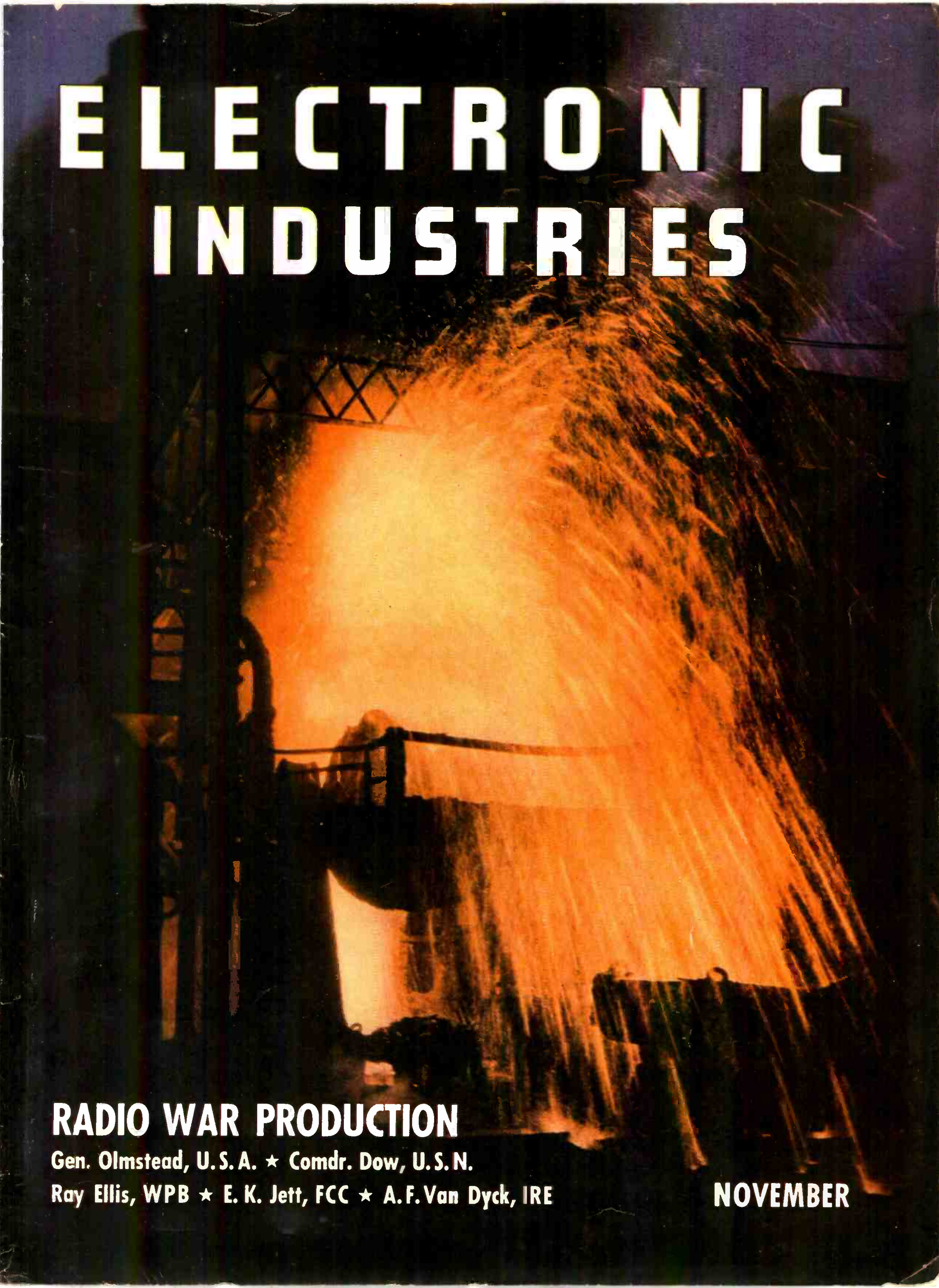
ELECTRONIC INDUSTRIES

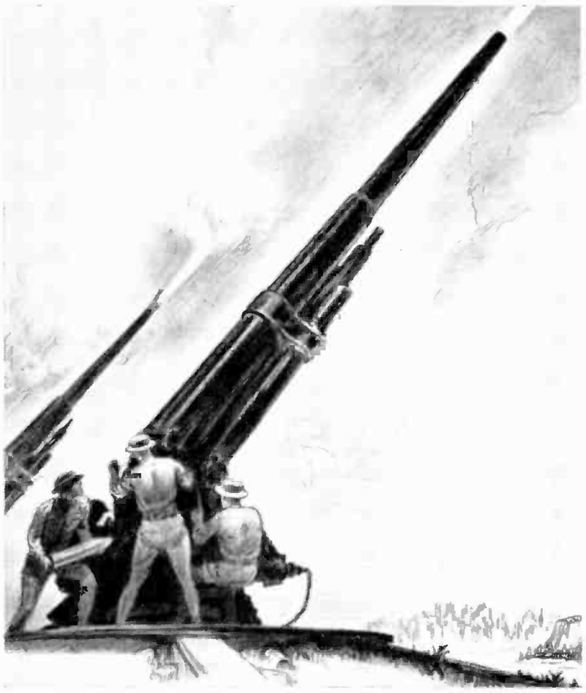


RADIO WAR PRODUCTION

Gen. Olmstead, U.S.A. ★ Comdr. Dow, U.S.N.
Ray Ellis, WPB ★ E. K. Jett, FCC ★ A.F. Van Dyck, IRE

NOVEMBER

Trained on the Target . . .
Thanks to Mallory Approved Precision Products



In the laboratories of a leading institution, electronic wizards have worked out a Yankee invention that's going to help Uncle Sam's anti-aircraft gunners bring 'em down far more often.

It's an electrical control apparatus that works in conjunction with a modern listening device. When a plane is heard . . . within a radius of 30 miles . . . this new electronic instrument predicts the plane's course mathematically, then helps aim and fire anti-aircraft guns automatically. Its accuracy is uncanny.

This new anti-aircraft "predictor", like many other military devices, includes such Mallory Approved Precision Products as switches, condensers, volume controls, jacks and plugs, which were supplied to the inventors by their neighboring Mallory Distributor.

Electronic engineers in many research laboratories . . . working on both military and industrial devices . . . have learned that it pays to keep in touch with the Mallory Distributors nearby. In many cases, the Mallory Distributor acts like a branch of the purchasing department . . . helping engineers to make out specifications quickly and easily, speeding up ordering and delivery of Mallory parts, and eliminating yards of red tape.

There are 253 Mallory Distributors from coast to coast . . . ready to serve you efficiently whether you need electronic parts for test or experimental work, for replacements in plant equipment, or for manufacturing some electrically operated product.

Call your nearest Mallory Distributor *today*. Ask him—or write us if you don't know his name—for your free copy of the latest Mallory catalog . . . used as a buying guide in the aeronautical, automotive, electrical, geophysical, radio and other industries.

Write today for free catalog describing entire line of Mallory Approved Precision Products.

P. R. MALLORY & CO. Inc.
MALLORY
APPROVED PRECISION PRODUCTS

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

PREFERRED *for* PERFORMANCE

IRC

RESISTORS

***"In your opinion, is any particular line of resistors superior to the others?"**

This question was put by an independent research organization to a country-wide list of Engineers and Executives in the electronics field. No brand of resistors whatever was mentioned in the questionnaire. **Result:** ***IRC was voted "superior" by more than twice as many as named any other single brand.***

IRC flies the flag of the Army-Navy Production Award

INTERNATIONAL RESISTANCE COMPANY

405 N. BROAD STREET • PHILADELPHIA

ELECTRONIC INDUSTRIES

November, 1942

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In this Issue

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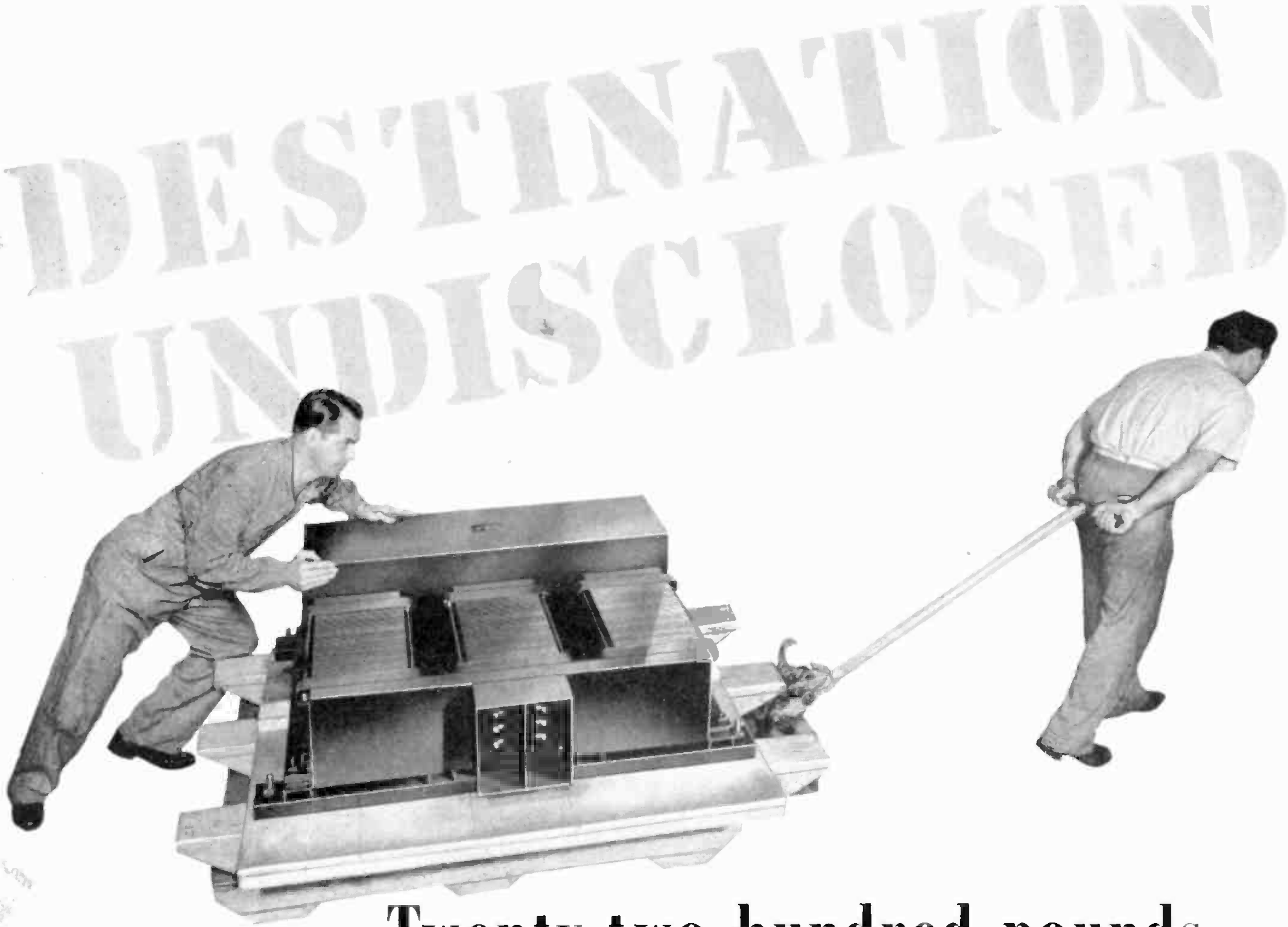


Twenty-two hundred pounds of Constant Voltage...

Somewhere on the industrial firing line this huge 3-phase unit is taking its place with the thousands of other Sola Constant Voltage Transformers that are rendering distinguished service in winning the all important battle of production.

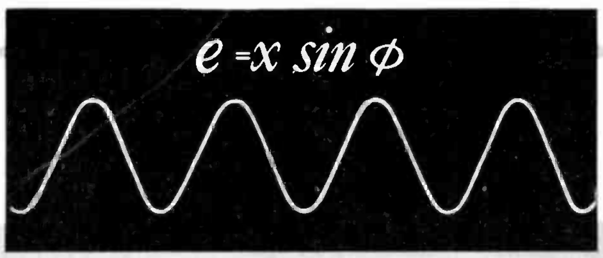
This war has placed a premium on *precision*. It demands a steady flowing production line of all materials of war.

In the industries that are geared to war production, Sola Constant Voltage Transformers are one of the principal contributing factors towards the maintenance of peak efficiency, twenty four hours a day, seven days a week.

Day and night, without manual control or supervision, Sola Constant Voltage units are transforming the unreliable voltages of heavily loaded supply lines into perfectly regulated power—on the production line, in the laboratory or in the field—protecting vital precision machines and instruments against line surges or loss of efficiency.

We have helped hundreds of industrial plants solve their most perplexing problems. We can help you solve yours

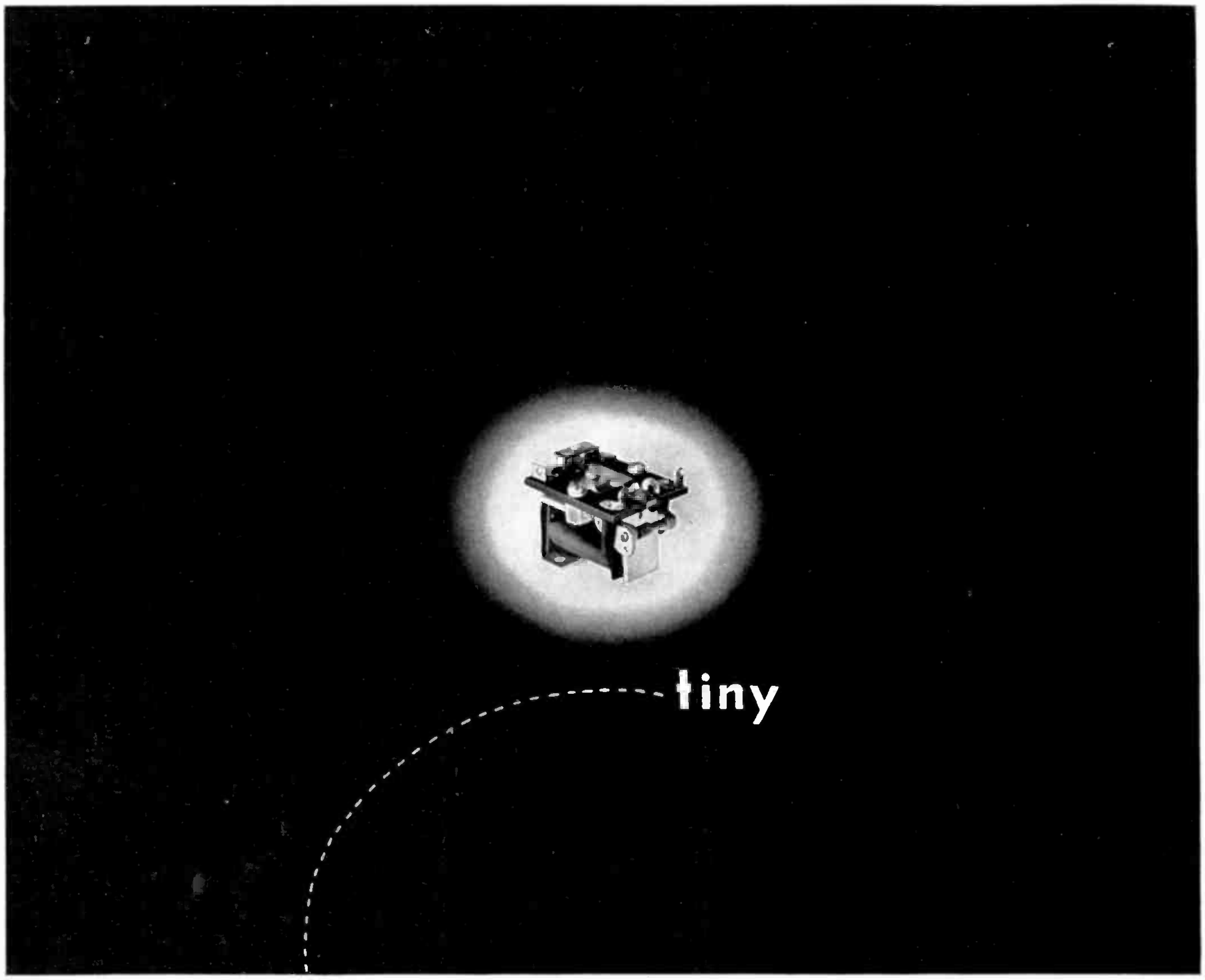
Write for Bulletin **DCV-74**



SOLA
ELECTRIC COMPANY
2525 Clybourn Avenue
Chicago

SOLA CONSTANT VOLTAGE TRANSFORMERS

To man's stature in 8 years



but **efficient**

Relay by Guardian

★ This tiny relay weighs less than an ounce but it's a cocky and energetic little bantam . . . full of life and fight—in a small way, of course—but plenty sufficient for its job in aircraft and radio where small size and light weight are at a premium. And tough, too . . . tough enough to withstand 10 g's vibration. Like to know more about it? A post-card will do—ask for Bulletin on the 195 series. No obligation.

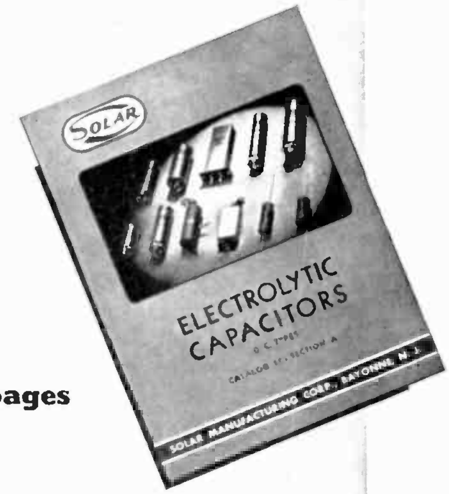
GUARDIAN ELECTRIC

1622 WEST WALNUT STREET CHICAGO, ILLINOIS

LARGEST LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

CAPACITOR GUIDES FOR BUSY ENGINEERS . . .

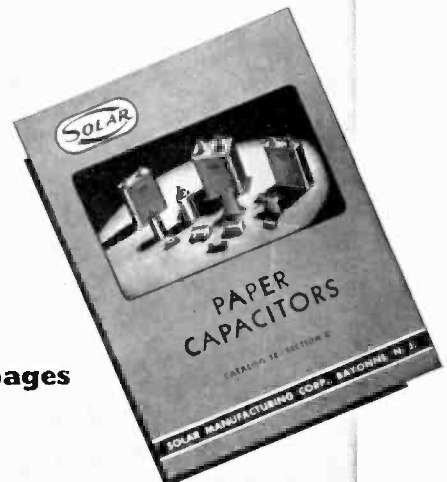
These new catalogs will help every engineer! They have been specially designed so that "he who runs may read" — and will simplify your capacitor-preference problems. Your letterhead request will immediately obtain any or all of the three catalog sections shown.



32 pages

ELECTROLYTIC CAPACITORS:

Thirty-two page Catalog 12 — Section A. Complete illustrations and descriptions of both wet and dry electrolytics for every purpose. Includes special constructions, such as low-temperature types for Government and industrial requirements.



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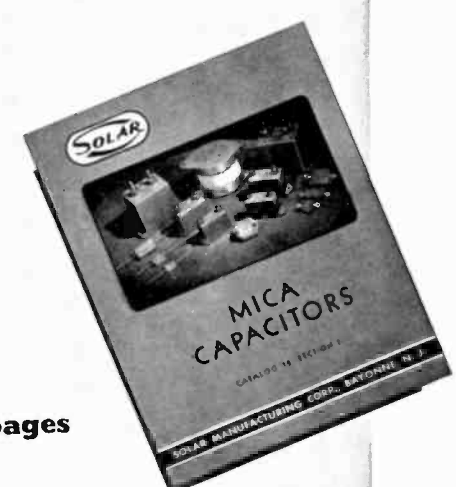
PAPER CAPACITORS:

Forty-eight page Catalog 12 — Section C. Complete illustrations and descriptions of all types of paper capacitors, including oil types, for broadcast and transmitting circuits. Also incorporates special types for unusual electronic applications.



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MICA CAPACITORS:

Thirty-two page Catalog 12 — Section E. Complete illustrations and descriptions of a wide variety of mica capacitors for both broadcast and transmitting applications. Includes many special constructions.

MICA CAPACITOR COLOR-CODES:

Industry color-coding standards are clearly defined in separate Solar Form MCC-1, available to all capacitor users.

SOLAR MFG. CORP. **Bayonne, N. J.**


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NAVY
"WELL DONE".. SAY OUR ARMED FORCES TO
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IN WARTIME
Motorola Mobile and Portable 2-Way F. M. Communication Systems for Our Armed Forces
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IN PEACETIME
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DESIGNED AND ENGINEERED TO FIT SPECIAL NEEDS
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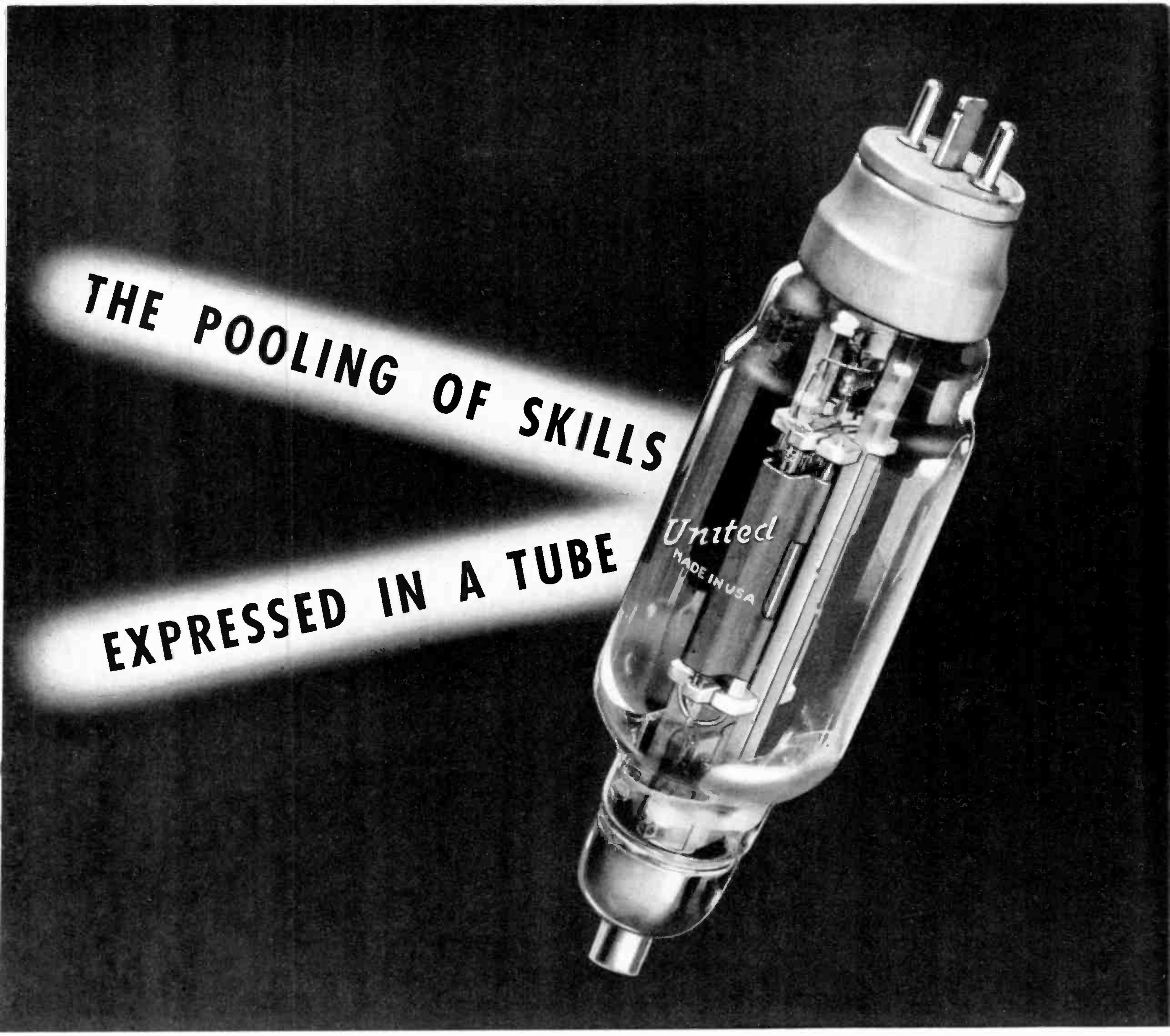
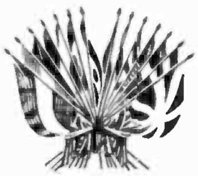




LONG BEFORE "UNITED" symbolized the might of Nations at War, the term possessed a vital significance in electronics.

"United" expressed the vision of a company that undertook to pool, under one roof, the skills of distinguished technicians, engineers and craftsmen, specializing solely in transmitting tubes.

Under the scrutiny of these electronic specialists have come scores of transmitting tubes, built to a degree of precision, hitherto unknown.

Today, the products of "United" are performing flawlessly in key sockets in countless transmitting instruments of our armed forces. Tomorrow—tempered under the fire of war—"United" products of advanced technical design will meet the exacting post-war requirements of Radio Communications, Physiotherapy and Industrial Electronics. Look for the name "United" on each tube.

UNITED ELECTRONICS COMPANY

NEWARK NEW JERSEY

Exclusive features of this compact power rheostat assure you 25% more capacity for handling possible overloads,—and consequently more heat dissipation—less temperature rise without taking up more space. The deeper winding form gives more wire, more surface area.

Our patented contact system, completely enclosed in the body of the rheostat, makes possible a maximum depth of winding space for any given back of panel space. The metal-graphite contact shoe, molded on a coiled pigtail, is the sole sliding electrical contact. It travels smoothly on the inside circumference where the turns of wire are most closely spaced. Each turn is a separate resistance step.

The terminals are *rugged screws* integral with the body of the rheostat,—another exclusive advantage.

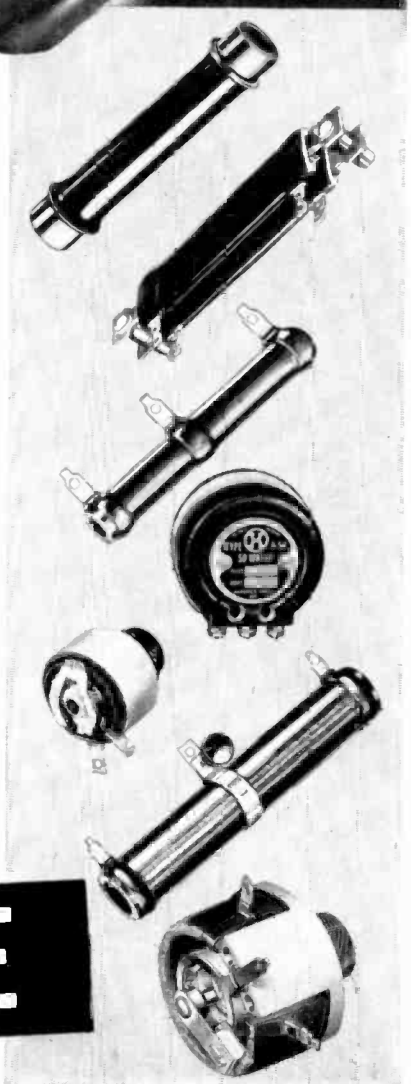
There are no organic parts to char, in this metal—porcelain vitreous enamel construction. All live parts are enclosed to eliminate many dangers and possible short circuits.

This rheostat is designed to give full protection from dirt and mechanical damage, as well as maximum ventilation.

Eight standard sizes in a wide range of resistance values—tandem fittings—tapered windings, etc.

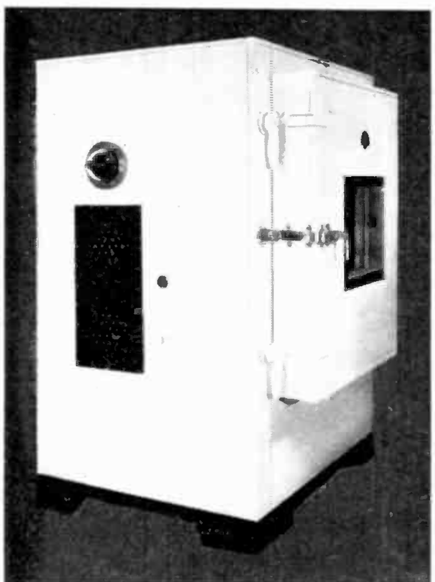
We offer many other types of rheostats and resistors with important exclusive advantages. Please consult us.

HARDWICK, HINDLE, Inc., Newark, N. J., U. S. A.



HARDWICK, HINDLE

Down to the Burning Sands of the Desert!



RATE OF EVACUATION ON STANDARD EQUIPMENT:

Altitude	*Time*
10,000 feet	1 minute
20,000 feet	2 minutes
30,000 feet	3 minutes
40,000 feet	5 minutes
50,000 feet	7½ minutes

● In Egypt, that's the daily stint of these giant Flying Fortresses. And delicate instruments on their panels *have to stand the gaff*—from biting cold to scorching heat!

The "TENNEYZPHERE" High Altitude Chamber is built for exacting tests of instruments that have to undergo just such punishment. These units meet the test requirements of all U. S. Government Agencies: Army Signal Corps, Navy Bureau of Aeronautics, National Advisory Committee for Aeronautics.

Standard range of temperatures run from —40° to 150° Fahrenheit a range that can be widened or narrowed to meet special requirements. Observation ports, permitting full visibility, are sealed to prevent interior condensation. The interior of the "TENNEYZPHERE" Chamber is scientifically air-conditioned to meet the engineer's strictest requirements as to pressure, temperature and humidity.

For illustrated booklet describing Tenneyzphere High Altitude Chambers, Constant and Variable Temperature Baths, Humidity Chambers and All-Weather Rooms, with tables giving specifications for many important installations write Dept. EI.

TENNEY ENGINEERING, INCORPORATED

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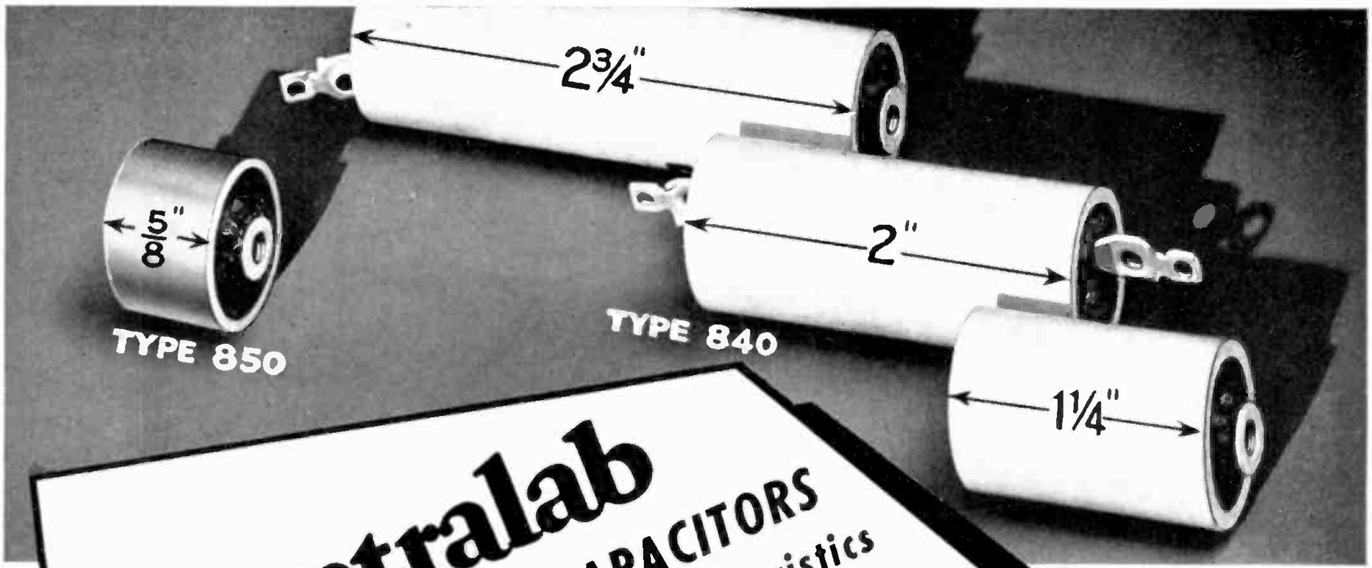

Centralab
CERAMIC TUBULAR CAPACITORS with Temperature Controlled Characteristics

Another important Centralab development in tune with our present war efforts. These parts are definitely suited to high and ultra high-frequency circuits.

Your inquiries are invited for special capacity problems in which Ceramic capacitors are indicated.

TYPE 840 High Capacity

Available in any temperature coefficient from zero to —.00075 mmf/mmf/C°.

(1) Zero Temperature Coefficient up to 1500 MMF.
(2) Negative Temperature Coefficient up to 3000 MMF.

SIZE: .780" diameter Steatite tube — length varies with capacity and temperature coefficient.

500 MMF	NTC	approximately	¾"	long.
1000 MMF	NTC	approximately	1"	long.
500 MMF	ZTC	approximately	¾"	long.
1000 MMF	ZTC	approximately	1½"	long.

Power factor of .05% — does not increase with ageing.

Voltage rating — 1000 volts D.C. Leakage more than 10,000 megohms.

Terminals — two types available:

(1) Lug .030" thick threaded for 6-32 machine screw, or conventional soldering
(2) Axial mounting post with 6-32 machine screw thread.

TYPE 850 High Frequency, High Voltage Unit

Capacity ranges 10MMF to 100MMF and intermediate values. Available either Zero or Max. Negative temperature coefficient. Standard tolerances as to coefficients and capacity. Size ⅝" long. .765" diameter, exclusive of terminals.

Power Factor .05% does not increase with ageing. Voltage rating 5000 volts D.C. A.C. voltage rating varies with frequency.

Terminals available in two types; same as Type 840.

CENTRALAB: Div. of Globe-Union Inc., Milwaukee, Wis., U. S. A.


"FIGHTING" MICROPHONES
in the Din of Battle
SHURE
In a Flying Fortress . . . in a General Grant . . . in a battleship or a shell hole . . . when the Microphone switch is pressed — the message must get through! Millions of lives may depend on it. This is the supreme test. Microphones made by Shure Brothers are in action on fighting fronts all over the world. Shure Microphones pass this supreme test because they have survived engineering and production tests more destructive than conditions they meet in service. These "Fighting Mikes" do their part in serving the cause of Freedom.
SHURE BROTHERS
Designers and Manufacturers of Microphones and Acoustic Devices
225 West Huron Street, Chicago, U. S. A.

TIMELY DATA ON CATHODE-RAY TECHNIQUE

★ The bi-monthly **DuMont Oscillographer** is keeping an ever-widening circle of readers posted on cathode-ray oscillography and allied developments. Most readers are maintaining a file of copies, which amounts to a good reference work on cathode-ray technique. A **free subscription** may be had by addressing Allen B DuMont Laboratories, Inc., Passaic, N. J.

NEW 1943 CATHODE-RAY REFERENCE MANUAL

★ After months of preparation, DuMont engineers are finishing the last few pages of the new 1943 **DuMont Reference Manual.** This loose-leaf 8½ x 11" book is the most comprehensive manual yet published on the subject. In addition to extensive listings and concise descriptions of DuMont oscillographs, accessories, cathode-ray and associated tubes, there is a considerable amount of engineering data on the selection and application of such equipment. A copy may be had by writing on your business letterhead to Allen B. DuMont Laboratories, Inc., Passaic, N. J.

NEW OSCILLOGRAPH WITH GREATLY EXPANDED FREQUENCY RANGE

★ Critical wartime requirements are responsible for a new cathode-ray oscillograph characterized mainly by a greatly expanded frequency range, more versatility in the handling of applied signals and special pickup means whereby input capacitance is reduced and stray pick-up eliminated. The removable front cover protects panel, controls and tube screen, and holds the shielded cable test probe, when instrument is not in use. Known as the DuMont Type 224, this instrument has a vertical deflection response uniform from 20 c.p.s. to 2 million cycles. It has a comparably faithful square and sinusoidal wave response. The horizontal deflection amplifier response is uniform from 10 c.p.s. to 100 kilocycles. Both amplifiers have distortionless input attenuators and gain controls. Widest variety of signal connections are available. Write to Allen B. DuMont Laboratories, Inc., Passaic, N. J., for detailed literature.

LOW-FREQUENCY LINEAR-TIME-BASE GENERATOR

★ Still another outstanding contribution to cathode-ray oscillography is provided by the new DuMont Type 215 Low-Frequency Linear-Time-Base Generator. This accessory instrument for use with the DuMont 175A or equivalent oscillograph, permits studies requiring sweep frequencies as low as 1 cycle every few seconds. In fact, the frequency sweep range is 0.2 to 125 cycles per second. The undistorted output signal is approximately 450 v. peak-to-peak. Single sweep is initiated either manually or by observed signal. Excellent linearity is assured by a feedback compensator circuit. When used with DuMont 175A Oscillograph, the pattern may in effect be spread out to an extent corresponding approximately to three times full scale deflection, or 15". Explicit engineering bulletin available by writing Allen B. DuMont Laboratories, Inc., Passaic, N. J.

ELIMINATING DISTORTION DUE TO FREQUENCY DISCRIMINATION

★ The input attenuator of an oscillograph may, quite unknown to its operator, be causing distortion due to frequency discrimination previous to amplification. In fact, DuMont engineers have frowned on the use of a wide-band deflection amplifier when the input attenuator gives rise to pre-distortion of the signal. By including a cathode-loaded input stage in Types 208 and 224 Oscillographs, and placing the variable attenuator in the low-impedance cathode circuit, DuMont engineers have eliminated the effects of changes in distributed capacitance influenced by the setting of the potentiometer rotor. Thus the overall transmission characteristic is the same at all settings of the gain control. This is one of the several reasons for the outstanding popularity of DuMont Types 208 and 224 Oscillographs today.

DU MONT

the Cathode-Ray Pioneer

A decade ago Allen B. DuMont had an idea — and a fond hope: to make the cathode-ray tube an everyday, commercial, mass-produced device at a within-reach price.

Today that idea and hope are fully realized. Rugged DuMont cathode-ray tubes are used under the most gruelling conditions in plants, out in the field, in laboratories, by technicians and workmen alike.

And DuMont pioneering continues. Constant refinements in design and construction; improved production methods; a steadily growing fund of application experience — these are all yours when you specify DuMont cathode-ray tubes and Dumont oscillographs. Write for data.

DUMONT

ALLEN B. DU MONT LABORATORIES, Inc.
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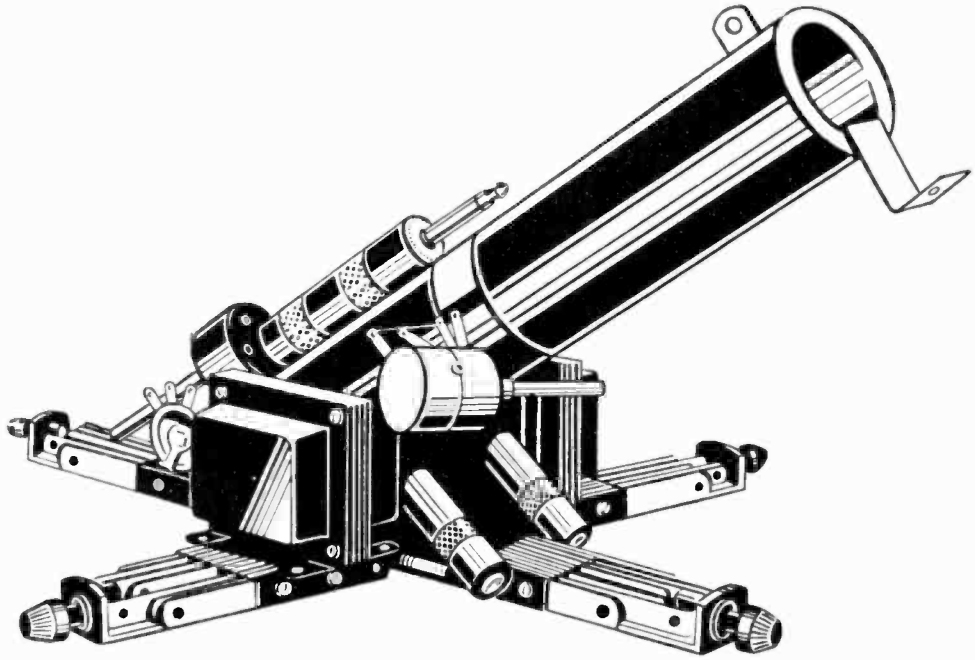
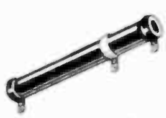


UTAH PARTS are RECOGNIZED
for their dependability under fire

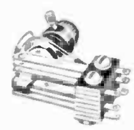
Again Utah Carter parts are proving their dependability. In scores of different products they are meeting innumerable requirements—in all branches of the Services—Signal Corps, Army, Navy, Air Corps and important civilian communications. Because dependable performance is assured at every Utah point, the proper functioning of the entire unit is protected.



UTAH RESISTORS have a minimum of two separately fired coats of vitreous enamel, forming a hard glassy surface. Resistors are available from 5-200 watts, either as fixed, tapped or adjustable. Also, non-inductive types.

UTAH JACKS owe their popularity to their compact size and high quality. The unique and patented design of the "Imp" Jack makes it the smallest jack to fit standard phone plugs. Long and Short Frame types also to meet standard plugs. Special Jacks to meet Signal Corps and Navy specifications.

UTAH SWITCHES are made to meet the circuit and space requirements you need. Available in the Long and Short Frame and "Imp" types. Small and compact, they are built to take minimum panel size.



UTAH PHONE PLUGS are designed to meet your needs—whether it's application, size or type. Two and three conductor types, they are compact, sturdy and dependable, and fit standard phone jacks. Utah is manufacturing Army Signal Corps type PL-55 plug.

UTAH TRANSFORMERS are fully guaranteed. Absolute installation prevents them from breaking down even under extreme atmospheric conditions. The complete line permits Utah transformers to meet your requirements in choke, input, output and smaller capacity transformers.

Utah also manufactures Wirewound Controls, Speakers and Vibrators. Write for full details today.

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General Offices and Factory: 848 Orleans Street, Chicago, Illinois
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SPEAKERS
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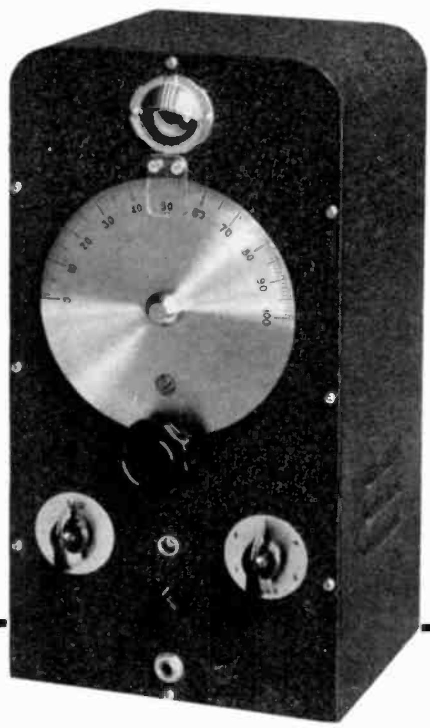
ELECTRONIC DESIGN

THE BROWNING LABORATORIES are specialists in the design and production of electronic equipment.

THE BROWNING ELECTRONIC SIGNAL SYSTEM, designed for boundary protection, is on guard night and day at various vital locations.



BROWNING
TYPE S-2
FREQUENCY
METER

THE BROWNING TYPE S-2 FREQUENCY METER is being widely used to check the frequencies of both FM and AM transmitters employed by police, utilities, and emergency services. Its salient features are:

★ Custom built and calibrated for specified frequencies.

★ Accuracy greater than .005%.

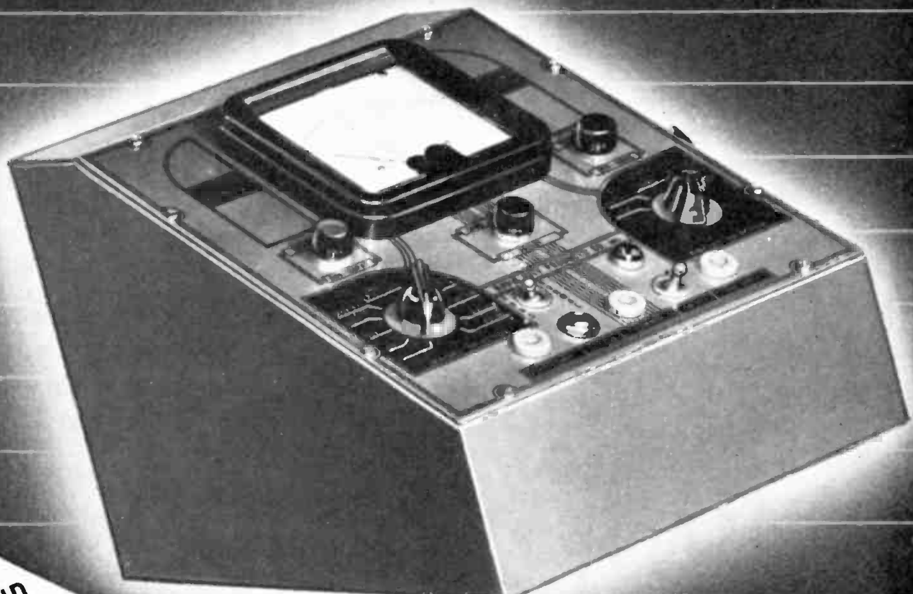
★ Cathode ray indicator allows accurate visual checks.

★ a.c.-d.c. operation.

BROWNING Laboratories INC
WINCHESTER·MASS·

MAXIMUM TESTING RANGE

WITH R. C. P.'s
NEW ELECTRONIC A. C.- D. C.
VACUUM TUBE VOLTMETER
OHMMETER AND
CAPACITYMETER



SPEEDS PRODUCTION TESTING AND SAVES VALUABLE ENGINEERING TIME IN LABORATORY

The new Radio City Product's Electronic Multitester Model 662 combines sensitivity with maximum utility and flexibility. Simple to read—simple to use, this instrument is suitable for either production line or accurate laboratory test purposes; in extensive use by U.S. Signal Corps.

• Here are a few of the outstanding features of this unusual instrument:

A genuine vacuum tube voltmeter on A.C. • A.C. Voltmeter measures signal and output voltages • Comprehensive capacity meter reads directly in microfarads—40,000,000 to 1 ratio • No danger of shock on low capacity measurements—no test leads to short—no resetting when changing ranges • Meter cannot be damaged by checking live resistors or by using a low range scale on high voltages • Voltmeter readings taken without affecting constants of circuit being checked • Matched pair multiplier resistors 1% accurate • Regulator tube and associated circuits control line voltage fluctuations • 2% accurate 4½" microammeter.

RANGES:

D. C. VACUUM TUBE VOLTMETER-DIRECT READING.
Sensitivity: Input Resistance — 160 megohms (high ranges); 16 megohms (low ranges).
Range: 0-6-30-150-600-1,500-6,000 volts.

A. C. VACUUM TUBE VOLTMETER-DIRECT READING.
Input capacity only .00005 mfd. Input resistance 160 megohms (high) and 16 megohms, (low).
Range: 0-3-6-30-150-600-1,500-6,000 volts.

VACUUM TUBE OHMMETER-DIRECT READING.
From the lowest scale division .1 ohm to 1,000 megohms.
Range: 0-1,000-10,000-100,000-1 megohm -10 megohms-100 megohms-1,000 megohms.

VACUUM TUBE CAPACITY METER-DIRECT READING.
Accurate measurements from .00005 to 2,000 mfd.
Range: 0-.001-.01-.1-1.-10-100-2,000 mfd.

Supplied in rugged, welded, crystalline gray finish steel case. Size: 9¾" x 9¾" x 7¼". Complete ready to operate **$47.50**
Model 662 V-7 with 8½" meter........ **$61.50**

VOLT • OHM • MILLIAMMETER—MODEL 423

Meter sensitivity 2,500 ohms per volt. 5 D.C. ranges 0-1,000 volts. 4 A.C. ranges 0-1,000 volts. 4 D.C. ma. ranges 0-1,000. 4 ohmmeter ranges 0-10 megs. db. range minus 10 to 55. Meter 2% accurate.
In portable case, complete **$25.95**

Other instruments in the complete line of R.C.P. electronic and electrical test instruments described in catalog No. 126.

If you have an unusual problem calling for either laboratory or production line test instruments, our engineers will be glad to cooperate in finding the most efficient and economical solution.

RADIO CITY PRODUCTS CO., INC.

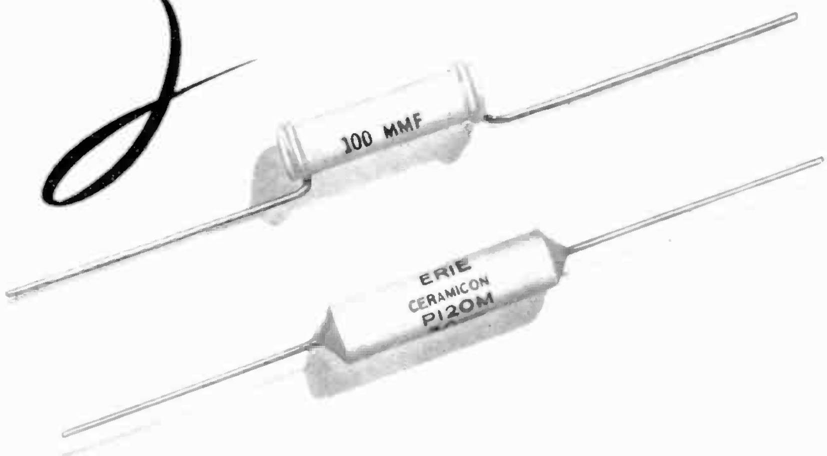
127 WEST 26 STREET • NEW YORK CITY

MANUFACTURERS OF QUALITY — ELECTRONIC LIMIT BRIDGES — VACUUM TUBE VOLTMETERS — VOLT - OHM - MILLIAMMETERS SIGNAL GENERATORS — ANALYZER UNITS — TUBE TESTERS — MULTITESTERS — APPLIANCE TESTERS.

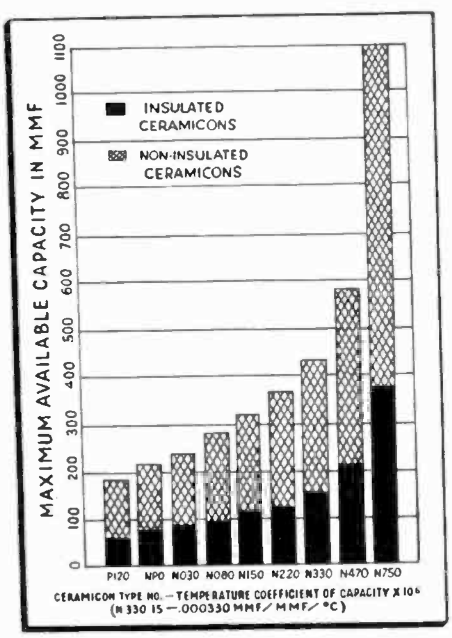
● Here is another of Farnsworth's distinguished new series of television advertising now running in *Life, Fortune, Business Week, Time, The New Yorker, Newsweek* and *U. S. News*. When the war is finally won and television becomes a living reality in the homes of the nation, you may be sure that Farnsworth will be outstanding in musical reproduction and television fields.

ERIE Ceramicons

REG. U.S. PAT. OFF.



• Provide dependable compensation for frequency drift in high frequency communications



WITH the supply of high grade mica becoming more limited each day, standard Erie Ceramicons, which employ a ceramic dielectric, are helping to relieve this shortage.

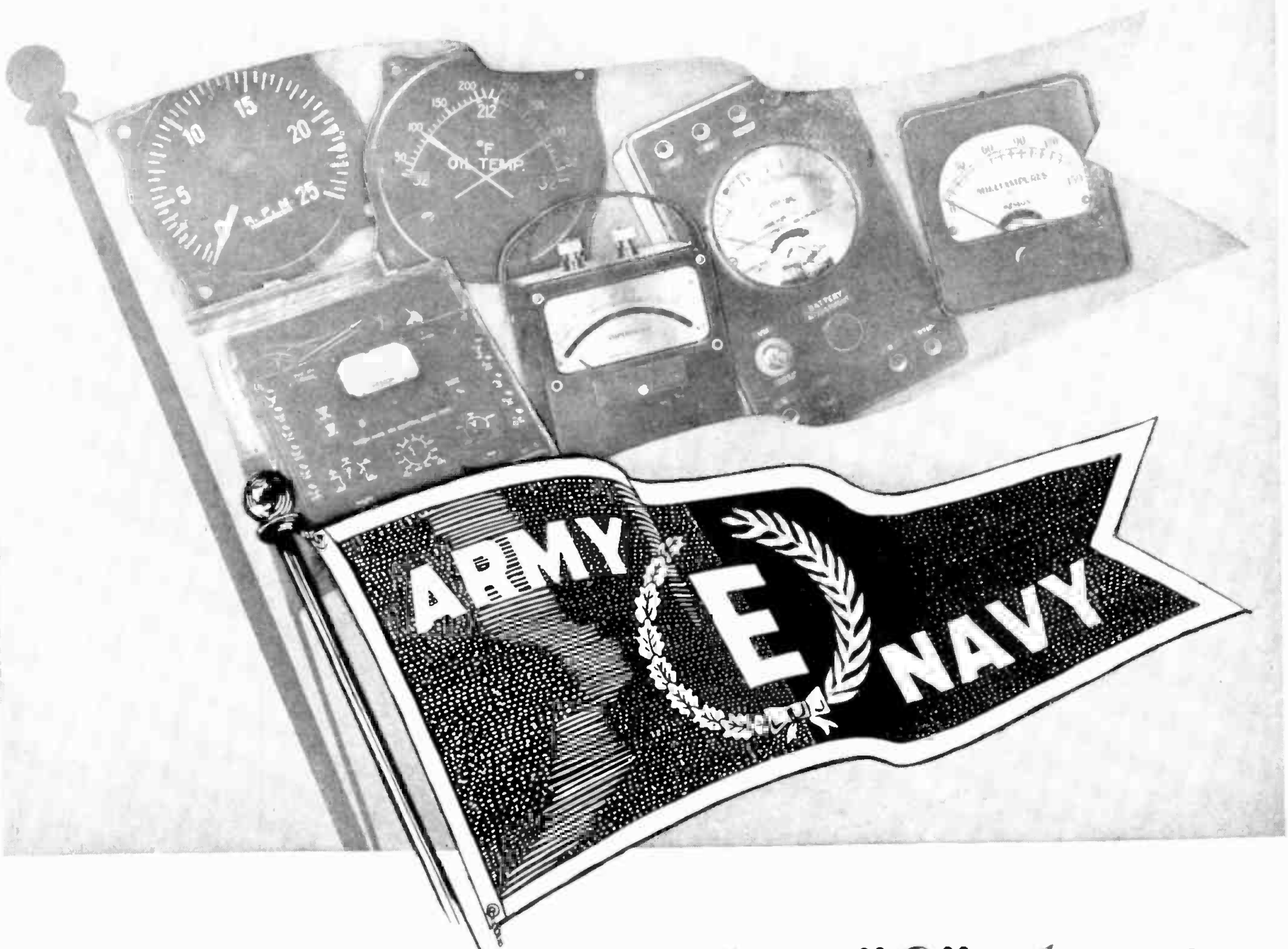
The inherently stable retrace characteristics of Erie Ceramicons with respect to temperature insures dependable compensation for frequency drift. When properly used, one of these small, silver-ceramic condensers will accurately compensate for drift caused by temperature changes in any number of components in the circuit.

Erie Ceramicons are made in nine different temperature coefficients from +120 parts per million per °C to —750 parts per million per °C, according to tentative RMA standards. Insulated Ceramicons are made in capacities up to 375 mmf; non-insulated units up to 1100 mmf, as shown in the table at the left.

We suggest that you check your specifications for silver mica and other types of mica capacitors for possible change-over to Erie Ceramicons. Write for data sheet which gives complete characteristics of Erie Ceramicons.

ERIE RESISTOR CORP., ERIE, PA. LONDON, ENGLAND · TORONTO, CANADA.

WESTON



Receives the Army-Navy "E" Award

"On LEADERSHIP rests the responsibility for getting things done."

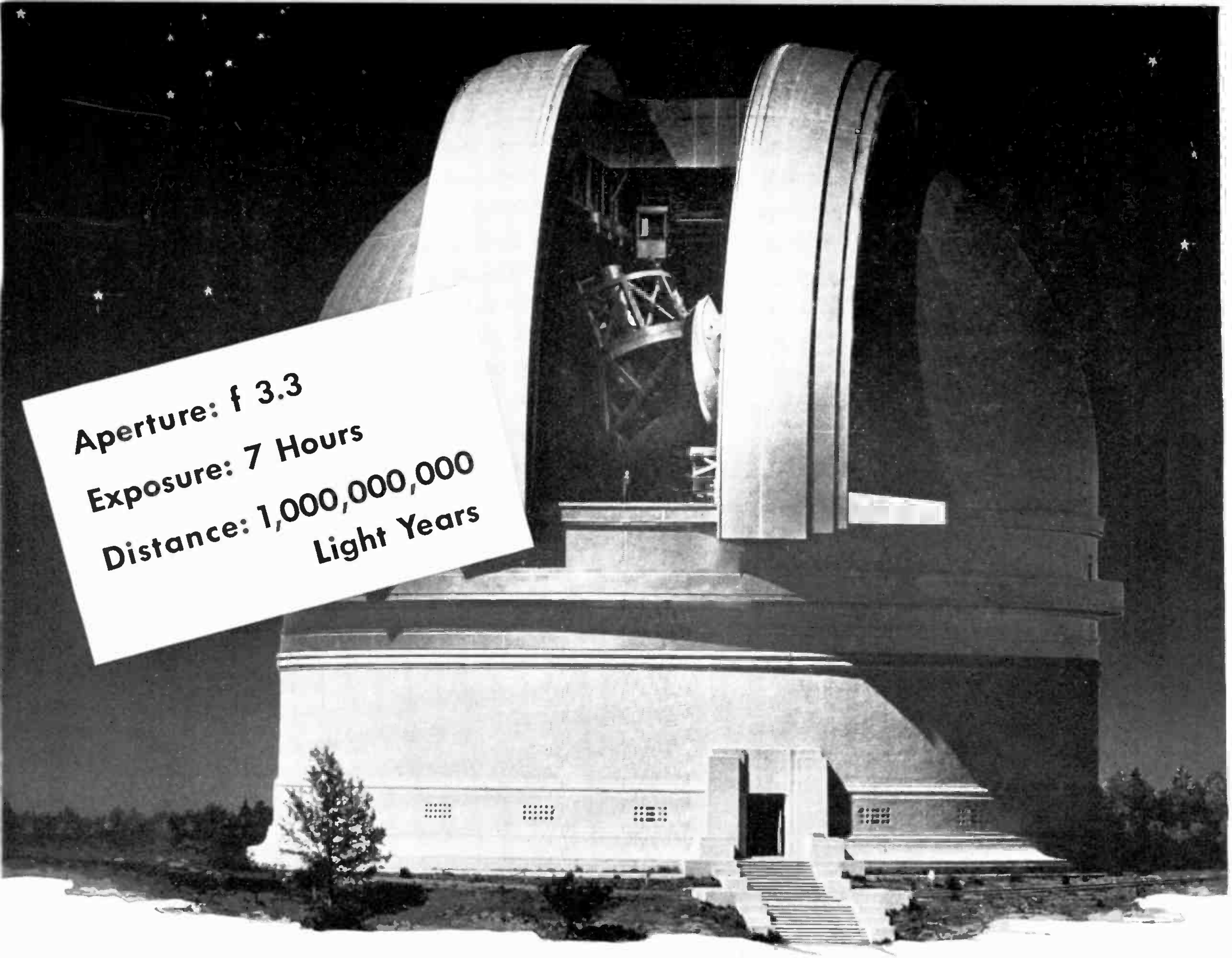
Only short months ago, the instrument goal in this mechanized war seemed unattainable. In almost unbelievable quantities instruments were needed for our huge plane program—for a two-ocean navy—for tanks, guns and walkie-talkies — for our arsenals and factories — and for countless new devices of war.

To approach this goal meant far more at WESTON than the mere addition of factory and laboratory equipment, and the usual worker-training program. It meant imparting to untrained hands the skill and instrument sense which ordinarily takes years to acquire. For it's this rare instrument sense, backing up sound engineering, which has been responsible for WESTON's continued leadership.

This "E" award to the workers at WESTON—the first to any group in this specialized field—means recognition of their efforts in striving to attain the goal in numbers, while never relinquishing the WESTON quality ideal.

And to our courageous fighting men everywhere, it conveys the assurance that they can depend on the men and women at WESTON to continue furnishing the essential instruments in ever increasing quantities . . . *until victory is won.*

WESTON ELECTRICAL INSTRUMENT CORPORATION, NEWARK, N. J.



ELECTRONIC *KEEPS IT "ON THE BEAM!"*

● A specially designed Electronic Power Supply will hold this 200-inch telescope of Mount Palomar Observatory accurately on its objective when it photographs new outposts of the universe for the first time! Objects, far too distant for visual observation, will be recorded on long-exposure photographic plates. The Electronic Power Supply, incorporating frequency synchronization, will help keep the telescope trained on its object throughout the long period of photographic exposure.

Electronic specializes in vibrator-type power supplies, designed to convert DC to AC or to higher voltage DC. An outstanding Electronic development has been constant frequency, or controlled variable frequency converters for synchronizing two or more electrical units.

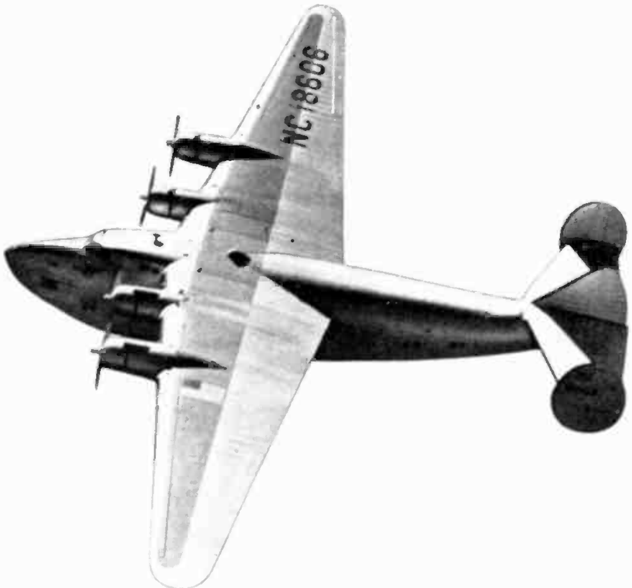
The Mt. Palomar installation is but one example of the resourceful engineering, precision manufacture, and outstanding performance which have made Electronic Power Supplies so effective on military aircraft, tanks, walkie-talkies, mobile amplifiers, jeeps, P-T boats! And after the war Electronic products and engineering service will be on the job for you again—better and more useful than ever because of their combat experience!

ELECTRONIC LABORATORIES, INC., INDIANAPOLIS, INDIANA

for POWER SUPPLIES *remember* ELECTRONIC

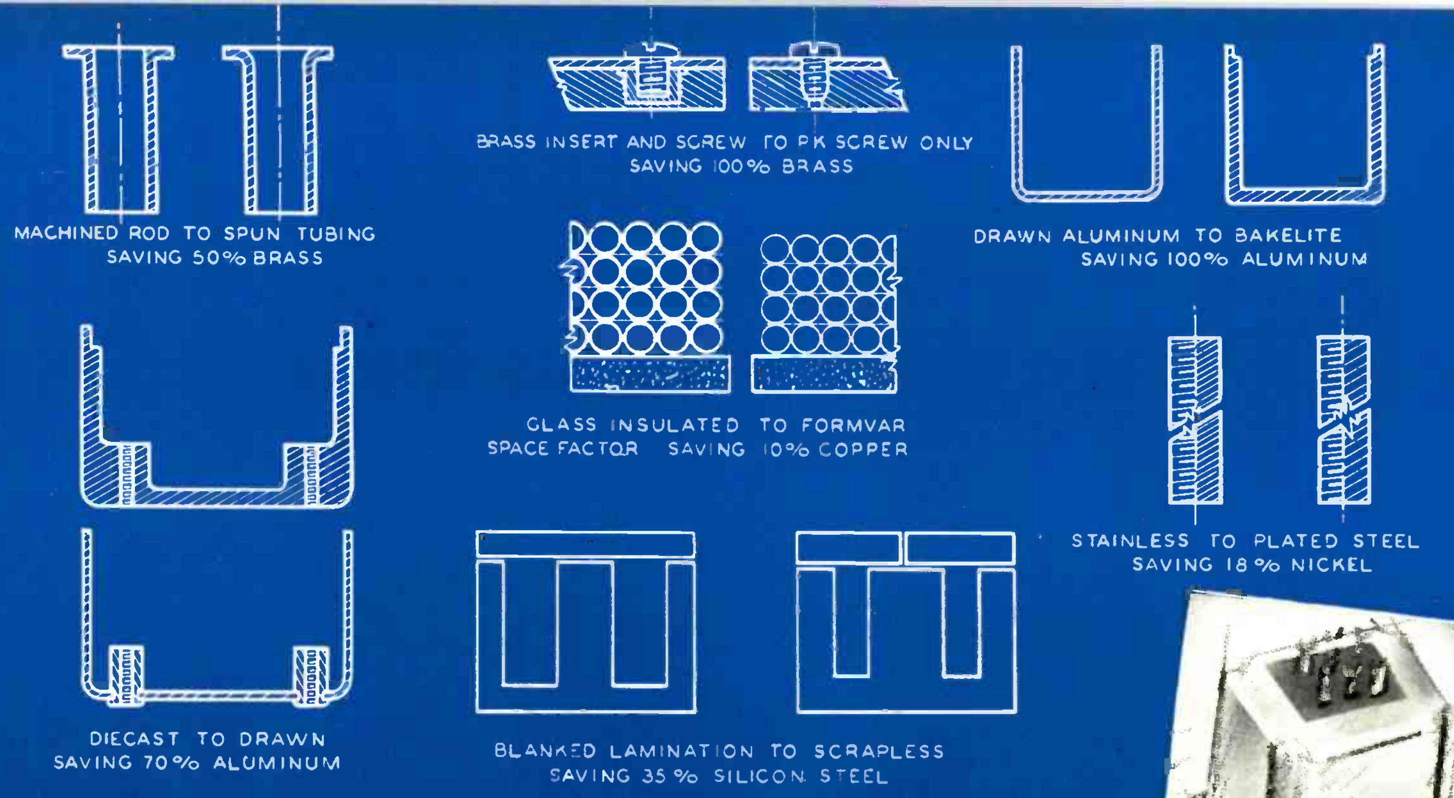
PHOTOS COURTESY OF PAN AMERICAN AIRWAYS, INC.

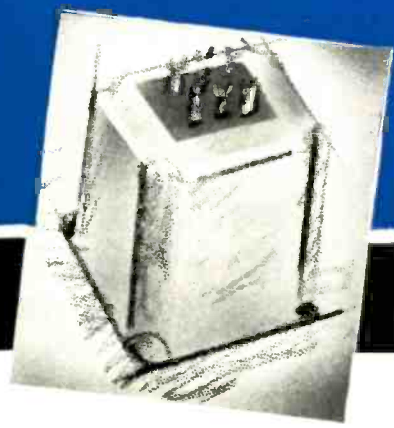
WHAT IS INSIDE A CLIPPER?



Well, take a look at the picture above. Most of a Clipper's equipment is unfamiliar to the uninitiated, but the clean efficiency revealed in every detail needs no description here. For in a Clipper, no detail is too small to be important, and no alibis are accepted. High as Pan American Airways' standards are, National parts "measure up."

NATIONAL COMPANY, INC.
MALDEN, MASS.





"and it can win or lose the war...

We all know that our greatest problem today lies in material shortages. The bulk of this problem . . . and it can win or lose the war . . . lies in our hands. A waste of materials, particularly critical materials, in an engineering design today, is as damnable as sabotage.

Here are a few cases in our organization:

1. **On one job our redesign combined two pieces of apparatus. The resultant unit, while more efficient, is smaller than either of the individual units. On the basis of projected requirements, the saving in aluminum alone is 500,000 lbs.**
2. **On this job our delivery schedule would have been delayed five months for the nickel iron core material and shielding cases required. Redesign made possible a unit using silicon core material and silicon shields with actually 10 DB less hum pickup than the original.**
3. **In this job substitution of a drawn aluminum housing for a die casting effected an aluminum saving of 70%.**

Designs must be improved constantly. Take a look at that job you have been running and see whether an extruded rod or a spun bushing won't save the scrap involved in a screw machine part. Check with the Government Engineering Bureau involved as to whether they would not allow a change in material to something lower on the critical list. You will be surprised at their cooperation.

Only when you can say to yourself, "There isn't one of my designs left that can be reduced in amount of material or to less critical materials," can you feel that your share in the War Program is effective.

UNITED TRANSFORMER CO.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

ELECTRONIC INDUSTRIES

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

Secrecy Is Delaying Radio Output

From studies which experts of the War Production Board are now carrying on in radio factories, it becomes evident that **our whole U. S. radio production schedule is being held back because the bright ideas and superior methods of one plant are not being made known to other factories.** An over-emphasis on secrecy is putting up walls between plants engaged in the same kind of radio production, so that efficiency discoveries in one shop never get around to the others!

Investigation by government experts reveals that every factory develops valuable production short cuts and methods that save time, material and manpower. Such improved techniques should be interchanged, not only between prime contractors and their own subcontractors, but between **all** concerns on war radio.

Help Exchange Factory Short Cuts

To this end, **Electronic Industries** offers its services as a patriotic duty to publish such improved manufacturing techniques for the benefit of all radio-engineering executives who can apply them to their own production problems.

Employees' prize suggestions are valuable sources of ideas, especially when illustrated with sketches and diagrams. Photographs showing close-ups of actual shop methods, workers, etc., are most valuable of all. Where these are in restricted areas of radio factories, the plant manager should get permission to take pictures from the local Government inspector, to whom the pictures will be turned over, the inspector to send them to Washington, with request for release to **Electronic Industries.**

Let's have ideas and pictures from your plant that will help speed U. S. radio production nation-wide!

"Electronic" Is The Word For It

"Electronic" is a word that grows increasingly current. A number of radio and non-radio manufacturers have recently added electronic divisions, and are playing up prominently these new branches of their activities.

The radio-parts distributors in June changed their name officially and legally to the "National Electronic Distributors Association." And in recent months in the RMA there has been a good deal of inside talk about bringing the broader term "electronic" into the manufacturers' corporate name. A strong feeling among some members is that "Electronic Manufacturers Association" would better define the wide and diversified production schedules of its member-companies, though this name might cause some confusion with the name of another manufacturers' group. At the present time the whole matter of a change of RMA's name is on the shelf, but may be taken up later.

Gen. Olmstead's Vast Army

A wise and humane policy has dictated that the present war shall be fought by the United States at a minimum cost of human life, though at the outlay of prodigious amounts of treasure and equipment.

This means an enormous mechanized outfit,—tanks, planes, and ships,—and tying them all together, radio apparatus on an undreamt scale.

The Signal Corps of the Army is now the largest user of radio, and its operations are chiefly devoted to handling radio equipment. A rapidly expanding staff has resulted, until now under General Olmstead's command there are more officers and men than served Napoleon, more than General Grant had in the Civil War, and more than General Pershing led in the Argonne in France!

Already the Signal Corps has contracted for about three billion dollars' worth of equipment,—an amount of riches more fabulous, as General Olmstead's friend, General Harbord points out, than any sum total of riches old King Croesus could ever have imagined!

OUR PLATFORM
FOR ELECTRONIC AND RADIO ENGINEERS

Electronic Industries believes that—

WAR

Electronic and radio engineers owe their first responsibility to winning the war.

LEADERSHIP

Because of the decisive character of electronic devices, executive leadership must fall more and more to qualified technical men.

DESIGN

Sturdy design and construction are needed in radio and electronic devices. Quality and standardization are essentials.

PRODUCTION

Coordinated with sound design, rapid and economical production is the next great opportunity for electronic progress.

EXPERIENCE

Electronic practice and advances in any field have valuable lessons for engineers working in other electronic fields.

INFORMATION

(Outside of present military limitations) electronic engineers are obligated to a free exchange of technical information—from which each benefits more than he gives.

PEACE

In the post-war future, electronic devices will revolutionize industrial and everyday life.

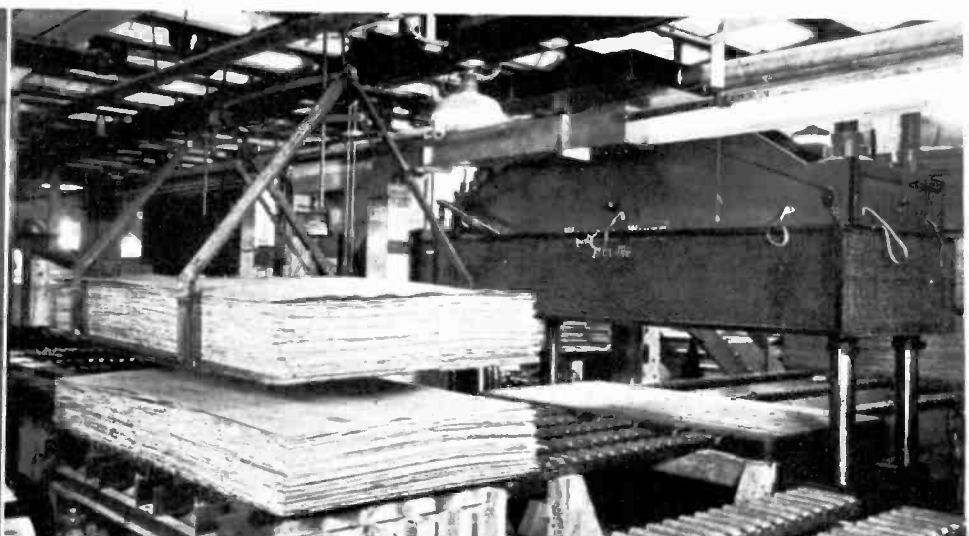
Electronic expansion can be a major factor in solving post-war economic problems, if the industry's leadership is adequate to its opportunity.

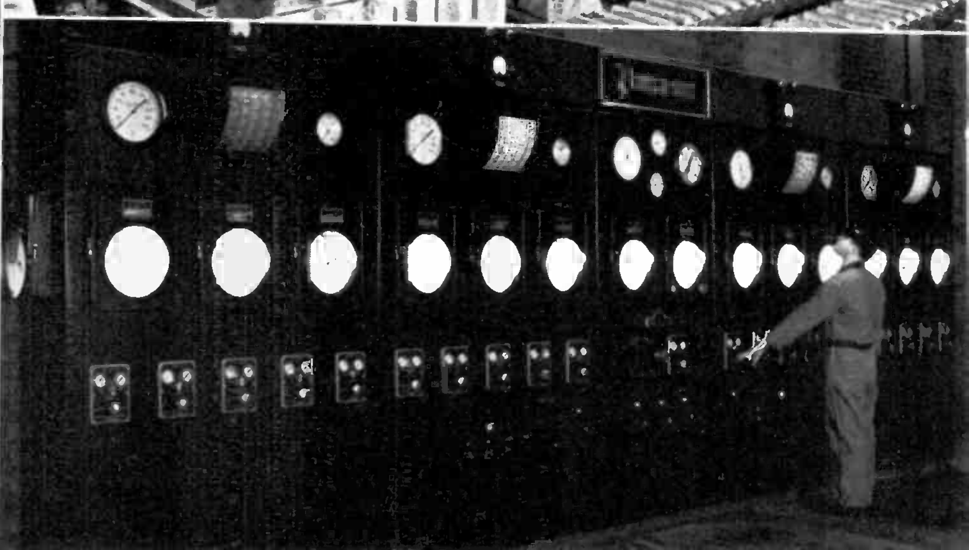
Electronic tubes and devices play a major role on the fighting fronts. At left, staff sergeant radio operator on YB-17 bomber reports to his home base. Bombers use many electronic devices.

On the home front, other electronic devices speed production in a hundrd ways. At right, photocells in plant of Moench Tanning Co., Gowanda, N. Y., control brushes and hot water sprays in glass-enclosed chamber, to clean dried paste from large framed plates to which hides are glued and conveyed through drying oven. Automatic operation saves time, does a better cleaning job, frees a man for other war work.

Below, Douglas fir plywood panels being stacked before bonding with plastic resin by high frequency heating. Electrostatic heating electrode divides stack, which may consist of panels of different thicknesses. Top and bottom plates of hydraulic press, at right, are grounded. High frequency bonding of plywood is superior to old gluing methods.

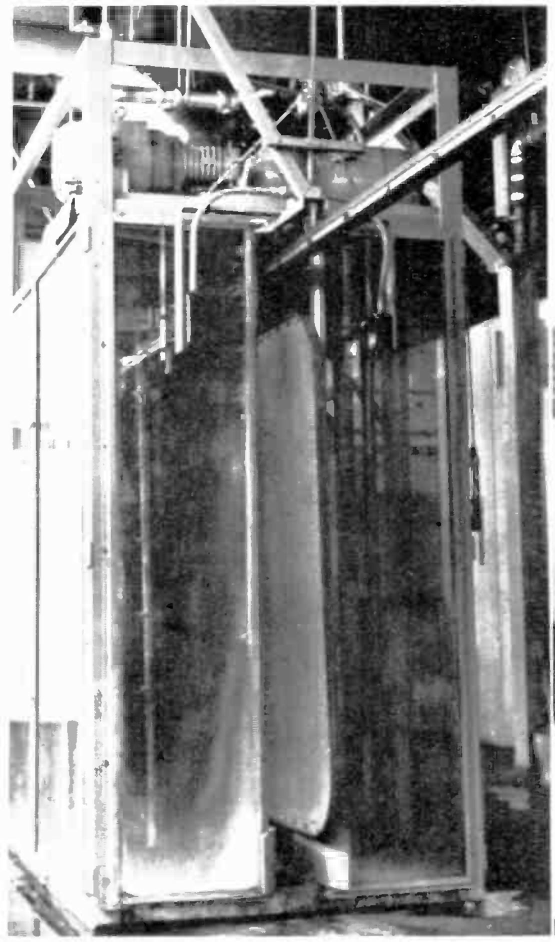
Electronic Devices SPEED





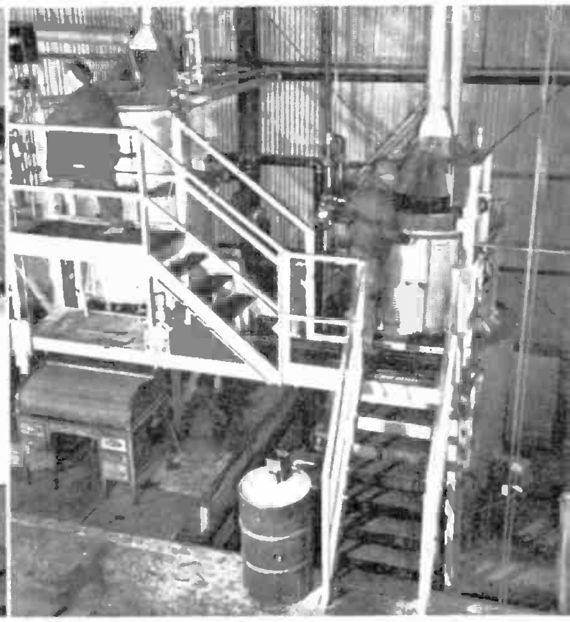
Above, the incendiary bombs in this photograph were among those Doolittle dropped on Tokio. The girl is inserting bombs in a special heating coil for quick, multiple brazing operation with induction heating.

At right, sensitive photo-cells indicate combustion efficiency by measuring density of haze in smoke stacks to one-half of one per cent CO-2 variation. Pictured is boiler room of Parkchester Housing Project, Bronx, N. Y., showing four Ess Hazegages (top of panel) and eight-pen recorder (at extreme left).



Electronic device for aircraft, developed by Minneapolis-Honeywell Regulator Co., measures ice forming on wings and operates de-icers at critical moment. Minneapolis-Honeywell is engaged in mass production of various electronic devices for war effort.

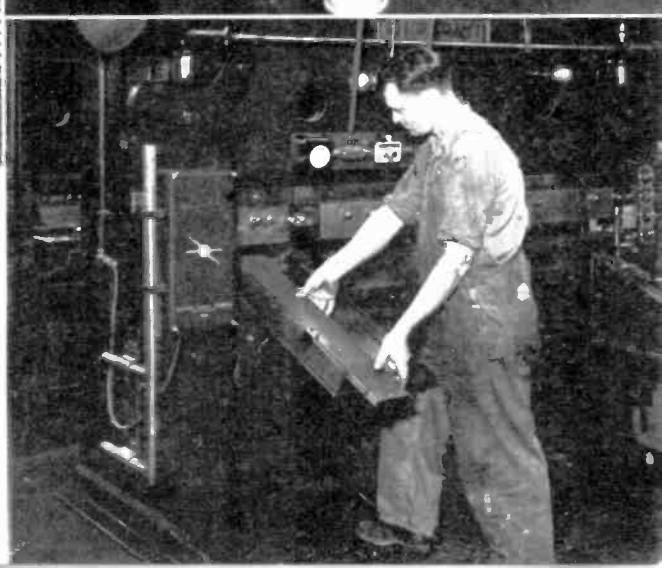
Wheelco electronic equipment protects varnish kettles in Brooklyn plant of C. W. H. Carter. Flame failure device guards against explosions, while a temperature control, worked by detuning of an oscillator by vane on galvanometer needle, protects varnish.



AMERICA'S WAR EFFORT

Self-balancing electronic potentiometer and recorder equipment to graph changing temperatures of up to 14 different points at once, in aircraft flight tests. Developed by Brown Instrument Company, the recorder is being widely used on Douglas B-19 and other planes. It records data faster than three or more men with pads and pencils and with ten times manual accuracy.

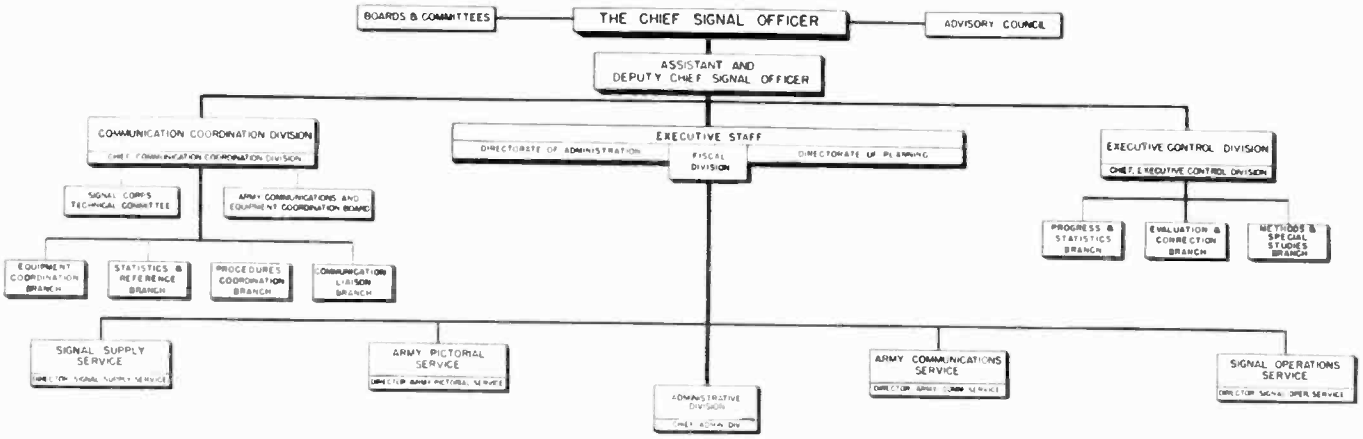
Top right, Photovolt electronic photometer in use at plant of U.S. Radium Corp., New York, to measure brightness of military "blackout buttons." The photo-tube is enclosed in cylindrical case, with fitting to correspond with size button being tested. The dc amplifier is sensitive enough to give readable deflections even with low-brightness aircraft instrument dials or powdered radium materials. Battery-operated model is shown here.



At right, Electronic Control Corp. photoelectric safety equipment used in a Western Electric plant.

★ ★ ★ ★

The SIGNAL CORPS,



The official organization chart of the divisions and services of the Signal Corps

A Message to Radio Men

by MAJOR GENERAL DAWSON OLMSTEAD

Chief Signal Officer, U. S. Army

General Olmstead tests out one of the Signal Corps' new walkie-talkies

Readers of this magazine who are connected with the manufacture of radio and other electronic equipment may already have come in contact with the research, development, and procurement activities which the Signal Corps conducts on behalf of the Army. Such readers will have formed an idea of the tremendous scope of the Signal Supply program.

For those who are not acquainted with our program—and only a limited number of Signal Corps officers and engineers are familiar with the entire program in all its ramified aspects—we may give an idea of its magnitude by pointing out that the Signal Corps alone requires from the American radio manufacturing industry more equipment than was produced for all commercial and government needs before the United States entered the war.

High standards

Not only is the requirement greater in quantity than ever before, but military needs call for higher standards of performance of components and of completed equipment than were faced by industry in time of peace. Frequently a manufacturer will find that a part which would have been satisfactory for ordinary commercial use is rejected by the Signal Corps inspector in his plant. He may wonder why the Army is so fussy. Let me set forth a few of the considerations which make it necessary for the Army to be exacting in its specifications.

A radio transmitter, for example, would normally be a stationary affair in civilian use. The manufacturer would know just where the set would be installed, how it would be arranged, the ordinary climatic conditions, and the routine of servicing and operation. On the other hand, the average radio transmitter procured by the Signal Corps for the Army is not stationary and has no fixed locale of operation.

Variety of uses

This transmitter might be mounted on a Signal Corps truck. It might be installed in a tank. The set must continue to operate despite the bumping and bouncing that it may sustain while a vehicle travels over rough terrain or while an airplane performs acrobatic maneuvers in combat. It may be used in any climate from the tropics to the arctic. The transmitter must operate on certain frequencies which are carefully controlled so that the transmission will be heard by receivers that have been designed to operate in the same net with it. That frequency must be maintained constant in all possible conditions.

the NAVY, and Radio Engineers

These are some of the reasons why the standards we set for signal communication components and completed equipments are higher than those to which many parts of the communications manufacturing industry were accustomed before they became suppliers of the Signal Corps.

Rigid specifications

Nevertheless, we recognize that in some cases our specifications may be more rigid than absolutely necessary, or that we are not getting the quantity production that we could if we were willing to modify the standards within reason. In such cases, where a bottleneck may be avoided by modifying a specification, our expediters in the field will always be glad to hear of suggestions from the factory engineers. We also should like to hear about possible substitutions for the materials on our critical list, such as copper, rubber, ceramics, and other insulating materials.

Our expediting engineers are always ready to take any other steps that may be necessary to the end that the production shall not unnecessarily be delayed. Recently there was formed a new Army-Navy Communications Production Expediting Agency to coordinate the efforts of the Signal Corps of the Army and the Radio and Sound Branch of the Navy Bureau of Ships in getting faster delivery of the communications equipment most vital to our armed forces.

Expediting deliveries

At regular meetings in this agency, representatives of both the Army and the Navy decide which of the products being manufactured are most urgently needed in view of the latest strategic considerations in the war plans of the United Nations. The Agency determines which items on the Army and Navy supply programs should take precedence, and these decisions are transmitted to the expe-

(Continued on page 96)

Electronics in Naval Operations

By CAPTAIN J. B. DOW

Head of Radio and Sound Branch, Bureau of Ships, Navy Department

With particular reference to radio and sound equipment, the field of electronics is playing a vital part in naval operations. In many instances, the success or failure of an operation can be traced directly to the availability and dependability of electronic equipment. By electronic equipment, I mean also the mechanical and electrical parts which enter as essential portions of the whole equipment.

In an industry which rapidly has expanded in an effort to meet several times the peace time demands, it is natural that the production problems which have arisen are many and varied. The greatest of these problems now interfering with production are:

(1) Difficulties due to the inability of industry to meet the demand for certain critical component parts with which to assemble the end product.

(2) Difficulties resulting from the inability of industry to adapt the smaller peace time organizations to meet the greatly expanded demands.

(3) Difficulties due directly to the magnitude of the problem of coordinating the demands for electronic equipment with those of other fields which are interlocked because of shortages of material facilities and the necessary interests of many procurement and control agencies.

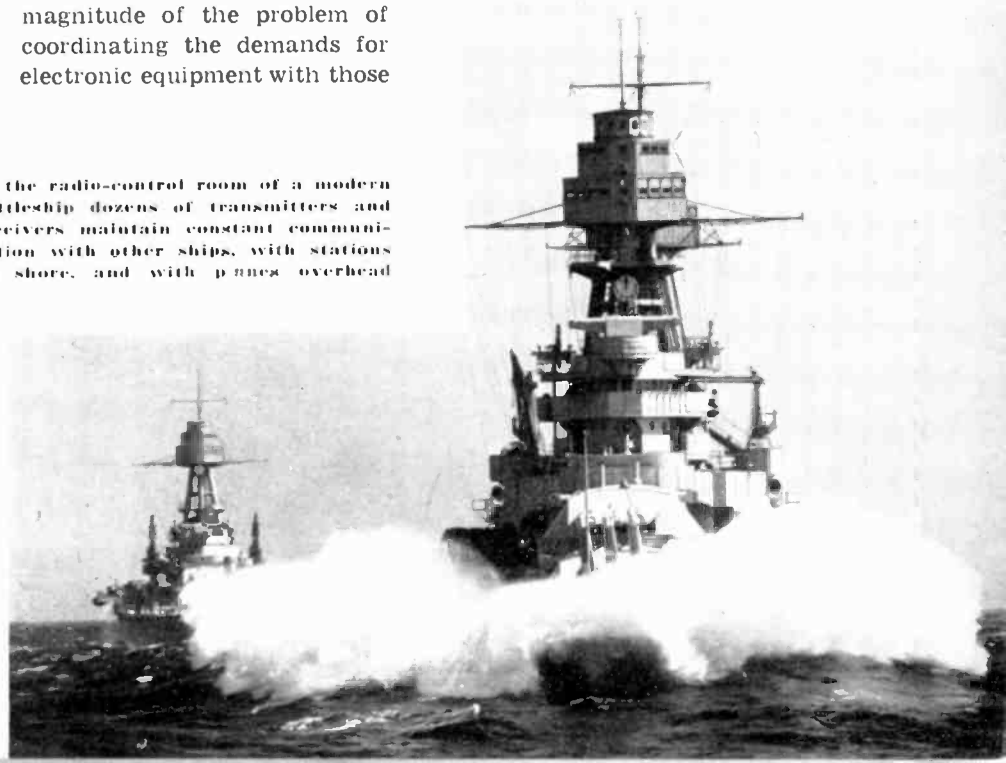
You, as our experienced executives, engineers and leaders can do much to assist by:

(4) Investigating possible substitutes for critical materials and components and reporting your recommendations promptly.

(5) Making organizational changes to close any gaps between your engineering, purchasing, expediting, production and inspection departments.

(6) Searching out and further utilizing idle facilities which may be gainfully employed.

The part which you as executives, engineers, leading men and workers of the electronic and associated industries are playing in the operation of our naval forces at sea and ashore will some day be unfolded to you. It will thrill you with surprise beyond comprehension.



In the radio-control room of a modern battleship dozens of transmitters and receivers maintain constant communication with other ships, with stations on shore, and with planes overhead

★ ★ ★ ★

Executives of Radio Branch W.P.B. Standing left to right: Marvin Hobbs, Myron E. Whitney, Gerald E. Miller, Frank H. McIntosh, Sidney K. Wolf, and Frank S. Horning. Seated left to right: Milton J. Lowenstein, Lt. Wm. A. Gray, John S. Timmons and Ray C. Ellis, Deputy Director

U. S. MULTIPLIES RADIO OUTPUT

by RAY C. ELLIS

Deputy Director, Radio Branch, War Production Board

In the vital task of producing enormous quantities of radio equipment for our fighting forces, there are four factors of the utmost importance—(1) materials, and their flow, (2) manpower, (3) product simplification, and (4) production methods.

Today, acute material shortages exist in rubber, nickel, tin, copper, chromium, cadmium and mica. The aluminum bottleneck still exists but only in certain critical shapes. Thus the whole materials picture is constantly changing, and substitutes must be found from time to time, as unexpected new shortages develop.

Already radio engineers are discovering how to use alternates and substitutes, so that production may go ahead even when specified materials are not to be had. And on its side, the Government is cooperating by making necessary changes in specifications, without delay, so that vital war production will not be held up.

Changes in specifications

We look to the engineers and manufacturers to initiate or propose such changes. As we see it, it is the duty of the producers to propose and to apply for revisions in specifications, just as rapidly as satisfactory substitutes are found — which will solve material shortages either present or impending. To speed such revisions and so impose the least possible delays due to critical material shortages when satisfactory substitutes are available, provision is now made to effect speedy specification changes through regular channels at the Signal Corps laboratories and at the Naval Research Laboratory.

Women in radio manufacturing

The shortage of manpower in radio production will have to be met by bringing in more women and older people, and by setting up training facilities designed to make present personnel capable of handling new and expanded tasks. There is no doubt that as the war goes on we are going to see more women take part in radio manufacturing, not only in factory work and on the assembly lines, but also in the engineering and drafting offices.

In England women are doing a great deal of this work, releasing men for heavier tasks. There, even the operation of powerful punch presses and automatic screw machines now falls in the field of feminine employment. Women can perform many jobs not now expected of them, if the factory management will take care to see that fairly comfortable working conditions surround their women employees.

The woman who comes from quiet home conditions, into the noise and distractions of a busy factory, may be limited more by the racket and confusion she faces in her new surroundings, than by any inherent difficulty in doing the work itself. Factory executives should not overlook this important aspect in dealing with women workers. In England, I found during a recent trip, that far greater use of industrial music is being made there, than here, and that this music has a beneficial effect on war production by women workers. In fact, the BBC now broadcasts special morning and afternoon industrial-music periods designed to be switched onto factory loudspeaker systems during those hours.

Adding non-radio factories

Another means of annexing skilled manpower for radio manufacturing, which the WPB has adopted here in the U. S., has been to utilize the workmen and equipment of non-radio plants otherwise shut down by war demands.

As a result we now have camera factories making variable condensers, vacuum-sweeper plants building dynamotors, pen factories stamping out capacitor plates, and watch factories making tube parts.

In certain cases, radio parts makers have "paired up" directly with particular non-radio factories, to expand the radio plant's own facilities of shops and manpower. In this way, certain meter plants are, for the duration, "married" to nearby watch and clock factories. The radio manufacturer in such a case works closely with his associate non-radio factory — in this way doubling his own plant capacity, while gaining the advantage of the skilled workmen and the highly efficient mechanical processes of the associate factory.

Comparing factory methods

The radio-division of the War Production Board has lately been making special studies of radio manufacturing processes in comparable factories, to compare the relative time and manpower required for each step in the processes of production and assembly. A group of WPB production experts was retained to visit plants engaged in the same kind of radio manufacturing operations.

HOW WPB RADIO BRANCH SPEEDS PRODUCTION

Breaking up bottlenecks in supply of raw materials
Securing authorization for substitutes in specifications
Enlisting non-radio factories to produce radio parts
Increasing capacity by "marrying" radio and non-radio factories
Analyzing and comparing unit processes in similar factories
Encouraging use of women in engineering and supervisory posts
Increasing female workers' efficiency by better factory conditions
Insisting on high-quality production standards
Securing exchange of manufacturing information

Out of this study have come surprising revelations concerning the wide differences in production efficacy at various points along the line. One factory would show up as being most efficient on a certain production operation, but in comparison with other plants would compare poorly indeed with the average unit-time for an assembly operation further along the line. As an example, one particularly wide discrepancy discovered was in the time taken by various condenser plants to "stack" mica. One plant required only 70 seconds to perform a certain operation, for which another factory took on the average 7 minutes or 540 seconds—a difference of six to one!

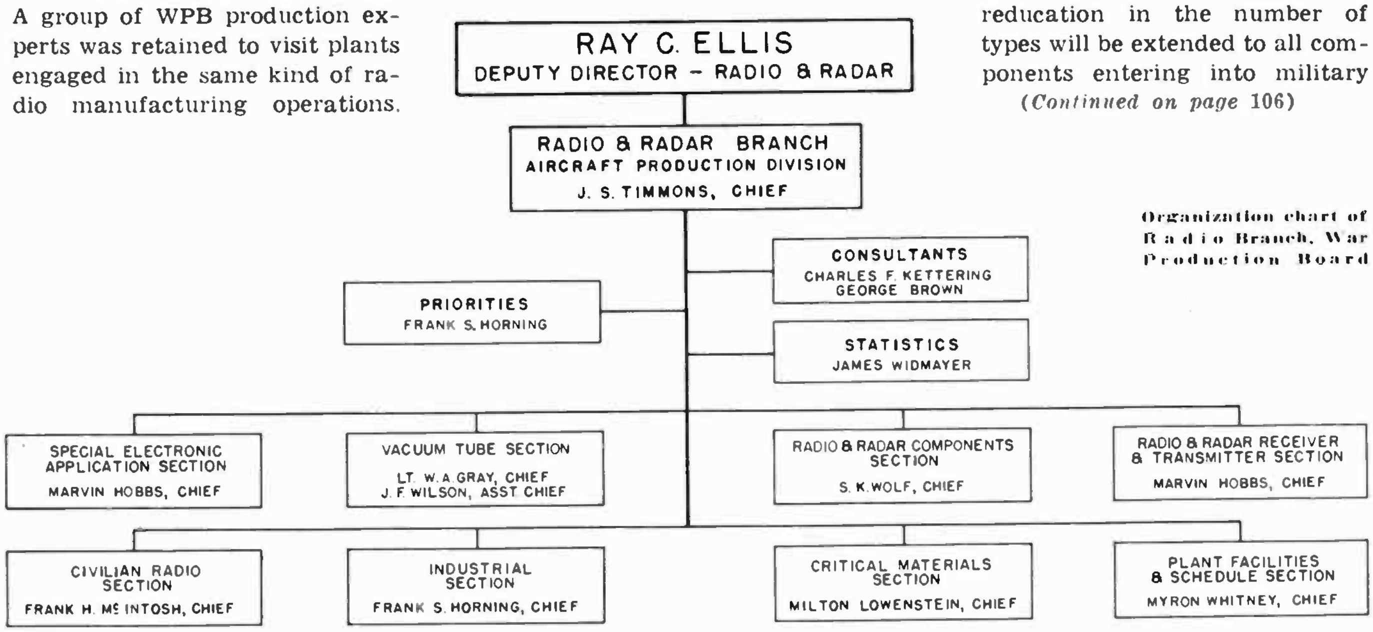
By comparing production efficiencies at points all along the manufacturing line, in this way, it will be possible to introduce methods which will speed up all operations more nearly to the best rates of production of the best plant studied, increasing overall production of critical parts and equipment.

Increase output 20%

Applying the results of such studies, it is expected to increase overall radio-parts production at least 20 to 30 per cent, as a result of interchange of information between plant managements and supervisors. Already these production studies by your WPB traveling experts have been made in the fields of mica condensers, quartz crystals, and vacuum tubes. The same method of plant study will be extended rapidly to other radio items.

Simplification of lines is another direction in which we are working to speed war production. Already much work has been done to reduce the number of types of fixed condensers, working in collaboration with the American Standards Association. This movement to effect simplification of lines and sharp reducation in the number of types will be extended to all components entering into military

(*Continued on page* 106)



Organization chart of Radio Branch, War Production Board

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STUDY POWER CUTS—To Keep BC Stations on Air

by E. K. JETT

Chief Engineer FCC

Chairman Coordinating Committee, Board of War Communications

Critical shortage of tubes may shut down two-thirds of broadcast transmitters within the next year

Under its broad authority to determine, coordinate, and prepare plans for radio, wire and cable communications of all kinds, the Board of War Communications has made specific recommendations to the Federal Communications Commission and War Production Board which have resulted in the adoption by those agencies of policies which are designed to conserve personnel and communications equipment. These conservation measures have affected the wire services, radio stations in the broadcast, fixed public, experimental, amateur, coastal, marine relay, emergency, aviation, and miscellaneous radio services.

The Board of War Communications has been giving particular study to plans for the conservation of domestic broadcast equipment. Briefly, the plans call for the division of the United States into conservation districts in which an industry-selected administrator, with industry assistance, will check inventories, administer the distribution and redistribution of equipment, requisition new equipment, and determine that proper and efficient operation of each station in his district is maintained.

"Minimum equipment" defined

A station will be considered as having the minimum required equipment, except vacuum tubes, when such equipment meets the manufacturer's specifications for spare parts. No spare equipment will be taken from a station whose equipment just fulfills the minimum requirements.

Minimum vacuum tube stocks will be considered on a basis of the requirements for spare tubes set out in the Commission's Standards of Good Engineering Practice or up to 100 per cent spares, depending upon the previous practice of the station. The plan calls for some supervision by the Federal Communications Commission in conformity with rules, regulations and orders of the War Production Board.

"Pool" deferred

Action with respect to the establishment of a "pool" of broadcast equipment has been deferred pending an analysis of data submitted by broadcast stations in response to a recent questionnaire on transmitting tubes. Questionnaires were mailed out to 927 standard broadcast licensees or holders of construction permits in the continental United States, Alaska, Puerto Rico, and the Territory of Hawaii. The data supplied will furnish the basis for a great number of different studies including a determination of the number of broadcast stations of each class (I, II, III, and IV) which will be forced to remain silent if no new transmitting tubes are allocated by the War Production Board or if no exchange of spare tubes is made between the stations themselves.

Up to the present time the War Production Board has been able to provide new tubes to meet current needs of broadcast stations; however, since there is no guarantee that tubes can be furnished indefinitely it is imperative that arrangements be made looking toward the maintenance of an adequate broadcast service in wartime.

67.5% may be silent in one year

For example, if no new tubes are available or if an exchange is not effected between stations, approximately 67.5 per cent of the existing broadcast stations will be forced to remain silent in about one year from now. The need for various types of tubes during the next nine months vary from some broadcast stations requiring no additional tubes of certain types, to as many as 88 stations requiring additional 866 and 872 type tubes.

In order to prevent the necessity of any stations ceasing operation or to reduce the number in so far as possible and to divert a minimum of material from the war effort, it is necessary that advantage be taken of every opportunity to prolong the life of tubes and component parts.

Reduction of voltage

Stations with power of 5 kw or greater, almost without exception, use tungsten filament power amplifier tubes. Reduction in filament voltage materially increases the life of such tubes; however, if the filament voltage alone is reduced, excessive distortion is frequently encountered and it is necessary to reduce the plate voltage or power output of the transmitter if substantial increase in filament life is to be expected without undue distortion.

Most stations with power of less than 5 kw have thoriated tungsten filaments in the power amplifier tubes which must be kept at normal operating voltages. Thoriated tungsten filaments are generally used in medium power tubes such as oscillators, intermediate power amplifiers, and final amplifiers of transmitters of 1000 watts or less. To obtain efficient service from this type of tube it must be operated very close to the normal operating voltage. Therefore, since the filament voltage of these tubes may not be reduced, the reduction in power of stations using tubes of this type in the power amplifier would not greatly extend the life expectancy of such tubes. However, it would reduce the strain on other transmitting components and for uniformity it is believed that the power of all stations would have to be reduced by the same amount.

Uniform reduction in power

Engineers agree that a reasonable reduction in power will produce no relative change or reduction of service areas of broadcast stations. Thus, in the event that the Board of War Communications should decide to recommend a reduction in power to the Commission, the change will be made uniform for all stations and listeners will be unable to detect any change in the extent or quality of service.

It is obvious that similar principles of power reduction can and probably should be applied to other services such as police radio. At this writing, however, the Commission has not adopted any policy which would involve the reduction of operating power of radio stations in any service.

WAYS TO SAVE TUBES

Economies now being used by BC engineers

Cooperating with the War Production Board in its request for the conservation of vital and necessary war materials, the broadcasting engineers of the major networks have been quick to figure out and put into practice a number of changes in station operation methods, without diminishing the efficiency of their service.

One of the common sources of tube failure is due to the burning out of filaments or the reduction of the tube's electron emission. Engineers of NBC, CBS and Mutual find that the life of certain types of transmission tubes, especially those employing tungsten filaments, can be materially lengthened by the simple expedient of using a slightly reduced voltage from that of the specified rating.

Reduce voltage

For instance, Type 880, which is a high-frequency power tube used in short wave transmission at such stations as those at Bound Brook, N. J., has a rated normal filament voltage of 12.6. However, if this tube is operated at a voltage of 12.2 or 12.3 its life is considerably lengthened. Inasmuch as the cost of one Type 880 is $750, and such tubes are extremely difficult to obtain, an enormous saving can be effected here.

Resourcefulness of the engineer has also been demonstrated in the operation of transmission tube Type 862 at broadcast station WEAF, New York; WTAM, Cleveland; WMAQ, Chicago; KPO, San Francisco, and others. Instead of operating these tubes at their specified rating of 33 volts, their voltage is reduced to 31.5 and often lower, thus increasing its operating life. Since one tube of Type 862 costs $1650, such a saving is important.

Transfer rectifiers

The war has accelerated, not retarded, the pioneering efforts of broadcast engineers. Much of their development work, now directed to the all important objective of winning the war, must of necessity remain secret for the present, at least. Yet, in the matter of conservation and the use of short cuts, these same engineers are providing interesting and ingenious solutions to offset the scarcity of available materials and equipment. The old adage that "the show must go on" is as true and urgent today with the radio engineer, as it has always been with the stage trouper.

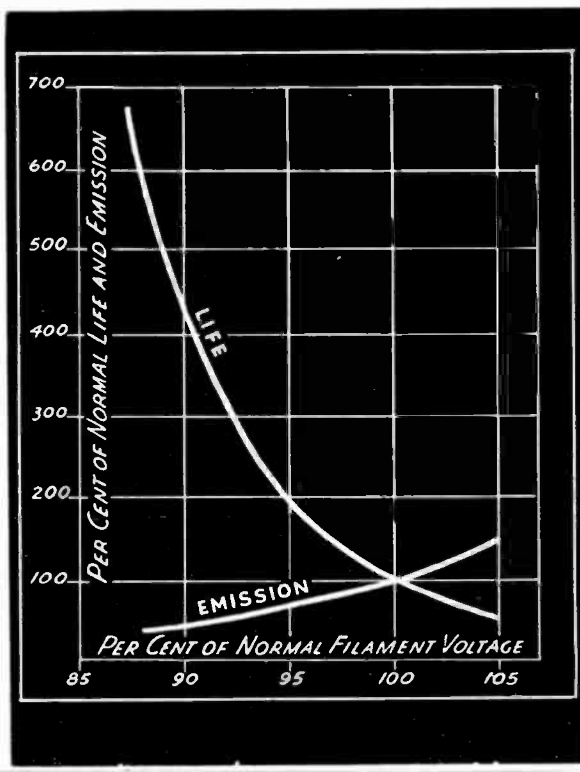
As an illustration of their economizing, broadcasting engineers are taking rectifier tubes of Type 857 which operates at a voltage of 18,000 dc, and when these rectifiers, after long, effective use in long-wave broadcasting are practically worn out, withdrawing them from their old sockets and sending them to shortwave stations where they can be reinstated and used in those circuits. When operated at a voltage reduced to as low as 12,000 dc, which is all that is required at such shortwave stations, the tubes perform satisfactorily.

Make substitutions

Substitution of different types of tubes is also often resorted to. Instead of using Type 892, equal results may be obtained by substituting Type 863 which operates at the same voltage but different current. Or older Type 207 can be successfully used.

In view of the great demand for all types of transmission and receiving tubes required by our armed forces the available supply of these same tubes on the stock shelves of the commercial radio stations may be limited to more of one kind than of another, hence in many cases, substitution may be the solution.

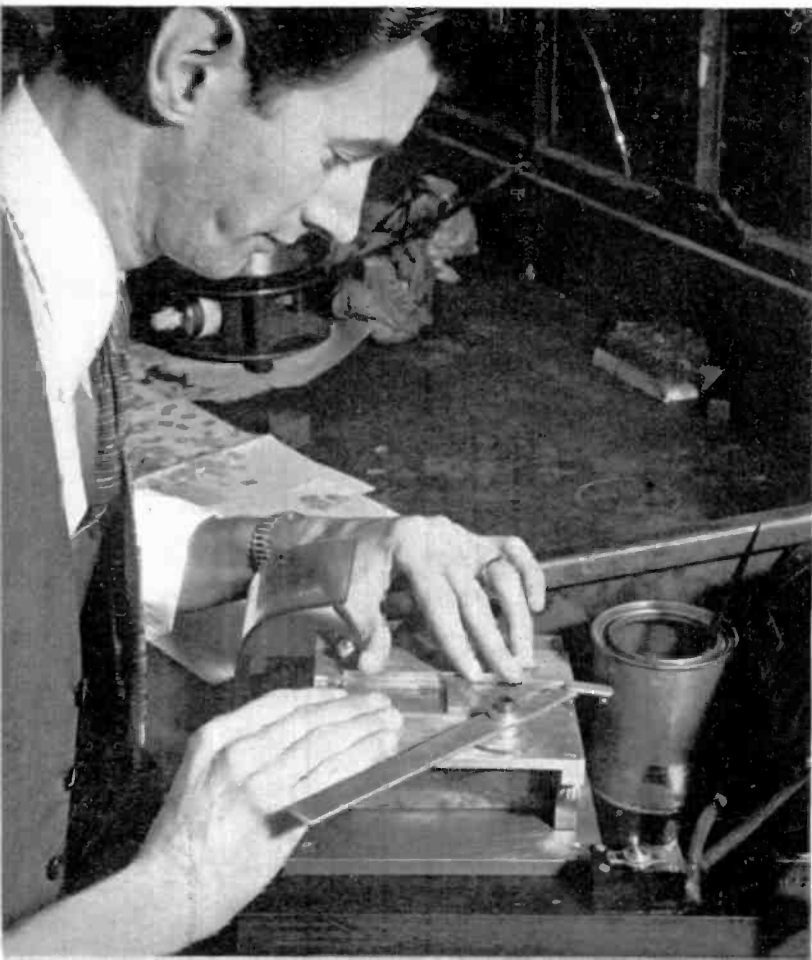
Life and emission of tungsten filament as a function of voltage

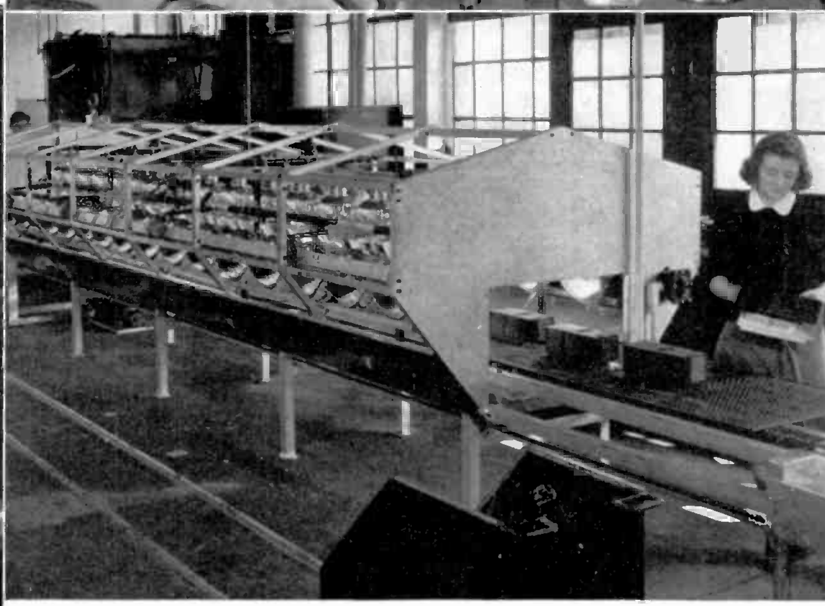


Radio Production Short Cuts

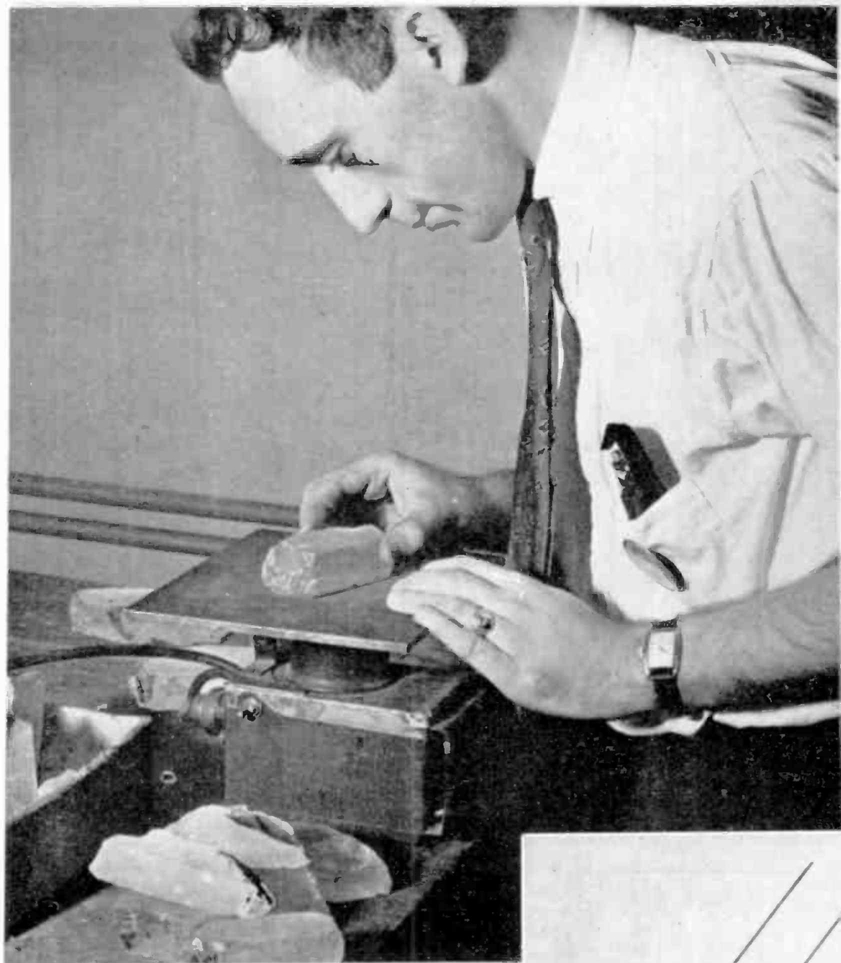
Microscopic inspection of glass V-jewel bearings, for all types of electrical measuring instruments, at West Lynn General Electric plant. Special-glass jewels, now in mass production, replace natural and synthetic sapphire previously imported

At right, chemical and mechanical methods of determining presence or absence of thorium in tungsten wire to be used for electronic tube filaments were slow, costly, and subject to errors in judgment. Dr. N. C. Beese, Westinghouse research physicist, designed the apparatus he is shown with here. A wire sample from each spool to be tested is burned in a carbon arc while under spectroscopic examination. Two lines in spectrum mean pure tungsten; four lines indicate thorium content



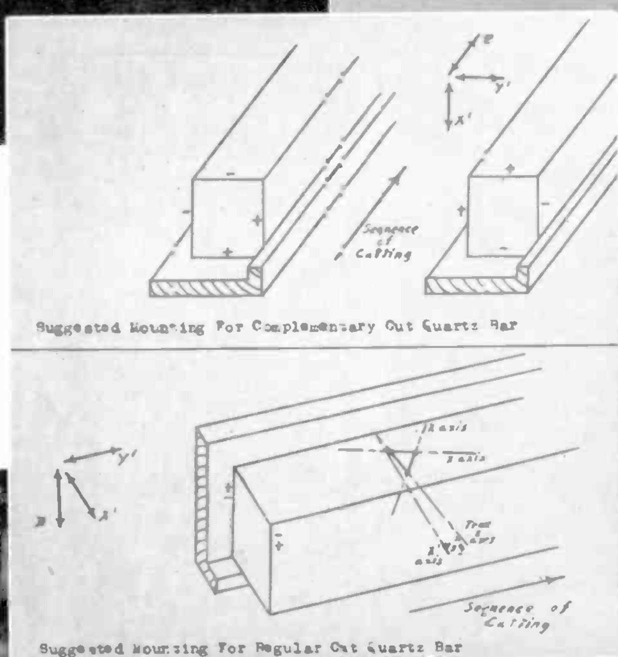


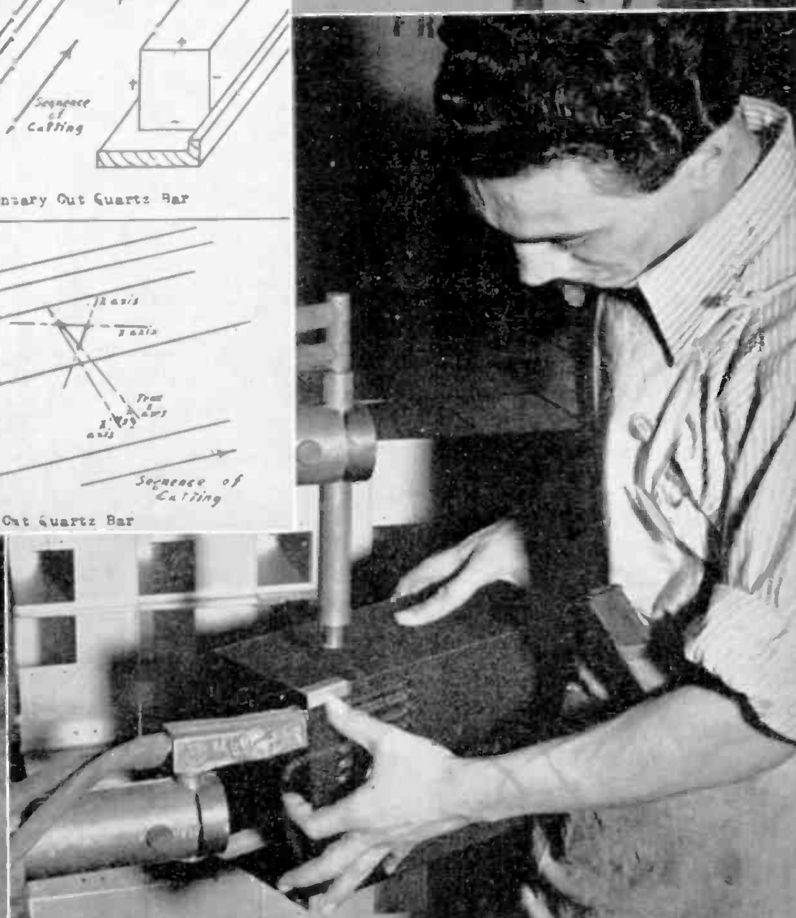
Infra-red baking tunnel at Western Electric's Kearny plant cuts 75% from drying time on wrinkle-enameled aircraft radio housings. Sixty-four lamps consuming 60,000 watts heat steel of housings to 425°F. At left, new type jig for slitting quartz crystals eliminates scratches, speeds production, and reduces breakage about 75%. Jig is shown in use by its designer, Benjamin Willett, instructor in crystal laboratory of RCA's Camden plant. Four or five 8-meg blanks can be cut at one time



A short cut in installation, maintenance, and replacement, this Western Electric "command set" is slid into belly of Airacobra fighter, instead of already cramped cockpit. Command sets are transceivers for communication among planes of one "task force"

In cutting quartz bars, considerable savings are effected by a special mounting fixture designed by Joseph Eckert, RCA X-ray operator, above. The bars are mounted as shown in his shop sketch. Each bar is sampled during blank saw set up without cutting intermediate wedge blanks. In addition to savings of quartz, special mounting saves saw set up time, X-ray measurement time, and orientation time





Transparent viewing screen protects face and eyes of operator on assembly mount of 25 watt transmitting tube, in Bloomfield plant of Westinghouse Lamp Division. The photo shows spot welding contacts and copper gas line to envelop weld in tiny flame, preventing oxidization while spot is cooling. Simple aluminum bracket demonstrated by Albert Ruggieri, RCA spot welder, replaces stainless steel bracket and sixteen rivets. Saving chromium steel and time, this short cut saves $120 per thousand units

RADIO ENGINEERS Must Come Out Of Their Shells

by ARTHUR VAN DYCK
President, Institute of Radio Engineers

Some frank talk to radio men about the broader responsibilities of technologists—in war, in business, and in everyday life

The duties and responsibilities of technologists in this most technical war of all time, are as varied as are the instruments of war, and these are no longer merely lethal weapons. All means of transportation, communication, and construction are enlisted. No longer can an army, as in Caesar's time, travel a thousand miles, conquer and subsist, without support from home, and with its technical work supplied by a few artisans traveling with the army.

Now, scientists and engineers are vital parts of the war machine. There are duties and responsibilities in connection with production of war materials, more rapid production, production with substitute materials. Not least among these is standardization, simplification, and interchange of ideas between engineers and between factories. In these matters alone there is enormous opportunity and need for the best efforts of engineers. Beyond these, new and better designs for old instruments, and conception, design, and production of totally new instruments, are necessary if the enemies are to be beaten at this inhuman game of total war.

Utilization of new developments is not in the hands of engineers alone. . . . . But wise utilization of new developments can not be planned by persons who do not understand their basic characteristics and therefore are unable to visualize their possibilities.

All of this is so well known that there is no need to dwell upon it. It is mentioned only to silhouette another duty and responsibility of the technologist which is not so well known, yet which must be fulfilled, if we are to win this war. That other responsibility is to improve the handling of technological developments, in order to obtain **at their beginning** a correct planning of utilization, and an orderly, rapid securement of their full possibilities. That new responsibility is not well understood, and needs to be explained further.

Plan to utilize new inventions

The tempo of technology has increased. From that increase have come new effects and a new responsibility for those concerned with the guidance, control, and utilization of technology.

It took fifty years for the steam engine to reach the stature which enabled it to open continents. With the growth of science, it took only twenty years for aviation, the automobile, and radio broadcasting to attain their full powerful influences. Now the status of electronics, including related electro-physics and electro-chemistry, is such that almost complete understanding and control over the elements of Nature is available, and the tempo of development of new things of science is more rapid than ever before. Now, a period of five to ten years can be enough to witness wide utilization of and consequently vast effect from, a new development of great impact upon civilization. Under the extraordinary pressures of wartime, that period is more likely to be shorter than longer.

Uncle Sam suffered a surprise attack at Pearl Harbor, despite the fact that reports of the enemy's approach were in hand. But they were "radar" reports, radar was new, and technologists had neglected to install understanding, when they built and installed the instruments!

There are many—far too many—similar cases.

Must know how to handle

It is obvious that if a new force grows to great magnitude in a short time, it is more important to understand its capabilities early, and to guide its utilization correctly, than if it develops slowly, when more time is afforded for study of the progress and for correction of mistakes made on the way.

The technologist has not only to invent new devices, design them, and produce them in quantity, but he has to "sell" an understanding of them, complete enough to have them utilized, properly and quickly.

We have not done well in the handling of the technological output since the time when its speed reached dizzy proportions. In fact, we have done rather badly, by the life-or-death standards of a war of survival. The difference between technical developments themselves, and the handling of those developments, is great, and now needs to be more clearly visualized than has been necessary before. Therein lies the greatest responsibility of technologists at this particularly critical time. Incidentally, it will not lessen with the coming of peace. Then, the problems of orderly introduction and the consequent need for wisdom and judgment in handling new developments will be the same, although the ends will be commercial and economic, instead of the present military.

Utilization of new developments is not in the hands of engineers alone, and in fact it is mostly in the hands of others, as our commer-

To win THIS war radio technologists have a responsibility not only to invent and design, but to come out of their shells into the haphazard world, explain their contributions clearly and fully, and take that share of responsibility which is theirs in the decisions and planning for the use of their inventions.

cial and military organizations are now set up. Wise utilization of new developments cannot be planned by persons who do not understand at least their basic characteristics and therefore are unable to visualize their possibilities. Consequently, it devolves upon technologists to educate those others who are in control, as to "the facts of life," technically speaking, as clearly, rapidly and forcefully as possible.

Lay executives must be educated

In peacetime we can allow the time needed for sufficient education to percolate slowly through the understanding of others involved, if we are willing to accept the accompanying mistakes, confusion, and loss. But in war time, we cannot with safety allow that time.

The recent advances in technology have been on many fronts. In radio, electronics, aviation, metallurgy, chemistry, plastics, to name only a few, the advance has been so rapid that the non-technical person could not visualize the implications of the early stages, until the final stages had been reached. Consequently, we have had various phases of aviation unappreciated until very recently, although aviation experts have pointed to them vociferously for years, and one of them, General Mitchell, sacrificed his career in the attempt to make others see the new facts which were so clear to him as an expert.

Radar's warning unheeded

Similarly we saw a surprise attack at Pearl Harbor, although reports of the enemy's approach were in hand. But they were "radar" reports, radar was new, and technologists had neglected to install understanding when they built and installed the instruments. There are far too many similar cases.

On the other hand, an example of the beneficial effects of giving adequate attention to the technical factors is afforded by the recent Baruch rubber committee report. That technical study and report is deservedly receiving high praise and acclaim, its program is obviously sound and excellent, and its recommendations are being put into effect. However, the point of present interest is that that committee was appointed only recently, after months if not one or two years of muddling, non-technically minded guidance, and worked on the problem for only a few weeks. If three men could solve the whole problem in a month's time, as was demonstrated, why were they not utilized in the beginning with consequent avoidance of the muddling period? The answer is that technical opinion is not appreciated or sought in most cases, and in the cases where it is asked, it is too often discounted until layman ideas have had full and unsuccessful trial.

Uses of technology

Unfortunately for the world, the full understanding of technology was first reached in Germany. In Hitler's brain trust, Dr. Hausofer's incredible Institute of Geopolitics with several thousand scientists, there was full realization of the new importance of technology, and an integrated utilization of it throughout the German national economy. If only that understanding and utilization had not been perverted to barbaric aims!

We need integration, coordination, and utilization of technological possibilities, with minimum delay and maximum efficiency. Not many specific examples can be discussed in public print but there is one which can, and a description of it will illustrate the point. This one is organization of the radio broadcasting systems for information, instruction and control in the event of attack upon us.

Up to now, this vast system of communication has not been arranged for such use at all, in spite of its obvious availability and effectiveness. The reasons for the present lack are a mixture of mis-

Modern electronic inventions have decisive force. A single one—applied by our enemies and not understood and anticipated by us—can lose the war for us!

understanding of technical factors, the generally prevalent non-realistic thinking about the war, and unimaginative thinking about the characteristics which a real attack upon us is likely to have.

Use of the broadcasting system is necessary to a defense which is to minimize the damage done by a major attack, for two reasons. First, to inform and control a public which is not bred to blind obedience as are Europeans, but rather has been bred to independence and initiative, and which has to be told why before it will act. Second, broadcasting is the only means of

(*Continued on page* 119)

Seven Presidents of the I.R.E. Top row—R. A. Heising, A. F. Van Dyck, L. C. F. Horle. Bottom row—L. M. Hull, H. Pratt, R. H. Marriott, J. V. L. Hogan

Adapted from Westinghouse Research Labs. Chart

10 CYCLES	180	1000	15 KILOCYCLES	60	500 — 10 MEGACYCLES
ANNEALING, HEATING TO LOW TEMP-ERATURES	PREHEATING, ANNEALING, HEATING MAG-NETIC METALS	PRINCIPAL BAND FOR COMMERCIAL HEAT-ING, MELTING, HEAT-TREATING WITH RO-TATING GENERATORS	SMALL SCALE HEATING, MELTING, HEAT-TREATING	PRINCIPAL BAND FOR COMMERCIAL ELECTRONIC IN-DUCTION HEATING OF METALS	SURFACE HEATING OF METALS, HIGH-FREQUENCY ELEC-TROSTATIC HEAT-ING, THERAPEUTICS
ALTERNATORS. MOTOR GENERATORS			ELECTRONIC GENERATORS OR SPARK GAP CONVERTERS		ELECTRONIC GENERATORS

THE INDUCTION HEATING FREQUENCY SPECTRUM

ELECTRONIC POWER SOURCES for Industrial Heating

Electron-tube oscillators turn electrical "losses" into industry's gains by providing quick, efficient, localized heat

The electron tube as a source of controlled heat in industry finds new applications almost every day. High-frequency electrostatic and electromagnetic heating often cuts time and labor costs, while doing a better job than conventional heating methods. In addition, many heating tasks that would be impossible with older methods are comparatively simple with electronic heating processes.

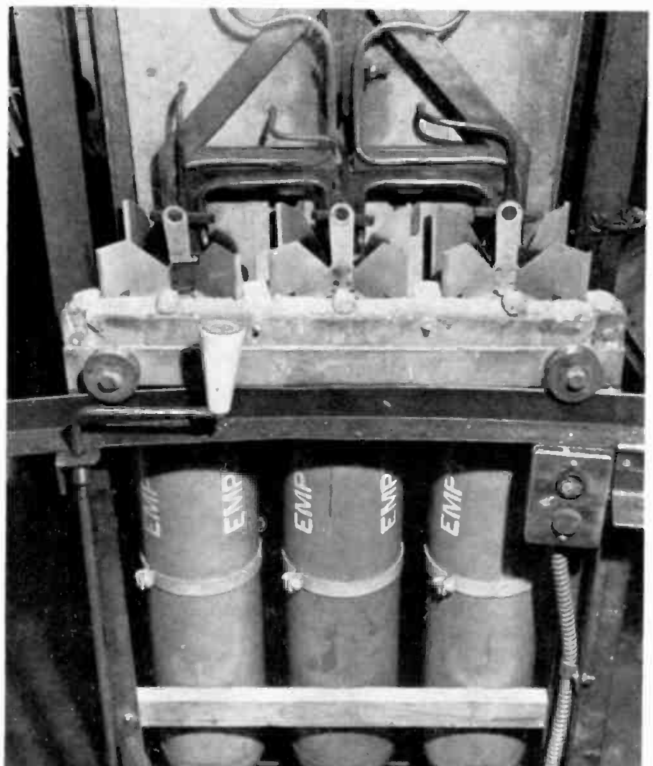
Although the principles of electromagnetic heating have been known for many years, practical industrial applications are a recent development. At the turn of the century it was known that iron could be heated by being placed in a varying magnetic field. Early sources of alternating current to produce such fields were rotating generators. Mechanical limitations of such equipment imposed an upper limit of about fifteen kilocycles per second. Since it was known that the higher the frequency, the greater the heat that would be produced, efforts were directed towards the development of suitable sources.

This led to the evolution of the resonant spark-gap oscillator, which was successfully used, and, in fact, accounts for many practical installations for heat treatment of metals today. Spark-gap operating frequencies above 300 kilocycles, however, are not generally used.

Electronic equipment using rectifying and oscillating tubes may be operated at practically any frequency and with almost unlimited

Inside hardening of aircraft engine raceway by induction heating

Set up for multiple brazing of bomb fuse liners with 20 kw "Thermonic" induction heating equipment



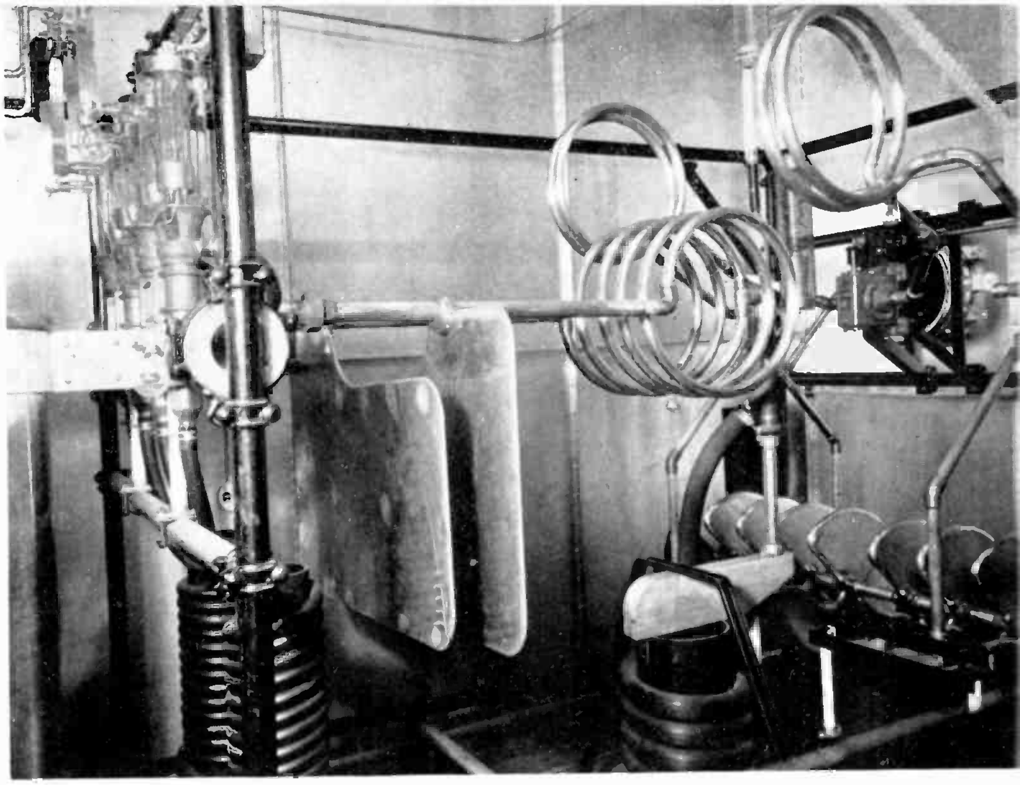
power outputs. In general, frequencies on the order of 300 to 500 kilocycles are employed in the heating of magnetic and non-magnetic metals, while equipment operating in the megacycle range serves to heat non-conducting materials.

This is shown in accompanying Frequency Spectrum Supplement.

Two factors combine to produce heat in ferrous and magnetic metals: magnetic hysteresis losses and eddy current losses. The output of an oscillator generating a frequency of 400 to 500 kilocycles is fed into a "work" or heating coil of copper fashioned to conform to the surface contours of the part to be heated. The rapidly reversing magnetic field causes the metal to be alternately magnetized and demagnetized, apparently imparting motion to the molecules. Molecular friction supposedly produces heat as a result of this motion.

Upon being heated to a point called its "critical temperature," magnetic material loses the magnetic property. Any further heating required is accomplished by eddy current losses. These losses result in resistance heating caused by circulating currents induced in the metal by the rapid building up and collapsing of the magnetic field. Since there is no magnetic hysteresis loss in non-magnetic metals, eddy currents alone cause heating.

Considerably higher frequencies are required to heat non-conducting materials. Oscillating current of 1.5 megacycles to 100 megacycles,



Power stage of "Thermex" 60 kilowatt high-frequency electrostatic heating equipment. Note tubes, tank circuit, and coupling coils

TYPICAL APPLICATIONS OF ELECTRON-TUBE HEATING:

Localized hardening of armor-piercing shell caps, cartridge drawing dies, gear teeth and "roots"

Brazing bomb fuse liners, fabricated aircraft struts

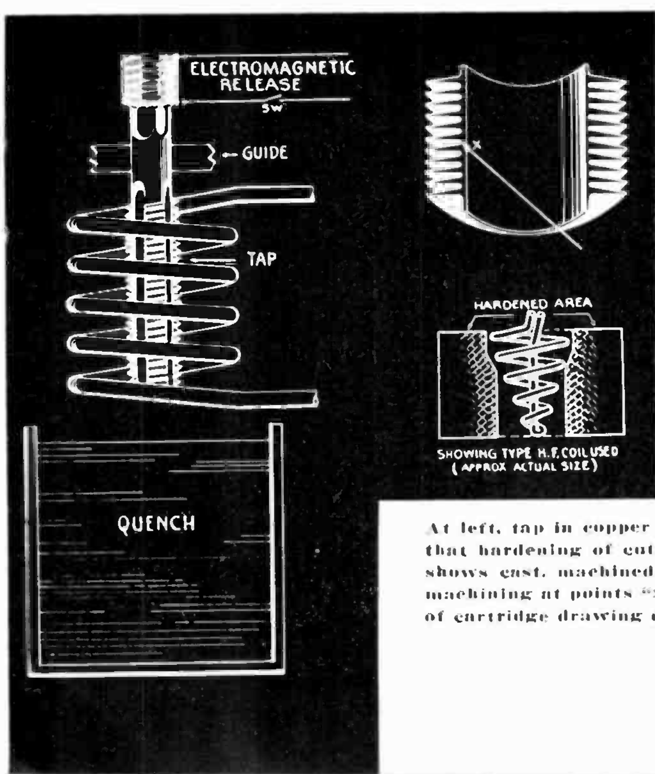
Continuously annealing steel wire

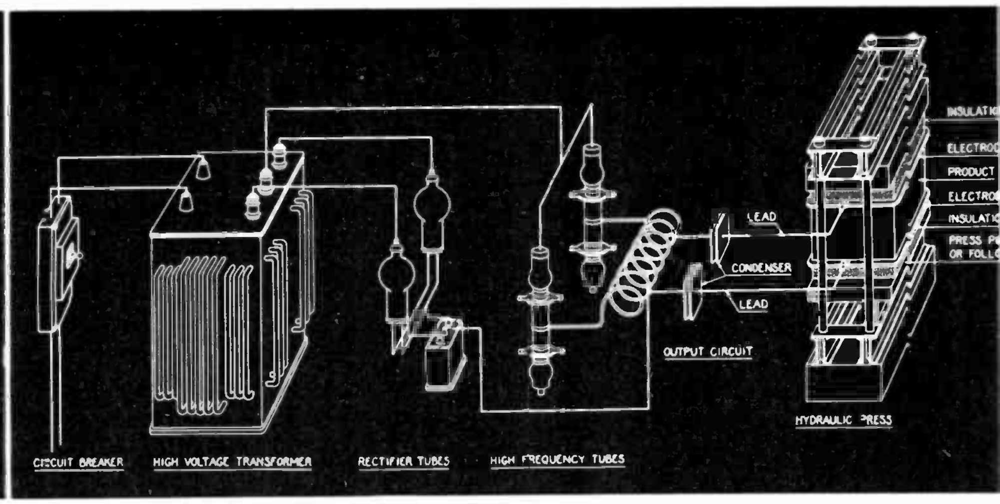
Drying paper, textiles, powdered materials, ceramics

Bonding plywood for aircraft construction

Softening thermoplastics for processing, wood and other fibrous materials for "compregnation"

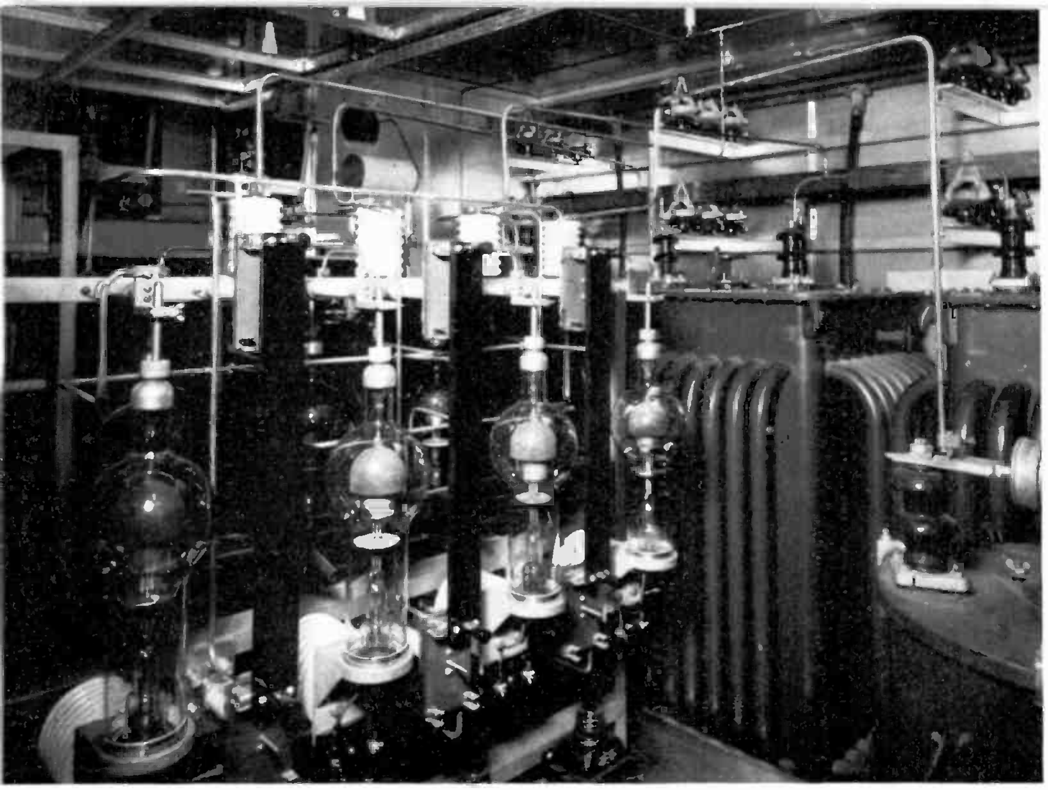
Destroying infestations in grains and cereals





At left, tap in copper "work" coil is heated so rapidly by induction heating that hardening of cutting sections only is accomplished. Top right, sketch shows cast, machined type aircraft cylinder. Brazed fins eliminate critical machining at points "x," besides saving time and metal. Below, cross-section of cartridge drawing die quick-hardened internally to avoid overall distortion

Above, conversion of power-line current to direct current, high frequency current, and dielectric heating of product. (Courtesy The Girdler Corporation)



Transformers and rectifying tubes of 600 kw electrostatic heating installation

depending upon the type of material and other factors, is fed into two or more flat electrodes or plates, with the material to be heated sandwiched between. Electrostatic hysteresis, apparently an ultra-rapid distortion and rubbing together of the molecules of the material, then produces heat. This is the principle, of course, of medical diathermy, which produces therapeutic fever in the human body. However, large scale, high power equipment for commercial heating is of comparatively recent origin. Apparatus producing up to 600 kw of "short wave" power is available.

Heat treating

Engineers in widely separated fields frequently solve their most difficult problems by using the electron tube as a heat source. Here are a few examples of the use of induction heating of metals:

One of the most important characteristics of induction heating is the "skin effect." The metal heats from the surface in, and with high power input resulting in practically instantaneous heating, the heat does not have time to be conducted through the entire part before hardening in the quenching bath. Use is made of this phenomenon in many interesting ways. A major tap and die manufacturer is now planning automatic equipment for "shallow-hardening" of taps. The tap is heated in a matter of seconds, then released to fall into a quench bath, with the very desirable result that the "flutes" or cutting edges and other outside portions of the tap are extremely hard, while a core of soft, tough steel is left, for strength and resistance to snapping under strain. Rockwell "C" hardness readings taken across the wide diameter of a tap shallow hardened in this way range uniformly from 65 on the flutes to 37 at the center of the cross section.

Hardening

Overall hardening of drawing dies often causes general distortion, making necessary considerable regrinding to shape. Quick-heating the critical internal drawing surfaces only, by induction heating, practically eliminates the distortion. Specially designed work coils for inside diameters as small as ⅝ in. are entirely practical.

In a similar manner, many other special parts are being locally hardened commercially. Gear teeth and their "roots," for instance, are being hardened without hardening the entire gear. In addition to giving greater strength to such gears, the induction heating process avoids the common overall distortion encountered when an entire gear is heated and hardened. Aircraft engine cylinders, too, are hardened on the wearing surface only.

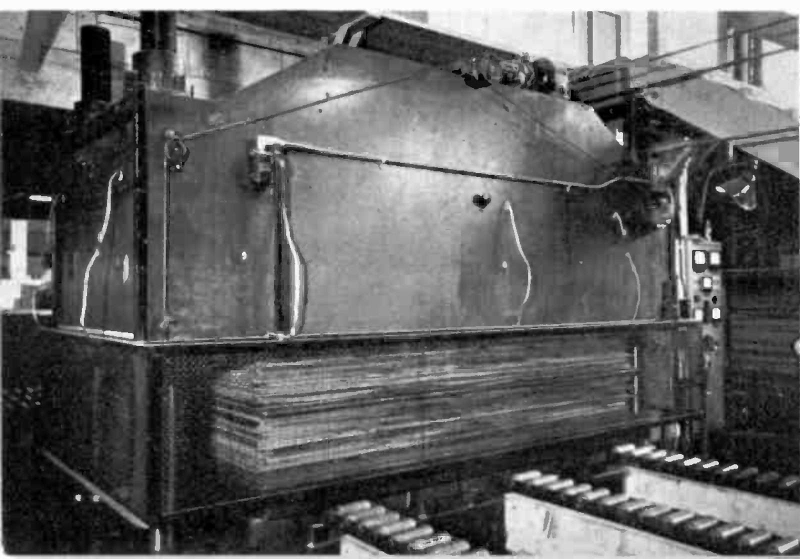
Brazing

Induction heating lowers cost and speeds production in many brazing operations and often makes for stronger joints. With fabricated struts, used for aircraft fuselage and other construction, joining thin steel tubing to a heavy cast boss by ordinary brazing means has frequently resulted in a weakening of the tubing at the joint. With a work or heating coil enveloping the boss and tubing, electronic brazing obviates this difficulty. A "split" coil is sometimes used, to facilitate removal after brazing.

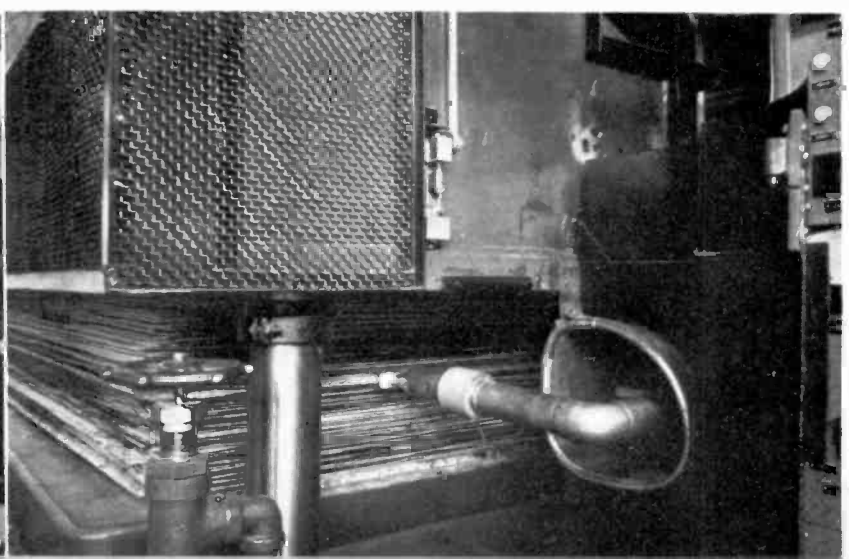
Standard practice in manufacture of aircraft engine cylinders is, of course, to cast cooling fins on

(*Continued on page* 116)

Hydraulic press fitted with high-frequency electrode for bonding plywood with thermosetting resins heated by dielectric losses



Close-up of electrode centered in stack of plywood panels of various thicknesses. Top and bottom press plates, or followers, are grounded



A Public Service supervisor using radio equipment in one of the mobile units

Test Engineer B. B. Miller is shown making an adjustment on one of the sets

MOBILE FM Guides St. Louis Lines

Engineering considerations in two-way radio system used to supervise street car and bus operation over 59 local routes

Probably the best non-military proving grounds for the noise-reducing feature of frequency modulation are to be found in the supervisory control systems for bus and trolley service in large cities.

Because of the necessity of operating mobile communication equipment in proximity to traffic lines, where electrical interference is high, it is essential that the transmitting-receiving method be capable of at least partially suppressing normally high interference and that it contribute no inherent noise. Both of these requirements are met by a frequency-modulated system. At least four cities — St. Louis, Cleveland, Boston and Chicago — have FM communication systems in operation for street railway and bus control, which, in addition to their normal functions, can be called on for emergency service under wartime conditions.

The St. Louis Public Service Company, operators of the transportation system of that city, maintains radio communication between a central dispatcher located at the company's general offices and the various supervisors who cruise in specified districts in automobiles carrying Motorola two-way FM equipment. Twenty-seven such units were installed. The normal service area is approximately 10 miles in each direction from the transmitter, but field tests have shown that satisfactory coverage can be had for about 35 miles for 2-way communication and satisfactory reception has been had up to approximately 80 miles from the fixed station transmitter.

Supervision of street car and bus service over fifty-nine routes by radio control has enabled the company to improve the quality of its service immeasurably by means of increased efficiency in handling emergency traffic conditions. The F.C.C. granted construction permits for the system as a special emergency station on an assigned frequency of 31,460 kc. The call letters are KEHG.

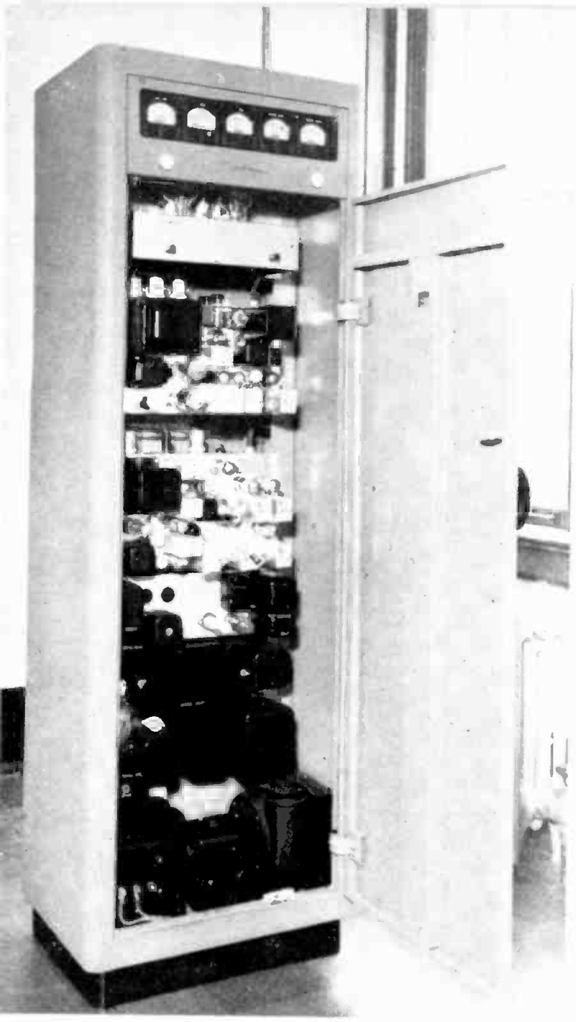
The main transmitter, which maintains contact with supervisors, superintendents and trouble trucks, is unattended and is remotely controlled by the dispatcher. All control is handled by a single telephone pair which, during standby, carries the output of the receiver to the line amplifier in the control console.

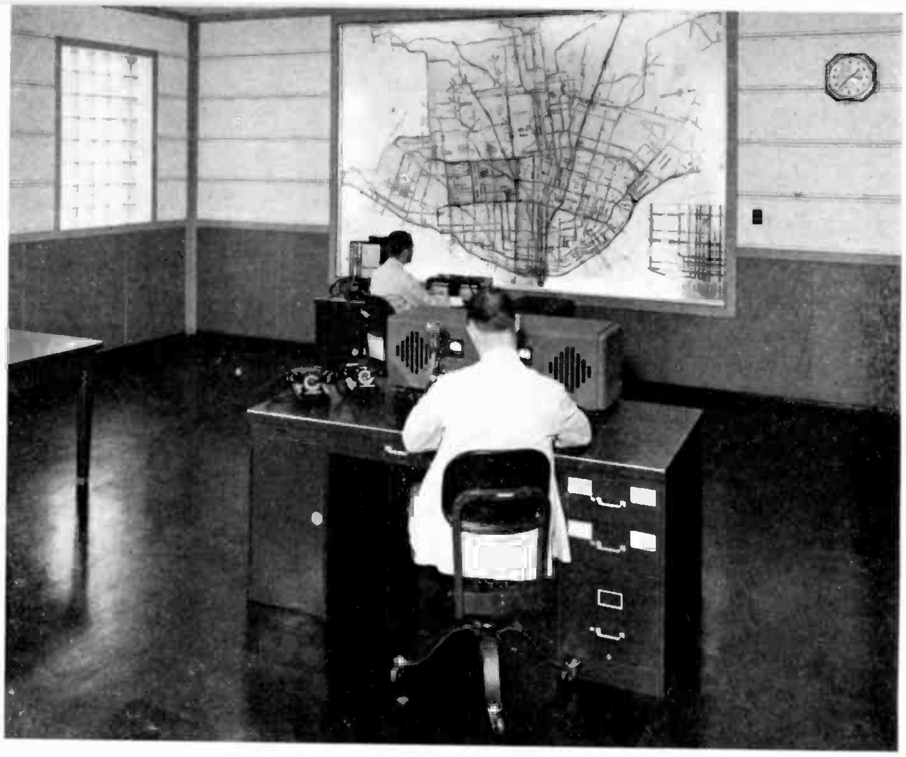
To transmit, the dispatcher has only to throw the key in the transmit position and the receiver is muted and plate power is applied to the exciter and final amplifier and the antenna is switched from receiver to transmitter, the same antenna being used for transmission and reception.

It has not been deemed necessary to permit any car-to-car operation, although it would be possible over most of the area covered by the radio system. The fixed station receiver is identical with mobile receivers, except that its power supply is from the 110-volt ac line. No change in the original equipment has been made since the system went into operation.

Design features

The mobile receivers are completely operated from the 6-volt car battery and are double-conversion superheterodynes. Both oscillators are crystal controlled; the first I-F





The main transmitter (left) for the St. Louis Public Service Co. Radio Station. This unit, which is unattended, is remotely controlled by the console in the dispatcher's quarters (shown above). The illuminated map shows the entire street car and bus system of the company. It is divided into ten districts by means of different colors, each district being under the supervision of one of the radio cars.

frequency is 4.3 mc and the second is 455 kcs. Cascade limiters are utilized. It has been found that complete limiter saturation takes place with a signal from the fixed station transmitter in any part of the service area and no so-called "dead spots" have been found.

The discriminator is a back-to-back double resonant circuit, rather than the conventional discriminator arrangement. The receiver sensitivity is close to the theoretical limit as determined by the inherent noise in the circuits of the first tube. The St. Louis FM system makes use of standard Motorola FM emergency equipment.

Dr. Daniel E. Noble, Director of Research of Galvin Manufacturing Corporation, explains that the sensitivity is rated in terms of the signal required to produce a noise reduction of 20 decibels when the signal is applied at the input terminals of the antenna coil. For the measurement a standard 18C Ferris signal generator is used, and the leakage of the generator is determined by extrapolating the voltage rating on a graph of the noise level as a function of the microvolts. In other words, the noise at the output of the receiver will increase as the input to the receiver from the signal generator is decreased; and after the attenuator of the signal generator has been reduced to zero voltage output, the final noise reading is taken with the signal generator disconnected from the 110-volt 60-cycle supply.

In this way, Dr. Noble obtains a noise reading for absolute zero voltage, since there is no doubt about the elimination of any stray feed to the receiver. By extrapolating he finds that the order of magnitude of stray leakage from the signal generator is .2 microvolts. On this basis a corrected figure for the sensitivity of the receiver with the output of the signal generator connected directly to the antenna input terminals is .4 to .6 microvolts for a noise reduction of 20 decibels.

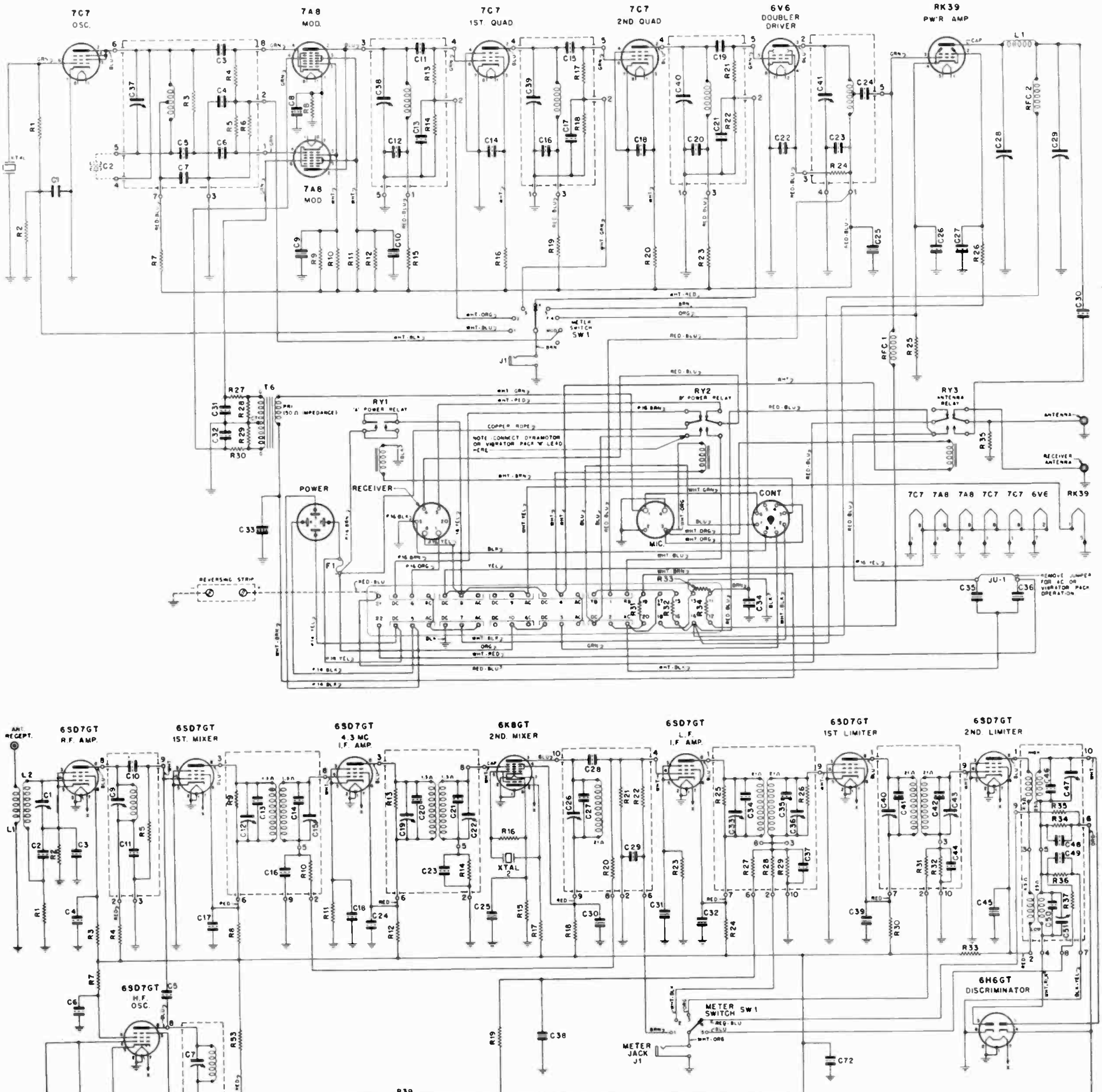
"We find it possible to hold such sensitivities consistently in our production runs," Dr. Noble reports. "Obviously, this high sensitivity is extremely important where a maximum range of equipment is required. It should be pointed out, however, that the sensitivity of the receiver cannot be utilized if the installation is made in an area where the average noise level exceeds the inherent noise level of the receiver. It is very important in designing a two-way system to select a receiving location where the electrical noise level is low."

Squelch system

A second important feature of the receiver is the squelch system. If the squelch system, which normally cuts off the audio feed to the speaker until a carrier is received, is designed so that it requires a signal strength greater than that necessary for communication purposes to operate the squelch, the range of the system will be limited by the sensitivity of the squelch system.

The Motorola squelch is designed so that it will operate on carrier levels too weak to be used for communication purposes. The squelch operates on a differential system utilizing the increase in grid current in the first limiter produced by the presence of the carrier and, also, the decrease in the voltage produced by the noise in the system. In other words, when a carrier is received, one voltage produced by the carrier tends to open the squelch, while the noise level which is reduced in the presence of the carrier also reduces the voltage which has been produced by the rectification of the noise output of the receiver, and the reduction of this noise voltage also tends to open

(*Continued on page 122*)



Circuit diagrams of mobile transmitter (top) and receiver (bottom) used in the St. Louis street-railway control system

Determining Gain in RC Circuits

by WILLIAM MOULIC

Asst. Professor in Vacuum Tubes,
N. Y. State Signal Corps Training School

Computing stage amplification at high, middle and low frequencies

The amplification of a wide range of frequencies in the audio and video spectrum can be more quickly calculated and the effects of part value changes in resistance-coupled amplifiers observed readily with the use of the two calculators presented here on the following two pages.

The typical equivalent circuit of a resistance-coupled amplifier circuit is shown in the diagram on this page. The circuit includes the tube voltage $-\mu E_g$, a load resistance R_L, a coupling capacitor C_c, a grid circuit resistor R_g, and an equivalent shunt capacity due to the input capacity of the second stage and the output capacity of the stage under consideration. The input capacity of the second stage includes that capacity produced by the grid-plate capacity of a tube in conjunction with a resistance plate circuit load. This input capacity is $C_i = C_{gk} + C_{gp}(1 + A)$ where C_{gk} is the grid-cathode capacity or the stated input capacity of the tube, C_{gp} is the grid-plate capacity of the tube, and A is the stage gain factor.

The amplification of the resistance-coupled amplifier stage is limited at low frequencies due to the increasing reactance of the coupling capacitor C_c, and at high frequencies by the decreasing reactance of the shunt tube capacity, C_t.

The gain of the amplifier can be expressed as $A = \frac{Gm}{G_p + G_L + G_g}$ where G_m is the mutual conductance of the tube in mhos, G_p is the plate conductance $(1/R_p)$, G_L is the conductance of the load resistor, G_g is the conductance of the grid circuit resistor. This gain will be the maximum available from the given circuit and conditions.

At low frequencies the gain will be less than the value at middle frequencies. The percentage of middle frequency gain obtained at a specific low frequency can be expressed as a factor

$$B = \frac{1}{\sqrt{1 + (X_c/Reqv.)^2}};$$

where X_c is the reactance of the stage coupling capacitor, C_c at a specific low frequency.

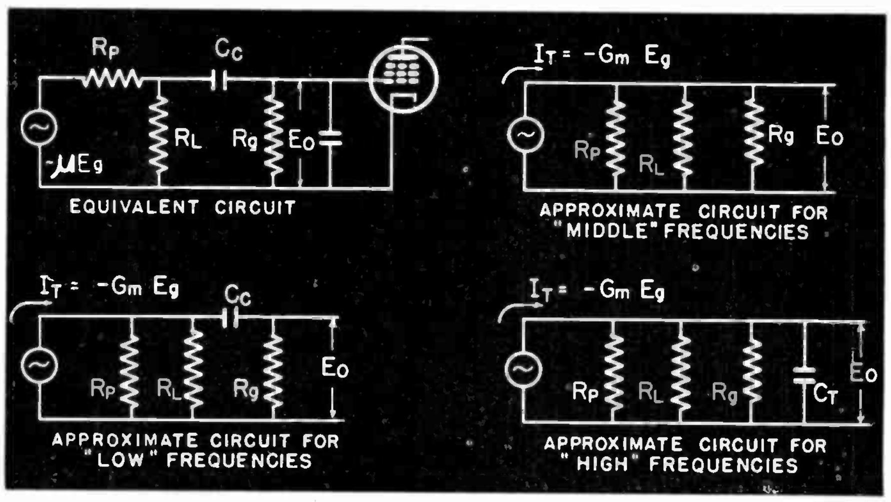
$$Reqv. = R_g + \frac{R_p R_L}{R_p + R_L}$$

The gain at this frequency will then be $A' = BA$.

At high frequencies, the gain is less than that at middle frequencies due to shunt capacity, C_t. The percentage of gain at middle frequencies available at some specific high frequency can be expressed as a factor $B = \frac{1}{\sqrt{1 + (Reqv./X_c)^2}}$ where $Reqv. = \frac{R_p R_L R_g}{R_p R_L + R_g R_L + R_p R_g}$ and X_c is the reactance of the shunt tube capacity C_t at the specific high frequency. The gain at high frequencies is then $A' = BA$.

These calculations are performed on the two charts in the following manner. The calculation of gain at middle frequencies is carried out on Chart I while the correction factor B for high and low frequencies is calculated on Chart II. The factor B is then transferred back to Chart I and the gain at either a high or low frequency can be calculated.

Equivalent circuits for RC amplifier stage at "middle," "low," and "high" frequencies. C_T is total shunt tube capacity due to all factors



Gain at middle frequencies

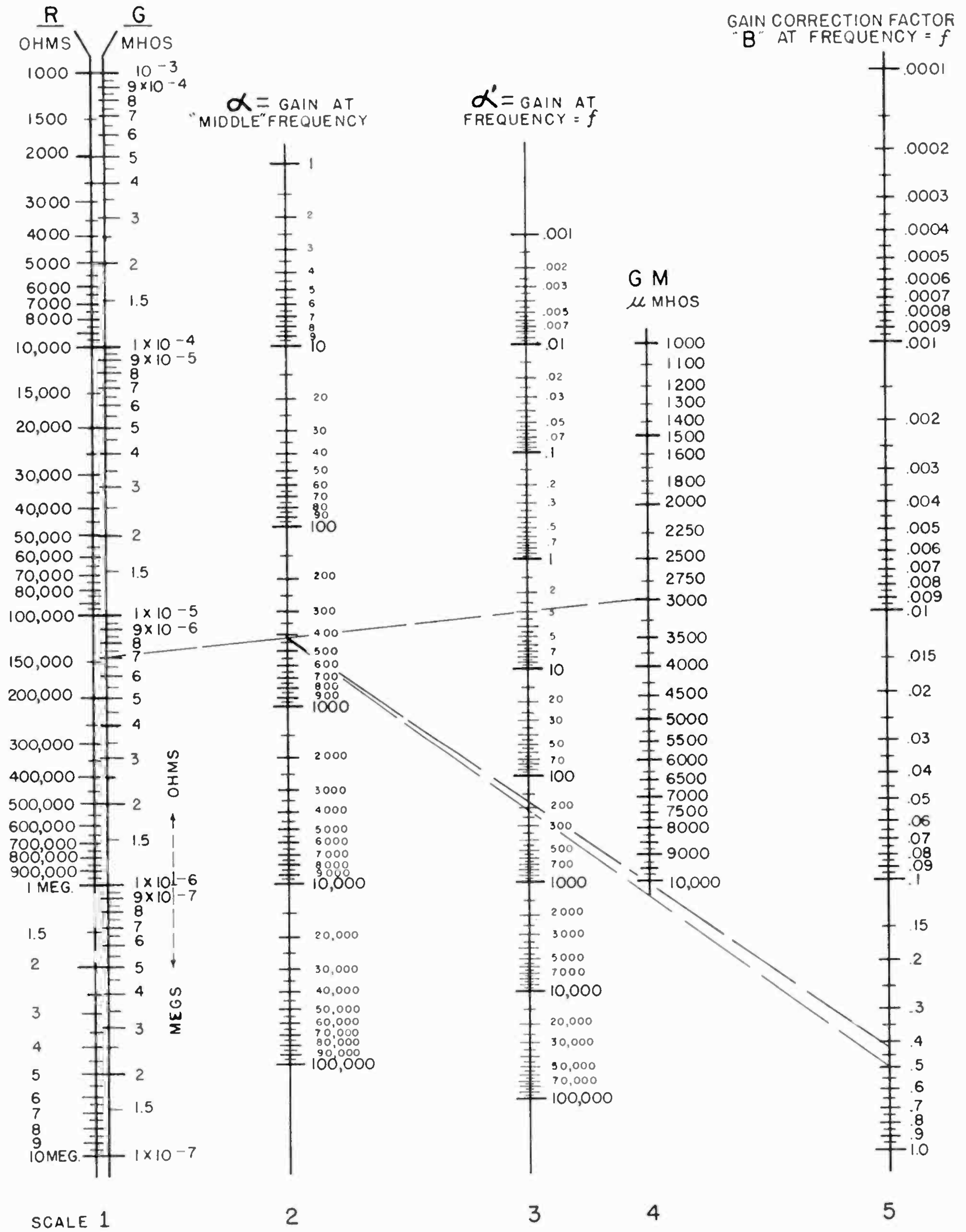
Opposite the value of plate resistance, for tube being used, on scale 1 read its equivalent conductance in mhos. Do likewise for the load resistor R_L and the grid resistor R_g. Add together the three conductance values obtained and locate this value on scale 1. Place a straight edge between the total conductance value on scale 1 and the mutual conductance of the tube on scale 4. The line between these two points will cross scale 2 at the middle frequency gain value.

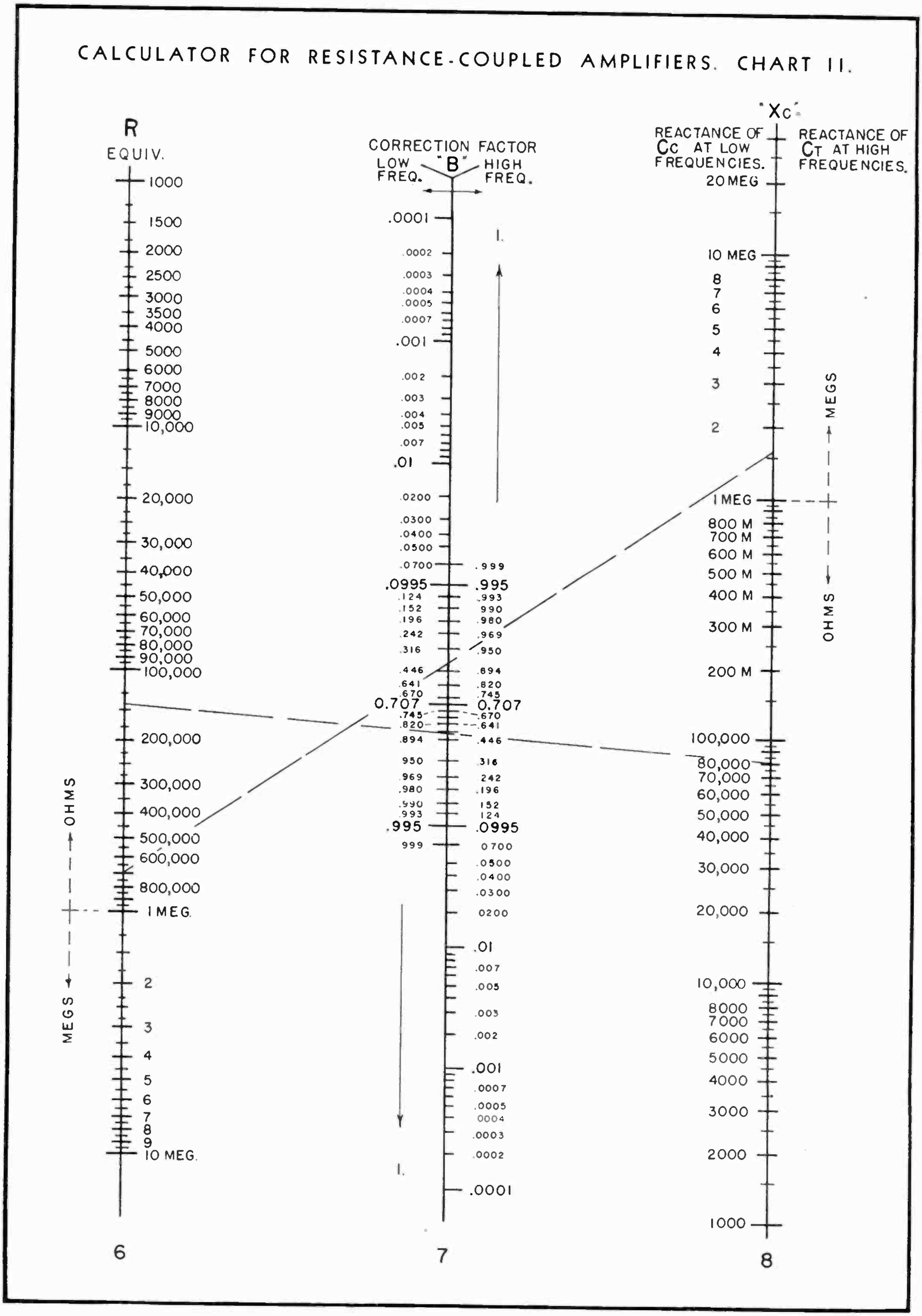
Gain at low frequencies

Calculate the gain at middle frequencies as previously described. Calculate $R_{eqv.}$ in the following manner. Read the conductance for R_p and R_L on scale 1 and add conductance values. Locate this sum on scale 1 and read directly opposite the parallel resistance and to this value of resistance add R_g, which gives $R_{eqv.}$ Locate this value

(*Continued on page 99*)

CALCULATOR FOR RESISTANCE-COUPLED AMPLIFIERS. CHART I.




CALCULATOR FOR RESISTANCE-COUPLED AMPLIFIERS. CHART 11.
R
EQUIV.
1000
1500
2000
2500
3000
3500
4000
5000
6000
7000
8000
9000
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
200,000
300,000
400,000
500,000
600,000
800,000
1 MEG.
2
3
4
5
6
7
8
9
10 MEG.
OHMS
MEGS
CORRECTION FACTOR
"B"
LOW FREQ.
HIGH FREQ.
.0001
.0002
.0003
.0004
.0005
.0007
.001
.002
.003
.004
.005
.007
.01
.0200
.0300
.0400
.0500
.0700
.0995
.124
.152
.196
.242
.316
.446
.641
.670
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950
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.980
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0200
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.005
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.002
.001
.0007
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0004
.0003
.0002
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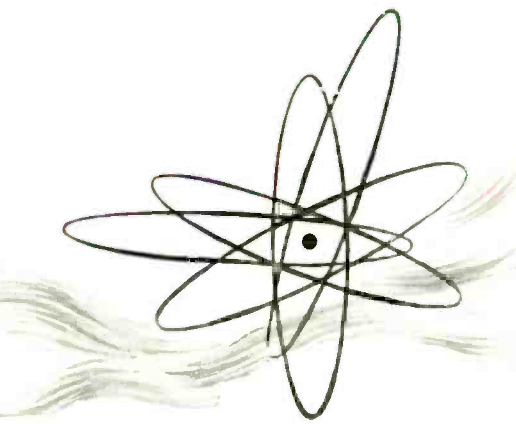
1.
1.
"Xc"
REACTANCE OF Cc AT LOW FREQUENCIES.
REACTANCE OF CT AT HIGH FREQUENCIES.
20 MEG
10 MEG
8
7
6
5
4
3
2
1 MEG
800 M
700 M
600 M
500 M
400 M
300 M
200 M
100,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
8000
7000
6000
5000
4000
3000
2000
1000
MEGS
OHMS
6
7
8

What General Electric is doing **now** for the **future** of electronics



What is electronics? It is a new science, yet it is not new. The General Electric radio is an electronic instrument. So is the talking moving picture, and the physician's X ray. So is television. And so are the thousand devices of industry that open doors, level elevators, guide printing presses, detect tiny flaws in castings, and control motors that speed the vast production of war materials.

General Electric faces the electronic future supported by nearly forty years of electronic research. It was a General Electric scientist, Dr. Irving Langmuir, who developed the high-vacuum tube and made it practical for widespread application. And other General Electric scientists, including Coolidge, Alexanderson and Whitney, contributed greatly in the development of electronics to its present stage.

G-E is building electronic equipment for our fighting forces and war industries

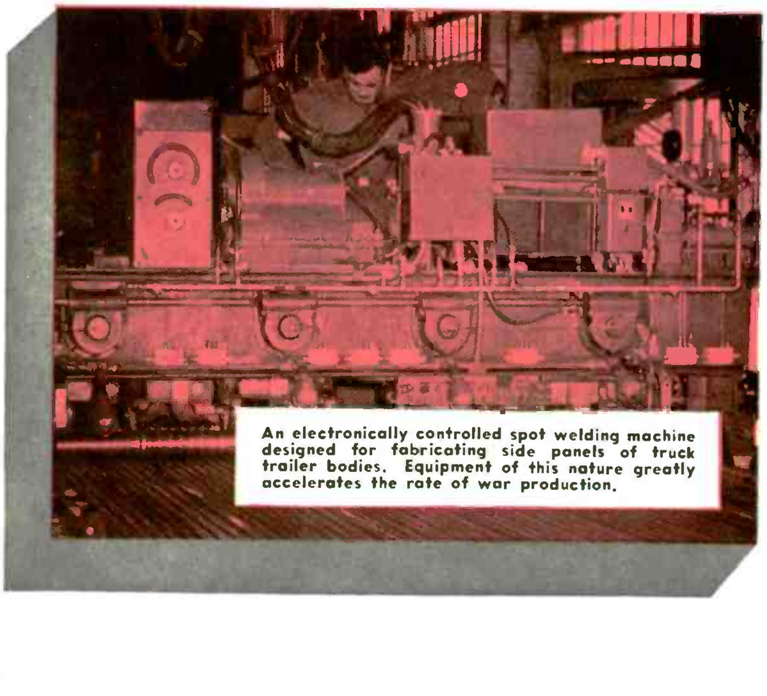
Months ago the workers in General Electric's war-radio plants solemnly promised their best to America's fighting men. They kept their promise and now proudly wear the Army-Navy "E."

Somewhere in the Pacific a soldier operates a General Electric electronic device. Across the European sky a fighter plane cruises, employing other General Electric devices. And in war plants throughout America, General Electric electronic equipment speeds the production of goods for the fighting front.

The nature of much of this equipment cannot be revealed now. But this can be told: production of General Electric electronic equipment is at the greatest point in history. The volume, and diversity, and the function of these amazing electronic devices are simply beyond popular belief.

This wartime activity is helping America and our allies win the war. And it is also providing a rich fund of experience for the days after victory.

Some day, General Electric plants, machinery, skilled workers, scientists, and engineers will help electronics build a safer, more comfortable, more efficient world for all of us.


An electronically controlled spot welding machine designed for fabricating side panels of truck trailer bodies. Equipment of this nature greatly accelerates the rate of war production.


Thousands of General Electric electronic devices and tubes are used by the Signal Corps of the United States Army. A sergeant demonstrates an operation to a radio maintenance class.

G-E is telling the American people what electronics promises for tomorrow

Electronics will grow as public understanding grows. General Electric is undertaking a campaign of public education, reaching all the people of the nation, and demonstrating the power of this new science to build a better world. In magazines, over the radio, by special literature, and by the operation of electronic devices in a thousand fields of activity, the public can see the outlines of the Electronic Era.

In national magazines, reaching millions of people weekly, General Electric advertisements are educating the American public in this new science.

This handsome General Electric brochure, "Electronics — a New Science for a New World," is the first book of its kind ever to explain to the general public the scope and meaning of the electronic science. Thirty-two pages, beautifully illustrated. We will be glad to send you a free copy. Write for GED-1028 to General Electric, Section 170-A2, Schenectady, N. Y.

Electronics on the Air. Over the CBS and American (FM) networks, Frazier Hunt, famous commentator, high-lights the day's news. Human interest stories about electronics bring the subject home to all America.

Power Transformers for Aircraft Use

by HARRY HOLUBOW

Engineering Research Division Thordarson Electric Mfg. Co.

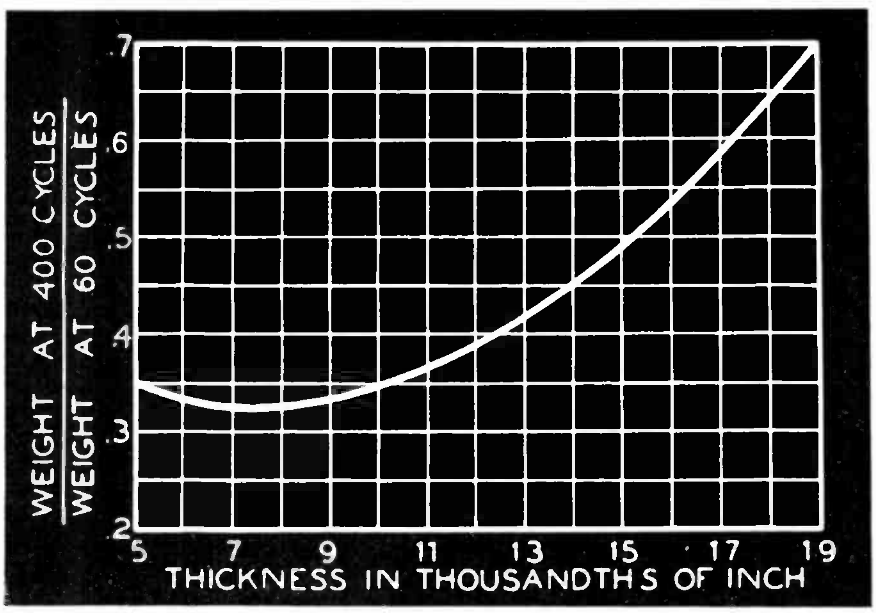
Designing units that are smaller, lighter and more efficient. Advantages of 400 cycles and higher frequencies

The present trend toward making mechanical and electrical equipment smaller and more efficient has placed new demands on the engineer engaged in the design of transformers. Especially in the last few years, the demand for light weight transformers has been growing with the growth of aviation. The limitation in the size of a transformer is usually governed by its ability to dissipate readily the heat generated in the core and coils. (In very small transformers the no-load to full-load regulation is often the limiting factor.)

The heat generated in a transformer is due to the I^2R losses in the coil and to hysteresis and eddy current losses in the magnetic materials. Although it is unlikely that much improvement can be expected in obtaining a coil material of a lower resistivity than copper, the application of glass to wire coating and insulation made it possible to operate transformers at higher temperature and thus make them smaller. However, the reductions in efficiency, poor regulation, and fire hazard that are present in transformers that operate at higher temperatures, tend to offset advantage gained by reduction in size.

Considerable improvements have been made in the core materials in the past several decades; especially noteworthy is the development of the material known as "Hypersil." The use of this material in transformers permits a reduction in size by about 20 per cent in the larger power transformer. Because Hypersil has to be used in strip form, it is not readily applicable to small transformer design. However, as the maximum saturation of present day magnetic materials occurs at about 22,000 gausses, it would be impossible to obtain a reduction in size of more than 40 per cent operating at 60 cycles even if the core losses were made negligible. We must therefore go to higher frequency if aircraft transformers are to be made small. Frequencies of 400 cycles are most commonly used now in this country, although 800 cycles are sometimes being used.

Fig. 1. Ratios of transformer weights vs. lamination thickness



The total core loss per unit weight of any given core material of a definite thickness may be expressed as

$$W_t = W_h + W_e = K\ F\ B^{1.6} + C\ F^2\ B^2 \quad (1)$$

B = Maximum flux density and is inversely proportional to F)

The expression (1) is not absolutely correct as the hysteresis and eddy current losses depart from this relation because of eddy current shielding. Furthermore, the value of 1.6 for Steinmetz coefficient may not be exact. Nevertheless, the departure at 400 cycles and medium flux densities is small and may be neglected. If we take a transformer that has been designed for 60 cycles and is operated at 400 cycles the core-loss:

$$W_t = .31\ K\ F\ B^{1.6} + C\ F^2\ B^2$$

This equation indicates that regardless of the thickness of the core material, a transformer designed for 60 cycles will have the same value of eddy current loss and only about 31 per cent of hysteresis losses when operated at 400 cycles. The greatest reduction in core losses will therefore occur in a magnetic material that has a greater ratio of hysteresis to eddy losses; that is in the lighter gage magnetic materials.

However, the reduction of core losses or the increase in efficiency is not the main objective in 400 cycle transformers, but because the core losses are lower, it is possible to operate the transformers at higher flux densities allowing considerable reduction in weight. An increase in flux density B increases the eddy current losses much faster than the hysteresis losses and it is therefore important to keep eddy current losses as low as possible. For a given core material of a variable thickness the eddy losses

$$W_e = C_1\ t^2\ F^2\ B^2$$

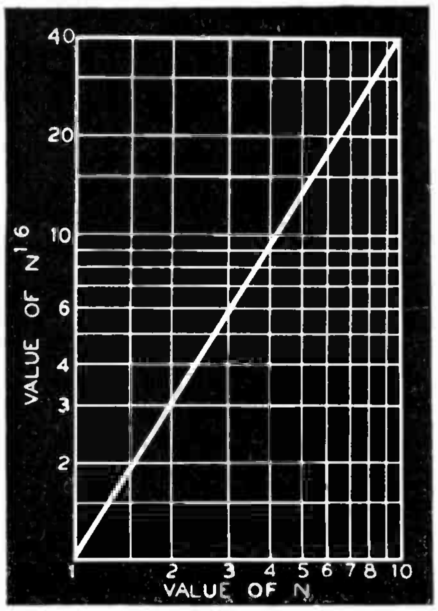


Fig. 2. Graph for frequency constant

The lighter the gage of the magnetic material, the lower will be the eddy losses. The curve in Fig. 1 shows the approximate ratios of total transformer weights for different thicknesses of magnetic material at 400 cycles using .019 in. silicon steel at 60 cycles as a base.

The design of power transformers to operate at 400 cycles does not differ much from that of 60 cycle design. However, in the case of 60 cycle transformers complete data is available on performance and core losses of the magnetic materials commonly in use, while the commercial information available on 400 cycle operation is incomplete. In general the permeability of magnetic materials may be assumed to be independent of the frequency and is a function of the flux density only; the core losses will depend on the frequency, flux density and thickness.

From the expression

$$W_t = K F B^{1.6} + CT^2 F^2 B^2 \quad (2)$$

for core losses it is possible to calculate the total core loss per unit weight at any frequency and flux density if the hysteresis and eddy current constants K and C are known. These constants are not usually readily available for most of the materials in use, and they would be cumbersome to use if they were known. The following method of calculations has been found to be very convenient: Let us assume that a transformer has been designed for 60 cycle operation at a flux density NB where N is any number larger than one (1) and B is 10.000 gausses. The total core loss per unit weight may be then expressed as

$$W_t = K F N^{1.6} B^{1.6} + C F^2 N^2 B^2$$
$$F = 60, \; B = 10{,}000$$

If we now operate this transformer at any other frequency F_x, higher than 60, the core loss may be expressed as follows:

$$W_t = K F \frac{F_x}{F} N^{1.6} \left[\frac{F}{F_x}\right]^{1.6} B^{1.6} + C F^2 \left[\frac{F_x}{F}\right]^2 N^2 \left[\frac{F_x}{F}\right]^2 B^2$$

Simplifying this expression we get

$$W_t = K F B^{1.6} \left[\frac{F}{F_x}\right]^{0.6} N^{1.6} + C F^2 B^2 N^2$$

But this relation may be written as

$$W_t = W_h \left[\frac{F}{F_x}\right]^{0.6} N^{1.6} + W_e N^2 \quad (3)$$

where W_h and W_e are hysteresis and eddy-current losses respectively at 60 cycles and at a flux density of 10,000 gausses. These values are usually available for most of the materials, and it is therefore not difficult to calculate the core losses at any frequency. Equation (3) can be handled quite easily for any frequency. If 400 cycles only are of interest, equation (3) may be written as

$$W_t = .31 \, W_h N^{1.6} + W_e N^2 \quad (3a)$$

The value of $N^{1.6}$ may be obtained from graph in Fig. 2 for any value of N. For example, if the material available is equivalent to Armco 58 or Allegheny transformer A grade, $W_h = 0.46$ watts per pound and $W_e = 0.12$ watts per pound approximately. Designing the transformer to have an equivalent 60 cycle density of 30,000, we have

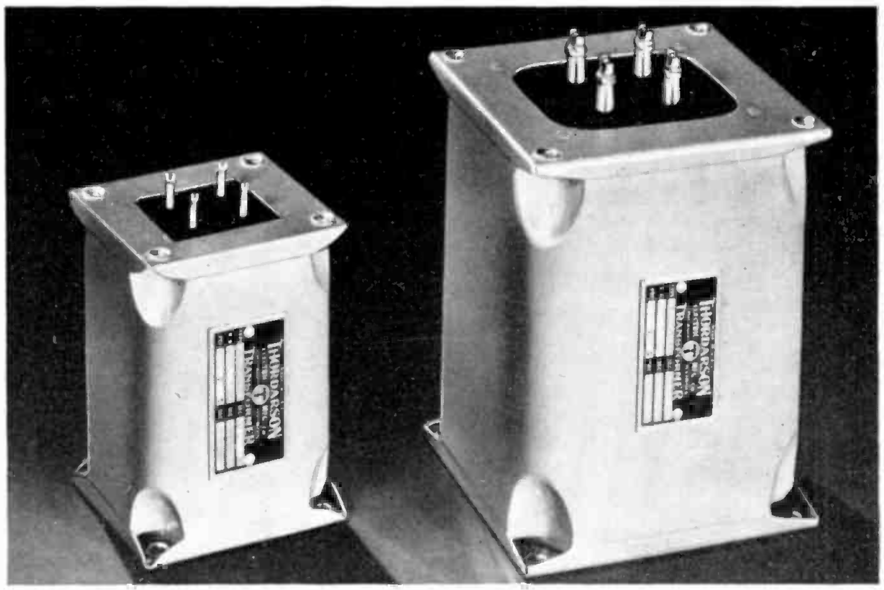
$$W_t = 0.31 \times 0.46 \times 3^{1.6} + 0.12 \times 3^2 = 1.91 \text{ watts}$$

per pound at 400 cycles. The actual flux density will be

$$\frac{30{,}000}{400} \times 60 = 4500 \text{ gausses}$$

The core losses obtained from relation (3a) at 400 cycles will be very close to the actual values. The method of designing 400 cycle transformers on the equivalent 60 cycle basis may seem to be a round-about method, nevertheless, it has important advantages besides the ease of calculating core losses. In the first place, as we are more acquainted with 60 cycle designs, and usually take this as a basis, the reduction in size and weight for 400 cycles becomes more apparent. In the second place, most of the designers usually have tables worked out for number of turns, etc., for the available lamination at 60 cycles, and

Two 200-watt transformers compared. At left is a 400-cycle unit; at right the corresponding 60-cycle type



this method therefore becomes a very convenient one.

How small can 400 cycle transformers be made as compared with 60 cycles? Obviously this depends upon a number of things such as capacity, cooling, efficiency, number of windings, etc. In large transformers the core loss, besides affecting the overall efficiency, presents a problem in heat dissipation. On the other hand, in small transformers the heat generated because of core loss is of not much importance, and the design is often limited by the no load to full load regulation. For example in a transformer using only about 5 pounds of magnetic material a core loss of 2 watts per pound is permissible while in one employing 100 pounds 2 watts per pound would be excessive. The problem, however, is somewhat simplified because in most cases the problem is limited to small transformers. Another problem that usually confronts the designer is the grade and thickness of material that can be used. Ordinarily it is believed that the thinner the material the more suitable it is. This is not always true. While theoretically the hysteresis losses do not depend upon the thickness of the material, actually the thinner material has higher losses, probably because of additional rolling and changed grain structure. In the grade of the material mentioned before, the hysteresis losses are near to 0.460 watts per pound for 0.014 in. steel, about 0.60 for 0.007 in. steel and 0.75 watts per pound for 0.005 in. steel. As it was previously shown, the total core loss in watts per pound at 400 cycle for an equivalent 60 cycle B of 30,000 gausses would be 1.91 watts per pound with 0.014 in. steel, about 1.39 watts per pound for 0.007 in. material, and about 1.48 watts per pound for 0.005 in.. Apparently there is little advantage to use .005 in. in preference to 0.007 in. Besides, it must be remembered that while the stacking factor with good laminations may be as high as .90 per cent with 0.014 in. material, it is only about .80 to .85 for 0.007 in. and probably not more than .75 for 0.005 in. steel. Lower stacking factor means a larger volume, larger copper weight and losses.

An approximate idea of the magnitude of reduction may be obtained from the following: Let us assume

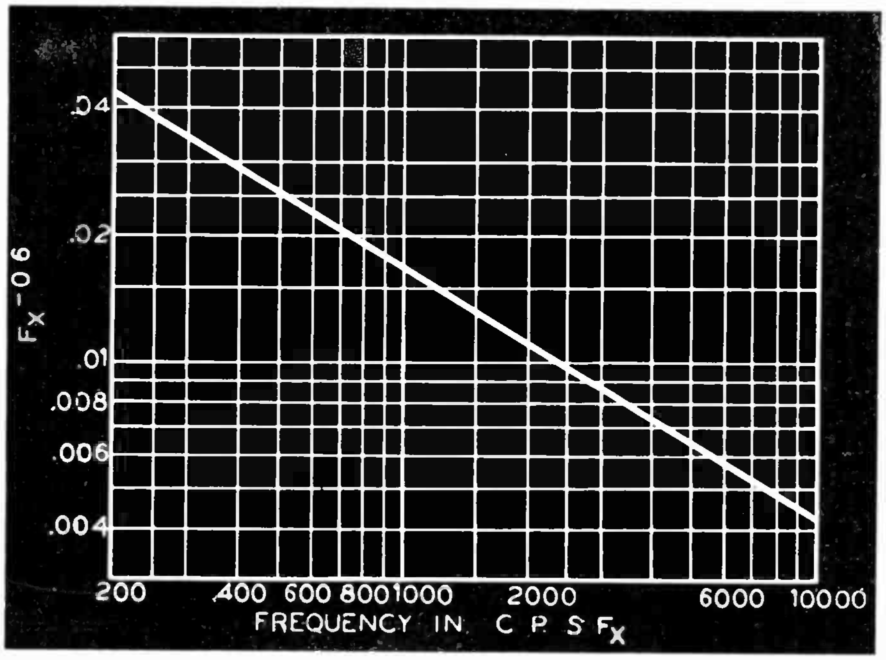


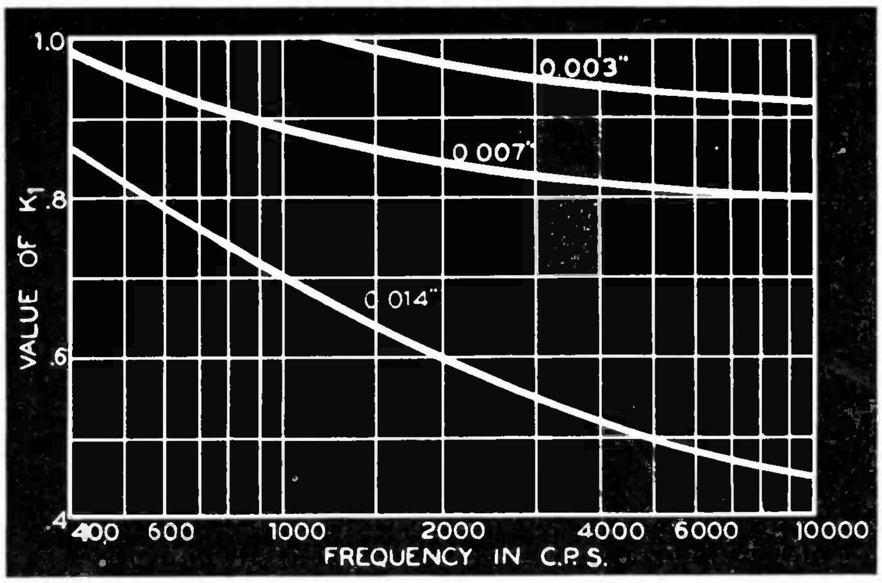
Fig. 3. Relation of frequency-constant to frequency

that a medium capacity transformer at 60 cycles uses a 0.019 in. steel of the best grade to give approximately about 1.4 watts per pound core loss; this would mean a flux density of approximately 15,000 gausses. If the transformer of the same capacity is to operate at 400 cycles, a core loss of about 50 per cent higher may be used safely because the reduction in the amount of material will more than compensate for the increase in loss per unit weight. If we select 0.007 in. material of the same grade, the core loss per pound at 40,000 gausses equivalent 60 cycle density will be

$$W_t = 0.31 \times 0.60 \times 4^{1.6} + 0.03 \times 4^2 = 2.18 \text{ watts per pound}$$

If we use for 400 cycles the same lamination size as for 60 cycles and reduce the stack, the reduction in core material weight will be 62.5 per cent. The reduction in copper weight (because of the reduction in the mean length) will be about 20 per cent. In the small wasteless type of laminations that are commonly used (the window height is one-half of the center leg, and the window length is 1.5 times the center leg) the ratio of weights will be 2.10 to 1, and a 400 cycle transformer will weigh about 47 per cent of an equivalent 60 cycles. Besides, the total core loss will be only slightly more than half and the copper losses about 80 per cent that

Fig. 4. Ratio of actual core losses to compared values



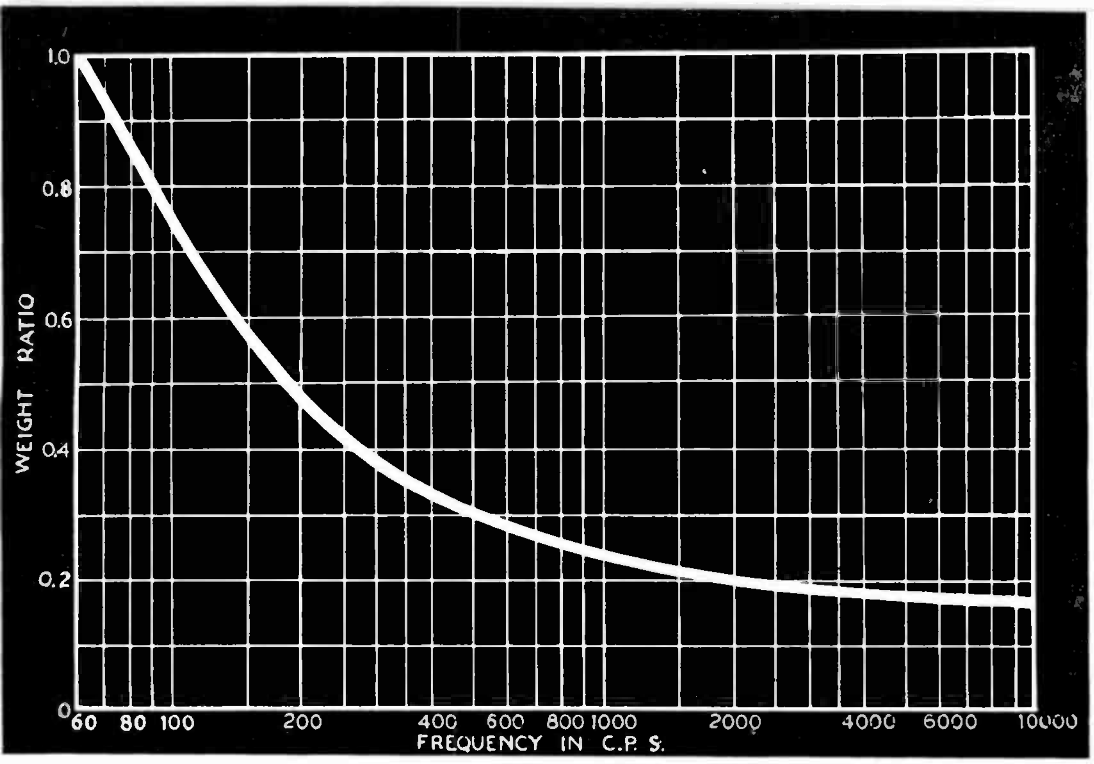


Fig. 5. Relative size of transformers for different frequencies

of the 60 cycle transformer. Ordinarily, however, such a design would not be used unless the transformer voltages are high, and it is desired to use the advantages of the larger window space. A smaller lamination that gives a cross-sectional area of about half with a square stack would be used. The number of turns of wire would be reduced in half, thus permitting a reduction in wire size. This design would give an overall size reduction, and the total weight would be 33 per cent that of 60 cycles.

There are, however, instances where full saving in size and weight cannot be realized. The most important of these are transformers with a great number of windings. The insulation requirements at 400 cycles are usually just as rigid if not more than at 60 cycles, and therefore, the space required in proportion at 400 cycles is much larger. High voltage transformer or transformers with high insulation value do not give a great saving in weight, because in these transformers the weight usually does not depend very much upon the capacity but upon the voltage. The reduction in weight of high voltage transformers is especially small if they are compound filled, because of the space required for the bushings, insulators, etc. Nevertheless, it is possible to reduce the size in most all transformers as illustrated in the photograph which compares two 200-watt transformers. At left is a 400 cycle unit and at right the same type of design and characteristics except 60 cycles.

The design of aircraft power transformers is not limited to 400 cycles; 800 cycle transformers are used, and it is possible that even higher frequencies may be used. Unfortunately, equation (3) cannot be used with a great degree of accuracy for the core loss calculations at the higher frequencies. The relation

$$W_h = K\ F\ B^{1.6}$$

is approximately true at flux densities as low perhaps as 2000 to 3000 gausses. As the flux density becomes lower the Steinmetz coefficient becomes larger, reaching perhaps the value of 3 at extremely low values of induction. Besides, at the higher frequencies the phenomenon known as eddy current shielding or skin effect becomes quite pronounced thus affecting the calculated eddy and hysteresis losses. This phenomenon may be explained as follows: At the higher frequencies when the ratio of the eddy to the hysteresis losses becomes larger, the eddy current within the laminations produces a flux at right angle to the applied flux, thus causing the flux to be unevenly distributed, and more concentrated near the surface of the lamination. Assuming a constant average induction, the effect of this uneven distribution of flux will be to decrease the eddy losses and increase the hysteresis losses. To illustrate, let us assume an exaggerated condition, that of the flux being concentrated in half the thickness of the lamination. B will be twice the average condition while the effective material thickness "t" will be half; consequently the loss per unit weight will be the same as under the condition of uniform flux distribution, and, inasmuch as only half of the material is subjected to the varying flux, the total eddy losses will be half that of the uniform condition.

The hysteresis losses do not depend upon the material thickness, and as the Steinmetz coefficient is always larger than one, the hysteresis losses due to non-uniform constant average flux will be higher.

The magnitude of the eddy currents in a magnetic material depend upon the flux density B, the thickness, the frequency, and the resistivity, while the value of the opposing flux depends upon the permeability of the material. It is, therefore, apparent the total core losses will depend upon all these. Theoretical relations have been developed attempting to calculate the core losses at audio frequencies.* These relations, however, are too complicated to be of any use to the general designer, and besides, they are admittedly inaccurate. To have experimental data covering the materials in use would be the most desirable thing, but this would involve a great deal of labor to assemble such data. Curves in Fig. 4 show the ratio of actual core losses to the values as calculated by relation (3). These values were obtained experimentally, for magnetic material equivalent to Armco 58 or Allegheny Audio A, and should result accurate enough for most purposes. Equation (3) may now be rewritten as

$$W = 12n^{1.6}\ F_x^{-0.6}\ K_1\ W_h + N^2\ W_e \quad (4)$$

Where W_h and W_e are hysteresis and eddy losses respectively at 60 cycles, B = 10,000. The values of $n^{1.6}$, $F_x^{-0.6}$ and K_1 may be obtained from Fig. 2, Fig. 3, and Fig. 4.

Very often it is desirable to know how high a frequency can be used, to obtain the smallest economical transformer assuming that the supply frequency can be easily generated. From relation (4) it is seen that as we go up in frequency the hysteresis losses will decrease, but

(*Continued on page* 107)

ELECTRONIC CONTROL in Steel-Making

Electrical engineers of the iron and steel industry have been among the most receptive users of new applications of electronic tubes and photo-cells—employing these devices in many ways to control their industrial processes.

This wide use of tube devices by the steel-makers—an industry well-known for inflicting the most severe industrial punishment on its equipment—is therefore striking testimony to the fine performance of electronic equipment under terrific industrial stress.

And since steel-making also involves enormous and heavy costly machines, continuously handling tons of molten metal at incandescent temperatures, the absolute confidence imposed in electronic devices to control these great mechanisms, gives proof of the dependability and durability of electronic apparatus.

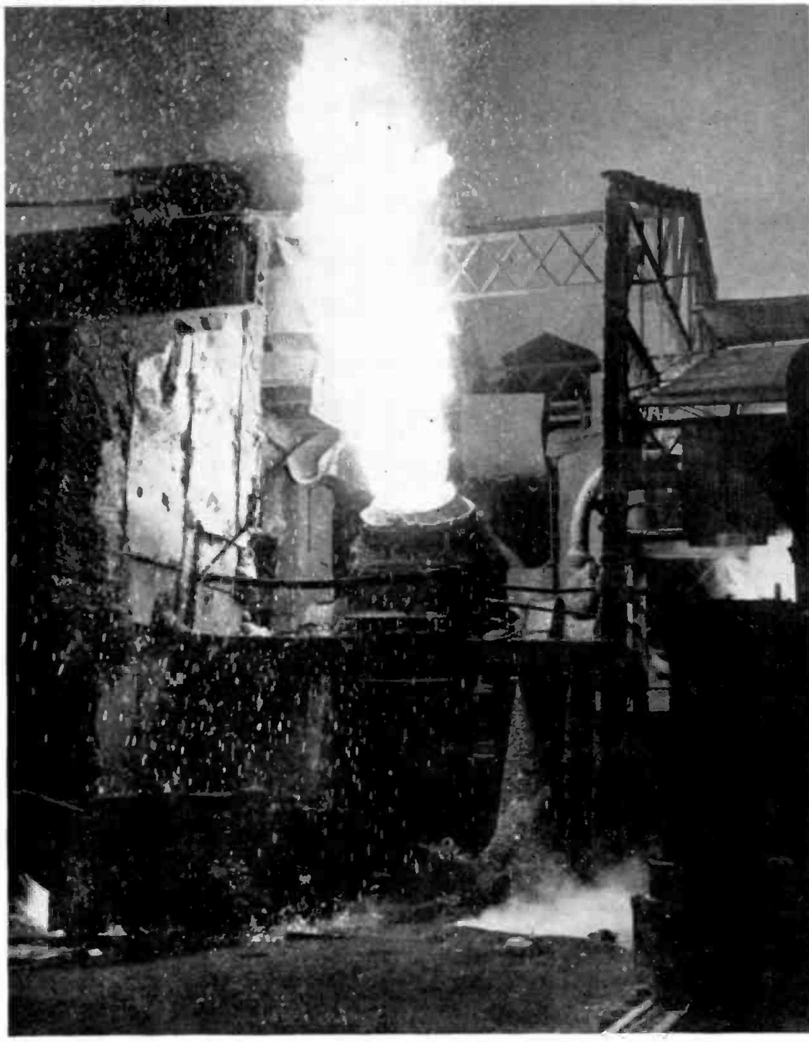
Certainly these lessons of electronic experience in steel-making can well be quoted to lesser industries whose engineers are slow to put full faith in electronic control.

In the production of steel, photo-cells are used in both the open-hearth and Bessemer processes. In the case of open-hearth furnaces, it is important to get the temperature as high as possible, yet not to endanger the melting or breakdown of the furnace and furnace roof. Photo-cell instruments enable furnace and roof temperatures to be continuously and accurately checked, so that safe limits are not exceeded.

Bessemer on front cover

In the Bessemer process, a critical index is the color of the flame from the converter, determining when the exact instant arrives for shutting off the "blow". Formerly trained experts were necessary to supervise this operation and to judge the color changes exactly. Now photo-cell color comparators are employed which detect the exact color-changes watched for, and give mistake-proof signals when necessary chemical reactions have been completed. The picture on this page shows a Bessemer converter at the beginning of its cycle. And the shower of sparks pictured on our front cover is characteristic of a Bessemer nearing the end of its cycle, after the photo-cell has operated. Jones & Laughlin, Pittsburgh, are understood to have made the first installations of photoelectric controlled Bessemers, and have also licensed several other steel companies to employ the method.

Reversing mills and cut-off saws are now photocell controlled. As huge incandescent billets come out from between the rolls, a photo-cell catches sight of the red-hot mass of metal, and at the precise instant, reverses the mechanism to send the billet back again through the rolls. Cut-off saws operate in the same way, actuated by either hot or cold material.



Bessemer early in steel cycle, before photoelectric control has operated. See front cover for later stage

Strip width and centering are also electronically controlled in modern steel mills, eliminating close human attention. For scanning strip for pinholes, photo-cells take the place of human eyes and throw out defective sections. Many electronic tubes are also used in connection with control relays.

Steel companies also use electronic equipment to regulate generator output voltage with line-drop compensation to increase voltage under load; to regulate arc length on automatic atomic-hydrogen arc-welders; to control timing on electric resistance butt-welders; and to turn off the gas in a gas-fired oven in case of the flame going out or in case of failure to ignite.

In one mill alone, the electrical engineer estimates—without taking a specific inventory—that these uses probably account for more than 250 electronic tubes, ranging from 6H6 dual diodes to water-cooled ignitron grid-controlled rectifier tubes.

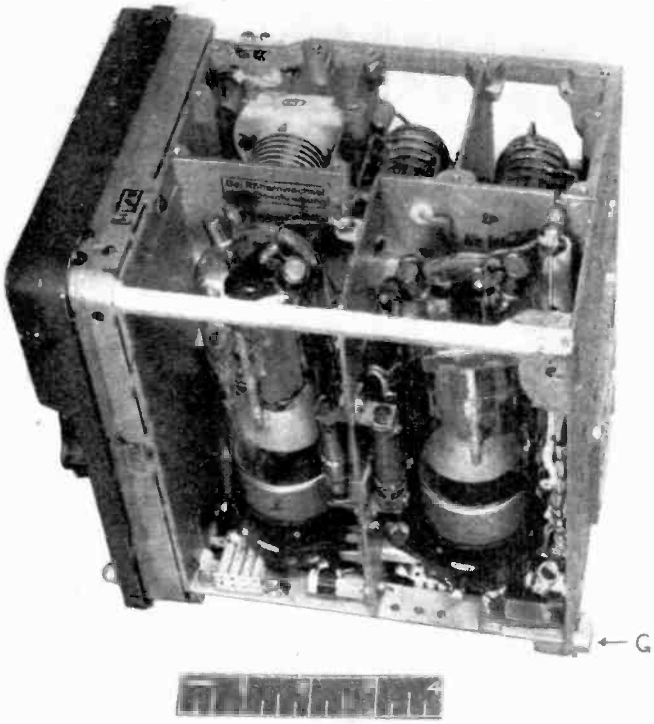
In addition, steel mill electrical engineers find that vacuum tube voltmeters and the cathode-ray oscillographs are valuable test instruments and a number are in use, mostly for experimental work, but occasionally in the mills themselves.

Other uses of electronic apparatus include tube devices for checking moisture and impurities in air and gases supplied to steel-making processes. Another new use is the electronic precipitator which produces a high-voltage direct-current charge to extract dust and dirt from air and gases, so that clean air can be furnished to the chemical reactions.

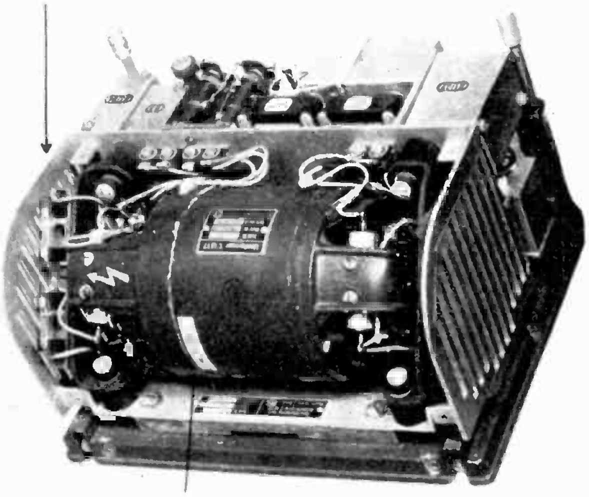
GERMAN LUFTWAFFE RADIO

The pictures shown here are representative of German military radio apparatus. They were made available to "Electronic Industries" through the courtesy of Frederick S. Barton of the British Air Commission at Washington. Their first showing in America was as lantern slides at the October 7 meeting of the IRE, reported on page 79.

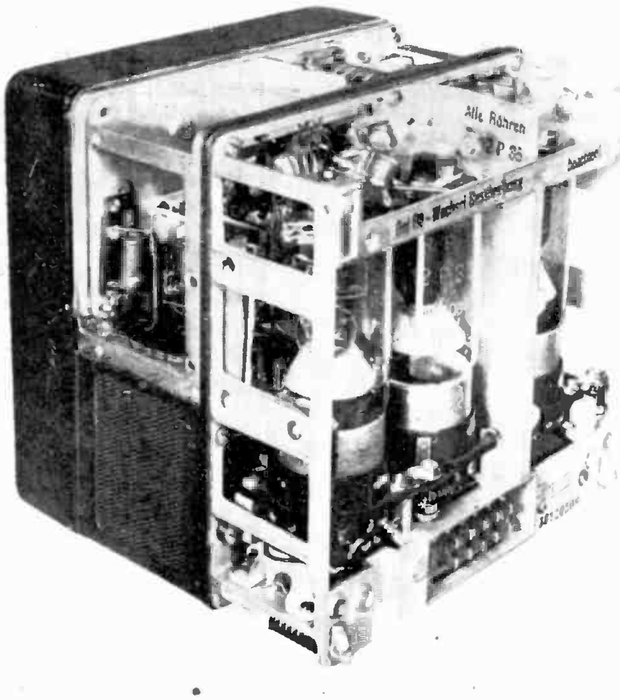
The rugged construction, good quality of materials, and compact layout, were emphasized by Mr. Barton. He inferred that current German radio equipment is of relatively old design, probably about 1935, and he commented that German radio apparatus seems very heavy and cumbersome. No crystals are used anywhere, the Germans apparently having no reserves of quartz crystals. Only two types of tubes are employed in these German Luftwaffe units, one type for transmitters and one type for receivers, pentodes being connected as triodes when necessary.



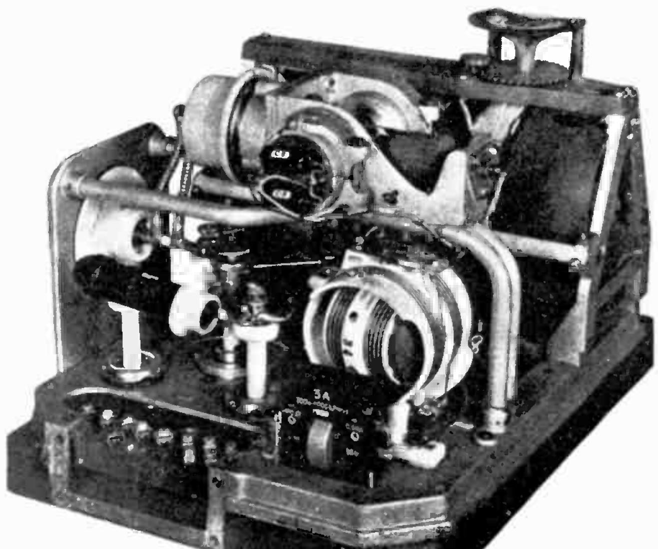
F.U.G.-16 transmitter for German fighter plane. Note the ceramic coil form with keyed-on winding in the master oscillator of this Luftwaffe transmitter. The unit uses an MO-PA unit with grid modulation, has an output of about 2½ watts and a frequency range from 2.9 to 3.5 mc



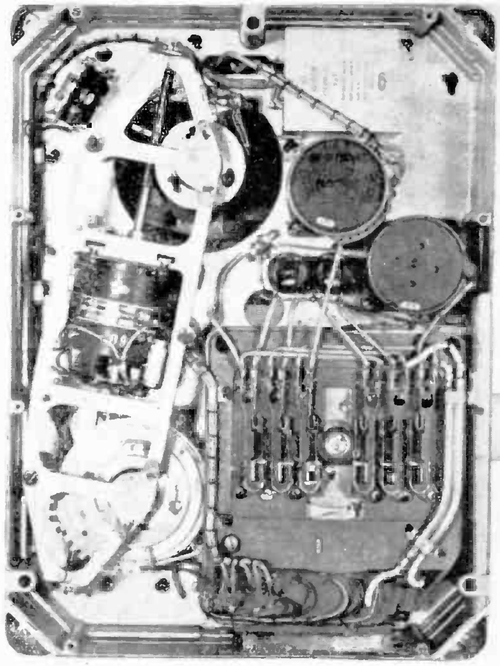
F.U.G.-16 power unit including rectifier and filter circuits. The warning arrow on dynamotor indicates high-voltage terminals



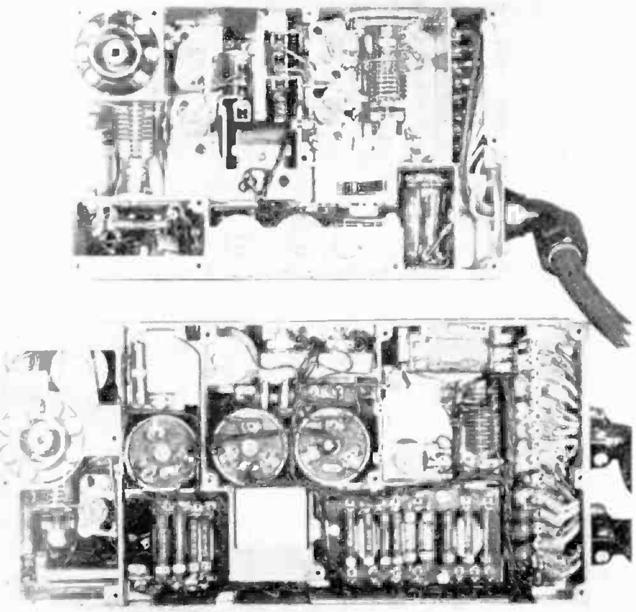
F.U.G.-10 transmitter with cover off, used in bomber. Note the power connector plugging into the supply. Four pre-set frequencies simplify handling by relatively unskilled crews. The input is 550 watts from 24-volt supply. All tubes are Telefunken 12P35's



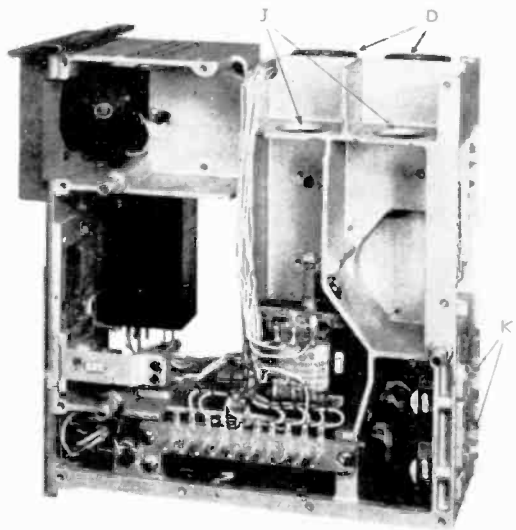
A top view of the F.U.G.-10 aerial tuning unit, commented on as "complex and cumbersome." Note the old-style variometer for matching the antenna



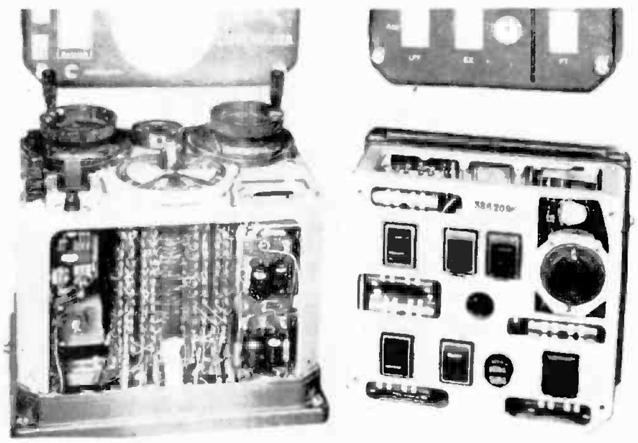
Underside of aerial tuning unit. Note the two selsyns for adjusting the aerial length



F.U.G.-10 direction finder and marker beacon receivers for the blind approach system. The direction finder works between 165 kc and 400 kc, the blind approach between 28.5 and 30 mc

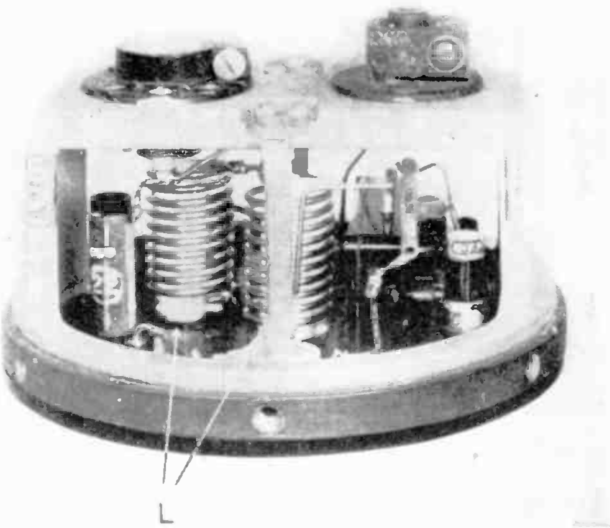


Aerial ammeter and audio components for the F.U.G.-16. Note the extra compartments and the mounting brackets, which are part of the die-casting

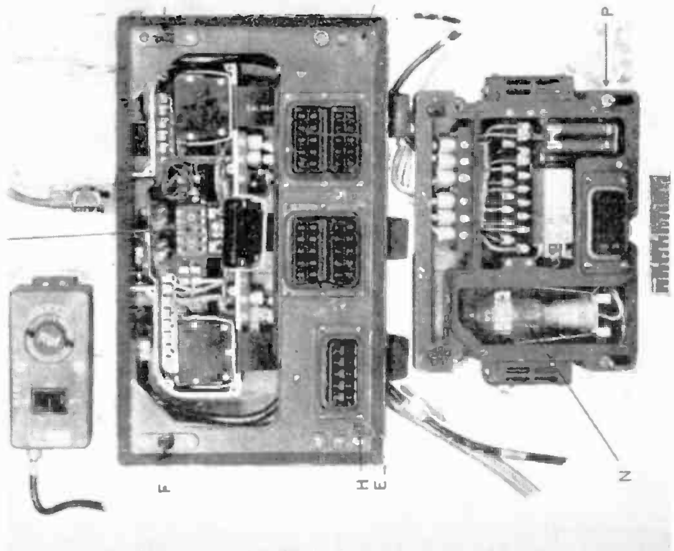


F.U.G.-10 aerial, set controller, and interphone switch box. A button is provided on switch box for "cutting out" rear gunner

The antenna of the F.U.G.-16 is matched to 40 mc by means of this massively-built unit



Cast alloy base on which F.U.G.-16 set and power unit are carried. The female outlets shown in the picture, connect with male contacts of other units



STATION OPERATING SHORT CUTS

Wartime economies when men, materials and supplies are scarce

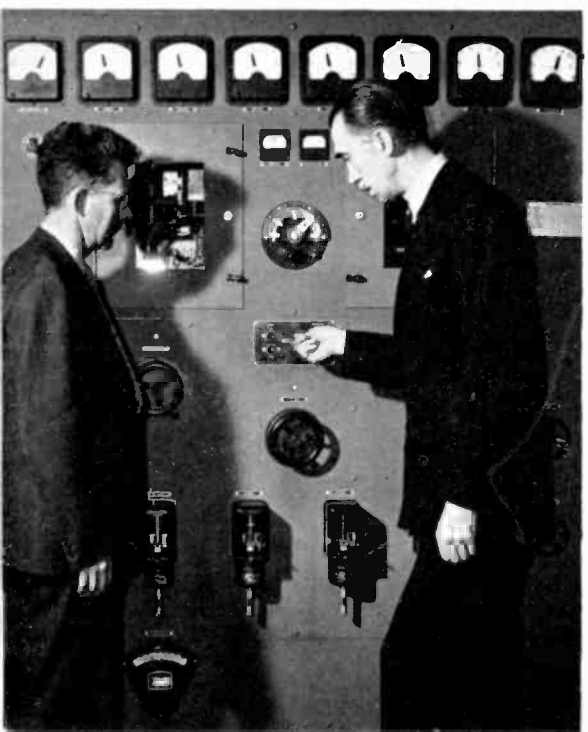
Tube "rejuvenation"

The wide-awake broadcasting engineer, always keen to detect where he may conserve or improve, does not throw away his old, weak transmission tube, even if it has a burned-out filament. He rejuvenates it—or rather, sends it to the factory, where it is turned over to a new, recently established division designed for salvaging defective or worn-out tubes, especially those of the costly transmission type.

Years ago we heard a great deal about "tube rejuvenation," but the idea was later pretty generally cast aside without any consideration, partly because it then applied only to tubes used in radio receivers. New tubes, of course, could be purchased almost as cheaply as the cost of reconditioning them.

Today, however, the method of reconditioning is highly efficient and scientific. Engineers at the factory can now take a defective tube, cut open the glass envelope, remove the various elements intact, readjusting them properly, if necessary, install a new "evacuation getter" and filament, re-seal or re-glass the parts, place it on a high frequency vacuum machine and a good, reconditioned tube is the result.

W. J. Purcell, engineer of GE broadcasting, Schenectady, N. Y., shows Robert E. Sherwood, OWI, how to switch on WEGO's new 100-kw short wave transmitter



Air-cooling fins

Many high-power transmission tubes originally equipped with water-cooling parts, which begin to show signs of weakness, are sent to the factory where air-cooling fins are installed in place of the water-cooling device. Recently at a broadcasting station located several hundred miles from New York, engineers noticed that the water-cooled tube in operation in the booth was showing unmistakable signs of deteriorating and might cease functioning at any moment. No spare duplicate tube was on hand and a hurried telephone call made to several neighboring studios and finally to the factory disclosed the fact that not a single tube of this type was available. Something had to be done quickly, otherwise the station might be compelled to go off the air, an unpardonable sin.

All-night vigil

Hurriedly, the frenzied engineers, obtained a worn-out, discarded water-cooled tube, jumped into their car and drove with it,all night, to the factory at Harrison, N. J. Here, while they waited, the water-cooled parts were immediately removed—a new filament installed and air-cooled fins substituted. When the repairs were finished, the return journey was made. The engineers lost two nights sleep, but got back in the nick of time to save the station from the embarrassment of being forced off the air.

Within the hour after their arrival, the old heavily-burdened tube went bad but fortunately the listeners of that station were not aware that anything unusual had happened. This is but one example of the ingenuity and skill displayed by that crew of unknown, unsung, faithful engineers who keep the air waves open and the stations in operation against all handicaps.

Reduce carrier power

Reduction of carrier power, one of a number of suggestions being considered by the FCC to conserve tubes and other broadcast equipment, would seem to be a logical solution to at least one phase of the broadcaster's wartime problem and should be welcomed.

D. C. Woods, chief engineer of WRVA, Richmond, Va., says, "If the FCC approves we will operate with a 20 to 25 per cent reduction in carrier power."

In the interest of prolonging life of equipment, WRVA has installed ventilating fans everywhere in the transmitting enclosure where a tube or other components gave indication of operating at high temperatures. Filament voltage on all tubes larger than receiving types have been reduced at least 5 per cent.

Keep tubes turned on

"Even though we are required to operate twenty-four hours daily as a key station and are of necessity keeping tube filaments on all the time—I am convinced that once a tube filament is turned on it should never be turned out," Mr. Woods said. "Our experience since December 13, 1941, has shown greatly improved tube life. I attribute this to the fact the tubes have been operating without interruption since that date. If we ever go off the 24-hour watch we intend to continue to keep filaments on all the time—maybe at half voltage."

Modulate 100 per cent

P. S. Gates, of Gates Radio & Supply Company, Quincy, Ill., believes that cutting power is good advice, but is not often heeded because the broadcaster has been accustomed to getting the most out of his equipment. Although FCC regulations allow 100 per cent modulation, he believes that stations are not exceeding 90 per cent. "You or your operator may think that 80 per cent is high enough to be safe. If you reduce your carrier power 25 per cent and place a rigid watch that this lowered carrier is modulated not 80 per cent or 90 per cent but 100 per cent, in nine cases out of ten you will not lose a thing."

"Go out 25 miles and listen. At a pre-determined time have your operator cut the power 25 per cent and I'll bet you won't even know when he dropped the power. You have lost one - and - a - fraction decibels. Where the big rub comes is on the fringe, but it is better to let your competitor have the fringe than the whole territory."

Later increase voltage

"In dropping power you can safely drop filament voltage five per cent. As the tube ages you can increase the filament voltage, and when the tube has reached 5,000 or more hours you can even increase the filament voltage to 5 per cent over the normal rating," Mr. Gates advises. "When you drop carrier power be sure to drop grid excitation, the current drain of preceding stages, etc., to save all down the line. If you drop power by coupling reduction, be sure of complete resonance and neutralization and that current and voltage on the final are so adjusted that if you are using Class B your rf impedance matches the Class B transformer."

Save the pieces

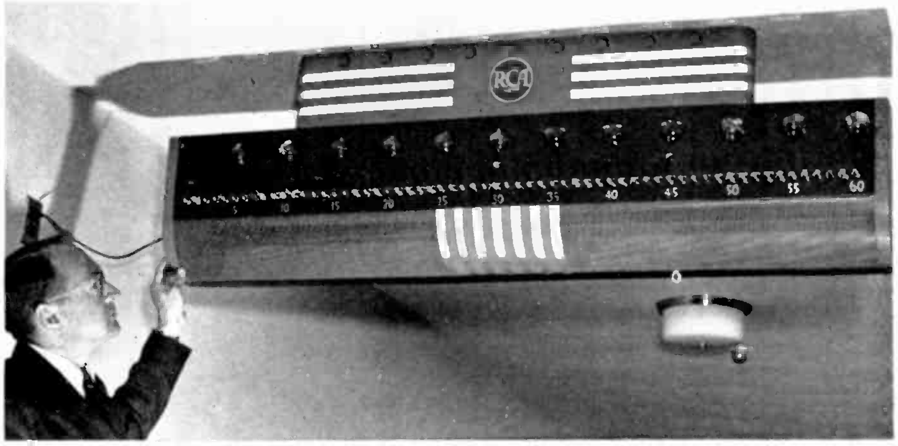
Lavishness in ordering spare parts for broadcasting equipment is a thing of the past and will not be practiced again, at least for the duration of the war. Formerly, it was only necessary to reach for a requisition blank, fill out the order for supplies and send it in. No worry. No bother. No delay.

Now, however, it is different. We are engaged in a total war and that means total conservation of materials and products. Worn-out or even partly-used parts which for years have cluttered stock shelves or been hidden away in storage rooms, are now resurrected and carefully looked through and checked over, to see what parts, if any, may be salvaged and used over again, in conjunction with some other good part from another similar piece of equipment.

Mica, one of the most important items used today in radio equipment is on the critical list of scarce materials and is practically impossible to obtain in the necessary amount. A broadcasting station could not function properly without its good grade of mica-capacitors which are made up of a number of small units, and it requires the greatest skill to reclaim and salvage these highly important parts, yet it is being done every day.

Practically all available apparatus produced by manufacturers of parts is being instantly absorbed by the several important active branches of our armed forces. But neither scarcity nor want has yet proven a barrier against the Yankee ingenuity of the radio engineer.

Dr. Zworykin's 170 - Tube Electronic Clock



With no moving parts, the 170 tubes in this electronic time-keeper count the alternations of the regulated power supply, and light small lamps which tell the time. The circuit was developed for another purpose and is now installed in RCA's Princeton, N. J., laboratories

Looking Ahead in the Electronic Industries

Remember "electronics"—the bright new word of the future! —*Frazier Hunt, CBS.*

The 1917 war was run by telephone; the 1942 war is run by radio.
—*E. F. McDonald, Jr., president Zenith Radio Corp.*

Have faith in electronics. It is helping to win the war and it will help to create a better world when peace comes. —*W. R. G. Baker, vice-president General Electric Co.*

This is a radio war. The troops on the ground, the sailors on the high seas, the pilots in the air, depend on radio for their success and their safety. —*David Sarnoff, president RCA.*

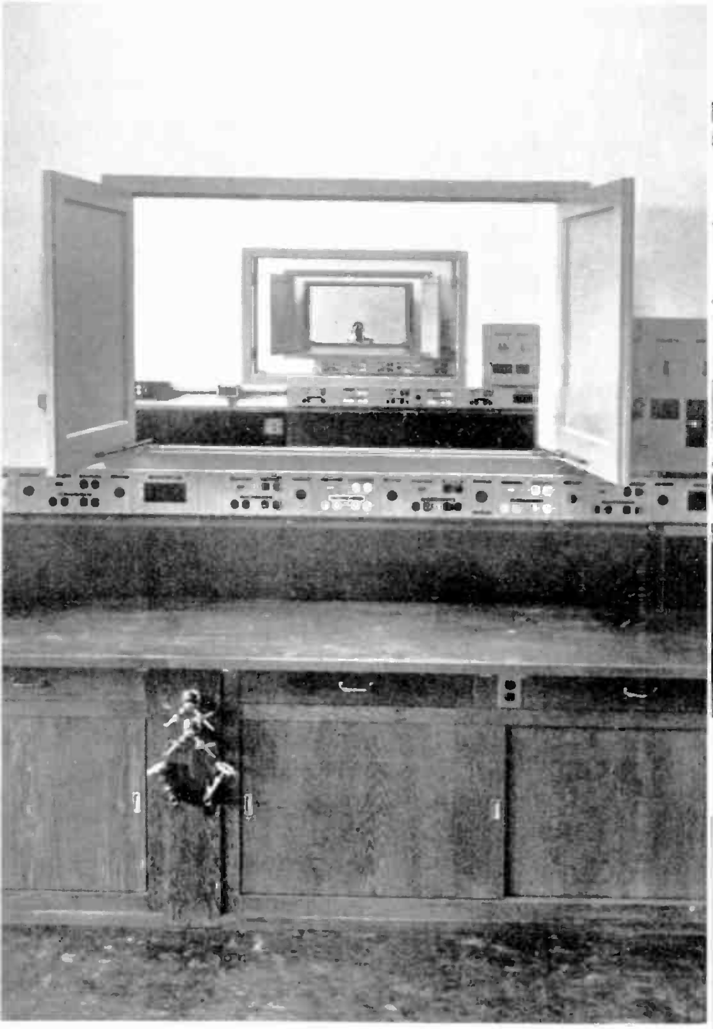
The age of the Americas has come. The world's center of gravity—intellectual, economic and political—has, after 450 years, followed Christopher Columbus across the Atlantic.
—*Dr. Nicholas Murray Butler.*

The world of 1940 has already become an antiquity. The scientific developments of the war may have effects on our lives and all civilization more wide-reaching and lasting than any military conquest. —*Dr. M. A. Stine, vice-president du Pont Co.*

Reports from the field indicate how important radio and electronics are to our fighting forces. Radio and electronic equipment are vital—in operation at sea, in protecting the lives of our fighters, and in inflicting serious damage on our enemies.
—*Commander A. M. Granum, Bureau of Ships, U. S. Navy*

Latest in ELECTRONIC LABS

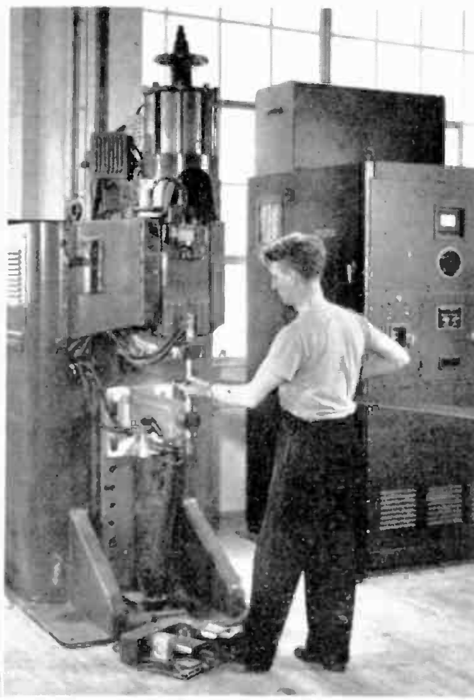
The Two-Million-Dollar RCA Research Layout at Princeton, N. J.



The optic laboratory bays have wall openings permitting long focusses for television tests. Bench outlets furnish variety of electric services, also air, gas, water, hydrogen and oxygen. Complete stockrooms carry 20,000 different electronic parts (below).

Big perfectly-equipped model shop has won enthusiastic admiration of every radio and production engineer who has inspected laboratories.

Huge padded door, with locks, leading to the free-field sound room baffled with curtains of ozonite.



Largest electronic welder (Raytheon) ever built, with tube equipment at right. Welds aluminum.

Frequency Spectrum

Accompanying this issue of **Electronic Industries**, the publishers send you a supplement, "Frequency Spectrum of the Electronic Industries," showing the full range of electromagnetic frequencies through radio, heat, light, ultra-violet and X-rays, together with their associated electronic devices and physical formulas.

Probably the most complete presentation of the electronic tube's field of activity ever undertaken, such an ambitious project would have been impossible for any publishing staff to compile, however large it might be.

Obviously the aid of specialists and experts in all fields of electronic activity was needed, so the editors enlisted the cooperation of the great research laboratories at Schenectady, with their hundreds of specialists. The resulting compilation therefore carries the combined authority of numerous outstanding experts. For this cooperation we are indebted to Dr. W. R. G. Baker, William C. White, Dr. Saul Dushman, Dr. E. E. Charlton, H. L. Deines, and E. L. Robinson.

Because of the great educational value of charts such as this, additional copies of the Frequency Spectrum will be made available for sale. Other charts in colors summarizing fundamentals of electronic principles and operations will be issued with following numbers of **Electronic Industries**.

German Planes Use Only Two Tube Types

At the New York IRE meeting, Oct. 7, Frederick S. Barton of the British Air Commission delivered a highly interesting talk, illustrated with slides, answering questions about enemy activity in the field of radio, and cleared up any possible misconceptions of secret weapons. Mr. Barton limited his subject to captured aircraft radio equipment, of which a few samples were exhibited for inspection by the thousand radio engineers present.

The Germans, he said, designed and built their equipment very well indeed, if necessary to last for ten years or longer, and as if war were their most important business. No deterioration of quality could be detected in the latest captured apparatus. Magnesium die castings are used extensively, workmanship is good, shielding and wiring is good, the layout is compact and the units are accessible for servicing. Bolted connector boxes are used, making firm contact between various units. Money was apparently no object.

On the other hand, the circuits were found to be very conventional, not at all advanced, since most designs seem to have been frozen around 1934 or 1935. The microphones used are of the throat type and are ordinary. The earphones are also ordinary. As a whole, the German equipment seems too heavy and too complex. A very peculiarly designed and cumbersome aerial control system, uses selsyns excited by special sliprings on the dynamotor. These motors "jam" when the correct aerial length has been reached, an overload relay shutting the selsyn off.

Probably the most interesting feature about the equipment is the standardization of parts and tubes. The Germans have cut down the number of tube types used to the absolute minimum of two, one for transmitters and one for receivers. The two types used are pentodes, sometimes connected as triodes to suit the purpose. The apparatus described by Mr. Barton consisted of bomber equipment, fighter equipment, a telephone communications receiver, and an emergency transmitter, all Lorenz or Telefunken systems. (See photos, pages 74, 75.)

Army-Navy Preferred Tube Types

The Army Signal Corps and the Navy Bureau of Ships have agreed on a Preferred List of Vacuum Tubes, with the purpose of eventually securing a reduction in the number of types used in U. S. service equipment. Instructions accompanying the list state:

"It is mandatory that all unclassified tubes to be used in all future designs of new equipment . . . be chosen from this list," with certain exceptions specified in detail. The list follows:

RECEIVING

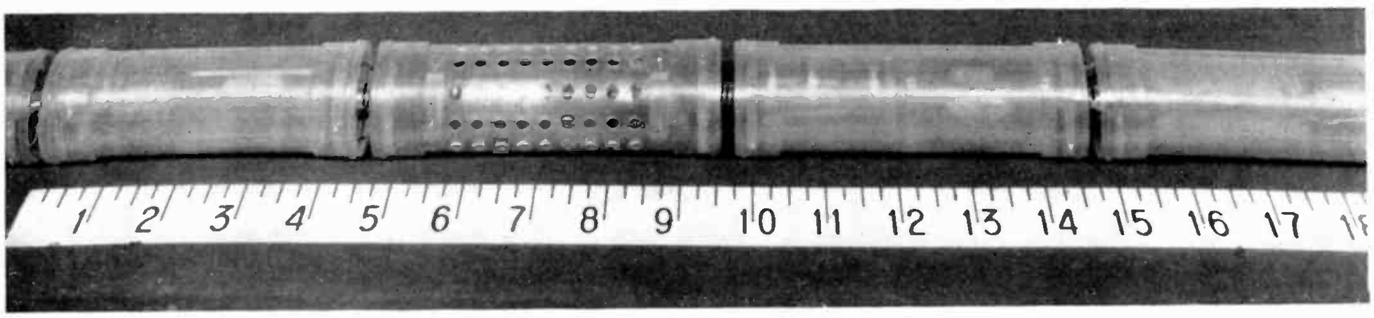
Filament Volts	Diodes	Diode Triodes	Triodes	Twin Triodes	Pentodes Remote	Pentodes Sharp	Rectifiers	Converters	Power	Indicators
1.4	1A3	1LH4	1G4GT 957 958A	1291 3A5	1T4	1S5 959 1LN5 1L4		1LC6 1R5	3A4 1299 3Q4 3Q5GT	991
5.0							5U4G 5Y3-GT			
6.3	6H6• 9004	6SQ7• 6SR7•	6J5• 1201 955 7193 9002	6SL7GT 6SN7GT	6SG7• 6SK7• 956 9003	6AC7• 6AG7• 6SH7• 6SJ7• 717-A 954 9001	6X5-GT 1005	6SA7•	6L6-G 6V6-GT 6N7-GT 6B4-G 6G6-G 6Y6-G	6E5
12.6	12H6•	12SQ7• 12SR7•	12J5-GT	12SL7-GT 12SN7-GT	12SG7• 12SK7•	12SH7• 12SJ7•		12SA7•	12A6	1629

TRANSMITTING / MISCELLANEOUS

Triodes	Tetrodes	Twin Tetrodes	Pentodes	Rectifiers Vacuum	Rectifiers Gas	Grid Cont. Gas Rectifiers	Voltage Regulators	Phototubes
801-A 811 826 833-A 838 1626 8005 8025 304TH	807 813 814 1625	815 829 832	803 837 2E22	2X2 836 1616 8020 (451) 705A 371A	83 866A 872A 4B25	2050 884 394-A C1B C5B	VR-90-30 VR-105-30 (38205) VR-150-30 (38250)	918 927

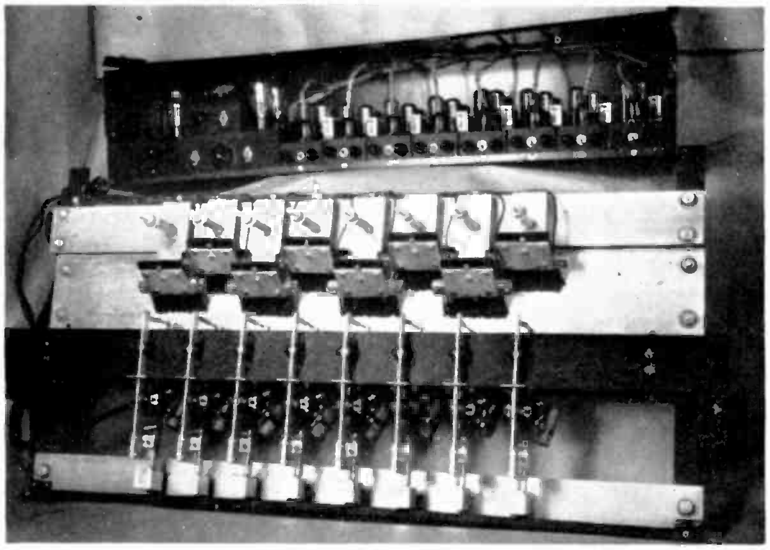
• Where interchangeability is assured GT counterparts of the preferred metal tubes may be used.

Telephone-Cable Repeater-Tube Chassis to Work at Bottom of Sea



Section of submarine telephone cable being designed by Bell Laboratories. Inside perforated cylinder is a vacuum tube; the others contain coupling networks. Entire repeater is about 7 ft. long, and is covered by steel rings and watertight copper seal. Repeaters would be located every 40 miles; tubes energized by dc from shore. Expected tube life, 20 years

Electronic Tubes ON THE JOB



Paper-inspection equipment. At top, amplifier case, containing eight independent units, with cover removed. Below, eight phosphor-bronze brushes and solenoid-operated inking devices

Automatic High-Speed Paper Inspection

Representing a novel use of vacuum-tube amplification to operate relays, the paper-inspection machine illustrated detects and marks holes, carbon spots, and tiny metallic particles broken or worn off of pulp crushers and other paper-making machinery. This Photobell unit at the plant of the C. E. Sheppard Corp., Long Island City, is mounted on a machine which slits stock to the proper width for cards to be used in electrically operated business tabulating machines.

Such cards must be without conducting spots or superfluous holes for error-free operation of the business machines. Visual inspection on a production basis being practically impossible, the paper manufacturers turned to electronics. The slitting machine on which the mechanism is installed cuts wide rolls of stock into eight strips, which are later printed and cut off as cards of the proper length. The wide strip passes between a metal plate and a set of eight phosphor - bronze brushes at speeds up to 400 feet per minute. Each brush is wired to an individual amplifier, which can be replaced by plugging in a new unit.

When a contact of more than one-fourth megohm resistance is made through the paper, a relay operates to energize a solenoid which inks a one-inch strip on the paper at the flaw. After the cards are cut to final size, any which show the stripe are easily discarded.

Selling Electronic Aids to Industrials

How a professional electronic engineer goes after business, and the practical questions he puts to prospective industrial clients, are well illustrated in the following letter and enclosure sent to chief engineers of nearby factories by Rex D. McDill of 1647 Lee Road, Cleveland. Mr. McDill's letterhead outlines his specialties as "Automatic Gages, Relay Systems, Detection Apparatus, Electronic Controls, Inspection Machinery."

Attention Chief Engineer.
Automatic Inspection Machinery.
Special Electronic Gages.

We have been building automatic inspection machinery for 11 years, for dimension gaging of OD, ID, taper, parallelism, concentricity, etc. Grading and sorting of electrical units for resistance, capacity and inductance are done on our machines.

Many of these machines work as fast as 120 pieces per minute on the gaging of three dimensions. We work on tolerances to 0.0001 inch on many special types. Hopper feed is used on pieces that are not injured in tumbling, and others are hand fed. Some gages are designed for a particular manual operation where an electronic gage is indicated.

Fully automatic machines are practical only where there is a large output that has to be inspected 100 per cent and sufficient work to keep the machines going at least eight hours per day. Some of our machines have paid for themselves in 30 days. One machine released 18 inspectors for other work.

Semi-automatic gages that perform two or more operations at one time have proven to be big money and time savers.

If you have a "Bottleneck" in your inspection line, please read over the information required for quoting on a machine to do this work, attached hereto.

Our facilities are limited and our capacity is 100 per cent devoted to Victory Work. In sending in your problem please advise Priority Rating and urgency, if it is urgent. Your problem will be analyzed, without charge to you by a specialist in automatic inspection and you will receive a prompt reply.

Yours very truly,
R. D. McDILL.

Information that would be helpful in determining if your product can be inspected on an automatic machine or inspection speeded up by inspectron semi-automatic gages

1. Print or sketch showing dimensions and tolerances.
2. A few samples of the product.
3. Quantity produced per day?
4. Present inspection cost?
5. Inspection speed by each operator on each inspection operation involved? We combine several inspection operations on one machine.
6. Would pieces be injured in a tumbling hopper?
7. As near as possible, please give a complete statement of the problem involved.

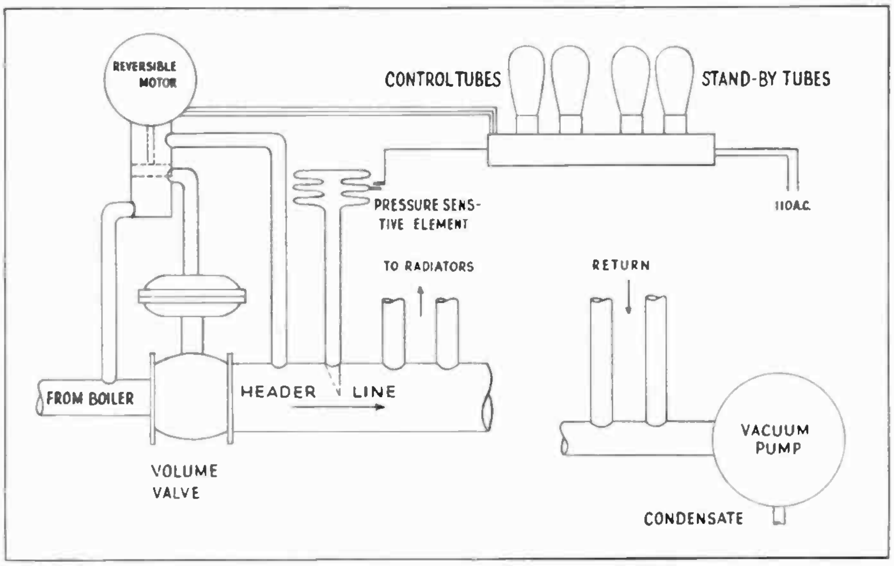
Have you considered all of the different types of inspection that can be done on automatic machines?

Dimensions to 0.00001 inch.
Hardness.
Microfinish.
Resistance of electrical units.
Capacity of electrical units.
Shade and color.
Permeability.
Unseen blow holes.

Thickness of steel, iron, brass or aluminum where only one side is available for making measurement.

Concentricity.
Parallelism.
Squareness.
Taper.

We have built automatic and semi-automatic inspectron controlled machines for valve seat



Electronic steam control. Motor operates pilot valve and main volume valve to admit steam to sub-atmospheric-pressure header line in response to spacing changes of non-touching, ionizing contacts acting on control tubes. Pump maintains pre-set vacuum

rings, valve guide locks, rolls for roller bearings, raisins, beams, piston rings, radio resistors, paper, automotive valves, battery plates, and scores of other products.

We have built and designed machines for checking the speed of a baseball, and of bullets, a machine to determine the thickness of the outer layer of metal in the bi-metallic wall of a hollow sphere, automatic weighing of charges accurate to .1%, opacimeters, and an instrument for determining sediment in crankcase oil, special direct reading permeammeters, etc.

Locates Hidden Tacks in Scrap Rubber

Designed by Andrews & Perillo, Inc., of Long Island City, N. Y., this device gives a warning when reclaimed rubber passing through it on a conveyor belt contains nails or other bits of metal. It is also used commercially to detect stray pieces of metal in old lumber, fiber, plastics, and other materials.

Operating on the same principle as the electronic gun detector, this device, known as the "Tramp Iron Detector," consists of wire-wound coils on permanently magnetized cores, mounted in such a way as to maintain a strong field in the area through which the material to be tested passes. Even a tiny particle of iron or steel moving over the rollers carrying the conveyor belt induces an emf in the coils. After amplification, this impulse operates a relay. The relay can be made to ring a bell, light a lamp, stop the conveyor belt, or mark the belt.

Electronic Control Cuts Steam Costs

Changeover at New York's Hotel Lexington, from low-pressure steam heating to an electronically-controlled vacuum system, has resulted in savings since 1937 of not less than 20 per cent in any year. That figure, according to Chief Engineer F. J. McKenna, represents a very conservative estimate. Maintenance costs of the vacuum heating system are at least 50 per cent lower.

In contrast with ordinary steam heating, where steam is forced through radiators at pressures higher than atmospheric, the vacuum heating system maintains a set vacuum on the return side of the radiators, and the steam admitted is literally drawn through the system. Aside from savings in the amount of steam needed, represented by a lowered temperature of the condensate, a vacuum heating system practically eliminates maintenance costs due to escape of steam under pressure and corrosion.

At the Hotel Lexington, a Hurley electronic control admits steam from the high-pressure line, maintaining a ten-inch vacuum in the heating line regardless of outside temperature or rate of flow. Warm condensate pumped out of the return is used to preheat guest room and laundry hot water and it has cooled entirely before being finally discarded. The latest Hurley control operates a motorized valve admitting steam in accordance with header and return-line pressures and the ratio between them.

McKenna recently had two more Hurley units installed at the Hotel Lexington to control steam heating of guest room and laundry hot water to within 3 to 5 degrees regardless of demand. "With any other system that we have used here," McKenna said, "40 to 50 degree variation in hot water temperature has been the rule."

Surgeon's Electronic Induction Probe

Latest improved form of the Moorhead-Berman electronic device which located shrapnel in victims of Pearl Harbor. Engineer Samuel Berman offered instrument in recent case of needle in child's heart

ELECTRONIC CIRCUS on Fifth Avenue

Electronic novelties in a streamlined setting mark Sonotone's demonstrations of principles of sound and hearing at 570 Fifth Avenue, New York, presenting spectacular tube ingenuities of interest to electronic men

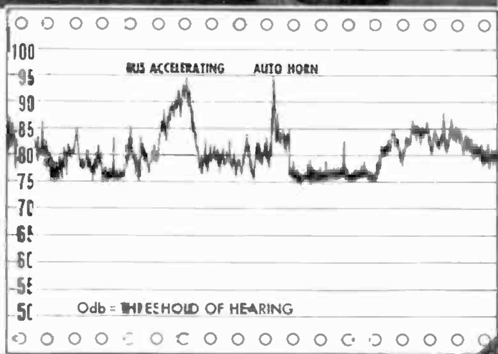
Electronic Idea No. 1. (At left) Pressing trigger fires "frequency gun," which projects a bright slice of light on any of the objects shown while emitting a pure audio tone to correspond. Frequency is varied from 60 to 15,000 cycles by position of gun, through vertical shaft controlling oscillator

Electronic Ideas Nos. 2 & 3. (Bottom left) When "window shopper" intercepts unsuspected photoelectric beam, high speed sound-level recorder graphs Fifth Avenue noises on a moving tape. Insert: Section of graphic noise record

Electronic Idea No. 4. (Below) Visitor "listens in" while operating "ripple tank," which illustrates sound-travel by reflection of water surface disturbed by touch of centered steel ball

Electronic Idea No. 5. (Right) Stroboscopic lamp "slows down" vibrations of tuning fork to illustrate process of setting air in motion to produce sound. Spectator operates hammer with eccentric crank

Electronic Idea No. 6. (Far right, top) Induction fields produced by concealed coils transmit descriptive monologues to plastic "magic trumpets" as visitor moves from exhibit to exhibit. Three endless steel tape recorders in basement repeat one-minute descriptions. "Magic trumpet" is a coil and hearing-aid earphone set in red and transparent plastic

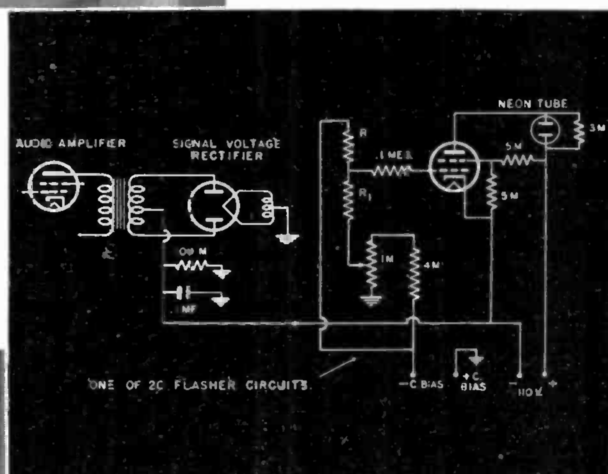


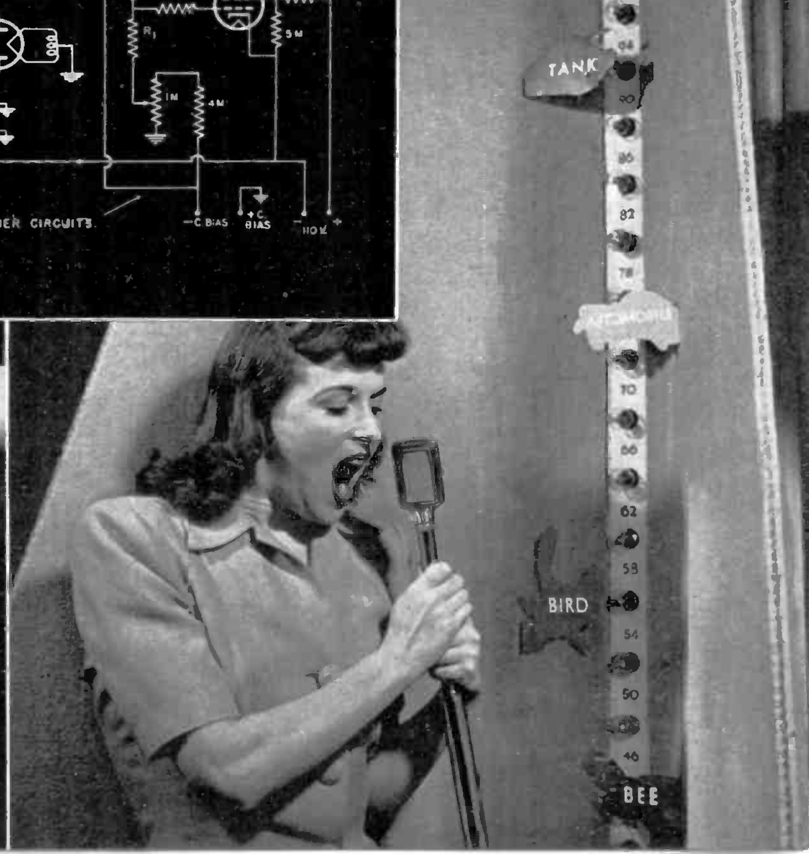
Electronic Idea No. 6 (Above) See No. 6 opposite page

Electronic Idea No. 8. (Below) "Sound thermometer" lights up column of neon bulbs in proportion to microphone input, after fashion of venerable sledge-hammer strength tests of amusement parks. Diagram shows one of twenty flasher circuits which light neon bulbs by amplification of rectified signal voltage. A three-stage audio amplifier lights bulbs from 42 to 74 decibels. Two-stage amplifier handles upper ten bulbs.

Electronic Idea No. 5. (Above) See caption No. 5 on opposite page.

Electronic Idea No. 7. (Below) Every visitor gets a one-minute recording of his voice in this soundproof booth. Magnetized on steel tape, the recording plays back and wipes off automatically to be ready for the next visitor.





A ONE-POUND Transceiver

by B. F. MIESSNER

Cases measure 6 by 3 by 2 inches. Self-contained antennas. Operate on 5, 50 and 100 megacycles. One unit frequency-modulated. Rf power about 100 milliwatts

Speech-modulated radio transmitters of portable type have long been a familiar sight at sports events and other spot broadcasts. The Army Signal Corps has used, almost since the inception of wireless telegraphy, various types of portable equipment in the field, at first with telegraphic, then later with telephonic modulation. The earliest of these used pedal and hand-driven generator power, some types of which are still in use. Others have used batteries.

This equipment has ranged considerably in weight as well as in radiation power and communication range. While twenty or thirty years ago such apparatus required several men or a pack animal for transportation, the modern vacuum-tube types, particularly those operating in the short or ultra short wave bands, are available with weights of the order of ten or twenty pounds and occupying a space of the order of one cubic foot.

Commercial developments of transceivers weighing about ten pounds exclusive of batteries, and some developments by amateurs of walkie-talkie transmitters with weights down to about five to ten pounds including batteries are also familiar in this field.

For high-altitude metereological exploration, the U. S. Weather Bureau has been using for some years now a special light weight radio transmitter known as the Radio Sonde, which is carried to high elevations by hydrogen-inflated rubber balloons. Operating in the vicinity of 75 megacycles at about 100 milliwatts power, these transmitters have been received at distances sometimes exceeding 100 miles. The oscillator is modulated by temperature and barometric pressure controls for coded signals. This unit with batteries having an operating life of several hours weighs only about two pounds.

16 to 24 ounces

The writer has recently developed several models of walkie-talkie transmitters which it is believed considerably surpass the previous records for weight and size. Their weights range from one to one-half pound, while their size is approximately six by three by two inches, small enough to be carried comfortably in a coat pocket. They are all complete with self-contained microphone batteries, and all other circuit components except antenna for two of them; the third has a self-contained antenna.

These transmitters use but one tube which is of the acorn or bantam type, operating at 1.4 filament volts from a standard flashlight battery. Two hearing-aid B batteries of 30 volts connected in series are used for plate supply. These batteries fit into spring connecting clips inside the transmitter case. A "push talk" switch conserves battery life, which should aggregate about 20 hrs. intermittent operation.

The operating frequencies of the three units are variable in the vicinity of 5, 50 and 100 megacycles. Two of the units are amplitude-modulated and have a very high acoustic sensitivity of about 25 db, which approaches the level of human audibility. Using a receiver in the same room they will maintain

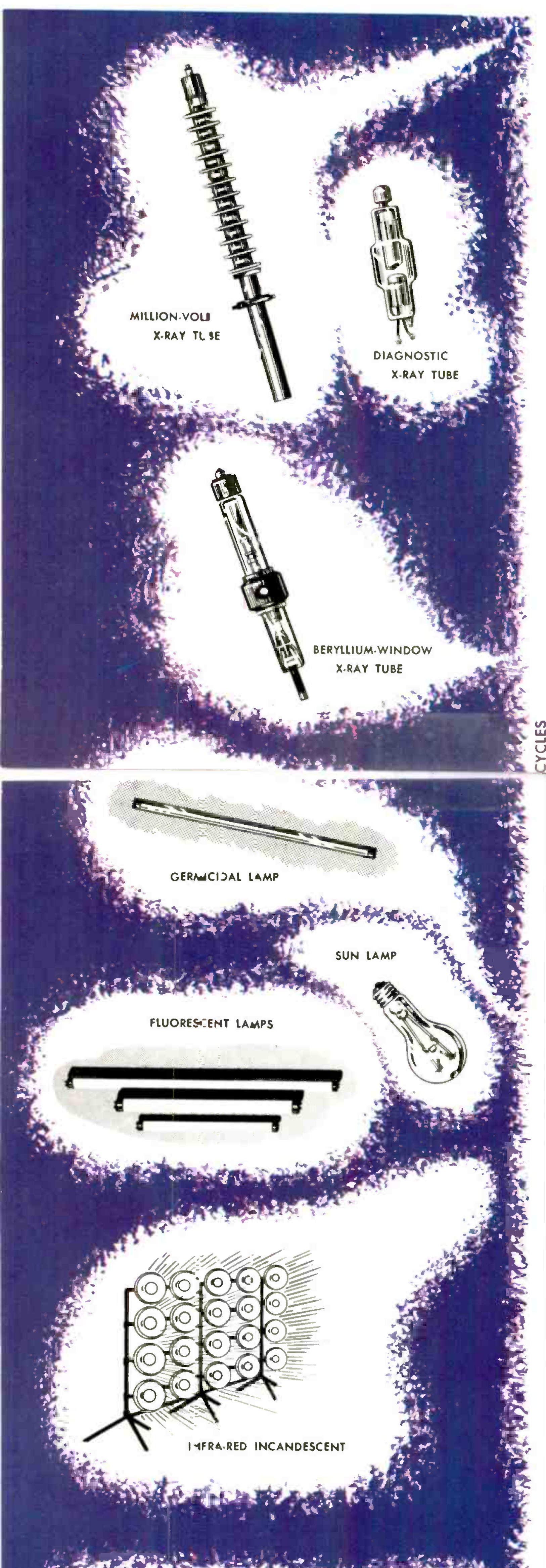
(*Continued on page —*)

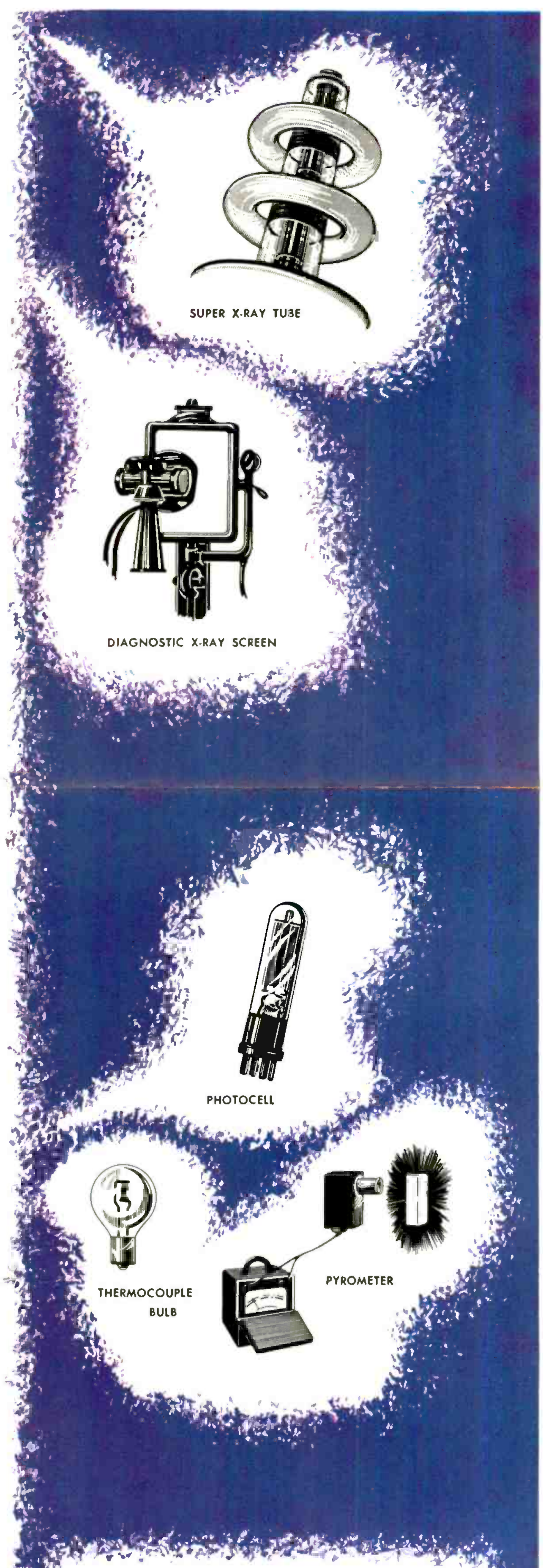
Left-hand picture shows the three models in this order: FM 42-46 mc; AM 40-100 mc; FM 3-6 mc. Middle picture shows set interiors. Right-hand photo is close-up of middle-size AM 40-100 mc unit

FREQUENCY SPECTRUM

of the ELECTRONIC INDUSTRIES

Showing representative electronic tubes and devices that operate at the various frequencies





BASIC FORMULAS

Wavelength and Frequency Relationship:

Speed = Frequency × wavelength

300,000,000 meters per second (approx.) = cycles per second × meters

Electrical Resonance:

$f = \frac{1}{2\pi\sqrt{LC}}$ — L = Inductance in henries; C = Capacitance in farads; f = Frequency in cycles

Radiation and Temperature Relationship:

$E = K(T^4 - T_o)$ — T = Absolute temperature of body; To = Absolute temperature of surrounding walls; K = Constant depending upon nature of radiating surface; E = Total energy radiated by body

Wavelength of an Electron (Fundamental of the Electron Microscope):

$\lambda = \frac{12.2}{\sqrt{V}}$ — λ = Wavelength in Angstrom units; V = Voltage accelerating the electron

Wien's Law (Wavelength — Temp. Relationship):

$\lambda_m T$ = a constant = 2885 — λ_m = Wavelength in microns corresponding to the maximum of the energy curve of radiation; T = Absolute temperature

REFERENCE CONSTANTS

Speed of Electromagnetic Radiations:
299,776 Kilometers per second = approximately 186,000 miles per second

Velocity of Sound in Air at 32°F. and 1 Atm.:
331.1 to 331.8 meters per second
1086.3 to 1088.4 feet per second
740.6 to 742.1 miles per hour

Charge of Electron:
4.8025×10^{-10} electrostatic units

Electronic Mass:
9.1066×10^{-28}g

Mass of Hydrogen Atom (^1H) (light Hydrogen):
1.6734×10^{-24}g

Planck's Constant:
6.624×10^{-27}erg × sec.

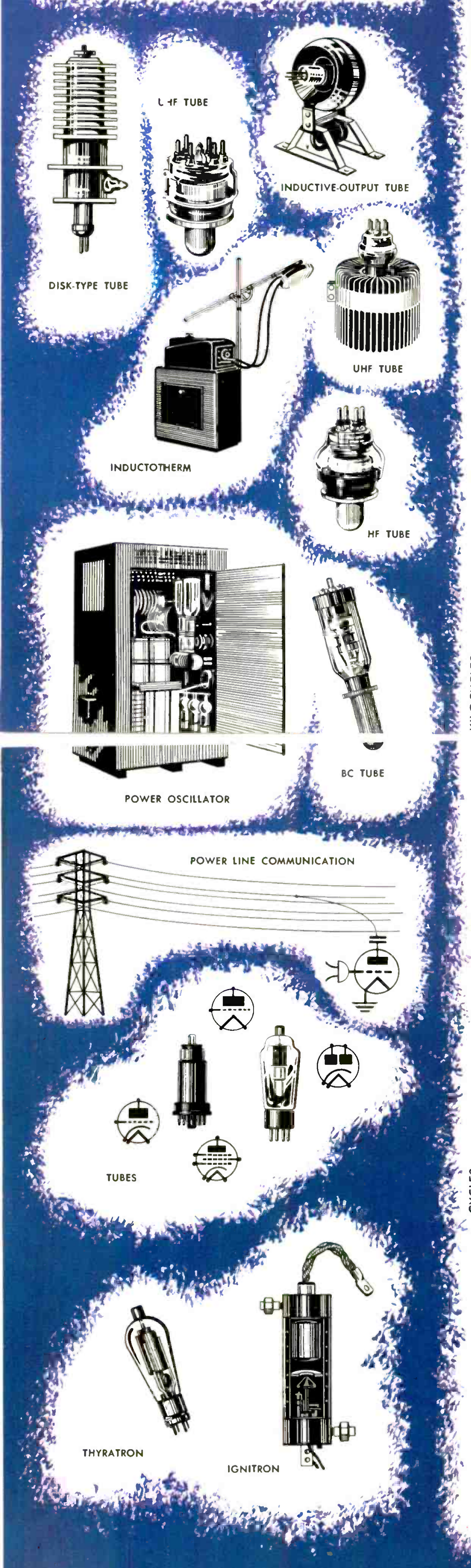
Wavelength of Red Line of Cadmium:
6438.4696 Angstroms

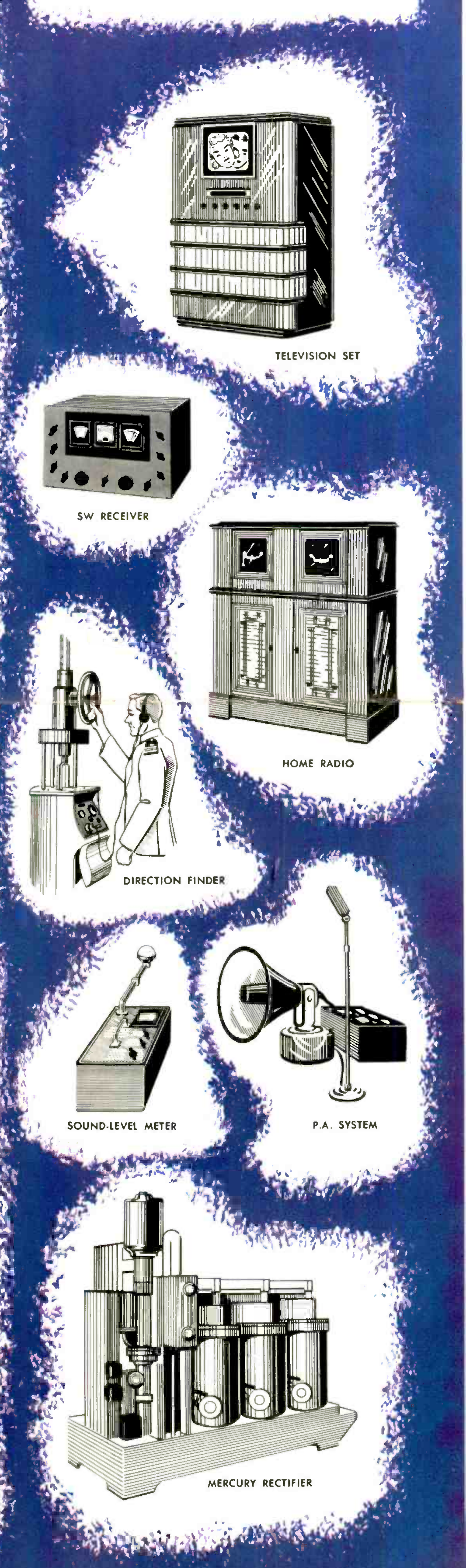
Absolute Zero:
−459.7° Fahr. = −273.16° Cent.

Units of Length:
1 mm = 10^7 Angstrom = 10^3 Micron
1 cm = 10^8 Angstrom
1 Micron = 1/10,000 of a cm
1 Angstrom = 1/100,000,000 of a cm

Units of Frequency:
1 Kilocycle = 1000 cycles
1 Megacycle = 1,000,000 cycles

Units of Power:
1 kilowatt = 1.341 horsepower
1 kilowatt = 3413 Btu per hour
1 kilowatt = 860 kg-calorie per hour

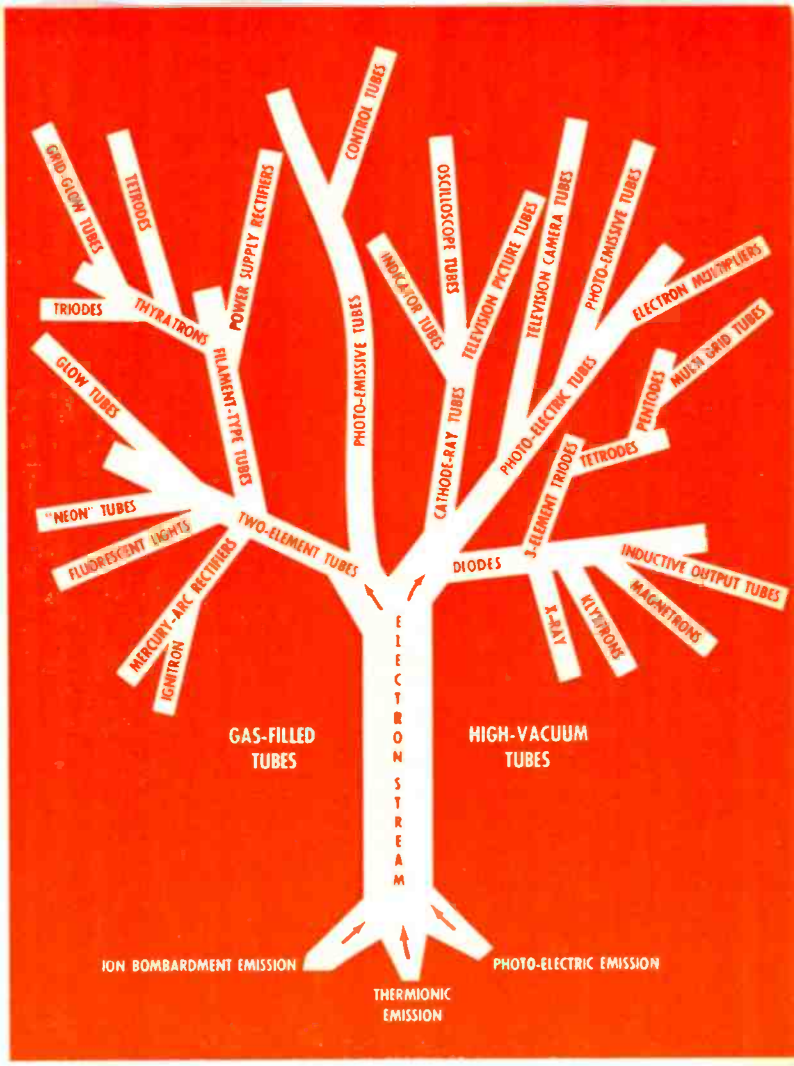




Compiled by ELECTRONIC INDUSTRIES in collaboration with the engineers of the Electronic Laboratories of the General Electric Co.

Supplement to ELECTRONIC INDUSTRIES NOVEMBER, 1942

ELECTRON TUBE Relationships and Definitions



CATHODE-RAY TUBES—Tubes using a beam of electrons which can be deflected and directed at a fluorescent target.

CONTROL TUBES—Photo tubes used as relays.

DIODES — Two-element electron tubes containing a plate and cathode and used as rectifiers of alternating current.

ELECTRON MULTIPLIERS—Vacuum tubes which produce secondary electrons when electrodes are bombarded by primary electrons.

ELECTRON TUBE—Any device in which current flow consists of a stream of electrons between two or more electrodes not joined by a conducting path.

FILAMENT-TYPE TUBES — Electron tubes using a heated filament to produce electron emission.

FLUORESCENT LIGHTS — Mercury-vapor electron tubes coated internally with fluorescent materials.

GRID-GLOW TUBES—Inert-gas-filled tubes containing a discharge control electrode.

IGNITRON—A mercury-cathode tube with "starting" electrode.

INDICATOR TUBES—Cathode ray tubes with fluorescent pattern-control electrode.

INDUCTIVE OUTPUT TUBE—An electron tube deriving its output energy by induction from the moving electron stream.

ION BOMBARDMENT EMISSION — The emission of electrons produced by physical impact of ion particles and by high potential gradient.

KLYSTRON—An electron tube employing a velocity-modulated electron stream.

MAGNETRON—An electron tube in which the electron motion is controlled by a magnetic field.

MERCURY-ARC RECTIFIER — A mercury-cathode tube for rectification of alternating current.

MULTI-GRID TUBE—Electron tube containing more than one control grid.

"NEON" TUBE—A vacuum tube for producing light by the ionization of inert gases.

OSCILLOSCOPE TUBES—Cathode-ray tubes used for analysis of electric voltage and current waves.

PENTODE—A five-element tube consisting of cathode, control grid, screen grid, suppressor grid and plate.

PHOTOELECTRIC EMISSION—The emission of electrons produced by application of radiant flux energy.

PHOTOELECTRIC TUBE—A tube in which the emission of electrons, or flow of electrons is controlled by an external source of light.

PHOTO-EMISSIVE TUBES—Electron tubes consisting of collector anode and treated cathode which releases electrons when exposed to light.

POWER SUPPLY RECTIFIERS—Mercury-vapor filled diodes used to rectify alternating current.

TELEVISION CAMERA TUBE—A light-sensitive electron tube with provisions for scanning image.

TELEVISION PICTURE TUBE — A cathode-ray tube with beam control grid.

TETRODE—A four-element tube containing a cathode, a control grid, a screen grid and a plate.

THERMIONIC EMISSION—The emission of electrons produced by applications of heat energy.

THYRATRONS — Three-element tubes containing an inert gas.

TRIODE—A three-element electron tube containing a control grid, a plate or anode and a cathode.

X-RAY—A two-electrode vacuum tube for producing frequencies of 10^{16} to 10^{20} cycles per second, by electron bombardment of the plate.

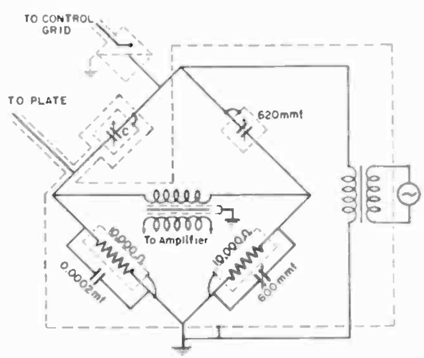
SURVEY Of WIDE READING

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

Measuring Small Three-Terminal Capacitances

J. R. Tillman, Ph.D. and A. C. Lynch, M.A., Post Office Engineering Research Station (Journal of Scientific Instruments, London).

An apparatus was designed and constructed to measure the "three-terminal" capacitance between the control grid and the plate of a tetrode or pentode with the remaining electrodes grounded. A Schering bridge with an equal arm substitution is used as shown in the circuit diagram. Condenser C



is specially made and consists of a tube and a cylinder for high and low potential electrodes. The cylinder carries a micrometer head having a scale corresponding to 9 to 13 mmf. Three-terminal capacitances up to 4 mmf may be tested at audio frequency. The accuracy of the device is 0.001 mmf. The time required for a measurement is about one minute and the only calculation involved is a subtraction of readings.

Mercury-Vapor in Flow Anode Arms

W. Deck, A. G. Brown, Boveri & Cie, Baden, Switzerland (Helvetica Physica Acta, Vol. XV, 1942).

The author calculated and experimentally investigated the periodic variations in density, pressure and temperature of the mercury vapor in the anode arm of a mercury tube. This knowledge may contribute to the designing of new tubes and to adapting existing tubes to handle higher power output. During the conducting period the mercury vapor in the anode arm is heated by the electric arc and, consequently, the vapor pressure rises. A corresponding part of the vapor escapes to the cathode space and the vapor density and pressure in the arm diminishes. The drop in temperature during the non-conducting period causes a drop in pressure in the arm and flow of mercury vapor into the anode arm. The author derives formulas corresponding to the successive steps of this process and calculates the pressure at the anode and along the sleeve as a function of time. A comparison of the values obtained and results of his measurements show satisfactory agreement.

High-Gain Audio-Frequency Amplifier

E. N. Rowland and W. Burns, The University of Aberdeen (Journal of Scientific Instruments, London).

The apparatus was evolved for the investigation of action potentials in nerves but may be adopted for various other uses. It was intended to amplify input signals of 10 microvolts to give deflection on an oscilloscope. A gain of 10^7 should be available. The inherent noise of the amplifier is very small. The frequency response is uniform from below 50 to 20,000 cycles. Potential peaks from .02 to .001 seconds can be reproduced with negligible distortion.

The author uses a pre-amplifier with a gain of 10 to 100, a filter consisting of resistors and condensers, a main amplifier with a gain of 10^5 and a variable filter consisting of resistors, condensers and inductances to cut off between 1,000 to 8,000 cycles. The main amplifier uses a feedback system.

The article discusses in detail the different stages of the amplifier, giving the values for the various parts. Wiring diagrams of the complete arrangement are also included.

Studies in Antenna Resistance

S. R. Khastgir and C. Choudhury, Physics Laboratory, Dacca University (Indian Journal of Physics).

Measurements of antenna resistance and reactance were carried out. Beat frequencies of two circuits are observed, one of which is inductively coupled to a third circuit, alternately connected and disconnected to the antenna to be measured. The antenna characteristics influence resistance and inductance of the third circuit, which in turn influence the second circuit, thus changing the beat frequency. Formulas for the dependency of the beat frequency on the antenna characteristics are derived.

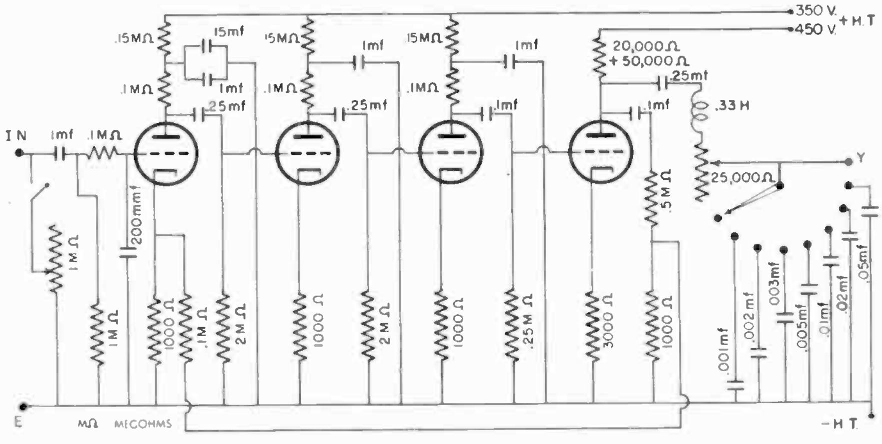
Vertical antennas, inverted L antennas and T antennas, all being grounded, were investigated within the range of 330 kc to 2.3 mc and the results are discussed.

Color Analysis of Light

J. Knight (The Australian Engineer).

Describes in principle a spectro-radiometer, an instrument for measuring the respective intensities of the component colors of a light source. The radiometer utilizes means to refract or diffract a beam of light into a spectrum and a device for measuring the intensities of small parts of the spectrum thus produced. Thermocouples, bolometers, photo-electric cells or barrier layer cells may be used for measuring. Their advantages and

High-gain audio-frequency amplifier with variable cut-off for amplifying transients of very short duration

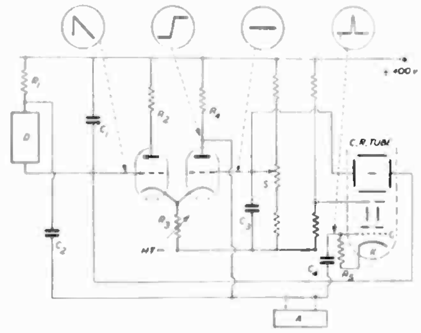


disadvantages are described. Results for a fluorescent lamp and an incandescent lamp are given. Selective reflection of surfaces can also be determined in this way. The fact that the human eye responds differently to different wavelengths has to be taken into consideration in illumination problems. A practical method for judging lamp characteristics is described.

Stroboscopic Cathode-Ray Tubes

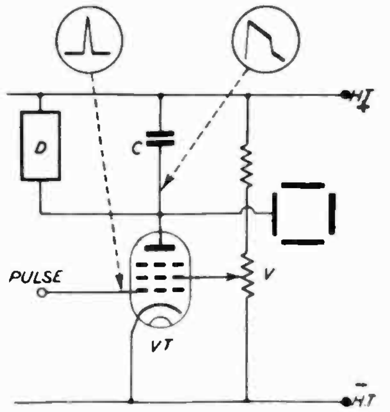
G. Bocking (Electronic Engineering, London).

The article after describing the mechanical principle of the stroboscope mentions the application of



Circuit for releasing the beam at a fixed point on the screen

this principle to the cathode ray tube, where it is frequently desirable to view stroboscopically some part of a waveform by quenching the beam at all other parts. Stroboscopic action was found essential when a part of the signal to be viewed is overlapped by another part occurring at a different in-

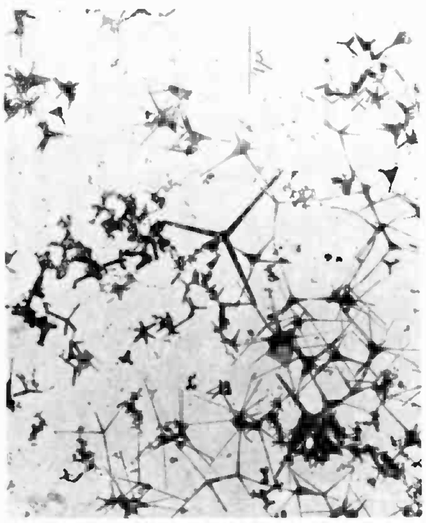


Increasing the conductance of the charging tube for extending the time scale

stant of time. An interesting application is the "time-base flyback blackout," where the return trace of the flyback is suppressed in order to eliminate confusion by the delineation of the signal. Another outstanding case of stroboscopic viewing is found in conjunction with extremely extended time-bases, such as the spiral time-base where the signal invariably overlaps several revolutions of the spiral. Several methods of obtaining beam release are described and illustrated. One sketch shows a typical circuit for releasing the beam at a fixed point on the screen. A device called the "beam trigger," where the signal itself triggers the beam is described. In cases where an extended time-base is desirable but the use of circular or spiral time-bases is not feasible, an accelerated linear time-base in conjunction with stroboscopic viewing can be used to advantage.

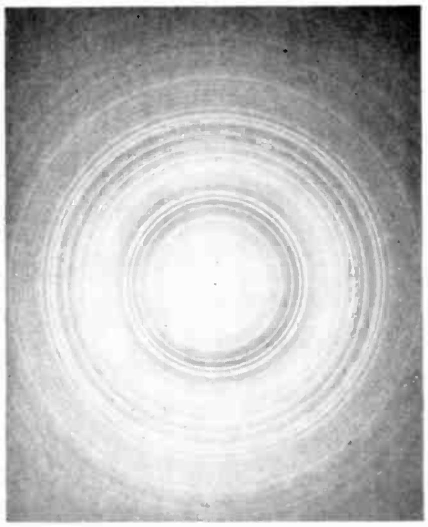
Electron-Microscope Diffraction Adapter

J. Hillier, R. F. Baker, and V. K. Zworykin, R.C.A. Mfg. Co. (Journal of Applied Physics, Sept., 1942).



Electron micrograph of zinc oxide smoke

An adapter has been developed which allows a conventional electron microscope to be used either as a diffraction camera or as a microscope. The standard projection lens of the electron microscope is replaced by the adapter unit consisting of a microscope projection lens, a diffraction camera specimen holder and a focusing lens. The unit is interchangeable with the conventional projection lens and the new coil is made so



Diffraction pattern of zinc oxide smoke

that the same current will produce approximately the same magnification as the former. The focusing lens, a short iron-encased coil, has been designed and connected to be operated from the projection-lens-coil supply. Transmission or reflection-type diffraction patterns may be taken. The pictures show a diffraction pattern and an electron micrograph of zinc-oxide smoke photographed within a few minutes of each other.

Specifying Plastic Parts

Julian C. Kazimier (Electrical Manufacturing, Sept., 1942).

Whether or not to use plastics, the molding advantages and disadvantages of the various thermosetting and thermoplastic materials, what type of metal inserts the engineer should specify, the tolerances to be allowed and the comparative mold capacities as related to the costs are a few of the interesting points discussed in some detail in this article.

The accompanying chart shows the relationship, between the approximate daily production, mold cost, piece cost and total cost of mold and pieces, which might be helpful to interested engineers.

Plastics — Piece Costs for Various Molds and Quantities

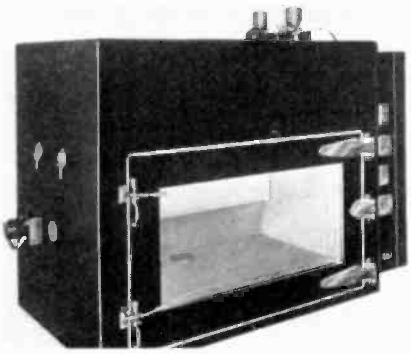
	1 Cavity Hand Mold	6 Cavities Hand Mold	12 Cavities Hand Mold	24 Cavities Hand Mold	24 Cavities Semi-Auto Steam Mold
Approx. Daily Production	80	500	925	1730	4500
Cost of Mold	$140.00	$560.00	$940.00	$1670.00	$1890.00
Piece cost per 1,000	185	46	32	23	22
Total cost mold and pieces per 1,000					
in 1M quantities	328.00	606.00	972.00	1693.00	1911.00
5M "	213.00	156.00	220.00	357.00	402.00
10M "	199.00	102.00	126.00	190.00	211.00
25M "	190.60	68.00	70.00	90.00	98.00
50M "	187.80	57.00	51.00	58.00	60.00
100M "	186.40	52.00	41.40	50.00	41.00
500M "	185.28	47.12	33.88	26.35	22.90

WHAT'S NEW

Devices, products and materials the manufacturers offer

DC Milliammeter

The DeJur-Amsco Corporation, Shelton, Conn., offers a bridge instrument having a laminated magnet. Ranges from 0 to 1 and from 0 to 1,000 milliamperes are available. The magnets are heavily cadmium or copper plated, the bridge assembly is nickel-silver, and instrument screws, lock-washers and spacers are of non-magnetic material. Prices listed are from \$6.50 to \$7.50 according to range.



Temperature Test Chamber

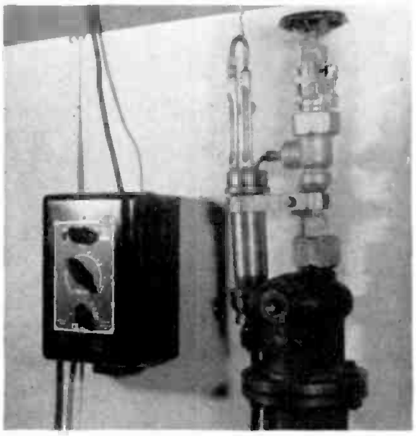
A constant temperature chamber, having an operating range from minus 55 degrees C. to plus 70 degrees C., for testing precision instruments in military use is being manufactured by American Coils, Inc., Newark, N. J.

Operation is controlled from a front panel board. In addition to temperature uniformity, positive air circulation is provided.

Observation of instruments being tested is made through a visible opening in a door containing five glasses sealed and dehydrated against future passage of moisture. The cabinet contains six inches of Fiberglas insulation. The usable interior is 28.7 cubic feet.

Conductivity Tester

Industrial Instruments, Inc., of 156 Culver Avenue, Jersey City, N. J., announces a modified Wheatstone-bridge circuit having a cathode-ray tuning-indicator tube as a null indicator. A vacuum-tube relay circuit operates on the unbalance of the bridge. This Solu-Bridge Controller takes samples of boiler water, steam condensate or raw water, measures its conductivity and operates a warning signal or other electrically operated device when the concentration exceeds a predetermined point. The indicator tube is hooded for better visibility.



A sample cooler is available for attachment to steam or hot sample source with a needle valve for adjustment of flow, and a thermometer for measuring temperature of cooled sample. The conductivity cell contains two platinized electrodes and measures resistance.

Measuring Thin Materials

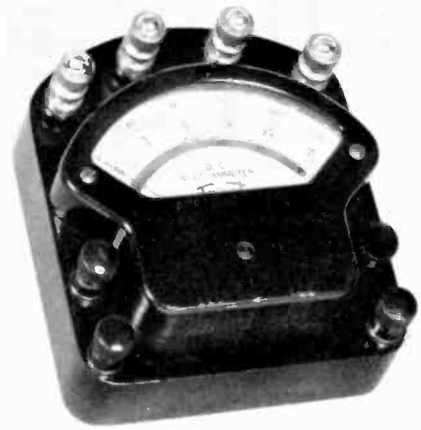
Quartz crystals, laminations and other thin materials can be measured quickly with a Ball Measuring Anvil, offered by George Scherr Co., Inc., 128 Lafayette Street, New York, as an attachment for the Scherr Comparitol. The inspection and measuring of extremely thin pieces, such as shims, small gages and other flat work can be accomplished rapidly, and accurate readings in 0.0001 in. or .00005 in. can be obtained. Danger of distorting or bending the shim or lamination out of size a few ten-thousandths due to measuring pressure of the instrument, is eliminated by the use of the measuring ball anvil. The instrument may also be used to check the flatness or parallelism of long thin pieces in all positions and on all parts of the work. The Comparitol column when used with this ball anvil, is provided with an index line so that the ball point and feeler point can be lined up from left to right as to center distance.

A News Service for Readers

Announcements of new products which appear on these pages are prepared by the editors as a service to our readers, and are published as news, without any advertising consideration whatever.

Demagnetizer

Ideal Commutator Dresser Co., Sycamore, Ill., announces a demagnetizer for tools, drills, punches, dies and work held in magnetic chucks. Abrasive particles such as metallic dust, flakes, fine chips, etc., that can not be wiped off with a cloth are removed after a single pass across the magnetic poles. Large parts may be demagnetized by moving the demagnetizer over the work. The demagnetizer has a pilot light indicating when current is on. It is rated at 115 volts, 50-60 cycles and 5 amperes. Other voltages and frequencies are available. The size is 5¼ in. x 10½ in. x 4½ in., and the weight 17 lbs.



AC and DC Meters

The Triplett Electrical Instrument Co., Bluffton, Ohio, announces another portable instrument. It has symmetrical case proportions, a long scale and a base size of 5 in. x 4⅜ in. Case and base are molded. Model 425 for dc has a 3.12 in. hand-calibrated mirror scale; model 435 for ac has a 2.88 in. hand-calibrated mirror scale.

It's a Buyer's Market at HYTRON

IF YOU PLAN YOUR WAR PRODUCTION WELL IN ADVANCE

IF YOU ORDER NOW THE TUBES YOU WILL NEED THIS WINTER, NEXT YEAR

FROM M-Day on, the Government has made long-range plans which at first may have seemed to deal with grandiose and astronomical quantities. Men in a position to know, however, realized that only such careful thinking and acting ahead could win the greatest industrial offensive of all time. In *your* production campaign, too, let logistics precede strategy and tactics. Make sure that you will have the necessary tubes to meet your delivery schedules. If you will look to the future, Hytron will do its bit toward turning a seller's market into a buyer's market for you.

HYTRON
TRADEMARK REG.

Immediate Production Already Scheduled

Already the procurement divisions of far-sighted manufacturers and government agencies, after conferring with Hytron engineers, have contracted for present production capacity at Hytron. Their tube needs have been fitted into a production plan which will give them the tubes they want, when they want them. Whenever possible, small orders for standard Hytron types will be filled on short notice. Please keep in mind, however, the difficulties of procuring materials, of diverting production facilities for small runs, and of training new workers.

Facilities Available This Autumn

Place your orders for late Fall delivery NOW, to take full advantage of the production facilities to be available later. Give Hytron a chance to add to its schedule now the tubes you will need in large quantities at the end of '42, at the beginning of '43. Let Hytron help you to avoid those echoes of a seller's market: "Sorry, but—. With regret—. Unfortunately,—." Quadrupled War production space, fast being converted into a beehive of activity, is Hytron's assurance that your anticipatory orders will be shipped on schedule.

REMEMBER — *With your cooperation, it's a Buyer's Market at Hytron.*

HYTRON CORP., Salem and Newburyport, Mass.

. . . Manufacturers of Radio Tubes Since 1921 . . .

WHAT'S NEW

Ignition Tester

An ignition-system tester is announced by the Slayter Electronic Division of Owens-Corning Fiberglas Corporation, of Newark, Ohio. The unit is operated through a cold-cathode rectifier tube. Polarity may be reversed by reversing the position of the rectifier tube and the tube is not damaged by flashovers or arc backs for periods long enough to actuate a circuit breaker or fuse. The unit is intended for measuring the leakage current or breakdown voltage of ignition cables, high voltage bushings, caps, etc. It operates on a power supply of 110 volts ac, 60 cycles, single phase.

Microphones

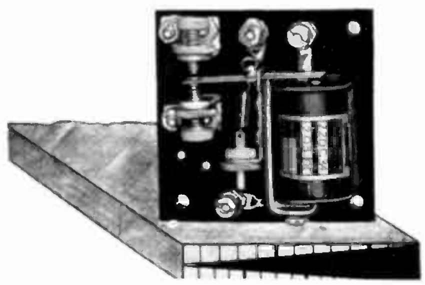
Universal Microphone Co., Inglewood, Cal., has discontinued its model AR-1 microphone and will standardize on types CU-1 and CU-2 in its line of microphones for aircraft and ground stations. Not available to the general trade, they will be procurable by government contractors in quantity, for instruction planes, transport and cargo aircraft, as well as bombers, pursuit and other types of aviation craft in military operations.

Wax Coating Machine

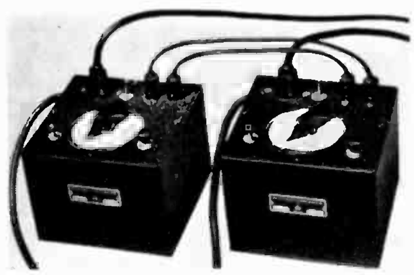
Developed by the Production Engineering Corp., Clifton, N. J., an automatic wax coating machine, for coating and impregnating coils and other small parts, in one instance replaced 18 operators dipping several million radio parts per month by hand. The machine soaks parts to be treated in molten wax held at a predetermined temperature, usually between 240 deg. and 260 deg. F. After a pre-set interval, depending on depth and thickness of coating desired, a wire basket lifts the parts out of the wax and centrifuges them in a current of hot air to remove excess wax as desired. Operation of the equipment is fully automatic, except for placement and removal of the parts to be treated. Small parts not easily subject to damage are placed in the wire basket and distribute themselves evenly for centrifuging. Large, delicate structures have to be arranged in advance to avoid shifting. The Production Engineering Corp. is set up to handle treating of small parts on a quantity basis, or the wax coating machines can be purchased.

Vibration Tester

The Kurman power fork for vibration testing, originally developed for testing Kurman relays to meet government specifications, has now been made available to others for vibration tests. Features of the device are its simple harmonic motion, adjustable frequency from 20 to 70



cycles per second, and adjustable amplitude. Direction of vibration is adjustable, even during tests. Capacity is up to 5 lbs., and acceleration provided is up to 30 G plus. Power, 75 watts. In two models, stationary and rotatable yoke. Kurman Electric Co., 241 Lafayette St., New York, N. Y.



Electronic Timer. An electronic timer for opening or closing an electric circuit for a preset time interval and designed for single action as well as for sequence timing and recycling in continuous operation, is being made by the Photovolt Corporation, 95 Madison Avenue, New York City. Some of the features are: timing from 0.05 seconds up, immediate automatic resetting, adjustable to make or break circuits during the timing period, push button or remote control, and the simultaneous switching of powered and unpowered loads. For sequence timing a number of standard units of Model 900 can be combined by plug connections without requiring any additional relays or control units.

"War Radio Production" Topic at Rochester, Nov. 9

The annual Rochester fall meeting of radio engineers will be held Monday, Nov. 9, at the Hotel Sagamore, Rochester, N. Y., under the joint auspices of IRE and RMA, and will be devoted largely to radio war production topics. Following are the subjects for the morning, afternoon and evening sessions.

9:30 a.m.—Symposium on radio production in the war effort.
- Dr. W. R. G. Baker, director RMA Engineering Division.
- Lt. Comdr. A. B. Chamberlain, Navy Bureau of Ships.
- Capt. Billings McArthur, Army-Navy Production Agency.

Informal conferences on production topics.

2 p.m.—Technical session on radio equipment production.
- "Flexibility in Communication Apparatus Production," J. J. Farrell, General Electric Co.
- "Radio Production Test Methods," Harry Rice, Sperry Gyroscope Co., L. I. City, N. Y.
- "Photographic Templates," E. C. Jewett and C. D. Tate, Eastman Kodak Co.

7 p.m.—Annual dinner.
- Speakers to be announced.

Virgil Graham and L. C. F. Horle are in charge of arrangements for the Rochester fall meeting, with local headquarters at the Sagamore Hotel, Rochester.

Conventions and Meetings Ahead

American Physical Society (Dr. Karl K. Darrow, Columbia University, New York), Nov. 7, Albany, N. Y.

Radio Manufacturers Association, Engineering Division, Nov. 9, Hotel Sagamore, Rochester, N. Y.

Institute of Radio Engineers, Rochester Meeting, Nov. 9, Hotel Sagamore, Rochester, N. Y.

American Institute of Chemical Engineers (50 East 41st Street, New York), Nov. 16-18, Cincinnati, Ohio.

American Mathematical Society, Nov. 27-28, Notre Dame, Indiana.

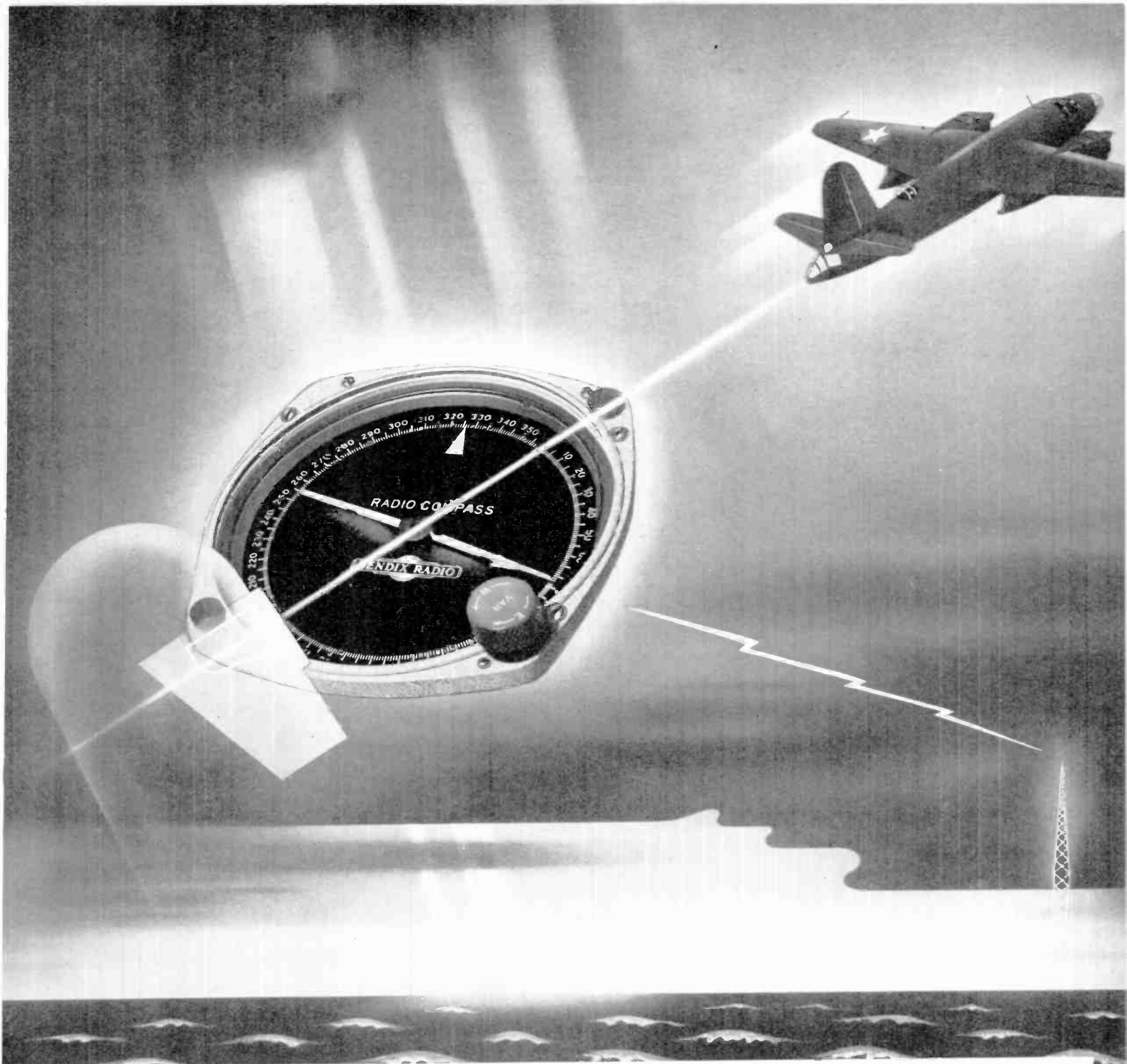
American Society of Mechanical Engineers (Ernest Hartford, 29 West 39th Street, New York), Nov. 30-Dec. 4, Hotel Astor, New York.

American Association for the Advancement of Science (27 Washington Square, New York), Dec. 28-Jan. 2, New York.

American Standards Association (29 West 39th Street, New York), Dec. 28-Jan. 2, New York.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York), Jan. 25-29, 1943, New York.

Electrochemical Society (Dr. Colin G. Fink, Columbia University, New York), April 7-10, 1943, Hotel Roosevelt, Pittsburgh, Pa.



The Seeing Eye of "THE INVISIBLE CREW"

TARGET FOR TONIGHT: a map-dot deep in enemy territory. No beams, no beacons . . . yet, "The Seeing Eye" of *The Invisible Crew* will guide the fighting men of this American warplane to their objective and back. Aloft in darkness, "The Seeing Eye"—the Bendix Radio Compass—sights a far-off radio signal and points the course. Others of *The Invisible Crew*, Bendix precision instruments, accessories and controls, help to keep that course and perform many more tasks of flight and combat. Members of *The Invisible Crew* back our fliers' skill with superhuman senses and strength on every American plane. Thousands of Bendix workers, by putting precision into high-speed production, help our invincible crews hit the Target for Tonight — and the Target for Tomorrow—*Victory*.

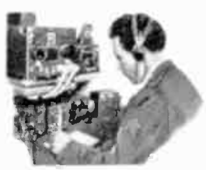
VOICE AND EARS OF "THE INVISIBLE CREW"

FROM THE GROUND, this typical Bendix Radio Transmitter air base installation flashes orders "upstairs" with the speed of light.

BENDIX RADIO DIVISION

THE INVISIBLE CREW

PRECISION EQUIPMENT BY Bendix AVIATION CORPORATION



IN THE SKY, light, compact Bendix Aircraft Receivers and Transmitters keep crews in constant contact with base and other ships.

NEMA at New York

At the annual meeting of the National Electrical Manufacturers Association held during the week of October 26 at the Waldorf-Astoria Hotel in New York, pioneers who have been associated with the electrical industry for the last half century received 50-year certificates. NEMA plans to honor pioneers in the industry at each annual meeting.

Various NEMA committees in allied branches of the electrical industry held discussions throughout the week. Of special electronic interest were the meetings of the X-ray section, the specialty-transformer section, the electrical-alloy section, and the aviation group.

Motion Picture Engineers

As this issue went to press, preparations were being made for the fifty-second semi-annual meeting of the Society of Motion Picture Engineers, to be held at the Pennsylvania Hotel, New York City, October 27 to 29.

On Wednesday, a paper was to be presented by H. Burris-Meyer of the Stevens Institute of Technology, topic: "Sound Control in the Theatre Comes of Age." At the same session Edward Honan and Clyde Keith of the Western Electric Co., Hollywood, were to deliver a talk on the subject of "Motion Picture Sound-Track Nomenclature."

On Thursday, John A. Maurer was to present a paper on "Sixteen-mm Sound Recording," one of nine papers to be read on the same day in a symposium on the production of sixteen-mm motion pictures.

Nela Park Electronics Branch

Establishment of an electronics branch at the Cleveland (Ohio) Nela Park division of the General Electric Co. and promotion of four executives to new posts, was announced by J. E. Kewley, vice-president in charge of the company's lamp division.

The new division will be supervised by W. G. Davis, general manager of manufacturing for the lamp department, and will embrace the manufacture, sale and performance of various electronic products made for the government in several of the lamp factories of the company.

Shipping Recording Discs

Major problems in the transportation of recording discs has been the packaging of these discs in a way that will cut down breakage. A new recording-disc shipping container "PacKarton" eliminates the possibility of broken records and is made of a perfected, light-weight corrugated material that safeguards the shipment of delicate glass-base records via air, railway or truck. The new container is easy to handle, dustproof, needs no excelsior or paper wadding to prevent contents from sliding, and reduces shipping costs considerably. The Gould-Moody Company, 395 Broadway, New York City, also makers of Black Seal glass-base records.

Fort Monmouth Adds Camp Coles for Research

On October 1, Brig.-Gen. George L. Van Deusen, commander of the Eastern Signal Corps Schools, dedicated a new sub-post of Fort Monmouth, named in honor of the late Colonel Roy H. Coles, who won the Distinguished Service Medal as executive officer of the first Signal Corps group with the American Expeditionary Force.

Directed by Army officers, a group of civilian employees, radio technicians and engineers will conduct research for the Signal Corps on development of communications entirely different from those under study at Squier Laboratory at Fort Monmouth.

Commander of the new post is Major R. D. Pollock, who had been an engineer at Squires Laboratory.

SIGNAL CORPS AND RADIO ENGINEERS

By Gen. Olmstead

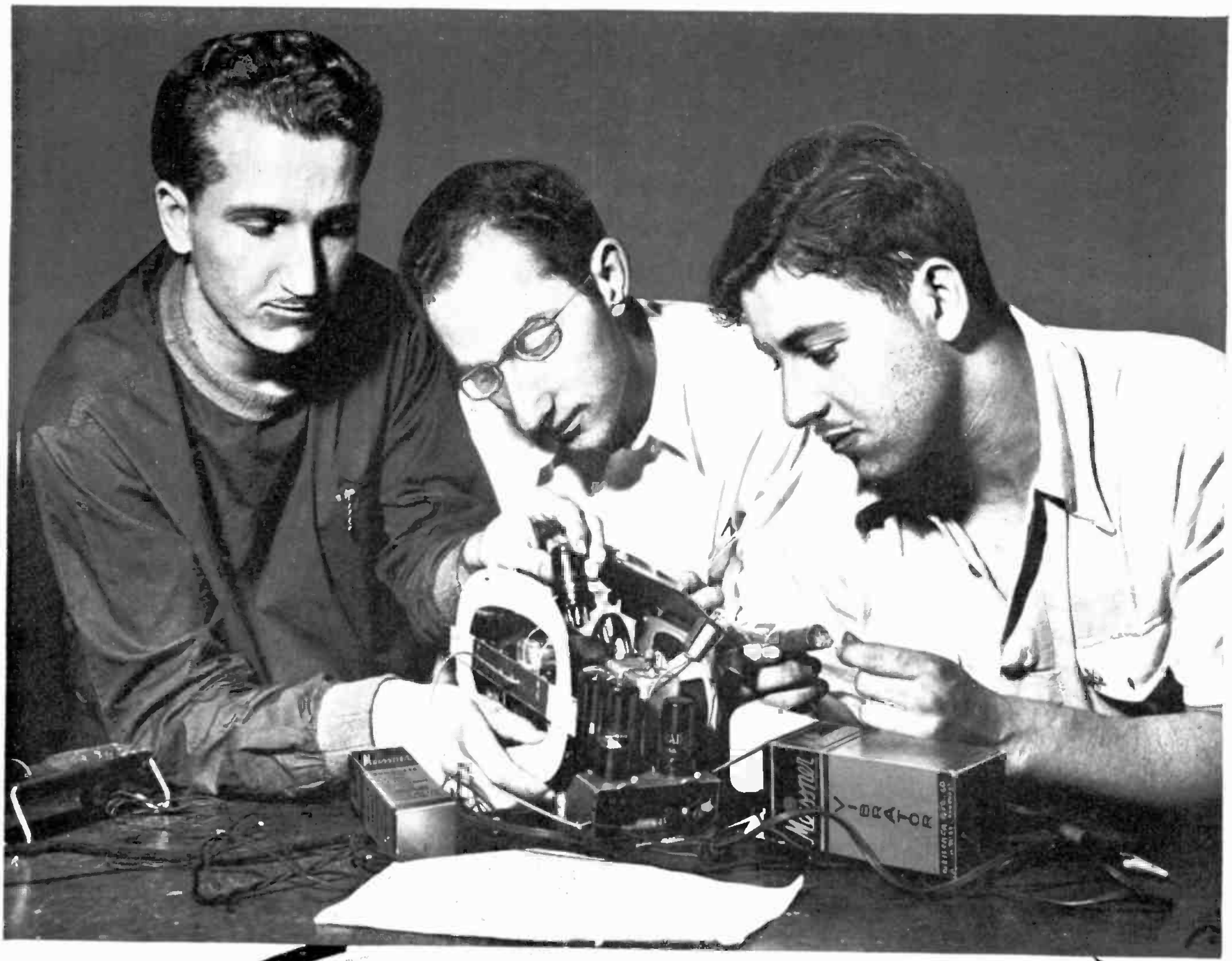
(*Continued from page 47*)

diting engineers who visit the producing factories. In some cases the job of the expediter may actually be to require a slow down in the production of certain types of equipment. This apparently paradoxical situation comes about when vital materials and components, which are urgently needed for a more strategic use, are being consumed in turning out equipment of a lesser degree of immediate importance.

It is not always possible for the Signal Corps representative in direct contact with the industry to explain the reasons motivating such a decision on precedence. These decisions may often be based on secret military considerations. It is therefore urgent that the industry cooperate with both the spirit and the letter of the requests of the Army-Navy Communications Production Expediting Agency. In this way, we will be sure of producing enough of the particular item which is most urgently needed at the time when it is most needed.

The present situation has given tremendous stimulus to the growth of America's electronic industries. Instruments made possible by the control of electrons in vacuum tubes are performing tasks of tremendous importance to the Army. They are serving to send messages to every theater of operation around the globe. They stand sentry duty along our coasts and at our distant outposts. They are extending the range over which the Army can function as an efficient, co-ordinated organism, quick to perceive the oncoming blows from the enemy and lightning-like in its counterattack.

The devices that have been developed for this purpose, and the techniques that are being mastered in our manufacturing plants, will serve in the years after the war as the basis for a vastly expanded industry. In that field of endeavor, the men who have been developing their talents in the factories and those who are learning to repair and operate the equipment as soldiers in the Signal Corps will join hands after the peace is written to build up one of the great new industries of the Twentieth Century.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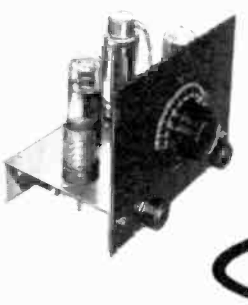
VIBRATOR



GAIN IN RC CIRCUITS

By William Moulic

(Continued from page 62)

on scale 6. Calculate the reactance of the coupling capacitor C_c and locate the value on scale 8. A straight edge between these two values will cross scale 7 where the correction factor B is read from the left hand side of the scale. This correction factor B is located on scale 5 and a straight edge placed between this value and the calculated middle frequency gain on scale 2. The intersection of this line and scale 3 is the gain at the specific low frequency.

Gain at high frequencies

Calculate the gain at middle frequencies as previously described. Using the sum of G_p, G_L, and G_g determined in the middle frequency gain calculation, read the resistance value on scale 1 opposite this sum; this is R_{eqv}. Locate this value on scale 6 and the reactance of the shunt tube capacity reactance on scale 8. A straight edge between these two values will cross scale 7. Read high frequency correction factor on right hand side of scale 7. Locate this correction factor on scale 5 and join this point to the gain at middle frequencies on scale 2 and read the gain at the specific high frequency on scale 3.

Example shown in charts

Example: Pentode resistance coupled amplifier. GM = 3000 micro-mhos, Rp = 1 meg., R_L = 0.25 meg., Rg = 0.5 meg., coupling capacity = 0.01 microfarad, shunt tube capacity ct = 20 micro-micro-farads. Low frequency limit is 10 cps, high frequency limit is 100 KC.

Gain at "middle" frequencies, Geqv. = 7×10^{-6} mhos. Line from 7×10^{-6} on scale 1 to 3000 micro-mhos on scale 4 gives gain of 430 on scale 2.

Gain at low frequencies. Reqv. = 700,000 Xc = 1.59×10^{-6} ohms at 10 cps. Line from 700,000 on scale 6 to 1.59 megs on scale 8 give low frequency factor of 0.430 on scale 7. Line from 0.430 on scale 5 to 430 on scale 2 gives gain of 182 on scale 3.

Gain at high frequencies. Reqv. = 140,000. Xc = 79,700 at 100 KC. Line from 140,000 on scale 6 to 79,700 or scale 8 gives high frequency factor of 0.494 from scale 7. Line from 0.494 on scale 5 to 430 on scale 2 gives gain of 212 on scale 3.

NEW BOOKS

Fundamentals of Electric Waves

By Hugh Hildreth Skilling, published by John Wiley & Sons, Inc., New York, 1942, 186 pages, $2.75.

The book interconnects theory with practical problems on such subjects as wave guides, radiation, reflection, polarization and other matters now becoming increasingly important to practical engineers. Mathematical methods are closely related to physical experience throughout the text, which thus constitutes a connecting link between highly theoretical books and purely practical ones. The author conveys basic knowledge of physical theory and of the corresponding equations of electricity, magnetism and, primarily, the electromagnetic field, to radio and electrical engineers already familiar with the practical results

The text starts with a few simple experiments to explain the fundamental concepts and laws of electricity and the essential equations of the electrostatic magnetostatic, stationary and quasi - stationary field are introduced. Examples are given to reduce the general physical laws to more familiar, concrete problems.

Maxwell's electromagnetic equations are considered in detail so as to make their physical meaning understood. From Maxwell's equations the wave equation for the free space and the retarded electromagnetic potentials are computed. These are required for the following discussion of electromagnetic radiation. The electromagnetic field close to a short, radiating antenna and at a considerable distance from it is described in detail and the equations are then integrated to be applicable also to antennas which are comparable to the radiated wavelength. Isolated and grounded receiving antennas as well as loop antennas are treated. The last chapter on propagation of electromagnetic waves along open-wire transmission lines and along hollow wave-guides is of particular value to practical communication engineers.

AC Calculation Charts

By R. Lorenzen, published by John F. Rider, Inc., New York, 1942, 160 pages, 146 plates, $7.50.

This book is intended to assist the practical man in working out alternating current circuit computations at great speed and with reasonably high accuracy. All the charts are direct reading and are readily understandable, covering a wide range of values. Detailed explanations and examples are given so that a person not accustomed to reading charts can work them satisfactorily.

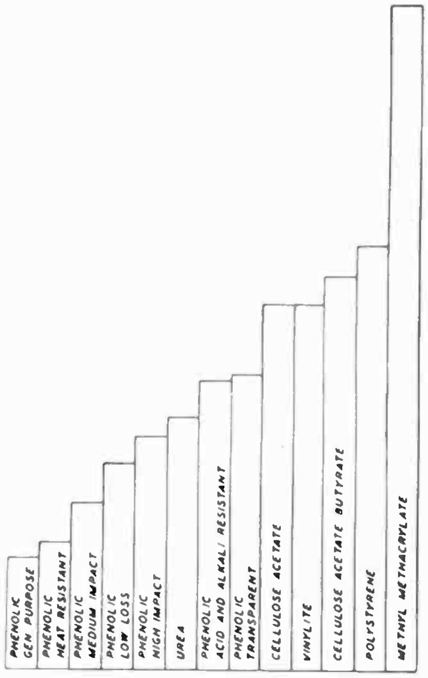
The book contains 146 nomograms by means of which inductive and capacitative reactance or susceptance can be determined and the impedance or admittance computed. A range from 0.1 ohm to 10 megohms over a scale of 10 cycles to 1,000 megacycles is covered. A chart for finding the ratio of the reactance to the resistance, or the susceptance to the conductance is also included, as is a chart for phase angles.

Plastics

By J. H. DuBois, Plastics Department, General Electric Co. Published by the American Technical Society, Chicago, 1942, 295 pages, $3.00.

Probably one of the most useful "handbooks" on plastics written for the engineer or executive who is totally unfamiliar with these materials or their uses is J. H. DuBois' "Plastics." Every kind of synthetic material is described in complete detail. First its history and background, the sources of raw materials, making of the resin, manufacture of the molding compound, the fillers (if any), the properties, general purposes and characteristics, and then why each material is better suited to one purpose than another.

Mr. DuBois goes into each type of fabrication describing compression, transfer, injection and con-



Relative economics of plastics

tinuous extrusion molding, machining, finishing and decorating.

In his last two chapters, he lists general rules to follow in selecting molding materials which will give the best service at lowest cost, as well as design and dimensional requirements which must be met to obtain uniformly high quality.

The book is profusely illustrated with interesting pictures of plastic products made from each type of material, molding presses, and sections of large manufacturing plants.

Future of Television

By Orrin E. Dunlap, Jr., published by Harper & Bro., New York, 1942, 194 pages, $2.50.

Sequel to his "Outlook for Television" (Harper, 1932), the present volume covers broadly the entertainment, educational and other sociological aspects of television. Outlining television economics, Author Dunlap comments:

"Telecasting is going to need plenty of capital outside of paying for programs to accomplish all the brilliant things predicted for its future. The pioneer 7½-to-10 kw plants in New York, custom-built as they are, cost about $500,000, a mobile televan $150,000, and a camera about $5,000.

"A 1-kw image transmitter costs approximately $19,000, the affiliated sound transmitter $7,000. Necessary test equipment and miscellaneous apparatus lift the total to $50,000, plus the aerial, transmission lines, installation, etc., making the overall minimum about $75,000, but this does not include the cost of the studio building. Studio costs depend upon their location, size and number, also the number of cameras and projectors."

Acoustic Design Charts

By Frank Massa, published by the Blakiston Company, Philadelphia, 1942, 228 pages, $4.

A welcome addition to Olson and Massa's "Applied Acoustics" will be these "Acoustic design charts," which with 107 full-page charts, 750 curves, and 100 sample problems should fill all requirements of the acoustic designer. The material is arranged in ten sections, each with an individual table of contents. Wherever possible classical theory has been reduced to practical data convenient for slide-rule use. To simplify the reading and extrapolation of the charts, parameters and ordinates have been so chosen that most relations appear as straight lines. Plottings of both the c.g.s. and the English-system relations are given.

The quantitative effect of varying the parameter of a system may be seen from families of curves provided with many of the charts. A wide range of subjects is covered, such as mechanical and acoustical vibrating systems, radiation of sound from pistons (direct radiator loudspeaker), reverberation and sound reproduction, exponential horn loudspeakers, electro-magnetic design data and miscellaneous relations, as decibel conversion charts, reflection losses due to impedance mismatching, etc.

The amount of labor saved by using these charts may be realized by glancing over some of the very complex mathematical expressions of acoustical relations in "Applied Acoustics." It might have been desirable, however, to include the basic formulas used in computation of the charts for reference purposes. The extent of application of the charts as well as errors introduced by extrapolation could then have been determined by comparison.

Letter to the Editors

How Phototubes Can Save Ammunition

Editor Electronic Industries:

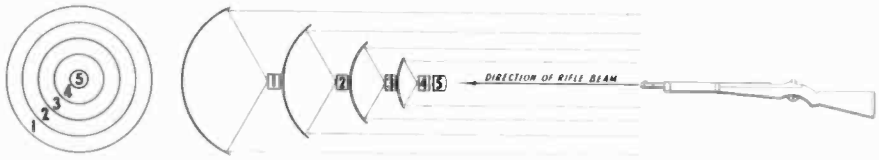
At the present time, tremendous quantities of ammunition are being used up by soldiers, sailors and aviators practicing the use of their guns.

Phototubes already have been used to save some of this ammunition, by making it possible for the marksman to **practice shooting**, and to **know** his **score**, **without** the use of ammunition. The principle employed is well known, and may be seen in "amusement centers" almost anywhere.

A dummy rifle is equipped to shoot out a narrow beam of light when the trigger is pressed, and consequently the value of the phototube equipment in training the marksman is not great.

An improved photoelectric target

However, it is possible and practical to construct phototube rifle equipment that can operate with all of the features needed to permit 50 or 75 per cent of shooting practice to be made with it, thereby saving half or more of the ammunition that would normally be required. It is also possible to construct similar equipment for other types of guns. This following description of a photoelectric set of equipment for this purpose is purely tentative, and does not follow out



Automatic record of marksman's skill, without expenditure of ammunition, is obtained by this nesting of concentric reflectors.

this light follows the path a bullet would normally take (approximately). Within the target is a phototube and amplifier, together with all necessary auxiliary items to operate a signal when the phototube receives light from the rifle. If the marksman aimed the rifle accurately, the phototube indicates a "hit."

Army unit must be different

There is a vast difference between these amusement devices and the rifles of the army and navy. Due to the short distances at which the amusement devices are used, and the large diameter of the spot of light coming from the rifle, as usually employed, it is not difficult to register a large number of hits, and any equipment which the writer knows to be in existence.

The rifle itself is built to resemble the usual weapon in all apparent respects, including general size, range, weight and balance. It contains a small lamp and optical system inside it, and also specially constructed adjustments for range and wind, all electrically connected up by a flexible cable to a control cabinet. When the rifle is fired, a solenoid plunger inside the rifle furnishes a kick-back, and a nearby loud speaker furnishes the "bang" in realistic fashion. Instead of a bullet, the rifle shoots out a beam of light capable of operating the phototube target at 300 yards. Through the use of lenses, this light beam is very narrow so that a small error in aiming will register truthfully as a miss and not as a hit on the phototube target. (For some types of training, however, the rifle light beam may be adjusted to a wider beam, with maximum intensity at the center, and lesser intensity further off. This will permit the phototube to receive a smaller amount of light when the aim is bad, and by the intensity received, to indicate the extent of the error in aiming.)

Nested reflectors from target "rings"

The phototube target consists of several paraboloidal reflectors nested together as shown, and one phototube for each reflector. When the narrow light beam system is used, the spot of light strikes the reflector-group, and the appropriate phototube is actuated, indicating whether the aim was perfect, or how poor.

The control cabinet receives wires from the phototube target assembly, and from the rifle itself. It also connects to a loud speaker (for the bang), and to an illuminated placard disc, which rotates slowly and continuously. This placard disc controls the operation of the entire system. It instructs the marksman in the use of the equipment, and tells him what adjustments to make for range and wind at each shot. At the sound of a bell, the marksman is expected to press the trigger, and then his hit, near-hit, or miss is recorded by the phototube. The program disc continues on, instructing the marksmen in the next shot to make.

Computation all automatic

At the completion of an entire program, all of the results obtained are recorded on a tape similar to that used in an adding machine. Each error in range or wind adjustment is clearly marked on the tape, and each hit or miss is also clearly indicated. At the bottom is a "total score." This tape becomes an official record, and by it the progress of each soldier may be made known, until the time when he is sufficiently proficient to graduate into bullet-firing guns.

The cost of operating this kind of device is negligible in comparison to that involved in using up ammunition. Very few persons need observe the actual training as it proceeds, because the control cabinet furnishes all needed supervision and instruction. A single maintenance man should be able to keep dozens of these machines in continuous operation with little effort.

If the rifle is properly constructed, the changeover from a photoelectric to a real rifle should involve very little difference to the marksman.

Abraham Edelman
Photobell Corp.
116 Nassau St., New York. N. Y.

NEW BULLETINS NEW LITERATURE

High Altitude Testing Chambers

A bulletin from the Tenney Engineering, Inc., 8 Elm Street, Montclair, N. J., describes high-altitude chambers, constant - temperature bath tables, temperature and humidity cabinets and weathering cabinets for radio and laboratory testing. Temperature, pressure and humidity ranges are listed.

Electrical Insulation

Owens-Corning Fiberglas Corporation, 718 Fifth Avenue, New York, N. Y., announces a booklet, called "What Keeps the Wheels Turning." Electricity is the answer, and the importance of insulation is pointed out; instances where fiberglas proved useful are explained. Yarns, tying cords, tapes, braided sleevings, cloth made of fiberglas are described and illustrated.

Uses of Fibre

"Could It Be Made from Fibre" is the title of a pamphlet released by the Wilmington Fibre Specialty Company, Wilmington, Del. The physical properties of vulcanized fibre are given as well as a table showing comparisons with other basic materials. Numerous uses of fibre are listed and illustrated. A catalog, describing their Ohmoid and Fyberoid products may be had from the same company. The materials may be obtained in sheets, rods, tubes, continuous rolls, coils and desired special shapes.

Instrument Springs

A booklet on instrument springs is released by the All - Weather Springs Company, of 72 Washington Street, New York, N. Y. Characteristics of springs, such as stiffness, dependency of deflection on load, hysteresis and temperature influence are given and illustrated, including requirements for special purposes.

Screw Products

Manufacturers Screw Products, 216 West Hubbard Street, Chicago, announce the publication of a new 96-page catalog in which all items conform to the revised suggested stock-size lists of the Office of Price Administration maximum price regulation No. 147. The book is sectionalized for easy reference, with one complete and twelve sectional indexes, and gives complete technical date, weights and dimensions of various products, as well as list prices.

Electrolytic Capacitors

The latest catalog issued by Solar Manufacturing Corporation of Bayonne, N. J., describes in full the Solar line of dc electrolytic capacitors. The new catalog consists of 32 pages, profusely illustrated, and the data has been especially arranged for design engineers. It is listed as Catalog 12—Section A and may be had only on letterhead request.

Shielded Wire

Precision Tube Co., of Philadelphia, with sales office at 2957—214th Street, Bayside, Long Island, N. Y., has announced the issuance of its new Bulletin No. 202, covering Precision metal-shielded wire by its method of protecting insulated wires enclosed in thin-wall seamless aluminum, copper or lead tubing, for positive shielding and maximum mechanical protection.

Transformers

In Bulletin No. D-11 of the Newark Transformer Co., Newark, N. J., describes distribution transformers. Coil construction, core structure, tank construction, bushings and oil are listed and several types are illustrated. Transformers of 5 to 500 kva capacity are manufactured for nominal system voltages of 480 to 13,200 volts in commercial frequencies.

Automatic Controls

Catalog No. 500 of the Mercoid Corporation, 4201 Belmont Avenue, Chicago, Ill., contains descriptions, pictures and diagrams of thermostats, relays, pressure controls, air-conditioning and oven-temperature controls, liquid-level controls, magnetic gas valves, refrigeration magnetic valves, hermetically sealed switches, gages, and various other devices for industrial application.

Electronic Resistance-Welding Control

Westinghouse Electric and Manufacturing Company of East Pittsburgh, Pa., announces an illustrated booklet (B-3102) describing different kinds of resistance welding with various types of electronic controls. The functioning of the various controls is explained and the accuracy obtainable stated. The booklet includes three pages of application data on the choice and application of ac single phase resistance welding control, an eight-page bulletin on fundamental electronic circuits, and a discussion of the cathode ray oscilloscope and its application to welding timers.

HOW WPB SPEEDS RADIO OUTPUT

By Ray C. Ellis

(*Continued from page 49*)

radio and radar production, including resistors, transformers, volume controls and tubes.

Already tremendous progress has been made in speeding up American military radio production. For example in a single day, we are now producing more quartz crystals than the entire yearly output of such crystals in 1938! We are securing more output of military radio per man-hour than ever before in American industrial history — but we know that we still have further advances to make, if we are to achieve the full possibilities of the American industrial system.

Radio engineers on the job

American radio manufacturing executives and workers now understand the high quality standards the Government is demanding for military radio. They are helping achieve such quality standards — day in and day out—with a minimum of errors or waste.

Radio is a tremendously important factor in this modern war and American radio engineers and production executives have responded magnificently to the call for more and more radio equipment for the Army and Navy. Great things are now coming out of United States radio factories—developing new inventions, new methods and new skills—all of which and more will be required in hastening the eventual days of peace.

ONE-POUND TRANSCEIVER

(*Continued from page 84*)

acoustic feedback between transmitter and receiver when the feedback tone level at the transmitter microphone is about 25 db.

One unit is frequency-modulated directly by a condenser microphone connected in the oscillating circuit, a plan devised by the writer in 1919. It also has a very high acoustic sensitivity.

The antenna for the largest of the units is self-contained. It consists of a three-foot length of flexible steel measuring tape which winds and unwinds on a spool inside the case and which, when extended, is self-supporting.

The radio frequency power of these transmitters, as measured on dummy antennas of 70 ohms resistance, is about 100 milliwatts. The reliable communication ranges have not been measured owing to war-time restrictions.

Some possible applications for these units are for army field use by outposts, patrols, motor or bicycle troops; for unmanned listening posts; for paratroops, shot-down airmen, or emergency use on aircraft. Supported by buoys they might also be useful for torpedoed merchantmen if fitted with an automatic SOS signal device and thrown overboard when attacked, or used in life boats. Another use of the unit might be as a radio dictaphone in counter-espionage or sabotage operations, because of its high acoustic sensitivity.

In time of peace it might be used by police patrolmen, in small boats or automobiles or in the homes of amateurs, and for various other short range operations.

Remler Wins Army-Navy "E"

Remler Company, Ltd., San Francisco, Cal., manufacturer of communication equipment, recently received the new Army-Navy Production Award. In center, at ceremonies, is E. G. Danielson, president of the firm, with Mrs. Archibald and Carl A. Hemmeter, oldest employees in point of service.

AIRCRAFT TRANSFORMERS

(Continued from page 72)

the eddy losses become predominant at the higher frequencies and the saving in weight is not very large unless thinner material is used. There is, however, a definite limit to the thickness of material that may be used. In 0.003 in. lamination the hysteresis losses are nearly twice as much as 0.007 in. and the stacking factor is very bad, nevertheless it is advantageous to use 0.003 in. laminations at frequencies above 1000 cycles. Laminations thinner than 0.003 in. have occasionally been used, but the manufacturing difficulties and the cost were too prohibitive to permit a more widespread use. An approximate idea of the comparable reduction in size may be obtained from the following: If we assume N = 10 at 10,000 cycles for a 0.003 in. silicon the core loss from equation (4) would be

$$W = 12 \times 10^{1.6} \times 10{,}000^{-0.6} \times 0.9 \times 0.92 + 10^{2} \times 0.006 = 2.2 \text{ watts}$$

as we have seen previously, at 400 cycles for approximately the same loss, N would be about 4. Allowing for added size and weight because of poor stacking factor, the approximate size at 10,000 cycles would be about half that of 400 cycles. The curve in Fig. 5 shows the relative size of power transformers for different frequencies.

The discussion so far has been confined to silicon steels, mainly because these are more generally available and economical. If further reduction in size is desirable, and the cost is no object, nickel-iron alloys may be used advantageously. The most desirable of these alloys is the 50-50 nickel iron alloy. The hysteresis losses for this material at 10,000 gausses 60 cycles is only half that of silicon steel. The resistivity is only slightly lower than those of silicon steel, hence the eddy current losses are somewhat higher. Because of higher permeability the eddy current shielding effect is more pronounced; the hysteresis losses at lower values of induction become proportionally much smaller than those of silicon steel. The net result of these properties is to make the losses for 50-50 nickel-iron alloy very small at the higher frequencies.

NEW PATENTS ISSUED

Summaries of inventions relating to electronic uses

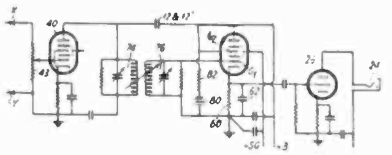
Note: Date application was Filed shown by (F). Date patent Issued, (I).

FREQUENCY MODULATION

FM-Limiter — A limiter tube for FM modulated signals, provisions being made for limiting the amplitude of the plate current impulses in the positive direction to a desired maximum value. Edwin H. Armstrong, (F) August 2, 1940. (I) September 8, 1942. No. 2,295,323.

Tuning Indicator—One of four by the same inventor, this patent covers a tuning indicator with two control electrodes for producing two separate shadows. One stage of amplification is provided ahead of each indicator electrode. A common cathode used for both amplifier tubes renders the differential variation of the shadows highly sensitive. M. G. Crosby, RCA, (F) February 20, 1940. (I) Sept. 15, 1942. No. 2,296,089.

AM-FM Demodulator—A system for demodulating either AM or FM utilizes a condenser for impressing the AM or FM signal energy on the control electrode of a tube, a parallel circuit resonant at the mean frequency of AM or FM carrier wave, a connection between spaced points on the parallel circuit and another control grid. The condenser is adjusted to have a large reactance for the demodulation of AM



signal energy and a small reactance for the demodulation of FM. The output circuit includes a load resistor connected between cathode and a point of relatively fixed a-c potential. M. G. Crosby, RCA, (F) April 6, 1940, (I) September 15, 1942. No. 2,296,090.

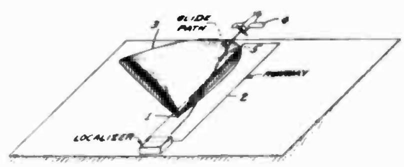
AM-FM Differential Detector—A circuit including two diodes each with a pair of cathode series resistors differential connected for demodulating either AM or FM signals. M. G. Crosby, RCA, (F) July 17, 1941, (I) September 15, 1942. No. 2,296,091.

FM Modulator— In a frequency modulator a pair of tubes are connected as a multivibrator, the frequency of which is controlled by its circuit constants. There are means for varying the potential on the cathodes in accordance with signals to obtain proportional frequency variations. George L. Usselmann, RCA, (F) October 30, 1940, (I) October 6, 1942; No. 2,297,926.

AIRCRAFT RADIO

Radio Direction Finder—A radio direction finder using a special cathode-ray oscilloscope to obtain a visible pattern for incoming signals. The beam is deflected radially with respect to the center of the screen in a circular path at a uniform rate. An auxiliary ringshaped electrode positioned within the tube between screen and deflecting electrodes has a circumference larger than the circular path and is concentric therewith. When radio signals are received the circular pattern is squelched at a point indicative of the direction of the incoming signal. Donald G. Little, Westinghouse, (F) Jan. 26, 1940, (I) Sept. 8, 1942. No. 2,295,412.

Aircraft Landing System—A specially designed antenna system producing a sharply directive radiation pattern in the shape of a hollow



linear conical surface with its apex at the ground. The incoming aircraft follows horizontally along a course line, which is displaced laterally an appreciable distance from the apex and intersects the conical surface vertically along a glide path determined by the intersection of conical surface and course line. A. Alford, I.T.&R.M., (F) January 3, 1940, (I) September 8, 1942. No. 2,294,882.

TELEVISION

Negative Feedback in Video Amplifier — A method of using negative feedback in a video amplifier over an appreciable range of picture - signal frequencies, provisions being made to vary the degree of feedback for controlling contrast in the reproduced picture. Charles N. Smyth, England, International Standard Electric Corp., (F) December 30, 1938, (I) September 8, 1942. No. 2,295,059.

Television Synchronizing Impulse Separator — A circuit arrangement for separating frame synchronizing impulses from line synchronizing impulses which are of the same amplitude but of different duration in a composite signal and amplifying the frame synchronizing impulses only. The amplifier circuit has a transmission characteristic curve with a steep sloping portion, terminating at each end in a horizontal portion. An input RC circuit with a predetermined time constant, responsive to the duration of the applied signal, varies the biasing potential and hence the operating point. The initial operating point is on the lower horizontal portion of the transmission characteristic, line synchronizing impulses causing the operating point to remain in the horizontal portion and thus producing no output changes, while frame synchronizing impulses swing the operating point through the steep sloping portion to the other horizontal portion of the characteristic. An output circuit is connected to the plate, in which the frame synchronizing impulses appear as a square topped waveform. William Jones and Baden J. Edwards, Pye Ltd., England, (F) April 21, 1939, (I) September 8, 1942. No. 2,295,346.

Television Noise Limiter—In a television receiver for the reception of carrier-wave energy negatively modulated by a composite signal consisting of picture signals, synchronizing impulses and the d-c component of the transmitted picture, a diode detector terminating into an output resistor is used for demodulating the signal. The detector output is coupled to an amplitude limiter circuit, consisting of a diode, its output resistor and a source of d-c potential in series with it. The diode is connected in such a direction, that synchronizing impulses appearing across the output of the detector oppose the current flow through the limiter diode. The d-c potential maintains current flow as long as a signal appearing across the detector output resistor of the polarity of the synchronizing impulses does not exceed a predetermined amplitude, the limiter output resistance being at least several times the value of the detector output resistance. Ciro C. Martinelly, RCA, (F) March 16, 1940, (I) September 22, 1942. No. 2,296,393.

COPIES OF U.S. PATENTS — Printed copies of U. S. patents may be obtained from The Commissioner of Patents, Washington, D. C., by sending 10 cents in coin, postal money order, or certified check (not stamps) for each copy. Order blanks in the form of coupons are available for 10 cents each and may be purchased from the same office. Coupons require the following information: Number and date of patent, name of patentee, and name of invention.

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Note the 4-color Spectrum Chart, loosely inserted in this issue. This is the first time that the tube family has been shown in association with the frequency spectrum, indicating the most suitable frequency range for application of the various types of tubes.

Three more highly instructive charts will be published within your subscription period. You will want them all —especially the next one, a new color chart of air stratas and wave reflection.

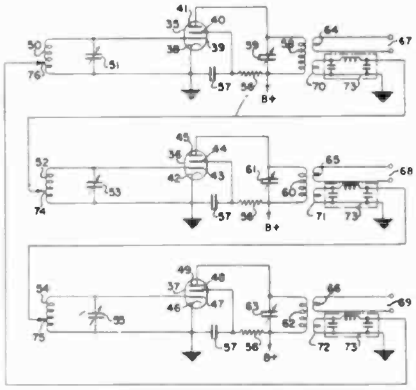
Another, equally useful, will be a Market Chart of the electronic industries.

Color Television—A photosensitive plate is mounted in an evacuated envelope inside of a cathode ray scanning oscillograph, so that it lies in the focal plane of the lens system. A tri-color light filter is spaced very near to this plate on the side of the lens system and within the envelope; the filter elements are co-planar. Everett Crosby, (F) Dec. 10, 1940, (I) Sept. 29, 1942, No. 2,296,908.

Television Image Projection—The cathode ray tube of a television receiver is adapted to produce on its screen a picture, which is contracted in the frame scanning direction. An optical projection system comprises a first cylindrical mirror facing the image screen with power in the frame scanning direction, while a second cylindrical mirror surrounding the image screen has its power in the line scanning direction, and projects the light received from the image screen to the projection screen with a greater magnifying power in the frame than in the line scanning direction, so that in the final picture the frame dimension is restored to its correct magnitude. Ferenc Okoliesanyi, England, (F) April 29, 1940, (I) September 29, 1942. No. 2,296,-943.

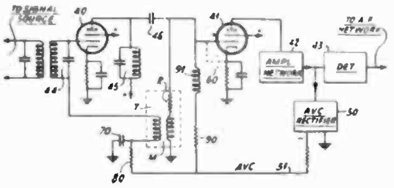
Oscillator for Medical Purposes
Electro-medical oscillator apparatus comprising a relaxation oscillator and externally excited oscillator tube circuit, the input of which receives impulses from the relaxation oscillator. The generated oscillations can be gradually dampened and periodically interrupted; an output circuit is included for applying these oscillations to a patient's body. A. W. Lay, RCA, (F) Sept. 21, 1938, (I) Sept. 1, 1942. No. 2,294,411.

Oscillator—A new oscillator system for obtaining a plurality of signals having different relative phases. The system comprises three oscillators, the output of each being shifted in phase by a network and then coupled to the next oscillator in series relationship. The network



in this particular circuit is adjusted to give 60-deg. phase shift for each oscillator. Therefore the voltage applied to the tap on the input coil of the second oscillator lags behind the voltage at the output coil of the first oscillator by 60 deg. A phase shift of 180 deg. occurs between input and output of each oscillator tube, so that finally the voltage at the output coil of the second oscillator leads the output voltage of the first oscillator by 120 deg. This process repeats itself in each stage, an output coil with terminals being provided for each oscillator, so that a variety of signals is produced, each varying in phase by 120 deg. Arthur L. Nelson, Farnsworth Television and Radio Corp., (F) Sept. 26, 1940, (I) Sept. 1, 1942. No. 2,294,797.

Electronic Reactance Circuit—A compensating system for neutralizing input capacity variations in a tuned rf amplifier due to gain variations of the tube resulting from avc. A signal amplifier circuit preceding the tuned stage is responsive to signal voltage across the tuned



circuit and simulates a negative capacity in shunt with the input capacity, the avc being connected also across this preceding amplifier circuit and varying the negative capacity in such a manner as to compensate input capacity variations and the detuning of the tuned circuit resulting from it. Walter van B. Roberts, R.C.A., (F) January 27, 1940, (I) Sept. 15, 1942. No. 2,296,-057.

Triode U. H. F. Converter—A heterodyne receiver with two triodes in the converter stage, a common signal input tuned to the signal and coupled to the two triode grids in parallel, the two plates being connected in push-pull to provide a common output circuit tuned to the IF. A local oscillator impresses oscillations upon the cathodes in push-pull relation and a common cathode resistor biases the tubes near cutoff in the absence of received signals in order to provide maximum conversion conductance. Each of the triodes has substantially equal gain and plate to grid capacity, input circuit loading being prevented by virtue of the automatic cancellation of the aforementioned connections. Charles N. Kimball, RCA, (F) May 9, 1941. (I) September 15, 1942. No. 2,296,107.

WHERE To SELL To UNCLE SAM

Government departments which buy radio and electronic equipment. Department headquarters, local addresses, Washington telephone numbers

Compiled by
ELECTRONIC INDUSTRIES

In most cases, the U. S. Government attempts to decentralize purchasing as much as possible. Contractual details are handled in various ways, but many agencies maintain bidders' notice lists of likely manufacturers. When requesting that your firm be included to receive bid requests, give all specific facts and figures on your production facilities. If your facilities are not large, the government agencies will supply you with names and addresses of prime contractors from whom you can get subcontracts.

SIGNAL CORPS

Office of the Chief Signal Officer. Constitution Avenue at 20th. N.W., Washington, D. C. REpublic 6700.

Signal Corps Procurement Districts (Bulk of Army and Lend-Lease radio equipment): Philadelphia, Pa.; Wright Field, Dayton, Ohio; San Francisco, Calif.; 1819 West Pershing Road, Chicago, Ill.

Signal Depots (Maintenance stock items): Philadelphia, Pa.; Chicago, Ill.; Lexington Signal Depot, Ogden, Utah; Dayton, Ohio.

Laboratories (Special items. Laboratories develop new equipment): Signal Corps General Development, Fort Monmouth, N. J.; Camp Coles Laboratory, Red Bank, N. J.; Signal Corps Radar, Belmar, N. J.; Aircraft Radio, Wright Field, Dayton, Ohio.

Signal Corps Schools (Maintenance stock items): Eastern: Fort Monmouth, N. J.; Midwestern: Camp Crowder, Missouri; Pacific: Camp Kohler, Calif.

Service Command Maintenance Depots.

ARMY EXCHANGE SERVICE

(Individual Post Exchanges make own purchases. Prices are arranged with manufacturers through New York office).

Army Exchange Service, Services of Supply, War Department, 111 Eighth Ave., New York, N. Y.

AIR CORPS

(Aircraft radio and other equipment. Equipment installed in ground locations bought by Signal Corps.)

Army Air Forces Materiel Center, Wright Field, Dayton, Ohio.

Procurement Districts: Eastern: 90 Church St., New York City; Central: 8505 West Warren Ave., Detroit, Mich.; Midwestern: Wichita, Kan.; Western: 506 Santa Monica Blvd., Santa Monica, Calif.

MEDICAL DEPARTMENT

(Short wave diathermy equipment, ultra violet and infra-red sources, electrocardiographs, galvanic generators, etc.)

Rooms 1203 and 1205 U.S. P. O. Bldg., Canal and Van Buren Sts., Chicago, Ill.; 461 8th Ave., New York, N. Y.; Second and Arsenal Sts., St. Louis, Mo.; San Francisco General Depot, Fort Mason, Calif.

CHEMICAL WARFARE SERVICE

(Miscellaneous electrical equipment; clips, connectors, wire, etc., under radio and electronic heading.)

Room 2000, Post Office & Courthouse Bldg., Boston, Mass.; Room 1506, North Wacker Drive, Chicago, Ill.; 292 Madison Ave., New York, N. Y.; American Bank Bldg., 6th Ave. and Grant St., Pittsburgh, Pa.; Room 201, 1355 Market St., San Francisco, Calif.

ENGINEER CORPS

(Welding equipment, alarm systems, etc.)

Room 533, U.S. Courthouse & Customhouse, Mobile, Ala. (Birmingham); 1117 United States Post Office Bldg., Chicago, Ill.; 120 Wall St., New York, N. Y.; 900 U.S. Customhouse, 2nd & Chestnut Sts., Philadelphia, Pa.; 1012 New Federal Bldg., Pittsburgh, Pa.; Room 410, Customhouse, San Francisco, Calif.

ORDNANCE DEPARTMENT

(Limited amounts electrical and electronic test and measurement equipment.)

New York Ordnance District, 80 Broadway, New York, N. Y.; Frankford Arsenal, Philadelphia, Pa.; Aberdeen Proving Ground, Maryland; Detroit Ordnance District, Buhl Bldg., Detroit, Mich.

QUARTERMASTER CORPS

Office of the Quartermaster General, Procurement Control Branch, War Dept., Washington, D. C. TEmple 5886.

Washington Quartermaster Depot (Lamps, ranges, fixtures, generators, etc.), 24th and M Sts., N.W., Washington, D. C.

NAVY DEPARTMENT

Bureau of Supplies and Accounts (Handles all contractual details), Constitution Ave. at 18th, N.W., Washington, D. C., REpublic 7400.

Radio and Sound Branch, Design Division, Bureau of Ships, Washington, D. C. (Charged with design, development, and manufacture of all radio equipment for the Navy.)

Radio and Electrical Section, Engineering Branch, Materiel Division, Bureau of Aeronautics, Washington, D. C. (Maintenance items.)

Radio Materiel Section, Fleet Maintenance Division, Bureau of Operations, Washington, D. C. (Maintenance items.)

Radio Facilities Section, Bureau of Yards and Docks, Washington, D. C. All Naval establishments in the field (Occasional purchases.)

U.S. COAST GUARD

(Coast Guard radio equipment. Minor purchases made through district offices and field establishments.)

Radio Engineering Section, Materiel Division: United States Coast Guard, Washington, D. C. REpublic 7400.

CIVIL AERONAUTICS ADMINISTRATION

Radio Engineering Section, Signals Division, Civil Aeronautics Administration, Department of Commerce, Washington, D. C. EXecutive 2460 (Bulk of CAA procurement.)

Central Depot, Civil Aeronautics Administration, Fort Worth, Texas (Maintains a reservoir of replacement parts.)

Regional Offices (Emergency purchases): New York, N. Y.; Atlanta, Ga.; Chicago, Ill.; Fort Worth, Texas; Kansas City, Mo.; Los Angeles, Calif.; Seattle, Wash.; Anchorage, Alaska.

MARITIME COMMISSION

Procurement Section, Production Division, Maritime Commission, Washington, D. C. (Wartime procurement.)

Division of Purchase and Supply, Maritime Commission, Washington, D. C. (Peacetime and special wartime procurement.)

WAR PRODUCTION BOARD

Radio and Radar Branch, Ray C. Ellis, deputy director, Room 4332, New Social Security Building, Washington, D. C. REpublic 7500, Ext. 2566.

WEATHER BUREAU

Procurement Section, U.S. Weather Bureau, Department of Commerce, Washington, D. C. MIchigan 3200 (Handles actual purchase details.)

Army Signal Corps
Navy Bureau of Ships
Army Air Corps
Coast Guard
Engineer Corps
Civil Aeronautics
Maritime Commission
War Production Board
Federal Communications Commission
Allied Purchasing Agents

Instrument Division, U.S. Weather Bureau, Department of Commerce, Washington, D. C. MIchigan 3200 (Designs all equipment.)

Regional Offices (Emergency purchases): New York, N. Y.; Atlanta, Ga.; Chicago, Ill.; Fort Worth, Texas; Kansas City, Mo.; San Francisco, Calif.; Seattle, Wash.; Anchorage, Alaska.

NATIONAL BUREAU OF STANDARDS

Purchase Section, National Bureau of Standards, Washington, D. C. (Actual purchase details.)

Radio Section, National Bureau of Standards, Washington, D. C. (Radio and electronic equipment.)

COAST AND GEODETIC SURVEY

Office of the Chief Clerk, Coast and Geodetic Survey, Department of Commerce, Washington, D. C. District 2200 (Actual purchase details.)

Division of Coastal Surveys, Coast and Geodetic Survey, Department of Commerce, Washington, D. C.

Division of Geomagnetism and Seismology, Coast and Geodetic Survey, Department of Commerce, Washington, D. C.

FEDERAL COMMUNICATIONS COMMISSION

Engineering Department, Federal Communications Commission, Washington, D. C. EXecutive 3620.

FOREST SERVICE

Division of Fire Control and Improvement, Forest Service, Agriculture Department, Washington, D. C. REpublic 4142.

Regional Offices (Maintenance items): Philadelphia, Pa.; Milwaukee, Wis.; Atlanta, Ga.; Missoula, Mont.; Denver, Colo.; Albuquerque, New Mex.; Ogden, Utah; San Francisco, Calif.; Portland, Ore.

OFFICE OF WAR INFORMATION

Outpost Bureau, Overseas Branch, Office of War Information, Washington, D. C.

TREASURY DEPARTMENT

(Procurement for Lend-Lease and a large number of Federal agencies.

Procurement Division, Treasury Department, Washington, D. C. District 5700.

MISCELLANEOUS

Bureau of Reclamation
Bonneville Dam Administration
Federal Bureau of Investigation
Panama Canal
Tennessee Valley Authority
National Park Service

DIRECT ALLIED PURCHASING

(Most of the important Allied procurement is now under Lend-Lease. However, some purchasing is still handled directly with American manufacturers. Most of the Allied Governments maintain offices both in Washington and in New York City, but radio and electronic equipment is usually contracted for by the Washington offices.)

GREAT BRITAIN—The British Ministry of Supply Mission, Willard Hotel, Washington, D. C.; The British Ministry of Supply Mission, 15 Broad St., New York, N. Y.

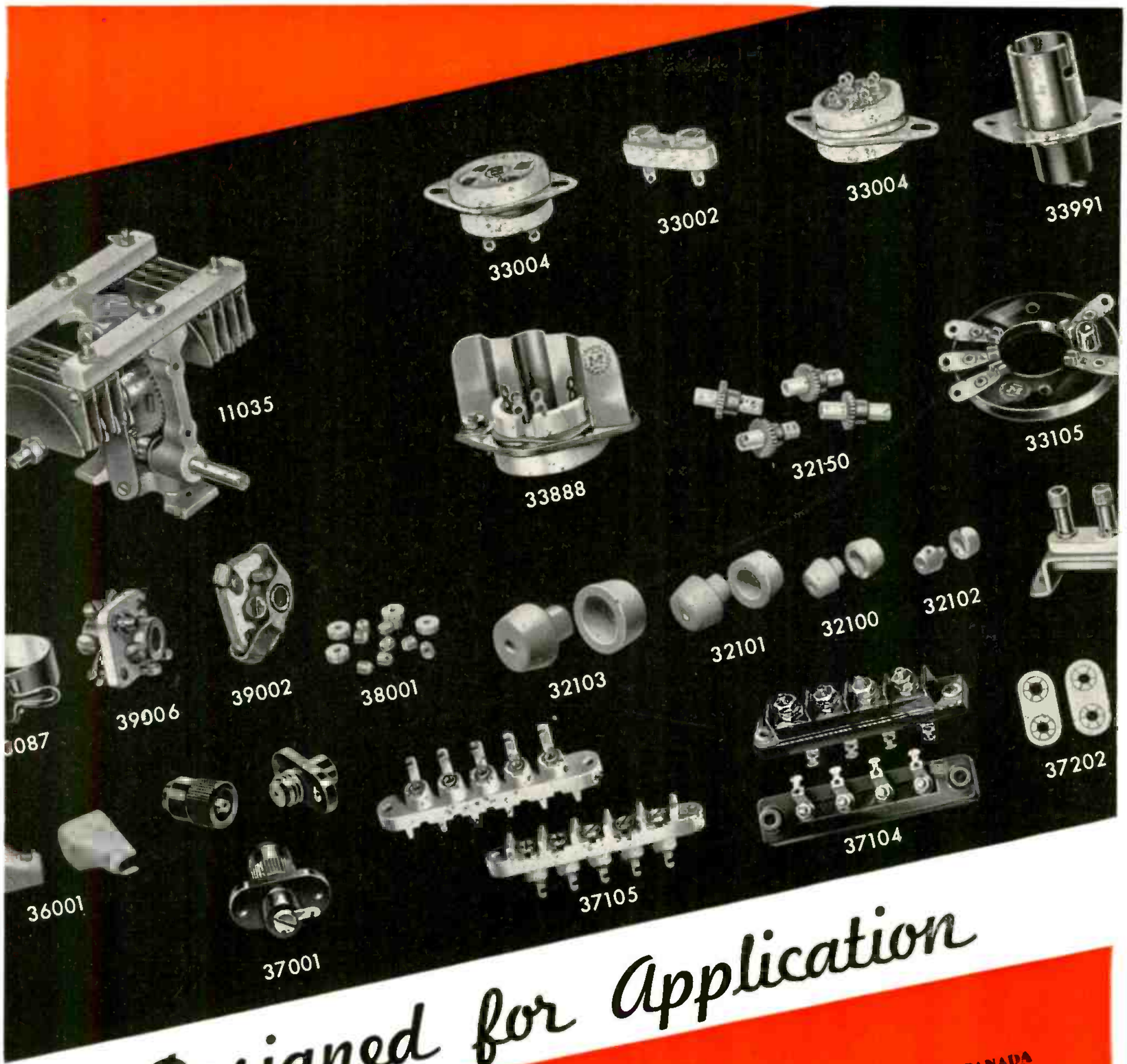
CANADA—J. B. Carswell, Department of Munitions and Supplies, 1205 15th St., N.W., Washington, D. C.

U.S.S.R.—Soviet Government Purchasing Commission, Washington, D. C.; Amtorg Trading Corp., 210 Madison Ave., New York, N. Y.

CHINA—China Defense Supplies Inc., 601 "V" St., N.W., Washington, D. C.; Universal Trading Corp., 630 Fifth Ave., New York, N. Y.

AUSTRALIA—Australian War Supplies Procurement, 1700 Massachusetts Ave., Washington D. C.; Australian War Supplies Procurement, 15 Broad St., New York, N. Y.

SOUTH AFRICA—South African Supply Mission, 907 15th St., N.W., Washington, D. C.



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MAIN OFFICE AND FACTORY

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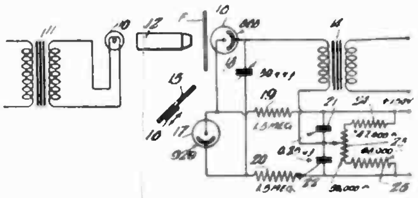
MODERN PARTS FOR MODERN CIRCUITS

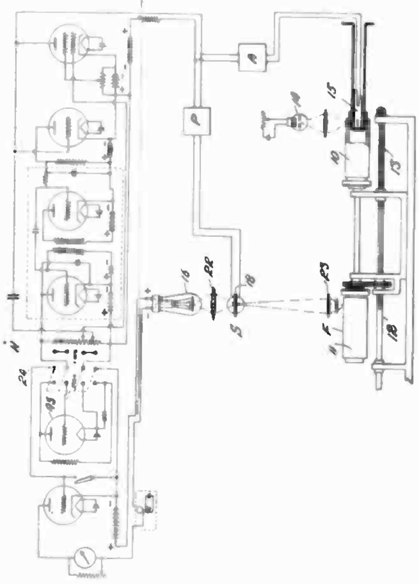
PHOTOCELL CIRCUITS

Photocell Voltage Regulator — An exciter lamp and photocell fed from a common power supply, a voltage regulating circuit being connected between supply and photocell, which varies the photocell voltage in inverse and greater ratio to changes in excitation and power supply. The voltage regulating circuit consists of a bridge having adjacent arms of a resistor and a constant voltage device, the voltage drop across the resistor being less than that across a regulator tube. H. Belar, RCA, (F) April 9, 1941, (I) Sept. 1, 1942. No. 2,294,375.



Photocell Hum Demodulator— Two patents describe methods of applying a-c directly to an excitation lamp and neutralizing the power-line hum produced in the photocell by using a balancing photocell in a bridge circuit. H. Belar, RCA, (F) July 31, 1941, (I) Sept. 1, 1942, No. 2,294,376; and R. A. Bierwirth, RCA, (F) July 31, 1941, (I) Sept. 1, 1942, No. 2,294,377.

Reproducing Pictures — The invention relates to printed reproductions of continuous-tone-pictures, in which the tones of the original are uniformly faithfully reproduced. The aim is to provide a wider contrast range than is possible with usual halftone reproductions. In scanning the picture the varying light intensities are translated into a light beam of uniform intensity, but of varying length and spacing between impulses, simultaneously also varying the width of the beam in accordance with the light and

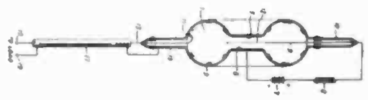


shade of the original picture. The photocell current produced by the scanning beam, after one stage of direct-current amplification, is divided into two parts. One part is transformed into a variable-frequency intermittent current (Hardy circuit) and is utilized to control the length and spacings of the produced dots, while the other part remains a direct current, the variations of which are proportional to the variations in the original photocell current, and controls the width of the dots of the contrast image. Francis L. Wurzburg, Jr., Interchemical Corp., (F) July 5, 1940, (I) Sept. 1, 1942. No. 2,294,643.

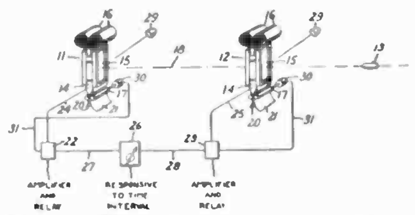
MISCELLANEOUS

Secondary Emission Tube — A secondary emission electrode is introduced in a tube, the secondary electron-stream flowing from the plate through an impedance, develops a voltage, which is coupled to an additional grid at a point where the electron velocity is small and in such a phase as to aid the voltage variations of the secondary emitting electrode. B. B. Jacobsen, Western Electric Co., (F) January 23, 1941, (I) September 1, 1942. No. 2,294,482.

Secondary Emission Tube — An evacuated hollow metallic toroidal shell having two parallel imperforate secondary-electron emissive sur-



faces in register with each other, an accelerating electrode positioned between the surfaces and an aperiodic inductive coupling impedance connected to the interior of the shell. Roscoe H. George, RCA, (F) Oct. 7, 1939, (I) Sept. 8, 1942. No. 2,295,396.



Projectile Timer — Each of two casings contains a photocell and amplifier, a measuring instrument responsive to time intervals connected between them. The casings are covered by light-impervious and easily ruptured sheet material and a source of light is provided for each sheet. A projectile rupturing the sheets permits light to reach and operate the photocell, the timing instrument recording the interval between successive ruptures. Ulrich Eggers, General Electric, (F) Sept. 23, 1940, (I) Sept. 1, 1942. No. 2,294,730.

ELECTRONIC HEATING

(*Continued from page 58*)

the cylinder and machine out excess metal later. Besides high cost in materials and time, this method has the added disadvantage that great care must be taken to leave enough metal at the bottom of each cut. In a method making use of induction heating, cooling fins are brazed in place. Heat dissipation of this type of construction is claimed to be better than that of the cast cylinder.

Besides a saving of time over ordinary methods of brazing, induction heating has meant more foolproof operation, fewer rejects, and a vastly lowered fuel-cost per unit in many cases.

Melting

Electronic heating to melt ferrous and other metals provides higher temperatures than ever before obtained. Although the mass of metal that can be melted at one operation with present equipment is limited to something like 100 pounds, induction heating is faster and produces perfect alloying.

Annealing

The extreme degree of control which electronic heating affords makes its use for critical annealing tasks of considerable value. In one recent installation, a manufacturer of steel wire continuously anneals the wire as it is reeled.

Forging and other uses

Most uses of induction heating for forging are in the experimental stage at present. Certain advantages, such as speed and freedom from scaling of the metal being heated, are claimed.

Numerous manufacturing uses of electronic heating of metals outside of these classifications have been developed. One of the most striking is the expansion of bearing races for the insertion of the balls.

Heating of non-metallic materials

As mentioned above, high-frequency electrostatic heating demands oscillating currents of 1.5 megacycles or higher. New uses in

industry are being discovered daily. In general, high-frequency heating applications fall into one of the following categories:

Drying processes

Drying time of paper and of textiles removed from dyeing vats has been greatly reduced by use of high-frequency heating. Various powdered substances, difficult to dry, have been handled quite efficiently by the electronic method, because the heat is generated uniformly within the substance itself instead of being applied externally to a material of poor heat conductivity. Quick, even drying of ceramics has been accomplished, eliminating cracking and checking of surfaces. For some time now, tobacco in hogsheads has been dried by internal electrostatic heating.

Causing chemical reactions

Probably the most well-known application is in the bonding of plywood for aircraft and other uses, with thermosetting plastics. The many advantages over cold press and hot plate press methods have been widely discussed, chiefly the savings in time and the improved quality of the product. In addition, so-called "laminated wood" is being bonded with high-frequency heating. A ten inch square beam made up of six layers of white oak can be glued with phenolic resin polymerized by heating to 240° F. in less than ten minutes. Rubber in thick sheets or large masses is being cured by heating.

Softening

Thermoplastics and other materials can be softened by high-frequency heating, ready for processing as desired. Compregnated wood, or "high density plywood" is heated before compression by the electronic method, then subjected to pressures of 1,500 pounds per square inch and higher. This new material has been made experimentally with surface hardness up to 90 per cent of that of plate glass. Almost any fibrous material can be heated in this way while being compressed into a solid mass.

One of the earlier applications of high-frequency heating was for killing infestation in grains and cereals. The electrodes of the generating equipment are placed on both sides of a hopper through which the grain to be treated is then fed. Internally generated heat destroys the infestation at low cost.

Many of the processes and applications described have been in commercial use for some time. A few of them are at present in the experimental stages only. However, under the impetus of the war effort, all types of electronic heating are finding new uses almost every day, pointing the way to better and more efficient war production now and new products and processes for peacetime living later.

RADIO ENGINEERS MUST COME OUT OF SHELLS

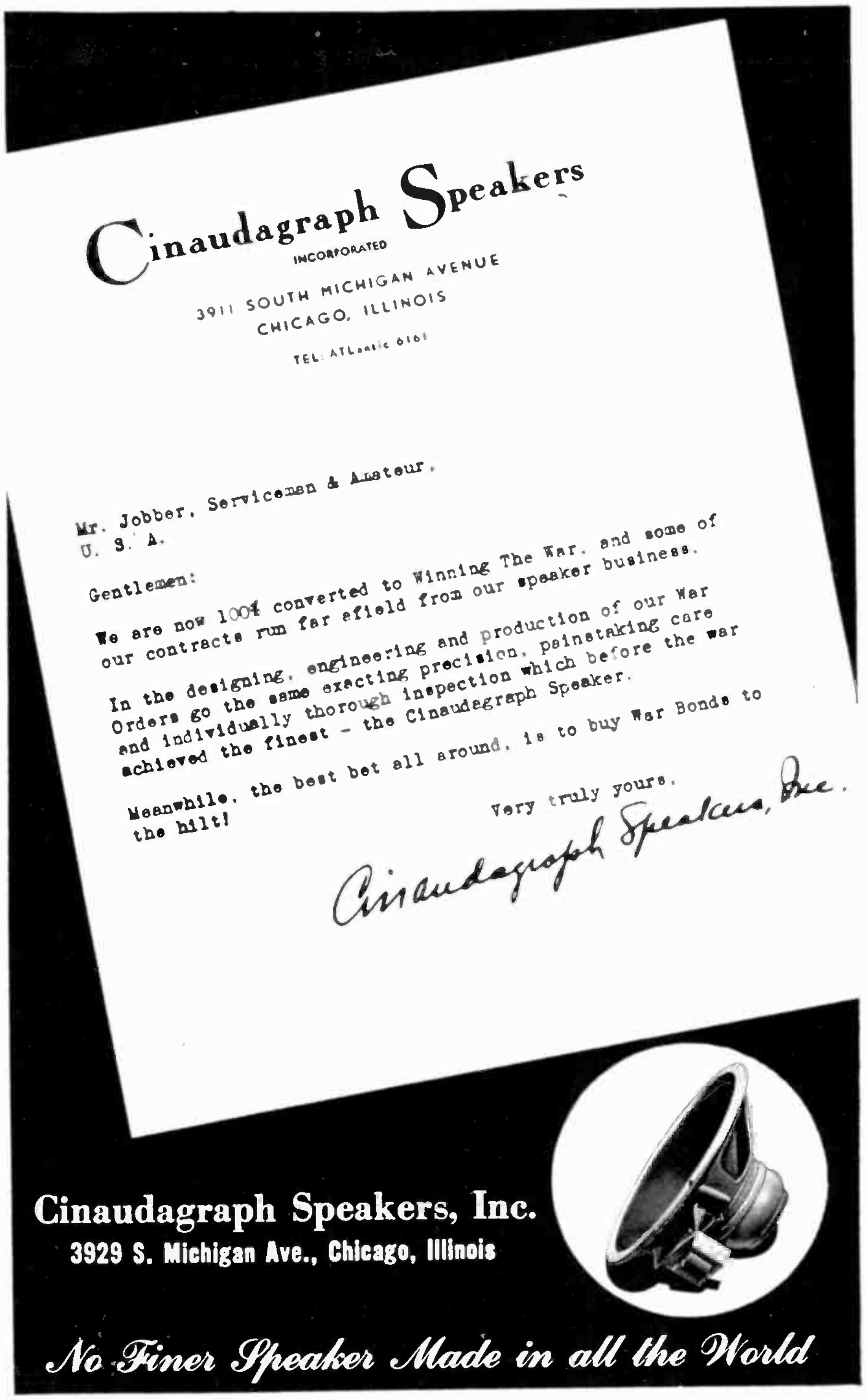
By Arthur F. Van Dyck

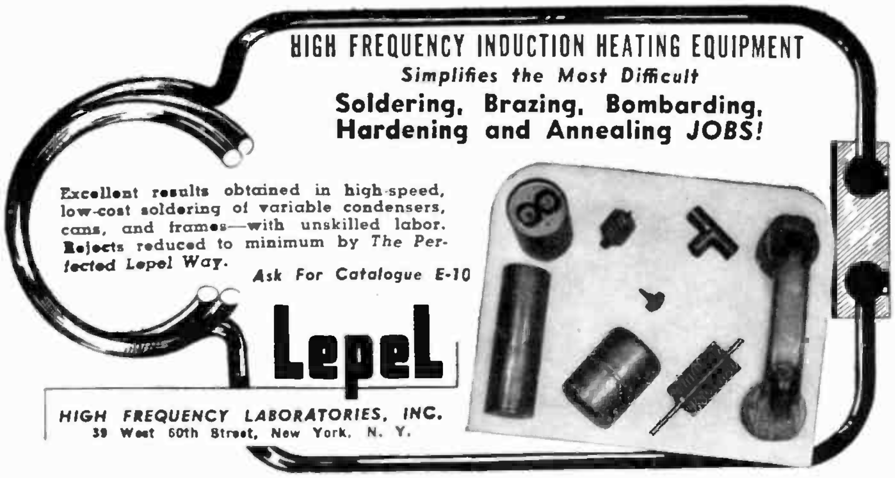
(Continued from page 55)

communication which can reach quickly enough all the defense forces likely to be needed. All-out attacks are in style now, and an all-out attack means incendiaries in cities and forests, high explosives, shelling, paratroopers, saboteurs, commandos, all mixed and served piping hot in numerous locations simultaneously. Under such circumstances one hundred citizens rallied and instructed instantly by radio can do more good than a thousand soldiers in the next county, or a thousand firemen in the next city. Perhaps such future attacks will include new elements which, in unsportsmanlike fashion, will not follow the program carefully set down in Civilian Defense instructions for well behaved enemies to follow. If the enemy does not follow the old rules, our citizens will need to be told about the new ones within a very few minutes, or the enemy will run up a high score because we had too little information, too late.

Engineers have not taught others

But so far, broadcasting shuts down when an enemy comes near, or is thought to be near. Dark or light, sunshine or moonshine or cloud, it shuts down. It shuts down and the searchlights shoot up. One can be heard and not seen, the other seen and not heard. Otherwise there is no difference, except





that searchlights can be located, and the broadcasting station cannot, if a few simple technical provisions are made.

This is another case in which technologists have not taught the principles clearly to others who need to know them—in this case that radio stations can be arranged for use as beacons, or can be arranged to be of no use as beacons, or to be false beacons. Engineers have not educated others to know that we have a mass communication system available which can be used without any objection, and which can be used for war purposes almost as readily as it can for entertainment and fireside chats. Such war purpose use by the public is now desirable. The public was not in the front lines in the last war, and did not need rapid communication. This war is different, but we have not educated old-line thinking to see that now there is advantage in instantaneous communication to the public comparable with its advantage in communication to planes and tanks.

So it comes about that the technologist has another job in this war. He has not only to invent new devices, design them, and produce them in quantity, but he has to "sell" an understanding of them, complete enough to have them utilized. properly and quickly.

Hard to get new ideas adopted

Unfortunately it is harder to get a new idea adopted and used properly and quickly, than it is to design and manufacture in quantity. It is not human nature to accept readily new things not thoroughly understood, and it is human nature to resist change from the old, tried, and familiar way. But since modern inventions are more complex and more numerous, it is more difficult for non-technical people to understand them and to evaluate them in advance of use. Technical men are trained in new thinking and in relating the new to the old.

Perhaps in a hundred years, all men will be technically trained, and able to understand and evaluate technological developments quickly. But to win this war the technologists have a responsibility not only to invent and design, but to come out of their shells into the haphazard world, explain their contributions clearly and fully, and take that share of responsibility which is theirs in the decisions and planning for use of the contributions.

Only in that way can the present Alice-in-Wonderland treatment of technological output be brought to sane efficiency. And that is necessary if we are to be safe, because the modern inventions of electronics have decisive force. **A single one** applied by our enemies and not understood and anticipated by us, can lose the war for us.

FM GUIDES ST. LOUIS LINES

(*Continued from page* 60)

the squelch. Noise in the absence of a carrier will tend to produce one voltage at the limiter to open the squelch, but it will also increase the noise voltage in a second circuit tending to close the squelch. This balanced design results in a system which may be adjusted to operate at a very low carrier level, but which will not open in the presence of noise produced by trolley cars, trucks, or other similar impulse electrical noises.

The antenna used on the cars is a ¼ wavelength vertical, mounted on left side of rear deck. This permits a short antenna lead to be used, as all equipment is mounted in the rear compartment of cars.

Mobile transmitters

The mobile transmitters are also powered from the 6-volt car battery. The plate supply is a 600-volt dynamotor rated at 170 ma at 5.7 volts input to dynamotor terminals. This dynamotor supplies power to all the stages of the mobile transmitter.

The transmitter circuit uses a two-tube balanced phase modulator followed by two quadruplers and a doubler. The crystal frequency, therefore, is 983.125 kc, 1/32d of the output frequency. The power amplifier may be either an RK39 or an 807 tube.

The fixed-station transmitter is rated at 250 watts output and consists of two units, the exciter and final output stage. The exciter is similar to the mobile transmitter, except that the dynamotor is replaced by a conventional ac power supply and the output stage consists of two RK39 or 807 tubes in parallel to obtain necessary drive for the final amplifier.

The final stage is push-pull Class C, using Eimac 100 T.H. tubes which are operated at 2,000 volts Ep, at 250 ma Ip. The filaments run at 4 volts during standby periods and come up to 5.1 volts with application of plate power.

The transmitter and fixed-station receiver and all power-supply components are mounted in an enclosed relay rack. This rack also carries the remote control relays and is equipped with a blower for forced ventilation which is controlled by a thermostat.

Flexibility of equipment

An important feature of the design of the system is the interchangeability of the standard receiver and transmitter chassis for different services. The standard receiver chassis is equipped with removable power packs, so that a vibrator power pack may be used for a mobile unit or a 60-cycle ac pack may be substituted when the receiver is used on the commercial 117-volt supply. The same receiver chassis may be mounted in the conventional rack arrangement in the transmitter cabinet with proper connections, so that the assembly becomes a complete station for both receiving and transmitting, with proper muting relays and circuits to mute the receiver while the transmitter is in operation.

The receiver may also be mounted in a single cabinet for ac operation. A removable power pack on the transmitter permits the operation of the unit with a dynamotor, with a vibrator power pack, or with an ac power pack. The ac version may be arranged with double or single 807 output power amplifier for 30 or 60 watt ratings. The chassis of the transmitter is constructed with all holes punched for the 60-watt version, and any 30-watt unit may be converted to a 60-watt unit simply by removing plug buttons and inserting the necessary parts. While the station is nominally rated at 255 watts, an output of 350 watts may be obtained without overloading the equipment. This flexibility and interchangeability permits the use of the same chassis in mobile, portable, or fixed station units.

Blind Sort Mica Sheets Unerringly

The Solar Manufacturing Company has attracted nation-wide attention by its use of blind workers to select mica sheets of definite thickness by sense of touch, and is already employing a number of blind men and women at its West New York, N. J., factory

These blind workers already have their sense of touch highly developed by their experience in reading the raised characters of Braille, in books especially embossed for the blind. Now that they are applying this special finger-tip skill to selecting mica sheets, their adeptness and speed has relieved a bottleneck that had developed when persons with ordinary sight were depended upon to do the work without the special steel gages which are no longer available.

The mica separators used in the condensers must be from two- to five-thousandths of an inch in thickness. If thicker or thinner they cannot be used. Several mica samples of correct thickness are given to each blind worker, explains W. C. Harter, Solar's general sales manager. By checking back to these from time to time, the sensitive finger tips of the sightless men and women quickly select the right thicknesses from supply piles and reject the others. On a piece-work basis, these blind persons have been able to earn as much as $50 a week, a high compensation for the sightless.

A New Spectrum Nomenclature

Of interest in connection with the Frequency Spectrum which accompanies this issue, B. C. Fleming-Williams makes the following suggestion in a letter to the editor of "The Wireless Engineer," London. He proposes that the whole frequency spectrum should be divided up into a number of bands defined in the following manner:

If a frequency is expressed in cycles per second, it will lie in a band whose number is equal to the logarithm of the frequency to the base 10. The band number is therefore given by expressing the frequency as a number between 1 and 10 multiplied by a power of ten, and using that power as the band number.

For example 50 megacycles is 5×10^7 c/s and the band number is 7.

It is pointed out that the present terminology does not correspond to the band numbers exactly, but this should not present difficulty. The system can also be extended widely, light waves being associated with band 14.

Advertisers' Index

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

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Famous Designer

The typographical layout evident in this issue of Electronic Industries was designed by Egmont Arens, a leading industrial designer. Mr. Arens, well known for his typographical work, formerly conducted the Flying Stag Press. He has designed many books, magazines, advertising and trade publications. Among periodicals he has restyled may be mentioned Creative Art, Vanity Fair, Liberty and Radio Retailing Today. Recently Mr. Arens has been doing some experimental work on molded plastic plywood for aircraft, eventually involving electronic induction cementing.

Mr. Arens is design consultant to a number of firms such as Reynolds Metals Company, Hobart Manufacturing Company, Dayton Scales, Hobart Brothers, The Great A. & P. Tea Company, Nashua Package Sealing Company and many others.

Charles F. Dreyer of Mr. Arens' organization designed and executed the art work of the Frequency Spectrum chart which accompanies this issue, as well as other feature pages of Electronic Industries.

Solar Factory for Chicago

The Solar Manufacturing Company of Bayonne, N. J., producers of condensers for radio and electronic purposes, has just received a grant of nearly $500,000 from Defense Plants, Inc., a U. S. Government subsidiary of the War Production Board, to erect a new modern plant for manufacturing Solar condensers and capacitors on a site in the Chicago area. Plans are proceeding immediately for the construction of the new factory to enlarge Solar's facilities.

★

Buy War Savings Bonds and Stamps

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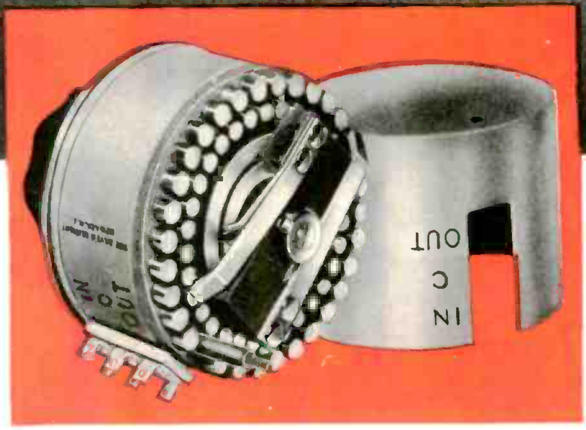
Official U. S. Navy Photograph



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