open, causing it to close again. This may recur several times, thus giving inaccurate timing.

Check with oscillograph

A check of the relay and clock action was taken with three elements of an oscillograph, and after adjustments were made, showed an accuracy of about plus or minus ½ per cent, which is sufficient. Greater accuracy could undoubtedly be obtained by using different relays.

The photoelectric relay is also utilized to close the electromagnetic valve "V" thus shutting off the air supply as soon as the safety block is released, enabling the pressure remaining in the tank to be read. The difference between the initial and final pressure, together with certain constants of the nozzle and tube, allow the average velocity existing in the tube during the test to be computed.

Experience has shown that this electronic timer stays in adjustment very well over extended periods of time, and needs only an occasional check, and cleaning of parts, to do an efficient and accurate job of recording time values of around 0.5 seconds, which would be difficult by any other means.

PRECISION REGISTER WITH PHOTOTUBES

(*Continued from page 98*)

on the end of the impression cylinder. It is the angular rotation between the alternate illuminating of the two photocells that determines the allowable misregister or tolerance. This angle may be adjusted to the optimum value.

Through suitable amplifiers the photocells are made to operate relays which, in turn, control the thyratrons that cause the correction motor to advance or retard the printing cylinder, however little or much may be necessary for precision register. At the same time relays also operate signal lamps on the control panel providing a visual means of determining the relative phase of the scanning photocells. Thus, the flashing of a green light indicates the need for correction in

one direction and this correction is automatically provided. A flashing red light indicates the need for correction the other way, also automatically made. In making initial adjustments, synchronization between the web and printing cylinder scanners is indicated by neither lamp flashing. Adjustments are provided for controlling register tolerance and also for controlling the speed of response of the correction motor.

Tube line-up

The tube line-up includes: Web scanning head, phototube type 926; first amplifier tube, type 954 acorn or 9001 tube; phase detector, two type 921 phototubes; first amplifier, type 6SC7 metal tube; control panel, web amplifier, type 6C8G tube; phase amplifier, type 6C8G tube; two type 2051 thyratrons; type 76 timing control tube; type 80 rectifier; voltage regulators VR 75-30 and VR-105-30.

LABORATORY KINKS

(*Continued from page* 99)

squeezed in the electrometer with the charges determined on the untwinned areas. It is then immersed in a mineral oil bath (Standard Oil Co. liquid paraffin-heavy) and the "hand" determined.

A word on the determination of the hand of the quartz might not be amiss at this time. For terminated crystals (those having apex faces) the rings are deflected from the faces causing six sets of rings to appear (one being observed on each rhomba face). However, as the center of these rings will extend out from the side of the prism face and when viewed from the apex it will appear as if the observer sees one set of rings, these rings will seem to contract when in reality they expand for right hand quartz. In mother quartz with a very predominant major rhomba, the center of the rings can be well observed and the indication will be the same whether the major rhomba is removed or not. (That is, the rings will expand for right hand and contract for left hand.) The major rhomba can now be readily ascertained.

The polariscope used in these determinations consists of a sun lamp, using the Westinghouse S-4 bulb, a 4½" diameter, 6½" focal length plano convex lens and two polaroid sheets.

SURVEY OF WIDE READING

(*Continued from page* 103)

Gamma-Ray Radiography

C. Croxson (Nature, London, April, 1943)

A paper on investigation of materials by means of gamma rays instead of X-rays, read by C. Croxson at a Meeting of the Industrial Radiology Group of the Institute of Physics, is reported. Gamma rays are essentially the same as highly penetrating X-rays generated by a source of 200—2000 kv, i.e., electromagnetic radiation having a wavelength of the order of 10^{-8} mm.

An essential advantage is that the source of gamma rays is relatively small and can therefore be used in locations inaccessible to an X-ray equipment. Radium sources have recently been replaced by radon which has an initial intensity 60 to 70 times that of radium but a half-life period of only 3.85 days as compared with 1,590 years for radium; the half-life period indicates the time within which the amount of the substance has decreased to half its original value due to radioactive decomposition.

On account of their short wavelength, gamma rays are highly suitable for the radiography of heavy metals. They have been used satisfactorily in the radiography of tungsten steel, tungsten carbide, stellite and lead alloys, in addition to the known application in the inspection of ferrous, copper and brass specimens. The technique is discussed and its application to pilot castings and welds mentioned.

Electron Microscope in Chemistry

Vladimir K. Zworykin (Industrial and Engineering Chemistry, Ind. Ed., April 1943)

Applications of the electron microscope to chemistry are illustrated by a number of micrographs of chemical materials. A stereo-electron microscope, a diffraction microscope, a high voltage microscope, a scanning microscope and a small desk microscope are described.

On Dielectric Materials

S. S. Attwood and W. H. Bixby (Journal of the Franklin Institute, March 1943)

Various theories are discussed explaining electric breakdown, and the time-lag connected therewith, in solid and liquid dielectric materials having ionic molecular constitution. Experimental values obtained with carbon tetrachloride

are compared with the computed values.

The mechanism on which the two modern theories described are based assumes at least partially free electrons in the dielectric which move in the electric field applied and excite vibrations of the positive and negative ionic constituents of the dielectric. Below breakdown field strength, the ionic oscillators absorb all the energy abstracted from the field by the free electrons which thus maintain constant velocity; for higher field strengths, however, the electrons acquire more energy than can be absorbed and are accelerated until they have sufficient energy to ionize the surrounding particles which ionization starts the process of breakdown.

Distortion Meter

J. E. Hayes (IRE Proceedings, March 1943)

The meter consists essentially of a bridged-T circuit in which the inductance element is replaced by a reactance-tube circuit. The advantage is the comparatively great flexibility of the reactance tube arrangement making it adaptable for any frequency in the audio range. Operation of the circuit is explained and discussed.

Coastal Radio Telephone System

H. M. Pruden (Bell Labs. Record, March 1943)

The equipment used in radiotelephone communication between coastal stations and ships, and between different ships is described, and the various switching procedures are explained.

Determining Half-Value Periods

A. G. Ward (Proceedings of the Royal Society, London, December 1942)

The half-value periods of radioactive elements is the time required for the substance to disintegrate to half its initial amount. It is a constant for any particular element and may be measured by the number of ionizing particles emitted by it over a known interval of time. The number of particles can be determined by means of specially constructed ionization chambers, called Geiger-Mueller counters, which show a decrease in voltage every time a particle ionizes the content of the chamber. Frequently, however, the problem is complicated by the coexistence of two or more radioactive substances originated from one another and all emitting similar particles. The amount of one of the substances present may be obtained by mathematical analysis, and for the computation it is necessary to have a record every time one ionization follows the preceding one within a given time interval.

The device designed for this purpose consists of a Geiger-Mueller counter connected between plate and grid of the first tube of a multivibrator. The output pulses are indicative of the number of voltage changes on the counter; their lengths, depending on the feedback resistance and capacitance, is varied from 10^{-3} to 10^{-4} sec. These pulses are fed to a modified Rossi coincidence pair and to a thyratron in such a way that if two pulses occur within a predetermined time interval an indication is obtained at a recorder. The complete circuit is shown.

Results of the measurements carried out with the arrangement described are given and discussed. The operation of the circuit is explained.

Counting Bees

A. C. Faberge (Journal of Scientific Instruments, London, Feb. 1943)

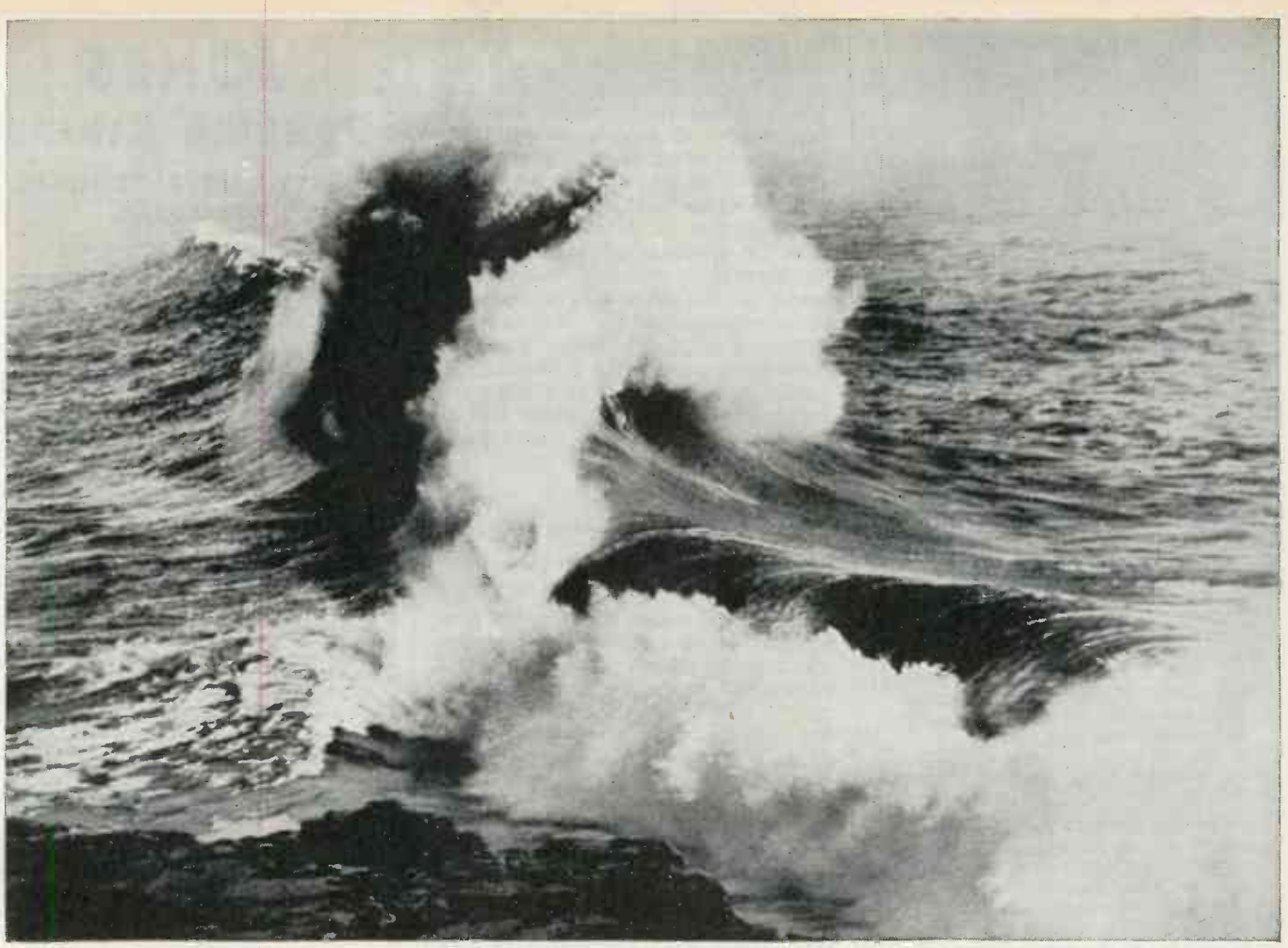
The purpose of the device described is to give a record of the number of times bees leave a hive, and of the number of times they enter it within a certain time interval. The entrances and exits of the hive are so arranged that the bees have to pass through channels, and at a certain point in the channel they tip a balance. An electrical contact is made and a condenser discharged. The impulse thus obtained is recorded by means of a Wynn-Williams thyratron pair and a mechanical recorder.

Reflection of Plane Waves

M. E. Rose (Physical Review, Feb. 1943)

Specular reflection of plane waves in media of arbitrarily varying reflective properties is treated by the wave theory method. For the computation, it is assumed that the velocity of wave propagation and the radiation resistance vary sufficiently slowly that multiple reflection may be neglected. The wave equation is solved for a medium consisting of a set of homogeneous, plane, parallel plates of different refractive properties and for monochromatic waves. Conditions for elimination of reflection by interference—applicable to the propagation of longer electromagnetic waves in transmission lines—are derived.

The results for monochromatic waves are then extended to wave



This is the reason they called the tube KLYSTRON*

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Inside this tube, the inventors were able to direct a stream of electrons which concentrated their power and released it much as waves do when they mount into crests and crash on the shore.

That's why the tube is called KLYSTRON. The name comes from a Greek word that denotes the breaking of waves on a beach.

Initial research on the KLYSTRON was done in California at Stanford University. The Sperry Gyroscope Company was quick to see the tube's possibilities. So they helped the inventors carry on further development of the KLYSTRON as a valuable tool of war and aeronautics.

When the tube got beyond the early experimental stages, the Varian brothers and Dr. Hansen joined Sperry's staff of inventors, engineers, and research men.

With the close co-operation of the Army and Navy, the development and perfection of the KLYSTRON continued, and is still continuing.

Applications of the KLYSTRON include the generation, amplification, and reception of ultra-high frequency waves. Naturally, they are being devoted exclusively to war uses at present.

When the war is won, Sperry research will explore the fascinating field of KLYSTRONICS** in relation to the comfort and security of a world at peace.

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pulses of arbitrary shape and duration, and it is shown that the reflected pulse consists of a series of wave trains identical in form with the incident pulse, aside from interference effects, and with the amplitude of each pulse reduced by the value of the appropriate Fresnel reflection coefficient.

Transition is then made to the case of a stratified medium with continuously varying velocity of wave propagation and impedance, for monochromatic waves and waves of arbitrary shape. The final formula is applied to a rectangular pulse, and reflection of a normally incident wave in sea water and in the atmosphere is numerically evaluated.

Light-Modulating Glass

W. E. LeClair (Electronics, May 1943)

Glass and other transparent materials become doubly refracting upon application of pressure. The velocity of propagation of the ordinary and extraordinary paths through the glass are different and depend upon the pressure applied, so that a varying phase difference is set up between these two modes of oscillations under changing pressure.

An apparatus is described making use of this effect to modulate the intensity of a light beam in accordance with variations of the electric current in one of the coils of an electro-magnet which controls the pressure exerted on a glass prism. The principle arrangement is similar to that of a Kerr cell, pressure being substituted for voltage.

Broadcasting in Wartime

J. A. Ouimet (IRE Proceedings, March 1943)

J. A. Ouimet, Assistant Chief Engineer of the Canadian Broadcasting Corporation, describes the measures taken by his organization to protect the equipment, conserve tubes, microphones, etc., and to maintain essential operations after destruction of regular facilities.

Resistance of Metals

V. F. Weisskopf (American Journal of Physics, Feb. 1943)

A comparatively elementary account of the modern theory of the electric resistance of metals is given, the basic considerations and calculations are explained in detail, and final results indicated.

The wave nature of electrons is introduced, and the consequent analogy between refraction of light waves and interaction of an electron wave with the lattice structure

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of a metal is pointed out. The scattering of these electron waves, which represents the resistance to the propagation of electrons in the metal, is caused by deviations from regularity in the lattice due to cracks, inclusions, or, primarily, to the thermal motion of the atoms. In a perfectly regular structure, there would be no scattering and no resistance. It can thus be seen why the resistance increases with temperature. Because of the Pauli principle, which postulates that not more than one electron may be in one quantum state and because of the fact that, at room temperature, the number of conduction electrons considerably exceeds the number of available quantum states having the right amount of energy, the energy distribution of the conduction electrons is very much different from the Maxwell distribution.

Computations of conductivity are based on the above concepts and every step and its physical meaning is discussed. The expression for the conductivity due to the scattering of an electron wave by thermal vibrations of the lattice is derived.

Besides the resistance caused by scattering, total reflection of the electron wave may occur and prevent electrons from assuming forbidden energies, thus causing a gap in the energy distribution. These energy gaps are impervious to electrons accelerated by an electrostatic field, and the resistance is increased. The requirements for total reflection are not met by monovalent metals but they may be present in divalent metals. Gaps may be crossed if energy is supplied by heat or light, explaining photoconductivity in insulators.

The most important characteristics of a good conductor are monovalency, large atomic mass and considerable hardness, both latter factors contributing to a decrease in amplitude of thermal vibrations.

A corrected expression for the conductivity at low temperatures illustrates the strong temperature dependence in this region. However, superconductivity below a certain critical temperature can not yet be explained by the theory.

A Mathematical Theory of Linear Arrays

S. A. Schelkunoff (Bell System Technical Journal, Jan. 1943)

The spacial radiation patterns of linear arrays composed of non-directive elements may be represented as complex polynominals. The expression for directional elements may be obtained by multiplication with the radiation pattern of one of the identical elements.

Various combinations of elements are considered, and their behaviour is derived from the properties of

the corresponding polynominal. General indications how to obtain maximum directivity are given, and it is explained how a prescribed directional pattern may be approximated with any desired accuracy.

Increase of Cosmic Rays

A. Duperier (Nature, London, March 13, 1943)

An exceptional increase in cosmic rays for the period August 12-15, 1942, was observed, but so far no satisfactory explanation nas been given.

Electron Distribution in Ionosphere

Olaf E. H. Rydbeck (Philosophical Magazine, Feb. 1943)

The electron density distributions in the upper ionosphere at different times are graphically shown and discussed.

Electric Propagation on Long Lines

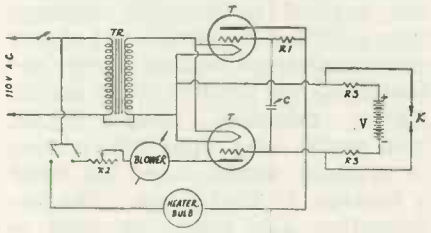
M. G. Malti & M. Golomb (Journal of the Franklin Institute, Jan. & Feb. 1943)

The article contains a thorough mathematical treatment of electric propagation on long lines terminated by lumped networks. In the January issue, the formulas for a line initially at rest are derived, and in the February issue the case of arbitrary initial distribution of voltage and current is studied.

A Thyratron Thermal Relay

D. Rittenberg and I. Sucher (Review of Scientific Instruments, Feb. 1943)

The circuit shown was found to function satisfactorily during a period of four years controlling a thermostat to 0.001°C in the range from 20 to 30°. In operation both



Thermal Relay

the fan and the filament of the heater bulb are continuously on though they receive varying ratios of power input.

Suspension Light Valve

J. S. Donal and D. B. Langmuir (I.R.E. Proceedings, May, 1943)

In two separate articles, a suspension light valve and arrangements for its practical application are described and discussed.

Colorimetric Determination of Bismuth

A method of quickly and accurately determining traces of bismuth in lead, developed by Clarence Zischkau, Barber laboratory, is reported in the June issue of "Metal Progress." In contrast with the gravimetric estimation which takes 12 hours, the colorimetric method takes 15 minutes. The colorimeter contains an incandescent lamp, a suitable color filter, the test solution or a calibrating solution, and a selenium cell connected to a galvanometer.

"The new electronics industry is going to need equipment of extreme reliability, plus an army of maintenance men who know their stuff. These men will be electronic specialists—as distinct from radio men as pattern-makers are distinct from cabinet-makers. The principles and tools will be the same, but the job will be very different. It will be a good profession—busy, profitable, and interesting."

—W. R. Ready, President, The National Company.

TUBES IN METEOROLOGY

(*Continued from page 64*)

offset the excessive response in the region 3100 to 3300 Angstrom units.

Considerable experimental work on the materials and construction techniques of phototubes for ultraviolet measurements has been done by Dr. Rentschler at Bloomfield, N. J. His contributions included the development of a zirconium cathode, which has two important advantages over magnesium. First, its spectral sensitivity is substantially in the desired region, and second, results in production are considerably more consistent than when magnesium is used. In the near future, a number of installations of u-v recorders is to be made throughout the country.

Miscellaneous instruments

One of the most interesting applications of electronics to meteorological work is the photoelectric cloud-height recorder. Several experimental models have been under development for some time at the U. S. Weather Bureau in Washington. A complete description of the instrument, with circuit diagram and several photographs, is to appear in the September issue of "Electronic Industries."

The transmission of weather information, synoptic maps and charts from one weather station to others represents an ideal use for facsimile transmission. The weather bureau at LaGuardia Airport, New York, has been working with facsimile equipment for some time, and is at present sending maps and charts over land wires to other agencies. In the postwar period, widespread use of facsimile transmission by the Weather Bureau is envisioned. Radio transmission will probably be used, to avoid the expense of permanently leasing land wires.

Electronic instruments to measure haze, dust, and humidity have been used and are expected to play an increasingly important role in meteorology. One promising type of humidity measuring equipment involves transmission of a beam of light through a distance of 10 feet or more, with photoelectric determination of the absorption of light of different wavelengths by the intervening air.

The "generating voltmeter" employed for measuring static conditions before and during thunderstorms is another device in the experimental stages. In it, a rotating vane alternately "contacts" the air and the grid of the tube of a V.T.V.M., registering the charge accumulated during the interval of exposure to air.

In addition to increasing use of many of the devices described, a number of tube-applications are indicated in connection with telemetering and telerecording from unattended automatic weather stations.

According to William R. Thickstun, chief of the Weather Bureau's instrument division, electronics will play an important part in the design of meteorological instruments after the war.

AMPHIBIOUS WARFARE

(*Continued from page 59*)

finding men and equipment deserves special mention. Signal Corps Radio Intercept teams, during the first phase, would normally operate from one of the vessels of the invading fleet. Its job would be to listen in on enemy traffic and turn over the information it receives to G-2 of the force. If the message intercepted were in enemy code, it would be turned over to the cryptographic section for decoding. Last, but not least, radio intercept units would monitor our own radio communications to keep radio traffic under control and to see that military security was not compromised by our own people.

Direction-finding equipment

Direction-finding equipment, operated by Signal Corps personnel, would go ashore as soon as possible after the beachhead was established. Direction finding is done by two radios set as far apart as possible. By tuning in on enemy stations the Signal Corps operators are enabled to compute, through triangulation, the position of enemy communications centers. After establishing the position of an enemy station, direction - finding signal men would relay their information to artillery, which would lay down a barrage at that point. The information also might be used to send out an air mission to bomb and strafe the enemy location.

Signal equipment and troops also would be intimately concerned with the operations of the Air Forces. One of the first objectives in this respect would be air fields.

Paratroops would infest enemy air fields after they had been bombed and strafed by American aircraft. Their means of communication would be the Handie-Talkie. Among the air troops would be sig-

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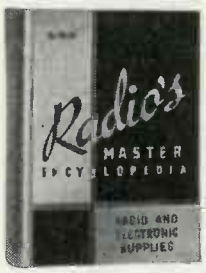

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nal troops who have the responsibility of establishing the same kind of communications as their ground force comrades—a message center, a radio net, and where necessary telephone and telegraph communications.

Today more than ever in this war of speed and distance the "nerve-center of the American Army" is its Signal Corps. It can be properly cited that after the Tunisian victory, General Sir Harold R. L. G. Alexander, Allied Forces deputy commander under General Dwight D. Eisenhower and in charge of all land operations, paid high tribute to the vital part that Signal Troops played. He noted that as soon as the enemy retires the signalers have to restore the telephone and telegraph wires and poles that the foe has cut down, and do this work aware of the fact that they may be the targets of Stukas at any moment or find themselves under the fire of a counter-attack.

NAVY RADIO ORGANIZATION

(*Continued from page* 56)

The actual research, design, procurement, and manufacturing details are handled by the Radio Division, but all such details must be satisfactory to the Bureau of Aeronautics. The Bureau defrays all charges and expenses entailed in such work by occasionally transferring funds to the Radio Division.

The Bureau issues instructions covering installation, operation and maintenance of all aircraft radio equipment. Where installations are to be made by aircraft manufacturers and others, the Bureau makes provision for such installation and issues specifications for guidance in this work.

Also under the cognizance of the Bureau of Aeronautics are interior communication systems and all aircraft radio accessories such as microphones, headsets, keys, reels, antenna insulators, fairleads, etc.

Commander Frank Akers, U.S.N., heads engineering and design activities at the Bureau. His background includes radio engineering courses at the Academy and at Harvard, and considerable experience in aviation as a Naval pilot and otherwise. He holds the Distinguished Flying Cross, for a hazardous experimental test flight. Heading the production activities of the Bureau is Lieut. Commander H. C. Guterman. Lieut. Commander E. M. Hartley is in charge of maintenance.

The United States Coast Guard, a Navy branch, has built up a complex but well-coordinated system of radio communication. The Service has 14 primary and 8 secondary radio stations handling all kinds of traffic both within the country and for Coast Guard and Navy ships at sea.

There are nine air stations with their own radio equipment. The expansion of Port Security activities in the war has led to an extensive use of radio in harbor areas for communication with small boats, cars and trucks.

Of particular importance to officers of merchant and naval vessels are the 20 radio direction finder stations and the Marine radiobeacons, used for position-fixing at sea. All Coast Guard stations and ships guard distress frequencies to be able to dispatch help to vessels in danger. In addition, five commercial stations have been leased to assist in watching for distress calls.

Captain Webster heads Communications

The present Chief of the Communications Division of the Coast Guard is Captain Edward M. Webster, U.S.C.G., who has participated in the program which has built the system to its present peak of efficiency. Captain Webster has served as Assistant Chief Engineer of the Federal Communications Commission and has represented this Government at several international radio conferences.

Much of the early development of Coast Guard Communications was done by the present Commandant, Vice Admiral R. R. Waesche, one of the first officers in the Service to specialize in this field.

Radio and other electronic equipment used by the Coast Guard is, for the most part, designed and procured by the Radio Division of the Bureau of Ships. Communications officers of the Coast Guard work closely with the Radio Division to insure that all designs shall be satisfactory for the purposes involved.

Marine Corps radio

A similar situation exists with regard to the U. S. Marine Corps, with radio and radar sections in the Radio Division staffed by Marine Corps officers for optimum liaison. The Marine Corps' communication training program includes radio, telephone and radar

EAR

to the ground

Two kinds of news that does not reach the public prints is known to Stancor engineers: new applications of electric energy to war communications, and new ideas for using electronic devices in peace-time production. Both are secrets of victory, not to be told until the war is won.

While devoting major attention to war production, Stancor engineers keep their ear to the ground . . . alert for news of developments that will help you to meet the challenge of a new industrial era.

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You see there *is* a secret to it—the secret of American know-how. For instance:

- **How to turn out such delicate, and at the same time, rugged instruments by the tens of thousands, and still have each the equal or superior of a handmade product.**
- **How to devise instruments to give *each* unit a complete "laboratory" test, in a few seconds, right on the production line.**
- **How to make telephones that will operate equally well whether they serve in arctic cold or tropic moisture.**

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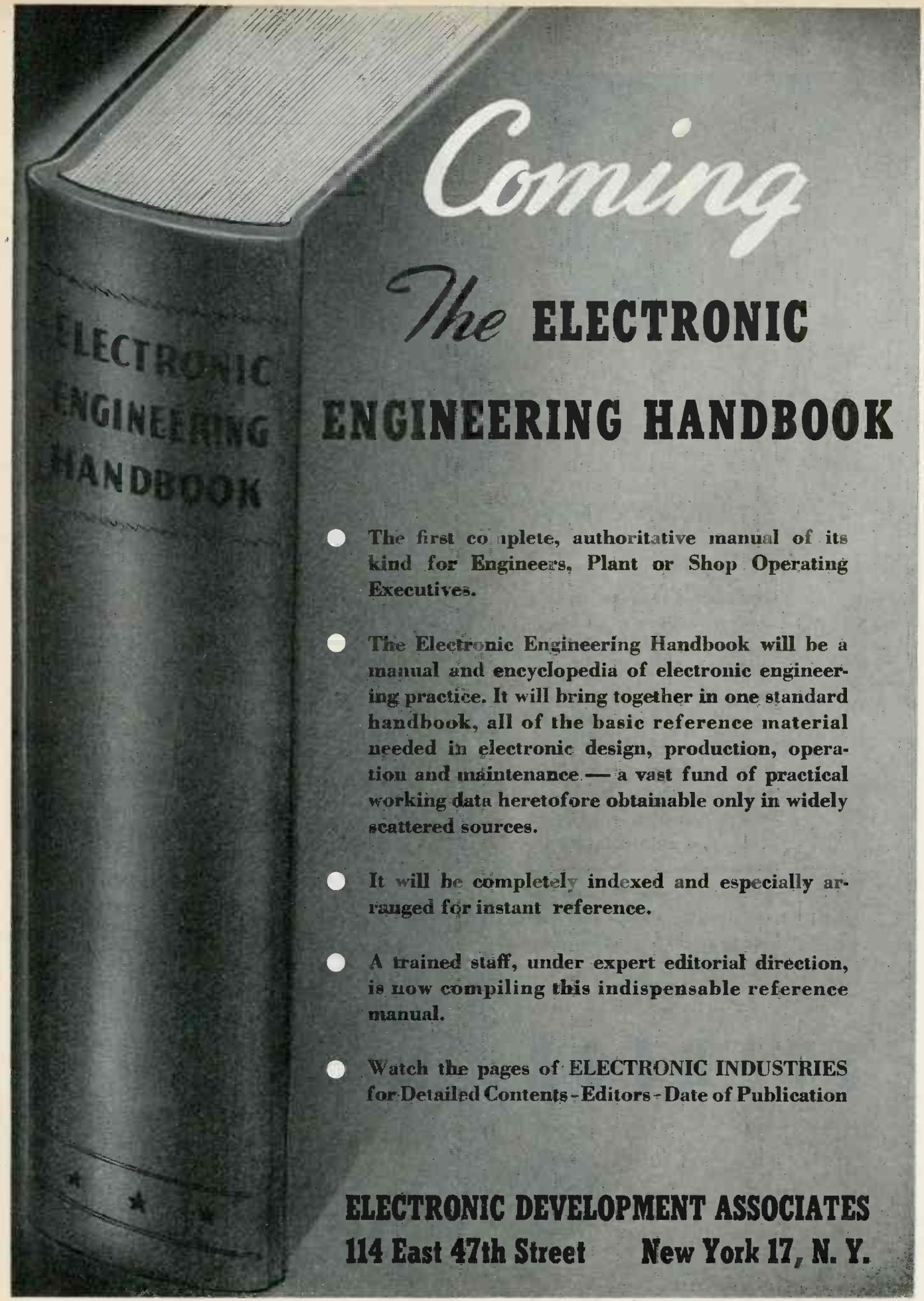

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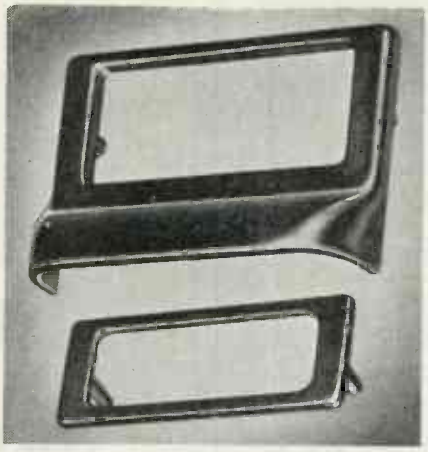

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ELECTRON TUBES AS ELEMENTS OF CONTROL

Referring to chart tipped in between pages 65-72.

For further research

In following up some of the circuit details illustrated on the colored chart on Industrial Control supplied in this issue, some may desire additional information.

Since it has been impossible to give complete details about all of the methods listed for making electron tubes handle unusual functions the following supplementary reading may be referred to on items of particular interest. There are many other sources of information on most of these items however, but those references listed are from readily obtainable sources.

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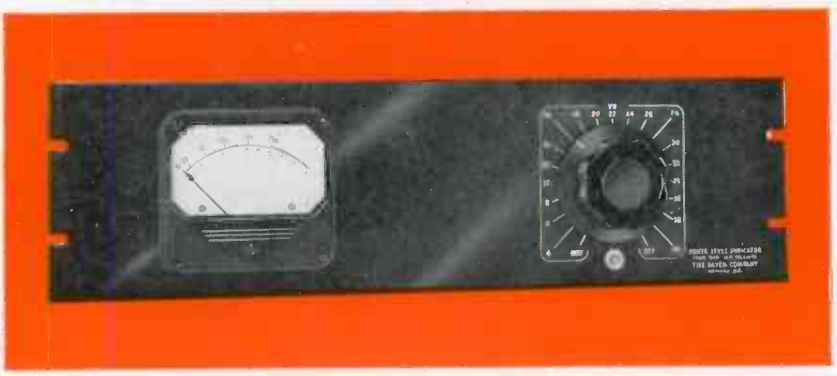

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