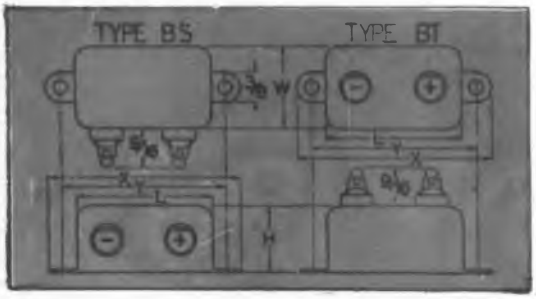
ELECTRONIC INDUSTRIES

Electronic Fire Control of Anti-Aircraft Guns
Carrier Current in Industry ★ Postwar Plans
Annual Radio Statistics ★ Factory Short Cuts

JANUARY

Caldwell-Clements, Inc.

Battle-Tested from the Arctic to the Equator



P. R. MALLORY & CO. Inc.

MALLORY

ELECTROLYTIC, FILM AND PAPER

CAPACITORS

A TYPICAL example of Mallory progress in building components is this BS 81 "Bathtub" Capacitor. Rated at 8 mfd. 500 volts, with a 700 volt surge, it is hermetically sealed in a steel case measuring only 2"x1¾"x1". Its −40° C impedance at 120 cycles runs as low as 220 ohms. The Capacitor itself has been thoroughly tested in war service from the arctic to the tropics.

In addition to withstanding great extremes of temperature, the double sealing and extra mechanical strength of this Capacitor protect it against vibration, humidity, atmospheric pressure and corrosive fumes. It is available in ratings from 10 mfd. 25 volts to 8 mfd. 500 volts, and is normally supplied with two side terminals—and with the working unit insulated from the case.

Specifications and complete test data on all Mallory BS and BT Capacitors are listed, with other heavy duty units, in the Mallory catalog. Send for a copy today. Write direct for special assistance when confronted with unusual problems, or see your Mallory distributor.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

ARMY E NAVY

Keep Faith with the Men Who Fight — Buy War Bonds

Day in and day out

LONG, UNINTERRUPTED SERVICE is the characteristic you want most in a capacitor. And that's the reputation of Tobe Capacitors, earned through an almost complete absence of "returns"! • Lasting stamina is built into Tobe Capacitors through every careful step in their manufacture...checked and cross-checked by frequent, rigid inspections. For your further assurance of complete satisfaction, every Tobe Capacitor is rated ultra-conservatively. • The Tobe Oil-Mite Capacitor shown below is oil-impregnated and oil-filled. It meets Army and Navy immersion tests. • The ingenuity of Tobe engineers is at your ready disposal in all capacitor problems. Inquiries will receive prompt attention.

LONG LIFE ASSURED!

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

SPECIFICATIONS—TYPE RAL 300 CAPACITOR

SHUNT RESISTANCE
1000 megohms or better

POWER FACTOR . . . .002—.005

WORKING VOLTAGE
400 Volts D. C. at 72° C.
600 Volts D. C. at 38° C.

INSULATING RESISTANCE—TERMINAL TO CASE 5000 megohms

CAPACITY . . . . . 5.0—5.0 Mfd.

DIMENSIONS . . . 2" x 3⅜" x 3¾"

Meets Army and Navy Immersion Tests

Oil Impregnated—Oil Filled

A small part in victory today . . . **A BIG PART IN INDUSTRY TOMORROW**

FOR EDITORIAL CONTENTS OF THIS ISSUE, SEE PAGE 4

WHY

One of a series showing ***AMPEREX*** *tubes in the making*

AMPEREX

WATER AND AIR COOLED

TRANSMITTING AND RECTIFYING TUBES

Amperex **"key" men have been associated with the vacuum tube art ever since its inception. Working against a background unique in the field, our engineers and production people are given free rein to conduct independent research and experimentation. Unhampered by mass production limitations, their high standards have resulted in advanced designs, greater efficiency, lower cost and longer life. Such "Amperextras" have carried our tubes to a commanding position in communications, ultra high frequency transmission, electro medical apparatus, high voltage rectification and many industrial applications.**

START THE NEW YEAR WITH EXTRA PURCHASES OF WAR BONDS

ARMY E NAVY

AMPEREX ELECTRONIC PRODUCTS

79 WASHINGTON STREET BROOKLYN 1, N. Y.

FOR EDITORIAL CONTENTS OF THIS ISSUE, SEE PAGE 4

ELECTRONIC INDUSTRIES

JANUARY, 1944

In this Issue

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NEW YORK 17

This G-E electronic tube cut transmitter rectifier losses by 95 per cent

another G-E electronic FIRST!

TODAY's complete line of G-E transmitting and industrial tubes includes many basic electronic "firsts."

For example, G. E. developed the hot-cathode mercury-vapor rectifier tube, the tube which has cut rectifier losses to a twentieth of what they were with high-vacuum rectifiers and reduced over-all transmitter power costs by 15 per cent. Moreover, the mercury-vapor rectifier has a lower first cost and longer life than the high-vacuum rectifiers that it has replaced. And by making it possible to use less expensive transformers and filters, over-all transmitter costs have been appreciably reduced.

ALL G-E transmitting tubes are designed and built to provide the greatest efficiency, longest service, and maximum operating economy possible.

Ask your G-E electronic tube distributor for current prices and delivery dates.

FREE BOOK—"*How Electronic Tubes Work.*" Address Electronics Department, General Electric, Schenectady, N. Y.

• Tune in "The World Today" every evening except Sunday at 6:45 E.W.T. over CBS. On Sunday listen to the G-E "All Girl Orchestra" at 10 P. M. E.W.T. over NBC.

G-E TUBES ARE "FIRST" IN INDUSTRY, TOO!

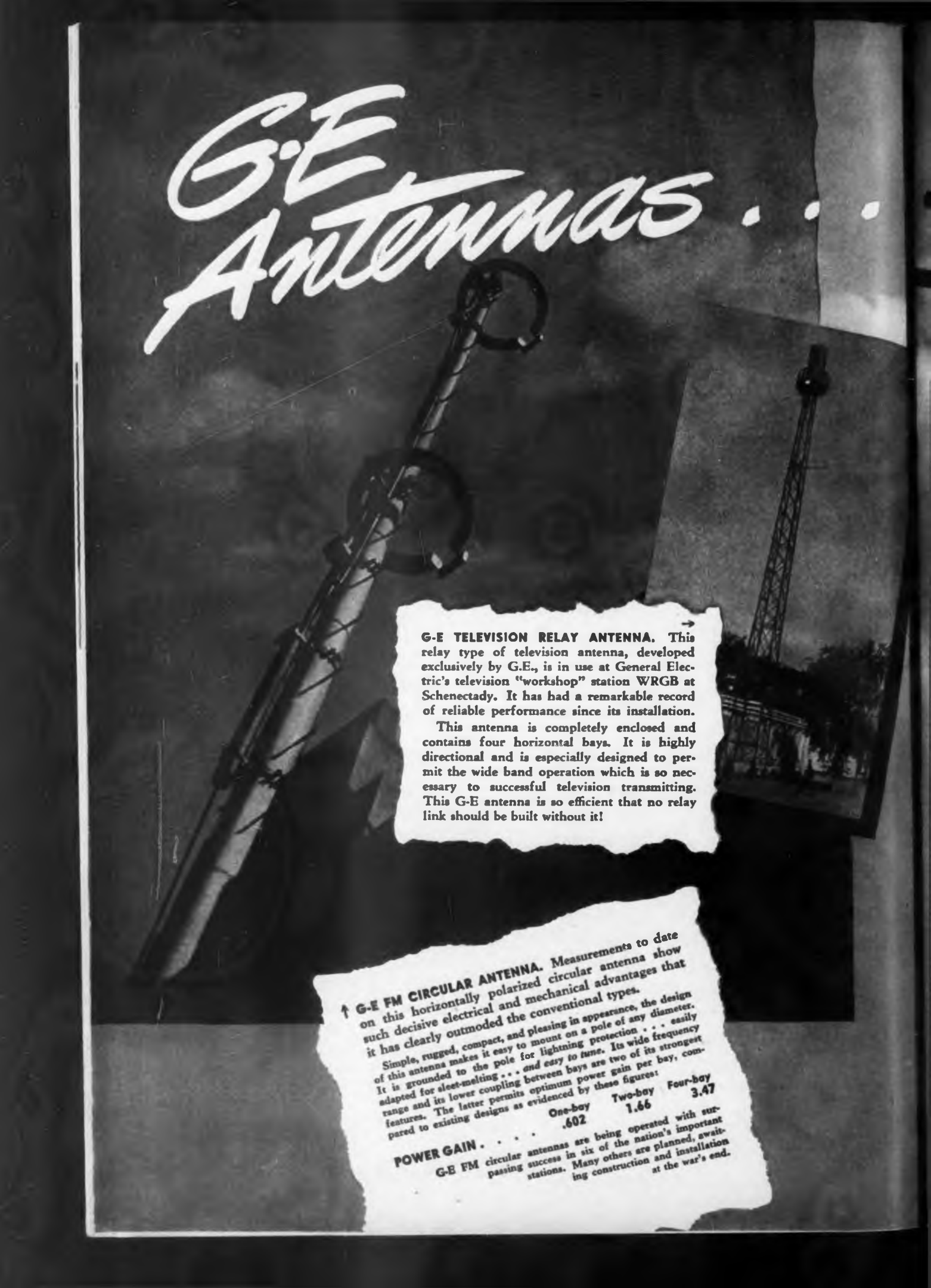
Many modern methods of manufacture could not have been achieved if G-E electronic tubes had not been developed to do the job. The G-E steel-clad ignitron and the G-E thyratron, for instance, made today's high-speed welding of aluminum and stainless steel both possible and practical.

G. E. HAS MADE MORE BASIC ELECTRONIC TUBE DEVELOPMENTS THAN ANY OTHER MANUFACTURER

GENERAL ELECTRIC

161-21-8930

G-E Antennas . . .



→ **G-E TELEVISION RELAY ANTENNA.** This relay type of television antenna, developed exclusively by G.E., is in use at General Electric's television "workshop" station WRGB at Schenectady. It has had a remarkable record of reliable performance since its installation.

This antenna is completely enclosed and contains four horizontal bays. It is highly directional and is especially designed to permit the wide band operation which is so necessary to successful television transmitting. This G-E antenna is so efficient that no relay link should be built without it!

↑ **G-E FM CIRCULAR ANTENNA.** Measurements to date on this horizontally polarized circular antenna show such decisive electrical and mechanical advantages that it has clearly outmoded the conventional types.

Simple, rugged, compact, and pleasing in appearance, the design of this antenna makes it easy to mount on a pole of any diameter. It is grounded to the pole for lightning protection . . . easily adapted for sleet-melting . . . *and easy to tune.* Its wide frequency range and its lower coupling between bays are two of its strongest features. The latter permits optimum power gain per bay, compared to existing designs as evidenced by these figures:

POWER GAIN	One-bay	Two-bay	Four-bay
	.602	1.66	3.47

G-E FM circular antennas are being operated with surpassing success in six of the nation's important stations. Many others are planned, awaiting construction and installation at the war's end.

TO RULE THE WAVES

G-E VERTICAL RADIATOR FOR AM. The WGY antenna illustrated is a 625-foot, all-steel, uniform cross-section tower. It is of the most modern and rugged type. Its installation improved the coverage . . . reduced fading . . . and provided generally more reliable performance for station WGY.

G-E S-T FM RELAY ANTENNA. A multiple-dipole antenna easily mounted on a single pole. Its housings (appearing as dipole tubes in the photograph) are completely sealed and pressurized to keep out moisture. One bank of enclosed dipoles is the antenna while the other acts as a reflector, and permits extremely sharp-focus directional beaming in a powerful, narrow, horizontal pattern. This gives a power gain of 10 at studio transmitter and, if also used at the receiver, provides an additional and second power gain of 10.

of AM, FM, and TELEVISION

AMONG the important recent G-E contributions to broadcasting, broadcast and relay antennas are especially outstanding. Illustrated are four types of G-E antennas, for four distinct uses. All four are proving their high efficiency in present broadcast use . . . all four are unique in their performance . . . all four are rugged in construction and easy to install. G-E can supply all these types of antenna with the station equipment.

The operating characteristics of these antennas enable the broadcaster to put out *more radio frequency power*, and to radiate that increased power with more *effective coverage*. G-E antennas, properly co-ordinated with their transmitters, give greatly improved performance . . . profitably . . . by more efficient and economical distribution or radiation over broader areas.

G-E electronic engineers can provide the antenna best suited to your needs whether AM, FM or TELEVISION, or, indeed, can help you equip your station with any equipment you may need from microphone to antenna.

A PLAN THAT WILL SECURE YOUR PLACE IN RADIO BROADCASTING POST-WAR

General Electric offers you "The G-E Equipment Reservation Plan". . . a plan designed to enable you to complete your post-war plans now. It will enable you to establish a post-war priority on a broadcast transmitter and associated equipment. It will enable us to plan definitely for large-scale post-war production, thereby giving you the fastest possible post-war delivery and the savings of planned production. Investigate this plan today and assure your place in radio broadcasting post-war. *Electronic Department, General Electric, Schenectady, N. Y.*

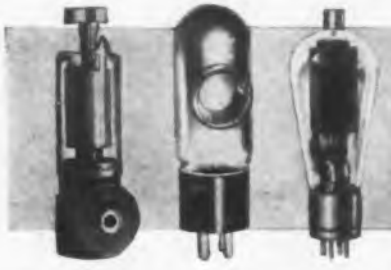
• *Tune in General Electric's "The World Today" every evening except Sunday at 6:45 E.W.T. over CBS. Sunday evenings listen to G-E "All Girl Orchestra" at 10 E.W.T., NBC.*

BACK THE ATTACK—BUY WAR BONDS!

Complete Station Equipment • Studio Equipment • Transmitters • Antennas • Electronic Tubes • Receivers

GENERAL ELECTRIC FM · TELEVISION · AM

See G.E. for all three!



A G-E X-ray tube (1), a G-E phototube (2), a G-E thyratron tube (3), and several G-E amplifier tubes are the "eyes and brains" of this ingenious machine.

To safeguard our fighting men, hand grenades must be flawless—*every* fuse must be timed to split-second accuracy.

From the engineering laboratory of General Electric has come an automatic X-ray inspector—the first of its kind—which checks time fuses at the incredible rate of 4000 an hour . . . with the unerring accuracy no other inspection method can even approach.

A movable belt carries the fuses through the penetrating beam of a 100,000-volt G-E X-ray tube which casts its glow on a fluorescent screen. A G-E phototube, or "electric eye," inspects the glow. If constant, verdict is "O.K." If intensity changes, powder charge is inadequate for proper timing. Instantaneously, a four-way alarm is given . . . a bell rings; a red light flashes; the imperfect fuse gets a dab of red paint; a photo-electric meter chart records the "dud."

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

FREE BOOKLET ON ELECTRONIC TUBES

Send us the names of interested men in your plant. We will mail them, without charge, an illustrated, easily understood book on "How Electronic Tubes Work." Address *Electronics Department, General Electric, Schenectady, N.Y.*

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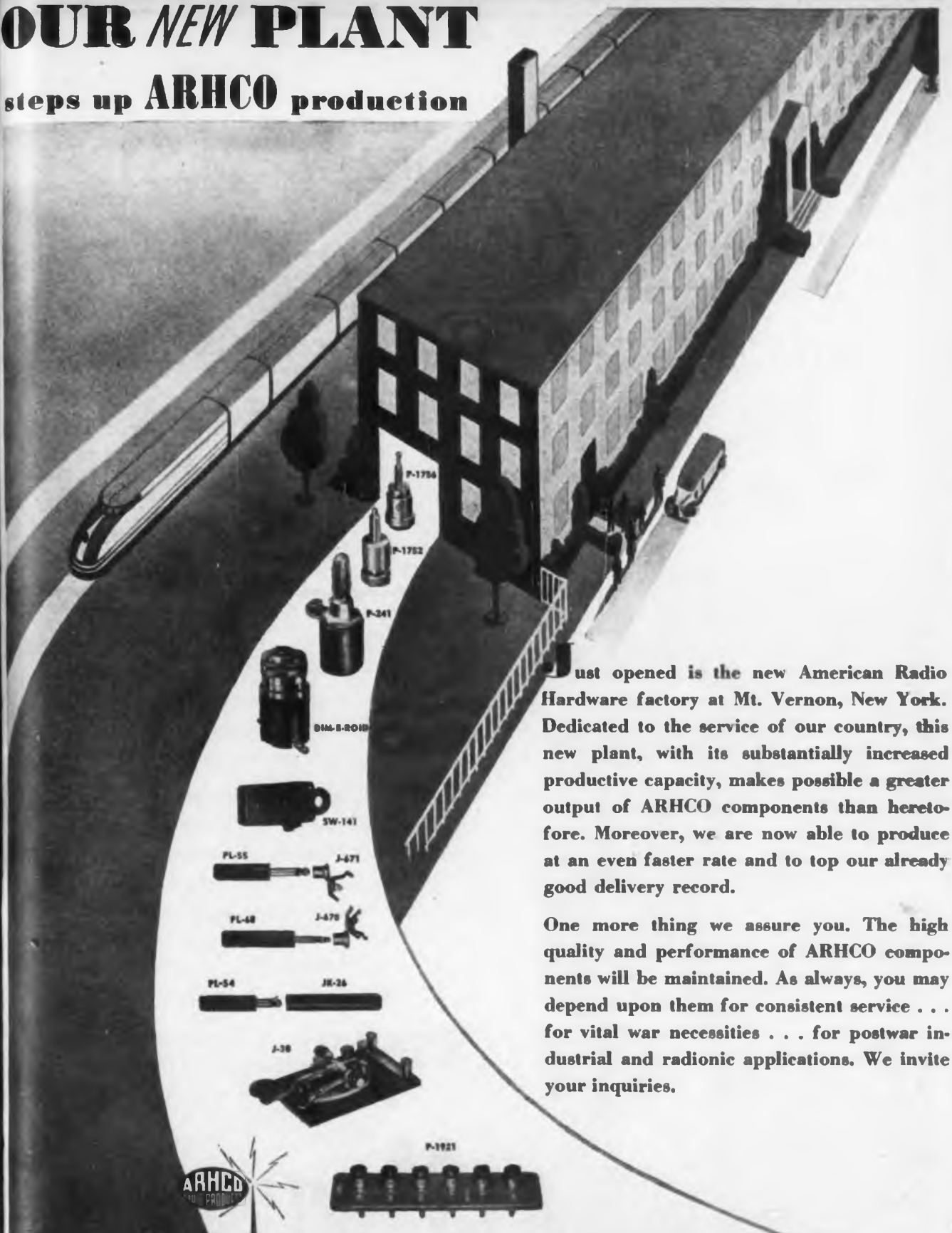
G. E. HAS MADE MORE BASIC ELECTRONIC TUBE DEVELOPMENTS THAN ANY OTHER MANUFACTURER

GENERAL ELECTRIC

OUR *NEW* PLANT

steps up ARHCO production



Just opened is the new American Radio Hardware factory at Mt. Vernon, New York. Dedicated to the service of our country, this new plant, with its substantially increased productive capacity, makes possible a greater output of ARHCO components than heretofore. Moreover, we are now able to produce at an even faster rate and to top our already good delivery record.

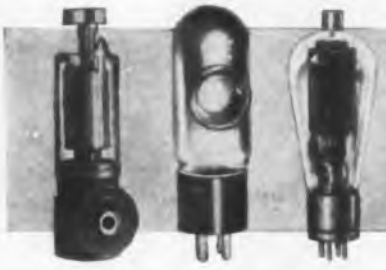
One more thing we assure you. The high quality and performance of ARHCO components will be maintained. As always, you may depend upon them for consistent service . . . for vital war necessities . . . for postwar industrial and radionic applications. We invite your inquiries.

American Radio Hardware Co., Inc.

152-4 MacQuesten Parkway South • Mount Vernon, N. Y.

MANUFACTURERS OF SHORT WAVE • TELEVISION • RADIO • SOUND EQUIPMENT

This electronic fuse inspector helps to make hand grenades safe for Johnny Doughboy



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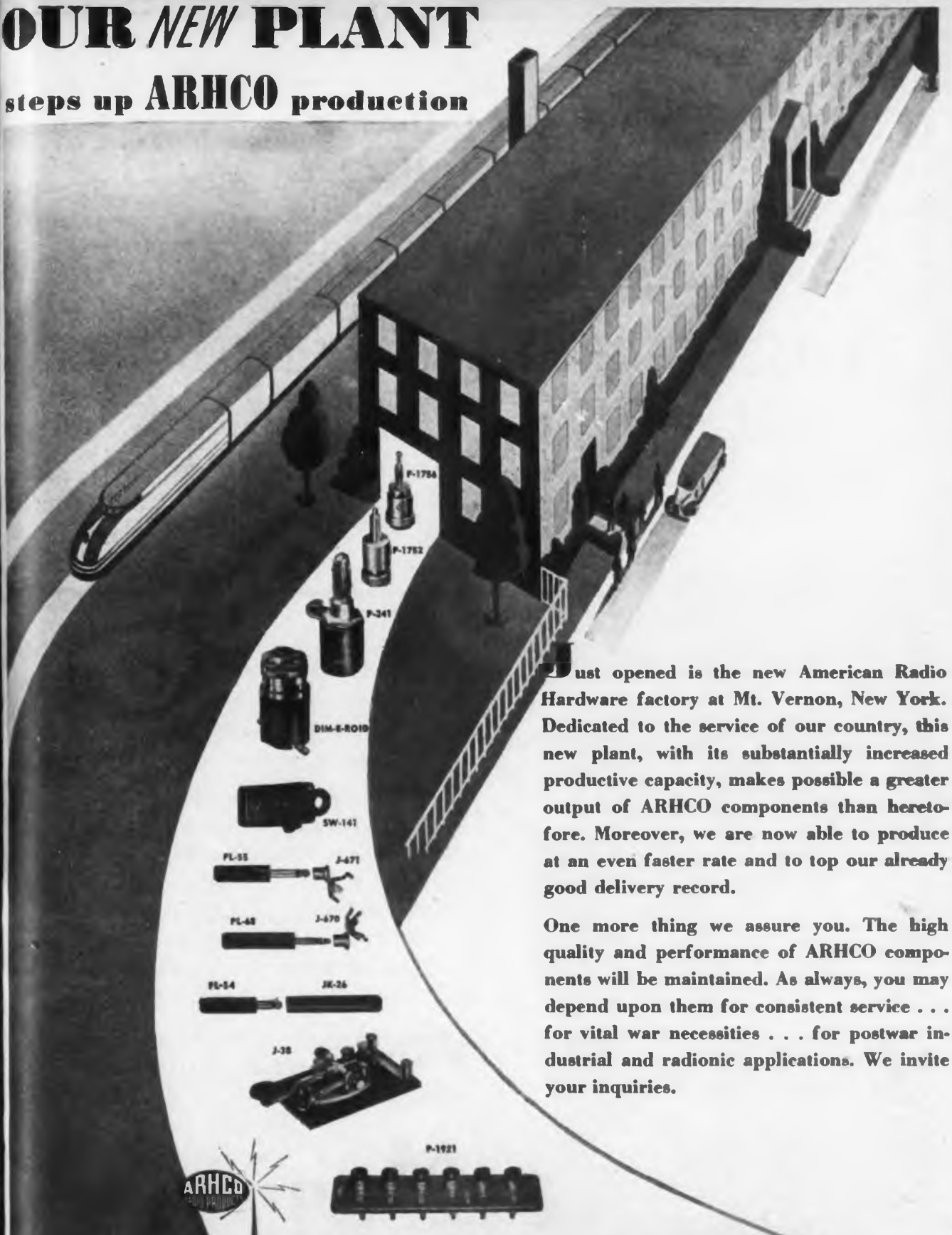

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American Radio Hardware Co., Inc.

152-4 MacQuesten Parkway South • Mount Vernon, N. Y.

MANUFACTURERS OF SHORT WAVE • TELEVISION • RADIO • SOUND EQUIPMENT

MAGNAVOX WILL MEAN EVEN MORE TO THE POSTWAR RADIO INDUSTRY

These highly technical instruments—some of the many Magnovox makes for the armed forces—will find their counterparts in peacetime developments.

THIRTY-THREE years of pioneering work in radio prepared Magnavox to produce these highly complex precision instruments, ranging from gun firing solenoids to the most intricate radio communication systems.

V-Day will find Magnavox skills and facilities at a new high, because of the miracles of invention and production demanded by the emergency—ready to play a more prominent part than ever in the coming peacetime developments in all phases of electronics. The most advanced engineering and manufacturing facilities are housed in the new, modern six-acre plant. The Magnavox Company, Fort Wayne 4, Indiana.

Magnavox craftsmanship won the first "E" award in this field (1941), now with 3 White Star Renewal Citations.

Magnavox

LOUD SPEAKERS • CAPACITORS • SOLENOIDS • COMMUNICATION & ELECTRONIC EQUIPMENT

A NEW, IMPROVED 872-A

We are now in quantity production on this better 872-A Tube and can supply to Army, Navy specifications. It is a medium power Rectifier. 10,000 volt inverse peak. Extensively used for power supplies from 1,000 to 5,000 volt output. Current output . . . 2 tubes . . . 2½ amperes.

1 Dome type anode. No sharp corners to concentrate discharge. Note rolled edges and strengthening ribs. This permits high temperatures used in evacuating tube, assuring for internal purity.

3 Glass bead prevents discharge from anode stem and lengthens operating life.

4 Sturdy filament construction with unusually large emission surface permitting an exceedingly low voltage drop in tube. Ceramic support prevents filament distortion, thus controlling mutual heating effects and providing long filament life.

2 Slotted side plates with no sharp edges to concentrate discharge. High temperatures also possible due to unobstructed construction.

5 Bottom closed shield plate prevents excess heat where leads come through glass stem insures freedom from gas bursts, a common cause of tube failure.

GENERAL ELECTRONICS INC.

Chicago: 1917 No. Springfield Ave.
Export Dept. — 89 Broad St., N. Y. C.

101 HAZEL STREET, PATERSON, N. J.

Cathode-Ray Technique Now Goes to the Aid of the Metallurgist...

Typical DuMont cyclogram as read by the operator. This reading is for the depth of case-hardening. Each division of grating represents .01". Waist thickness equals 22 tenths, or closely corresponding to micrograph examination of same piece.

Another DuMont cyclogram, this time indicating high internal stresses. The Cyclograph may be used to distinguish between two pieces of steel having the same hardness, one of which has low internal stresses and the other higher internal stresses and therefore more brittle.

DuMont Cyclograph

Still another typical DuMont case history . . .

Wartime metallurgists are scarce. Yet metallurgical requirements are highly critical. In some processes incoming materials must be 100% checked for exact metallurgical properties. Finished production is individually checked since faulty pieces might get by percentage or spot checks. No chances can be taken with the lives of our fighting men. What to do?

The problem was given to DuMont cathode-ray specialists. In due course the DuMont Cyclograph evolved. Here is a truly revolutionary means of metallurgical checking and automatic sorting. After undergoing exhaustive tests at the hands of metallurgists, production men and ordnance experts, it is now offered not only as an instrument but as a continuing engineering service, on a lease basis. Thus another milestone in production uniformity, efficiency, economy, in war and in peace.

Cathode-ray technique may be applicable to your industrial or engineering problems. Write on business stationery for the new DuMont Manual. And submit that problem for engineering suggestions or recommendations.

DUMONT *Precision Electronics & Television*

ALLEN B. DuMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: WESPEXLIN, NEW YORK

ESSENTIAL REQUIREMENT

THE essential requirement of an ideal electronic connection is a sound electrical joint assuring constant, low resistance value, regardless of operating and atmospheric conditions. ¶ It is met by STA-KON* (Solderless) Wire Terminals. ¶ When properly applied to the wire with a T&B Hand or Power Tool, these T&B Pressure Connectors become an integral part of the wire itself. ¶ They are made in any desired design of tongue and in wire sizes #22 to 250 MCM AWG. ¶ We invite electronics manufacturers to consult our engineering service on unusual wiring problems. ¶ STA-KONS, like the thousands of other T&B electrical fittings, are sold only through recognized T&B Distributors who reduce the manufacturer's selling costs, thereby reducing the cost of all electrical material to the user.

WRITE FOR DETAILED, ILLUSTRATED STA-KON BULLETIN 500

* Patented STA-KON: Reg. U. S. Pat. Off.

T&B

THE THOMAS & BETTS CO.

INCORPORATED

MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH 1, NEW JERSEY

In Canada: Thomas & Betts Ltd. Montreal

E Flag awarded April, 1943
White Star awarded October, 1943

Centralab offers

Type 817-001 55MMF ±10%
Neg. Temp. Coefficient
— .00052 MMF/MMF °C
Test voltage is 2000 V. D.C.
working voltage 1000 V. D.C.

Type 817-002
. Mechanically as above
Capacitance 15 MMF ± 20%
Sketch is TWICE actual size.

Type 814-078 300 MMF ± 10%
Neg. Temp. Coefficient
— .00075 MMF/MMF °C
Test voltage is 1400 V. D.C.
working voltage 500 V. D.C.
Sketch is TWICE actual size.

Two Types of
BUSHING MOUNTED CAPACITORS
for special applications

Both types are used in high frequency circuits where a capacity ground to the chassis and a "lead through" is desired.

The ceramic capacitor tube is plated internally and externally with silver and then with copper. The tube is snug fit in the brass bushing and the external capacitor plate is soldered to the bushing.

In types 817-001 and 817-002 the tinned copper wire is also snug fit inside the capacitor tube and is soldered to the internal plate.

We are equipped to produce other sizes and capacities where quantity need justifies the tooling of special parts.

Centralab
ERL

Division of **GLOBE-UNION INC., Milwaukee**

PRODUCERS OF VARIABLE RESISTORS . . . SELECTOR SWITCHES — CERAMIC CAPACITORS, FIXED AND VARIABLE . . . STEATITE INSULATORS

Centradite

A new Centralab Ceramic Material

Centradite is particularly recommended for coil forms where thermal expansion must be low to prevent undue change in inductance. At 20-600°C thermal coefficient of expansion is 3.1×10^{-6} as compared to 8.3×10^{-6} at 20-800 °C for Steatite.

Centradite can be supplied in various shapes by extrusion or pressing.

Centradite due to its resistance to heat shock, lends itself to a new process of soldering metal to ceramic, whereby the ceramic surface is metallized to permit soldering.

We invite inquiries regarding the future uses which may fit your applications.

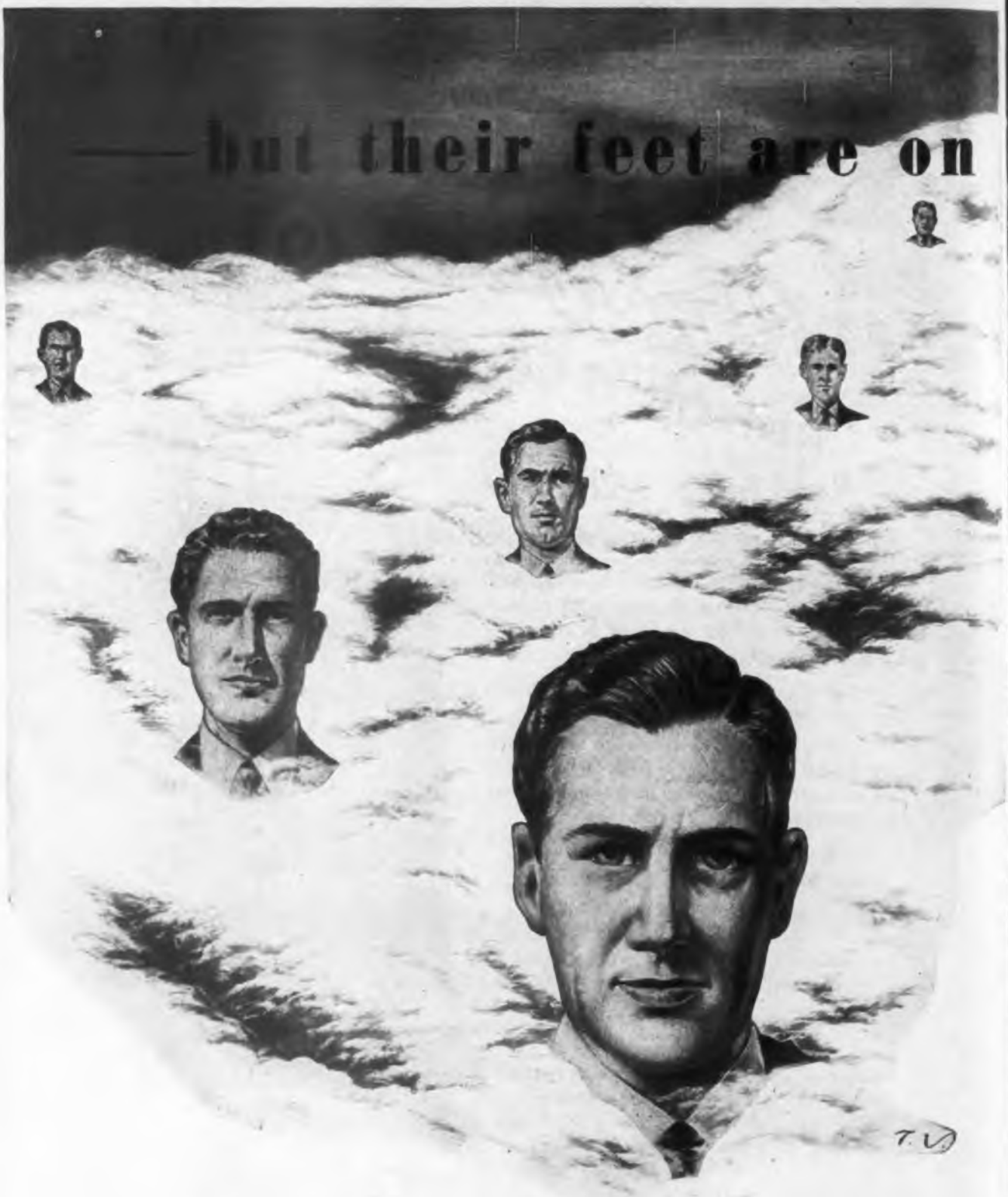
★ LOW THERMAL EXPANSION ★ HIGH RESISTANCE TO HEAT SHOCK ★ LOW POROSITY ★ LOW LOSS FACTOR

BODY NO. 400	DESCRIPTION OF MATERIAL
20-100 °C 1.9×10^{-6} 20-600 °C 3.1×10^{-6}	Thermal coefficient of expansion per degree Centigrade
13,000 lbs.	Modulus of rupture in lbs. per sq. in.
5.4	Dielectric constant
3.00 or less.	Dielectric loss factor
Class "L3" or better	Grade per American Stand. C75.1-1943
Zero to .007 %	Porosity or moisture absorption
White	Color of material

Centralab

Division of GLOBE-UNION INC., *Milwaukee*

PRODUCERS OF VARIABLE RESISTORS . . . SELECTOR SWITCHES — CERAMIC CAPACITORS, FIXED AND VARIABLE . . . STEATITE INSULATORS



Westinghouse

Electronic Tubes *AT WORK*

the ground . . .

TODAY there's scarcely a problem that doesn't have its electronic answer.

Electronics sees all, hears all, knows all!

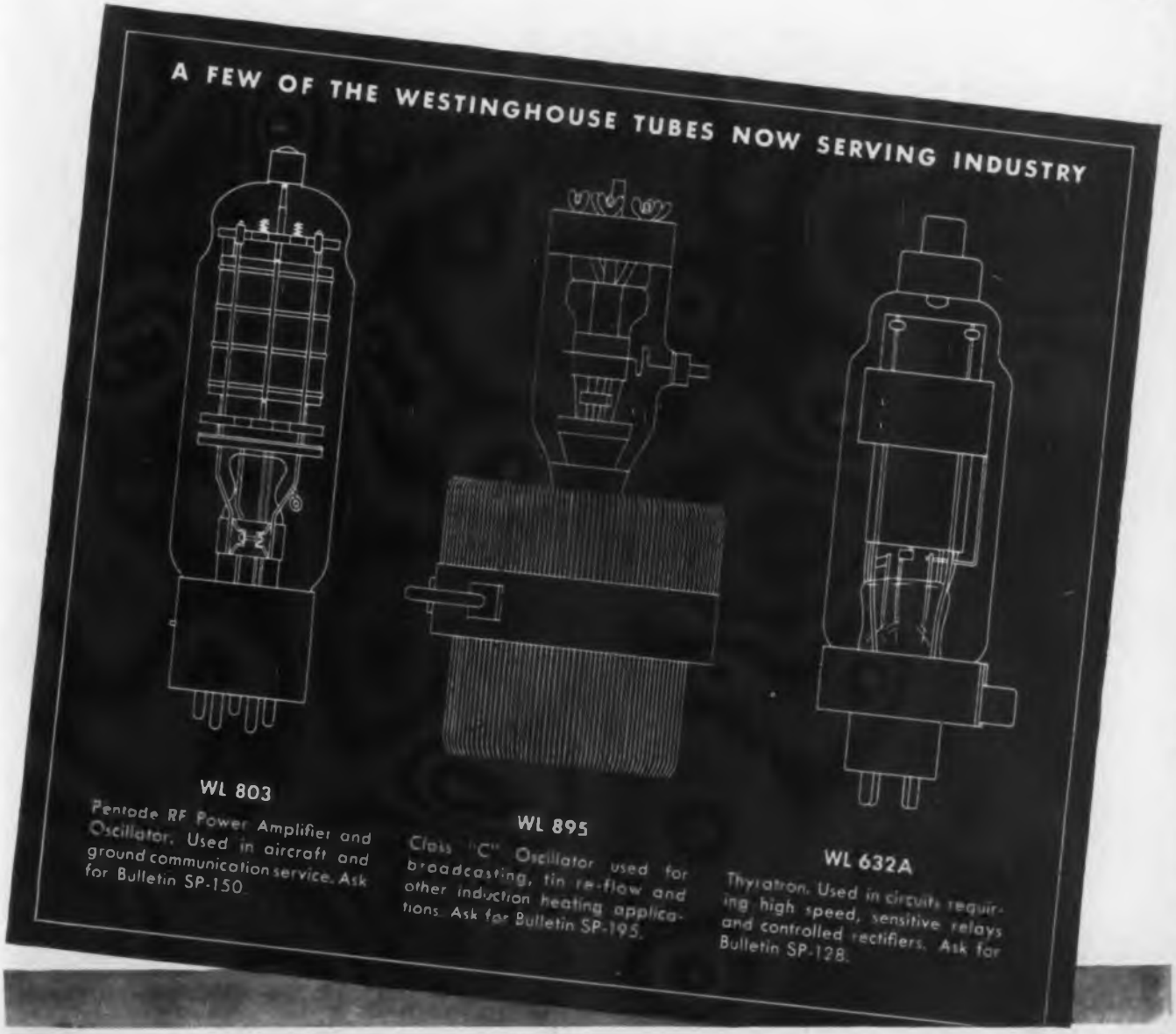
From trapping microscopic dust particles . . . to welding giant girders . . . or sewing together metal skins that surface airplanes . . . electronic tubes perform a multiplicity of special tasks and daily duties that stagger even present day imaginations.

In this field of modern magic Westinghouse has an outstanding record.

On a thousand fronts, military and industrial, Westinghouse Electronic Tubes are doing a thousand jobs. Soundly designed and engineered they are all true products of Westinghouse "know-how"!

Include electronics in your post-war planning . . . but before you carry your plans too far, make sure they are practical *electronically*. Take advantage of the technical assistance Westinghouse has to offer.

Westinghouse engineers have their heads in the clouds but their feet, you'll find, are on the ground. Westinghouse Electric and Manufacturing Co., Bloomfield, N. J. *Plants in 25 cities . . . offices everywhere.*



GREASED LIGHTNING STREAKS IN

National Vulcanized Fibre and Phenolite, laminated Bakelite parts, because of their lightness in weight, high dielectric strength, exceptional wearing and other qualities, are playing a vital part in everything of Uncle Sam's that "flies, floats or shoots."

FOR THE KILL

THE bigger they are, the harder they fall! That's the slogan of the PT's. There's nothing the NIPS can show that PT's won't take on and send to the bottom. The record proves it.

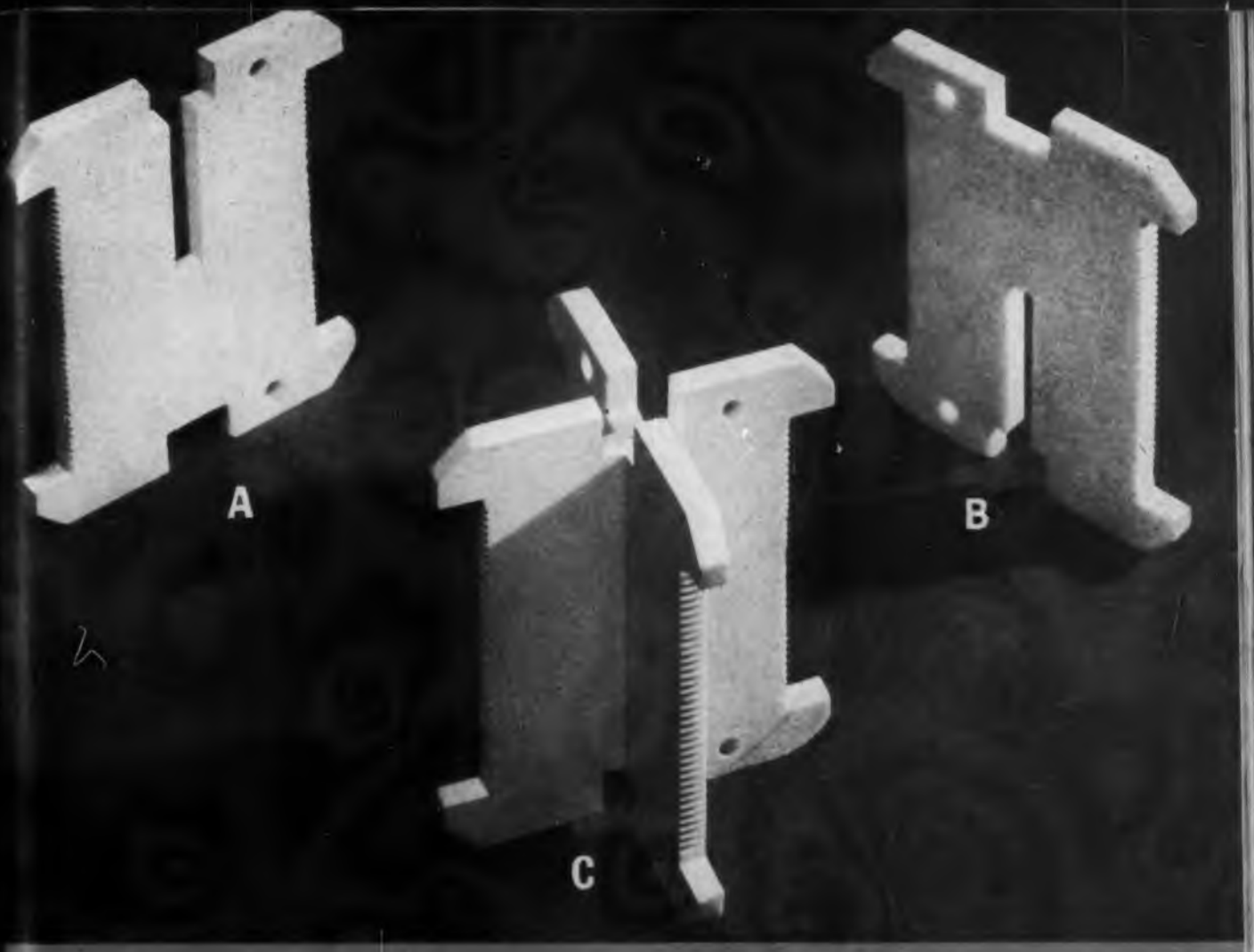
In the production of PT boats, lightness in weight and exceptional strength are important factors. That's why there is found in their construction and insulation—strong, lightweight plastics like National Vulcanized Fibre and Phenolite, laminated Bakelite. We salute the Naval architects who gave our fighting men at sea the lightning striking panther, the PT boat.

NATIONAL VULCANIZED FIBRE CO.

WILMINGTON DELAWARE

Offices in Principal Cities

Official U. S. Navy Photo



A + B = C

AND SAVED THE CUSTOMER LOTS OF MONEY

"Of course we can make it," we told a customer after studying his latest blueprint of a coil form, "but we can save you a lot of money and give you more satisfactory service if you follow the suggestions of our Engineering staff. The boys recommend making the piece in two parts. They can be pressed quickly at a high production rate and assembled into a coil form of practically the same design as you brought us."

Above are illustrated the parts which we finally shipped to the customer. Simple as A, B, C, isn't it? But it demonstrates that it is well worthwhile to consider the services of American Lava when designing Steatite Ceramic Insulators. Perhaps we can make recommendations that will be of real benefit to you.

Army-Navy "E"
First Awarded July 27, 1942
Second Award: "Star" February 13, 1943
Third Award: "Star" September 25, 1943

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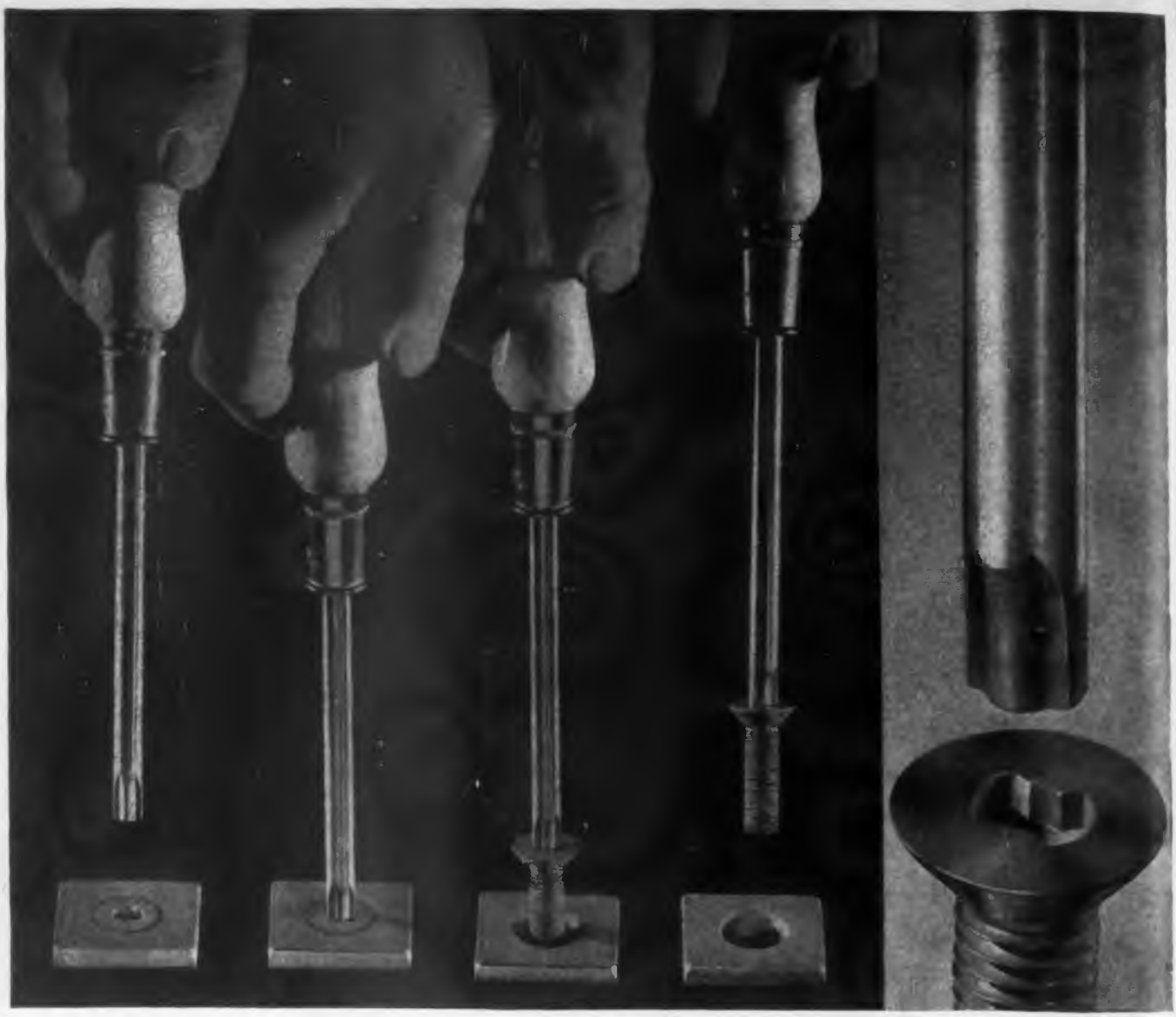
STEATITE CERAMIC ELECTRICAL INSULATION
FOR ELECTRONIC USES

AMERICAN LAVA CORPORATION
CHATTANOOGA 5 TENNESSEE



When the job has to be "Un-buttoned" . . .

. . . when screws painted-in, rusted-in, or "frozen-in" have to be *removed, saved, and used again* . . . here is a tool that eliminates this serious problem of field maintenance. This rugged Center Pivot hand driver, as used with CLUTCH HEAD Screws, is the answer. Note its structure; its careful engineering to make a deep dead-center entry to engage the straight walls of the Clutch with a powerful torque that breaks the "freeze" of any screw for straight, easy, and *undamaged* withdrawal. More than that, this simple tool *saves the screw for re-use* because the withdrawal action automatically unites the screw and driver as a unit . . . to prevent trouble and possible danger arising from dropped and lost screws. In addition to speeding and simplifying normal field adjustments, this positive Lock-On feature frequently saves disassembling surrounding units by furnishing dead-sure access *to and from* these otherwise impossible or hard-to-get-at spots.

CLUTCH HEAD SCREWS

For closer personal understanding of this and other exclusive CLUTCH HEAD *features, may we send you an assortment of screws and a sample Center Pivot Bit . . . along with illustrated Brochure on* CLUTCH HEAD *Screws?*

UNITED SCREW AND BOLT CORPORATION

CHICAGO CLEVELAND NEW YORK

Allied's

Relays for the Electronic Age of Tomorrow are Battle Proven Veterans of Today

-BO-

MODEL BO	DP	DC	COIL DATA	
COIL NUMBER	NOMINAL VOLTS	AMPERES	RESISTANCE	WATTS
24	2.1	1.21	1.7	2.5
28	5.0	.500	10.0	2.5
29	6.0	.422	14.2	2.5
30	7.8	.319	24.5	2.5
32	13.2	.190	70.0	2.5
34	20.0	.125	160.	2.5
35	24.0	.106	230.	2.5
36	32.0	.078	415.	2.5
40	77.0	.032	2380.	2.5
42	112.	.022	5000.	2.5

Also readily available for AC.

BO is a compactly designed 2 pole DC 2½ watt relay; equipped with a semi-balanced armature; withstands vibration to 12 G; operates at temperatures of + 70° C. or – 50° C.; resists corrosion; weighs 4 ounces; measures 1⅞ by 1⅝ by 1-17/32 inches; standard is double pole double throw and rated 15 amperes at 24 volts DC or 110 volts AC.

-BJ-

MODEL BJ	DP	DC	COIL DATA	
COIL NUMBER	NOMINAL VOLTS	AMPERES	RESISTANCE	WATTS
18	0.36	5.590	0.06	2
20	0.57	3.520	0.16	2
22	0.89	2.240	0.40	2
24	1.41	1.414	1.00	2
26	2.25	0.089	2.53	2
30	5.65	0.354	16.	2
33	11.6	0.173	67.	2
36	22.5	0.089	255.	2
38	35.4	0.056	625.	2
40	56.6	0.035	1600.	2

Also readily available for AC.

BJ is a small and compactly designed 2 watt relay; equipped with a semi-balanced armature; withstands vibration to 12 G; operates at temperatures of + 70° C. or – 50° C.; weighs 2¼ ounces, measures 2-5/16 by 1-9/16 by 25/32 inches; can be supplied in various contact arrangements, standard is double pole double throw and rated 5 amperes at 24 volts DC or 110 volts AC.

-AR-

MODEL AR	SP	DC	COIL DATA	
COIL NUMBER	NOMINAL VOLTS	AMPERES	RESISTANCE	WATTS
20	.329	3.043	.108	1
22	.526	1.900	.277	1
24	.844	1.185	.712	1
28	2.168	.461	4.70	1
32	5.568	.180	31.0	1
35	11.31	.088	128.	1
38	22.98	.035	528.	1
40	36.81	.027	1355.	1
42	59.03	.017	3485.	1
44	94.68	.011	8965.	1

Also readily available for AC.

AR & AS are featherweight 1 watt relays; weigh only 50 grams, measure 1-3/16 by 1⅜ by 15/16 inches; contacts handle 5 amperes at 24 volts DC or 110 volts AC single pole double throw.

Model AS is insulated from frame . . . otherwise identical to model AR.

-AN-

MODEL AN	SPDB	DC	COIL DATA	
COIL NUMBER	NOMINAL VOLTS	AMPERES	RESISTANCE	WATTS
24	3.07	1.140	2.70	3.5
27	6.16	.568	10.8	3.5
30	12.3	.284	43.4	3.5
31	15.6	.225	69.1	3.5
32	19.6	.178	110.	3.5
33	24.8	.141	175.	3.5
34	31.1	.112	277.	3.5
36	49.5	.071	700.	3.5
39	99.2	.035	2810.	3.5
40	125.	.028	4460.	3.5

AN & ANS are power relays with 3½ watt coils; equipped with semi-balanced armatures; withstand vibration to 12 G; operate at temperatures of + 70° C. or – 50° C.; weigh 9 ounces; measure 2½ by 2¼ by 1-31/32 inches; standard is single pole single throw normally open double break and rated 50 amperes at 24 volts DC.

Model ANS has special alloy contacts to handle 75 amperes DC . . . otherwise identical to model AN.

ALLIED CONTROL COMPANY

INCORPORATED

[illegible] EAST 52ND AVENUE [illegible] NEW YORK 21, N. Y.

History of Communications Number One of a Series

A FORERUNNER OF MODERN COMMUNICATIONS

One of the first known channels of message carrying was by runner, and annals of Grecian and Phoenician history describe the nimble lads who firmly grasped rolls of parchment and sped hither and yon. Clad in typical running gear of the period, they covered amazing distances with almost incredible speed. That was the forerunner of today's modern communications where scientific electronic devices are "getting the message through" on every war front. Universal Microphone Co. is proud of the part it plays in manufacturing microphones and voice communication components for all arms of the United States Armed Forces, and for the United Nations as well. Other drawings in the series will portray the development of communications down through civilization and the ages to the modern era of applied electronics.

< Model 1700-UB, illustrated at left, is but one of several military type microphones now available to priority users through local radio jobbers.

UNIVERSAL MICROPHONE CO., LTD.
INGLEWOOD, CALIFORNIA

FOREIGN DIVISION: 301 CLAY STREET, SAN FRANCISCO 11, CALIFORNIA ·· CANADIAN DIVISION: 560 KING STREET WEST, TORONTO 1, ONTARIO, CANADA

when you say

Cornell Dubilier

you say **DEPENDABLE**

CAPACITOR

PERFORMANCE.....

Once the name of a product is firmly established, its mention awakens definite associations in the mind. It is no longer just a name . . . it is an actual symbol of the product. Thus it is that the name Cornell-Dubilier has come to mean incomparable capacitor performance. It is the name of the oldest, largest exclusive capacitor manufacturer in the world. It is the safest name to think of when you need capacitors for any purpose. It means trouble free long life, so important in any capacitor installation. Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

IT'S C-D FOUR TO ONE: In an independent inquiry just completed, 2,000 electrical engineers were asked to list the first, second and third manufacturers coming to mind when thinking of capacitors. When all the returns were in, Cornell-Dubilier was far in the lead – *receiving almost four times as many "firsts" as the next named capacitor.*

TYPE **TK** DYKANOL FILTER CAPACITORS

No other capacitor of such fine quality for large capacity and high voltage filter service has ever been offered in such compact dimensions. Thus the design engineer, faced with arbitrary space limitations, solves a knotty problem. TK features are:

HIGH PURITY ALUMINUM FOIL— Lower R.F. resistance—High tensile strength, means longer life.

HIGH GRADE MULTI-LAMINATED KRAFT TISSUE—Higher voltage breakdown—maximum safety—high insulation resistance.

DRIED, IMPREGNATED AND FILLED — Under Continuous Vacuum—Lower equivalent series resistance, particularly at higher temperature—8,000 megohms per microfarad insulation resistance.

HEAVY-DUTY WET-PROCESS GLAZED PORCELAIN INSULATOR—High dielectric and mechanical strength.

CORK-GASKETED PRESSURE-SEALED Terminals—Leakproof joints—high dielectric strength.

STURDY, ARC-WELDED STEEL CASE—Leakproof—durable strong.

CONSERVATIVE D.C. RATING—Will safely operate continuously at 10% above rated voltage.

FILLED WITH FIRE-PROOF DYKANOL—Eliminates all fire hazard.

Cornell Dubilier capacitors

more in use today than any other make

MICA • DYKANOL • PAPER
WET AND DRY
ELECTROLYTIC CAPACITORS

WILCOX IS IN SERVICE
. . . Along the Route of The Capital Fleet

Photograph, courtesy PENNSYLVANIA-CENTRAL AIRLINES.
(left) H. J. Vierling, Supt., Maintenance, (right) Earl Raymond, Chief, Ground Station Maintenance.

"Installation of Wilcox transmitters, at many of our points, has given our communications the high degree of dependability so necessary for airline operations," states Mr. Earl Raymond of Pennsylvania-Central Airlines. In addition to installations on major airlines throughout the United States, Wilcox radio equipment is being used now in connection with world-wide military aircraft operations.

WILCOX ELECTRIC COMPANY

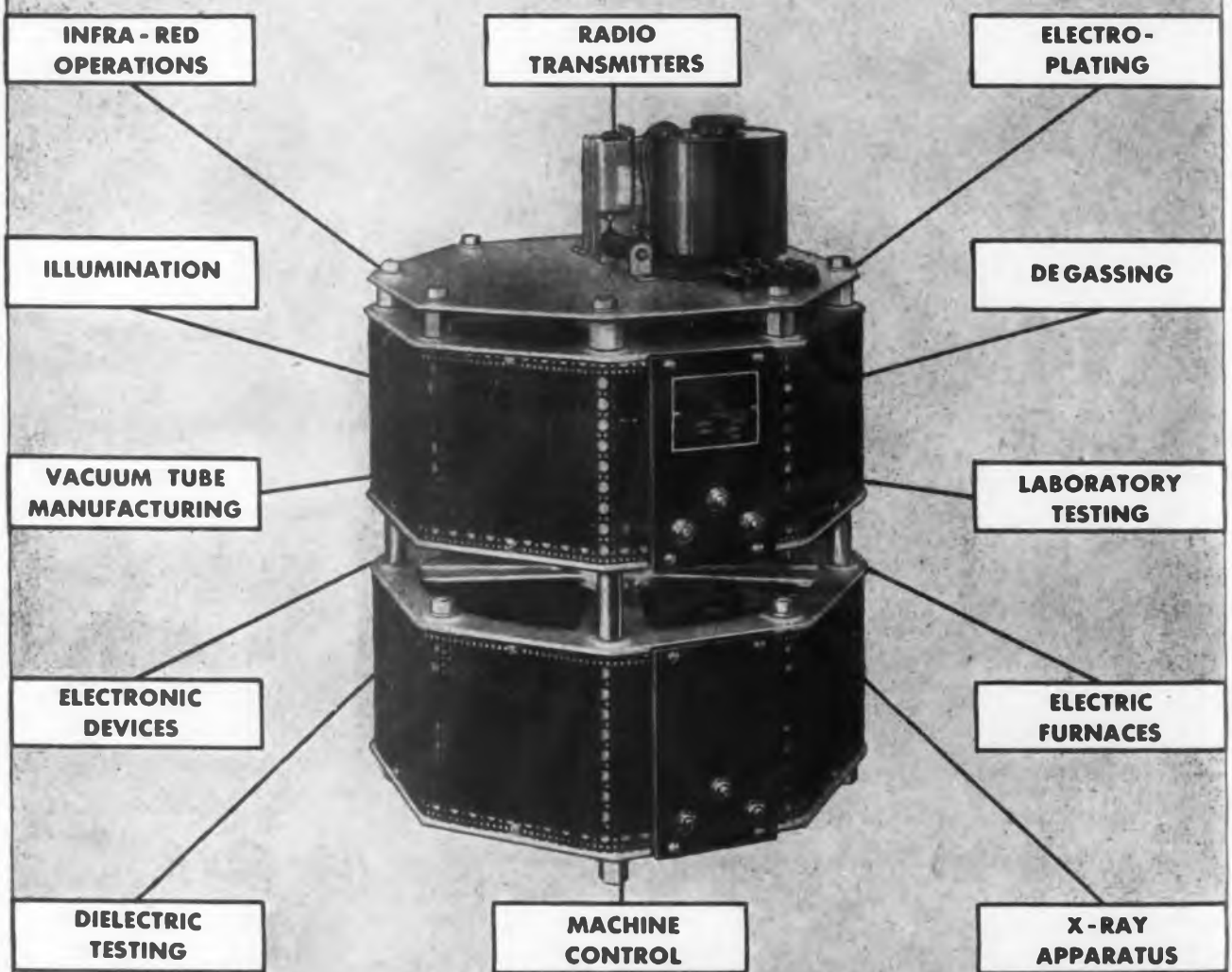
MANUFACTURERS OF RADIO EQUIPMENT • FOURTEENTH & CHESTNUT, KANSAS CITY, MO.

Your VOLTAGE PROBLEM *please*

TO obtain the exacting performance of today's industrial processes and electrical equipment — use POWERSTAT precision voltage control.

SECO'S standard line of distortionless variable transformers enables you to set voltage quickly and exactly to any specified value independent of load, power-factor, and frequency.

SECO'S line of manually or motor driven POWERSTATS for remote push-button or automatic operation is applicable to your control problem.



Standard types are available for single or polyphase operation on 115, 230 or 440 volt circuits in capacities up to 75 K V A.

Send for Bulletins 149 IE and 163 IE

SUPERIOR ELECTRIC COMPANY

280 LAUREL STREET • BRISTOL, CONNECTICUT

Safety Zone

FREE FROM THE BLACK HAND OF ELECTRO-CHEMICAL CORROSION

UNLIKE many dielectrics, Lumarith (cellulose-acetate base), when in contact with current-carrying copper wire, remains unaffected in the presence of moisture, and does not promote corrosion of the wire. In foil and film, it is used as an extra covering for bobbins and spools and as between-layer insulation in wire-wound coils—wherever the black hand of corrosion threatens.

A-78 finished Lumarith foil—matte-surfaced on one side—eliminates the need of talc or lubricants required by ordinary foil when it is slit and wound into cops. A-78 finished foil has good elongation—making it ideal for use in automatic machinery. You are invited to write for booklet of facts about Lumarith plastics and their special electrical applications. Celanese Celluloid Corporation, *The First Name in Plastics*, a division of Celanese Corporation of America, 180 Madison Avenue, New York City 16. *Representatives:* Cleveland, Dayton, Philadelphia, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.

LUMARITH PLASTICS IN FILM . . . FOIL . . . MOLDING MATERIALS AND OTHER FORMS

LUMARITH*

A CELANESE* PLASTIC

*Reg. U. S. Pat. Off.

For the next 20 seconds, the pilot's name is Elmer!

APPROXIMATELY 20 nervous seconds elapse between the time a bomber goes into its final run and the time it pulls out and heads for home.

During these vital 20 seconds, which determine whether the mission succeeds or fails, the pilot of this bomber is a machine—the Sperry Gyropilot.* He's "Elmer" to the U. S. bomber crews —"George" to the fliers of the R.A.F.

Why is the plane turned over to Elmer? Because Elmer provides the precision control necessary to maneuver the airplane correctly during the bombing run.

Elmer holds the ship steadier—truer —than any man can do. His errorless control is one of the big reasons for the accuracy of American precision bombing.

Elmer not only does this but, going to and from the target, he can hold the big ships in level flight and on their course with no hand on the controls.

Naturally, a device like this is not created overnight. Sperry developed the first automatic pilot before the last war. It was designed to increase safety in flight. Pioneering and development work continued. In 1933, Wiley Post flew around the world alone with the aid of a Sperry Gyropilot.

Post's epochal flight furnished spectacular proof that Elmer was practical. Sperry Gyropilots were soon standard equipment on transport planes the world over. When World War II came, still further improvements had been made to give Elmer the precision needed for bombing missions.

Improvements are still being made. When the war is over, Elmer, along with many other Sperry devices developed for peace and adapted to war, will return to the work for which he was originally designed.

With more than 30 years of development behind him, Elmer, the Sperry Gyropilot, will be well-equipped to serve tomorrow's world-wide airlines.

American bombers are now being equipped with the new Sperry Gyrotronic Pilot, a precision, electronic version of the Gyropilot.**

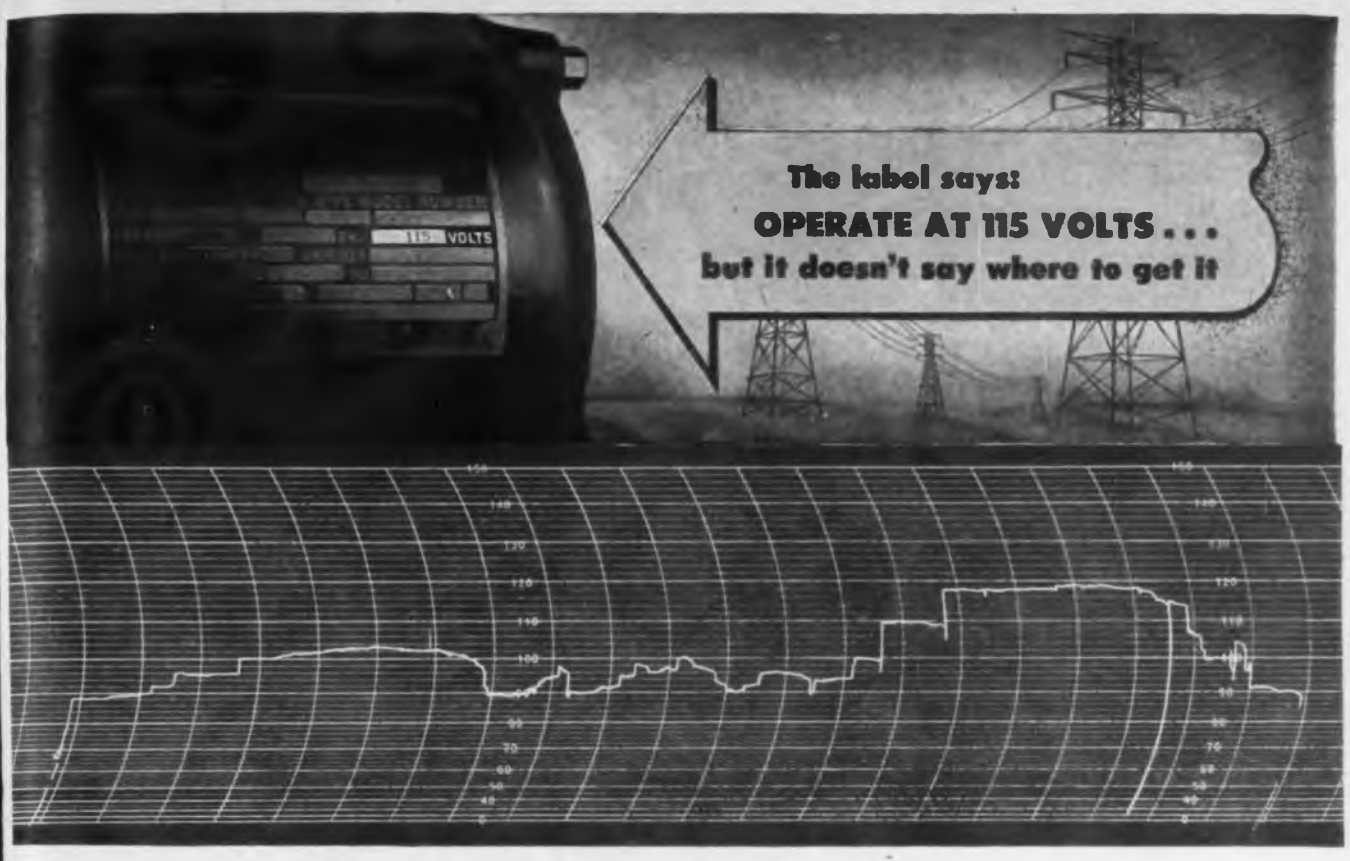
*Trademarks Registered

SPERRY

GYROSCOPE COMPANY, INC.

Brooklyn, New York

Division of the Sperry Corporation



RATED VOLTAGE is always available to equipment protected with built-in CONSTANT VOLTAGE

"Operate at 115 volts" on the label of electrically operated precision equipment is not simply informative —*it's a warning!*

A *warning* that the device is too sensitive to tolerate the voltage fluctuations that may be met on America's power lines, and still perform with efficiency. A *warning* that sensitive tubes and other delicate mechanisms may be irreparably damaged by line surges and that costly replacements, with consequent loss of time and efficiency, lie ahead.

The design engineer who assumes that the precisely controlled voltages of the research laboratory will be duplicated in the field is heading his product toward trouble. Nominal line voltage ratings can no longer be used as single, stable reference points for design considerations. Commercial power lines are too heavily loaded and unpredictable.

"Operate at 115 volts" is no longer sufficient on a label. A guarantee that the "115 volts" will always be available, in spite of the unpredictable fluctuations of commercial power, is a prime requisite if the device is to perform with unfailing efficiency and precision.

The place to provide voltage control is within the equipment. With a Constant Voltage Transformer as a component part, the device is provided with a dependable source of voltage and unfailing protection against performance interference and construction damage.

SOLA Constant Voltage Transformers are available in sizes and capacities to meet design requirements of any electrically operated equipment or electronic device. Items so protected will deliver as efficiently in the field as under the most ideal laboratory conditions.

SOLA Constant Voltage Transformers have no moving parts to get out of order. There are no manual adjustments to be made. They perform instantly and automatically, maintaining output constant to within ± 1% of the rated voltage, regardless of line fluctuations as great as 30%.

Constant Voltage Transformers

SOLA

To Manufacturers:
Built-in voltage control guarantees the voltage called for on your label. Consult our engineers on details of design specifications.
Ask for Bulletin 10CV-74

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

IN SELECTING YOUR PLASTIC MOLDER — LOOK FOR BALANCE!

To do your molding job and do it right, your custom molder has four functions to perform—Engineering, Mold-making, Molding and Finishing. Some like to add a fifth one—Selection of Material—but that's actually an essential part of Engineering, and should be treated as such.

The measure of your molder's usefulness to you lies in his ability to so balance all these functions in one plant that soundly engineered, thoroughly inspected parts feed into your production lines on rigid schedules . . . without delays or excuses. In other words, on his ability to assume full responsibility from drawing board to delivery.

At Kurz-Kasch, this balance is struck at the Plastics Round Table, where experts of *all* departments plan production together with your engineers or designers. Behind them lies a generation of experience in molding all plastic materials by all accepted methods. And in growing up with the Plastics industry, they've picked up experience you might need. You can sit in with no obligation.

RIGHT NOW is the time for Design and Engineering on your post-war plastics applications. And, in some cases, Mold-making. Do this, and you'll have the jump on the field . . . we'll be all set to serve you better . . . and your Plans will turn into Products more smoothly. Ask for an engineer!

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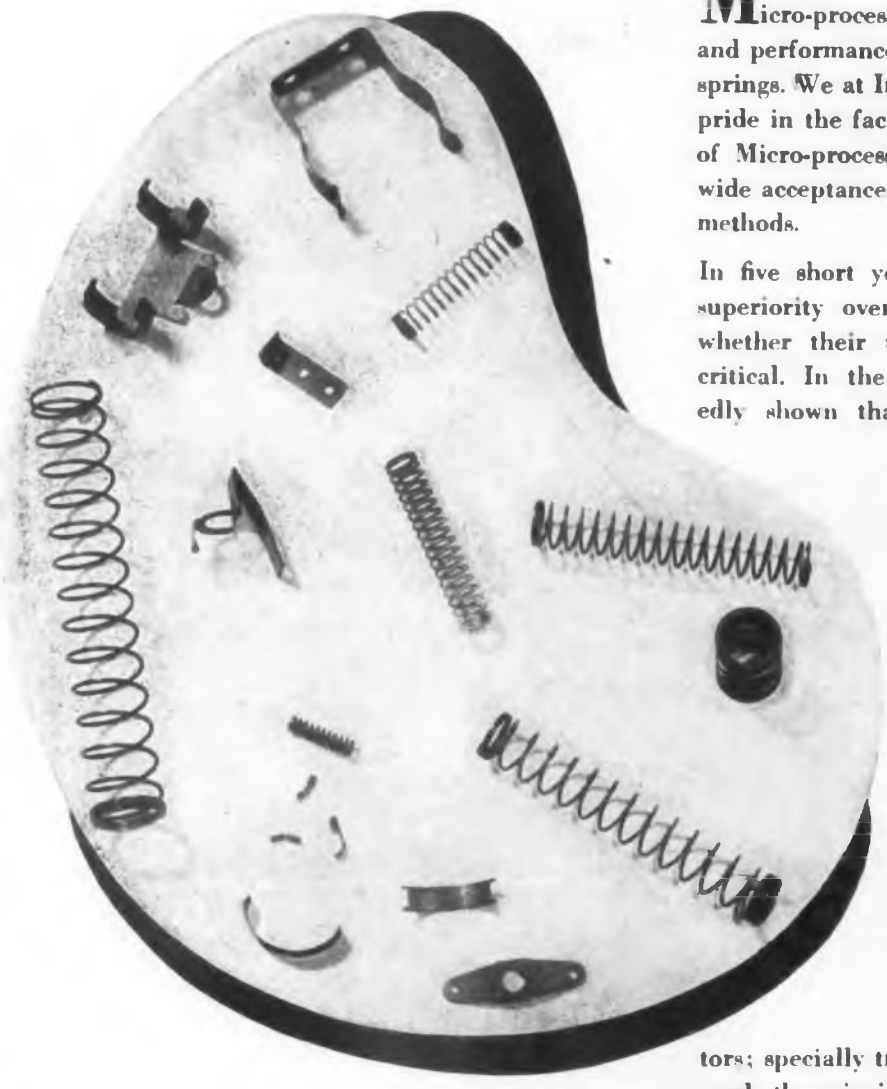
"But he that is greatest among you shall be your servant"

Matt. 23:11



"Micro-processing" sets new standards of design and performance for beryllium copper coil and flat springs. We at Instrument Specialties Company take pride in the fact that the service record of millions of Micro-processed springs has resulted in nation-wide acceptance of our unique precision production methods.

In five short years I-S springs have proved their superiority over *any* beryllium copper springs — whether their ultimate use is average or highly critical. In the same five years we have repeatedly shown that only Micro-processed beryllium copper can achieve certain desired physical and electrical characteristics. Every step in our progress is backed up in fact — on your own springs, designed and Micro-processed to meet your particular need.

How does I-S attain mass production when orders range from 1,000,000 to 10 springs with simple or complex requirements? The answer is plain to see. Special "spring grade" wire, drawn to specifications set up by the I-S production control laboratory; coiling, heat treatment and electronic micrometer inspection is directed by routine control methods based upon known factors; specially trained tool and die makers skillfully apply the principles of Micro-processing to flat spring work; and in addition, Instrument Specialties Company has in the field, resident engineers in major industrial areas who are ready to discuss with you and act upon your spring problems.

By re-defining the possibilities of spring performance we have opened new avenues for the use of beryllium copper springs — *Micro-processing, more than ever before, is a servant to the nation's industry.*

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Don't fail to get your hands on a copy of this book of data. It's the "last word" on the subject of glass-bonded mica, from the history of the product to its almost-endless applications. It shows that MYKROY differs in formula from the earlier glass-bonded mica materials, and states the case for MYKROY as the perfect dielectric for the more exacting needs of all high frequency circuits.

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Masterpiece of Skilled Hands

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Transmitting Tubes EXCLUSIVELY Since 1934

In every art or craft, the work of a few masters will always be of a quality above all else of its kind . . . The name Wedgewood denotes rare excellence in pottery. The name Gobelins characterizes tapestries of incomparable beauty. So, too, in its field, the name UNITED stands for electronic tubes which are individual masterpieces . . . While electronic tubes are the very heart of countless machine-age devices, their manufacture is as dependent upon expert minds and skilled hands as is the fashioning of a fine vase or violin . . . UNITED Tubes are engineered to the most exacting specifications. They are constructed of the highest quality materials obtainable. Yet no tube can be one bit better than the skill that assembles its intricate component parts. Herein lies one reason why UNITED Tubes are in a class by themselves for efficiency and long life.

Here is a low-powered E·L Power Supply (Model S-1361). Its output power is 10 watts. Input voltage is 24 volts DC, and output voltage is 350 volts DC at 25 ma. It weighs only 5 pounds.

Can You Build a Vibrator Power Supply?

We don't know. Right now, we build them *this* big and *this* little. And the limit has not yet been reached—in either direction.

Only *E·L* VIBRATOR POWER SUPPLIES Offer All These Advantages:

1. **CONVERSION**—DC to AC; DC to DC; AC to DC; AC to AC.
2. **CAPACITIES**—Up to 1,000 Watts.
3. **VARIABLE FREQUENCIES**—A power supply may be designed to furnish any frequency from 20 to 280 cycles, or a controlled variable output within a 5% range of the output frequency.
4. **MULTIPLE INPUTS**—For example, one E·L Power Supply, in quantity production today, operates from 6, 12, 24, 110 volts DC or 110 volts AC, and 220 volts AC, with a single stable output of 6 volts DC.
5. **MULTIPLE OUTPUTS**—Any number of output voltages may be secured from one power supply to suit individual needs.
6. **WAVE FORMS**—A vibrator power supply can be designed to provide any wave form needed for the equipment to be operated.
7. **FLEXIBLE IN SHAPE, SIZE AND WEIGHT**—The component parts of a vibrator power supply lend themselves to a variety of assembly arrangements which makes them most flexible in meeting space and weight limitations.
8. **HIGHEST EFFICIENCY**—E·L Vibrator Power Supplies provide the highest degree of efficiency available in any type power supply.
9. **COMPLETELY RELIABLE**—Use on aircraft, tanks, PT boats, "Walkie-Talkies," jeeps, peeps and other military equipment, under toughest operating conditions has demonstrated that E·L units have what it takes!
10. **MINIMUM MAINTENANCE**—There are no brushes, armatures or bearings requiring lubrication or replacement because of wear. The entire unit may be sealed against dust or moisture.

Increasing wattage limitations from 100 up to 1,000 in two years is no accident. It is the result of many years' specialization in the technique of vibrator power supplies, and the most extensive research ever conducted on power supply circuits.

For radio, lighting, communications, and other current needs, *E·L* Power Supplies will bring you a dependability and service life far beyond anything we would have dared prophesy even a few years ago. This is being proved every day, all over the world, under the toughest operating conditions of war.

No matter what your power supply problem may be—whether it's primarily one of size . . . weight . . . input . . . output . . . efficiency . . . or whatever—the chances are that *E·L* engineers will be able to provide you with the best solution.

Electronic
LABORATORIES, INC.

INDIANAPOLIS

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

2 FLASHES TO A WAITING WORLD 1805 . . . 1944

A crude lantern flashed the news of Nelson's victory at Trafalgar to watchers on the English coast. Thus, the second night after the battle the news began its slow spread around the world.

TODAY, while the smoke and flames of a bombed city rise high in the sky, news of a raid goes around the world by radio before the planes return to their home bases.

Sentinel

RADIO

Quality Since 1920

SENTINEL has played a prominent part in developing the miracle of radio—is playing a *vital part* today, in creating and producing wartime equipment which is helping to carry out the strategy and guide the action of our armed forces.

The Sentinel radios of tomorrow will emerge conditioned by this wartime experience . . . radio and electronic Products that promise volume sales for Sentinel dealers.

SENTINEL RADIO CORPORATION
2020 RIDGE AVENUE, EVANSTON, ILL.

TEST ASSIGNMENT

ECA has along with other manufacturers, been assigned a number of specialized tasks in the war effort. One of these is the production of test equipment for air fighters. This assignment is being fulfilled with a knowledge growing out of more than 20 years of diversified radio and electronic techniques.

During these years, most of our executives and personnel have functioned as one unit. We've worked together, experimented together, learned together. Accordingly, ECA assignments have been, still are, and will be delivered as promised . . . to your fullest satisfaction. *100% in war work . . . occasionally, however, production schedules enable us to accept additional contracts.*

BE A BLOOD DONOR

On some far-off battlefield a soldier lies wounded. Perhaps he's your boy or the son of a neighbor. A pint of blood . . . just one pint of blood . . . may mean the difference between life and death. You can render no finer service to America than to donate a pint of your blood regularly to the Red Cross.

ELECTRONIC CORP. OF AMERICA

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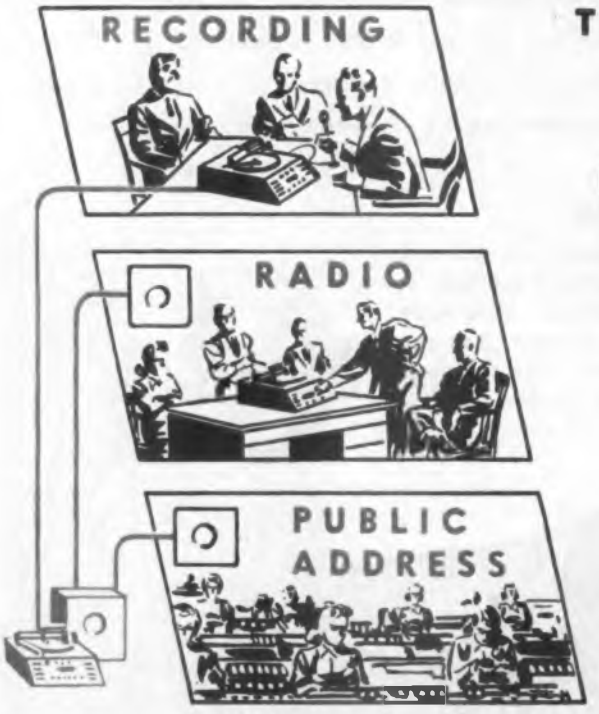
Radiotone



THE ONLY UNIT THAT *Gives You All 3*

It is a high-fidelity professional recorder combination which includes a microphone recorder, radio recorder, radio, phonograph and public address system. It can be equipped with any number of loud speakers or used in conjunction with your present P. A. system.

DEALERS CAN PARTICIPATE *NOW!*

In the distribution of Radiotone to essential industries, including schools and other institutions . . . as well as the complete line of Radiotone accessories including recording discs and needles. Write for catalog and complete details.

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Division of
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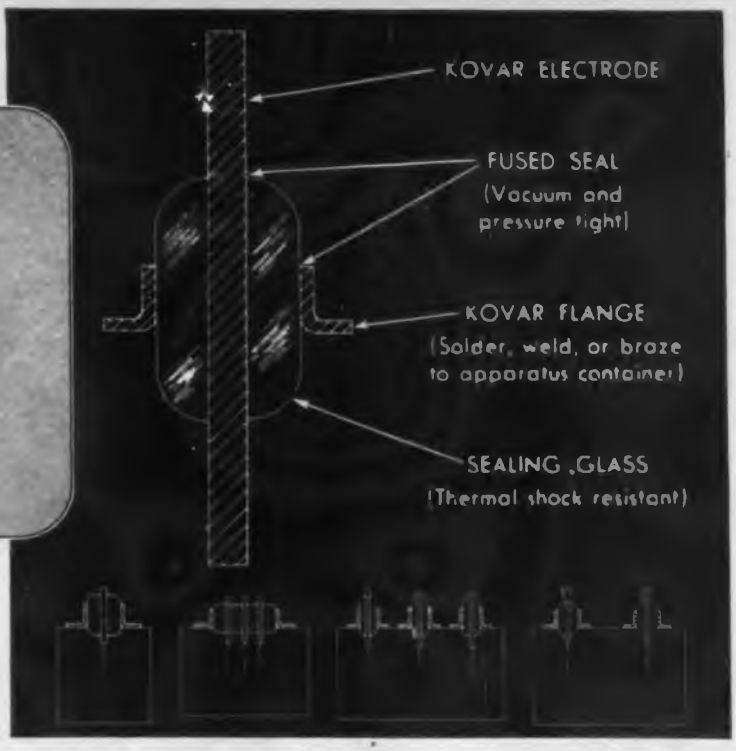
Columbus, Ohio

Hollywood, 7356 Melrose Ave. ★ SHOWROOM AND SALES OFFICE, 1811 Chestnut St., Philadelphia

WE'VE BEEN DOING IT FOR YEARS



SEALING GLASS TO METAL WITH KOVAR

TRADE MARK 237962, REGISTERED IN U. S. PATENT OFFICE

KOVAR, an iron-nickel-cobalt alloy, was primarily developed to meet the need for metal-to-glass seals in electronic tubes. Kovar matches the expansion of hard or thermal shock resistant type glass—is readily formed by machining or deep drawing—resists mercury attack.

The seal between Kovar and glass is a chemical bond in which the oxide of Kovar is dissolved into the glass during a heating process. The result—a permanently vacuum and pressure tight seal effective under the most extreme climatic conditions—tropical to stratosphere.

Stupakoff supplies Kovar sheet, rod, wire, tubing; and for those not equipped for glass-working, Stupakoff makes Kovar sealed terminals and other assemblies designed for soldering, welding or brazing to metal containers to form vacuum or pressure tight seals.

Kovar IS the answer to permanent vacuum or pressure tight sealing. Let us help engineer YOUR sealing problems.

Use KOVAR for sealing

- ELECTRONIC TUBES
- TRANSFORMERS
- RESISTORS
- CAPACITORS
- CONDENSERS
- VIBRATORS
- SWITCHES
- RELAYS, ETC.

ARMY (E) NAVY
"for great achievement"

Buy War Bonds

SINCE 1897

STUPAKOFF

Products for the World of Electronics

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Famous for endurance
. . . the SUPER-PRO "SERIES ◈ 200"

HAMMARLUND radio receivers have long been popular with Chinese engineers. And now Super-Pro receivers are aiding our admirable Ally in the struggle to preserve her country and its many fine traditions.

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

THE SIGN OF QUALITY IN RADIO

HAMMARLUND


The Chicago Telephone Supply Company has specialized in variable resistors for 15 years . . . production of them in the last peace-time year exceeded 14 millions.
Today, all production is going into the war effort.
When peace-time production can be resumed, Chicago Telephone Supply will continue to serve the electronic industries with the quality workmanship and the service that customers have grown accustomed to during the years.
Manufacturers of Quality Electro-Mechanical Components Since 1896
Plugs Jacks Switches
Variable Resistors
Telephone Generators
and Ringers
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Throw Away Your Expensive Test Equipment

that is . . . if the components contained in the physical interpretation of your engineering designs do not meet your specifications. Be sure that the final product incorporates the same high quality components that you tested in your original model

There's no guesswork when your specifications include Raytheon Tubes. Regardless of the intricacies involved in the designs of your electronic devices, you can rely on Raytheon Tubes to perform with a high degree of perfection the functions demanded of them.

Raytheon's leadership is proved through unfailing tube performances under the most severe military applications. When peace comes, Raytheon ingenuity will afford users many new and important advancements in tube engineering to meet the requirements of their new radio-electronic devices.

ARMY-NAVY "E" WITH STAR
Awarded All Four Divisions of Raytheon
for continued excellence in production

RAYTHEON

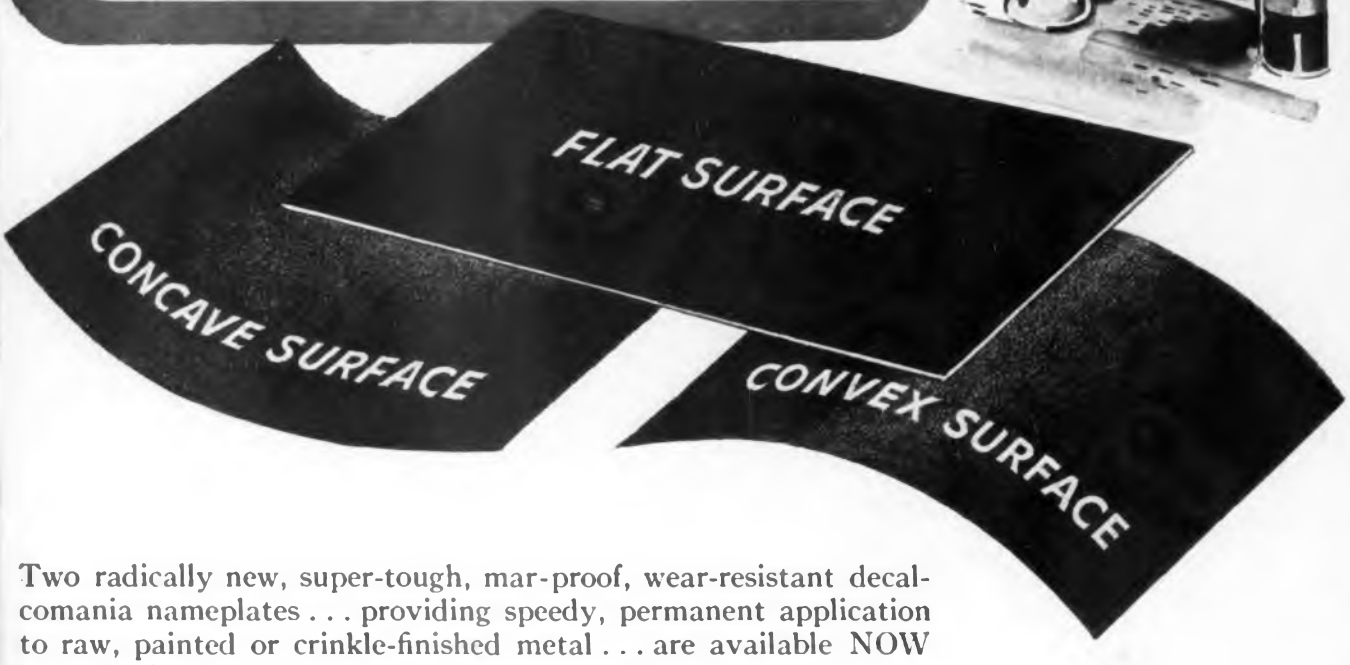
RAYTHEON MANUFACTURING COMPANY
Waltham and Newton, Massachusetts

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

New! Durable! Different!

MEYERCORD "MAR-PROOF" DECALS

SOLVE NAMEPLATE IDENTIFICATION ON CRINKLE, PAINTED OR PLASTIC SURFACES FOR WAR USES



Two radically new, super-tough, mar-proof, wear-resistant decalcomania nameplates . . . providing speedy, permanent application to raw, painted or crinkle-finished metal . . . are available NOW to authorized manufacturers of war material.

Developed for war use in the laboratory of The Meyercord Co., the new transfers not only save time, money, weight and critical nameplate metals but eliminate rivets, bolts and screws and avoids sharp, protruding edges. Usable on flat, convex or concave surfaces. Both types have withstood rigid tests for abrasion, extremes of heat and cold, immersion, salt spray and humidity. Offered in a wide range of colors, Type C is an open letter design and Type G a background transfer design. If you have a tough identification problem — investigate "mar-proof" Meyercord Decal nameplates for efficiency at low cost. Address Department 621.

Investigate Meyercord's complete line of Decalcomania nameplates, trademarks, serial numbers, patent data, operation instructions, dial faces, panels, etc. Available in any color or size.

50th Anniversary 1942

DECALS SAVE METAL

THE MEYERCORD CO.

World's Leading Decalcomania Manufacturer

5323 WEST LAKE STREET · CHICAGO, ILLINOIS

Two "E" pin wearers at Ray-O-Vac give Ray-O-Vac Batteries a final inspection before they are shipped to our armed forces.

8 Million Tests A Day

Most of Ray-O-Vac's large production of batteries is going into the electronic marvels of this war — portable radios and other special equipment — and specially engineered in close cooperation with the Signal Corps.

The "Know How" We Gained In Our War Work Can Be Used By You In Your Plans For The Future

Every single one of the many millions of Ray-O-Vac Batteries are tested and retested as they progress through the plant. Based on our 37 years of battery-making experience these tests insure dependability. If dry batteries are required in your products, the long-time experience of Ray-O-Vac's staff of engineers can be of real aid to you.

RAY-O-VAC
Guaranteed
BATTERIES

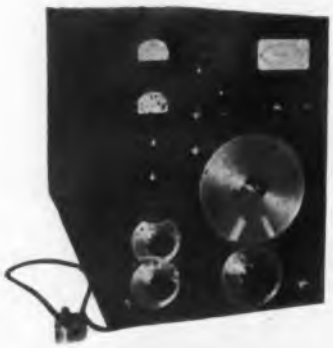
RAY-O-VAC COMPANY • MADISON 4, WIS.

FLASHLIGHT • TELEPHONE • LANTERN • HEARING AID • RADIO • IGNITION • MULTIPLE

FERRIS INSTRUMENTS

for LABORATORY STANDARDS AND NEW DEVELOPMENT WORK

MODEL 40-A
20-250 MC.



MODEL 48-A
200-500 MC.

MODEL 16-C
50 KC.-25 MC.

STANDARD PRECISION AMPLITUDE MODULATED SIGNAL GENERATORS FREE FROM FREQUENCY MODULATION WITH FERRIS TRANSMISSION LINE OUTPUT CABLES

FERRIS

FERRIS INSTRUMENT CORPORATION

110 CORNELIA STREET, BOONTON, N. J.

The 24-A loudspeaker horn has been designed principally for outdoor applications. It is weatherproof. A new type vitreous finish provides non-corrosive qualities even in combat areas where high corrosion conditions exist. With a 50 watt electrical input it will produce a sound level of +94 db. (zero reference level 10^{-16} watts per CM^2) at 100 ft. distance on the axis of the horn. The horn being of exponential form, the off-axis levels follow the usual curves. Receiver attachments are available for coupling two or four driver units making the horn capable of maximum inputs of 50 and 100 watts. Frequency response 110 to 6500 C.P.S. Over all length 38"; over all width 26"; bell diameter 25". Mounting bracket furnished. Bulletin on request.

The Langevin Company
INCORPORATED
SOUND REINFORCEMENT AND REPRODUCTION ENGINEERING

NEW YORK
37 W. 65 St., 23

SAN FRANCISCO
1050 Howard St., 3

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1000 N. Seward St., 31

Waveform

MEASUREMENTS of the waveforms of electrical currents and voltages are particularly important to the communications engineer. The processes of modulation and demodulation, and of harmonic generation and reduction, consist essentially of alterations in electrical waveforms. Consequently, the precise measurement of harmonic amplitudes provides an index of circuit performance.

In other branches of engineering, too, wave analysis is important. Electric power generators must be designed and operated to keep harmonics at a minimum. Vibrations in acoustical and mechanical systems are now measured by converting them to electrical impulses whose waveforms can be analyzed electrically.

Waveform-measuring instruments have for many years been an important part of the General Radio line of test equipment. This Company pioneered in the development of a commercial heterodyne wave analyzer and the degenerative analyzer for the measurement of acoustic and vibration waveforms. General Radio direct-reading distortion and modulation meters have greatly simplified the problem of broadcasting station monitoring and maintenance. In addition, the present line includes many types of wave filters and a continuous-film recorder for oscillographic work.

Up-to-the-minute design and high quality construction are the reasons why General Radio waveform-measuring equipment is used in the world's leading laboratories.

Because all our facilities are devoted to war projects, these instruments are at present available only for war work.

GR **GENERAL RADIO COMPANY** Cambridge 39, Massachusetts

NEW YORK CHICAGO LOS ANGELES

OFFICIAL government figures disclose that our war cost had reached 289 million dollars a day by mid-year, 1943, and the cost has been over 7 billion dollars a month ever since.

As manufacturers of communications and aircraft material on which human lives often depend, we know of one heartening reason for this tremendous cost: Uncle Sam will not compromise with quality at the expense of our fighting men. They are getting the finest, most dependable equipment any army ever had. And that saves lives.

Is it any wonder we are being asked to dig down and buy War Bonds until it hurts? And isn't it well worth it, knowing that our sacrifice is maintaining quality as well as quantity of weapons? Our people here at Connecticut Telephone and Electric Division think so . . . they are 100% pledged to regular payroll deductions for War Bonds, on an average of 15% of their incomes.

OUR CONTRIBUTION TO THE WAR EFFORT

CONNECTICUT
TELEPHONE & ELECTRIC DIVISION
MERIDEN, CONNECTICUT

Engineering, Development,
Precision Electrical Manufacturing

"The difficult we do immediately, the impossible takes a little longer." —*Army Service Forces*

Electro-Voice DIFFERENTIAL MICROPHONES

Developed by our Engineering Department in close collaboration with the Fort Monmouth Signal Laboratories, and hailed as an accomplishment in the science of speech transmission, the *Differential Microphone* effectively shuts out all ambient noises and reverberation . . . permitting voice to come through clearly and distinctly . . . while rejecting the terrific din in tanks and the roar of gunfire.

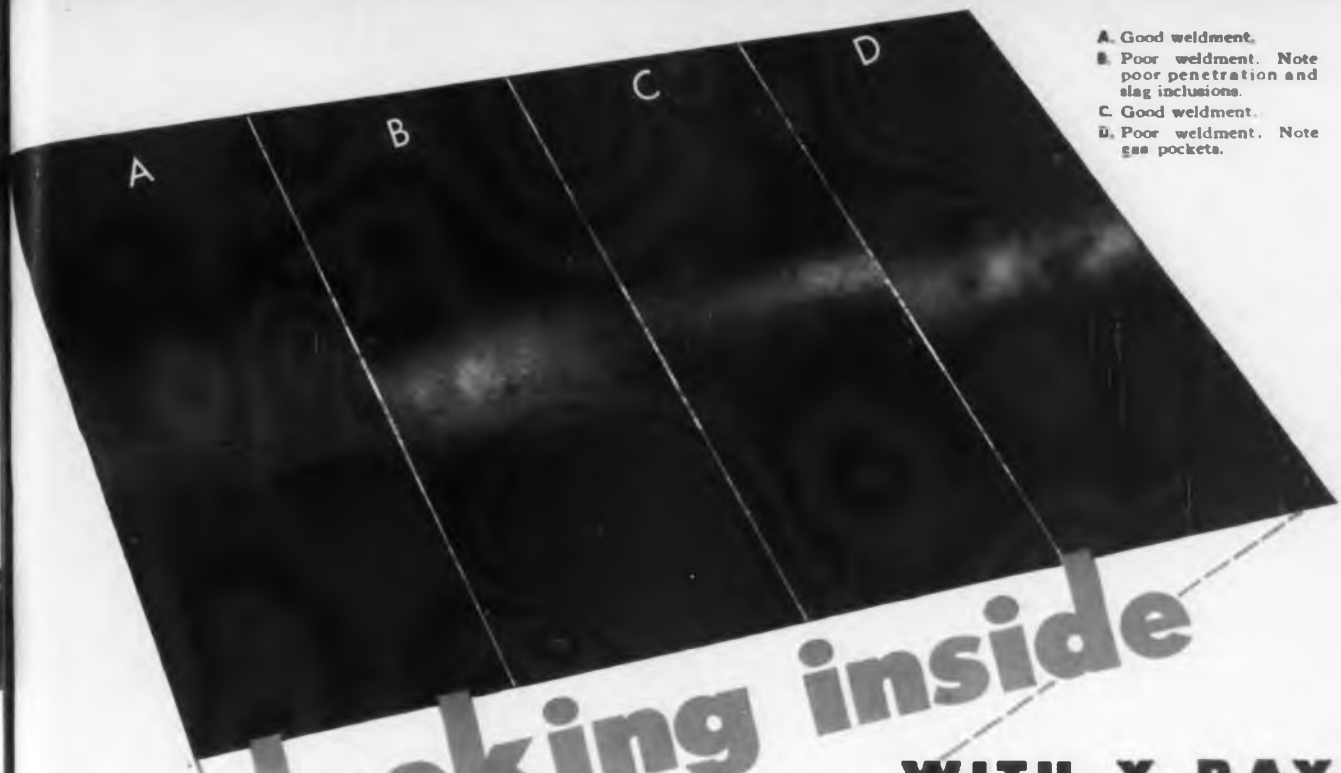
In its present form, the *Differential Microphone* is produced as the T-45, a "Lip Mike," for use in battle by our Armed Forces and those of our Allies. Postwar developments will provide a variety of models with advantages that will be felt in many phases of civilian life.

- Frequency response substantially flat from 200-4000 cps.
- Low harmonic distortion
- Cancellation of ambient noise, but normal response to user's voice
- Self-supporting, to free both hands of the operator
- Usable when gas mask, dust respirator or oxygen mask is required
- Uniform response in all positions
- Unaffected by temperature cycles from —40° F. to +185° F.
- Ability to withstand complete immersion in water
- Physical strength to withstand 10,000 drops
- Weight, including harness, cord and plug, less than 2 ounces

Electro-Voice MICROPHONES

ELECTRO-VOICE MANUFACTURING CO., INC. • 1239 SOUTH BEND AVENUE • SOUTH BEND 24, INDIANA

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



A. Good weldment.
B. Poor weldment. Note poor penetration and slag inclusions.
C. Good weldment.
D. Poor weldment. Note gas pockets.

looking inside WITH X-RAY

HELPS TRAINEES "CATCH ON" QUICKER!

They can SEE the difference between a good weld and a bad one

X-ray rules out guesswork in training, qualifying or classifying welders—or other workers—according to actual ability. It puts these all-important functions on a factual basis. For radiographs clarify . . . provide absolute proof . . . are readily understood because they *show* internal conditions that words fail to describe adequately.

They let the worker *look inside* the weldment, casting or assembly . . . show him whether it's good or bad . . . show him what to do and what to avoid. He "catches on" quicker, adheres to good, sound methods, and becomes a faster, more efficient producer from the start.

In addition to shortening training time and putting worker-classification on a factual basis, Westinghouse Industrial X-ray is doing countless other jobs faster, better and more economically. These fall into such major classifications as speeding production, saving machine and man-hours, conserving critical materials and improving quality.

For more information, write for Booklet B-3159. It suggests how and where you can benefit by using industrial x-ray. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-02025

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Industrial X-RAY

GUTHMAN *Super-Improved* COILS

For many years before the war, Edwin I. Guthman & Co. was especially known for manufacturing better coils. With war came greater demands upon our facilities . . . U. S. Army and Navy orders for many diversified radio parts . . . expansion of our plant . . . the addition of many new manufacturing departments. All manufacturing and assembling of these many units was done in our own completely equipped plant. Thus, our engineers and skilled personnel gained a broader experience in modern radionics. Now, we are concentrating all this technical experience in the engineering and production of Guthman Super-Improved Coils . . . promised leaders in peacetime radionics.

EDWIN I. GUTHMAN & CO. INC.

15 SOUTH THROOP STREET · CHICAGO

PRECISION MANUFACTURERS AND ENGINEERS OF RADIO AND ELECTRICAL EQUIPMENT

TIME STANDS STILL!

Time stops for the Ultra High-Speed Camera. Action taking place in the wink of an eyelash, the distortions, deformations, all of the physical changes of matter in motion are open secrets to the High-Speed Cameras at Waugh Laboratories.

SHOWN: *One of the world's fastest cameras, the new 16 mm. Eastman Ultra High-Speed Motion Picture Camera taking 3000 frames per second.*

Waugh Laboratories makes available the services of skilled camera technicians and the equipment needed, including super-speed cameras, special lights and stroboscopes for making ultra high-speed photographic investigations. Write for booklet.

WAUGH *Laboratories*

Pacific Coast Branch: 180 East California St., Pasadena 5, California • **422 LEXINGTON AVE., NEW YORK 17, N. Y.**

OUT OF THE LABORATORY ...AND INTO PRODUCTION

It Takes Volume Production to Make Research Effective

In war as in peace, the products of research become fully effective only when they can be put into mass production—*and put there fast!* This is a Delco Radio specialty. For years Delco Radio has been putting this know-how to work in the mass-manufacture of radios for leading makes of cars.

This experience is now being turned to meet the demands of wartime industry. Amazing new electronic devices—built to microscopically-close tolerances—are being manufactured in large quantity for the planes, ships and tanks of war. When the full details of this remarkable manufacturing story can be told, they will add another bright page in the history of Delco's leadership in "precision on a production basis."

Today—as never before—quantity and quality are needed vitally. Delco Radio is uniquely qualified to give both in full measure.

Delco Radio
DIVISION OF
GENERAL MOTORS

BACK OUR BOYS BY BUYING BONDS

..is making *electronic* BLOCK-BUSTERS

A design problem holding up some war project in electronics is no less important than a strategic enemy stronghold which must be blasted out of action. Immediate and skillful handling is essential.

Seemingly insuperable difficulties, such as climate, weight, shock, vibration, moisture, etc., assume an almost routine status at N-Y-T. Unusual frequency characteristics, critical limits on distributed capacity, immunity to surges, special shielding and regulation requirements find speedy solutions under constant testing, devising and experimentation.

Electronic "block-busters" will be needed in the post-war period, too. The N-Y-T Sample Department will be available for such assignments.

NEW YORK TRANSFORMER COMPANY

22-26 WAVERLY PLACE NEW YORK, 3, N. Y.

Naturally, we cannot answer all your questions right now. But it is certain that our production of tens of thousands of mechanical tuners and variable condensers to the precision standards required for military use will lead to many new postwar designs.

PHONOGRAPH RECORD CHANGERS – HOME PHONOGRAPH RECORDERS – VARIABLE TUNING CONDENSERS – PUSH-BUTTON TUNING UNITS AND ACTUATORS

ARMY E NAVY

GENERAL INSTRUMENT CORPORATION

833 NEWARK AVENUE, ELIZABETH, N.J.

HALLICRAFTERS WAS READY!

Under the abnormal climatic and operating conditions of war, the Signal Corps SCR-299 communications truck, built by Hallicrafters, is providing peak performance for the Allied armed forces, fighting throughout the world.

Hallicrafters peacetime communications equipment is meeting the wartime qualifications and demands of the Military!

Just as Hallicrafters Communications receivers are meeting the demands of war Today—they shall again deliver outstanding reception for the Peace—Tomorrow!

hallicrafters BUY MORE BONDS

World's largest exclusive manufacturer of short wave radio communications equipment...First exclusive radio manufacturer to win the Army-Navy Production Award for the third time.

HOW TO GET 250 MEN BEHIND A RADIO TUBE

IT sounds like a big order—but we do it at Corning. And for any user of electronic glassware, big or little, this is a service mighty hard to equal.

Behind every radio tube, x-ray bulb, cathode ray bulb, resistor tube, every one of the hundreds of electronic glassware products made by Corning Glass—stand 250 glass experts. Planners, research workers, engineers, production men—each a specialist in his own right, backed by one of the largest, most modern laboratories in the United States.

This unmatched reservoir of glass-making experience is one of the factors which make Corning's position unique in the industry. In its 75 years of pioneering, for example, Corning has developed more than 25,000 glass formulae. It has made Pyrex brand heat resistant glasses a practical fact instead of a dream; it has developed glasses with an expansion coefficient practically equal to that of fused quartz, and which can be formed in a variety of intricate shapes which only recently were impossible in glass.

To the manufacturer of electronic equipment—Corning's "know-how" in glass is particularly important. It means that here, under one roof, you too can find helpful, expert advice on any glass problem. If you are interested in a detailed study of electrical glassware, write for "Glass in the Electrical Industry." Address Electronics Sales Dept. I-1, Bulb and Tubing Division, Corning Glass Works, Corning, N. Y.

CORNING *means* Research in Glass

Electronic Glassware

CORNING U.S. PAT. OFF. PYREX U.S. PAT. OFF.

"PYREX" and "CORNING" are registered trade-marks of Corning Glass Works

A Chemical Formula, Too!

Chemistry is but one of the many sciences which are collaborating at National Union in the work of producing better electronic tubes for today's vital war assignments. Indeed, our chemists are playing a decisive role in making National Union Tubes *measure up* to the precise standards of scientific instruments.

Thanks to chemical research, we know for example that not only must the formula of a tube's emission coating be *right*, but also the application and processing methods must be rigidly controlled.

To effect such control our chemists, in cooperation with the engineers of our Equipment Division, designed, built and put into production a new type automatic coating machine. Operating in an air-conditioned chamber, this equipment provides exact control of both the coating operation and the chemical processing of the emission coating—free from all extraneous elements.

The fact that tube manufacture *is* such a many-sided scientific job—is a subject to keep in mind when making post-war plans. If you have electronic tube problems—*count on* National Union.

NATIONAL UNION RADIO CORPORATION, NEWARK, N. J.
Factories: Newark and Maplewood, N.J., Lansdale and Robesonia, Pa.

NATIONAL UNION

RADIO AND ELECTRONIC TUBES

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs

HAVE YOU ANY OF THESE

Capacitor Application Problems?

- SPACE OR WEIGHT LIMITATIONS
- EXTREMES OF TEMPERATURE
- GREAT STRESS OR SHOCK
- SEVERE VIBRATION
- HIGH ALTITUDE
- HUMIDITY

Whatever your specifications, we're likely to have the answer

WE are in an excellent position to provide you with hermetically-sealed capacitors for wartime applications. Our extensive engineering, research, and manufacturing facilities are at your service.

In some cases there will be no need to look further than our standard line of Pyranol* capacitors for built-in applications.

The line includes more than 350 ratings in space-saving shapes and sizes. Many of the ratings are available in three shapes—oval, cylindrical, rectangular—to make your design problems easier. And they can be mounted in any position.

BE SURE TO GET your copies of our time-saving catalogs on d-c (GEA-2621A) and a-c (GEA-2027B) types. Ask your G-E representative for them by number, or write to General Electric, Schenectady, New York.

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

PYRANOL CAPACITORS

BUY WAR BONDS

GENERAL ELECTRIC

Faithfully Yours

The familiar Triplett trademark stands as a pledge of long service for those who require instruments that *faithfully* retain their accuracy over the years. Engineers realize the importance of Triplett contributions in making better instruments. In Triplett laminated magnet construction, for example, exclusive methods give permanency and provide for uniform scale linearity. Scientific heat-treating in automatic furnaces, followed by peening of each lamination, and the use of selected "cut-off" segments insure uniform standard printed scale accuracy. Careful ageing of all magnets follows to provide unchanging permanency of strength.

THE TRIPLETT ELECTRICAL INSTRUMENT CO. • BLUFFTON, OHIO

Buy More War Bonds

Model 625—0-30 D.C. Voltmeter (illus.) is one of today's most popular portables. This new design has a hinged dial cover for added protection; insulated molded case, and hand calibrated mirror scale 4.58" in length. Furnished to an accuracy within one-half of one per cent.

TRIPLETT

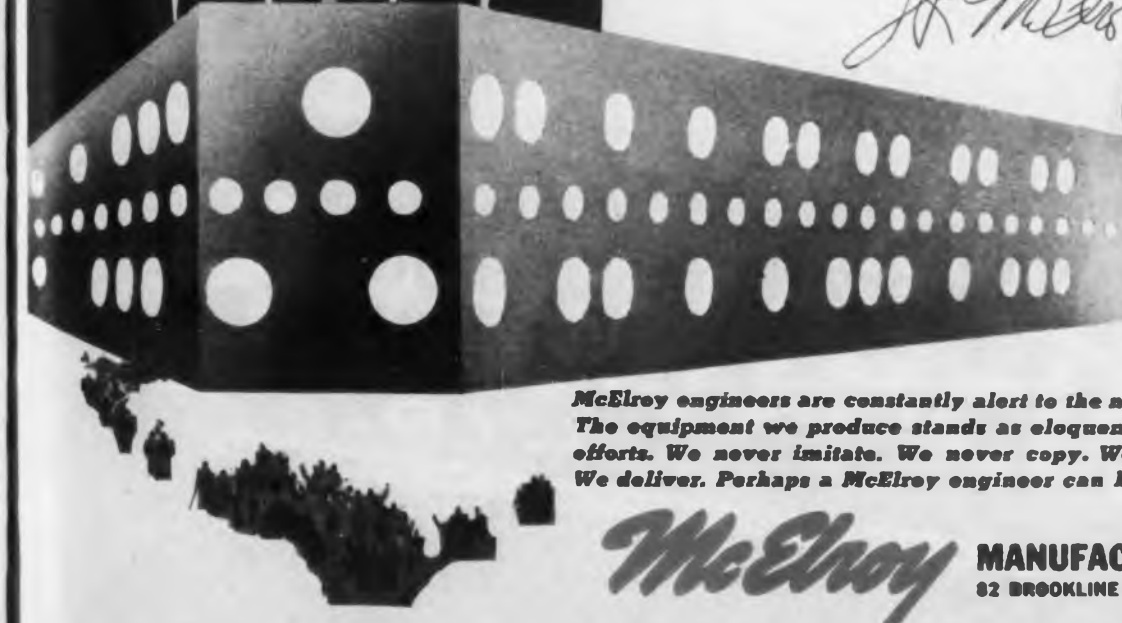
ELECTRICAL MEASURING INSTRUMENTS
RADIO AND INDUSTRIAL TEST EQUIPMENT

Proudest moment

The pride that we take in our products has been overshadowed by an even greater emotion. On November 8, 1943, we of the McElroy Manufacturing Corporation were awarded the Army-Navy "E". It isn't easy for us to express in words just how much a flag and a tiny "E" pin mean. We're thrilled. We're grateful to the Army and Navy. And we shall try, above all, to live up to this high honor.

Here, in Boston, we have a happy factory group. There are several hundred of us . . . fine men and women . . . putting our utmost into each job. On the basis of thirty years' experience, I have ideas as to what constitutes good telegraph apparatus. Our engineers, under Tom Whiteford, work out the original models which are later translated into actual equipment by our skilled personnel.

As for our selling policy . . . we have no salesmen. We do have a few resident representatives at points where they may be helpful. To these men, and to the men and women of the McElroy plant, I'd like to say — thanks . . . keep building for Victory.



McElroy engineers are constantly alert to the needs of our industry. The equipment we produce stands as eloquent testimony to their efforts. We never imitate. We never copy. We design. We build. We deliver. Perhaps a McElroy engineer can be of service to you.

McElroy MANUFACTURING CORP.
82 BROOKLINE AVE. BOSTON, MASS.

WORLD'S LARGEST MANUFACTURER OF AUTOMATIC RADIO TELEGRAPH APPARATUS

TWICE SIZE

It can be done!

Coil forms with wall thickness of .009 and tolerances of $\pm .000\,1$ are being INJECTION MOLDED by ARNOLD BRILHART LTD.

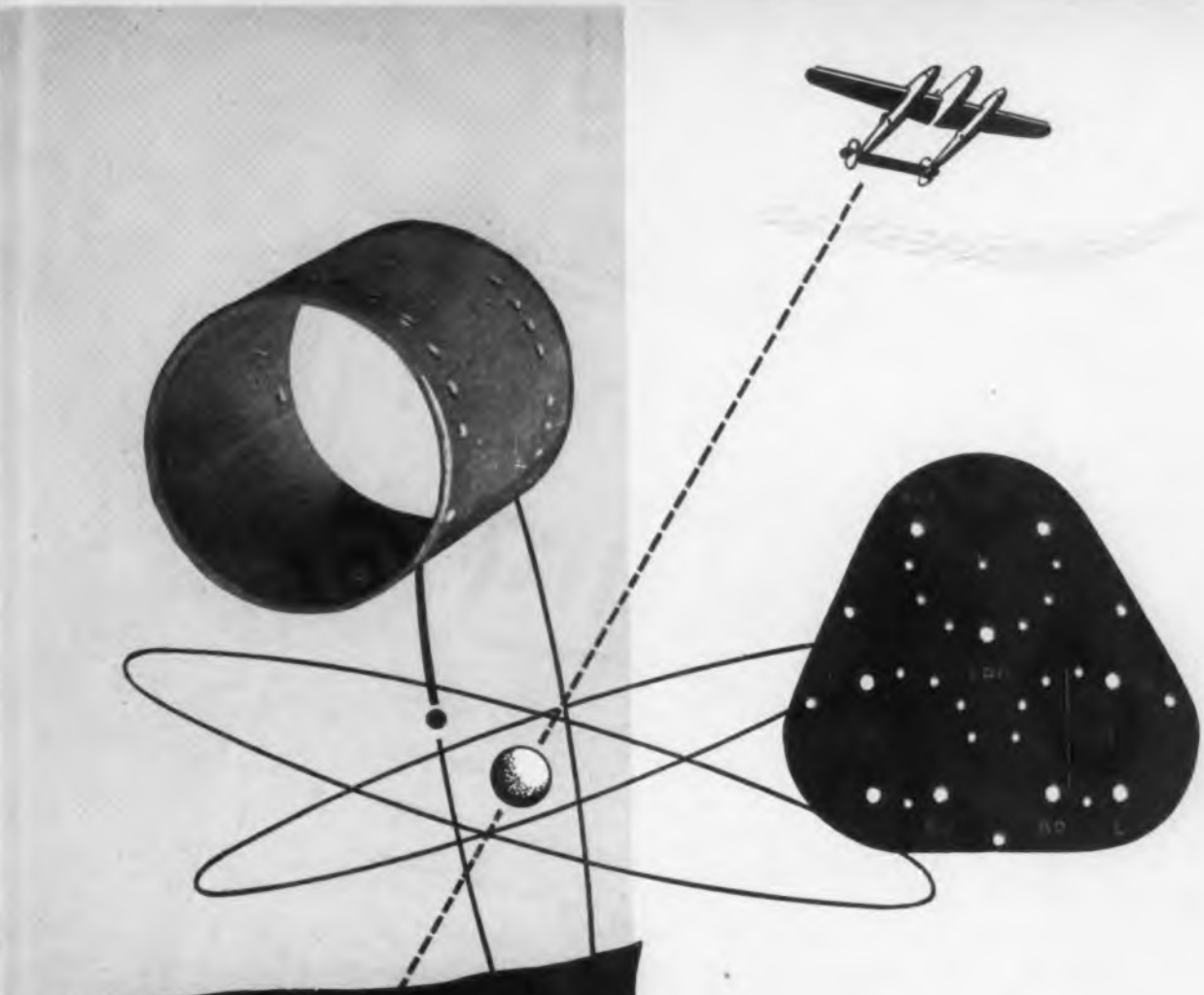
Material used: HM-119 LUCITE and FM-1 NYLON

Just another of the ... "Impossible things proven possible"

Send us your unusual problems in plastics!

ARNOLD Brilhart LTD.

437 MIDDLENECK ROAD • GREAT NECK, N.Y. *Phone* GREAT NECK 4054



Low Power Factor! High Mechanical Strength Good Machinability!

ARMY E NAVY

FORMICA

Formica MF—Glass Mat Base—Is a High Frequency Insulating Material That Can Replace Ceramics for Many Uses!

One of the recent developments of accelerated research in the Formica laboratories—Grade MF—has qualities of the greatest usefulness to the electronic designer.

As an insulating material it permits only minimum losses at high frequencies.

It has mechanical strength to stand extreme conditions of vibration and stress in antenna insulators, coil forms, tube bases.

Its efficiency is little affected by moisture absorption. Cold flow is less than for the best previous grades of laminated plastics. It is readily machined, and therefore handled at low costs in production.

"The Formica Story" is a sound-moving picture showing the qualities of Formica, how it is made, how it is used. It is available for meetings.

THE FORMICA INSULATION COMPANY

4647 SPRING GROVE AVE., CINCINNATI 32, OHIO

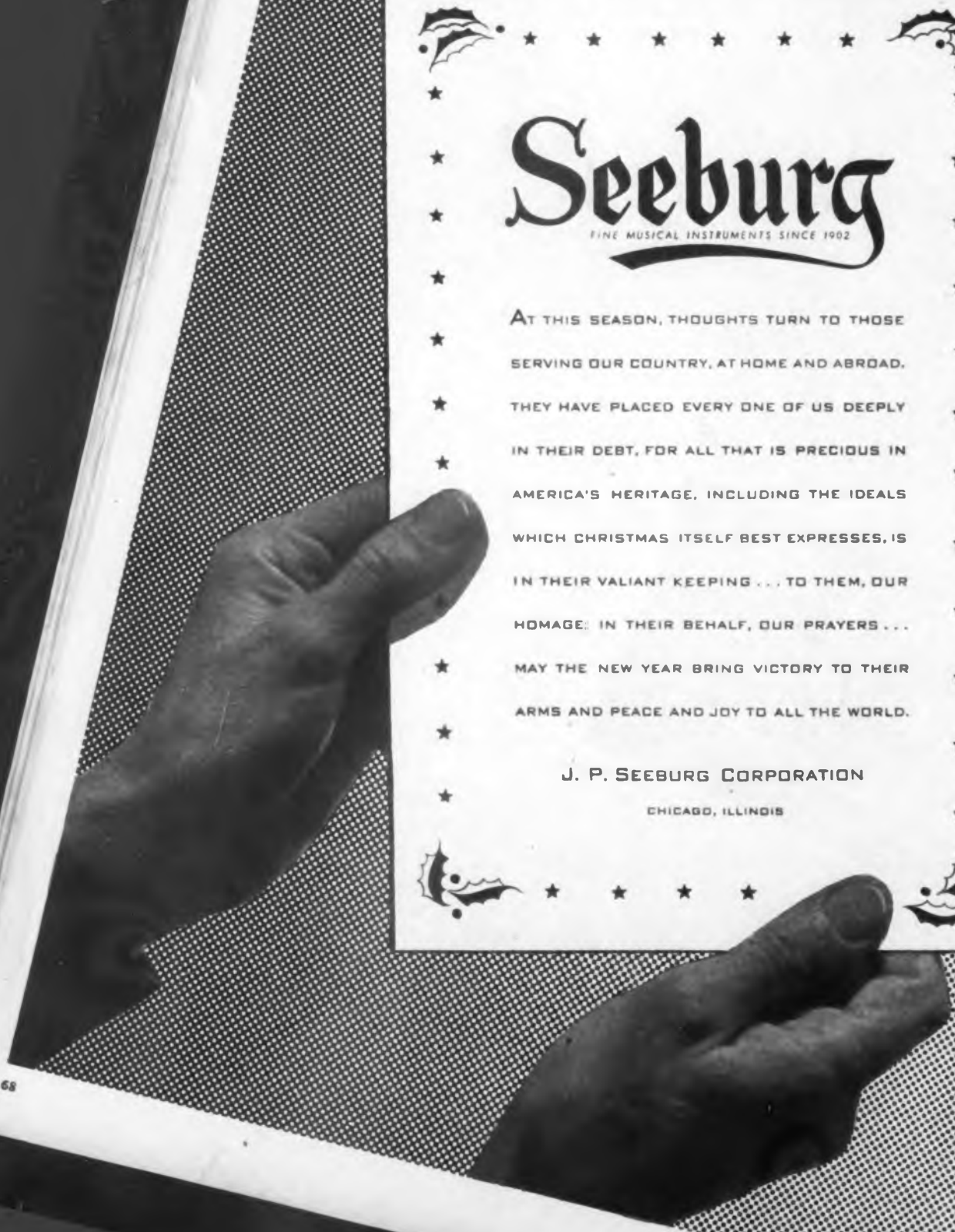
Seeburg

FINE MUSICAL INSTRUMENTS SINCE 1902

AT THIS SEASON, THOUGHTS TURN TO THOSE SERVING OUR COUNTRY, AT HOME AND ABROAD. THEY HAVE PLACED EVERY ONE OF US DEEPLY IN THEIR DEBT, FOR ALL THAT IS PRECIOUS IN AMERICA'S HERITAGE, INCLUDING THE IDEALS WHICH CHRISTMAS ITSELF BEST EXPRESSES, IS IN THEIR VALIANT KEEPING . . . TO THEM, OUR HOMAGE: IN THEIR BEHALF, OUR PRAYERS . . . MAY THE NEW YEAR BRING VICTORY TO THEIR ARMS AND PEACE AND JOY TO ALL THE WORLD.

J. P. SEEBURG CORPORATION

CHICAGO, ILLINOIS



THERE IS ONLY ONE MYCALEX

This building houses MYCALEX which in the opinion of reputable engineers, is ". . . the most nearly perfect electrical insulator known today". Developed and perfected more than twenty-five years ago, MYCALEX has been improved to such an extent that it now possesses advantages which make it superior to other types of glass bound mica insulation.

In any number of military and industrial applications . . . in any weather and climate . . . the unique properties of Leadless MYCALEX have been tried and tested, and found more than satisfactory. A few desirable properties are high dielectric strength combined with mechanical strength, heat and arc resistance, low moisture absorption, low power factor and low loss. Furthermore, MYCALEX meets all standards for close tolerances. Leadless MYCALEX is adaptable, too . . . it can be cut, tapped, machined, drilled, ground and polished...*or moulded.** And in any of these assignments it will prove to be extremely dependable. *Sheets and rods are immediately available for fabrication by us or in your own plant.*

MYCALEX
Trade Mark Reg. U. S. Pat. Off.

Keep Buying More and More War Bonds

Remember . . . MYCALEX is not the name of a class of materials, but the registered trade-name for low-loss insulation manufactured in the WESTERN HEMISPHERE by the Mycalex Corporation of America.

**If you have a special job where moulded parts are needed, we invite your specifications.*

MYCALEX CORPORATION OF AMERICA

Exclusive Licensee under all patents of MYCALEX (PARENT) CO., Ltd.

60 CLIFTON BOULEVARD CLIFTON, NEW JERSEY

COMMUNICATIONS EQUIPMENT

WAR-TESTED Precision for Post-War Performance

On far-flung battlefields—in the air—on the sea, equipment produced by Sherron is serving importantly in the drive toward victory. Under the most exacting conditions—where failure is fatal—this equipment is demonstrating, to vital manufacturers and utilities, Sherron's high standards of performance.

To Manufacturers—For war or postwar needs we offer an exceptional combination of facilities . . . Engineering, Design, Manufacturing, Assembly, Complete Production to Specifications. (Single units or quantities.)

SHERRON METALLIC
CORPORATION
1201 FLUSHING AVENUE • BROOKLYN, NEW YORK

More than just sheet steel specialists. ours is an organization where top emphasis is placed upon the men and women responsible for designing and building our products. Working as a team, over a long stretch of years, we've welded together a fine group of exacting, conscientious artisans, supplemented by skilled replacements and additions due to the war.

We build cabinets, chassis, panels and racks for diversified electronic equipment . . . quickly, precisely, economically. The hundreds of different dies available will reduce the cost of the dies needed on your job and may, in many instances, eliminate die-cost entirely. Because of these unique facilities, we manufacture to required specifications at the lowest possible cost. Moreover, we'll go over your plans with you . . . make recommendations if they can be helpful . . . suggest means of expediting deliveries. Briefly, *ours is an extra pair of hands* . . . offered willingly as part of a firmly-established policy of unselfish service to our clients.

The services of a Karp engineer are available for a discussion of your problems.

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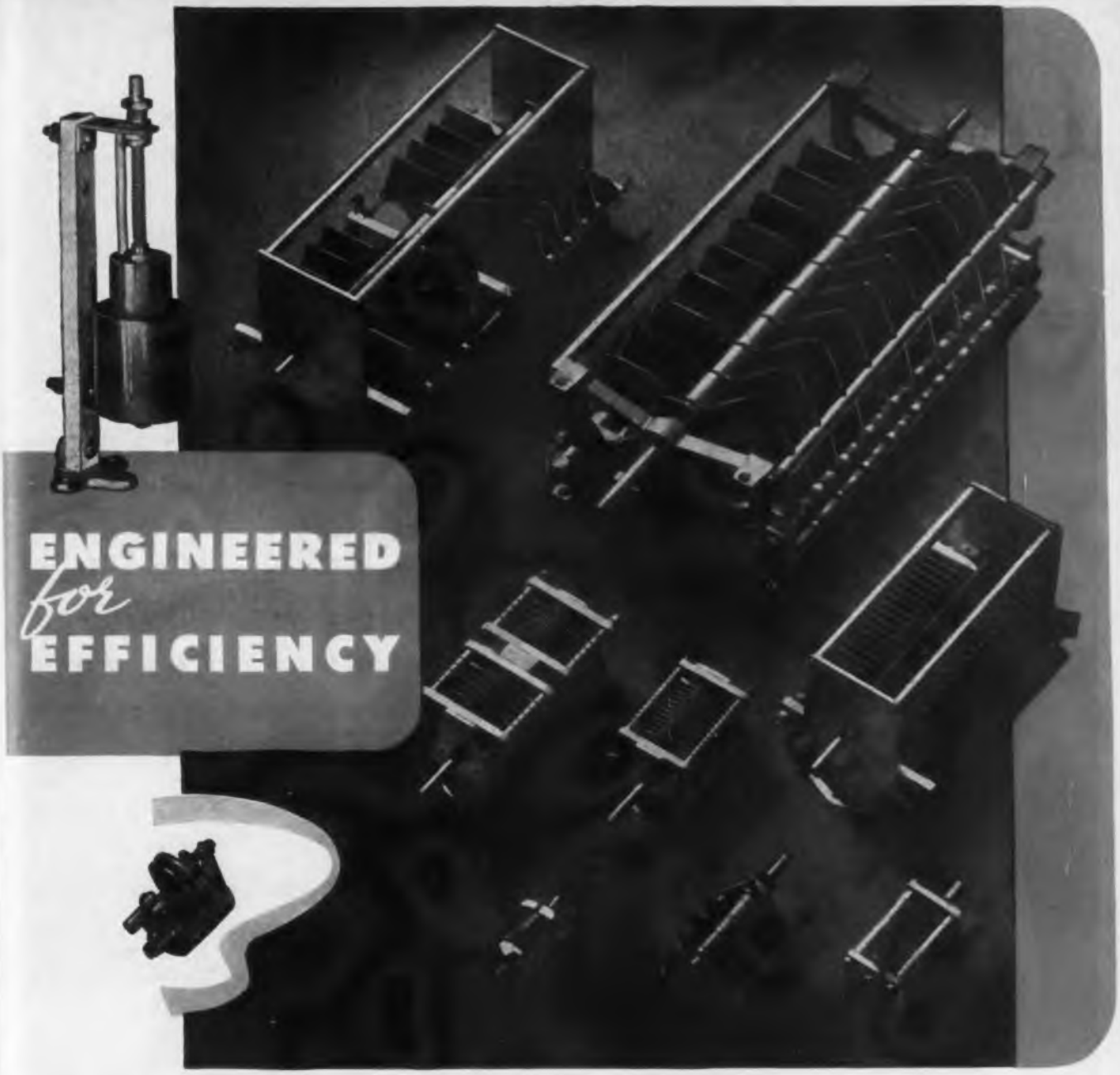

From the little "J" to the big commercial type "A", from the neutralizer type "N" to the special temperature compensator type, all JOHNSON variable condensers are correctly designed and engineered for the part they must play in the transmitter circuit. Corona discharge, flash-over rating, galvanic and electrolytic action of metals, closed loop (losser) circuits within the condenser, and dozens of other problems enter into the design of an efficient condenser. The metal and the alloy used, the shape and size of each part, the shape, size, and material of the insulators, all are highly important. Mechanically they are simple—electrically, an efficient condenser demands years of experience and "know how." Write us concerning YOUR condenser problems and JOHNSON will recommend a type for YOUR needs.

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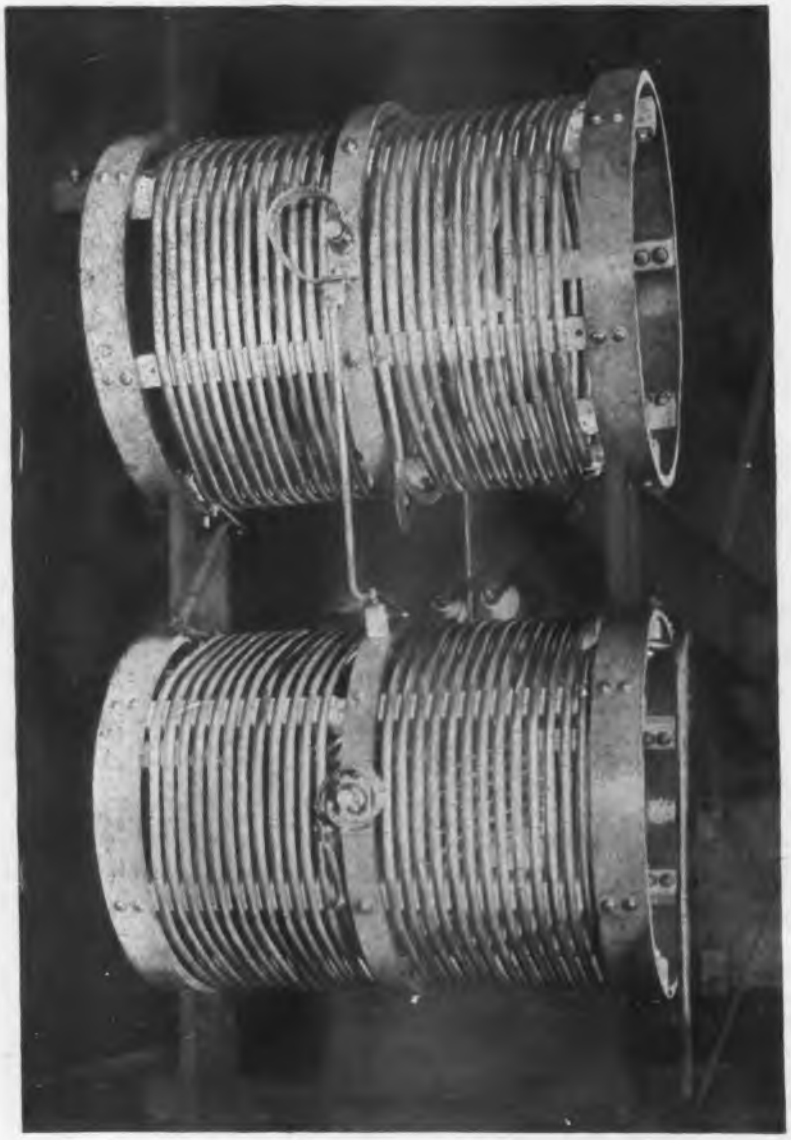

Well, we don't make the biggest transmitters. And we don't make the most.

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Radio Receptor, since the very beginning of the U. S. system has worked with governmental authorities in the development of radio ranges and other radio navigational aids.

In peace, we equipped many leading airports and airways. Today, we are making radio ranges and airdrome traffic controls as our special contribution to the war effort.

When peace comes again, *Radio Receptor*, with its rich background of experience in the design, manufacture and installation of radio navigational aids and airport traffic control equipment, will broaden its activities in keeping with the tremendous growth of postwar aviation.

Send for a copy of our non-technical booklet, "Highways of the Air" — DESK EI-1

A postwar airport development program to cost approximately $800,000,000 is recommended by William A. M. Burden, special aviation assistant to the Secretary of Commerce. The airport survey, made by the CAA in 1939 and which recommended some 4000 airports, will now be increased to approximately 6000, most of the increase being in small fields. "One thing is certain," Burden said, "And that is, if the program is to be developed on a sound basis, there must be a far higher proportion of local financial participation than there has been in the past."

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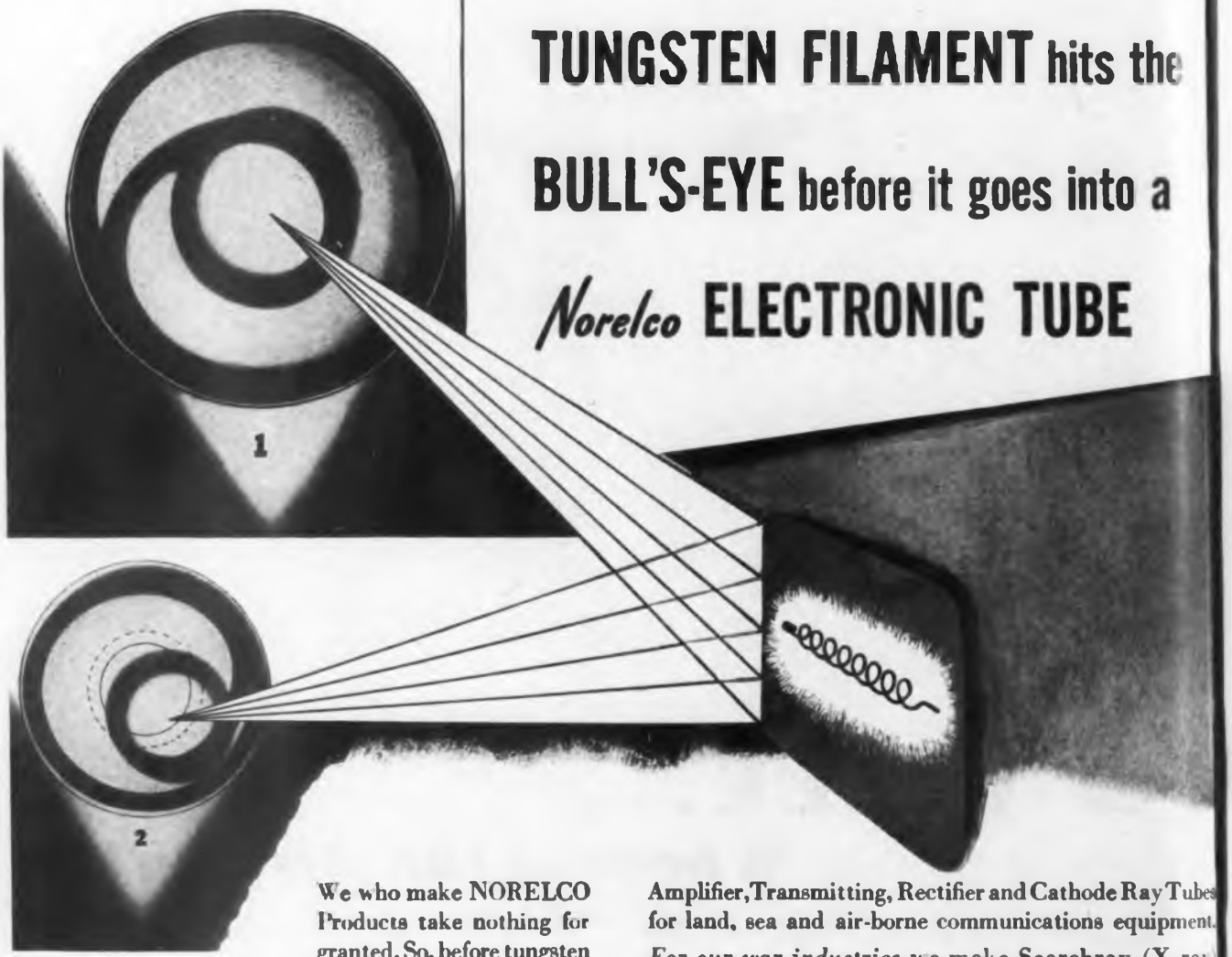
★ SINCE 1922 IN RADIO AND ELECTRONICS ★

TUNGSTEN FILAMENT hits the BULL'S-EYE before it goes into a *Norelco* ELECTRONIC TUBE



We who make NORELCO Products take nothing for granted. So, before tungsten filament coils are anchored to assemblies in tubes, they go into the limelight of a slide film projector. The projection beam is focused squarely through the dead center of the coil, and is projected against a screen on which a circle is painted.

A perfectly wound coil [*No. 1 above*] will cast its image on the screen coincident with the painted circle. An imperfectly wound coil [*No. 2 above*] *may* give adequate performance when assembled into certain types of electronic tubes—but since we who make NORELCO electronic products like to prevent possibility of failures before they get a start, we reject coils that do not meet our high standards of coil winding.

This is only one of the 61 inspections to which the various parts and assemblies of one type of NORELCO electronic tube is subjected before the final inspections in test operation.

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For our Armed Forces we make Quartz Oscillator Plates; Amplifier, Transmitting, Rectifier and Cathode Ray Tubes for land, sea and air-borne communications equipment.

For our war industries we make Searchray (X-ray) apparatus for industrial and research applications; X-ray Diffraction Apparatus; Electronic Temperature Indicators; Direct Reading Frequency Meters; High Frequency Heating Equipment; Tungsten and Molybdenum in powder, rod, wire and sheet form; Tungsten Alloys; Fine Wire of practically all drawable metals and alloys: bare, plated and enameled; Diamond Dies.

And for Victory we say: Buy More War Bonds.

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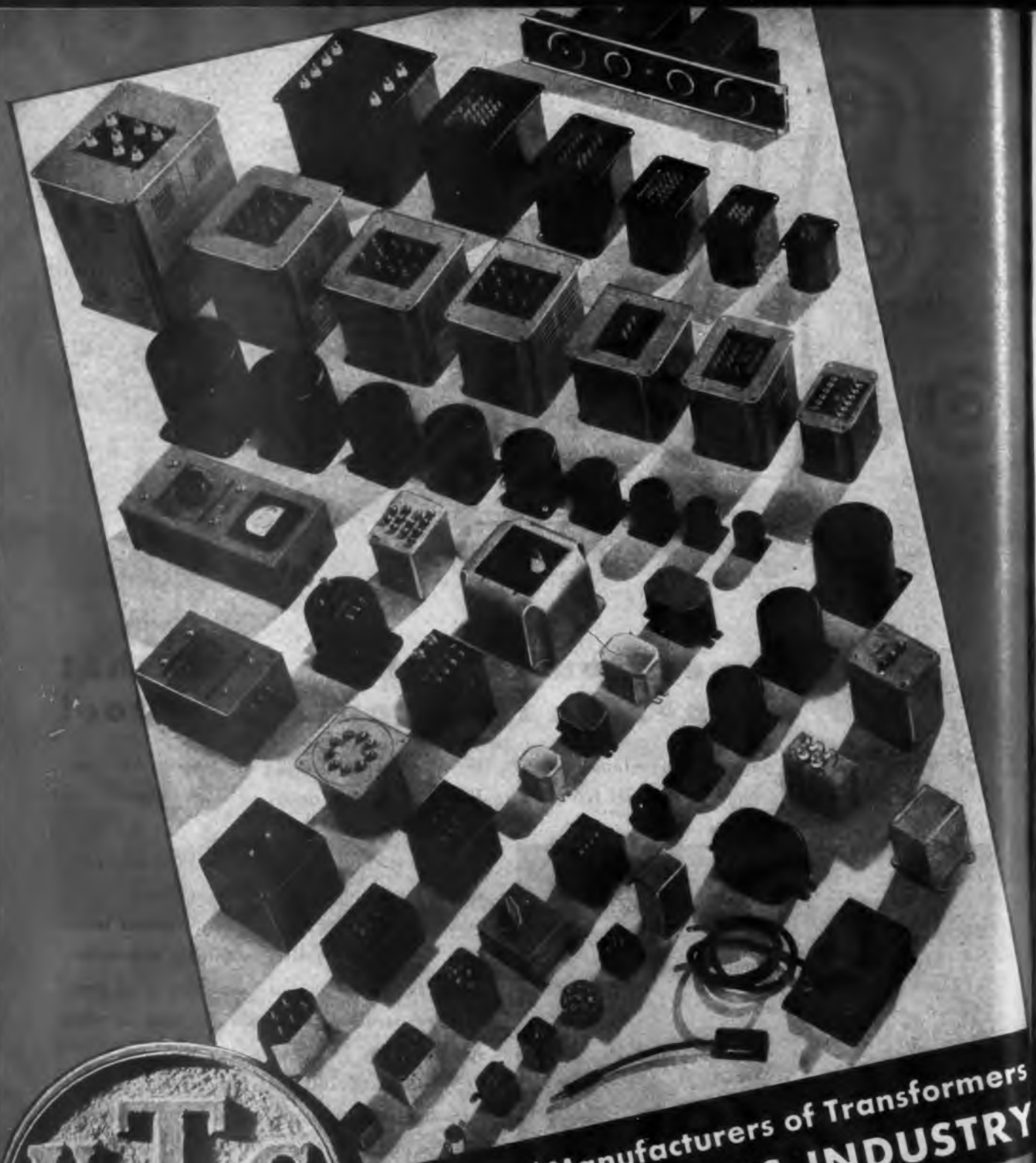

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ELECTRONIC INDUSTRIES

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

Ultra High Frequency Technic

The use of frequencies around 5,000 megacycles and the experience being gained at frequencies over 30,000 megacycles bring forth many unusual effects. The extremely high frequency of these radio waves makes possible their travel through metal pipes and solid tubes of dielectric. In order to "turn down the volume" on these microwaves one merely reduces the diameter of the pipe until the high-frequency wave bounces back and forth across the pipe so many times the losses reduce the output to the desired level.

The early days of radio are brought to mind by the use of crystals as detectors and modulators in this ultra-modern uhf practice. Since the wavelengths are less than 4 in. the fields around antennas, and in the mouths of radiating horns may be examined point-by-point with probe-like antennas connected to a crystal rectifier and microammeter.

Conventional tubes with control grids cease to function because of the sluggishness of the electrons at these frequencies. Other types of tubes which take advantage of the electron velocity to generate these extremely short waves become necessary. Oscillators become simpler as far as the number of parts and their placement goes and it is actually easier to generate 3 or 4 thousand megacycles than to generate 1,000 megacycles with conventional negative grid tubes.

Metal boxes, butter-churn paddles, pipes and horns of every shape and description are the new order of the day.

There Is No Free Lunch

As industry begins to emerge from under the war cloud, there is bound to be a sizeable crop of inventions which if not plainly chimerical, at least will cause a lifting of engineering eyebrows. After all, technically trained individuals are tough and are not very apt to accept at face value claims that the average man in the street accepts with avidity. Counting the really great things that are being done with vacuum tubes nowadays, the electronic industries likely will prove a fertile field for exploitation. But there are two very, very old homilies that may always be applied and that still represent a pretty good test. One of them is: Every action must have a reaction; the other—"There is no free lunch."

Simplifying Civilian Components

The simplification of civilian radio components which has been effected under the pressure of wartime production, is expressly limited to "the duration." When peace comes, radio manufacturers will be free to diversify their lines again as much as they wish.

Yet certainly something very fundamental has been accomplished when our widely varied components have been simplified as follows:

Volume controls	2700	types	cut	to	12
Electrolytic condensers	400	"	"	"	10
Paper condensers	320	"	"	"	9
Transformers, chokes	280	"	"	"	12
Tubes	700	"	"	"	250
Meters	1500	"	"	"	150

Such gains cannot be allowed to disappear when peace comes again. Users as well as manufacturers are bound to benefit from the savings which such a list indicates.

Swinging Around the Electronic Circle

The electronic art, Aloysius, isn't so new as the newspaper boys and stock-market enthusiasts picture it. And don't say it doesn't circle back over its early tracks, either!

For your Editor's own first contact with electron tubes dates back 46 years, to that day in 1898 when the first X-ray tube was brought into the office of an Indianapolis doctor, his father. That early X-ray tube was operated by the doctor's "static machine," and it was your Editor's job after school, toilsomely to turn the crank that generated the high-voltage sparks. Later he learned to connect up that '98 electronic tube, polarizing it carefully, anode and cathode, and also to use the fluoroscope and to take pictures. Then, a few years later, static machines became passé as X-ray sources.

But now in 1944, electronic history swings back, to repeat itself. For the latest power source for high-voltage industrial X-ray tubes is again a static machine, the new improved Van de Graaff generator. Compacted now to a height of only 9 or 10 ft. these 1944 generators and tubes are being made ready for industrial plants, to be taken right onto the job wherever a 12-in. steel casting needs looking into!

Industry

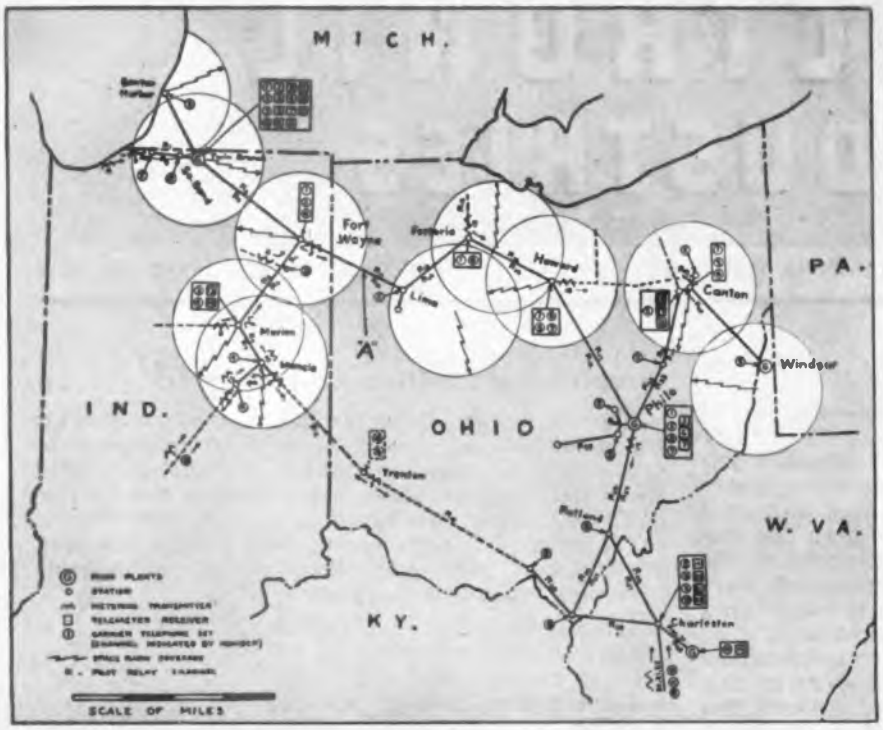


Fig. 1—Map outlining a portion of A.G.E. 132 kv system showing radio and carrier locations

Fig. 2—Torrey station, showing carrier relay transceiver in small cabinet at center, with coupling capacitor above it

● Electric utilities have made increasing use of electronic equipment for more than two decades. Today such equipment is giving material assistance in the wartime job of supplying more kilowatts per dollar of installed capacity than ever before. Carrier telephone, relaying, telemetering and control have become so useful as a means of coordinating the activities of men, and control of the equipment on large interconnected systems, that saturation of carrier frequency bands is becoming a major technical problem. Improved regulators, exciters, PA systems, time standards and many other devices resulting from electronic developments are each playing their parts.

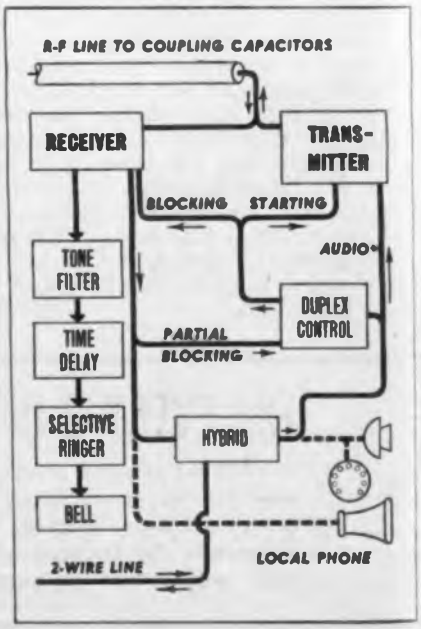
Line production

The methods of protecting transmission lines from damage and of maintaining electric service through storms, accidents, floods, and other disturbing influences, include among other things, multiple power circuits and generating sources to provide a diversity factor, ground wires to shield the lines, lightning arresters to limit surge voltages at substations, space radio to speed repairs, and protective relaying. Carrier relaying is most important.

The number of carrier sets of all types on the Central System of this company, operating in seven states, totals 342. These sets operate in the 50-to-150 kc carrier band and provide 150 separate carrier channels, which of course must also avoid interference with carrier channels used by neighboring interconnected companies. In one case, 18 different channels are used at a single station. This existing con-

Fig. 3—Main switchboard at Torrey; two right hand panels contain carrier relays and testing facilities

Fig. 4—Block diagram of single frequency duplex carrier set



USES of CARRIER CURRENT

by G. G. LANGDON*

Applications of low current electronic equipment that help coordinate super-power electric utility system

centration may be compared, on the one hand, with the original concept of the 1920's that 10 or 11 channels spaced 10 kc apart might be the practical limit for any one system; or, on the other hand with the continuing requirements for more channels in the future.

Consider a single line, section "A," of an extensive inter-connected high-voltage system such as shown in Fig. 1 and assume that lightning has caused a flashover on this line section. The power arc following the flashover will burn the line down and subject the system to a major disturbance unless the section is de-energized immediately. However, other line sections between the faulted section and the generating plants should remain in service to avoid preventable interruptions. The most effective solution of this problem uses carrier current relaying. The faulted line section is quickly opened at both ends and all other line sections remain closed and in operation.

With the ultra high-speed reclosing circuit breakers now coming into general use, such momentary faults as lightning flashovers can be cleared and the faulted line section placed back in service in less than one-third second, without much damage to the line and with a minimum of disturbance to the system or to connected synchronous motors. A typical time sequence for ultra high-speed reclosing with carrier relaying would be as follows:

(1) Fault occurs;
(2) Carrier relays energize correct circuit breakers in one cycle (on a 60 cycle system);
(3) Breakers open in 5 cycles;
(4) Line de-energized for 10 to 12 cycles to allow ionized gases at the arc to clear away from conductors before circuit breakers reclose and return the line to normal, in a total time of 16 to 18 cycles.

Part electronics plays

The part which electronics plays is the transmission and reception of carrier signals from one end to the other of each line section. The method is based on the fact that if fault power flows out of any line section, the fault cannot be within that section. In a typical set-up, if fault power flows into one end of a line section and out of the other (section not faulty) the "out" end automatically telegraphs a carrier signal to the "in" end which prevents the circuit breakers from opening. If fault power flows into

*American Gas & Electric Service Corp., 30 Church St., New York

Fig. 6—Linemen, replacing insulator on 6.9 kv line, can be called in emergency by space radio

Fig. 7—Portable five-watt carrier telephone with self-contained handset and lead-in conductor

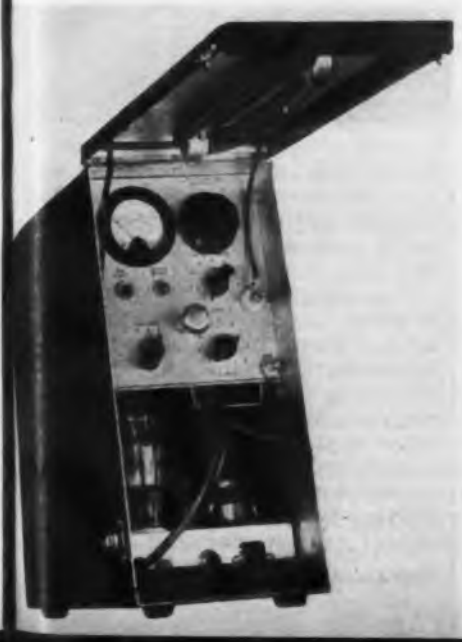


Fig 5—Carrier room at Sunnyside substation. Extension phones for supervisor's office being placed in service

one end of a line section and not out of the other, or if it flows into the section from both ends, the carrier signal is not transmitted, allowing both circuit breakers to trip out and clear the fault.

Each carrier relay terminal consists of a high-voltage coupling capacitor, a carrier current transceiver (Fig. 2), a power directional relay, a receiver relay, fault detector relays, and testing facilities (Fig. 3). Fault detector relays detect the presence of an abnormal condition, making it unnecessary to transmit carrier continuously; the power directional relay determines whether the fault power flows into or out of the section being protected, and contacts on these relays start or stop the carrier transmitter.

Typical carrier-relaying transceivers, designed for either indoor or outdoor use and to operate from station battery power supply, provide 15 to 25 watts output and have single or two-tube receivers. Received energy levels are on the order of one watt to provide a high margin against interference. Particular attention is paid to reliability in the design, construction, installation and maintenance of the equipment. Carrier relaying is the only practical method of protecting long lines by providing instantaneous clearing of all types of faults.

Power line carrier telephony started shortly after World War I and it has since become increasingly important in the operation of large electric utility systems. It has solved the problem of rapid and reliable communication between the system dispatchers or load supervisors and all major power plants and stations. It has also provided communication channels between interconnected companies for supervision of power interchange between them. In addition to its use for system operation, power line carrier has also found considerable application for administrative, maintenance and construction uses.

On the American Gas & Electric Co. system, single frequency duplex or single frequency simplex (push-to-talk) equipment is used for system operating purposes because the party line type of system is advantageous in this service and also because this method conserves frequencies. Fig. 4 illustrates the method used for duplexing on a single frequency.

Voice operated electronic keying starts the transmitter and blocks the receiver when the microphone is spoken into. Similarly the transmitter is partially blocked during reception to prevent it from being started falsely, which would create an unstable condition interfering with reception. Only partial blocking of the transmitter is used, because it is important that the operator to be able to gain control of the transmitter during lightning storms or other severe interference which might otherwise keep the transmitter blocked continuously; "fair weather" communication does not meet operating requirements.

The usual installation provides selective ringing for normal use, but loud speaker standby for emergencies because the latter is the speediest method known. Transmitters are 25-watt, plate modulated, with modulation limiting and crystal control. Receivers are made as selective as practical, use fixed tuning, automatic volume control, and squelch. Rack mounting in cubicles as shown in Fig. 5 provides uniform appearance, design flexibility, and accessibility for maintenance.

Operating over ruggedly constructed transmission lines, such as the one shown in Fig. 6, carrier has repeatedly been the only remaining means of communicating out of many stations during severe storms and it is playing an important part in the wartime operation of the system by providing necessary communication with a minimum expenditure of critical materials.

Fig. 8—Turner station. Carrier receiver in cubicle at left drives graphic recorder at bottom (Scale 100-0-100 megawatts) recording interchange with the Ohio power company at Philo. Top recorder shows system frequency (59 to 61 cycles)

Fig. 10—Curve of sleet-detector readings during storm. Reduced signals caused by ice coating of ½ in. at one point tapering to 1/16 in. four miles in either direction. A sleet melt was indicated at 9:30 A.M. but other more heavily iced lines were melted first

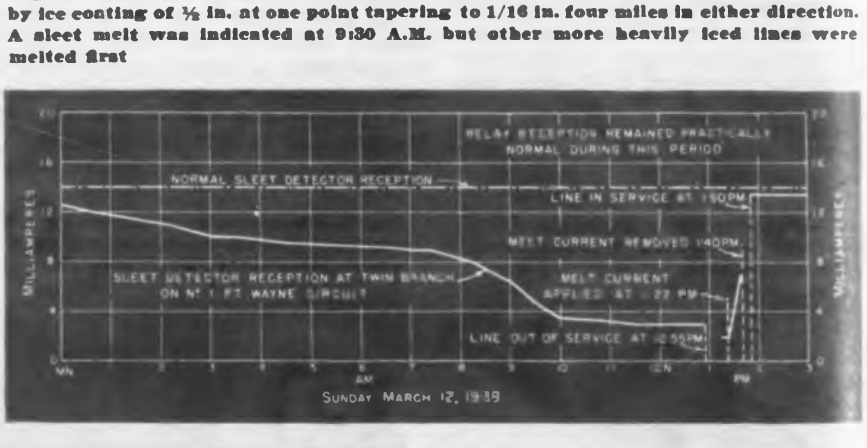


Fig. 9—Main switchboard at Winfield hydro plant. First four panels contain supervisory control equipment for operating this plant from Turner station. Carrier equipment installed outdoors at both locations

Portable carrier telephones are used extensively by a special transmission line maintenance department, operating in three states. Each truck is equipped with a 5-watt portable two-way push-to-talk carrier telephone set for operation on any of three carrier telephone dispatching channels into any type of line coupling and powered from truck through 500 to 1,000 feet of power supply cable installed on a motor-driven drum. These sets have a two-way range up to about 150 miles of line. Coupling points, made by insulating the regular ground wire (top conductor on steel tower Fig. 6) and installing a heavy lead down the tower to a convenient point where it remains grounded through a heavy knife switch when not in use, have been installed at selected points where the 132,000-volt lines are accessible by truck.

In operation, the portable sets are coupled at points where line work is being done and are used by linemen for communication with system supervisors and with their own headquarters. These portables have made it possible to handle many repair or reconstruction jobs in approximately half the time previously required when the nearest telephone—often of the farm type—was used. They are also valuable for patrol work. The set shown in Fig. 7 may be used during extremely bad weather by closing the front cover after removing the hand set and lead-in conductor. They cannot be used enroute as with space radio though their use is not limited to emergencies. The range is such that repeating is unnecessary, and installed cost is very low for the coverage obtained.

Carrier telemetering

In wartime to an even greater extent than in peacetime it is necessary that load schedules be set up between interconnected electric companies to effect a maximum utilization of lines and plant generation with a minimum strain on the coal pile. These schedules take into account, among other things, the efficiencies of generation, load diversity, use of waterpower when available, and coordinated construction programs. There may also be hour-to-hour schedules between companies to take care of load changes on dark days, temperature changes and other local occurrences which affect the load. By this means interconnected companies are enabled to carry the constantly increasing wartime loads with a minimum expenditure of critical materials and fuel.

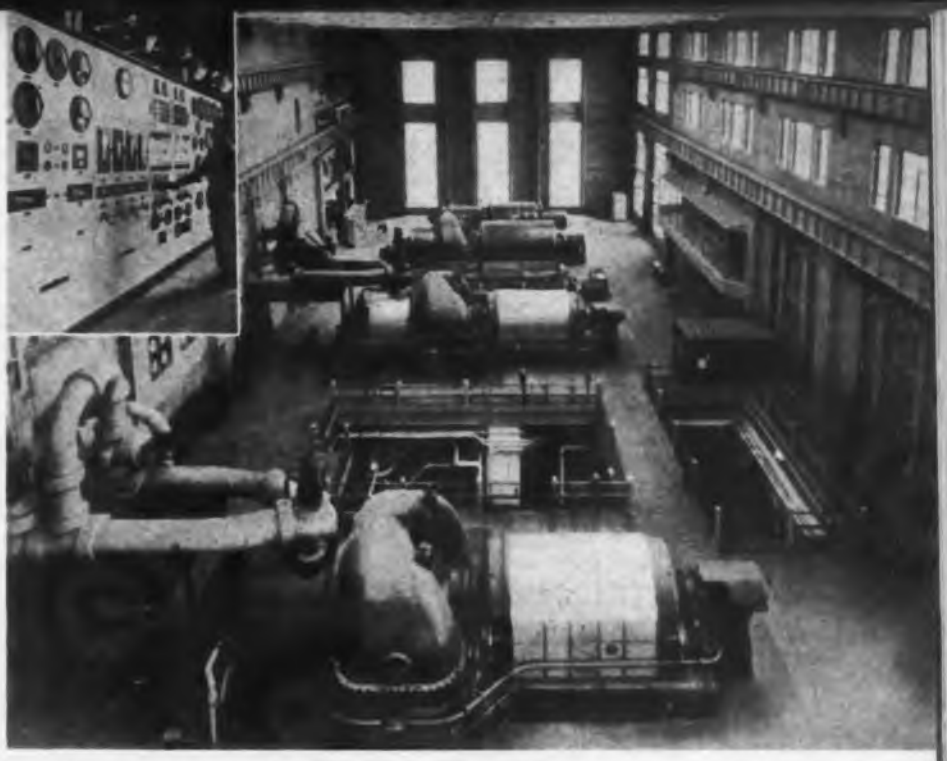


Fig. 11—Turbine floor at Twin Branch plant. Insert is close-up of PA system speakers at far left

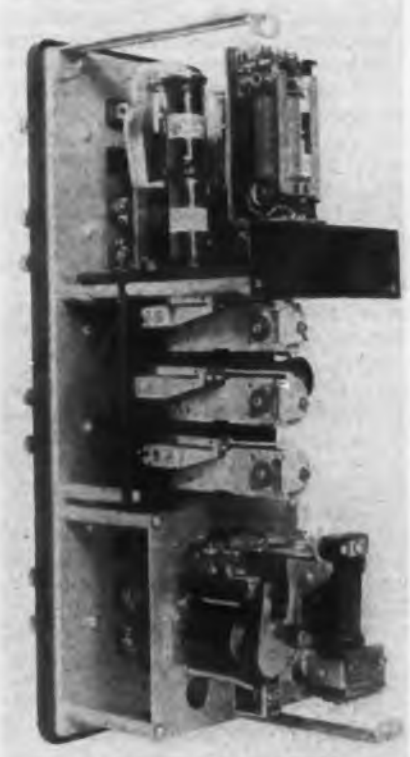


Fig. 12—Automatic synchronizer uses two low-power vacuum tubes

Setting up such load schedules is only part of the job; adhering to them is another intricate part which may involve, for example, seeing to it that a certain tie line having a carrying capacity of 200,000 kva carries 190,000 kva without tripping out on load swings. Here is where carrier telemetering fits into the picture by giving the load supervisors a continuous graphic record (see Fig. 8) of the load on all important tie-lines and power plants. From this information, off-schedule load trends can be "nipped in the bud" and by direct carrier communication between supervisors of neighboring companies, the "step in time" of readjusting the generation at various plants can be taken. Telemetered readings may be combined locally to give total or net power interchange between companies on a single chart where necessary.

(*Continued on page* 198)

Fig. 13—Electronic exciter at Torrey. GF-172 Thyratrons at top left in protective covers. Six type FG-238-A ignitrons are in separate cubicles behind first three panels. Fifth and sixth panels contain control and protective equipment for the 30,000 kva synchronous condenser. Automatic oscillograph on sixth panel records line faults

PLANNING NEW PRODUCTS

The problem is not merely to find another item, but to find the optimum one for your own particular situation

● The most important part of any company's postwar or future plan is that dealing with new products. There is an old saying that man, as he grows older, either goes forward or backward—he never stands still. This is just as true with any kind of business. And with companies engaged in electronic industries, it is more than true.

There is a lot more to going forward than just sitting back and dreaming up new products. That, especially in electronics, is easy. But what is not so easy is to get that one, (or if you really hammer away at the job, more than one), certain product that will click.

Now the man who has been brought up in merchandising and has become successful at it has developed a sort of sixth sense as to what will or will not click with the public. Give him a sample to see or feel, and he will have a definite reaction. He will be right more often than wrong. He may require market surveys, studies of buyer attitude, dealer needs, salesmen's attitudes, competitors' products, pricing tests, territory potentials, buying habits or experience data. But given these, he will be able to say whether or not it will be successful and give a good sound estimate of how many can be sold at a certain price and even who will be the probable purchasers.

Should we make it?

Suppose we have studied a new product just this way and the answer is "yes." Does that mean that we should make it? The answer seems obvious but a study of business failures in any field would show that probably more losses resulted from diving into a product that "clicked" merchandise-wise than from not going into any new products at all. And often the action taken was based on sound merchandising investigation rather than hunch play.

For example, a company, now extinct, went into "commercial" production of "scanning disk" type television receivers not once but three times in a one-year period during the very early thirties. This was quite a costly procedure, but not so much so as some of the other classic flops that have studded the last three decades of our industry. One may ask, "If I can't depend on this type of information, what can I use as a guide? How can I know whether this particular product will not only click merchandise-wise, but also prove to have clicked when scrutinized by hindsight as to its having been a profitable addition to our business?"

Basic analysis

This doesn't mean that a merchandiser's judgment of a product is valueless. On the contrary, it is absolutely necessary at some stage of the tedious process of evaluating the application of the product to the particular company that is doing the searching. But it does mean that something far more important from a basic analysis standpoint must be answered. Only by carefully studying the various internal factors involved can a really satisfactory judgment of a product be made.

What do we mean when we say internal factors? This can best be answered by a negative such as "those things which do not bear on our customer relationship". In other words, starting backwards from the warehouse door and keeping right on until we are back to the smallest component or piece of raw material. Then completely segregating out all matters of sales methods, discount policies, retail price, advertising—in other words all those things which our merchandiser evaluated to decide that he had a product that clicked.

The keyman in a small business is so used to dealing with a complete operating statement, not just the half that comes ahead of "cost of sales", that he often subconsciously acquires a handicap in competing with the larger companies where specialization of function is the rule—for better or for worse. The larger company often runs into trouble because the trained merchandiser keeps right on merchandising—even to selling his particular new product to top management.

The result is that those who are responsible for the ultimate successful manufacture of that product quite frequently find themselves in an already advanced situation where they either have to be regarded as "bucking the management", "not being progressive", or, on the other hand, must do the best they can in making a product that may be almost totally unsuited to their organization, equipment or type of operation.

The purpose of this article is to outline broadly the type of thinking necessary to evaluate the more important internal factors. A subsequent article will deal with the subject of how to set about gathering the required data and a third with some suggested ways of arranging this material in report form.

Key factors

To start with, let's list the things that we should know, or be able to make an informed estimate of, before even passing an opinion on how well a product lines up with our abilities, present and potential. The check list accompanying puts these in question form. There undoubtedly may be others because a general list of this sort cannot exactly fit each type of electronics industry. For example, a vacuum tube manufacturer will be interested greatly in shrinkage possibilities or exhaust equipment, while a test equipment assembler may have entirely dissimilar problems. The internal factors here discussed have been chosen because, broadly speaking, they apply in some degree to almost any kind of electronic enterprise.

First, a general investigation of the product itself—not as an article of merchandise, remember, but as an article of manufacture. Why did others who tried it give up, or if they are still making it, can our shop make it cheaper or better? Unless we can, shouldn't we stop right here and look for a product that shows promise of needing a real job done with it? Or if no one has ever made it before—why? So often something that looks brand new has a hidden weakness,

for POSTWAR MARKETS

often engineering or production-wise, that has been a red "stop" sign to everyone who has explored its potentialities.

There is one example of a "new" product that has been going the rounds so long that its patents have now expired. A succession of promoters have been extolling its virtues to anyone who would listen. Merchandise-wise, it is perfect, if the claims made for its performance and cost could be realized. In every case where a manufacturer has become interested, he has, sooner or later, concluded to reject the idea. Invariably it is an "internal factor". This is merely an illustration, but significant in that it shows how great a mistake might be made, if internal factors are glossed over because of over-enthusiasm from a merchandising point of view.

Study of the patent and licensing situation on a new product is a subject all by itself, especially when viewed in the light of current governmental thinking. All that need be said here is: use care and diligence.

Unless the product we are viewing under our internal factor microscope is very, very good, it should be definitely related to our present line. The grass is always greener in the other field, but an ounce of "know how" is worth a pound of grass, especially when the grass may turn out to be brown and dry rather than green and fresh.

Importance of design

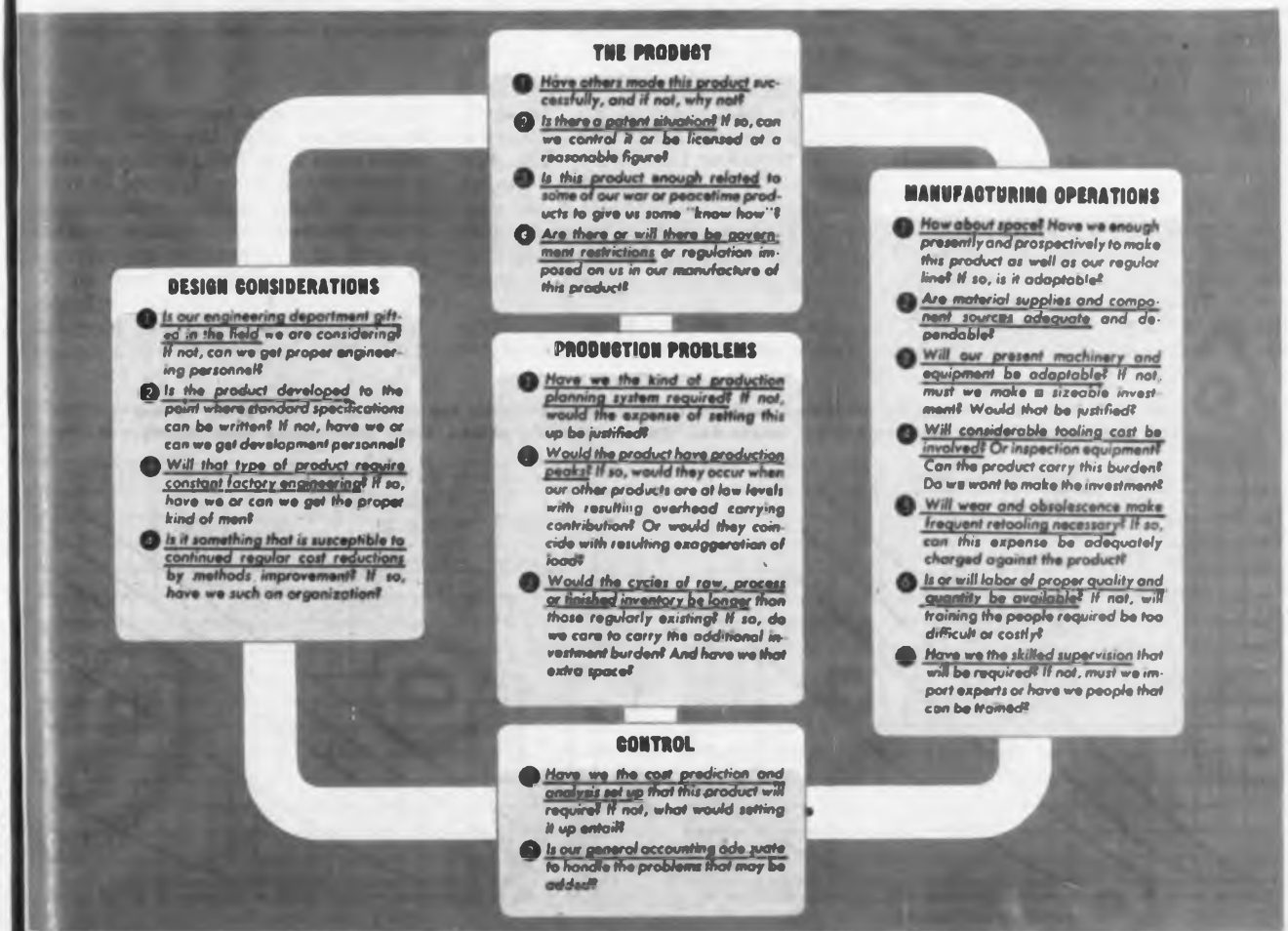
What we don't know about the other man's troubles and headaches may be stimulating to our outlook on his kind of product, but it might well fill a book—with red ink. And "related" doesn't mean that everything electronic in nature is related. A delicate thermocouple-operated relay is as much akin to a twenty-kilowatt transmitter as a flea is to an elephant—both in delicacy of design and in appetite for space and money consuming nourishment.

Possible restrictions or regulations of a government nature carrying over into the postwar period are the subject of concern in many quarters. No new product should be decided upon without at least doing some informed guessing on these points. They might matter a great deal.

Second in our broad classification of internal factors, is the design of the product. Generally speaking, we should look at its design for things other than appearance and customer appeal. They may be very good but we must know how well it can be made, what troubles we will have, what the chances are of correcting them, whether it can be made cheaper and better as time goes on. We should find out what kind of an engineering and manufacturing organization—mentally—we have for this kind of a product.

(Continued on page 252)

INTERNAL FACTORS THAT AFFECT THE NEW PRODUCT



USING SERIES TUBES AS

by WILLIAM MOULIC
Associate Editor

Linearity characteristics of series operated direct coupled tubes. Factors influencing gain and performance

● Direct coupled operation of vacuum tubes for amplifiers is old and in most instances superseded by mutual impedance coupling and dc blocking methods. In recent years many systems, particularly cathode ray oscillograph and television circuits, have required the association of the dc component with the actual signal, thus requiring direct coupling from each plate to following grid. In the usual form of a direct coupled amplifier circuit, each plate is returned through a load impedance to a point successively higher in voltage on a power supply bleeder than the previous tube. Bias is obtained by several standard methods.

A variation of this direct coupling method is shown in Fig. 1. Here, a tube T_2 (triode or pentode) is used as the plate load impedance for the input tube T_1. The load tube T_2 receives its grid signal voltage from the degenerative i_p R_k drop voltage across the drive resistance R_k. The dc current component, I_b, produces a bias for the grid of T_2.

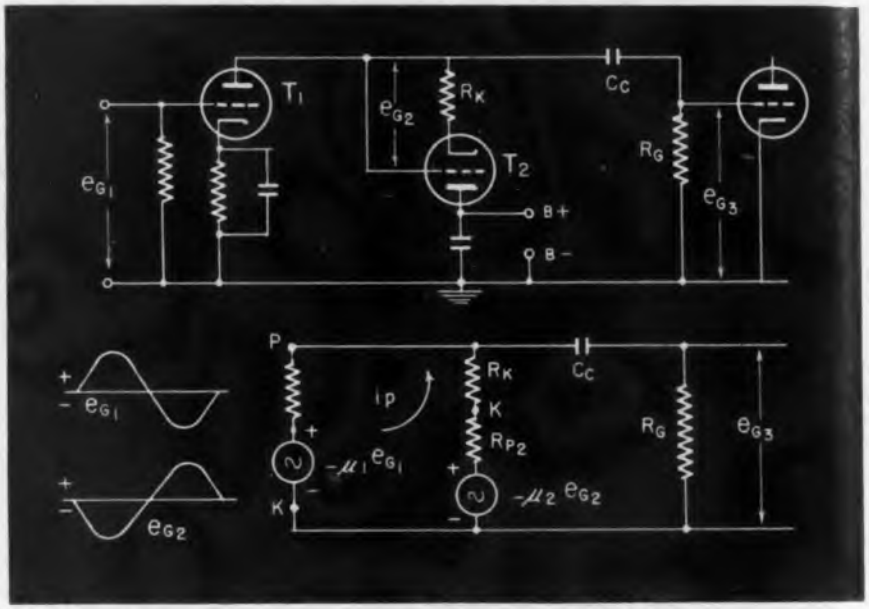


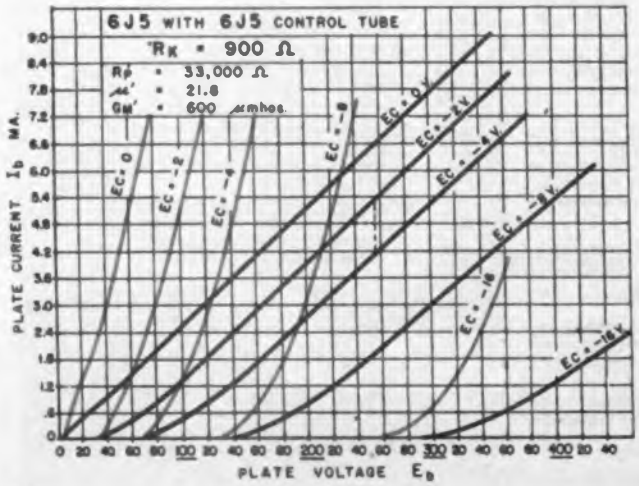
Fig. 1—Typical circuit with tube T_2 acting as load impedance for input tube T_1. Voltage E_{g2} is developed across R_k. Equivalent circuit below shows relative polarity of equivalent generators

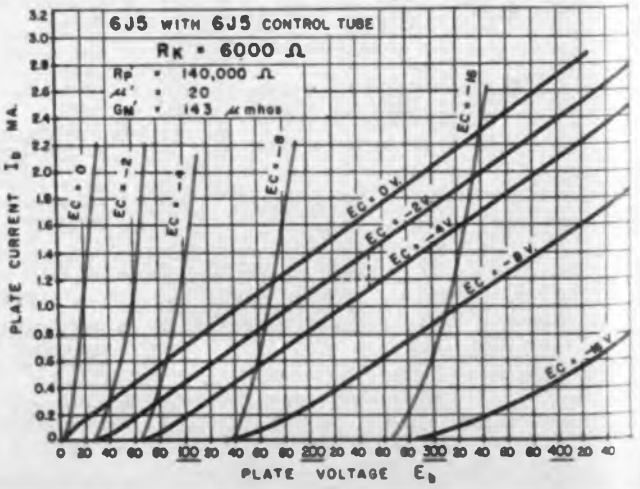
Equivalent circuit

On the constant voltage equivalent circuit shown in Fig. 1 are the relative instantaneous polarities of the equivalent plate circuit generators. This relation is explained by the degenerative connection of T_2. As i_p increases with an applied positive half-cycle of e_{g1}, the i_p R_k drop increases making e_{g2} increase on a negative half-cycle. The two equivalent plate circuit voltages $-\mu_1 e_{g1}$ and $-\mu_2 e_{g2}$ are each 180 deg. out of phase with their respective grid voltages and therefore 180 deg. out of phase with respect to each other.

As the plate resistance of a tube increases with increased negative grid voltage and conversely, it may be expected that the operation of tubes such as in Fig. 1 would produce a more linear E_b vs. I_b plate characteristic than either tube alone. Since decrease in negative voltage on grid of T_1 produces an increase of negative voltage at grid of T_2, the plate resistance R_{p1} will decrease while R_{p2} of T_2 will increase. The result should be a more

Fig. 2—Plate characteristics of series combination of two 6J5 tubes for cathode resistance R_k of 900 and 6000 ohms. Curves in color are for single 6J5. Tube constants shown were determined graphically.





CONTROL IMPEDANCES

nearly constant total impedance to A C. and consequently a more linear plate characteristic. This conclusion is shown to be true in the experimental $E_b - I_b$ curves for two 6J5 tubes in series as shown in Fig. 2. The conventional 6J5 characteristic curves are shown superimposed in color on Fig. 2.

The gain of a circuit such as that of Fig. 1 may be expressed as

$$\alpha = \frac{\mu R_L}{R_p + R_L} \qquad (1)$$

where

$$\mu = \mu_1, \quad R_p = R_{p1}$$

neglecting for the moment the shunt loading action.

From the equivalent circuit,

$$R_L = \frac{E}{i_p} = \frac{\mu_1 E_{g1} - i_p R_{p1}}{i_p} \qquad (2)$$

and,

$$i_p = \frac{\mu_1 E_{g1} - \mu_2 E_{g2}}{R_{p1} + R_{p2} + R_k} \qquad (3)$$

where,

$$E_{g2} = i_p R_k \qquad (4)$$

Substituting (4) in (3) and solving,

$$i_p = \frac{\mu_1 E_{g1}}{R_{p1} + R_{p2} + (1+\mu_2) R_k} \qquad (5)$$

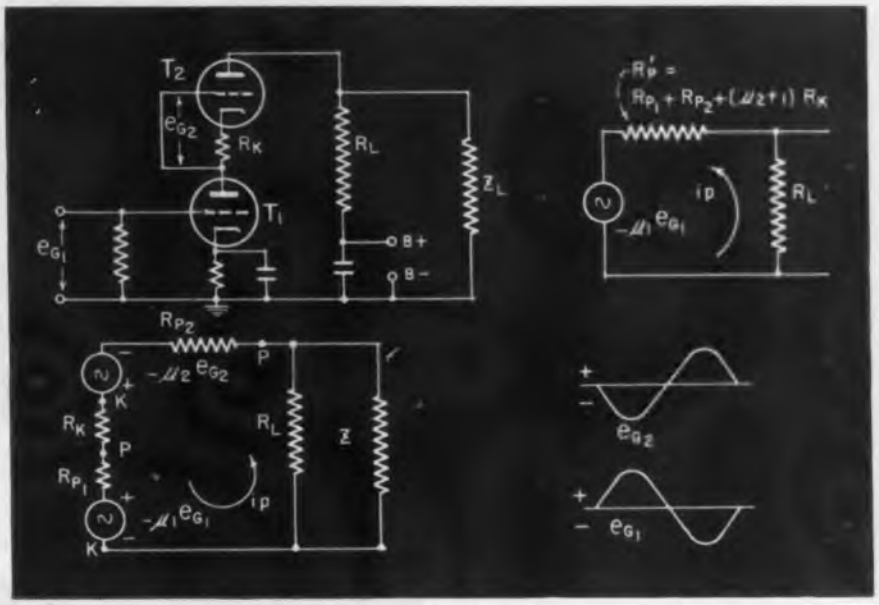


Fig. 3—Actual and equivalent circuits for series tubes working into resistance load. Voltage E_{g2} is developed across resistor R_k 180° out of phase with E_{g1}

The equivalent load impedance is then

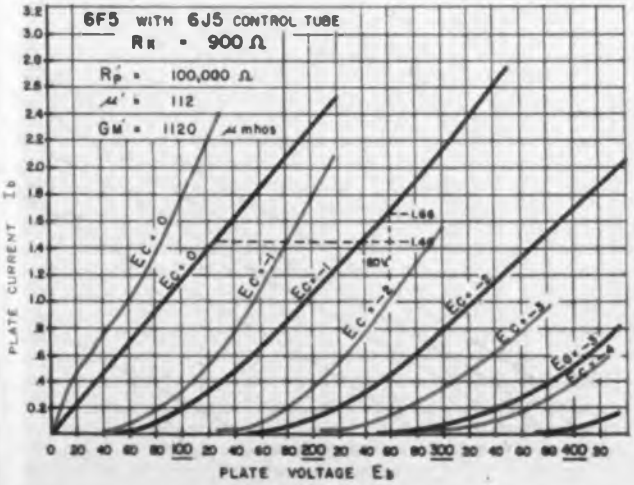
$$R_L = R_{p2} + (1+\mu_2) R_k \qquad (6)$$

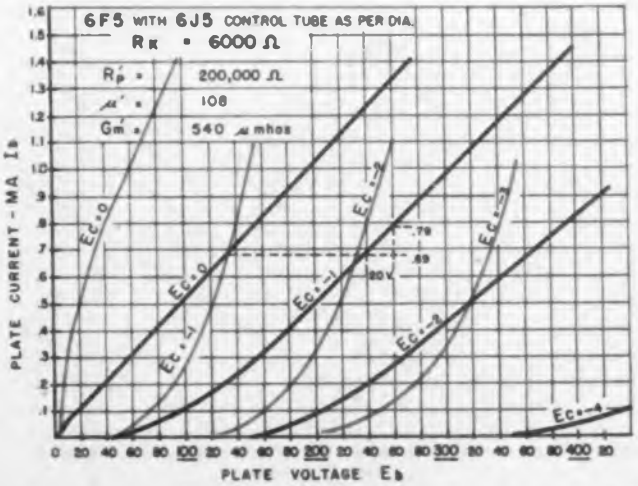
From (6) it is seen that the dynamic load impedance can be made very large if a high μ tube is used as T_2. Since high μ tubes also have high values for R_{p2}, further increase in the dynamic R_L results. The dynamic R_L may be 10 or more megohms a value that would be impossible with an actual resistance in practical circuits since the dc voltage drop would be near 10,000 volts. Since the dc resistance of T_2 is a few hundred thousand ohms, much lower power supply voltages are required. The gain of this tube combination approaches μ_1, as a limit (as the load impedance approaches ∞).

A second method of using tubes in series is shown in Fig. 3. Here, T_1 and T_2 act as a combination of two series generators, the voltage of one being controlled by the other. This combination is equivalent to a hypothetical tube having plate characteristics similar to Fig. 2, Fig. 4, and Fig. 7.

From the equivalent circuit for

Fig. 4—Plate characteristics of series combination of 6F5 input tube with 6J5 as load tube for R_k values of 900 and 6000 ohms. Curves in color are for 6F5 alone





this combination as shown in Fig. 3, it is apparent that the hypothetical tube has a much greater plate resistance. The new R'_p and other factors may be calculated as follows.

Neglecting for the moment the shunt action of a load Z, the current is

$$i_p = \frac{\mu_1 E_{g1} - \mu_2 E_{g2}}{R_{p1} + R_{p2} + R_k + R_L} \qquad (7)$$

Substituting (4) for e_{g2} and solving,

$$i_p = \frac{\mu_1 E_{g1}}{[R_{p1} + R_{p2} + (1+\mu_2) R_k] + R_L} \qquad (8)$$

The gain of the circuit is, therefore,

$$\alpha = \frac{\mu_1 R_L}{R'_p + R_L} \qquad (9)$$

where,

$$R'_p = R_{p1} + R_{p2} + (1+\mu_2) R_k \qquad (10)$$

From (9) and (10) it is seen that the hypothetical tube has the same μ as T_1, the input tube, but a much larger R_p. The transconductance, Gm, is therefore reduced below that for T_1 alone.

Values for μ, R_p and Gm may be calculated graphically as shown in Fig. 4. In this instance a 6F5 is operated in series with a 6J5 acting as the control impedance. Fig. 2a is a plot of data taken with R_k = 900 ohms and Fig. 2b has an R_k value of 6000 ohms.

In the case of Fig. 2a, the reciprocal of the slope of the $E_b - I_b$ curve at $E_c = -1$ and $E_b = 250$ V. gives R_p = 100,000 ohms. The measured μ is 112 and Gm is 1120 micromhos.

(*Continued on page* 194)

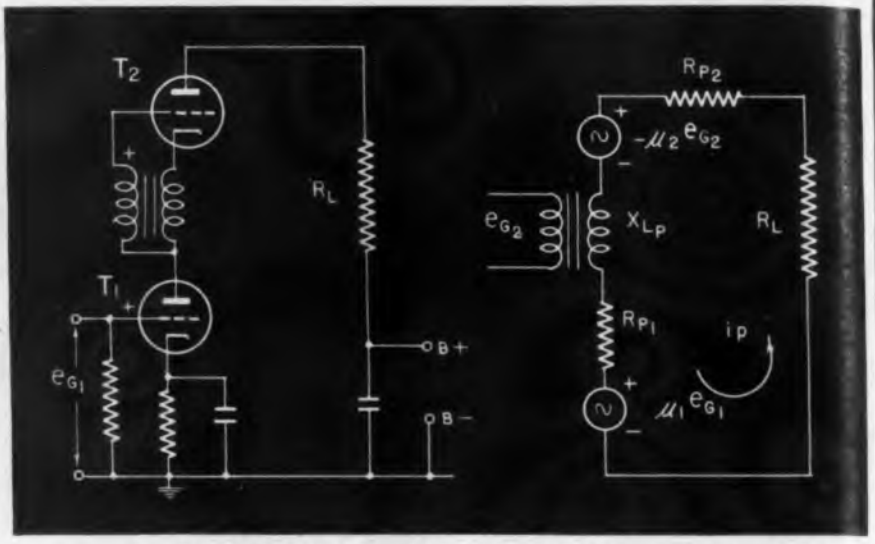


Fig. 5—Actual and equivalent circuit for transformer coupled series tubes. Equivalent circuit voltages 90° out of phase approximately

Fig. 6—Three tubes operated in series with resistance R_L as load. Phase relations of grid voltages shown on equivalent circuit

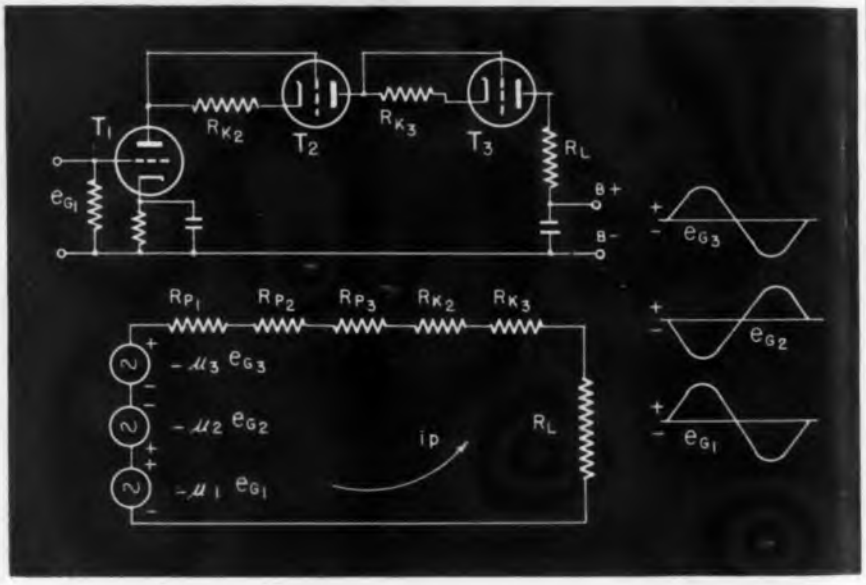
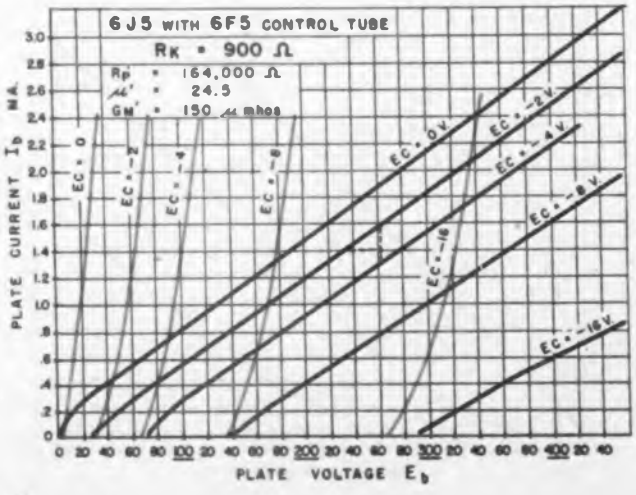
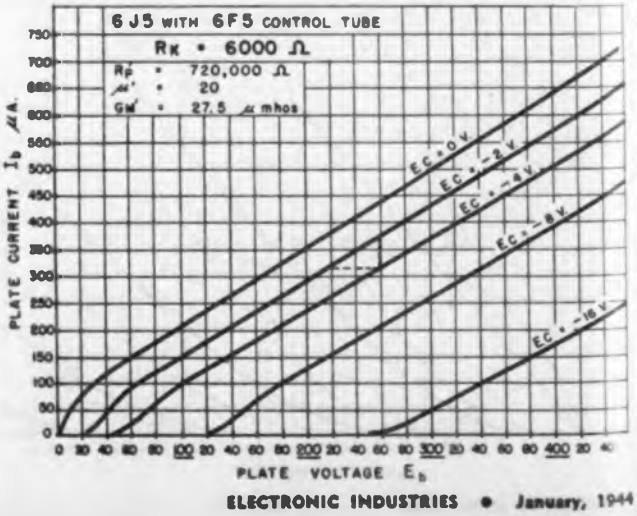


Fig. 7—Plate characteristics for series operated 6J5 input tube and 6F5 load tube for coupling resistance R_k of 900 and 6000 ohms. Curve in color is for 6J5 operated alone





1944 STATISTICAL Picture

Radio-electronic output, civilian and military totals. How production and use compare during past 20 years

● From the very beginning of broadcasting the present publishers of "Electronic Industries" have been compiling the annual statistics of civilian radio. Continuing the practice of many years in past January issues of "Radio Retailing" and "Radio Today," there are summarized on this page past radio figures. And new statistics for the current situation are also presented.

With civilian radio production almost completely shut down, except for a limited number of tubes and repair parts, it has proven impracticable to give detailed figures on 1943 wartime output of components, transformers, condensers, volume controls, etc., since such data might reveal military radio production secrets.

THE RADIO INDUSTRY, JANUARY 1, 1944

	Total Investment	Annual Gross Revenue	Number of Employes	Annual Payroll
Radio manufacturers (1200)	$350,000,000	$3,500,000,000	400,000	$900,000,000
Radio distributors, dealers, etc.	280,000,000	200,000,000	100,000	150,000,000
Broadcasting stations (947)	90,000,000	215,000,000	*20,000	55,000,000
Commercial communication stations	60,000,000	———	15,000	7,000,000
Listeners' sets (57,000,000)	3,600,000,000	———	———	†320,000,000

*Regular staff—not including part-time employes, artists, etc., who number at least 25,000 more, and earn in talent fees $45,000,000.

†Annual operating expense for listeners' sets, for tube replacements, electricity, servicing, etc.

Civilian Sets in Use

	Jan. 1, '43	Jan. 1, '44
U. S. homes with radios	30,800,000	30,000,000
"Secondary" sets in homes	16,660,000	16,000,000
Battery portables	3,130,000	3,000,000
Auto radios	8,750,000	8,000,000
Total sets in use, U.S.	59,340,000	57,000,000

Annual Bill of United States for Radio

Sales of time by broadcasters, 1943	$215,000,000
Talent costs	45,000,000
Electricity, batteries, etc. to operate 57,000,000 receivers	200,000,000
17,000,000 replacement tubes	19,000,000
Radio parts, supplies, etc.	70,000,000
Phonograph records—120,000,000	52,000,000
Total	$601,000,000

Note: WPB ordered (April, 1942) all civilian radio-set production stopped and factories converted to war production.

PRODUCTION OF CIVILIAN RADIO EQUIPMENT—1922 TO 1943

	Total Civilian Sets Manufactured		Total Civilian Tubes Manufactured		Automobile Sets Manufactured		Total Reception Equipment	Auto Sets in Use	Homes with Radio Sets	Total Radio Sets in Use in U.S.	At Close of
	Number	Value	Number	Value	Number	Value	Value	Number	Number	Value	
1922	100,000	$ 5,000,000	1,000,000	$ 6,000,000	.....	.....	$ 60,000,000	.....	60,000	$ 1,400,000	1922
1923	550,000	15,000,000	4,500,000	12,000,000	.....	.....	136,000,000	.....	1,000,000	1,500,000	1923
1924	1,500,000	100,000,000	12,000,000	36,000,000	.....	.....	358,000,000	.....	2,500,000	3,000,000	1924
1925	2,000,000	165,000,000	20,000,000	48,000,000	.....	.....	430,000,000	.....	3,500,000	4,000,000	1925
1926	1,750,000	200,000,000	30,000,000	58,000,000	.....	.....	506,000,000	.....	5,000,000	5,000,000	1926
1927	1,350,000	168,000,000	41,200,000	67,300,000	.....	.....	425,600,000	.....	6,500,000	6,500,000	1927
1928	3,281,000	400,000,000	50,200,000	110,250,000	.....	.....	690,550,000	.....	7,500,000	8,500,000	1928
1929	4,428,000	600,000,000	69,000,000	172,500,000	.....	.....	842,548,000	.....	9,000,000	10,500,000	1929
1930	3,827,800	300,000,000	52,000,000	119,600,000	34,000	$ 3,000,000	496,432,000	.....	12,048,762	13,000,000	1930
1931	3,420,000	225,000,000	53,000,000	69,550,000	108,000	5,940,000	300,000,000	100,000	14,000,000	15,000,000	1931
1932	3,000,000	140,000,000	44,300,000	48,730,000	143,000	7,150,000	200,000,000	250,000	16,809,562	18,000,000	1932
1933	3,806,000	230,099,000	59,000,000	49,000,000	724,000	28,598,000	300,000,000	500,000	20,402,369	22,000,000	1933
1934	4,084,000	270,000,000	58,000,000	36,600,000	780,000	28,000,000	350,000,000	1,250,000	21,456,000	28,000,000	1934
1935*	6,026,800	330,192,480	71,000,000	50,000,000	1,125,000	54,562,500	370,000,000	2,000,000	22,869,000	30,500,000	1935
1936*	8,248,000	450,000,000	98,000,000	69,000,000	1,412,000	69,188,000	500,000,000	3,500,000	24,600,000	33,000,000	1936
1937*	8,064,780	450,000,000	91,000,000	85,000,000	1,750,000	87,500,000	537,000,000	5,000,000	26,666,500	37,600,000	1937
1938*	6,000,000	210,000,000	75,000,000	93,000,000	800,000	32,000,000	350,000,000	6,000,000	28,000,000	40,800,000	1938
1939	10,500,000	354,000,000	91,000,000	114,000,000	1,200,000	48,000,000	375,000,000	6,500,000	28,700,000	45,200,000	1939
1940	11,800,000	450,000,000	115,000,000	115,000,000	1,700,000	60,000,000	584,000,000	7,500,000	29,200,000	51,000,000	1940
1941	13,000,000	460,000,000	130,000,000	143,000,000	2,000,000	70,000,000	610,000,000	8,500,000	29,700,000	56,000,000	1941
1942	4,400,000	154,000,000	87,700,000	94,000,000	350,000	12,250,000	360,000,000	8,750,000	30,800,000	59,340,000	1942
1943	.....	.....	17,000,000	19,000,000	.....	.....	60,000,000	8,000,000	30,000,000	57,000,000	1943

*Figures for sets include value of tubes in receivers. In normal years replacement tubes have run 25% to 40% of total tube sales. All figures are at retail values. (Statistics Copyrighted by Caldwell-Clements, Inc.)

IRE-AIEE Winter Meeting

Annual technical session, internationally flavored, to include joint engineering evening with AIEE

● Grown from an initial membership of fewer than 50 in 1912 to an international roll of more than 11,000 members this year, the Institute of Radio Engineers on January 28 and 29 celebrates the beginning of its thirty-second year with its 1944 Winter Technical Meeting, to be held at the Hotel Commodore in New York.

In addition to furnishing two days of top notch technical fare, the gathering will also signalize still closer liaison between the IRE and its electrical cousin, the American Institute of Electrical Engineers through the scheduling of a joint technical session of these two bodies. That meeting is to be held on Thursday evening, January 27, immediately preceding the IRE gathering, and will be held in the Engineering Societies Building, 33 West 39th street, New York. AIEE is to hold its annual technical meeting during the week of January 24, but for the convenience of IRE members who may wish to attend sessions having to do with communications, all such matters are to be concentrated in an AIEE sessions scheduled for Thursday afternoon preceding the joint IRE-AIEE technical session that evening.

International flavor

The IRE gathering, it is planned, is to have a distinctly international flavor. In addition to devoting much of their time and talks to war aspects of radio and electronic engineering, members are to hear a number of foreign engineering experts including prominent British, Russian and Chinese authorities who will outline radio and electronic matters peculiar to their respective countries.

It was in May, 1912 that the Institute of Radio Engineers first came into being through the merging of two organizations active in the technical radio field. One of these was the Wireless Institute, with headquarters in New York The other was Society of Wireless Telegraph

(*Continued on page* 194)

Joint IRE-AIEE Technical Session

Thursday, January 27, 1944 (Engineering Societies Bldg.)
33 West 39 Street, New York

2:00 P.M.—American Institute of Electrical Engineers Session.
Five electronics and communication papers:
"A Short-Cut Method of Estimating the Telephone Interference Factor of Power Systems with Rectified Load," by C. W. Frick (General Electric Co.).
"Crossbar Toll Switching System," by L. G. Abraham, A. J. Busch, and F. F. Shipley (Bell Telephone Labs., Inc.).
"Automatic Ticketing of Telephone Calls," by O. A. Friend (Bell Telephone Labs., Inc.).
"Electronically Controlled Dry-Disk Rectifier," by Allen Rosenstein and H. N. Barnett (Signal Engineering Products Co.)
"Rectifier Circuit Duty" by C. C. Herskind (General Electric).
8:00 P.M.—Joint IRE-AIEE meeting.
"Enemy Communications Equipment" by Major-General R. B. Colton, Signal Corps, United States Army.
Exhibition of captured apparatus.

IRE Technical Meeting Program

Friday, January 28—Hotel Commodore

9:00 A.M.—Registration.
10:30 A.M.—Address of welcome—B. E. Shackelford, chairman, 1944 Winter Technical Meeting.
10:40 A.M.—Dr. L. P. Wheeler, presiding.
10:45 A.M.—Ceremony of "passing the gavel" from retiring president Wheeler to incoming president Turner.
11:00 A.M.—Annual meeting of the Institute of Radio Engineers, Dr. H. M. Turner presiding.
Amendment of Institute's charter.
11:15 A.M.—Dr. Wheeler resumes chairmanship for the session of technical papers.
12:20 P.M.—Session adjournment.
12:30 P.M.—President's luncheon—Dr. H. M. Turner.
2:30 P.M.—Symposium—Haraden Pratt presiding.
"Work of the Radio Technical Planning Board," W. R. G. Baker, chairman of Radio Technical Planning Board; several panel chairmen.
4:30 P.M.—Mr. Pratt resumes chairmanship for the session of technical papers.
5:30 P.M.—Session Adjournment.
7:00 P.M.—IRE Banquet (Informal)
George Lewis (Int. Tel. & Tel.), master of ceremonies.
Awards, Presented by Dr. Turner:
1943 Medal of Honor—to Haraden Pratt.
1943 Morris Liebmann Memorial Prize—to W. L. Barrow.
1943 Fellowship Awards—to S. L. Bailey, C. R. Burrows, M. G. Crosby, C. B. Feldman, Keith Henney, D. O. North, K. A. Norton, S. W. Seeley, D. B. Sinclair, Lee Young, Harry Diamond.
Annual address of retiring president L. P. Wheeler.
Prominent speaker on timely subject (to be announced).

Saturday, January 29—Hotel Commodore

10:00 A.M.—Symposium—H. M. Turner presiding:
"Engineering Work of the Federal Communications Commission" by E. J. Jett, chief engineer, FCC.
"Timely Broadcast Matters" by G. P. Adair, assistant chief engineer of the Federal Communications Commission.
"Police, Aviation and Maritime Services" by W. N. Krebs, chief of the Safety and Special Services Division, FCC.
"International Point-to-Point and Allocation Problems" by P. F. Siling, chief of the International Division, FCC engineering department.
12:30 P.M.—Students' luncheon.
2:30 P.M.—Technical session—Lloyd Espenschied presiding. It is also expected to have prominent American, British, Russian and Chinese authorities outline radio engineering in their respective countries.
4:30 P.M.—Final adjournment.

FM BROADCASTERS
Jan. 26-27

FM Broadcasters, Inc., has scheduled its regular meeting for Wednesday and Thursday January 26 and 27th. It will be held at the Hotel Commodore.

Hubert Michael Turner

Hubert Michael Turner, Professor of Electrical Engineering at Yale University, and newly elected president of the Institute of Radio Engineers, has gained country-wide recognition for his experimental and laboratory technics, as well as for his work on matters relating to standardization, technical advancement, instruments, measurements, and communications.

Dr. Turner was born on July 20, 1882, at Hillsboro, Ill. After being graduated from the University of Illinois in 1910, he remained as an assistant instructor for two years while taking graduate work in mathematics, physics and electrical engineering. From 1912 to 1918 he instructed at the University of Minnesota and organized courses in transient phenomena and radio. When the United States entered the first World War, Dr. Turner was placed in charge of technical instruction of a unit of Signal Corps enlisted men at the university until October, 1918, when he became assistant professor of radio with the Signal Corps for Officer Candidates at Yale.

The following year, he was appointed assistant professor of electrical engineering at Yale, and in 1926, associate professor. His entire time is being devoted to the graduate course in communication engineering, developing new methods of presenting theory, power and communication work, and consulting in several branches of his field.

He is a member of the American Institute of Electrical Engineers, the International Union of Scientific Radio Telegraphy, the American Association for the Advancement of Science, the Franklin Institute, and Sigma Xi.

He became an Associate Member of the Institute of Radio Engineers in 1914, a Member in 1920, and Fellow in 1937.

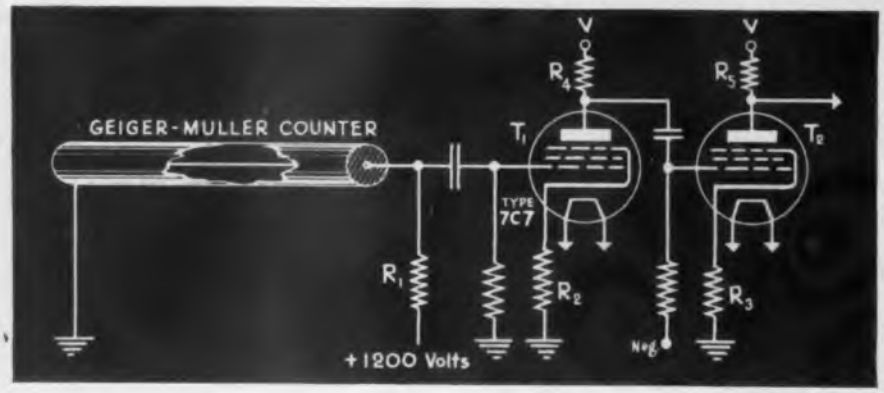


Fig. 1—Cosmic ray counter circuit

Fig. 6—Newly established laboratory

Fig. 2—72 G-M tube cosmic ray counter

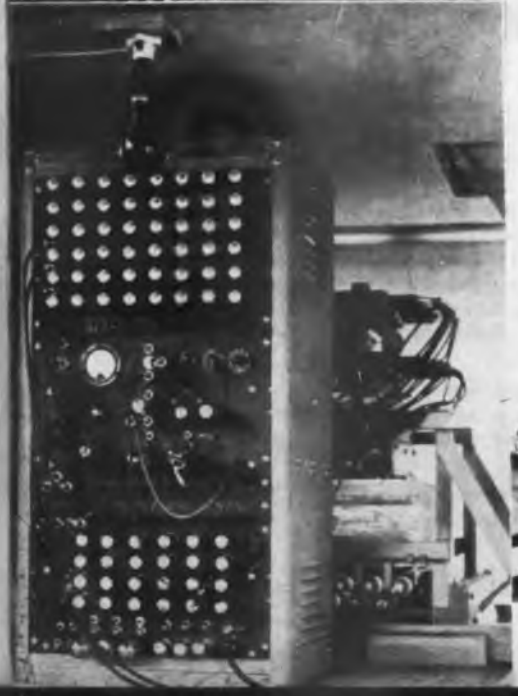
EXPLORATION

● Electronics enter another field of exploration at the new laboratory of Cosmic Terrestrial Research at Needham, where the Massachusetts Institute of Technology in a tie-up with the University of Chicago and other institutions has just started its part in a novel program for the study of cosmic rays. An elaborate apparatus built especially for the project at Chicago's Ryerson Physical Laboratory has recently been installed. In it 72 Geiger-Muller counters fed through an 88-tube amplifier cause the cosmic rays to click their way to a multiple-printing recorder that automatically counts hour by hour the numbers of the "rays" reaching the earth from the mysterious depths of space.

Fig. 3—Shelter on grounds of laboratory

Fig. 4—Interior of shelter from the north, showing 88-tube amplifier control panel and thermostatically controlled motor-driven roof shutter at right

Fig. 5—Recorder printer in the laboratory actuated by relays in cosmic ray shelter outside



Every one familiar with cosmic rays knows that they presumably come from interstellar space, though their exact origin is still one of those unsolved mysteries of science. Some of these rays are unquestionably electrons; others, mesotrons and protons. All are traveling with exceedingly high velocities. Some are more penetrating than others. M.I.T.'s new machine sorts these rays into "soft", "medium" and "penetrating" radiations, and records hourly their "counts" in three divisions of the cosmic ray spectrum. Here, as in myriad other applications, electrons in vacuum tubes have been put to work gathering data on another field of investigation that the tools of electronics have made possible.

Cosmic rays can be recorded with either electroscopes or Geiger-Muller counter tubes. The latter have the advantage of being adaptable to electronic amplification, so that the rays can be made to operate mechanical counters. The hourly counts reveal certain variations attributable to magnetic fluctuations and changes in meteorological conditions of the upper atmosphere.

for terrestrial research at Needham

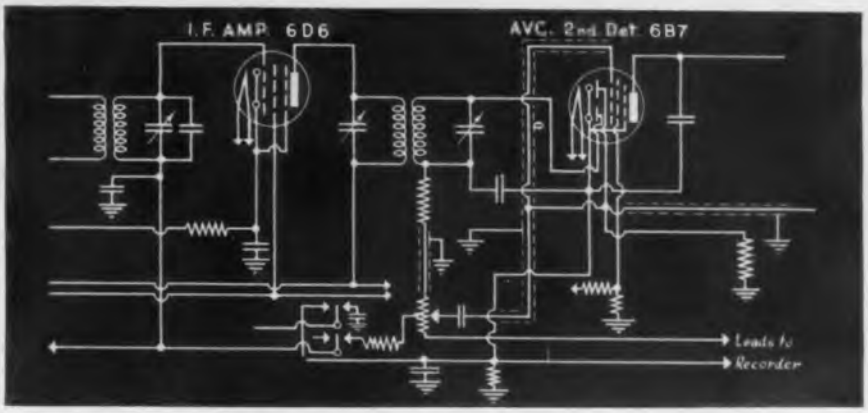


Fig. 7—Diagram to show leads from ave circuit of a standard communication receiver to recording galvanometer for field intensity measurements

# of COSMIC RAYS

by **DR. HARLAN T. STETSON**
Massachusetts Institute of Technology
Director Cosmic Terrestrial Research Laboratory, Needham

Electronic devices used in study of soft, medium and penetrating radiations and in sun spot radio disturbances

The Geiger counters used in the present instance consist of cylindrical brass tubes two inches in diameter and from 28 to 40 inches in length, containing a mixture of argon and alcohol vapor at a reduced pressure of 10 cm. of mercury. Stretched along the axis of each tube is a central wire, supplied with a constant positive potential of 1200 volts. The conditions within the tubes are such that an entering cosmic ray ionizes the gas and renders it conducting to the voltage impressed between the central wire and the wall of the tube, which is grounded.

There are various arrangements of circuits possible utilizing vacuum tubes for the operation of a mechanical counter arrangement. The principle of operation involves, in general, simple resistance-capacitance amplification as illustrated in the diagram (Fig. 1). When an ionizing particle passes through a G-M tube, the central wire collects a negative charge which causes a change in the voltage of the grid in the tube T_1. As this grid goes negative, the plate potential of the tube T_1 rises, communicating a change in the potential to the grid in tube T_2.

This second tube then passes current, and a mechanical recorder can be operated after some further amplification. In the elaborate multi-counter, a photograph of which is shown in Fig. 2, several stages of amplification are used, the last stage of which operates the relay which actuates the recording printer each time a cosmic ray enters. Circumstances do not permit here the details of all of the circuits involved in the 88-tube amplifier which must await publication later.

To differentiate true cosmic rays from gamma radiation emanating from radioactive materials in the earth and air, or from strays that may enter at oblique angles, some means must be provided for insuring that the ionizing radiation actuating the Geiger tube comes from a point near the zenith. This is done by a tandem series arrangement of two or more counter tubes placed in a vertical plane so that the cosmic ray entering the first counter from directly above may also actuate the counters immediately beneath.

When two or more of these counters and their input amplifiers have been actuated practically simultaneously, the current will have been closed through all input amplifiers belonging to counter tubes in the same vertical plane; then and only then will the appropriate relay re-

Fig. 8—Dr. Stetson checking apparatus for recording continuous nightly disturbances at broadcast frequencies

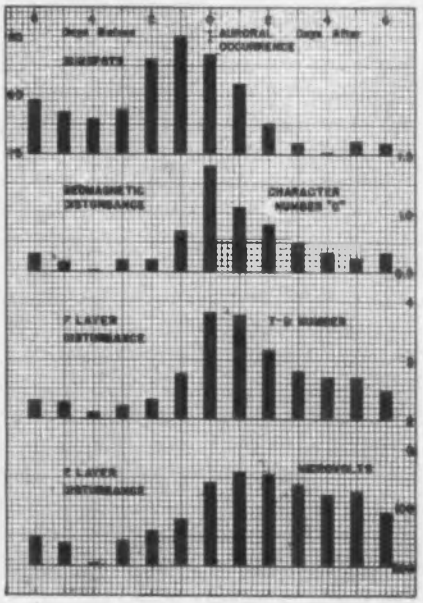
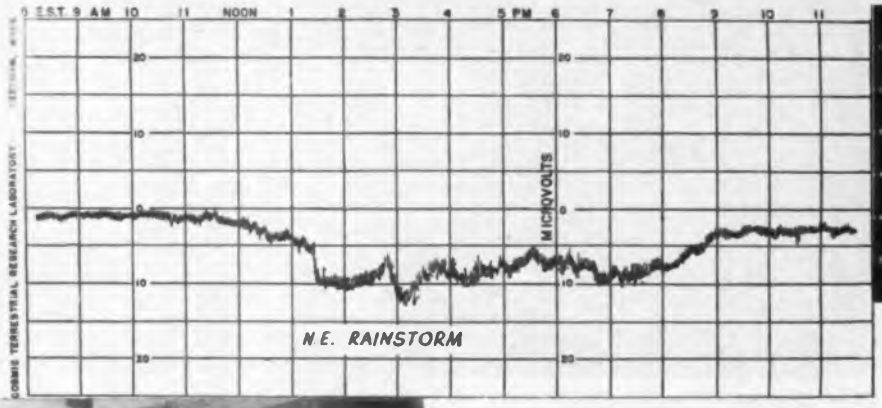
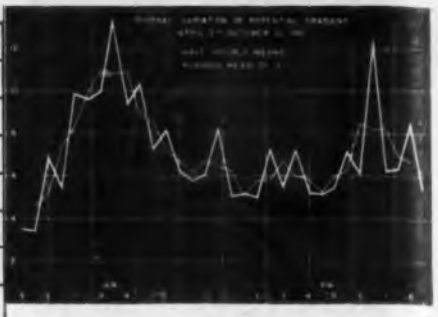


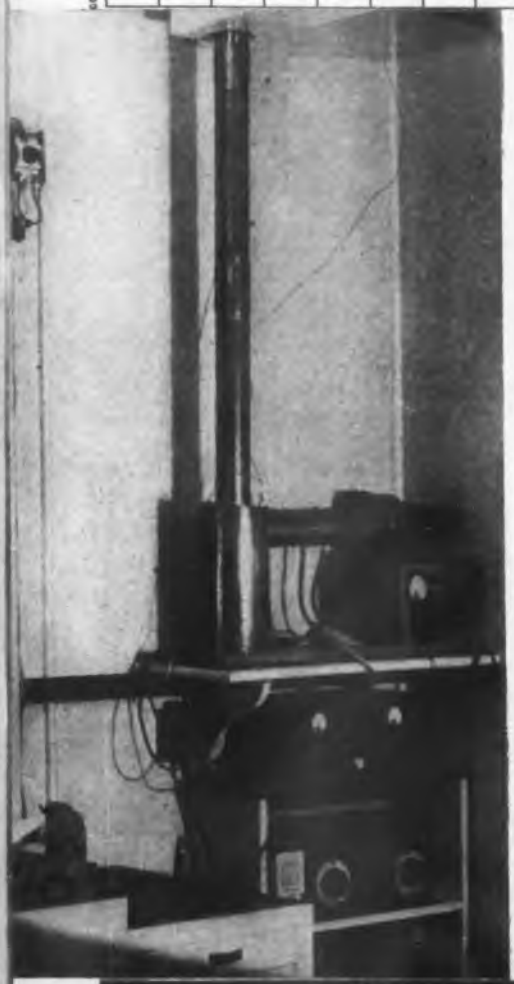
Fig. 9—Sunspots, geomagnetic disturbances and disturbances to F and E layers of the ionosphere follow a sequence. E layer disturbance is shown by inverted field intensities based on ten years observations



10 ↑ **Portion of record of October 26, 1943, showing point discharge between earth and sky during a rainstorm**



11 ↑ **Diurnal variation of potential gradient at Needham**



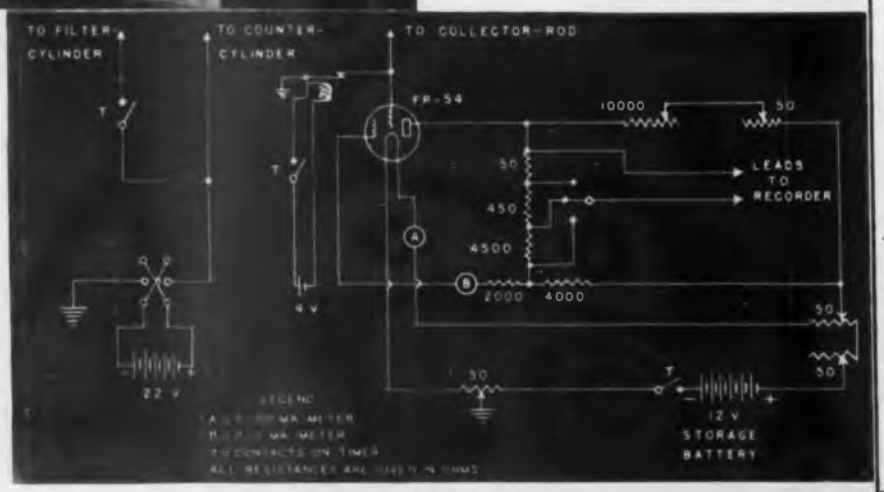
spond. Stray rays coming in obliquely will activate one or the other of the amplifiers but not all simultaneously. A vertical ray on the other hand will pass through both or all within practically the same instant. Such an arrangement of counter tubes and vacuum tubes is termed a coincidence amplifier. Much cosmic ray apparatus now in use is equipped with coincidence amplifiers.

Classifying rays

Since cosmic rays differ very greatly among themselves in the amount of energy present, it is important to have some means of differentiating those of high penetrating power from the slower or "softer" rays. This is accomplished by utilizing, as in the present arrangement, three separate banks of counters with different amounts of lead separating the banks.

12 ← **Ion counter for small negative atmospheric ions utilizing an FP 54 tube**

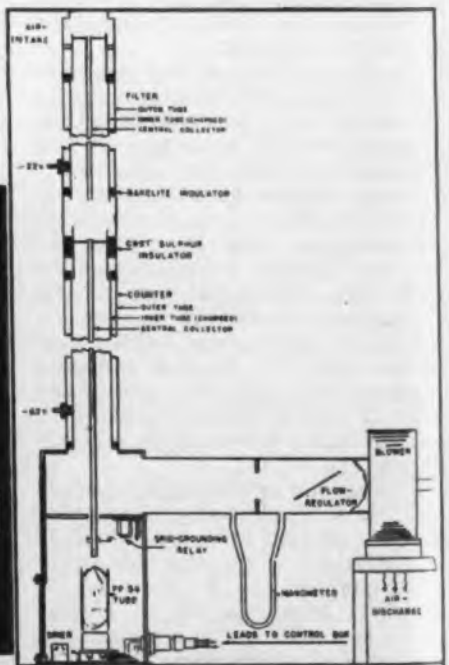
13 ↓ **Schematic of ion counter and its associated circuit constructed at Cosmic Research Laboratory**



The top bank, for example, which will register the softer rays, will be actuated by all cosmic radiation of sufficient intensity to penetrate the atmosphere, and the walls of the counter tube. Below the top bank, sheet lead 10 cm. in thickness stops these soft rays from actuating the second bank of counters beneath. Cosmic rays of sufficient penetrating power to pass through this 10 cm. of lead will obviously actuate the counters in bank 2. Separating bank 2 from bank 3, the lowest layer of counters, is an additional 20 cm. of lead plate so that when the counters in the bottom layer are activated, the cosmic rays responsible for the operation of these counters must have penetrated through 30 cm. of lead altogether. These are very penetrating rays.

Fig. 3 is a photograph of the shelter housing the apparatus on the grounds of the Cosmic Terrestrial Research Laboratory. Fig. 4 is a view of the interior looking from the north and showing the

(*Continued on page* 244)



Goldsmith V-Chairman RTPB

Panel organization expanded—New appointments to spectrum frequency allocation, television and communications groups

• Activities of the Radio Planning Board during the past month have been confined chiefly to organization matters in preparation for the big engineering job ahead of the group and its panels.

Dr. Alfred N. Goldsmith, consulting engineer, 580 Fifth Ave., New York, has been elected vice-chairman of the RTPB and of its administrative committee, and, with the Chairman, Dr. W.R.G. Baker, will have general supervision over the operations of the Board and its 13 panels. Dr. Goldsmith is also chairman of the important Spectrum Utilization Panel of RTPB, which will make recommendations for the assignment of radio services to various frequency bands. He was a member of the original IRE committee which cooperated with RMA in setting up the RTPB plan, and had an active part in all the preliminary work which led to the present board structure. Dr. Goldsmith is a charter member and Fellow of the IRE, and for the last 30 years has served as editor of the monthly "Proceedings" of the Institute.

Haraden Pratt, vice-president of Mackay Radio, who had been mentioned for RTPB vice-president under the original organization plan as presented before the earlier meetings of the organization, withdrew his name for consideration for this post, but continues as chairman of the Radio Communications Panel. Mr. Pratt is being signally honored for his work on the IRE committee which drew up the RTPB plan of organization, as well as for other distinguished services to IRE, when later this month he will be presented with the Medal of Honor of the Institute of Radio Engineers, during the coming Winter Convention at New York.

Following are the newly announced personnel of panel groups whose organization has been essentially completed.

Dr. Alfred N. Goldsmith, Consulting Engineer. Vice-Chairman RTPB.

H. H. Beverage, RCA Communications, Inc., Vice-Chairman Communications Panel.

PERSONNEL OF FOUR RTPB PANELS

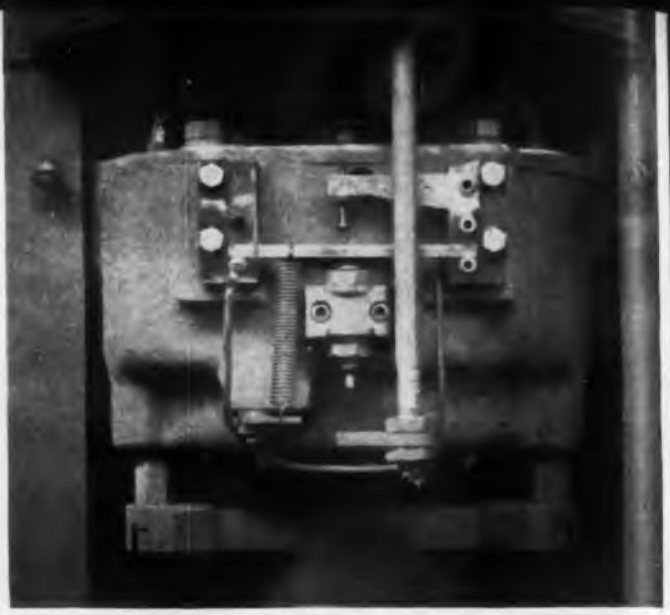
Panel No. 1—Spectrum Utilization

Dr. A. N. Goldsmith, Chairman, 580 Fifth Avenue, New York
Dr. R. H. Manson, Vice-Chairman, Stromberg Carlson Co., Rochester
George Grammer (M), ARRL, West Hartford, Conn.
K. B. Warner (A), ARRL, West Hartford, Conn.
A. C. Peterson (M), Bell Telephone Labs., 436 West Street, New York
W. G. Richardson (M), Canadian Broadcasting Corp., Montreal
E. K. Cohan (M), CBS, 485 Madison Avenue, New York
W. B. Lodge (A), CBS, 485 Madison Avenue, New York
P. C. Goldmark (M), CBS, 485 Madison Avenue, New York
Robert Serrell (A), CBS, 485 Madison Avenue, New York
G. F. Leydorf (M), Crosley Corp., Cincinnati
W. S. Alberts (A), Crosley Corp., Cincinnati
Dr. L. P. Wheeler (M), FCC, Washington
P. F. Siling (A), FCC, Washington
H. B. Marvin (M), General Electric Co., Schenectady
H. R. Summerhayes, Jr. (A), General Electric Co., Schenectady
Walter S. Lemmon (M), International Bus. Machine Corp., 590 Madison Avenue, New York
C. M. Jansky (M), Jansky and Bailey, National Press Building, Washington
Stuart L. Bailey (A), Jansky and Bailey, National Press Building, Washington
Leroy Spangenberg (M), Mackay Radio, 67 Broad Street, New York
Howard S. Frazier (M), NAB, 1760 N Street, Washington
O. B. Hanson (M), NBC, 30 Rockefeller Plaza, New York
Raymond Guy (A), NBC, 30 Rockefeller Plaza, New York
Dr. D. E. Noble (M), Galvin Mfg. Co., 4545 Augusta Blvd., Chicago
H. O. Peterson (M), RCA Communications, 66 Broad Street, New York
Dr. B. E. Shackelford (M), RCA Laboratories, 30 Rockefeller Plaza, New York
W. C. Lent (A), RCA Laboratories, 30 Rockefeller Plaza, New York
A. J. Costigan (M), Radiomarine Corp of America, 66 Broad Street, New York

(M) Member, (A) Alternate.

(*Continued on page* 256)

Haraden Pratt, Mackay Radio and Telegraph Co., Chairman Communications Panel.



Resistance welding equipment for high speed precision operation. Right, close-up of double pressure mechanism

Below—Control panel of Hi-Wave equipment shown above

Dual Pressure

by S. M. HUMPHREY

Executive Engineer
Taylor-Winfield Corp., Warren, Ohio

How application of electronic setting valves has improved

● With the vast improvements in other features of welding equipment during the last five years, application of the resistance welding processes to precision work, what with the attendant tightening up of weld-quality specifications, made it necessary to develop an accurate and consistent method of applying a dual pressure sequence to resistance welding, if such a sequence were to be used at all in a precision welding machine. Taylor-Winfield engineers set about solving this problem, keeping in mind that the final system must adequately meet the following characteristics:

1—The time of second pressure application in its relation to the welding current must be infinitely adjustable, and must not vary on repeated operation more than plus or minus 5 per cent of the specified value.

2—The rate of pressure increase must be as rapid as possible, but at least must increase by threefold in not less than fifteen milliseconds.

3—The magnitude of the initial pressure, the slope of pressure increase, and magnitude of final pressure must be consistent on repeated operation within plus or minus 5 per cent of the specified value.

4—The control equipment and the exhaust valve mechanism must be such that it could run at high speeds (at least 250 per minute) without electrical or mechanical failure.

In analyzing these specifications, the problem seemed to resolve itself into two major components: first, to develop a solenoid operated exhaust valve which would permit rapid air exhaust at the required speed; second, the design of an accurate timing mechanism independent of line voltage, frequency, phase relationship, etc., or any mechanical operating conditions of the welder.

Capacitor control

The major methods of timing were considered. One, the method which made use of synchronous timing of the solenoid valve from a given point in the power line supply with simultaneous timing of the welding, was discarded because the plan required some initiation point preceding the start of the welding current.

The method finally adopted made use of a solenoid valve operated by discharging a capacitor through it. Referring to the accompanying schematic diagram, the capacitor C is maintained at a uniform voltage

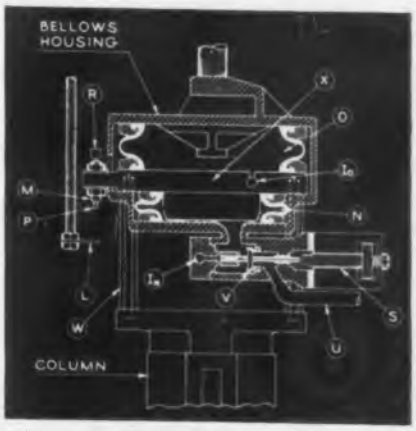
by the trickle charging action of the thyratron tube V-1, acting as a single phase rectifier. This type of circuit will maintain within plus or minus 2 per cent of the dc voltage on capacitor C throughout line voltage variations of plus or minus 25 per cent or more.

The solenoid which operates the double pressure exhaust valve is placed in series with thyratron tube V-2, across capacitor C2, in such a manner that as long as V-2 remains non-conducting, the valve remains closed, but as soon as the grid of tube V-2 is driven positive with respect to its cathode, the capacitor C will discharge through tube V-2, thereby operating the solenoid, which opens the exhaust valve.

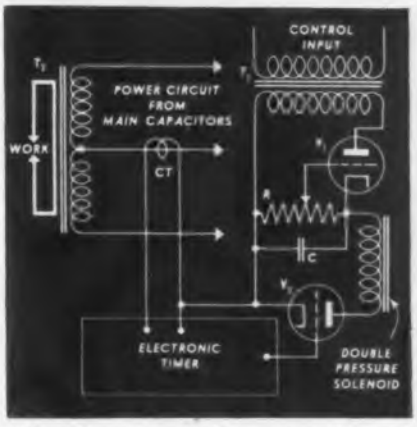
capacitor is delivered to the solenoid in extremely short time (approximately 5 milliseconds). This results in a very high force being applied to the solenoid armature with attendant high acceleration.

The armature then moves forward at a high rate of speed, gaining kinetic energy very nearly equal to the original energy stored in the capacitor. This is clearly brought out in the oscillogram representing typical pressure characteristics. Solenoid valves designed on this principle have been successfully operated literally for millions of strokes at 250 strokes per minute with only slight visible signs of mechanical wear, and with only

(*Continued on page 230*)



Cross section of double pressure bellows system with the head in the up position of operating stroke



Thyratron circuit times operation of pressure control solenoid

Resistance Welding

control to solenoid of pressure reliability of bonding process

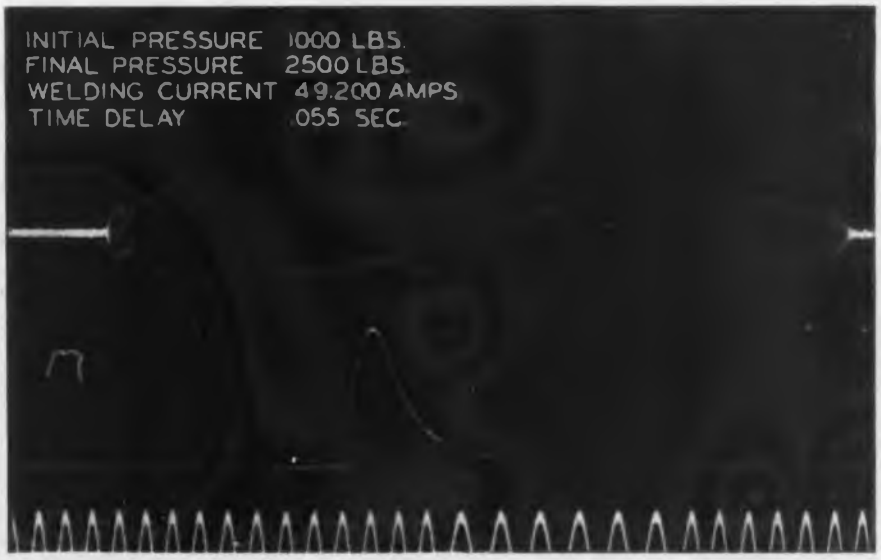
The mechanism for timing this discharge with relation to the welding current consists merely of a current transformer, placed in series with the primary of the welding transformer, the impulse from which starts off an electronic type of capacitor discharge timing mechanism, which at the end of its preset time interval drives the grid of tube V-2 positive, thereby operating the exhaust valve. Accuracy of timing is assured by proper circuit design and the use of a regulated source of voltage to feed all timer circuit components. Such a system is of universal application.

Fundamentally, the design of a suitable solenoid valve presented a somewhat greater problem. Past experience with solenoid valves operating at high speeds was disappointing. There was not at the time any solenoid operated air valves which would run even at 80 spots per minute without undue maintenance, let alone operate at the goal we had set of 250 spots per minute.

The capacitor discharge accurately controls the total amount of energy delivered to the solenoid, permitting a design such that the major portion of this energy is used in opening the valve. The solenoid winding and the capacitor are proportioned so that the energy in the

Oscillographic analysis of relation of pressure variations before and after weld-interval, and one of the oscillograms

Film	Operating Speed Spots per Min.	Measured Time	Ave.	Max. Deviation
1	80	110; 110; 110	110.0	0
2	80	110; 113; 107	110.0	±3
3	20	109; 111; 110; 113	110.1	+3
4	20	110; 111; 111; 110	110.5	+1



Military Radio Should Be

by SIDNEY K. WOLF*
Assistant Director Radio Division, WPB

Radio & Radar Division, WPB, outlines necessity for applied standardization to improve production efficiency

● We believe that this is the time for great courage and great fortitude, on the production front as well as on the battlefront. While the optimist and the forgotten saboteur are preaching an early end of the war and an immediate return to civilian production, we are faced with the problem of producing four units of electronic equipment in 1944, where only three units were produced in 1943.

Electronic equipment production will always be an uphill problem during this war. The science is too new to become static. What we produced in 1942 is obsolete today, and 1943's production will be obsolete in 1944. The 1943 production requirements will consume the labor of some 600,000 men and women.

Therefore, to realize the 1944 production goal in accordance with the current "utilization factor" of labor, we will require the additional labor of over 100,000 men and women in 1944. Yet, if we request this additional manpower, I can assure you that we will get the same response that the commanding general on Attu received when, after invading that island with 12,000 American troops to engage less than 3,000 Japs (the first few days the going was tough), he requested an additional 5,000 troops. How many additional troops do you suppose he received? "Just one" and that one was a replacement for the commanding general. The net gain in manpower on Attu was none, but the battle at Attu was won. Likewise, the battle for increased production in 1944 must also be won—and probably without additional manpower.

Army and Navy in far places

Consequently, we must find a way to conserve our manpower resources. We must improve our production efficiency, increase our manpower "utilization factor." And we of the War Committee believe that "Applied Standardization" is one of the most effective tools available with which to accomplish this and with it the necessary additional production.

Never in the history of our country have the Army and Navy been required to fight so inseparably as a team. As you know, their responsibility is so delicately balanced that in the North Pacific an Admiral happens to be the boss of operations against the enemy: and in the South Pacific, a General happens to be the boss of operations.

You may be interested to know that just before I left Adak in Alaska, the personnel of a bomber squadron of the 11th Air Force was ordered to another theater. The Navy sent complete crews to be instructed to operate the bombers left by the Army personnel. It is important that our equipment be unified, as even closer cooperation will be required as the Pacific War increases in intensity.

But I am getting ahead of my story in pointing out the benefits of standardization in the combat theater, when at the moment we are more concerned about the benefits of standardization in production.

300,000 capacitor types

Before discussing the production benefits of standards, I would like to touch upon one kind of problem WPB has experienced in converting the Industry to standards. For example, one of our larger capacitor manufacturers (he, by the way, is a rugged individualist and despises standardization for commercial reasons—which may be understandable, but certainly intolerable in wartime) boasts of having 300,000 different specifications on capacitors in his plant, 115,000 of which he claims are in active military use. Only 300 of the 300,000 are required to meet our military needs if they were standardized.

To take another case, which was discovered by accident: one capacitor manufacturer, when requested by Prime Contractor "A" to supply capacitors in accordance with War Standards, informed him that Prime Contractor "E" could use all of the capacitors he could produce with his own type designation on them, and unless he wanted them the way he chose to manufacture and label them, he was not interested in his business. When Contractor "E" wrote the same manufacturer for capacitors in accordance with American War Standards, he informed him that Contractor "A" could use all that he produced by his type designation, and that he would take them the way he produced them or not at all.

We cannot tolerate such lack of cooperation because we know full well that the manufacturers in question are capable of producing in accordance with American War Standards. For it was around their production, as well as the produc-

Eight Men and Plane Lost—because Army and Navy Had Different Capacitor Designations!

At Adak in the Aleutians, a B-24 left the flying field on a bombing mission over Kiska without its vhf operating, because of the want of a mica capacitor, of which the Air Corps repair shop had no remaining spares. While on the mission, the crew was instructed to search for a small Jap convoy 500 miles southwest of Kiska. On the way back the weather closed in, as it frequently does in the Aleutians. The crew reported by radio that they were running low on gas and would have to land. They did not know their exact position and therefore could not relay it for rescue.

Had the vhf been working, their position could have been located and a rescue party no doubt could have saved them. However, the crew of eight and the Liberator were lost. Later, upon investigation *we discovered that the Navy had plenty of spares of an identical capacitor in their stockpile at Adak.* But they were identified differently and neither the Army nor the Navy repairmen recognized the similarity.

This is one of the many examples that could be given of the advantages of a common type designation for all electronic components, which standardization can provide.

*Now Lieutenant Colonel, AAF. (See news pages following.)

Simplified and Standardized

by COMMANDER D. R. HULL
United States Navy

The Navy offers some practical suggestions to attain fewer types of components with greater dependability

tion of other leaders in industry that the standards have been developed. (It is always from the better current production of all components that the War Standards are being prepared so as to avoid any loss of production that is not at least commensurate with the immediate advantages of standardization.)

Ten components completed

American War Standards for ten components have been completed. They cover perhaps 50 per cent of the total number of components used in electronic equipment, perhaps 65 per cent of the components where production is insufficient, and perhaps 75 per cent of the components that are giving maintenance trouble in the theaters of operation. Work on fifteen or twenty more is well advanced. The Signal Corps Standards Agency has started preliminary work on many additional components. The Navy, the Air Corps, and Industry as well have contributed to the work on standards.

Some of the obvious advantages of our program are as follows: (a) simplifying procurement, (b) eliminating duplicate inspection, (c) reducing inventory requirements, (d) reducing the number of spare

(*Continued on page* 266)

● The Bureau of Ships of the Navy Department views with concern the trend toward increasingly complex radio and allied electronic equipment. This tendency is objectionable because of:

(a) The large variety of slightly different components to be manufactured for initial production.
(b) The difficulties confronting servicing personnel in maintaining equipment.
(c) The astronomically large variety of components that must be carried in stocks throughout the world.

It is fully realized that in part the equipment complications arise in improvements intended to afford the Fleet equipment with improved operating characteristics.

Simplest satisfactory design

It is also realized that electronics designers have been schooled for years, in particular, to strive for perfect performance from each circuit. Frequently this urge to reach perfection has resulted in assemblages of circuits that not only meet the overall performance characteristics desired but also have a large margin of unusable capacity.

The Bureau desires design supervisors be instructed to carefully examine each proposed design with a view to the ultimate production of the simplest possible, functionally satisfactory equipment.

A few examples of the questions that should be considered during such an examination are:

(a) Considering the overall performance desired, is this special component (transformer, condenser, etc.,) actually necessary or will the component now in production be really satisfactory though slightly less efficient?
(b) Considering the overall performance desired, and all of the resistors (or condensers) used, of approximately the same size, as a block, would it be undesirable or impracticable to use the same resistor value at all circuit points? Could that value be a standard one?
(c) Considering the overall performance desired, is it necessary to use so many different tube types? Or would it be desirable from a broad viewpoint to use fewer types perhaps even at the expense of an added stage?
(d) Have the layouts, and wire plans become complicated because of a desire for ultimate performance (particularly gain) from each stage, so that excessive overall performance has been obtained at the expense of ease of maintenance?

(*Continued on page* 264)

Radio Engineers and Production Men at the Baltimore Conference

Called for the purpose of standardizing and simplifying military radio components and deriving uniform nomenclature, a two-day conference was held under auspices of the War Committee on Radio, headed by S. K. Wolf, assistant director, Radio Division, WPB. Pictured are some of the civilian, Army and Navy men at the Bendix Radio plant at Towson, Md., visited by the group. In the center, hatless, are Chairman Wolf and host W. P. Hilliard, of Bendix

Modulated Carrier

by STEPHEN L. JAVNA
Research Engineer, Curtiss-Wright Corp., Propeller

Characteristic of thyratron for amplification of dc and

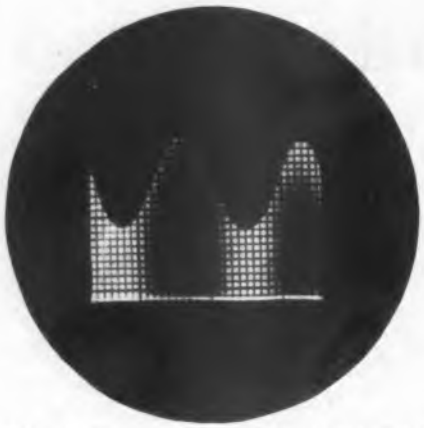


Fig. 3. Oscillogram of voltage across plate condenser of a sawtooth oscillator while an alternating voltage is applied to its control grid

● It is frequently necessary in electronics laboratory applications to amplify and measure small quantities of dc with available equipment. Dc amplifiers are not ordinarily found in the average laboratory and, due to wartime conditions, are often unobtainable. Makeshift dc amplifiers will be found unstable unless considerable time and energy are applied to their design and construction. Furthermore, these are not generally suited to efficient low impedance matching as with ac amplifiers. However, good ac amplifiers usually are available in most laboratories, and carrier modulation is a popular means of dc amplification.

In this method the carrier amplitude of a local audio frequency oscillator is modulated by the test signal which may be dc or low frequency ac. If the modulated carrier is amplified and the output rectified and selectively filtered, the voltage across the load will be found proportional to the test signal. It is important that carrier frequency be high compared with that of the modulating signal.

A common system of carrier type amplification is illustrated in Fig. 1. Here a carrier signal is generated by the 6C5-G oscillator and mixed with the input signal to the 6L7-G mixer producing an amplitude modulated signal at the mixer plate load. After being amplified, the signal is rectified and a by-pass condenser is placed across the load to filter out the carrier signal. The result is an amplified replica of the input signal. While this system can be set up more easily than a dc amplifier, components such as oscillator coils must be designed and considerable time is required to achieve proper operation.

A simple method of carrier amplification utilizing a type 884 thyratron as a combined linear self-excited carrier oscillator and modulator is described. The oscillator is of the saw-tooth type commonly used in cathode ray oscillographs as a linear time base. Operation of the circuit depends upon the fact that the thyratron grid voltage determines a value of plate voltage, known as the "critical plate voltage," below which the thyratron is non-conducting, and above which conduction takes place.

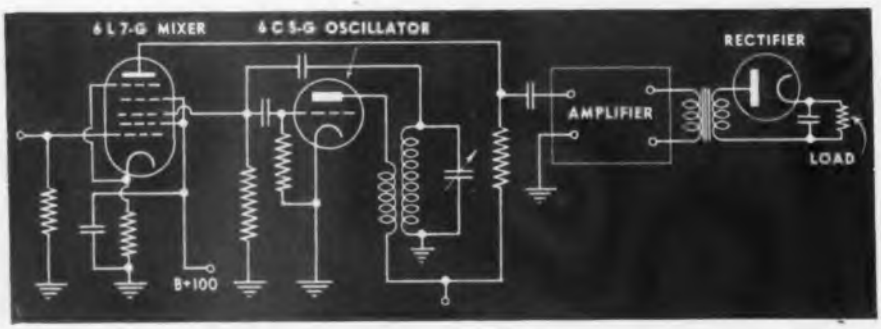
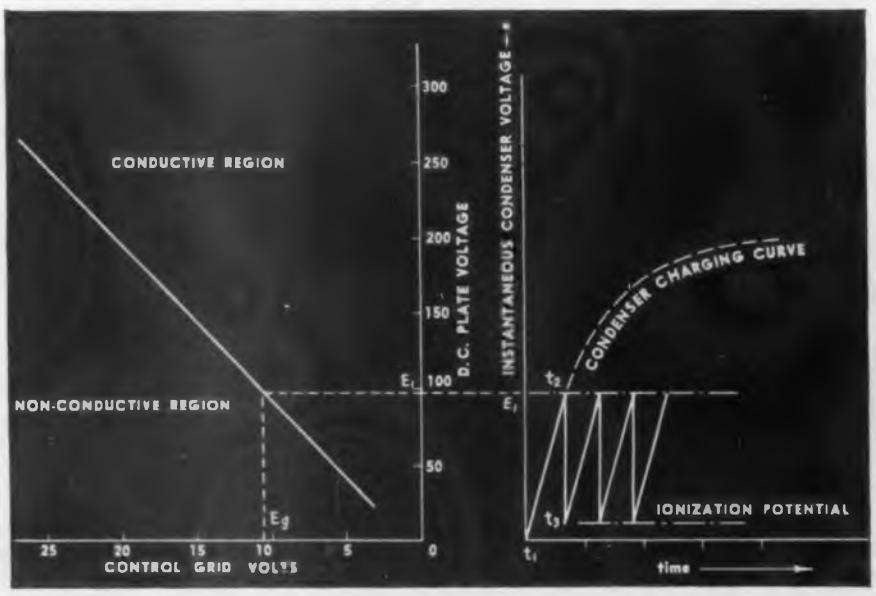
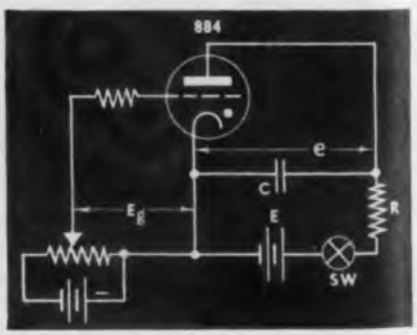


Fig. 1. General circuit for amplifying a steady potential by letting it modulate a fixed carrier

Fig. 2a (Left). How control characteristics of an 884 affect oscillation voltage and frequency. Fig. 2b. How a thyratron generates oscillations



2c. Thyratron saw-tooth oscillator circuit



for DC Amplifiers

Div., Caldwell, N. J.

to generate oscillations low frequency potentials

This is illustrated in Fig. 2a which gives the critical characteristics of an 884 tube. Once condutcion starts, the grid loses control (except in certain very special cases) and cannot regain it unless the plate voltage is reduced below the ionization potential of the gas in the tube, at which time conduction ceases. The rate of deionization is very rapid so that a sudden removal of plate voltage causes rapid current cutoff. This characteristic makes possible oscillations of relatively high frequency.

Oscillation generation

Oscillations come about as follows: In Figs. 2a, 2b, and 2c a fixed grid voltage E_s is shown applied to the grid of the thyratron. This predetermines a fixed value of critical voltage, E_1. When the switch, sw., is closed at instant t_1 a voltage is applied between the plate timing network, resistance R, and capacitor C, and the latter commences to charge along the path indicated in Fig. 2b.

No current flows through the thyratron yet. When the capacitor voltage reaches the critical value E_1 at instant t_2 the thyratron becomes conducting and a discharge occurs through the tube almost instantly. When the plate voltage has dropped to the ionization potential at instant t_3, the thyratron stops conducting and the capacitor begins to charge again, repeating the cycle. It is therefore evident that maximum capacitor voltage is determined by the critical plate voltage, which in turn is determined by the grid voltage. In other words, the peak-to-peak amplitude of the capacitor voltage can be varied by changing the grid voltage.

The relationship that exists between variations in applied grid voltage and resultant variations in amplitude of the voltage at which discharge occurs may be understood by considering Figs. 2a, and 2b. The ionization potential remains substantially constant, and independent of grid voltage, so that the lower peak of the wave will always be at the same potential with respect to cathode. The upper peak, however, will vary directly and linearly with applied grid voltage as Fig. 2a is a straight line.

Since the slope of the critical plate characteristic is about 10, for each unit change in grid voltage there is a 10 unit change in critical plate voltage and constantly in peak condenser voltage. Fig. 2a, a curve of peak-to-peak condenser voltage vs. grid voltage shows a gain of approximately 10, which substantiates the above discussion. Non-linearity in the region between 0 and —5 grid volts is due to grid conduction.

That this method is not limited to dc amplification alone but may be applied to relatively low frequency ac is shown by the oscillogram, Fig. 3. If the voltage across capacitor C is applied to an amplifier with good frequency characteristics, and the output is transformer-coupled to the load through a rectifier and filter, linear response will be obtained. This circuit is illustrated in Fig. 4.

If R, C, and E are chosen so that the charging rate is as in Fig. 5, the wave form of the condenser voltage will be flatter topped than the wave of Fig. 2b. Practice generally is to choose R and C so that operation takes place in the lower

(*Continued on page* 194)

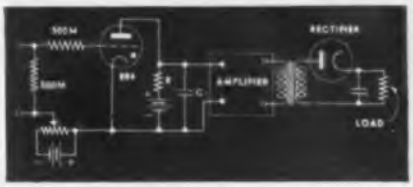


Fig. 4. Basic amplifier circuit

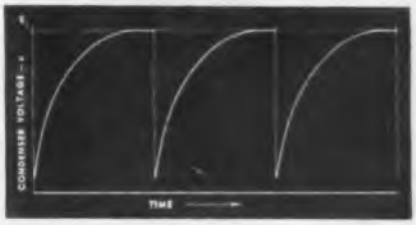


Fig. 5. Alternate oscillator waveform

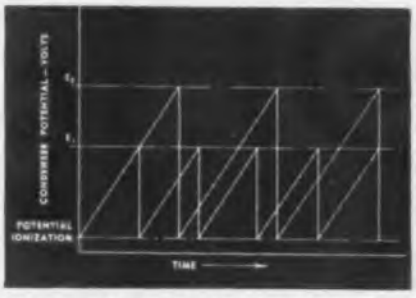


Fig. 6. Effect of critical plate voltage

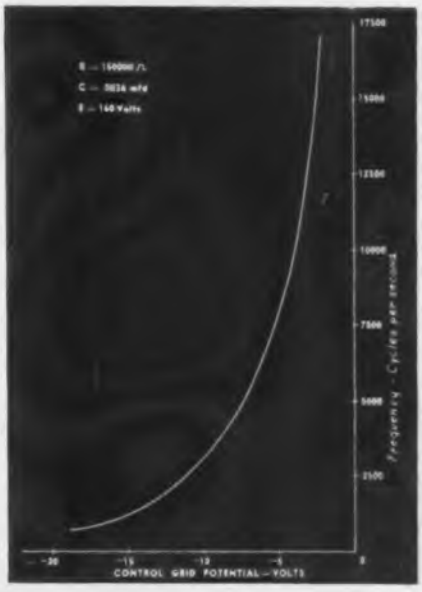
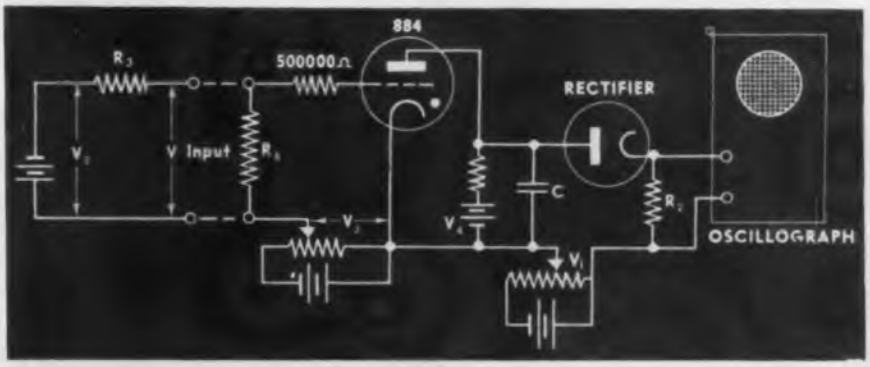


Fig. 7. The effect of grid voltage on carrier frequency →

Fig. 8. Thyratron used in conjunction with an oscilloscope as a vacuum tube voltmeter



1 STRIPPING enameled wires for soldering. New method at Electronic Laboratories, Indianapolis, Ind., is twice as fast as old way and lengthens life of wire brushes in motor-driven stripper. Solder pot at right, filled with molten lead, softens enamel before brushing.

FACTORY

2 DENTAL MIRROR enables solder-girls and inspectors to see both sides of every connection at Electronic Labs., speeding wiring and eliminating rejects.

3 HOLDING DOWN a drill press is better done by the force of gravity than a worker's muscle. Weights on feed levers at General Motors Cadillac Division, Detroit, allow operator to handle two machines instead of one.

4 SILVER SOLDER dispenser, like old-time photoflash magnesium-ribbon holder, simplifies feeding solder to work being brazed and prevents waste. In old method, worker cut off a foot or two of solder and hand-held it. As it became short and hot, worker would drop scrap and get a new piece. Dispenser is a flat metal case containing roll of solder-ribbon and roller near tip over which solder is fed with thumb.

SHORT CUTS

5→ DIAMOND SAW, newly improved by John Meek Industries, Chicago, is said to slice quartz faster and with less "sawdust" waste. Saw made by Atlas Press Co., Kalamazoo, Mich.

6 TIME SAVING suggestion on removing insulation was worth $1,057.60 to Stromberg-Carlson Co., Rochester, N. Y. Operator formerly charred short lengths of insulation, then blew out flame. By using bench-ventilator suction instead, greater lengths of insulation on several wires at once may be more thoroughly charred

7 CLOSE-UP illumination of cramped spots is easy with this versatile flashlight bulb extension cord devised by a Westinghouse engineer

8 TEMPERATURE CHAMBER one of the largest ever built, accommodates all units of a complete radio range station for test at the Aerial Navigation Division of Federal Telephone and Radio Corp., Newark, N. J. Inside measurements are 22 12 by 10 ft. high. Range is 55 degrees C. down to minus 30 degrees C. in little over 20 minutes

9 HIPOT SPHERE GAPS control voltage developed by surge-generator used in tests of plastic-filled high voltage transformers at Westinghouse Sharon, Pa., plant. Each gap is set to hold voltage correct for one type of transformer

ELECTRONIC Fire Control

Our Cover

Illustrated are computers for electrical gun directors being tested after assembly at the Western Electric company's Hawthorne Works, Chicago. These units, the "brains" of the deadly directors which aim the guns of anti-aircraft batteries with such uncanny accuracy, measure the position of a target and predict where the guns are to be aimed and how the fuses of the shells are to be set so that they will explode in the path of the target at the predicted position. Conceived and developed by Bell Telephone Laboratories, the equipment is manufactured by the Western Electric Co. for the armed forces.

Gun pointers stand by but electronically controlled motors do the work

The computer is truck mounted, may be a considerable distance removed

Soldiers orient the tracker in elevation and azimuth; computer does the rest

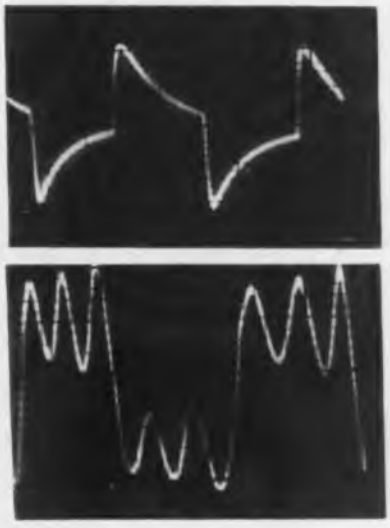
● One of the editors of "Electronic Industries" was priviledged to witness on December 9th an impressive demonstration of Western Electric's new M-9 tube-operated computer or gun director, which takes the place of, and does a better job than, earlier types of computers based on mechanical principles.

Consisting of twenty-nine separate amplifiers, forty-two miles of wiring, and more than 3,000 other pieces of unmentionable equipment, this computer in ten seconds goes through mathematical calculations which would occupy five and one-half hours of the time of a trained mathematician.

Effective gunnery with explosive shells depends ultimately on two factors: first, aiming the gun so as to place the projectile on or near the target; second, timing the detonation of the shell so as to explode it on arrival at the target.

Many important variables must be dealt with even when the gun and target are both fixed points. When the target is an aircraft moving at high speed in a three-dimensional medium, the number and complexity of these variables are greatly increased. Chief among these are the direction and distance of the target, the target's course and speed, the muzzle velocity of the shell, speed and direction of the wind, density of the air (not only on the ground, but upwards through the various layers the projectile must traverse), the fact that a rifled gun barrel throws its pro-

(*Continued on page* 234)



Upper pattern is voltage across inductance for circuit 1 at right. End point of decay is 4 per cent of initial voltage. Lower pattern is 2.5 cycles of damped oscillation for circuit 2

Square wave test set-up using the Reiner Electronics Co. oscillograph and self-contained variable frequency square wave generator

Square Wave Measurements

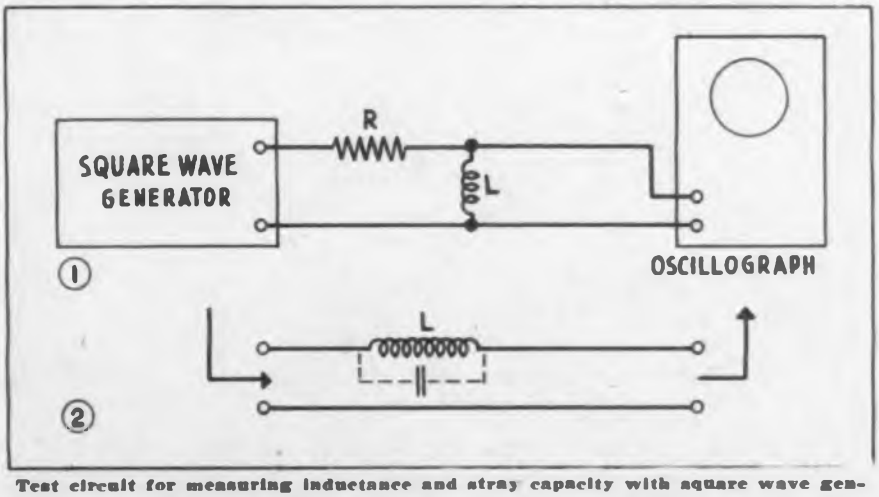
A convenient method for measuring inductance and stray capacitance of coils with square wave generator and oscillograph

• The square wave of current and voltage is extremely useful to the communication and industrial electronic engineer alike. The square wave is a self-contained fundamental frequency sine wave and the odd numbered harmonics up to approximately the twenty-first in practical square wave generators. Theoretically, the number of odd harmonics is infinite in a wave which rises to its maximum value in zero time.

Since the square wave contains a large number of frequencies, the response of any piece of electrical equipment to this wave of voltage is an indication of the response to each of the frequencies contained in the original wave. Thus, a square wave will instantaneously check the performance of a circuit to twenty or more harmonics of the fundamental frequency. The fundamental frequency of the square wave is the same as that of the lowest sinusoidal component.

The quickest method of determining results from a test with square waves, is to observe the resultant wave shape on a cathode ray oscillograph. In this way, the effect of the circuit on the square wave and, therefore, the components of such a wave, is immediately shown. If a square wave of voltage is impressed on a circuit and the output voltage wave, as observed on an oscillograph, is different in shape from the original

(*Continued on page* 218)

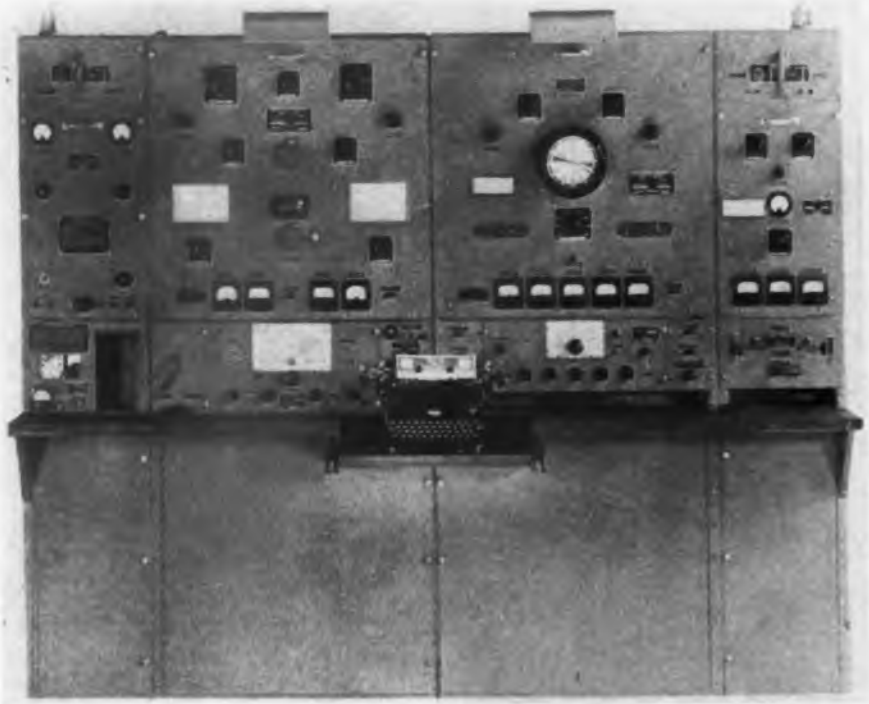


Test circuit for measuring inductance and stray capacity with square wave generator and oscillograph. Circuit 1 will measure capacity if R is replaced with C and L by R

MARINE

by JOSEPH H. McDONALD
Engineering Department,

Three transmitters and as auto alarm provided



Left to right, panels in the unit hold the auto alarm, high frequency unit, low and intermediate frequency unit and the emergency equipment

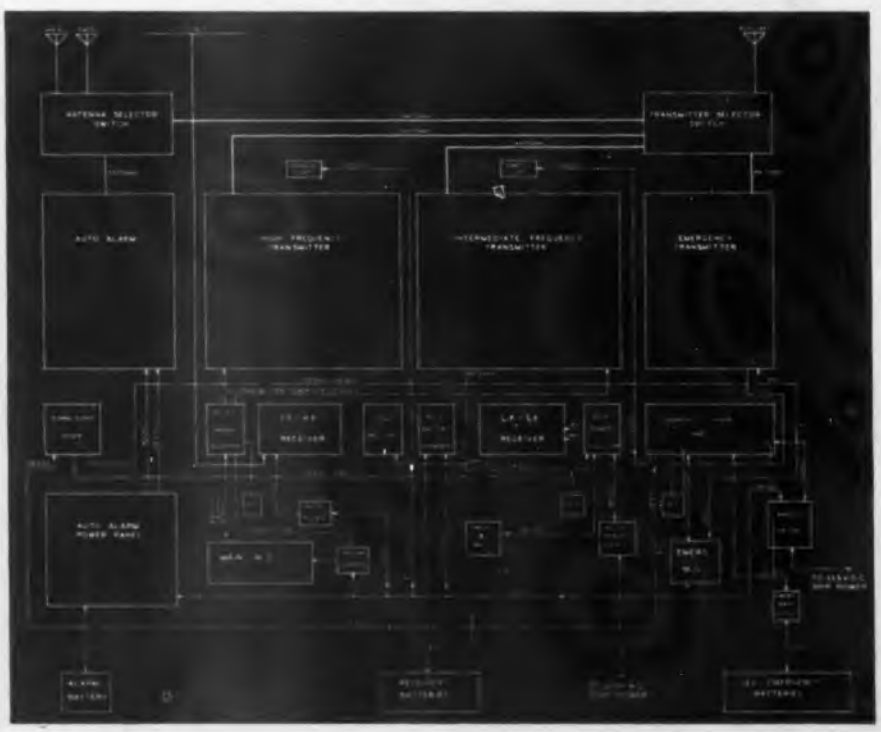
● The most recent development in a completely integrated type of radio console unit for the expanding of the U. S. Merchant Marine is exemplified by Radiomarine's latest design. Heretofore, console or "packaged" units for shipboard applications have been restricted to the marine intermediate frequency band of 350 to 500 kc. In the new unit, provision for high frequency transmission and reception also has been included, with the result that ships equipped with the new apparatus can communicate over extremely long distances.

The console unit embodies three transmitters, three receivers, an automatic alarm, an alarm signal keying device, a large operating table with built-in typewriter well and facilities for charging all storage batteries associated with the equipment. The design is based on specifications of the U. S. Maritime Commission and also fully complies with the requirements of the Federal Communications Commission and the Bureau of Marine Inspection and Navigation.

The inclusion of an independent emergency transmitter and a combination intermediate-high frequency radio receiver makes the unit applicable to passenger as well as cargo vessels. Under the present large scale shipbuilding program of the Maritime Commission, the console will be installed in the new Victory vessels as well as on tankers and vessels of the C1, C2 and C3 classes.

The complete unit comprises four frames constructed separately for convenience in shipping and installation, and which are then bolted together on a foundation in the radio room to form a unit approximately 90 in. wide, 72 in. high and 38 in. deep. Built into the unit are the necessary interframe cables, so that the only external wiring done at the shipyard consists of the power supply cables and the circuits to the battery room and bridge. The various transmitters, receivers, etc. use a total of 39 tubes, not all of which, of course, are in use simultaneously.

Block dingram of the complete console radio marine equipment showing relation of circuits in the four operating components



Electronic alarm timing

Viewing the console unit from the front, the frame at the left end houses the automatic alarm, the alarm signal keyer and the antenna selector switch. The auto alarm is a superheterodyne receiver pretuned to 500 kc, which in combination with a vacuum tube timing circuit operates to accept the international auto alarm signal of four second dashes separated by one second spaces. The use of electronic timing in the alarm results in the elimination of all rotating equipment. The alarm signal keyer,

CONSOLE RADIO UNIT

and **GORDON C. HOPKINS**
Radiomarine Corp. of America

three receivers as well in new Victory ship job

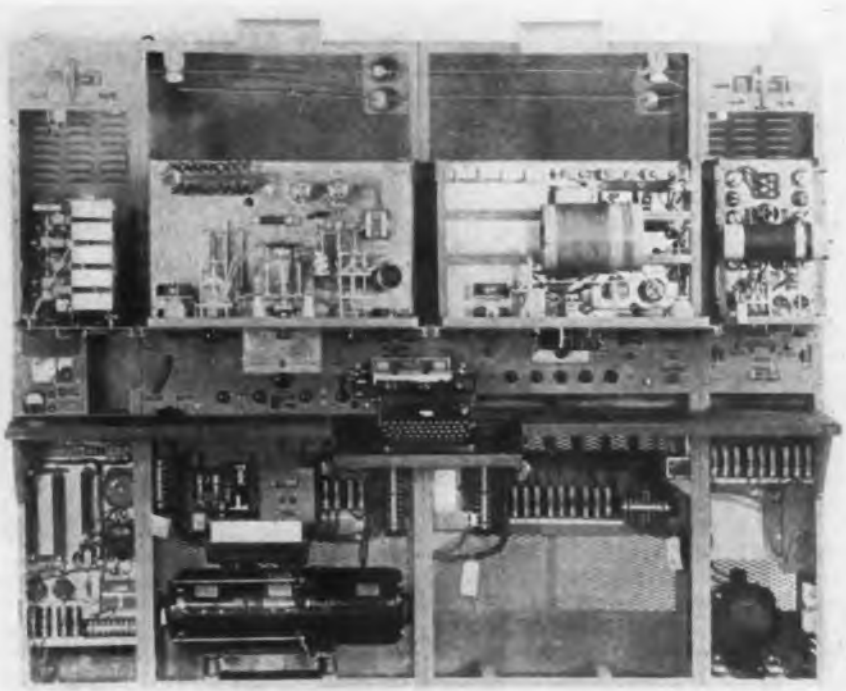
mounted beneath the auto alarm, comprises a highly accurate battery operated vibrator unit which operates a small synchronous motor, the later driving a cam for automatically keying the radio transmitters with four second dashes and one second spaces.

The high frequency portion of the console is enclosed in the frame to the left of the typewriter well. A 200 watt transmitter, crystal and master oscillator controlled, provides a continuous frequency coverage of 2000 to 24000 kc. The radio circuit in this transmitter uses respectively, three 1624 tubes as oscillator, first buffer and second buffer, and two parallel connected 813 tubes as power amplifiers. The first and second buffer stages are designed to function either as fundamental amplifiers or frequency multipliers, only four crystals being required to provide 17 different output frequencies in the marine bands. Either A1 (continuous wave) or A2 (modulated wave) emission is available.

Low radiation receiver

Beneath the high frequency transmitter and located for convenient use by the operator is a combination intermediate-high frequency receiver of the low radiation type. This receiver is a five band superheterodyne of high performance and covers 85 to 550 kc and 1900 to 25000 kc. A notable feature of this receiver is ac-dc operation without the use of any external equipment such as a rotary converter or vibrators. Adjacent to the high frequency receiver is a simple 350 to 515 kc crystal receiver for compliance with the "Safety Convention".

The intermediate frequency transmitter covers the 350 to 500 kc band, with eight pretuned frequencies in this band and with provision for either crystal or master oscillator control. The output of this transmitter is 200 watts or more.



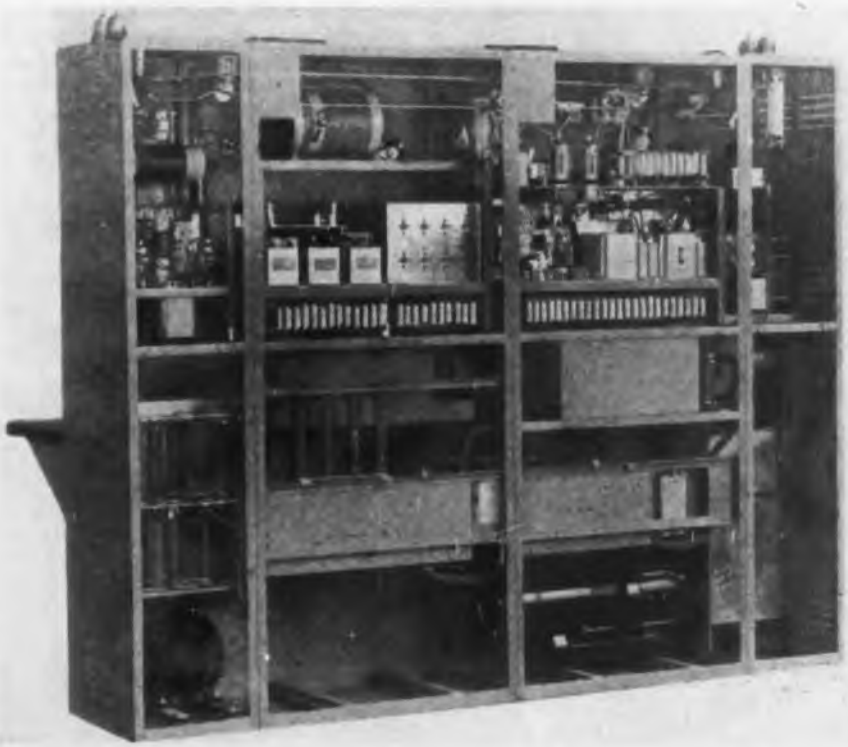
Front view of the console unit with all panels open showing arrangement of the various transmitters and receivers and their accessibility

The radio circuit is built around 1624 oscillator tube and two parallel connected 813 power amplifier tubes. Either A1 or A2 emission may be quickly selected by the operator by means of a toggle switch.

A low and intermediate frequency receiver to the right of the typewriter well is provided to cover the band 15 to 650 kc. This receiver uses a trf circuit with two stages

(*Continued on page* 262)

Rear view of the unit which is completely pre-wired in construction only addition being power supply cables and circuits to batteries and bridge



PRACTICAL APPLICATIONS

by L. W. REINKEN
Chief Engineer
W. Green Electric Co., New York

Factors which determine adaptability of equipment to specific uses covering extremes in current capacity

• One of the most striking facts about selenium rectifiers is the extraordinarily wide range of currents for which they are used—a range of practical values unmatched by any other power supply or conversion device with the possible exceptions of the electronic tube and the transformer.

The little meter rectifier illustrated, which is somewhat smaller in edge dimensions than a postage stamp weighs a fraction of an ounce, and is rated at 5 volts and 8 milliamperes. On the other hand, the complete rectifier equipment illustrated, weighing about a ton, is one of a group of 36, totalling 90,000 amperes at 7.5 volts. Between these intermediate ranges, used for electroplating, anodizing, welding and other applications, rectifiers have been built in voltages ranging from 6 to 48 volts, and in current capacities (for single units) from 4 to 4,000 amperes.

These examples of extremes in current are not intended to imply that the selenium rectifier is the ideal choice for any application requiring dc. Although the selenium rectifier has been used since about 1929 it is, particularly in this country, still on the toe of its "growth curve" and not all of its potential applications have been clearly defined. However, enough practical experience has been gained to define those factors which will determine, for any specific problem, whether or not the selenium rectifier is the optimum choice.

Current and voltage capacity

Any desired current capacity can be obtained from selenium rectifiers by increasing the rectified area in direct proportion to the number of amperes, other conditions being equal. The optimum maximum in the size of individual plates is based on considerations of cooling efficiency and cost of rejects of the larger plates. Similarly, the optimum maximum for: (a) "stacks" (plate assemblies) and (b) complete unit equipments incorporating a number of stacks, is determined chiefly by considerations of ease in manufacture, transportation and installation.

Theoretically, it would be possible to build a rectifier equipment in the form of a single unit as large as a box car. Practically, the upper limit for units to be shipped by any ordinary means, appears at present to be of the order of a couple of tons. Fortunately, this limitation imposes no penalty on performance, since any number of individual units may be paralleled on a site

← Six-channel multi-control to be used with 6-section multi-plater, each panel providing independent control and metering over one 6-volt, 500-ampere rectifier section

Tiny selenium meter rectifier unit, reproduced full size

Typical laboratory rectifier unit for plug-in operation from 115-volt single phase supply

Inside view of large rectifier unit showing ventilating fans at top, three decks of rectifier stacks, control switches and transformer

# of SELENIUM RECTIFIERS

with physical ease and with no loss in efficiency.

Any desired voltage rating can be achieved by connecting the required number of rectifier plates in series. In fact, at least one 150,000 volt unit is already in service, and units of a few thousand volts for certain radio transmitter applications are comparatively common.

Permissible inverse voltage

The permissible inverse voltage of single plates is of the order of 14-18 volts rms, which, although higher than other metal rectifiers, is insignificant compared to inverse voltage ratings of 5,000-10,000 volts for typical mercury vapor tubes. Basically, the cost of a selenium rectifier assembly is roughly proportional to the kw output, and when kw is the product of high voltage and low current the cost per watt is very high compared to tube rectifiers. From the foregoing we can define one of the boundaries of the selenium rectifier field: when the ratio of current-to-voltage is high, selenium rectifiers should be seriously considered. When the ratio of voltage to current is high, the selenium rectifier will probably be ruled out on the cost basis, and should be used only if one or more of its special characteristics are rated above cost.

Static operation

A whole group of useful characteristics derives from the two simple facts that along with tube rectifiers, (a) the selenium rectifier has no moving parts, (b) no physical or chemical change takes place with use.

The individual items in the following list are deceptive in that, although any one of them is not striking, a combination of several may make the selenium rectifier the optimum choice for an application —even for those high voltage uses in which the cost factor is greater.

Operation is independent of: position; vibration; shock; altitude or barometric pressure; temperature (below a practical upper limit); other useful features when selenium rectifiers are used with electronic equipment: there is no rf hash due to arc or commutation; operation is silent; life is unlimited—no replacement is normally required.

Where the ratio of current to voltage is high, complete selenium rectifier equipments including transformers, usually will weigh less than alternative power supply sources of the same capacity.

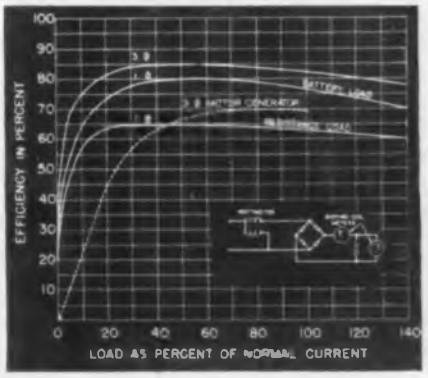
For example, a three-phase rectifier equipment with a capacity of 4,000 amperes at 6 volts, complete with step down transformer, voltage control transformer and selector switches, cooling fans, meters and all auxiliary apparatus, will weigh approximately 2,200 lb. A comparable motor generator may weigh two to three times as much.

Since position is of no importance, a rectifier equipment may be made tall and narrow—generally similar to radio transmitter equipment in appearance—which conserves floor space. The unit mentioned can be housed in a cabinet requiring only about 7 sq. ft. of floor space, as contrasted with an on-site assembly of generator, exciter, control panels, etc., which may require a protected area of 100 sq. ft. or more.

(*Continued on page 212*)

Group of selenium rectifier units, with master control panel at left end, to provide output of 1500 amperes at up to 48 volts

Efficiency of selenium rectifier operating at full load voltage compared to average typical efficiency of a motor generator set with exciter



Selenium rectifier equipment in the background provides power for automatic operation of barrel-type electro-plater for small parts

ENGINEERING

Modern building and exten
torola research is carried on

Left—Assembly bench in engineering laboratory room

Above—A corner of the transmitter development laboratory

Left—Experimental set-up in engineering laboratory

Below—General view of the well-equipped model shop

LABORATORY

sive facilities where Mo-
by Galvin Mfg. Co., Chicago

Right—View of part of the research production department

Above—Part of measurement room, Research Division
Right—Front view of the modern engineering building

Right—Checking temperature characteristics of equipment

Below—One side of the contract engineering laboratory

Wound-Core Transformer

by **REUBEN LEE**
Radio Engineer, Westinghouse Electric & Mfg. Co., Baltimore, Md.

Improved magnetic circuits based on the grain-oriented high silicon steel, Hipersil

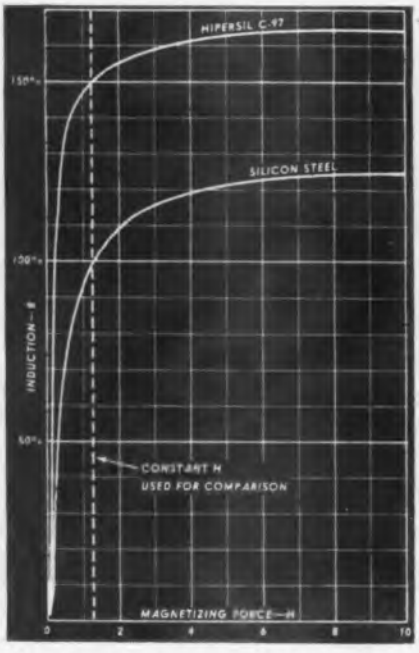


Fig. 1—B-H Curves of Hipersil and silicon steel

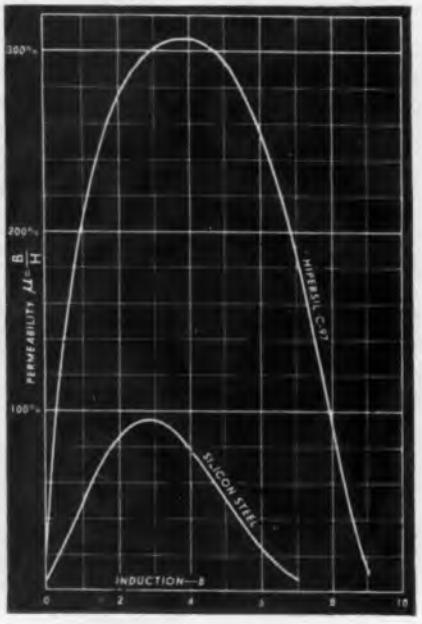
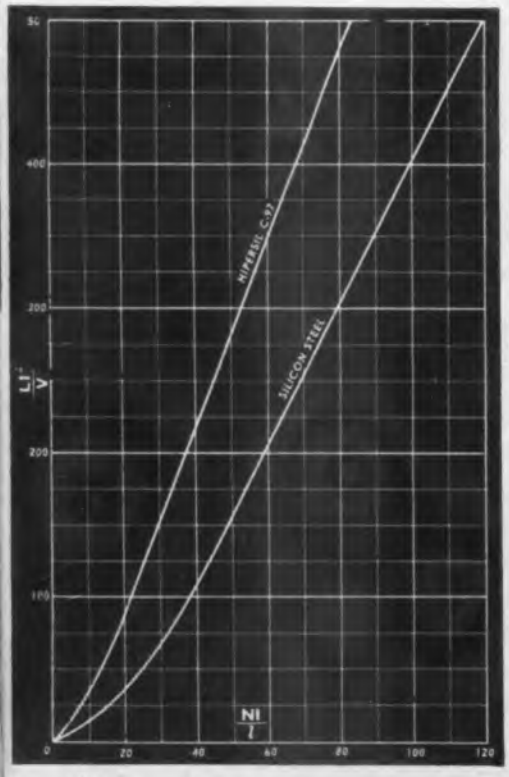


Fig. 2 — Permeability of Hipersil and silicon steel

Fig. 3—Curves show relation between energy per unit volume and ampere-turns per inch of core



● The advent of grain-orientated silicon steel strip such as Hipersil* has shifted all the "base lines" in radio transformer design. Not only is this true because of reduction of size and increase of efficiency, but also by the extension of frequency ranges and introduction of transformers into new fields.

Probably the most remarkable property of the new material is its higher knee of the saturation curve. This is depicted in Fig. 1, where the comparison is given in terms of a hypothetical 60 cycle working induction using high grade unorientated silicon steel. Calling this value 100 per cent, the induction obtained with Hipersil is 150 per cent, with no increase in magnetizing force.

Another way of expressing this improvement is shown in Fig. 2 as a comparison of the permeability of the two steels. Here it is seen that the permeability of Hipersil is much higher at the maximum point, and has the same percentage increase as in Fig. 1 for normal working inductions. Iron loss in Hipersil is correspondingly less than in silicon steel.

For 60 cycle applications, the increase in induction is beneficial in several ways. First, it permits a reduction of core area for the same magnetizing current. Second, it results in a smaller mean length of turn and thus a reduction in the amount of copper needed. In distribution and power transformers, for maximum benefit a reproportioning of the iron and copper losses is effected. In small radio transformers, the iron loss is usually a small part of the total, and therefore the reduction in copper loss is of greater significance. Within certain limits, the sum of the two losses determines the size of a transformer, and this is where the usefulness of the new steel becomes most apparent, both to the designer and to the user of a particular transformer.

At higher power-supply frequencies, such as the 400 and 800 cycle supplies encountered in aircraft and portable equipment there is a somewhat different picture. The decrease in iron loss is not so marked, because the eddy current loss then forms a larger proportion of the total iron loss. However, it is usual practice to use thin gage laminations at these frequencies, and much better space factor can be obtained in the wound-cores than is possible in stacked cores. The increase in permeability is just as effective in these higher frequency applications as at 60 cycles. The net result is a smaller transformer than was formerly possible, though for different reasons and in different proportions.

Incremental permeability

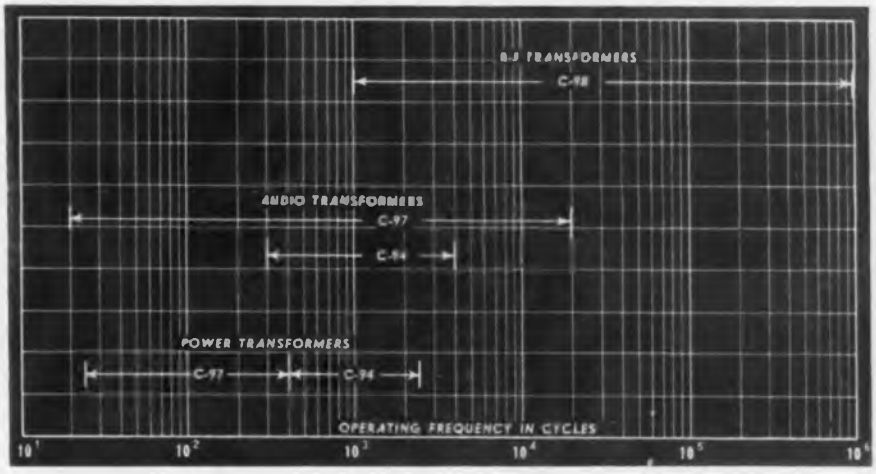
Reactors which carry direct current are usually smaller when made with Hipersil than with silicon steel. At low voltages, where low inductions are involved, Hipersil has greater incremental permeability, and it also maintains this margin of permeability at high flux densities. Consequently, a reduction in weight of 50 per cent is often feasible using the new material. Typical performance curves of Hipersil and silicon steel are shown in Fig. 3.

*Hipersil is a registered trade mark of the Westinghouse Electric & Manufacturing Company for high permeability silicon steel.

Design

Fig. 4—Core sizes used in audio transformers

Fig. 5—Approximate frequency ranges for various core materials



In audio transformers the use of Hipersil is not feasible in many cases where the high nickel content alloys are now used. Such cases are usually worked at low inductions, and with little or no direct current. The nickel-iron alloys usually have higher permeability than Hipersil at low flux densities, and therefore their use in this field will not be changed appreciably. Where these alloys are used at inductions of 1000 gausses or higher, they often may be supplanted by Hipersil, an advantageous fact now that nickel alloys are scarce. But at high inductions, or where considerable amounts of dc are involved, nickel-iron alloys fade out because of saturation and the new material really comes into its own.

Lower distortion, extended frequency range, or small size are the result of using Hipersil, and sometimes a combination of all three is possible. An idea of the range of sizes available for this purpose is given in Fig 4. Both smaller and larger sizes than those shown can be made, but sizes in the range shown have already been used on a wide scale.

In the numerous small items in the audio range operating at one frequency, as in filters and oscillators, the use of thin gage Hipersil is advantageous. The principal gain here is the better space factor of the material, together with its lower losses. Here again, smaller size or higher Q or a combination of both are possible.

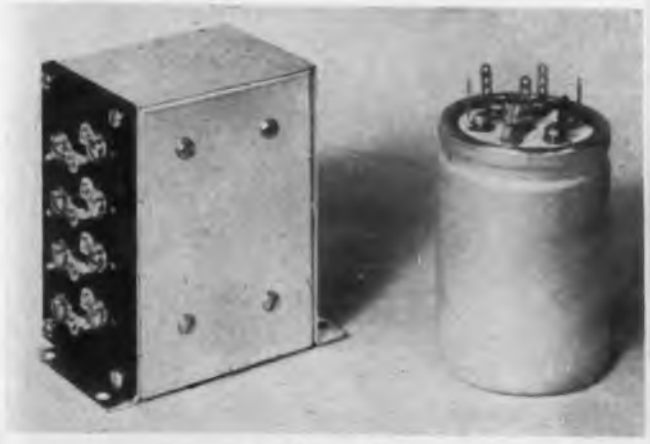
At frequencies higher than audio, the better space factor of Hipersil, together with its availability in thin gage, strip wound, pre-assembled form, combine to form a multitude of advantages. They make possible the use of transformers in various applications in the low and medium frequency rf bands, at power levels ranging up to 200 kw. The same is true of video and pulse transformers, which may be regarded as covering an extended frequency range down into the audio range and up into the medium radio frequency range.

Such transformers are grouped rather loosely together as rf transformers in the diagram shown in Fig. 5. In this figure the several classifications of rf, audio, and power transformers are shown with respect to their frequency ranges.

(*Continued on page 220*)

Fig. 7—Before and after redesigning with Hipersil

Fig 6—Some mounting arrangements possible with wound cores



ENGINEERING DETAILS OF

by D. W. PUGSLEY
Receiver Division,
Electronics Dept. General Electric Co.

Design principles and mechanical construction that have made possible practical perfection of the equipment

● Magnetic recording, on steel wire and tape, is almost a half a century old, and yet very little application of its principle has found its way into popular use as yet. It was back in 1898 that Valdemar Poulsen, a Danish scientist, invented his famous "Telegraphone." This was demonstrated in the Paris exposition of 1900. Ever since, there has been a periodic interest shown in magnetic recording, but no real use has been made of its principle.

It is difficult to understand why there has not been more emphasis placed on the development and application of magnetic recording, especially in this country. Europe has adopted the principle far more extensively than we in America, but the indications today are that we may also soon find wide application for this type of recording.

The armed services are exhibiting considerable interest in magnetic recording on wire, and have already purchased a number of machines for many varied uses. For example, Col. E. M. Kirby, of the Bureau of Public Relations, has placed some machines in service in Sicily and Italy for the purpose of recording "on the spot" news. These reels are then flown to some base for broadcast or other use.

Magnetic advantages

The advantages of magnetic recording over other types of recording are as follows:

(a) A recording can be made with the machine tilted in any position, and also under conditions of extreme vibration. This makes it possible to use the machine under battle conditions, in airplanes, on trucks, etc. It is this property which makes this type of recording valuable to the military forces.

(b) Long, uninterrupted recordings can be made, an hour or more, and still keep the recording medium in a small package.

(c) The record requires no processing after recording, except rewinding. It can be played back immediately.

(d) The record is permanent. Records have been played over 100,000 times with only a 4.5 db loss in volume.

(e) The record is relatively nondestructible. Being made of steel, it is less subject to damage in case of an airplane crash or other accident and is also less subject to damage by the elements.

(f) The record medium can be used an indefinite number of times. If a record has served its usefulness, it can be quickly and easily erased, leaving the medium clean and ready for another recording.

All of these advantages can be ascribed to either tape recording or wire recording. Wire recording has an additional advantage over tape recording in that a given length of record can be wound on a reel having a smaller volume and weight than an equivalent recording on tape. That is, the space factor is superior to that of the tape. Tape recording has an advantage over wire recording in that the tape is less subject to breakage than wire.

(Left) Front panel view of the magnetic wire recording machine with recording head visible between the reels. (Right) Interior view of the machine, which is built by General Electric, showing the belt and friction driven mechanism by means of which the reels are turned for recording and reproducing

MAGNETIC WIRE Recorder

However, in a well-designed wire machine this is relatively unimportant. Furthermore, in case of breakage, the wire can be easily and quickly spliced by tying a simple knot. Other than these reasons the choice of wire or tape is largely dictated by mechanical problems in designing suitable recording and reproducing heads and drives to obtain a given fidelity and quality. Both have been used with equivalent results.

One hour recordings

A new type of wire recorder being currently manufactured by the General Electric Co. for the armed services is illustrated. The spool at the left carries the wire recording medium. This spool contains half a pound of specially heat-treated steel piano wire of .004 in. diameter. The length of the wire is 11,500 ft., or roughly two miles. This record is good for slightly more than an hour's recording of speech. The wire passes from this spool through an erase coil, around a pulley, back through the recording head, around another pulley, and then onto the take-up spool at the right. During recording or play-back, the take-up spool is driven at constant speed.

Those familiar with recording technic will at once realize that this will have the same effect as in a disk recorder, in which the turntable rotates at constant speed. Just as in the disk recorder, wherein the record surface passes the needle with a gradually changing velocity from beginning to end of the record, so the wire in the wire recorder passes the recording and reproducing head with a gradually changing velocity due, of course, to the build-up of the wire on the take-up spool.

Small speed change

However, in this recorder the hub-to-flange ratio of the spool is such that the linear speed of the wire for an hour's recording varies only ± 7 per cent from a nominal value of 2.9 ft./sec. In an average disk recorder the speed for a five-minutes' recording (12 in. record) may vary as much as ± 50 per cent from a nominal value. This is an important but adverse factor in both types at higher speeds.

The recording and reproducing head, midway between the two spools, is designed to utilize the principle of longitudinal recording. That is, the magnetizing force, during recording, is directed longitudinally along the wire, parallel to the direction of motion. This is the only method which can be used successfully with a round wire. With tape any of three methods are available: longitudinal (magnetic force parallel to direction of motion); transverse (magnetic force perpendicular to direction of motion and parallel to face of tape); and perpendicular (magnetic force perpendicular both to direction of motion and to face of tape). The latter two methods cannot be used with wire because the turning of the wire would introduce distortion during playback.

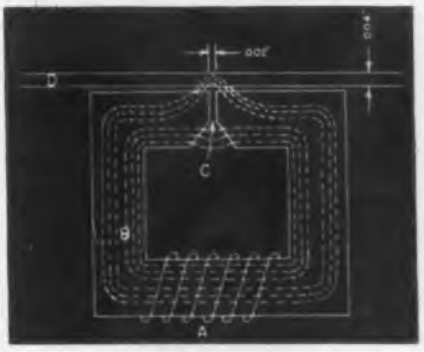
Several views of the recording head removed from its can are shown, one of them illustrating the .005 in. slot through which the wire passes. In the cross-sectional view, taken longitudinally through the center of the recording head, the coil, **A**, is energized with audio frequency current through a transformer from an amplifier. This sets up a magnetic flux in the iron path, B, represented by the flux lines. "C" is an air gap (actually a piece of copper) .002 in. wide. "D" is the recording wire.

Longitudinally magnetized

Since the iron core of the head has very high permeability (mumetal) and the wire has relatively low permeability (steel), most of the flux lines remain in the head until they reach the air gap, "C". Then, since the copper has very low permeability compared to the steel wire, the flux lines prefer to by-pass the gap and pass through the wire. Thus the section of wire in the gap is magnetized longitudinally. As can be visualized, it is very important that the wire be kept in close contact with the head as it passes the gap in order to keep the reluctance of the path around the gap as low as possible.

Two-purpose head

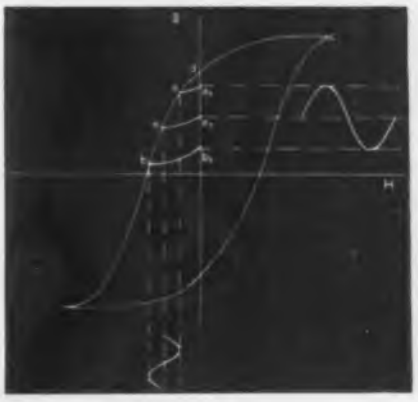
It can be seen that if a previously magnetized wire is passed through this head a magnetic flux will be set up in "B", which will induce a voltage in the coil "A". Thus "A" may be used as a pickup coil in reproduction. With this particular head, approximately 2 volts is required at 400 cycles to record a loud note, and about 2 millivolts will be reproduced. The



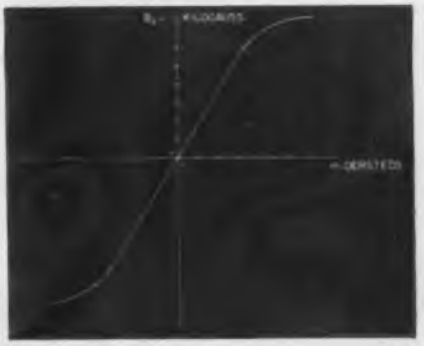
Sectional view of recording and reproducing head showing flux path

Typical B-H curve for iron

Showing recording on linear portion of B-H characteristic



Relationship between Br and Hr when using h-f recording system



Side and end views of the magnetic wire recording and reproducing head

coil has 3500 turns of wire, and an impedance at 400 cycles of about 300 ohms.

In the sectionalized view, it appears as though the head is only on one side of the wire. Actually the wire rides in a slot in the head and is surrounded on three sides by the mu-metal core. An enlarged view of the slot in the head reveals this. This construction is used so that the wire can be placed easily in the slot without the necessity of threading the wire through a hole. Another advantage is obtained by tapering the entrances to the slot in such a manner that a knot will ride up out of the slot and over the head, without jamming. This would not be possible without the slot.

Referring to the illustration of the complete machine a separate coil may be seen at the bottom of the recording head. This coil, called a hum coil, is connected in series with the recording head, and is so built and oriented, as to pick up an approximately equal and opposite voltage to the recording head due to any stray magnetic induction field. The circuit shown is in the schematic diagram.

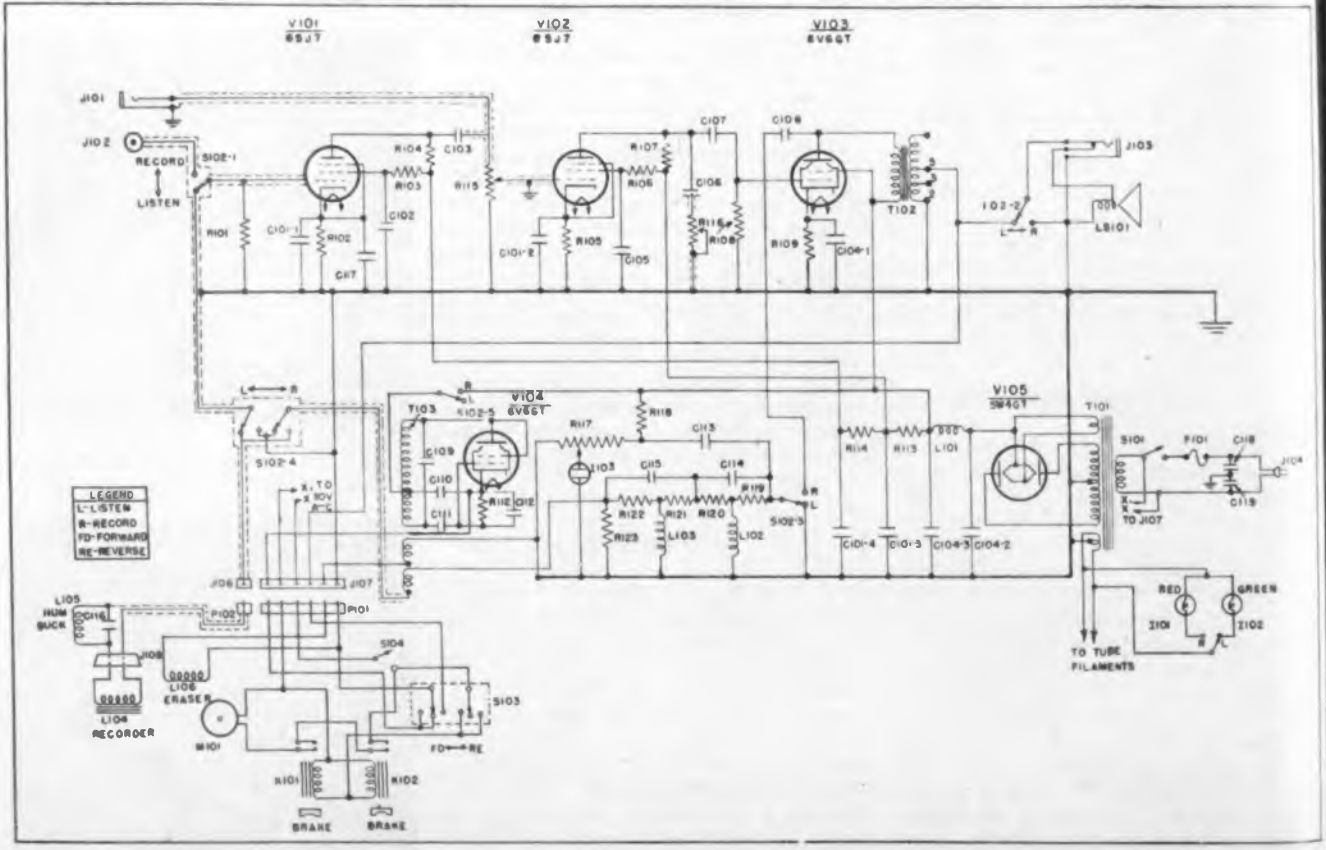
The erasing coil may also be seen located just ahead of the first pulley. This coil erases any previous record on the wire just prior to a new recording. As can be seen by referring to the schematic diagram, the switches are arranged so that this coil is energized automatically whenever a recording is being made, thus eliminating the possibility of double recording. Conversely, this coil, is never energized at any other time, thus eliminating the possibility of accidental erasing of a record.

The recording and reproducing head removed from its case

Erasing is accomplished by simply energizing the coil with a rela-

(*Continued on page* 206)

Complete wiring diagram of the General Electric produced magnetic wire recording and reproducing equipment



ENGINEER AS EXECUTIVE

by **LEWIS M. CLEMENT**
Crosley Corp., Cincinnati

How the engineering-trained executive can best tackle industrial management

• The difference between an engineer and an engineering executive is that the engineer has been trained to think clearly and logically, to analyze problems carefully and accurately, to check his results and account for everything which happens and strive for perfection of detail and design of the finished product, while the engineering executive must balance technical perfection with required performance, delivery promise, cost, life and saleability of the product. In addition to the strictly engineering duties relative to product development the engineering executive has many additional responsibilities.

Chart all functions

1. **Organization**—The proper organization must be set up, and it must be based on functions to be performed and not on the personal capacity of the individuals. After the functions have been decided upon, the best man must be selected and placed in the proper position. He must prepare a chart of the functions of his organization and keep it up to date. He must be given clear-cut responsibilities with corresponding authority and delegate this authority to his subordinates.

Must establish policy

He must make sure that no change is made in a subordinate's responsibility without a clear understanding by all. He must see to it that orders are not given to one in the organization over the head of his immediate superior. He must establish a policy that promotions or any action affecting an employe must be approved by his immediate superior.

Personnel surveys

2. **Personnel Relations** — Facilities may be constructed of brick, mortar, and steel but a company is only as good as the personnel in its organization. The engineering executive must carefully select the personnel for various jobs, giving due weight to education, past experience, ability to cooperate, and personality. He must make regular personnel surveys and study each man with relation to his job and with relation to possible up-grading.

About Lewis M. Clement

Born January 25, 1892, Oakland, Calif. Graduated from the University of California with degree of B.S. in E.E., 1914.

1914-1916—Engineer, American Marconi Wireless Tel. Co., Kahuku, Oahu, T. H., and Bolinas, Calif.

1916-1925—Engineer, Western Electric Co. and Bell Telephone Laboratories, New York
Electrical design of radio equipment for U. S. Government, World War I. Design and installation of Avalon-Los Angeles Radio Toll Circuit, 1920

1925-1928—Chief Engineer, Fada Radio, New York

1928-1930 — Vice-president and Chief Engineer, Kolster Radio, Newark, N. J.

1930-1931 — Engineer, broadcast receivers, Westinghouse Electric and Manufacturing Co., New York and Newark, N. J.

1931-1935 — IT&T CO. subsidiaries: Technical Director, Federal Tel. Co. and Kolster Radio, Newark, N. J. European Chief Engineer (receivers). International Standard Electric Co., London-Paris.

1936-1940 — Vice-president in Charge Research and Engineering, RCA Manufacturing Co., Camden, N. J.

1940-to date—Vice-president in Charge Research and Engineering, The Crosley Corp., Cincinnati, Ohio.

Encourage cooperation

He also must encourage cooperation with others in the same department and with other departments of the company, as well as with customers and vendors. He must see that credit is given to those who deserve it. He should encourage the recognition of his engineers by fellow engineers, engineering societies, trade associations, etc. He should encourage the writing and publishing of technical papers by his staff. He should make it known that no one is better than the people who work for him. He should point out that it is the duty of every one to prevent his superior from making a mistake. He should educate the superior to be big enough to accept the information and act on it for the good of the company.

Evaluate problems

3. **Business Management**—The engineering executive must be a business manager and recognize his department as a small business within a larger one. He must act in an advisory capacity to the management. He must be able to plan and schedule his work so that promises can be met. He must be cost-conscious and able to forecast the cost of engineering development and expenses and see that they are met by adequate control. He must be able to evaluate problems presented to him and make fair decisions based on all the facts and circumstances of the cases.

Broad-gage view

To summarize: The engineering executive must take a broad-gage view of the engineering problems, cooperate with all departments of his company, be organization-minded and make personnel relations one of his important jobs, and conduct his department as a going business.

Electron TUBES on the JOB

Automatic Devices Aid Airway Safety

New automatic radio safety devices which stand guard over the radio ranges forming the airway lanes over the United States and sound an alarm when anything goes wrong, have been recently delivered to Civil Aeronautics Administration, by Islip (L. I.) Radio Mfg. Corp.

Under certain weather conditions, or because of malfunctioning, the four radio courses projected by a radio range station will sometimes shift without warning to the pilot, or even stop functioning. The new radio range monitor eliminates this danger by providing, to both the fliers and the ground crews, instant warning if any radio course shifts as little as 3 deg. from its normal setting, or fades below its normal strength. The monitor may be adjusted to operate all warning devices with a range course shift of less than 1 deg.

Four-course range

The course monitor receiver is located 1200 ft. from the radio range station, directly on the radio course, and is connected through a telephone line to an indicator panel in the airport control room. Four receivers are required for all the four radio courses of the standard government four-course radio range. So long as the radio course does not shift, the monitor receiver continuously picks up the interlocking A and N signals transmitted by the range station.

Radio range monitor constantly receives signals and automatically warns the control station of shift in radio course

If the course shifts, either the A or the N signal begins to predominate, the amount of the course shift being indicated by the comparative difference in strength between the A and the N signals. When this happens, the monitor receiver automatically transmits an electrical impulse to the monitor board at the airport, which flashes a red light and sounds a siren to warn the ground crew; at the same time, the monitor automatically dials the range transmitter which instantly begins to send out to all pilots a warning signal at the end of each A-N cycle.

Monitor signal light

The same warning is given by the automatic monitor if the link circuit relay fails to interlock the A and N signals correctly or becomes locked; or if the output of the radio range station drops below a predetermined level; or if more than one-half of the range station identification call is not being transmitted.

The functioning of the monitor receiver presents many interesting electrical features. To measure the comparative strength of the A and N signals more accurately than it can be done by a human ear, the receiver automatically divides them and feeds them into separate channels. After the two signals have been equally amplified and rectified, the resultant direct currents from the two channels are fed, in opposite phase, to a balanced bridge circuit. Should the course shift, the output of one channel becomes greater, causing the pointer of the indicating instrument on the control board to move, showing how much the course has shifted, and to which side; at the same time, the warning light and the siren begin to operate.

The course monitor board, located at the airport, mounts the visual indicator to show the radiation strength of the range station; a green light which remains lit so long as the station is transmitting its courses correctly; a red warning light which flashes on if anything goes wrong; a siren with a resetting switch which allows the ground crew to silence it while repairs are being made whereupon it automatically resets itself to sound a new warning; and an Esterline - Angus recorder which automatically traces a complete record of the performance of the radio range station.

A similar device is used to safeguard the functioning for the airway fan markers—those fan-shaped fountains of radio energy transmitted athwart the radio courses as the pilot approaches an airport, to give him a definite position check along the radio range course.

Electron Diffraction Camera

This instrument is an electron diffraction camera developed by Dr. John E. Ruedy, research engineer in the RCA Laboratories at Princeton, N. J. It has a two-fold purpose: (1) to identify surface materials used in electronic research; (2) to study the crystal structure of the surface layers of such materials

Inspection Equipment

Another important application of electronics is indicated in a recent letter from the Army Ordnance Association to Electric Eye Equipment Co., Danville, Ill. The letter says, in part, "Your development and manufacture of electronic equipment has been responsible for the saving of untold man-hours in the inspection of war equipment, especially of small arms ammunition." The equipment referred to is being used in Army Ordnance plants and provides automatic precision inspection of mass production units to tolerances of

plus or minus .0001. As an illustration of the speed at which this equipment operates, one ordnance plant reports that a battery of inspection machines is making seven simultaneous dimensional inspections on machine gun bullets at the rate of 93 bullets per minute.

Diathermy Machine as Light Source

The man looking into the future is Dr. Samuel G. Hibben, director of applied lighting at the Westinghouse Lamp Division, discussing future trends in lighting at a gathering of architects and industrial designers in New York. Dr. Hibben speculated on the possibility of transmitting power by directional uhf after the war, and demonstrated the effectiveness, if not the efficiency, of the method as applied to lighting. In the photo, Dr. Hibben holds a fluorescent glass globe in the path of energy radiated from a prewar medical diathermy machine.

Spectrophotometer Camouflage Technic

Latest application of photoelectric spectrophotometers is to match camouflage colors so that they cannot be detected by the enemy's infra-red cameras. Camouflaging suffered a major setback when the infra-red camera was developed. Two objects which to the eye have the same color may photograph differently with the special film, due to differing infra-red reflection factors. Thus, the camouflage artist cannot judge from the appearance of a color how it will look to the infra-red camera.

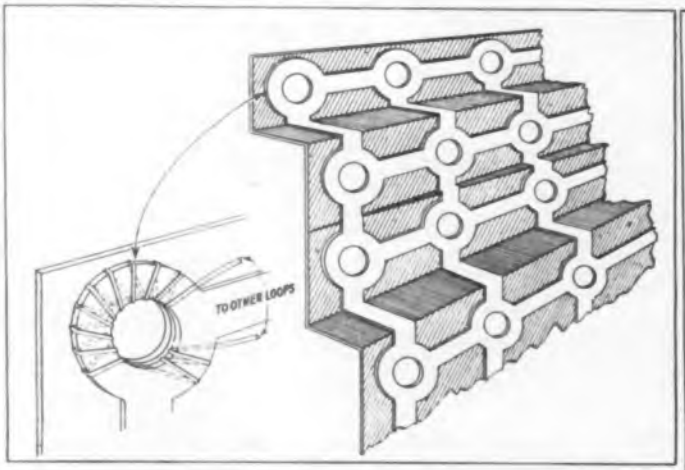
The spectrophotometer gives the camouflager a measure for color—both visible and invisible—which puts him on an equal footing with the infra-red camera. By determining the amount of light of various infra-red wavelengths that is reflected by any paint or other material, the exact appearance of the material to infra-red film may be predicted in a matter of two or three minutes.

Camouflage color-technic modernized by General Electric spectrophotometers

Welding Plane Parts

Application of electric spot welding equipment in many of the twenty-three Hagerstown, Md., plants of Fairchild Aircraft, has eliminated a large amount of riveting and represents a considerable saving in time and material. Several Sciaky machines are used for such purposes as welding sheets of aluminum for cowlings, inspection opening covers and detailed assemblies used in primary and advanced training planes and in utility-cargo ships.

Direct current Sciaky spot welder in use to fasten shut aluminum aircraft parts



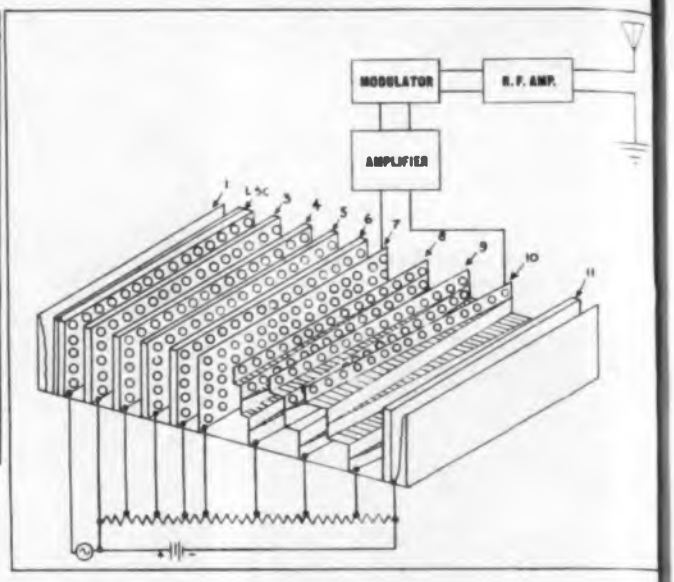


Fig. 1, Right—Basic elements in the Craig pickup tube for deriving a television signal without scanning
Fig. 2—Closeup of a few of the holes of the signal generating electrodes of Fig. 1. Method of applying winding to an element shown in inset

Television Without Scanning

Craig system transmits all picture elements simultaneously but requires scanning at receiver—Principles of operation

● Throughout its whole existence, from the time when Bain first disclosed the possibility of sending images to a distance, a great many rules have been formulated that show what can and cannot be done in the design of television equipment. That pictures must be broken down and transmitted point-by-point in order to get thousands of bits of visual information to pass over a single communication channel, has been known to be the basic principle with all systems. All practical and theoretical experiments have proved the need for certain, rather wide, frequency bands to transmit this intelligence and a straight forward mathematical analysis has proved that it is impossible to reduce this bandwidth requirement by any kind of circuit or gadget, as long as the scanning principle of reproduction is used.

There also have been many attempts to produce televised pictures without scanning. One of the most noteworthy was an early experiment by the Western Electric Co. using many neon lamps and individual wires to connect the transmitter and receiver. Even here, the transmission of signals to a distant point required the use of a scanning commutator system. The reproduction of a satisfactory picture by any non-scanning principle has always proved to require an almost fantastic amount of apparatus, and no satisfactory solution to many of the problems has been proposed.

Therefore, a proposal that satisfactory television programs can be transmitted in a narrow band of say 20 to 60 kc and that scenes can be transmitted continuously by radio in their entirety without scanning, may well be received with scepticism.

Dr. Palmer H. Craig, head of the Department of Engineering, University of Florida. See note at end of article

All this leads up to reporting a new non-scanning system disclosed by Palmer Craig, head of the department of electrical engineering, University of Florida, in New York last month.

50 kc bandwidth

Notwithstanding the fact that the presentation mainly was concerned with a discussion of the advantages of a television system that would keep within a 50 kc band and the economic factors resulting from the use of the longer waves permitted with such a bandwidth, a few of the principles proposed are of great engineering interest. It can be said at the outset that this plan is rather daring and ingenious and while it involves several components that will require much engineering work to bring within the realm of practicability, still there seems to be no technical impossibilities inherent to the general plan although a rather bewildering precision is called for in some parts. Indeed it is rather interesting and refreshing to contemplate a system that throws out all presently-known principles and procedure of the television art.

In Dr. Craig's system the scene is picked up by a lens system

(*Continued on page 222*)

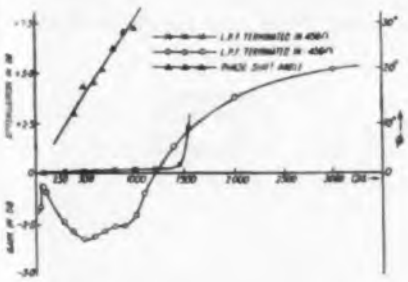
SURVEY of WIDE READING

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

Filters Terminated in Negative Impedances

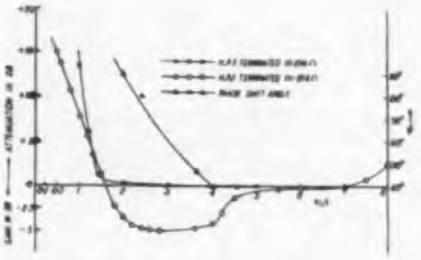
S. P. Chakravarti (Indian Journal of Physics, Calcutta, February, 1943)

If low-pass or high-pass filters are terminated in stabilized negative impedances of a magnitude approximately equal to their maximum characteristic impedance in the transmission band, band-pass filter characteristics and amplification over the transmitted band is obtained. Use of a negative impedance differing from the maximum characteristic impedance in the transmission band has the effect of adjusting gain, transmission bandwidth and sharpness of cut-off.



A cathode-ray oscillograph was used to study attenuation or gain and phase-shift characteristics of these filters. The terminating negative impedance was obtained by a screen-grid tube under secondary emission condition.

A low-pass H-type filter section of 100 mH total series impedance and 0.5 μF total shunt capacitance having a nominal characteristic impedance of 450 ohms and a cut-off frequency of 1500 cycles was investigated when terminated in a negative impedance of approximately 450 ohms. It will be seen from the diagram that this low-pass filter, when terminated in a negative impedance, behaves similar to a band-pass filter; the cut-off frequencies are 500 and 1000 cycles, the phase-shift varies linearly with frequency, amplification is obtained.



A high-pass filter section of 0.075 μF total series capacitance and 50 mH total shunt inductance having a nominal characteristic impedance of 814 ohms and a cut-off frequency of 1330 cycles also was investigated when terminated in a negative impedance of approximately 814 ohms. In this case, the figure indicates cut-off frequencies of 2150 and 4000 cycles for the resulting band-pass filter; the phase-shift again is an almost linear function of frequency, and amplification is obtained.

Similar Electromagnetic Fields in Tubes

H. Koenig (Hochfrequenztechnik und Elektroakustik, Berlin, Vol. 60, August, 1942)

In studying the behavior of actual devices it is frequently convenient to make use of experimental models similar in shape to the device but of different size. Rules are then needed for the relationship between physical dimensions and operating characteristics of the two systems. The article is concerned with finding these rules for electrically charged particles moving freely in a varying electromagnetic field; these rules are then applied to different types of electron tubes, where it may be advisable to have a large model for a small decimeter-wave apparatus. Alternatively, two or more of the operating conditions for the same tube may be so altered as to result in a similar electromagnetic field.

The ratio of the linear dimensions l, l', in the two corresponding systems is designated by m. Electric and magnetic intensities **E, E'**, and **H, H'**, velocity of charged particles, **v, v'** and unity of time, **t, t'**, are to be proportional in the two systems, the factors of proportionality being, respectively, $\alpha,\beta,\gamma,\delta$. From these requirements and the additional conditions that the electromagnetic field and the charged particles in the derived system also obey the physical laws, follow the proportionality factors listed in the table. In the headings, λ = the operating wavelength, **S** = Poynting's vector, $\mathbf{I}_v$ = displacement current (current induced in a dielectric by the movement of charges in its neighborhood), $\mathbf{I}_k$ = convection current (current due to the movement of charged particles), **V** = voltage, $\mathbf{b}_t$ = accelleration with time (change of particle velocity with time at a certain point), $\mathbf{b}_s$ = accelleration with space (change of particle velocity in space at a certain time).

In most practical cases, some of the quantities determining the proportionality factors are so small compared to others that they can be neglected; this results in more flexibility in the choice of the model and its operating conditions.

PROPORTIONALITY FACTORS

Determining Quantities	$m^{-1}=$ l'/l	$\alpha=$ E'/E	$\beta=$ H'/H	$\gamma=$ v'/v	$\delta=t'/t$ $\delta=\lambda'/\lambda$	$\alpha m^{-1}=$ V'/V	$\alpha\delta^{-1}=$ I'_v/I_v	$m\alpha\gamma=$ I'_k/I_k	$\gamma\delta^{-1}=$ b'_t/b_t	b'_s/b_s	Example
II IV	m^{-1}	$m\gamma^2$	$m\gamma^2$	γ	δ	γ^2	$m\gamma^2\delta^{-1}$	$m^2\gamma^2$	$\gamma\delta^{-1}$	$m\gamma^2$	Triode
II V		m	$m\gamma$			1	$m\delta^{-1}$	$m^2\gamma$			
(I) II IV (VI)		$m^{-1}\delta^{-2}$	$m^{-2}\delta^{-3}$	$m^{-1}\delta^{-1}$		$\delta^{-2}m^{-2}$	$m^{-1}\delta^{-3}$	$m^{-1}\delta^{-3}$	$m^{-1}\delta^{-2}$	$m^{-1}\delta^{-2}$	Klystron
(I) II V (VI)		m	δ^{-1}			1	$m\delta^{-1}$	$m\delta^{-1}$			Magnetron
I II (III) IV (V) (VI)			m	1	m^{-1}		m^2	m^2	m	m	Magnetron

The different lines in the table give the proportionality factors, provided the process is determined only by the quantities indicated by the numbers in the first column. Of course, the approximations made in neglecting some of the quantities must hold for both systems. The last line corresponds to the most general case; none of the quantities being negligible. I stands for displacement current, II for convection current, III for curl of electric field intensity, IV for electric component of the force causing movement of charged particles, V for magnetic component of the force causing movement of the charged particles, and VI for change of particle velocity with time at any given point. Brackets indicate that either one of the conditions may not be met without changes in the proportionality factors.

Several examples where the approximations may be used are given in the last column. It will be seen from the first line of the table that if the same triode ($m = 1$) is operated with a voltage $V' = \gamma^2 V$ and a wavelength $\lambda' = \delta\lambda$, the two electromagnetic fields will be of similar shape though γ and δ may be chosen arbitrarily.

A Klystron, mentioned in the third line of the table, may be operated with a wavelength $\lambda' = \delta\lambda$, however, if the two resulting electromagnetic fields are to be similar, the voltage V must be made equal to $\delta^{-2}V$.

In the case of the magnetron, last line of the table, wavelength and voltage are determined by the size of the tube and neither may be chosen if a similar electromagnetic field in the same tube is desired. Line four gives only a rough approximation.

Harmonic Analysis by Photographic Method

A. W. Straiton and G. K. Terhune (Journal of Applied Physics, October, 1943)

The Fourier coefficients for the interval $0 < x < 2\pi$ are given by

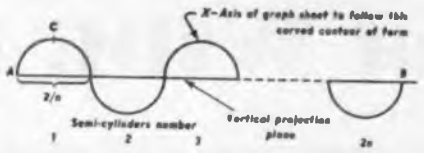
$$b_n = \frac{1}{\pi}\int_0^{2\pi} f(x)\,\sin nx\,dx$$

and

$$a_n = \frac{1}{\pi}\int_0^{2\pi} f(x)\cos nx\,dx$$

where n has the values 1, 2, 3, . . .

To obtain the value of the first integral, a form is made up of a series of tangent semi-cylinders, alternately convex and concave, whose diameters are each equal to 2/n; a horizontal cross-section is shown in the figure. The graph



Horizontal cross-section of form for finding Fourier coefficients

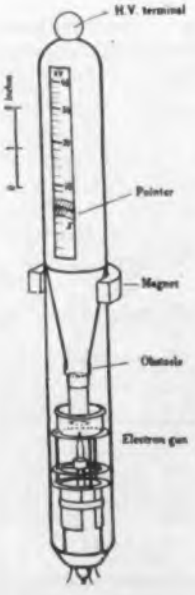
sheet is placed to follow the curved surface of this form, with the x-axis in a horizontal plane and the y-axis lying along a line of tangency between two cylinders; the lines $x = 0$ and $x = 2\pi$ pass through A and B, respectively. A projection of the curved graph on a vertical plane is produced by photographing the graph from sufficient distance to reduce distance distortion to a desired value.

A mathematical derivation proves that the area between curve and x-axis on the photograph over 2n semi-cylinders is proportional to the coefficient b_n. The sense of the area measurements must be reversed each time a new semi-cylinder is reached. Planimetric determination of the area is recommended. If the y-axis of the graph is moved parallel to itself to fall along a maximum of the semi-cylinder form,—the cross-section point of this maximum line is indicated by C,—the a_n values are obtained in the same manner.

CR Tube Voltmeter

W. Ehrenberg and H. Hirsch (Journal of Scientific Instruments, London, October, 1943)

A cathode-ray tube without deflecting plates has been designed to operate as high-tension voltmeter up to about 50 kv with an accuracy of approximately three per cent; the scale is nearly linear.



CR tube voltmeter

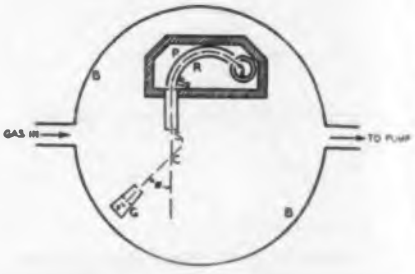
The electron beam is deflected by a small permanent magnet onto the fluorescent screen scale which is arranged parallel to the undeflected beam, while the voltage to be measured is applied to the anode or H.V. terminal and counteracts the deflection caused by the magnet. The whole upper part of the tube forms the anode; it is metallized on the inside except for the strip on the side covered with fluorescent material.

The electron beam is focussed by a circular opening to form a point source so that the obstacle, an oblong aperture along which a fine wire is stretched, will cast a well-defined shadow, the pointer, for all values of anode voltage. Detailed construction features and dimensions are given and discussed.

Gas Analysis by Electron Scattering

S. West (Geophysics, October, 1943)

When a beam of electrons is projected into a gas at low pressure, many of the electrons are deflected or scattered out of the beam by collision with the nuclei and elec-



Gas analyzer using electron scattering

trons of the gas molecules. The collision is called inelastic if the scattered electron loses energy to the molecule and elastic if it does not. The probability of scattering of an electron depends upon the atomic and molecular structure of the gas, the gas pressure, the energy of the incident electron, the angle of scattering, and the loss of energy by the electron during collision. Possible methods of using electron scattering phenomena to analyze mixtures of hydrocarbon gases and to investigate the molecular structure of hydrocarbon gases are discussed.

The analyzing apparatus shown measures the number of deflected electrons for a certain angle of scattering having a certain energy or velocity. Electrons emitted by cathode F are accelerated and if scattered from the region C through an angle ϕ they enter the

(*Continued on page 240*)

"In recognition of Service beyond the call of duty . . ."

In this grim business of war, the men in uniform take the risks; they deserve the decorations.

We tube manufacturers don't expect medals. When, however, credit does come our way . . . and when it comes from such a man as Paul V. Galvin, President of RMA . . . it makes us mighty proud and happy.

"Let me take a moment for special mention of the tube engineers. Too often they are not fully recognized. We see fine accomplishments in apparatus, but we fail to appreciate the important work that has been done behind the scenes by the tube engineer. Hats off to you—your accomplishment has been most extraordinary. But you, also, you cannot as yet rest upon your oars. The job is not finished, and new and additional accomplishments are required before we are finished with this war." *

Hytron engineers realize fully that "the job is not finished", and they continue to strive for "new and additional accomplishments" needed to win the war. Their aim is to develop better tubes to make possible better fighting equiment—let the decorations fall where they may.

* Excerpt from address of Paul V. Galvin, president of the Radio Manufacturers Association at the Institute of Radio Engineers' Rochester Fall Meeting, November 9, 1943.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

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ASSOCIATION NEWS

McIntosh Outlines Engineers Survey

Multi-path problems in television transmission and reception came in for careful study at the December meeting of the Institute of Radio Engineers and the Radio Club of America held in the Engineering Societies Building, New York. In "Television Broadcast Coverage," Allen B. Du Mont and T. Goldsmith, Jr., of Allen B. Du Mont Laboratories discussed a series of observations on many television receivers permanently installed in the metropolitan area together with other observations with special receiving equipment aboard a cruiser which cruised all waterways within the range of the transmitter. Continuous records of signal field strength, still photographs and motion pictures of the received television pictures were shown. The survey was particularly concerned with the multi-path problem in television transmission which causes ghost patterns in the received pictures. Photographs and diagrams illustrating the appearance of these patterns were shown and explained and a series of working rules was given by which the probable cause of the signal reflection can in many cases be ascertained. The lower frequency channels provided the least multi-path interference in the metropolitan territory, as around New York.

(*Continued on page* 238)

Conventions and Meetings Ahead

Institute of Radio Engineers (330 West 42nd Street, New York), Jan. 5, New York.

Radio Club of America (11 West 42nd Street, New York), Jan. 13, Columbia University, New York.

American Physical Society (Karl K. Darrow, Columbia University, New York), Jan. 13-15, New York.

Society for Measurement and Control (New York Section Meeting), Jan. 25, New York.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York City), National Technical Meeting, Jan. 24-28, New York; joint meeting with Institute of Radio Engineers, Jan. 27, 28, 29, New York.

Electrochemical Society (Colin G. Fink, Columbia University, New York), Spring Convention Meeting, April 12-15, Milwaukee.

Society of Motion Picture Engineers (Harry Smith, Jr., Hotel Pennsylvania, New York, N. Y.), April 25-27, Hotel Pennsylvania, New York.

American Mathematical Society, February 26, New York, April 28-29, New York, Chicago, Berkeley, Calif.

McIntosh Outlines Conversion Problems

Frank H. McIntosh, head of the Domestic and Foreign Branch, Radio and Radar Division, WPB, addressed several hundred radio-electronic engineers and executives at an American Marketing Association Radio-in-Wartime luncheon in New York on December 15th. He traced the history of radio and electronic war-conversion problems and subsequent growth, revealing a number of interesting figures.

The replacement parts and tubes allocated to maintain existing civilian broadcast receivers now represent less than two per cent of the total industry production. The largest single item is tubes, with from ten to twelve per cent of total production now going into civilian channels, or approximately 1,400,000 tubes per month.

BC receivers in service

In normal times, said Mr. McIntosh, four to six per cent of all broadcast receivers are out of service for repairs. Today, after two years of war, the figure is 7.8 per cent, a rather heartening news-item to many. According to a recent survey, thirty-two and one-half million American homes are radio-equipped. If there are thirty-six and one half million homes in all, this represents an 89 per cent market saturation, without regard to the factor of obsolescence. Broken

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down in terms of numbers of sets per home, 66.2 per cent have one set, 27.1 per cent have two sets, 5 per cent have three, and 1.6 per cent have four or more sets.

Mr. McIntosh pointed out that at the beginning of the war production period, one of the tightest fields was transmitting tubes. In peacetime, each broadcasting or other transmitting station accounted for many thousands of receivers. On the contrary, military requirements make necessary the production of about one transmitter per receiver.

Transmitting tube situation

Warnings and fears last year that the future would see the closing of at least half of the broadcasting stations were sidestepped by greater care in handling transmitting tubes and equipment, and by reduction of transmitter output one db. At present the civilian transmitting tube situation is looking forward and upward and will continue to do so. Some idea of the vast expansion in transmitting tubes may be gained from the fact that the annual prewar production of 200,000 tubes worth two million dollars, is to be contrasted with a total production of three hundred million dollars' worth of these types during 1943.

1944 radio production

The twelve to fifteen times-normal expansion of the radio-electronic industries has been a result largely of the excellent work of the industry in accepting the challenge of war production. The producers may be divided into three classes: (1) those whose product and quantities are relatively unchanged from prewar standards, (2) those firms who are producing their peacetime products but in vastly larger quantities, and (3) those who entered the electronic field from a totally different, non-essential prewar activity. Mr. McIntosh expressed the belief that many of the latter like the kind of work they are doing and would undoubtedly stay in the electronic field. War-radio production for 1944 will be 30-40 per cent above 1943, Mr. McIntosh said.

Postwar television

Ira Hirschmann, vice-president of Metropolitan Television, Inc., and Bloomingdale Bros., Inc., owners of an FM station in New York, spoke on postwar television and programming. He described television as a potentially great advertising and entertainment medium to supplement, not replace, existing media, and discussed its use by

(*Continued on page 240*)

ENGINEERS REPORT ON POSTWAR RADIO PROBLEMS TO SENATE COMMERCE COMMITTEE

Whether FM broadcasting or television is better entitled to the major attention of industry, and of Government bureaus, occupied the greatest attention of engineers testifying before the Senate Interstate Commerce Committee early last month. With advocates of an extension of FM facilities urging more space for that service, and those who believe television to be the most important future development seeking increased room in which to operate, much data that may be helpful was made public.

Major Edwin H. Armstrong, father of frequency modulation, believes that with the start this system already has had, it is ripe for great expansion. Nevertheless, he stated to the committee that he did not believe he had enough imagination to go along with the prediction that FM eventually would replace telephone wires. He emphasized though, that television must trail behind FM, opining that if it had not been for the war, FM would by now have been in operation throughout the world, especially in the tropics. After the war, he believes that FM development will be so rapid that additional space will be imperative, and feels that progress would be blocked by establishing inflexible allocations.

As another reason for most carefully considering FM possibilities and probabilities, Consulting Engineer C. M. Jansky, Jr. predicted that it will be possible to put multiplex teletypewriter or facsimile service on the same frequency used by an FM station without interference.

Pointing out the well known fact that as frequencies become higher the difficulty of producing tubes to produce adequate amounts of power increases, O. B. Hanson, vice-president and chief engineer of the National Broadcasting Co., urged experience with the use of frequencies between 30,000 and 100,000 kc as a logical reason for concentrating current development in that portion of the spectrum. "Research and development," he said, "have opened up the frequencies between 300,000 and 3,000,000 kc, but the rate at which public service can utilize these bands depends upon the ability of the radio laboratories to design and produce equipment that will make their use possible. Thus, the generally known developments in this field draw the attention of the many contemplated new radio services toward the lower portions of the very high frequency spectrum, or to be specific, to the frequencies between 30,000 and 150,000 kc, in which range practical amounts of power can be generated.

"Looking toward the progress that may be expected in the next decade I visualize television as representing the greatest potential possibility for service to the public.

"It is my opinion that if the present frequency allocations and technical standards for television are not greatly disturbed in the anticipated shuffling of frequency allocations, at least one thousand television stations can be placed in operation in the United States during the next decade following the cessation of hostilities. These new stations would represent a capital investment of roughly $250,000,000. They would employ in their operations about 65,000 persons directly and many additional thousands indirectly. the additional thousands representing advertising agency personnel, artists, performers, mu-

(*Continued on page 234*)

Wolf Made Lt. Colonel; Assigned to South Pacific

Sidney K. Wolf, Assistant Director of Production of the WPB Radio and Radar Division who has been a leading "spark-plug" of that agency during his service with it for the past two years, has just been commissioned a Lieutenant Colonel in the Army Air Forces and is due to be sent to the South Pacific during the middle of January to do important operational research and technical work in that combat zone.

Lt. Col. Sidney K. Wolf, starts soon for South Pacific

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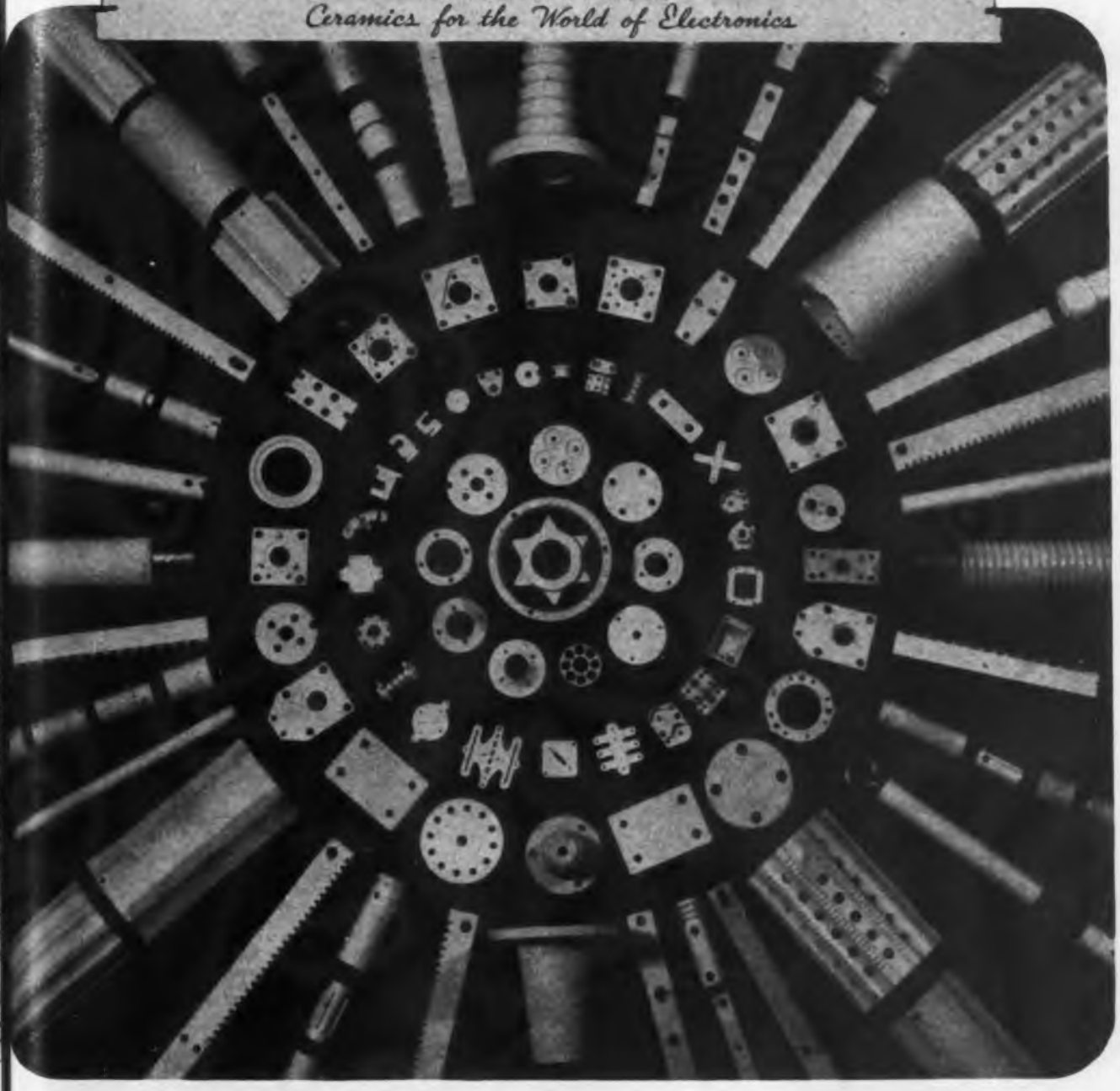

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WHAT'S NEW

Devices, products and materials the manufacturers offer

Sensitive Relay

A new Struthers Dunn relay, Type 79XAX, is designed for a variety of applications calling for a highly sensitive unit having snap-action contacts. Contact pressure remains constant despite slow variations in the coil current in which it is connected. When the coil current reaches a certain point, the contacts operate with a positive snap action. The relay operates on as little as 10 milliwatts and its greatest field of use-

fulness lies in applications where current varies slowly rather than quickly from 0 to rated value. Made by Struthers-Dunn, Inc., 1321 Arch St., Philadelphia, Pa.

Strain Gage Analyzer

This instrument used to analyze and indicate on a recording oscillograph, strains in mechanical members such as railroad rails, beams, and similar structures. The instrument consists of six individual direct coupled amplifying units featuring individual master bridge circuits. This makes it possible to indicate the strains produced on structural members by six individual pickups. All outputs and inputs are available from the front-of-panel and each amplifying unit is removable from the front-of-panel by removal of four panel screws. This makes it possible to check calibration or service the instrument in the field very conveniently. The unit has a built-in ten tube regulated power supply holding the plate voltage and filament voltage to a variation of 1 per cent. A dc voltmeter is connected in the circuit at all times and a zero center milliammeter is used with a patch cord for initial balance of output plate current before the recording oscillograph is used. The direct current output on each amplifier is 20 ma linear over the whole scale within 1 per cent. The units may be used with any standard recording system. The frequency response of each unit is linear within 1/10 of 1 per cent from 0 to 40 kc. Gain in decibels of each unit is 90 db. The complete instrument is 36-in. high, 20-in. wide, 18-in. deep, and weighs 150 lb. Manufactured by Televiso Products, Inc., 6533 No. Olmsted, Chicago 31, Ill.

Square Wave Generator

This new low-priced square wave generator Model 530, designed for production testing, incorporates a method for synchronizing with any external frequency source. It has a hand-calibrated frequency scale reading from below 10 cycles to more than 100 kilocycles. The decade multiplier has four steps. The accuracy of the frequency calibration is 5 per cent over extended periods. In cases where great accuracy of frequency is desired, the instrument can be made to synchronize with any standard frequency generator, provided that a synchronizing voltage of at least 0.1 volt is available. The synchronization can also be made with any other external frequency source. Output impedances available are 100-200-500-600-1,000-2,000 ohms. Output voltage

may be varied either in fixed steps or may be continuously varied by means of the variable voltage potentiometer. The power supply is for 110-120 volts, 60 cycle ac. Manufacturer is Reiner Electronics Co., 152 West 25th St., New York.

Pneumatic Controller

In this new electronic pneumatic controller there is neither a motor nor other continuously moving parts. The measuring circuit, including the galvanometer and the photoelectric system are identical with the standard Celectray controller, but in place of the relay found in that controller there has been substituted a magnetic air valve which acts as an amplifier and converter from electric to pneumatic operation. As temperature varies, the light image moves across the controlling edge of the flag varying the light that reaches the phototube and

causing more or less current to flow through the magnetic air valve, thus altering the controlled air pressure. If the sensitivity is lowered by moving the arm to a lower value on the scale, then the flag will follow the light beam as it moves back and forth with changes of temperature. The flag will follow to the limits of the throttling zone as determined by the position of the arm. The instrument is made by the C. J. Tagliabue Co., 550 Park Ave., Brooklyn 5, N. Y.

Bushing Mounted Capacitor

This bushing mounted capacitor (No. 817-001) is a special type for use in high frequency circuits where a capacity ground to the chassis and a lead-through are required. Capacitance is 55 mmf ±10 per cent; temperature coefficient .0052 mmf/mmf/ deg. C.; test voltage 2000 dc; working voltage 1000 dc. Maker is Centralab Division of Globe-Union, Inc., Milwaukee, Wis.

Non-Conductor Plating

A process for electro-plating a smooth, non-porous adhesive metal coating on plastics and other non-conducting materials including wood, has been developed by Metaplast Corp., 205 West 19th St., New York. The process is applicable to non-conductors of almost any shape and the coating retains the detail of the underlying surface. Precision plating is being done to Army and Navy specifications insuring one or a combination of properties such as high conductivity, resistance to vibrational strains or dimensional stability. Illustrated is a polystyrene antenna loop partly plated to a specified thickness.

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RECTIFIER EST. 1892 ENGINEERS

Micro-Crystalline Wax Alternate

To meet the shortage of micro-crystalline wax, Wishnick-Tumpeer, Inc., 295 Madison Ave., New York, has developed a new group of waxes. Witco Hamp Wax is a hard amorphous petroleum wax which possesses high resistance to moisture vapor transmission. It is available in several grades, with melting points ranging from 155 deg. F. to 168 deg. F. and penetration of 35 to 50 at 77. The product is amber in color.

Coil Winding Calculator

A new slide-rule type rapid calculator permits determination of inductance, capacitance, and frequency components of series or parallel tuned rf circuits as well as inductance, turns-per-inch, wire type, wire size, coil diameter and coil length for single layer-wound solenoid type rf coils. All values, in either case, are found with a single setting of the slide and are accurate to within approximately 1 per

cent for coils ranging from ½-in. to 5⅛-in. in diameter and ¼-in. to 10 in. in length. Wire types and sizes include 11 to 35-gage plain enamel, 11 to 36-gage SSC, DSC, and SCC, and 12 to 36-gage DCC. The rule is also engineered to indicate: turns-per-inch from 10 to 160; inductance from 0.1 to 15 microhenries capacitance from 3 to 1.000 micromicrofarads; frequencies from 400 kilocycles to 150 megacycles with equivalent wavelengths in meters. Made by Allied Radio Corp., 833 West Jackson Blvd., Chicago 7, Ill.

Two New RCA Tubes

Two new tubes are being made available to equipment manufacturers against WPB rated or allocated orders by RCA Victor Division, Harrison, N. J. Type 829-B is an improved design of push-pull rf beam power amplifier having a total maximum plate dissipation of 40 watts. It is recommended especially for use in ff power amplifier equipment. Having the same size and general appearance as the RCA-829 which it replaces, the new 829-B differs in that it has not only a higher plate-voltage rating (750 volts) but also an improved mechanical structure to permit use of the tube in applications involving considerable vibration. The efficiency and high power sensitivity of the 829-B permit full power output with very low driving power. For example, a single tube operated in push-pull class C telegraph service is capable of handling a power input of 120 watts with less than a watt of driving power at frequencies as high as 200 megacycles.

Type 931-A—an improved 9-stage multiplier phototube—has the same size and general appearance as the RCA-931 which it supersedes, but differs in that its current amplification has a minimum value 6 times higher, and an average value more than 3 times higher for the same voltage per stage. At 3750 Angstroms, the 931-A has a sensitivity of 1800 microamperes per microwatt of radiant flux at 100 volts per stage whereas the 931 had a corresponding value of 532 microamperes per microwatt—an improvement of over 3 times. 931-A is recommended for use in light-operated relays, in sound reproduction from films, in facsimile transmission, in scientific research utilizing low light levels, and in military equipment.

Heating Coils

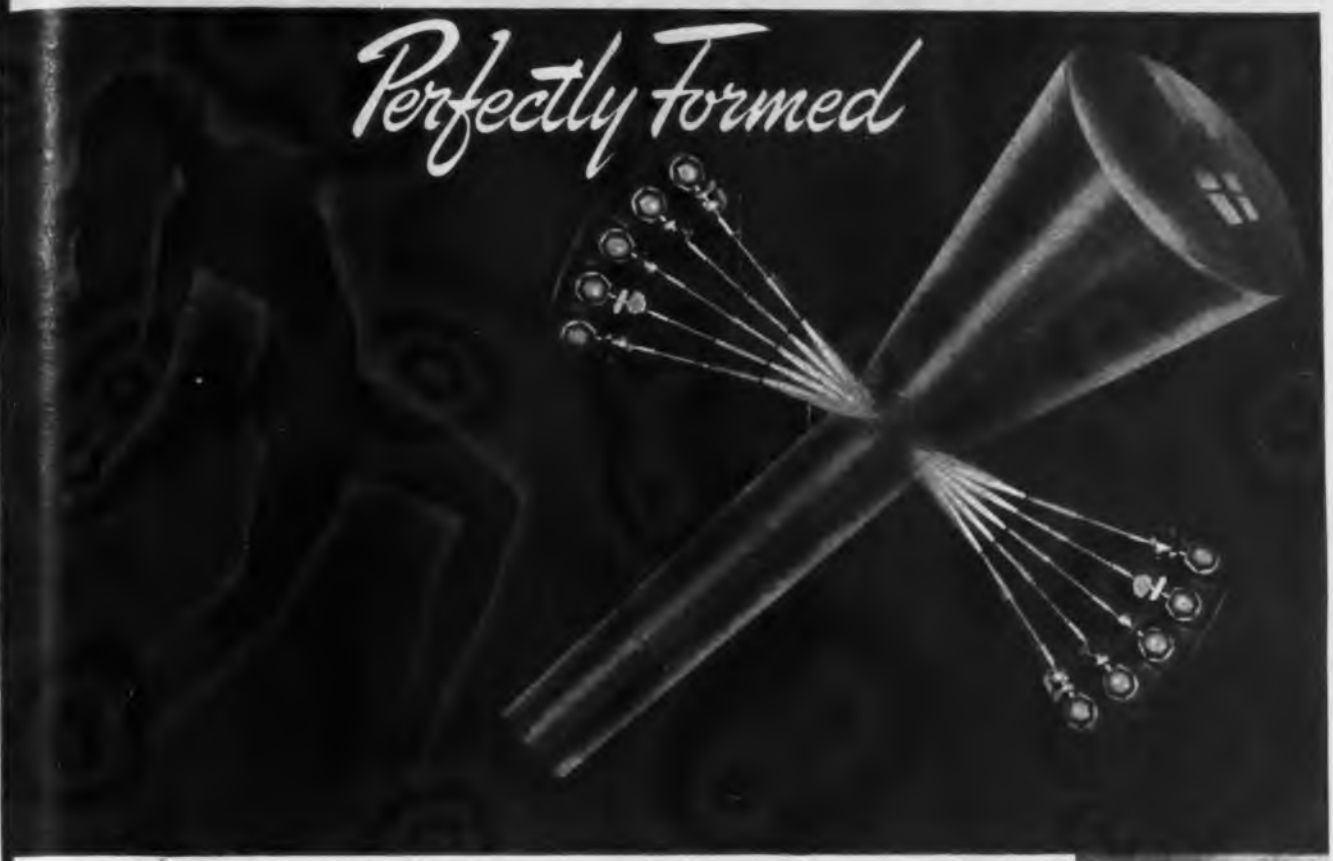
A broad assortment of standard coils for electronic heating applications, plus specialized facilities for the production of non-standard types, is offered by Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa. Standard heavy duty coils meet many electronic heating applications up to 1 kw. Of air wound design, these coils are light, adaptable to numerous mounting arrangements, sturdy, and have low dielectric loss. They are wound to uniform pitch, offer design adaptability, and lend themselves readily to mechanical and electrical revisions in circuits that must be adjusted, or which are still in the experimental stage.

Insulating Varnish

A new type of insulating varnish, styled Synthite clear baking varnish, is being produced by John C. Dolph Co., 168 Emmett St., Newark, N. J. It is intended to be useful on high speed armatures and tightly wound fine wire coils. The product is clear, of a gravity of 25 deg. Baumé, is thinned with naphtha, has considerable resistance to acid and alkali and is unaffected by fresh or salt water after 500 hours.

Ionization Gage

This new gage provides a simpler way to measure the degree of vacuum in a system. It gives continuous reading and will take a variety of tubes with a simple setting. It is designed for economical operation with low-priced monometer tubes. Left hand meter is for simple setting of ionization current. Right hand meter gives continuous reading of degree of vacuum. There are four ranges measuring down to .01 micron. Operation is on 117 volts, 60 cycles ac with stability maintained by adequate bleeder current and voltage regulators. Furnished complete with connecting cables and monometer tube, 1-5Y3G, 1-2051, 2-VR150-30, 2-7B4 and 2-7C7 tubes. Available in stationary or portable models. Manufactured by General Electronics, 101 Hazel St., Paterson, N. J.



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Fluorescent Ballasts

For cold cathode fluorescent lighting, Jefferson Electric Co., Bellwood, Ill., has developed a ballast which incorporates a transformer, two reactors and a capacitor all enclosed in a case 2½x3⅛x9½-in., weighing 9 lb. The ballast lights two 40-watt tubes with a power consumption of 105 watts and operates from the ordinary 115-volt alternating current lighting system. The tube connections are made in multiple and operation is such that the stroboscopic effect is reduced to a minimum and the tubes light instantly without the use of starters.

Vacuum Switches

Four new vacuum switches for a wide variety of radio and industrial switching applications have been developed by the Tube Division of the General Electric Co.'s Electronics Department, Schenectady, N. Y. They can be adapted to oil or water-immersed operation because of their enclosed construction and are especially applicable for hazardous installations where fire and explosion are a risk. Two of the new switches are also designed for high altitude applications. Contacts are mounted in a vacuum, are relatively free from the effects of corrosion and arching, and are unaffected by dirt or oxidation. The vacuum-type construction also gives the switches a high current rating for their size and permits them to handle enough power to operate equipment at greatly reduced voltages. No self-contained coil or other operating mechanism is built into the switches. Movement is obtained from the mechanism to be controlled

Electric Tachometer

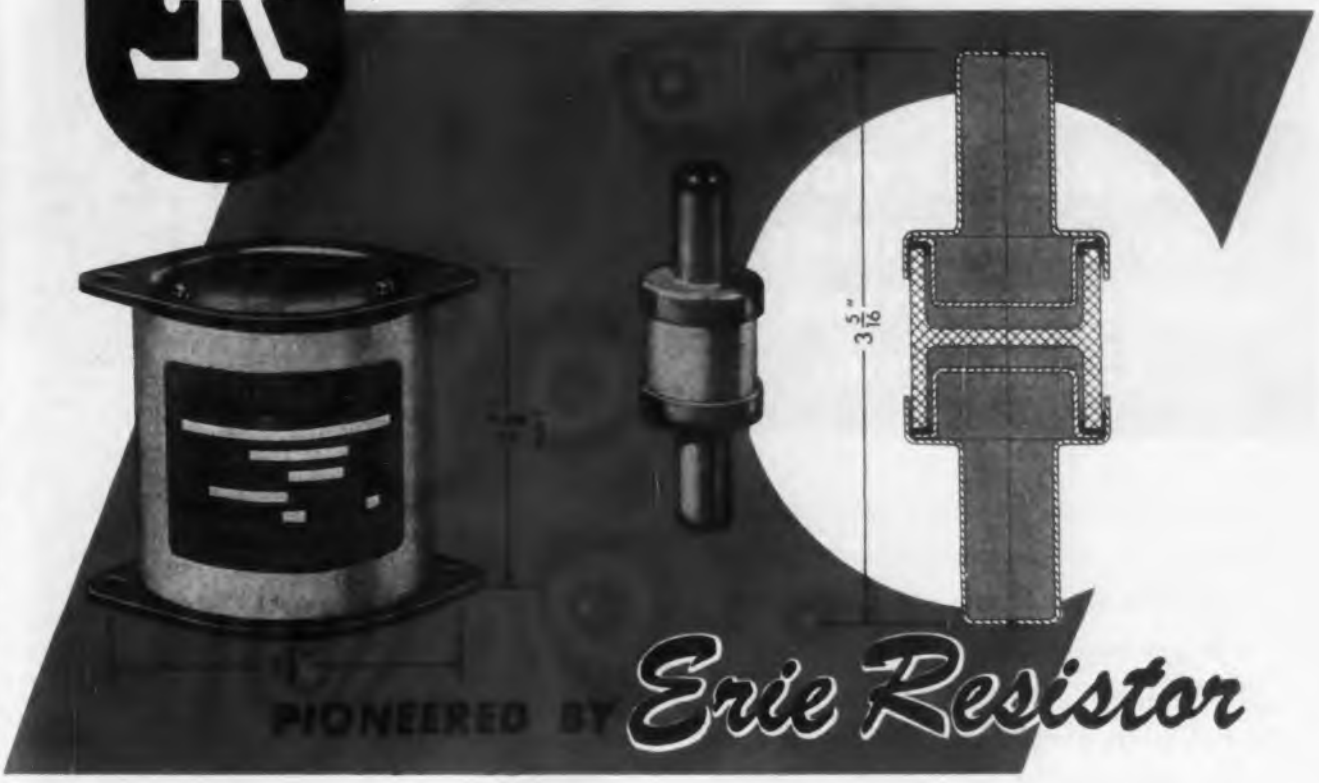
Accuracy to plus or minus one per cent of full scale deflection—up to 5,000 rpm. is the main feature of the new Ideal tachometer which consists of a small generator coupled electrically to an electric meter. An "Alnico" magnet rotor is mounted on precision sealed ball bearings capable of continuous operation at any speed within limit of the meter. As ac is generated within the tachometer itself, no brushes, commutators, or gears are required—thus assuring rugged reliability for all types of service. It can be used as "hand type" or "separable type," so that it provides a new step in speed measurements for testing, laboratory and production requirements. Ideal Commutator Dresser Co., Sycamore, Ill., is the manufacturer.

(*Continued on page 270*)

Ceramicon Designs

REG. U.S. PAT. OFF.

FOR HIGH VOLTAGE AND HIGH KVA APPLICATIONS



THE two condensers illustrated above are examples of two basic ceramic condenser designs developed by Erie Resistor for high voltage, high KVA applications.

Shown at the left is the Erie Type 680A transmitting condenser that is designed for 6000 volts RMS test voltage. This unit consists essentially of a number of silvered ceramic discs, each having the well known stability and temperature retrace characteristics of compensating Ceramicons, and in addition are designed to safely withstand high voltages required in this type of condenser.

The Antenna Coupling Ceramicon illustrated at the right employs the double cup design originated by Erie Resistor. In developing this unit Erie engineers successfully overcame the problems of eliminating corona and dissipating internal heat while retaining small size and simplicity of design. The specifications of this condenser, given at the right, show the high degree of perfection it has now reached.

Erie Resistor is working further on the development of similar Ceramicon designs for other applications. If you have a condenser problem connected with present day equipment, or for postwar applications involving high voltage, high KVA units, we would like to discuss Erie Ceramicons with you. Our wide experience, beginning in 1935 with the first development of ceramic condensers in this country, gives us a comprehensive background on which to base recommendations.

CHARACTERISTICS

Left: Type 680A Transmitting Ceramicon Maximum capacity 400 MMF in zero temperature coefficient, 2000 MMF in -750 P/M/°C. 10,000 volts D. C. test voltage.

Right: Erie Antenna Coupling Condenser: Maximum capacity 50 MMF in zero, 250 MMF in -750 P/M/°C temperature coefficient. Typical rating in zero coefficient, maximum R. F. current 3 amps at 3 MC and 5 amps at 9 MC at 65°C. Test voltage 6000 volts D. C.

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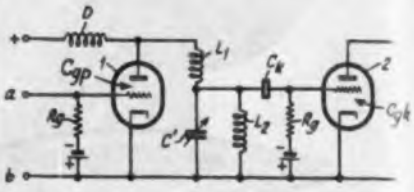
NEW PATENTS ISSUED

HF APPARATUS

UHF Amplifier

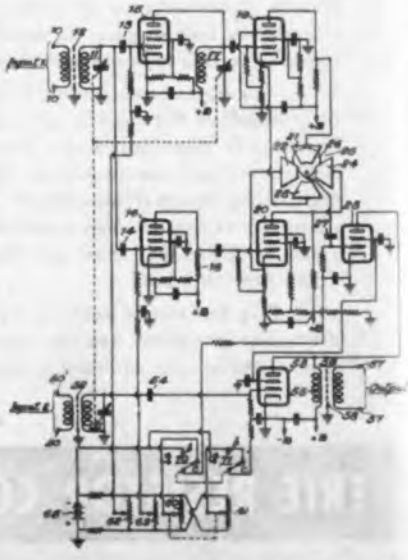
To avoid feedback through the plate-grid capacitance C_{gp} at operating frequencies below 5m, the plate circuit is made series resonant at that frequency. Practically no alternating voltage will then be generated at the plate of the tube reducing the alternating voltage fed back to the grid to a minimum. Preferably, a tetrode or pentode with low grid-plate

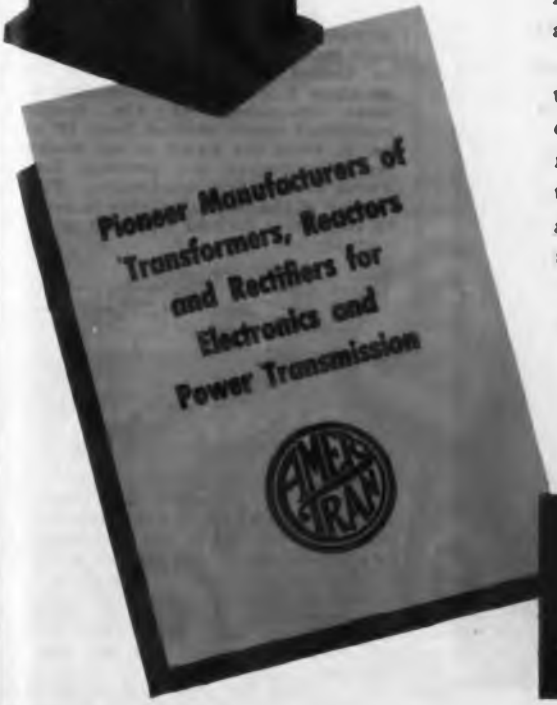


capacitance is employed. The series resonant circuit consists of inductance L_1, its capacity including C', grid-cathode capacitance C_{gk} of the following tube and inductance L_2 which is intended to reduce the effective capacitance of C_{gk}—C' may be omitted altogether—to such a degree that sufficient amplification is obtained. W. Klee, Alien Property Custodian, (F) June 3, 1941, (I) Oct. 26, 1943, No. 2,332,919.

Combining UF Waves

Several high frequency waves are simultaneously applied to the receiver; their amplitudes and relative phase may be adjusted as desired. Voltages derived from input 1 are applied to the grids of tubes 15 and 16, the load circuits of which are reactive and resistive, respectively, introducing a relative phase-shift of 90 degrees. It will be seen that the voltages at the stator plates 21, 22, 23, 24, of condenser 25 are each 90 deg. out of phase with the adjacent plates, two opposite plates being taken off cathode and plate resistor of tubes 19 and 20 and therefore of opposite polarity. The input voltage to grid of tube 28 will have a phase depending on the position of rotor plate 26, its output is combined with that of tube 53, containing the wave received at input





IT IS SAID that no chain can be stronger than its weakest link, and this is equally true of a rectifier. All three magnetic components are important, and the design of each should be coordinated to the other two units for best results. AmerTran Plate Transformers, Reactors and Filament Transformers, operating together, insure optimum overall performance.

These economical dry type, self-cooled units are wound and treated to withstand wide climatic changes and operating conditions. Adequate insulation — well above minimum requirements — and rugged construction provide trouble-free operation. Compound-filled, adequate bushings, electrostatic shields, are a few items of construction that denote the high quality of these units. The three components are designed to meet all the usual, and some of the unusual, requirements common to such applications.

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AMERTRAN
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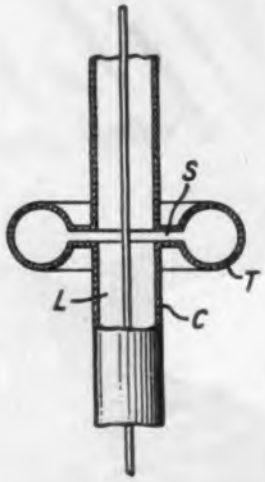
2, in transformer primary 56. The relative gains of the branches from inputs 1 and 2 are adjustable by biasing potentiometers 60 and 61. Gains of tubes 15 and 16 may be independently varied by potentiometers 62 and 63 to adjust the voltage amplitudes at the condenser plates. Switches provide for a possibility to receive either input separately or both simultaneously. H. O. Peterson, RCA, (F) Jan. 21, 1942, (I) Oct. 19, 1943, No. 2,232,253.

Suppressing RF Waves in Coaxial Lines

A wave of definite frequency is suppressed in a line by providing a narrow slot S in the outer conductor which connects to a hollow chamber T. The circuit consisting of the capacity of S and the inductance of T is made resonant to

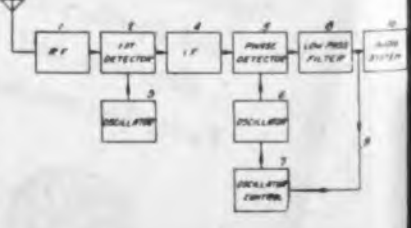


the wave to be suppressed. Other shapes and arrangements for the resonator are also shown. F. Tischer and H. J. R. Baeyer, Alien Property Custodian, (F) Nov. 30, 1940, (I) Oct. 26, 1943, No. 2,332,952.

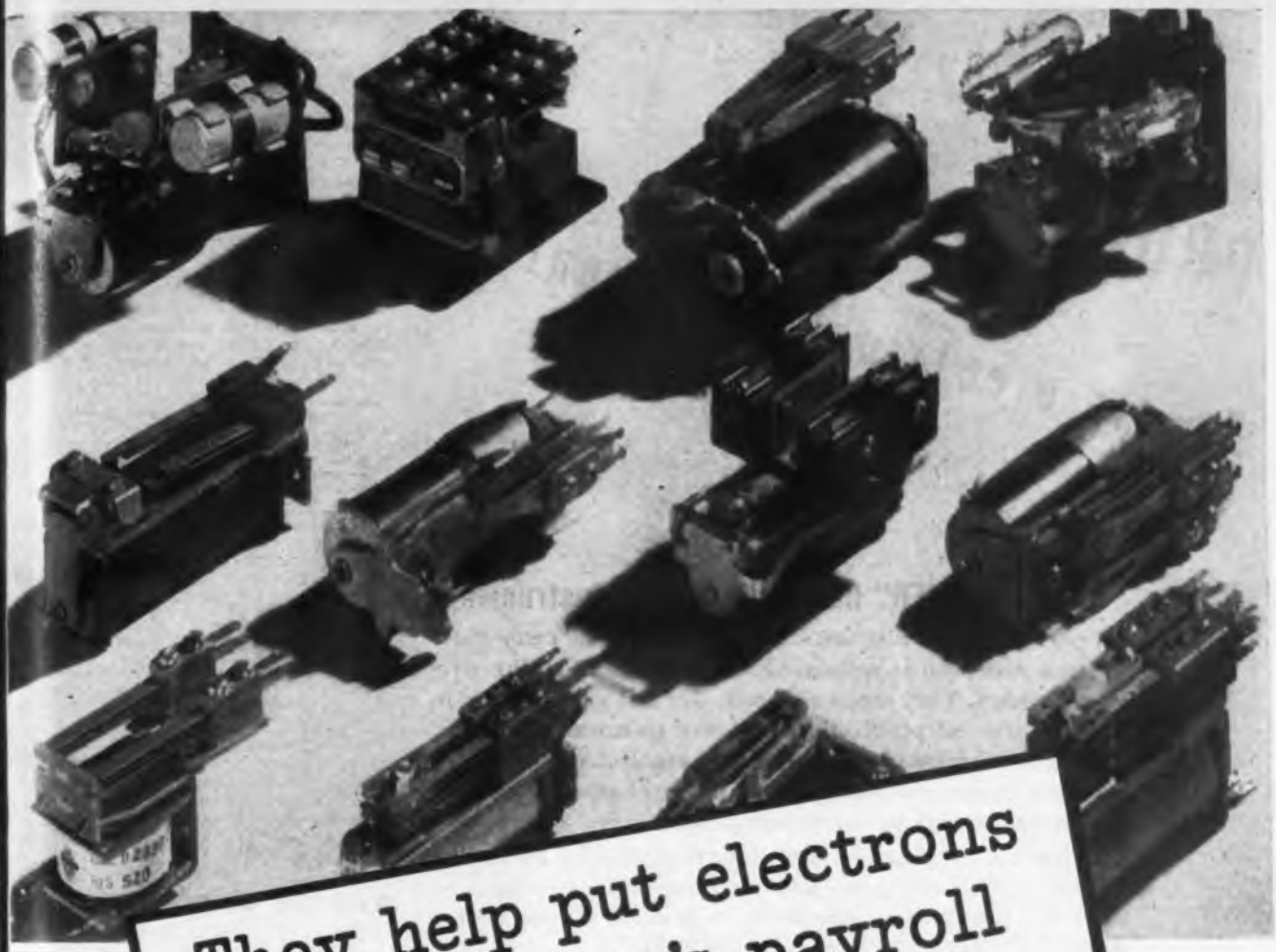
FM AND PHASE MODULATION

Discriminator

The circuit is designed to be responsive to frequency variations but not to amplitude modulation so that no limiter would be needed in the FM receiver. Local oscillator 6 is adjusted to oscillate at the mean frequency of the frequency-modulated signal derived from IF amplifier 4; when the signal is not modulated, both frequencies are identical but the waves are in phase quadrature. The frequency of the local oscillator is controlled by the signal derived from the phase de-



tector which provides a voltage the amplitude of which is proportional to the cosine of the phase angle between the two oscillations. This control voltage is, at the same time, the audio output voltage of the system. Two embodiments are shown and described in detail. C. Travis, Philco Radio and Television Corp., (F) Feb. 7, 1941, (I) Oct. 26, 1943, No. 2,332,540.



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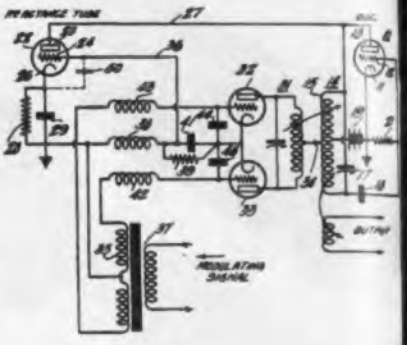
Frequency Modulator

Coupled circuits 14 and 31 are tuned to resonate at the carrier frequency so as to produce quadrature phase relation between the respective voltages. Tuned circuit 31 is the plate circuit for the push-pull connected amplifier tubes 32 and 33, the plate impedances of which combined with grid-cathode capacity 50 of reactance tube 22 may be considered as two potentiometers which provide, respectively, reactance-tube grid-voltage leading or lagging the plate voltage. It is assumed that the tubes 32 and 33 have low plate impedance compared with the reactance of grid-cathode capacity 50. It will be seen that reactance tube 22 acts alternately as an inductance or capacitance depending on which of the two



amplifier tubes 32 or 33 predominates, in case of class A operation, or which of them conducts, in case of class B operation. E. S. Winlund, RCA, (F) Oct. 31, 1941, (I) Oct. 12, 1943, No. 2,331,821.

TUNING RECEIVERS

Music-to-Speech Switch

A relay automatically switches the receiver from music position, which gives an accentuated bass response, to speech position, and vice versa. The voltage dissymmetry of speech audio waves with respect to zero voltage—as distinguished from music audio waves which are symmetrical—is utilized to operate the relay which adjusts the response of the audio network by connecting or disconnecting a parallel condenser. M. G. Crosby, RCA, (F) Dec. 9, 1941, (I) Oct. 26, 1943, No. 2,332,782.

Silencing Receivers During Tuning

A tertiary winding is provided with the tuning motor; the voltage generated thereby is rectified and used to prevent the set from receiving different stations during tuning and, at the same time, to prevent the automatic frequency control from seizing and retaining an undesired station. D. H. Mitchell, Galvin Manufacturing Corp., (F) Dec. 15, 1937, (I) Oct. 5, 1943, No. 2,331,039.

Receiving Special Messages

Intended for the reception of air raid warnings or other special messages, the apparatus is designed to receive a message transmitted by a particular transmitter regardless of how the receiver is tuned. Upon a special signal of the transmitter the device automatically connects a loudspeaker and upon another signal disconnects the loudspeaker after completion of the message. G. G. Roberts, (F) Oct. 17, 1941, (I) Sept. 28, 1943, No. 2,330,241.

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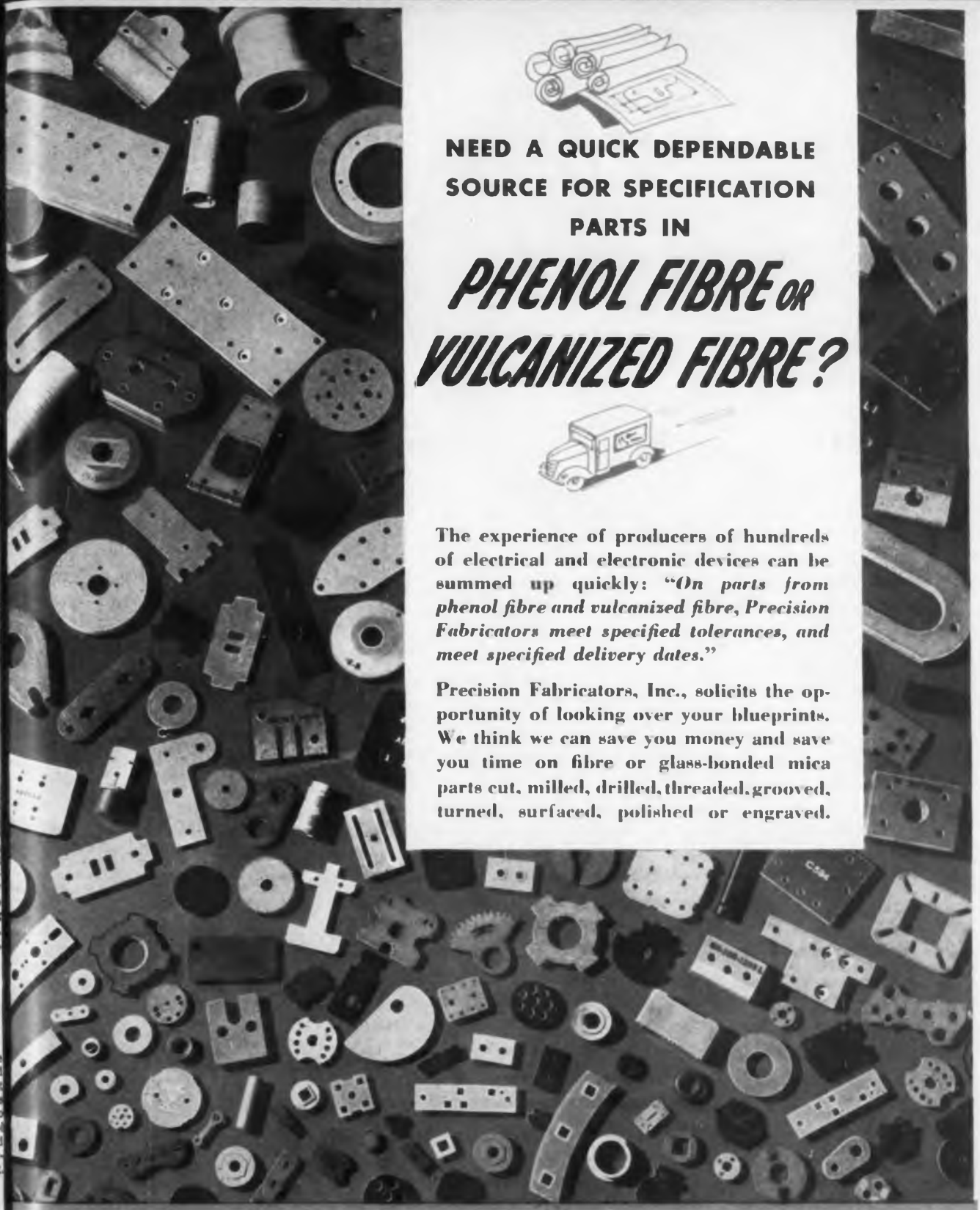

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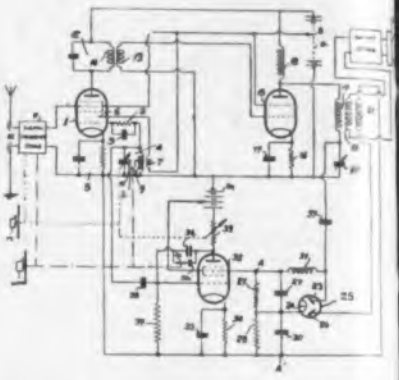
Automatic Tuning

When a receiver is tuned approximately to a desired station, the automatic tuning device provides for exact tuning. The circuit described for this purpose makes use of the reflected capacity between inner control grid and cathode of tube 31 which depends upon the capacity between plate and inner grid and upon the voltage amplification of the tube. This reflected capacity is effective in shunt across tuning condenser 10 of the local frequency oscillator and mixer tube 1. The control potential for the automatic tuning device is derived from intermediate frequency amplifier 15. For this purpose the values of the output circuit elements 19, 20, 21 and 22 are made



such that the voltage set up at the exact intermediate frequency across coil 21 is equal to that set up across condenser 1 at that frequency. For any other frequency, the difference of these voltages is a function of detuning. By the action of diodes 24,23 and 24,26, this voltage difference is applied to the outer control grid of tube 32, varying mutual conductance and amplification factor of the inner control grid, and, consequently, the reflected capacity in shunt with tuning condenser 10. To provide frequency independence of the automatic tuning system, which will depend on the relative values of condenser 10 and the reflected capacity, the latter is also made frequency dependent by varying additional capacity 36,38 (originally inserted to increase the effective inner grid-plate capacity of tube 32) and/or resistor 33. R. E. Spencer, Electric and Musical Industries, Ltd., (F) Dec. 12, 1935, (I) July 6, 1943, No. 2,323,630.

CR TUBES

CR Frequency Multiplier

It is known to use a cathode ray tube for the generation of high frequency oscillations by placing an apertured electrode into the paths of the rotating electron beam. Different targets having high impedances are suggested. Radiation of the target is reduced by suitable shaping the electrode or by additional parts, and the electron beam is made to impinge on the point of the target at which the impedance is highest. W. S. Percival, Electric & Musical Industries Limited, (F) Dec. 1, 1938, (I) Oct. 12, 1943, No. 2,331,723.

CR Tube

The deflection of the cathode ray T is effected by electron mirror S which consists of the three electrodes 1, 2, 3. Electrodes 1 and 3 are at constant potential. A variable potential is applied to elec-

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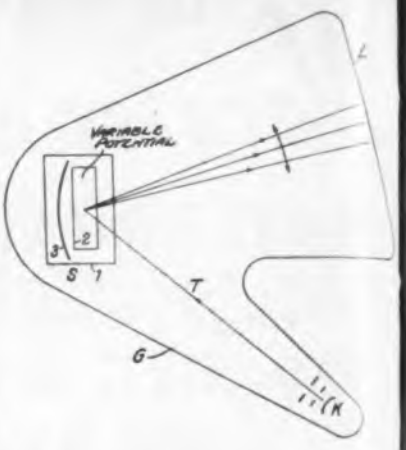


trode 2 causing the reflecting angle of the mirror to change; a fluctuating potential will eause the beam to scan the screen L. Deflection in another direction, if desired, may be obtained by a similar arrangement or by any conventional method. W. Uhlmann, Alien Property Custodian. (F) March 14, 1939, (I) Oct. 26, 1943, No. 2,332,876.

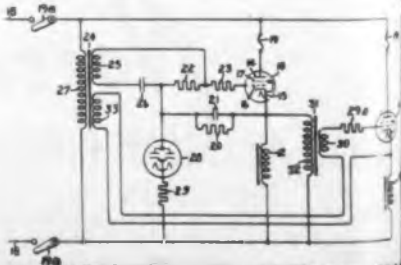
MISCELLANEOUS

Signaling System

Asymmetric alternating current of voice frequency is transmitted as signal over a line to operate a receiver which is responsive to asymmetric current,—wherein the positive and negative current amplitudes are different,—but not to voice current which is only slightly asymmetric as compared with the signaling current. A rectifier or a transformer with a polarized core is used to provide the asymmetric signal current. The receiver described contains one relay so combined with the output of two electron tubes as to be responsive to unsymmetrical signals only, another relay responsive to both symmetrical and asymmetrical currents, and a relay operated by the combined action of both other relays. W. W. Fritsch, Bell Telephone Labs., (F) April 23, 1942, (I) Oct. 26, 1943, No. 2,332,907.

Shaker Control

An electromagnetic shaker for a vibrating screen or similar device is often required to carry out a complex motion. This may be done to advantage by applying phase-displaced periodic forces to the screen at different places. The present invention is concerned with providing phase displaced periodic voltages for energizing the operating coils 12, 13 of such electromagnetic shaking devices. Tube 10 is rendered conductive by the leading alternating voltage across resistor 22. Upon conduction of tube 10, load 16 is energized and the voltage across the load charges condenser 21 making the grid of tube 10 negative beyond cut-off. Resistor 20 and capacitor 21 are so chosen that tube 10 becomes conductive again a desired number of half cycles later. Th



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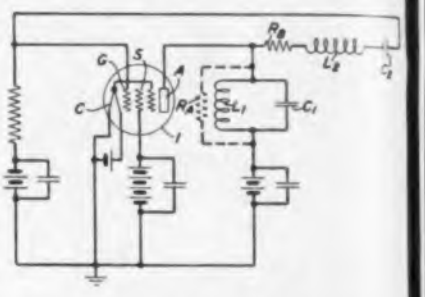
voltage across load 12 also causes a voltage across winding 30 which maintains tube 11 non-conductive by overcoming the voltage of winding 33 which tends to render tube 11 conductive. Consequently tube 11 conducts for all positive half cycles during which tube 10 is maintained non-conductive. L. G. Levoy, General Electric Co., (F) March 6, 1942, (I) Oct. 19, 1943, No. 2,332,325.

Negative Transconductance Tube Oscillator

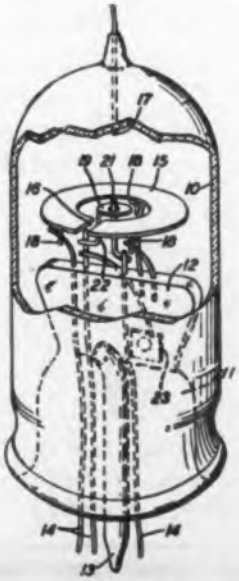
An increase in control grid potential of tube 1 causes a decrease in plate current, i. e. the tube has a negative transconductance. Consequently, plate current and grid voltage are in phase. Circuit L_2C_2 is resonant at oscillator



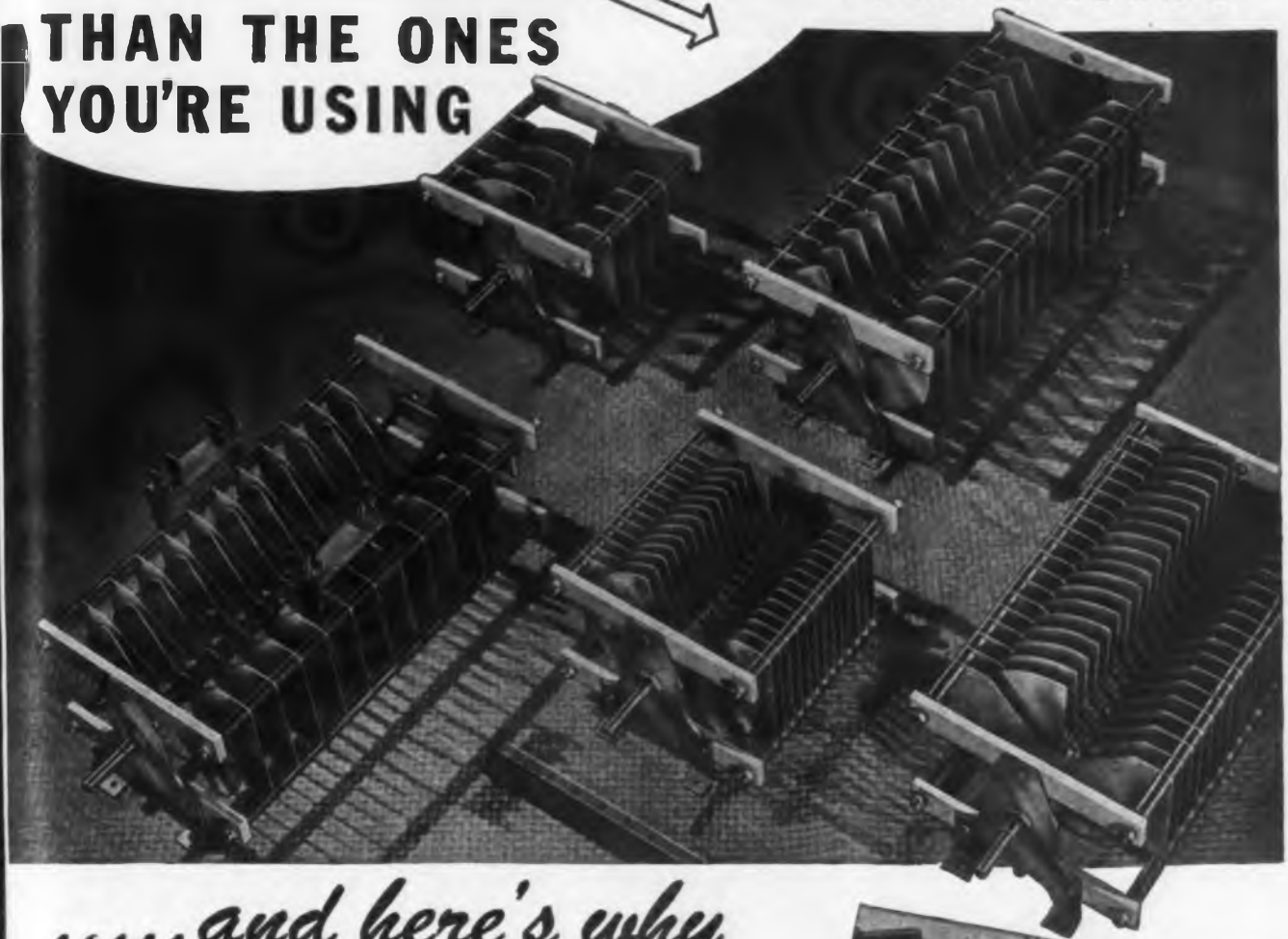
frequency; L_1C_1 (C_1 includes the tube capacity) is antiresonant at oscillator frequency. It will be seen that both impedance combinations operate as pure resistances, denoted by R_b and R_a, respectively; maximum gain and, since no phase shift is introduced, frequency stability are thereby insured. L_2C_2 may be substituted by a piezoelectric crystal operating at its series resonance point. W. P. Mason, Bell Telephone Labs., (F) Nov. 26, 1941, (I) Oct. 19, 1943, No. 2,332,102.

Glow-Discharge Tube

It is desired to obtain stable operation and ready control of the discharge. Auxiliary cathode 19 and auxiliary anode 21 are provided to insure the establishment and maintenance of an initiating glow discharge at a relatively low potential. This initiating glow discharge is controlled within prescribed limits to fire or break down the main discharge path between cathode 15 and anode 17 which permits a large energy flow. S. B. Ingram, Bell Telephone Labs., (F) Oct. 19, 1942, (I) Oct. 12, 1943, No. 2,331,398.



WE'LL BET THESE CONDENSERS *are better* THAN THE ONES YOU'RE USING



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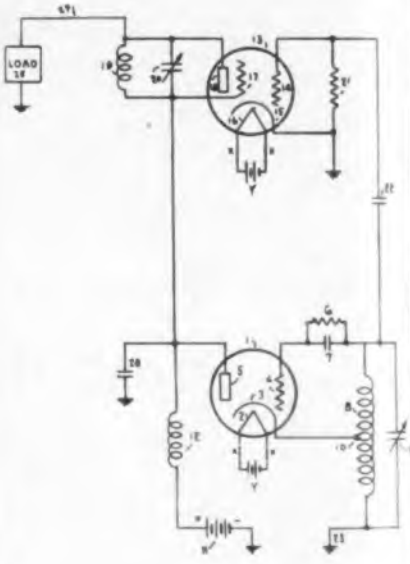
Correcting Phase Distortion

A phase distortion network is inserted in the video frequency channel of a television system to compensate for the phase distortion introduced by the broad band amplifier for the modulated carrier. As the overall phase shift introduced has to be a linear function of frequency, the change of phase shift with frequency has to be a constant. A suitable phase shift network for the video signals can be designed provided the change of phase shift with frequency in carrier and intermediate frequency sections is symmetrical about the carrier frequency. However, at the higher upper side-band frequencies where the symmetry requirement is no longer met, the amplitude falls off very rapidly and therefore phase distortion is of little importance in that region. G. L. Fredendall, RCA, (F) March 12, 1941, (I) Oct. 5, 1943, No. 2,330,965.

Harmonic Generator

The fundamental frequency is generated by the oscillator circuit including tube 1, and is applied to grid 14 of tube 13 as well as to its second grid 17. Inductance 19 is tuned to the desired harmonic; if a sequence of several harmonic frequencies is desired, this inductance is designed to have a flat response. Condenser 28 offers a low impedance to the harmonic frequency, but a high impedance to the fundamental frequency. It is stated that large amounts of harmonic energy can be secured with relatively good plate efficiency and without the use of extra filters or wavetrap circuits. J. Markowitz, (F) March 31, 1942, (I) Sept. 7, 1943, No. 2,329,069.



Measuring Time Intervals

A high frequency oscillator is connected to an amplifier feeding a counter circuit which counts the number of impulses provided by the oscillator. Ordinarily the amplifier is biased to cut-off but a pulse generated at the beginning of the time interval to be measured causes the amplifier to operate, while another pulse generated at the termination of the time interval interrupts operation of the amplifier. This action is obtained by means of two additional oscillator tubes and two control tubes, one each for the starting and interrupting circuits, respectively. E. D. Cook, General Electric Company, (F) Nov. 7, 1941, (I) Oct. 19, 1943, No. 2,332,300.

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★ The newest CINCH Miniature Socket development with "integral" or one piece shield and saddle. This is one of the "hottest gadgets" in present day Electronics.

The high base, a product of CINCH ingenuity, virtually acts as a shoe horn . . . as tubes must travel a straight path when inserted or removed thus preventing tube breakage.

Full floating contacts...a shield base that acts as a support neutralizing vibration shock and distortion. Test reports have definitely proven that pin bending and breakage is reduced. Constructed to simplify assembly and to save labor at inaccessible points. Socket bases supplied both from ceramic and mica filled insulation.

FRONT VIEW: ACTUAL SIZE

BOTTOM VIEW: ACTUAL SIZE

CINCH MANUFACTURING CORPORATION • 2335 WEST VAN BUREN STREET, CHICAGO, ILL.

SUBSIDIARY: UNITED-CARR FASTENER CORPORATION, CAMBRIDGE, MASS.

Frank M. Folsom, New RCA Head at Camden

Frank M. Folsom, who has been chief of the Procurement Branch of the Navy Department, has been elected a vice-president and a director of Radio Corporation of America. Mr. Folsom will be in charge of the company's manufacturing division, RCA Victor, with principal plants in six cities and headquarters at Camden, N. J.

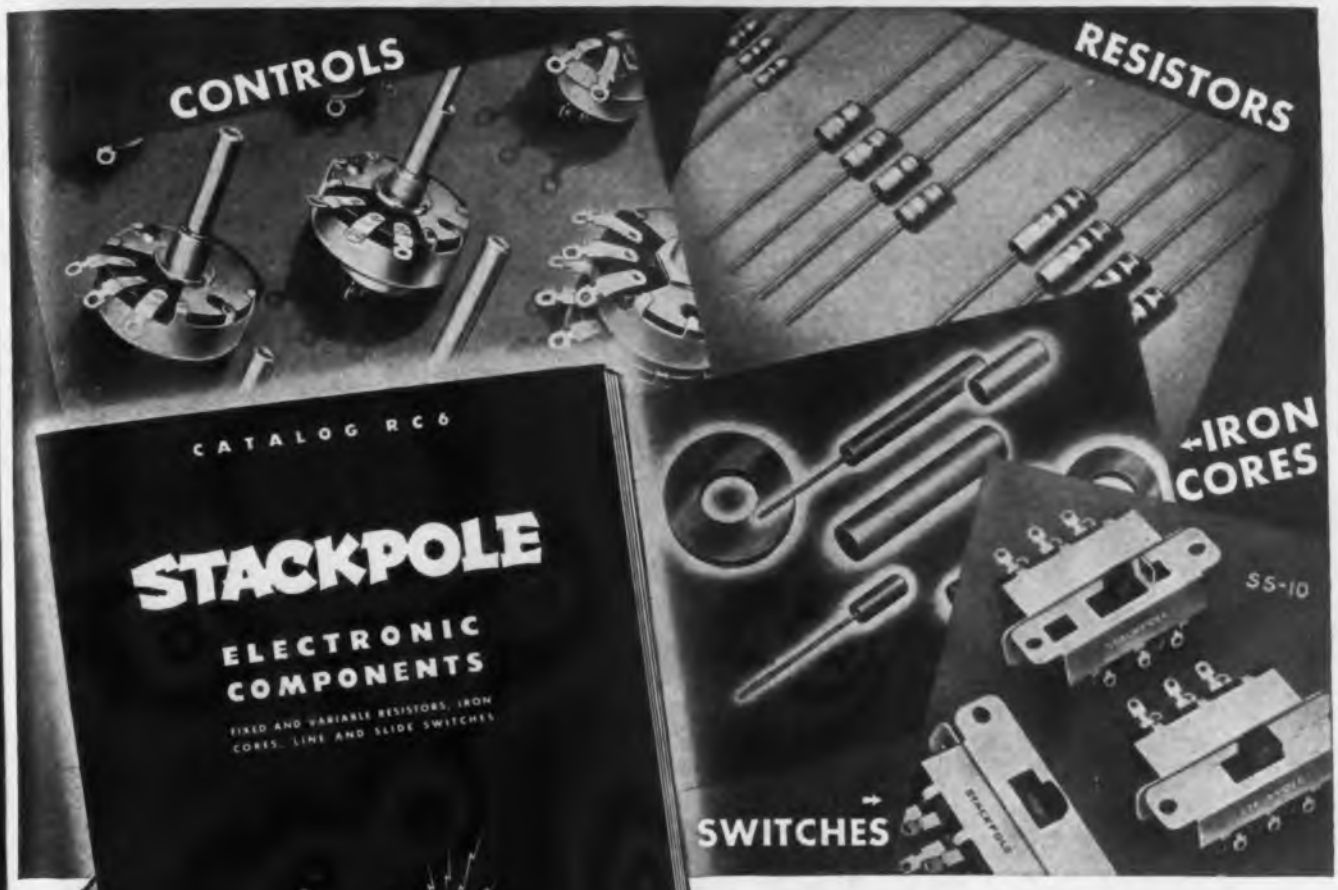
George K. Throckmorton, former head of the RCA Victor Division, is retiring for reasons of health, but will continue as a consultant to the company.

Frank M. Folsom became the first head of the Procurement Branch of the Navy when that branch was organized in February, 1942, moving from a similar post in the WPB at the invitation of the Secretary of the Navy. He carried with him the War Production Board's delegation of its authority to clear

Navy contracts. The speeding up of Navy procurement has been attributed to the unique authority entrusted to Mr. Folsom, through the delegation to him of full responsibility to act for both the WPB and the Secretary of the Navy in clearance of all contracts in excess of $200,000. At the same time Mr. Folsom has been Chairman of the Procurement Policy Board of the WPB, the coordinating agent for procurement policy of all the war services and agencies.

Mr. Folsom introduced into the Navy the commercial practice of requiring prospective contractors to submit price breakdown statements, and he recruited a staff of business men to assist Navy Bureaus on contract negotiation. He established a uniform Navy Insurance System, handled V-loans and advance payments to Navy contractors, administered the renegotiation law, and worked out with the Army a system of a joint procurement, especially in food, textiles, lumber and petroleum.

GET YOUR COPY NOW!



Complete catalog listings, dimension diagrams of every unit, up-to-the-minute engineering data on fixed and variable resistors for radio and other electronic uses, iron cores of all types, and inexpensive slide, line, and rotary-action switches. . . .

That's the story of this new 36-page Stackpole Electronic Components Catalog, just off the press. Write, wire or ask your Stackpole District Engineer for a copy today. Please ask for Catalog R6.

THESE ELECTRONIC DIVISION ENGINEERS TO SERVE YOU

CHICAGO, ILL.
A. A. Woods, 643 Roscoe St.

CINCINNATI, OHIO.
Wm. C. Laing, 3253 Lambert Place

DETROIT, MICHIGAN
J. E. Vollmer, 18310 Pennington Drive

INDIANA, SO. ILLINOIS and EASTERN IOWA
C. R. Booth, 840 N. Michigan Ave., Chicago

KANSAS CITY, MO.
Maury E. Bettis, Mfr's. Exchange Bldg.

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H. A. Lasure, 2216 W. 11th St.

MINNEAPOLIS, MINNESOTA
J. H. Heimann Company
1218 Harmon Place

NEW YORK, N. Y.
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PHILADELPHIA, PA.
J. R. Bange, 6710 Hollis St.

PLAINVILLE, CONN.
Karl Dornish, 105 Farmington Ave.

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STACKPOLE

ELECTRONIC COMPONENTS

Bryant Joins G-E

J. W. Bryant has joined General Electric Co.'s Electronics Department and will be located at the company's Chicago headquarters. He was formerly with the radio division of the Missouri State Highway Patrol and in his new work will assist users of emergency equipment selection and installation work throughout the central region of the United States. He has been active in affairs of the Associated Police Communications Officers, Inc., since 1936.

Cargile to Meck

J. Wayne Cargile has been appointed production manager of the electronic division of John Meck Industries, Plymouth, Ind. For the past three years he has been production engineer on geophysical equipment for Wells Surveys, Inc., and Engineering Laboratories, Inc., affiliated Tulsa (Okla.) companies. From 1927 to 1938 he was proprietor of Cargile Service Laboratories, Tulsa, handling wholesale service work for ten companies in the area.

E. I. Appoints McMinn ME

Stanley P. McMinn has been appointed managing editor of "Electronic Industries," published by Caldwell-Clements, Inc., 480 Lexington Ave., New York. Mr. McMinn has been active in radio and electronics for more than twenty years and has had wide publishing experience in the automotive and aviation fields. He was for several years associated with a manufacturer of high frequency police communications systems, had charge of the testing and installation of radio equipment on fighter planes produced by a large eastern aircraft manufacturer, and was part owner and managing director of a communications school training radio operators for the U. S. Signal Corps.

Stanley P. McMinn, appointed managing editor of "Electronic Industries"

it's Pre-assembled!

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

HIPERSIL CORES

NEW TWO-PIECE HIPERSIL* CORE SPEEDS ASSEMBLY OF HF EQUIPMENT

Here's a practical short-cut that will speed assembly of High-Frequency Communications Equipment.

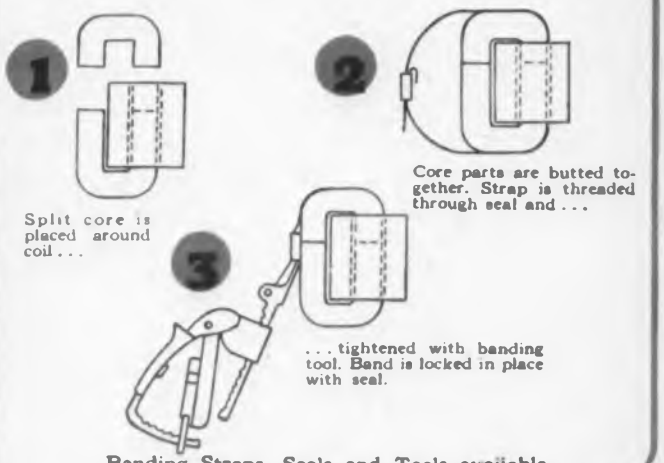
Instead of stacking tissue-thin laminations by hand, you can now get pre-assembled, two-piece **HIPERSIL** cores, ready for quick, easy assembly. Because there are just **TWO** pieces to handle per loop, valuable man-hours are saved in production—faults in assembly are prevented. **HIPERSIL** cores are available in a complete range of standard as well as special sizes and forms.

GET ALL THE FACTS ABOUT HIPERSIL TYPE C CORES . . . write for copy of **HIPERSIL** Booklet, B-3223-A. It contains performance facts and application data that will help speed the production of vital Communications Equipment for the Fighting Forces. Address: Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania, Dept. 7-N.

J-70422

*Registered Trade-Mark, Westinghouse Elec. & Mfg. Co., for HIgh PERmeability SILicon steel.

HERE'S HOW TO SPEED COIL ASSEMBLY



Banding Straps, Seals and Tools available from Westinghouse. See Page 9 of B-3223-A.

Black Adds Mec-Rad

Black Industries, Cleveland, long known as a manufacturer of machine tools, has organized Mec-Rad Division of its company for the production of precision type transmission lines and radiation components and other electronic devices. John Altmayer is chief engineer and Theodore R. Finke is development and production engineer. The company is located at 1400 East 222nd St.

Kane Joins Universal

Jerry Kane, formerly in the research laboratories of The Turner Co., Cedar Rapids, Iowa, has joined the staff of the Universal Microphone Co., Inglewood, Calif., as electro-acoustics engineer. He will be assigned to design in current war microphone production, as well as the postwar planning division.

Curtis to Induction Heating

Frank W. Curtis has made development engineer for the Induction Heating Corp., New York. Formerly he was chief engineer for the Van Norman Co., Springfield, Mass., and is a former president of the American Society of Tool Engineers.

Norden Joins Aircraft-Marine

For the past 10 years executive vice-president of the L. A. Brach Mfg. Co., Newark, N. J., Alexander Norden has joined Aircraft-Marine Products, Inc., Harrisburg, Pa. and will specialize in product development and postwar merchandising research. Active in the radio industry for many years, he was instrumental in the formation of the Norden-Hauch Electric Co., Philadelphia.

Alexander Norden, who has joined Aircraft Marine Products

SHURE Research ...Throat Microphones

Sounds transmitted through the throat present different problems in microphone design than sounds transmitted through the mouth. For better design, correlation had to be established between throat vibrations and sounds transmitted by the mouth. To do this, special throat microphones having constant acceleration characteristics were developed for use in conjunction with laboratory standard microphones and frequency analyzers. Experiments covered the frequency range of speech sounds and tests included a variety of callers to study the effect of the thickness of throat tissues. Shure Research has produced a throat microphone that has been declared definitely superior. It is the kind of research that assures you the superior microphones of tomorrow.

SHURE BROTHERS, 225 W. Huron Street, Chicago

Designers and Manufacturers of Microphones and Acoustic Devices

SHURE MICROPHONES

Sylvania Adds Two More Factory Buildings

A new plant for the manufacture of radio tube parts has been acquired at Wakefield, Mass., by Sylvania Electric Products Inc., and is already in production. It is a four-story structure containing 35,000 sq. ft. of floor space. Internal assemblies of radio tubes made in the new plant will be shipped to the Salem plant for completion.

A new electrolytic plant has been put into operation at the Williamsport, Pa., works of Sylvania Electric Products Inc.

Equipped with 108 electrolytic cells, high-powered compressors, low-pressure and high-pressure storage tanks (300 to 2,500 p.s.i.) and a distillery to supply the large quantities of chemically pure water which is processed into hydrogen and oxygen.

The new gas-generator will supply the hundreds of tube-makers in the Williamsport factory, with a surplus to meet the needs of Sylvania's plants at Towanda, about fifty miles to the north.

Consuming a gallon of water per cell per hour, the generator will produce 2,000 cu. ft. of hydrogen and half as much oxygen per hour, using a current of 1,200 amperes at 150 volts dc.

NA Philips Moves

New York headquarters of the North American Philips Co., Inc., will move into new and considerably enlarged offices on January 21. New offices will be at 100 East 42nd Street, New York, and will house practically the entire executive personnel now occupying offices in the Hotel Roosevelt. Some of the Dobbs Ferry personnel also will move into the new headquarters.

Chicago Radar Factories Seeking Women Workers

Banded together into an organization styled Radar-Radio Industries of Chicago, Inc., 42 manufacturers of that city have pretty effectively spread the term Radar over some of their local newspapers. They are short of help and the reason for the big advertisement, reproduced here in miniature, is to induce more women to get on production lines. In fact, they want 11,000 of them right away and see the need for another 9,000 early this year when all production for the armed forces must be stepped up one-third. The advertisement is the first in a campaign described as extensive.

The emergency committee of Radar-Radio Industries is composed of Charles M. Hofman, Belmont Radio Corp., chairman; E. W. Shepherd, Philco Corp., vice-chairman; Henry C. Forster, Radio Speakers, Inc., treasurer; and James P. Wray, Crowe Name Plate & Mfg. Co. The executive Board of the corporation consists of Leslie F. Muter, The Muter Co., president; Paul V. Galvin, Galvin Mfg. Co., vice-president; R. D. Burnet, Zenith Radio Corp., vice-president, and Leonard J. Shapiro, Belmont Radio Corp., secretary.

To Study Laminates

A test program to record properties of laminated materials, organized and financed by the plastics industry and to standardize specifications and determine "best use" applications has just been given further impetus in a research-test center at Johns Hopkins University, Baltimore. The testing laboratory plans to standardize new laminates and assist in writing specifications when the materials become standard in the industry. The membership of the group—Laminated Section of NEMA—that has organized and financed the program, is Continental-Diamond Fibre Co.; the Formica Insulation Co., General Electric Co., Mica Insulator Co., National Vulcanized Fibre Co., Panelyte Corp.; the Richardson Co., the Spaulding Fibre Co.; Synthane Corp., Taylor Fibre Co. and the Westinghouse Electric & Mfg. Co.

Radar Help Wanted

Newspaper advertisement, much reduced, used by Chicago manufacturers to speed recruiting of women workers

Brigham to Block

Cecil E. Brigham has been appointed general sales manager of Wesley Block & Co., New York. During twenty-one years of service with the IT&T Co. and its subsidiaries in this country and abroad, he has held many important assignments, including those of chief engineer of C. Brandes Inc., chief engineer of Kolster Radio Co., consultant for IT&T companies in Central Europe, chief engineer and technical director of Kolster-Brandes Ltd., England. During 1941 and 1942 Mr. Brigham served as technical representative for Federal Tel. and Radio Corp. at Washington, and his last post was head of R-5 Laboratory of Federal Tel. and Radio Laboratories at 67 Broad St., New York.

Templetone Adds Two

Dr. Gregory Timoshenko, associate professor of electrical engineering at the University of Connecticut, has joined the Templetone Radio Co., Mystic, Conn. He is a specialist in electrical measurements and will serve Templetone in a research capacity.

Captain Robert Adams, recently retired from the Signal Corps for reasons of medical disability, has joined Templetone as production manager of the radio division.

Prior to entering the Armed Service he was works manager of Sonora Radio and Television Co. Previous associations were as superintendent, radio division, Stewart Warner Corp., and with General Electric Co., RCA Victor Co., and Raytheon Mfg. Co.

Major Rider Moves North

Major John F. Rider, publisher of Rider's Manual and other radio books, who has been developing Signal Corps instruction courses, is now stationed at Building T, 541, Fort Monmouth, N. J. He was formerly at West Palm Beach, Fla.

Gibbs Joins Detrola

John Gibbs, for 14 years with RCA at Camden, has been appointed contract administrator for Detrola Corp., Detroit. His professional work includes a year with Philco Research Laboratories and a year with AT&T.

Executives Want Out

Some pressure is being brought by industry on WPB for the return of many top ranking radio executives who have been steering the destinies of various of that body's bureaus. In their place, industry is suggesting second-string executives, the idea being that their release would upset industry less than continued absence of their bosses. However, men like Communications Director Leighton H. Peebles, and Ray Ellis, chief of the Radio and Radar Division will be asked to stay in government service to the last possible moment.

Quick Communications Repairs

In a demonstration in Philadelphia, early last month, attended by representatives of the Army Signal Corps and leading communications executives, the American Telephone & Telegraph Co. displayed apparatus designed to restore broken communication lines to service while permanent repairs are in progress. Also demonstrated were new methods which reduce emergency repair time by 50 per cent. The devices and new technics, which were worked out by R. G. Giese, New York Division plant superintendent of the Long Lines Department, and Ralph H. Ross, Philadelphia plant superintendent, were demonstrated on a simulated break in a lead cable housing 488 circuits, including high priority lines. Highly coordinated teamwork by repairmen using the new devices and methods enabled them to splice a complete section on the shattered cable without interrupting music being transmitted over one circuit.

Hallicrafters Dine Halligan

The Old Timers Club of Hallicrafters Co., Chicago, late in November celebrated the tenth anniversary of the company with a surprise dinner tendered to W. J. Halligan, president and founder of the company. Hallicrafters, operating eight plants in the Chicago area, and rated the world's largest exclusive manufacturer of short wave communications equipment, is operating 100 per cent on war production.

W. J. ("Bill") Halligan, dined by Hallicrafters' Old Timers Club

RECTIFIERS

Built to Meet Specific D-c Needs

General Electric is the only designer-manufacturer of Selenium, Copper-Oxide and Tungar Rectifiers. This is important to all who design equipment requiring rectifying units: it means G-E can give completely impartial advice on which type of rectifier will most efficiently, most effectively and most economically do the specific job you require of it. And the stacks . . . whether Selenium or Copper-Oxide . . can be specification-built for that specific job. Address inquiries to Section A-144-124, Tungar and Metallic Rectifier Division, General Electric Company, Bridgeport Connecticut.

GENERAL ELECTRIC

Electronic Separation of Impurities from Coal

Editor, Electronic Industries:

For a good many years there has been an idea in my mind that it would be possible to clean, or remove from coal, the impurities by some method using electronics, similar in some respects to the method of separating black beans from white ones.

The color of coal and of the impurities therein contained, is practically the same. However, there is a very decided difference in the structure,—coal, as you know, being more or less the structure of crystal, while the impurities have a structure similar to rock. Thus the structures of coal and of its impurities are entirely different. The impurities, in passing along a conveyor with the coal, are discernible to the eye and are removed by the use of persons employed to remove impurities as they pass in front of them on a belt. This is an expensive operation. The only other method so far developed to remove impurities from coal is by the use of a process employing the difference in specific gravity of coal and impurities.

I would be glad to work with you, or anyone you may recommend, to carry on experiments relative to the preparation of coal through the use of electronics. To say the least, it offers an interesting problem and if the results desired can be obtained, it would be one long step forward for our industry.

Yours very truly,
E. E. JONES,
Vice-president & Gen. Mgr.
Winding Gulf Collieries,
Bluefield, W. Va.

Langmuir Smokes Up

The production of smoke for military screening purposes is a far cry from anything electronic, yet one of the most famous electronic engineers, the one who is directly responsible for modern technic in the production of vacuum tubes has gained fame in this widely different field. He is Irving Langmuir, Nobel prize winner and associate director of General Electric's research laboratories.

Langmuir and his associate were asked to produce not only smoke, but smoke ideally suited for the purpose. After preliminary investigation he concluded that size, color and density of particles determine the effectiveness of any smoke. A smoke screen accomplishes its purpose by scattering rays of light by reflection from many particles and also to some extent by actual obstruction of the light rays.

Having arrived at the theoretical ideal particle, he assigned the problem of designing equipment to produce the kind of smoke he specified to his assistant Vincent Schaefer. In the course of only a few weeks a machine was designed and Standard Oil Co. built it. The machine uses steam to break a special oil down into tiny particles, and while the resulting dense white fog has considerable persistency, it is almost odorless, contains no sooty particles and hence does not stain or deposit carbon on surfaces it comes in contact with. The smoke, more like a fog, is produced by steam distillation of a special petroleum product and is made up of droplets that are uniform in size and of extremely small diameter. Already a revised machine one-tenth the size and weight of the original and small enough to be carried on a jeep is in production. It will make much more smoke, weight for weight, than the first.

Voice-Powered Telephone

A sound-powered telephone operated without batteries proved one of the most useful pieces of equipment on Guadalcanal. Power in the telephone is generated by the voice. It is capable of carrying its message as far as ten miles under favorable conditions and has a range of five miles under almost any circumstances. Commercially developed, the sound-powered telephone has been adapted to war communications by the Signal Corps.

The equipment was found particularly advantageous on Guadalcanal because of the lack of batteries, which have been found susceptible to deterioration from the humidity and dampness of the South Pacific. In addition, it is considerably smaller, more compact and more durable than battery-powered telephones. In size and appearance it is similar to the handset in use in American homes. Signaling is accomplished merely by whistling into the transmitter.

The orally-powered telephone equipment was installed on Guadalcanal for fire control of Infantry mortars and within Infantry companies, since at night all men were instructed to remain in their fox holes. Orders had been issued that anyone moving about after dark was to be fired on.

In the parlance of Wall Street, one may think of the electron as a bullish factor. For it promises new highs in the advance of science and industry.—Ralph Beal, RCA

Electrolytic Standard Revised

The American Standards Association has just published a revision of the radio war standard on dry electrolytic capacitors (home receiver replacement type) (C16.7-1943—2nd edition), which was first approved February 16, 1943. The capacitors chosen represent the least number of units necessary at this time for servicing the great majority of home radio receivers. The minimum performance requirements are designed to furnish capacitors which will use as small an amount of strategic materials as possible, will not restrict production and will prove satisfactory from an electrical and service-life standpoint.

"Handie-Talkie" Sets Demonstrate War Worth

Although virtually every type of equipment furnished by the Signal Corps was at the disposal of the landing troops at Salerno, the concensus was that the "handie-talkies," the small compact radio sets that give the platoon an opportunity to communicate with its company or battalion leader instantly, won universal approval and provided much-needed communication with isolated groups and reconnoitering parties. This was reported back to the War Department from an Observer attached to the American Fifth Army.

Praise 600 series

Regimental communications officers were generally high in their praise of the 600 series communication equipment, which gained considerable use in the Salerno invasion. The 600 series of Signal Corps radios consists of three different types: the SCR 608, SCR 609, and SCR 610. All are operated with frequency modulation for voice communications and are used by combat troops to set up wireless nets during battle. The SCR 608 is a mobile artillery and field artillery set which is powered from the storage battery of the vehicle in which it is installed, and is extremely rugged in construction. It consists of two receivers and one transmitter mounted on a single base. Intercabling complications are by-passed by a series of plugs on the set matching sockets on the base. The set has a number of channels which can be changed instantaneously by push-button tuning.

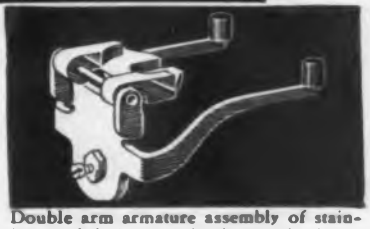
The SCR 609 is a two-piece battery-operated set, each part of which looks like a portable typewriter case when carried. It has a telescopic antenna, which can be

VIBRATION?

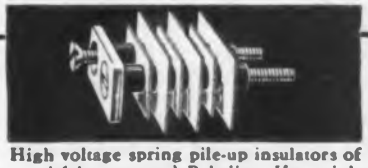
SHOCK?

EXPOSURE?

This CLARE Type G Relay Withstands Them All!



Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly of magnetic metal.



High voltage spring pile-up insulators of special heat treated Bakelite. Has minimum cold flow properties, low moisture absorption content; and permits punching without cracks or checks.

Contacts are welded to nickel silver springs by special process. May be of precious metals or alloys in 12 different standard, or special, types and sizes.

Spring bushing insulators are made of Bakelite rod under patented process. Resist vibration and withstand heavy duty service.

THIS Clare Type G Relay has come through the rigorous tests of war with flying colors. Its ability to withstand unusual shock, vibration and exposure has been proven time and time again in aircraft use, in radio equipment, compasses and controls of all kinds.

Clare Type G is a short coil relay—just 2½" x 2¼" x 1¼" and weighs but 6½ ounces. Coils are carefully wound to exact turns on precision machines. They are protected with a transparent acetate covering and are available impregnated with special varnish. The pile-up shown is of nine springs, but as many as twelve springs can be used.

Permanency of the spring tension is assured by the way in which the spring pile-up is assembled. Heelpiece and pile-up are placed in a hydraulic press while automatic screw drivers tighten the high tensile screws which hold the pile-up to the heelpiece.

Contacts of rare metals or special alloys can be used either flat or hemispherical and in sizes from .062" to .1875" diameter. The core, heelpiece and armature are made from the highest quality magnetic iron. This is purchased to rigid specifications and carefully annealed in precision controlled furnaces in our own factory.

Type G like all Clare "custom built" relays can be accurately adapted to the specific requirements of your design. We will be glad to work with you to that end. Let us know what your relay problem is. Our engineers will be glad to put our years of relay experience at your service.

Send for the Clare catalog and data book. C. P. Clare & Company, 4719 West Sunnyside Ave., Chicago (30), Ill. Sales engineers in all principal cities. Cable address: CLARELAY.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical, Electronic and Industrial Use

fitted into the top case when not in use. It is operated when set down, and has a choice of several channels, selected by flipping a switch. The SCR 610 is similar to the SCR 609 with added components allowing it to be operated while in motion in a vehicle. It gets its power from the storage battery of the vehicle in which it is mounted.

War Slows Science

Throwing a dash of cold water on the general optimism that wartime scientific discoveries will have wide peacetime application, Dr. Frank B. Jewett, vice-president of AT&T and board chairman of the Bell Telephone Laboratories, expressed the view to the New York University Institute on Postwar Reconstruction that the war has impeded the progress of fundamental science.

However, Dr. Jewett did concede that radar, especially in the field of aeronautics, would be adaptable to peacetime uses, but added that "virtual cessation of research work in fields not considered as essential to the war has offset progress in certain other fields of scientific knowledge." He pointed out that there is no longer any intercourse between the scientific bodies of the warring nations. Much of the war technic will be useful in peace time, he added, noting the war had stimulated interest in science.

Hallicrafters' $44,000,000

Founded in 1933 by William J. ("Bill") Halligan, a radio distributor who had pioneered as an amateur, the Hallicrafters Co., Chicago, in two years of war since Pearl Harbor, has manufactured and delivered more than $44,000,000 of short wave equipment to the armed forces and for lend-lease. Most of this has been short wave transmitters and receivers and self-powered mobile radio stations for the Signal Corps. As the company entered into its third year of U. S. war production, it has a backlog of government orders in excess of $20,000,000.

In the year preceding Pearl Harbor the company produced and sold $2,000,000 worth of communications equipment. In the year ending December 7, 1942, the company delivered $9,700,000 worth of short wave receivers and transmitters for the armed forces. In the year ending December 7, 1943, the company's seven plants produced $34,300,000 worth of equipment for the army, navy and lend-lease.

In 1936 the Hallicrafters company moved from its Marion, Ind., location to Chicago. It continued as a partnership between Halligan and Raymond W. Durst until September

"Long Electrical Life" WITH NEW STERLING SWITCHES

MECHANICAL RUGGEDNESS is not enough for today's switch applications. That is why all conducting paths in STERLING SWITCHES are made of *pure silver.* So permanent are the electrical characteristics of this newest development of Communication Products that the "electrical life" of the STERLING SWITCHES is as long as their mechanical life.

C-P research revealed other advantages in the use of pure silver. Silver, even the oxide of which is an excellent conductor, makes unnecessary high spring pressures to cut the insulating oxides that are formed on the metal contacts of conventional switches. This reduction in friction permits multiple-gang assemblies with no loss in ease of operation.

With an almost infinite variety of wiring designs made possible with the many rotor and detent styles available, it is more than likely that STERLING SWITCHES offer the solution to your switch and switch gear arrangements, manual or machine operated. Available in two standard sizes, 86S and 88S. Send for complete information.

Illustrated, Type 88S—2-Gang Sterling Switch

SURE, "'PHONE BOOTHS" WILL HAVE FRESH AIR...

When the war is over, what a boon to this country radio telephony is going to be! In bridge building, for example, a construction foreman will be able to communicate directly and *instantaneously* with key men anywhere on the job, saving man-hours and, perhaps, even human life.

After the war, the various Communication Products listed below will again be entirely at the service of industry—for improving commercial broadcasting and helping to develop whatever new applications of radio and television peacetime may reveal.

Coaxial Transmission Line and Fittings • Sterling Switches • Auto-Dryaire • Antenna and Radiating Systems • Q-Max A-27 Radio Frequency Lacquer

Communication PRODUCTS COMPANY

744 BROAD ST. NEWARK, N. J.

FACTORY: 346 BERGEN AVE., JERSEY CITY, N. J.

1, 1943, when the company was incorporated with Halligan as president, Durst as vice-president, Katherine Halligan as treasurer, and Grace Durst as secretary. The company received the Army-Navy production award on September 9, 1942, was awarded the white star on April 5, 1943, and a second white star on October 9, 1943.

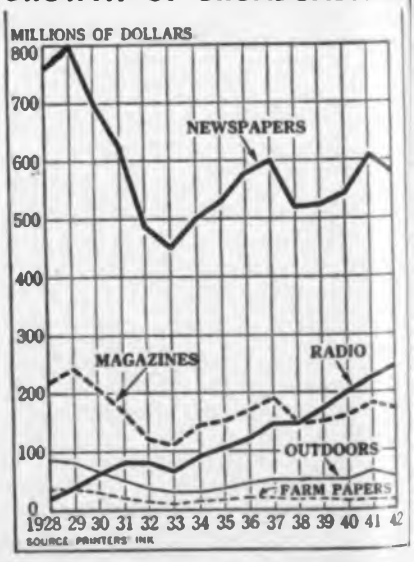
HF Heating Terminology

W. C. White, in charge of G-E's electronic laboratory, feels strongly about the adoption of correct, intelligent, and, above all, uniform terminology in the electronic industries. Since Mr. White was one of the pioneer advocates of electron-tube applications to industrial processes, his recommendations carry considerable authority.

High-frequency heating, Mr. White finds, is called various things by various people. "Electrostatic heating," for instance, is a misnomer, since there is nothing "static" about the voltages and currents involved. If you want to differentiate between the process in which heat is caused by induced eddy currents in metals and the process in which a non-metal is a dielectric, the proper terms would be high-frequency induction heating for the former and high-frequency dielectric heating for the latter. By "high-frequency" is meant anything in the kilo- or megacycle range.

Two other terms mistreated by men in the industry are the common pronunciations of "ignitron" and "ignitor." The first is properly pronounced "ig-nye-tron" rather than "ig-nee-tron." And the second ought always to be pronounced and spelled with the "or" ending to agree with capacitor, resistor, etc.

GROWTH OF BROADCASTING



How broadcasting has increased during a period of 14 years

the amateur is still in radio...

No other industry has had the benefit of such an eager and proficient group of supporters as the radio amateur.

By his own experimentations and inventions, and because of the extreme demands he made upon radio equipment, the radio amateur has been the driving force behind many of the major developments in radio. Out of the amateur testing grounds have come advanced techniques and vastly superior equipment of which Eimac tubes are an outstanding example.

Eimac tubes created and developed with the help of radio amateurs, possess superior performance characteristics and great stamina. They will stand momentary overloads of as much as 600% and they are unconditionally guaranteed against premature failure due to gas released internally. These are good reasons why Eimac tubes are first choice among leading electronic engineers throughout the world.

Follow the leaders to

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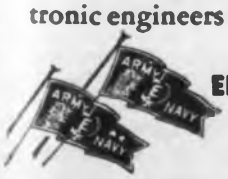

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Eimac 250T

NEW BOOKS

Fundamental Radio Experiments

By Robert C. Higgy, Department of Electrical Engineering, Ohio State University, published by John Wiley & Sons, Inc., New York, 1943, 93 pages, $1.50.

This laboratory manual describes experiments to present the fundamental principles of electricity and radio in a manner that illustrates the application of these principles in radio communication systems. Reference to one of the standard textbooks on radio is desirable to supplement the suggested laboratory work.

The experiments include direct current measurements, Wheatstone bridge, alternating current elements, tube characteristics and testing of different properties of various tube circuits.

Die Mathematischen Hilfsmittel des Physikers (Mathematical Tools for the Physicist)

By Dr. Edwin Madelung, published by Dover Publications, New York, under license of U. S. Alien Property Custodian, 1943, 384 pages, $3.50.

This standard German collection of mathematical definitions and formulas and of laws and equations used in theoretical and applied physics contains an unusual amount of information in a comparatively small space. Since the book is primarily intended for reference purposes, no derivations are included and a very high degree of condensation is accomplished. All branches of theoretical physics and the associated sections of mathematics are covered.

Formulas and tables represented in internationally understood symbols constitute the essential part of the contents. The accompanying text containing additional statements and short explanations is written in comparatively simple German; a German-English glossary of the more important and less familiar terms used has been added.

Though originally written for physicists, some of the sections should be of interest to electronic engineers engaged in scientific research or in developmnt work. It will assist them to find solutions to the more complicated mathematical problems involved. In particular, the following subjects are treated: trigonometric functions, vector analysis, determinants and matrices, systems of simultaneous

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★ Wherever the rectifier type of tube is used, generally there's a job for a relay . . . a RELAY by GUARDIAN . . . in secondary and/or primary circuits where double pole, double throw "on and off" switching is desirable.

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Electronic rectification, long used to convert A.C. to D.C. power, is now coming into use to operate variable speed D.C. motors . . . battery chargers, etc. In such applications, the type B-100 relay shown above is often used.

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RCA has always pioneered in development of high-frequency antennas ...and is now building many different models for the armed services.

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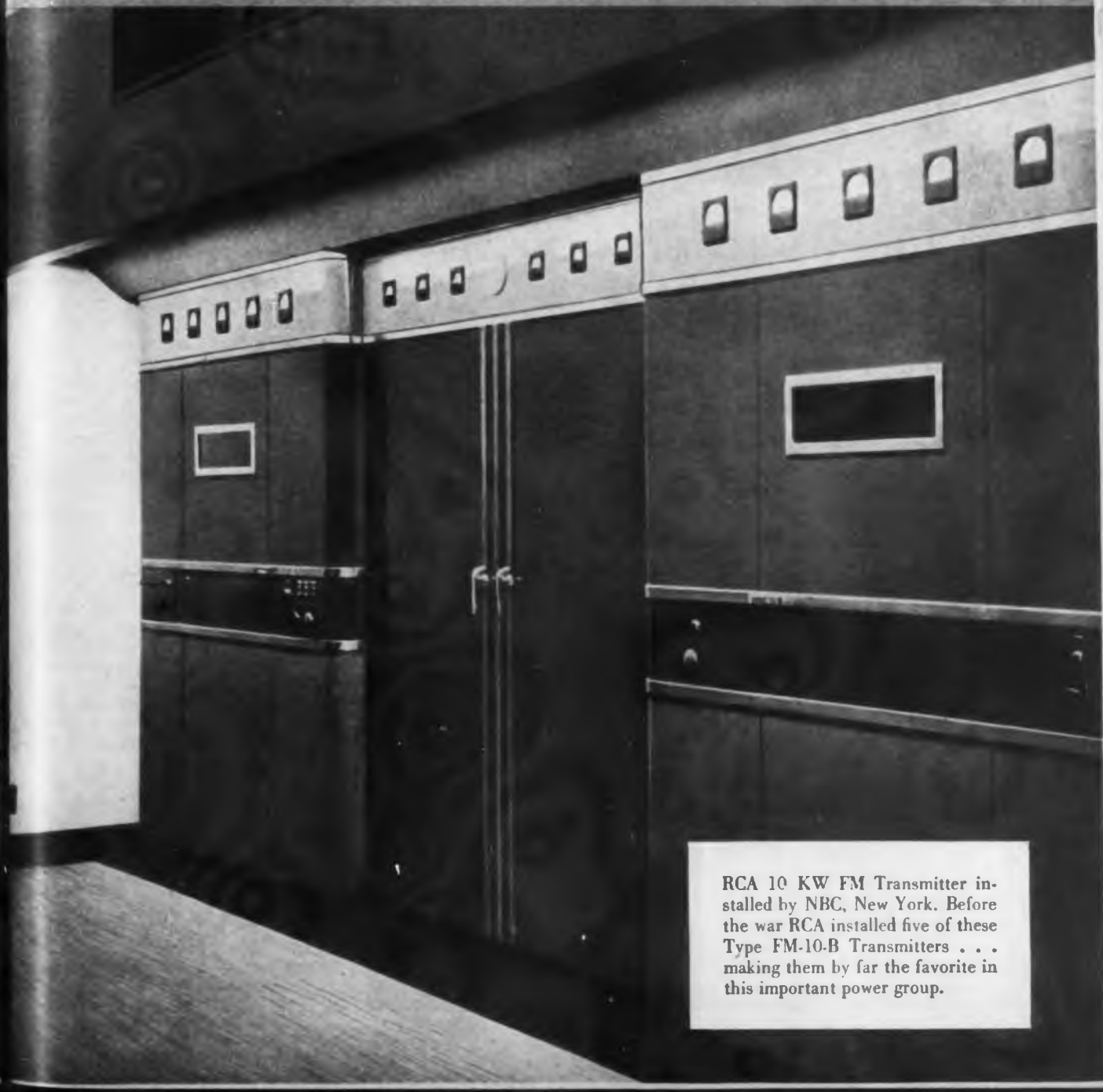

RCA 10 KW FM Transmitter installed by NBC, New York. Before the war RCA installed five of these Type FM-10-B Transmitters . . . making them by far the favorite in this important power group.

equations, tables on integration and differentiation and methods to assist in the evaluation of certain types of integrals, Bessel's differential equation and Bessel functions, relations between different coordinate systems, methods for the solution of ordinary and partial differtial equations, Fourier series, and theory of electricity.

Radio

By R. E. Williams and C. A. Scarlotte, published by American Book Co., New York, 1943, as a part of the "Training for Victory" series. 282 pages, cloth bound. Price $1.48. (Radio I at $1.04 and Radio II at $1.24.)

This book was prepared for high school students and military training courses that are intended to give a general idea of the principles of radio and the equipment that is used. It is intended as an outline for those who are interested in using radio equipment, where it is not necessary to go into the details to permit servicing or repairing.

The book can be obtained in one binding or as two separately bound sections.

NEW BULLETINS

Ceramic Tubular Capacitors

A new 8-page bulletin containing tubular capacitor dimensions and capacity and color code charts besides general descriptive information has been published by Centralab, Division of Globe-Union Inc., 900 East Keefe Ave., Milwaukee, Wis. One section is devoted to an explanation of test equipment and controlled temperature compensation. It explains correlation methods and results of experiments. This bulletin may be had by asking for Form 630 Revised.

Production of Plastics

A considerable amount of detailed information on injection molding processes is contained in a new bulletin issued by the Standard Molding Corp., 460 Bacon St., Dayton, Ohio. Although the bulletin is chiefly descriptive of the company's own products and methods, it is also valuable for the information contained on the use of plastics in mass production.

Quartz Crystals

General Crystal Corp., 1776 Foster Avenue, Chicago, has issued a four-page folder illustrating and describing the various types of quartz crystals it supplies. These include vacuum tube types in three sizes as well as more conventional types of ceramic and plastic holders.

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Electric "Relay" Catalog

Several new types of relay including a line of very small lightweight and vibration-resisting relays for aircraft service, are shown in the 104-page relay catalog recently issued by Automatic Electric Co., 1033 West Van Buren St., Chicago. Complete operating data and scale mounting drawings are given for these relays, and there are more than forty other types similarly treated in this big book. A double-page chart shows the important characteristics of each type, simplifying selection of the proper design for any purpose.

Also shown for the first time in this catalog are two desk microphones—a "carbon" and a "magnetic" type. Other items include stepping switches, keys lamps and lamp holders, solenoids, counters, switchboard plugs, jacks and cords and various types of microphone handsets, and transmitter and receiver units for telephone and radio use.

50 Years for Goat

Fifty years of engineering achievement are set forth in an attractively bound illustrated booklet issued by the Fred Goat Co. Inc., 314 Dean St., Brooklyn, 17, N. Y. One of the subsidiaries of this firm is Goat Metal Stampings, Inc., manufacturer of electronic tube parts. The Fred Goat Co. Inc., was established in 1893 by Fred Goat who came to this country from England at the age of eight. Two men and three machines comprised the organization. Now the company, its subsidiaries and affiliates comprise many hundreds of men and machines. Present officers are Walter Goat, son of the founder, president and treasurer; Jens L. Mortensen, vice-president; Edward F. Staver, secretary; Carlton Mellick, sales manager; Fred Hafecost, master mechanic; Arthur J. Ever, chief engineer. Goat Metal Stampings, Inc., has specialized in production of light stampings, including form fitting tube shields, using materials ranging from .002 to ¼ in. thick.

Dial Lights

Dial lights of a score of different types are illustrated and described in a new 24-page catalog issued by Dial Light Co. of America, 90 West St., New York. Complete engineering and installation data are included as is information on specific types of colored and etched jewels. Information is also given on Navy specification sockets, socket assemblies and on a lamp installing tool for miniature and candelabra lamps.

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We do not think so, not for a long time at least, but we do expect plastics to assume far greater importance in post-war engineering, architecture, and manufacturing operations than ever before.

Plastics are not likely to perform miracles, but if your business or employment involves products of wood, leather, metal, paper fabrics, rubber, ceramics, or coating materials, *you cannot afford to ignore plastics in your post-war plans.*

The impetus of war research; the discovery of new materials and new methods; the eminently satisfactory performance of plastics in replacing older materials during war is bound to bring manufacturing economies and improved consumer goods when peace returns.

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Heat Control

Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill. has issued Bulletin A2-3, describing its line of potentiotrols. The bulletin, of eight pages, describes the potentiometer method of heat measurement, and explains the electronic principle used in the company's instruments to gain instant control in line with the temperatures recorded. Also included is a list of instrument features, four operating diagrams, and a table of potentiotrol scale ranges obtainable with various thermocouples and a photoelectric pickup unit.

Intercommunicating Systems

A new four-page folder has been issued by Executone Co., 415 Lexington Ave., New York, descriptive of that company's complete line of inter-communicating equipment. In addition to descriptions of the various units, block diagrams are included showing the four basic systems from which networks can be arranged for up to 100 stations.

Welding Chart

Causes and cures of fourteen common welding troubles are set forth in chart form in a new Westinghouse Electric & Mfg. Co., (East Pittsburgh, Pa.) publication. On an 18 x 24 in. wall chart, trouble, cause and cure are set forth in photographs together with clear explanations designed to obviate faults.

Timing Motors

Various types of timing motors, both ac and dc, providing output shaft speeds ranging from 450 rpm to one revolution in 1000 hours, make up a portion of a new 24 page catalog being distributed by Haydon Mfg Co., Forestville, Conn. The booklet gives technical data as well as a complete exposition of the mechanical construction of this product. Included is descriptive material on time delay relays, electric metronomes, mercury tube interrupters, polarity reversing switches, exposure rate governors for x-ray equipment, electronic timers, stroboscopic timers and other specialties.

Transparent Models

Demonstration models molded of transparent plastic to reveal their construction and operation are described in detail and illustrated in a folder just issued by Strickler & Brunhuber Co., 19 West 24 St., New York. The company specializes in such work and in the production of molds of all sorts for plastics.

Stackpole Products

Just off press is a new 36-pag Stackpole electronic component catalog giving full details on fixe and variable resistors, switches an iron cores for a wide variety of elec tric, radio and other electronic ap plications. Also included is engi neering information and data. In cluded are listings of standard an high-frequency iron cores. In ad dition to complete listings on th various types of insulated and non insulated cores, etc., the catalo contains helpful reactance chart as well as time constant charts fo series circuits. Other features in clude detailed listings and dimen sion diagrams, of slide, line, an rotary-action switches; ½-, ½- an 1-watt fixed resistors, as well a variable resistors in standard an midget sizes. Publisher is th Stackpole Carbon Co., Electron Components Division, St. Marys, P

Special Fastenings

It is probable that no one not i possession of a new catalog recenti prepared by John Hassall, Inc Clay and Oakland Sts., Brooklyn N. Y., has any conception of th tremendous variety of plain nail special nails, rivets, screws an other fastening devices of the kin that are available. Yet this catalo runs to 48 pages of pictures, speci fications and engineering data o such products.

Product Designers' Guide

For those who are seeking ne ideas in postwar design, the Mon santo Chemical Co., Plastics Divi sion, Springfield, Mass., has issue a colorful and detailed list of th plastic materials it manufacture The physical characteristics an adaptability to product design o polystyrene, cellulose acetate, cellu lose nitrate, phenol-formaldehyd vinyl acetals and melamine-formal dehyde are discussed.

Cable and Wire Data

Cannon Electric Development Co 3209 Humboldt Street, Los Angele Calif., has published a 24-page loose leaf booklet on signal system, cabl and wire data for engineers, esti mators, wiremen and the electric industry in general. Among th data will be found: standard tele phone cable color code, interphon telephone cable, switchboard tele phone cable, wire types used f telephone and signal installation resistance of copper wire, carryin capacities of wires, etc. The page 4 x 6-½, are 3-hole punched to f into standard data books.

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THIS PLAN BROUGHT A FLOOD OF LETTERS FROM AMERICA'S LEADING RADIO DISTRIBUTORS AND DEALERS

CONTROLLED DISTRIBUTION

In the trade press last summer, we announced the Majestic Controlled Distribution Plan—a post-war program aimed at the correction of certain wide-spread pre-war evils in the distribution of radio receivers. In subsequent advertisements, we have attempted to amplify the principles of operation of this program and its anticipated benefits to distributors and dealers.

The response to these advertisements overwhelmingly demonstrates that the radio industry recognizes the value and validity of the Controlled Distribution formula. From throughout the nation, leading radio distributors and dealers have written us and visited us, confirming their great interest in the plan, heartily approving its principles, and inquiring further about its application to their local areas.

The Majestic Controlled Distribution Plan, formulated out of many years of merchandising observation and experience, offers interested distributors and dealers not only greater and more stable profits, but the assurance that one year's selling activity and profits are building still greater sales possibilities and larger profits for the next year.

Likewise, in this program we have established the foundation for an orderly movement of merchandise, from parts manufacturer, to set manufacturer, to distributor, dealer, and the ultimate consumer, that will mean a stable and profitable business for Majestic suppliers.

E. A. Tracey, President

Majestic MIGHTY MONARCH OF THE AIR

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FIRST MILESTONE OF THE ELECTRONIC ERA?

Evidence that Dr. deForest Working along Purely Thermionic Lines, Laid Real Foundations Independently of Edison or Fleming

By FRANK E. BUTLER*
Former Chief Engineer,
DeForest Wireless Telegraph Co.

As we look over the famous patents of Edison and Fleming which form the sole basis for latter-day historians to form their assumptions, it is found that Mr. Edison on Nov. 15, 1883, filed an application for a patent on his "Edison effect" idea under the caption "An Electrical Indicator," for which, on October 21, 1884, he was allowed U. S. Patent No. 307,031. The patent reads in part, as follows:

> "The object of my invention is to produce an efficient apparatus for indicating variations of electro-motive force in an electric circuit. • • • I have discovered that if a conducting substance is interposed anywhere in the vacuous space within the globe of an incandescent electric lamp and said conducting substance is connected outside of the lamp with one terminal, preferably the positive one of the incandescent conductor, a portion of the current will when the lamp is in operation, pass through the shunt circuit thus formed, which shunt includes a portion of the vacuous space within the lamp. This current, I have found to be proportional to the degree of incandescence of the conductor or the candle power of the lamp. • • • In applying my invention, I place a standard lamp having within its globe a piece of thin plate, placed preferably between the limbs of its carbon conductor, connecting said terminal to one terminal of a galvanometer and the other terminal to the positive lead of the circuit."

It seems fair to assume that had Mr. Edison observed half of what he is given credit for having done, certainly he, with his unquestioned skill, imagination and patent technique would have made some mention—in the patent—of ionic action within the globe, had he discovered or known what it was. . . . Yet there appears not an inkling of it in his specifications or claims.

Dormant for 20 years

That Edison considered this "discovery" as being of little or no consequence is evidenced by the fact that this brain-child of his lay dormant and

*Frank E. Butler has been active in radio from its very beginnings. Back in 1904, while Dr. Lee deForest, Butler operated a wireless telegraph station at the St. Louis World's Fair, the first high-power transmitter to communicate with Chicago. In 1906 he built the transatlantic station at Manhattan Beach, N. Y., and sent messages to Alexander Graham Bell in Iceland. As chief engineer for Dr. deForest, Butler continued with his chief during the historic experiments which led to the invention of the three-element tube, here described. Later, Mr. Butler assisted deForest in developing the wireless telegraph, equipping 34 Navy ships under Admiral "Fighting Bob" Evans. He also aided deForest in developing the sound-on-film technic, now employed in sound pictures. Mr. Butler now lives at 2912 Rockwood Place, Toledo, Ohio, and is occupying himself in sound amplification research and in writing a history of the growth of radio.

forgotten for about 20 years,—not worth the price of the paper the patent was written on.

Twenty years is a long time to be extremely busy on something else.

It was, then, not until about 190[illegible] that Fleming resurrected the "Edison effect" from the dusty shelves, shortly after the electrical world was startled by the announced discoveries of Nikola Tesla . . . during that eventful period between the years 1886 and 1903 when practical achievements in polyphase currents and alternating-current engineering were in their growing pains.

Professor Fleming, taking up where others had left off, realized the necessity for adequate and improved measuring equipment for the many new motor and dynamo developments springing up,—being apparently more interested in this than in wireless reception at that early date. Hence the idea of utilizing the old discarded "Edison effect" idea, with its unilateral action offered an ideal field for research and action. Consequently his efforts along this line resulted in the invention of a device which he called the "Fleming Valve" as outlined in his patent No. 803,684, filed on April 19, 1905, Serial 256,483, and granted on November 7, 1905, under the caption "Instrument for Converting Alternating Electric Currents into Continuous Currents" which he describes as follows:

> "This invention relates to certain new and useful devices for converting alternating electric currents into continuous electric currents for the purpose of making them detectable by and measurable with ordinary direct current instruments such as a 'mirror' galvanometer. It is * * * able to detect feeble electric oscillations such as are employed in Hertzian wave telegraphy. This can be done, if the alternating current can be 'rectified' . . . that is, either suppressing all the constituent electric currents in one direction and preserving the others, or else by changing the direction of one of the sets of currents which compose the alternating current so that the whole movement of electricity is in one direction."

Aside from the mere mention of the fact that the idea might be adaptable to wireless reception, the full stress of the invention was placed upon its value as a measuring device. It is significant that in a book later published by Professor Fleming, entitled: "The Principles of Electric Wave Telegraphy" there is no mention of the "Edison effect." This has erroneously been construed by some to indicate that Fleming first came upon this principle or "effect," and not Edison. Fleming repeatedly refers to his invention as an "Oscillation Valve" . . . a stopper for a one-way channel of electric waves,—there being a vast difference between "valve" action and "relay" action. It is the latter that is so essential in establishing "control" in an electronic device.

What Fleming actually did was to utilize the "Edison effect" in addition


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to the ideas of the old Elster-and Geitel apparatus in a modified for and thus produce a weak and decided inefficient wireless detector, rectifica tion being brought about owing to th unidirectional condition heretofor mentioned. The "Fleming Valve" wa purely and simply a rectifier and i no way was it an intensifying devic nor was it a means of generatin oscillations. The claim therefore tha he alone is the originator of the pre ent thermionic valve is exaggerated, t say the least, since the intensifyin properties of the present electroni devices are far more important tha its detecting properties.

Another interesting angle to th present controversy is the fact that th filing date of the Fleming patent i actually two months and nineteen day . . . after . . . February 2, 1905, when Dr. Lee deForest filed his four basi patents, Numbers 979,275 — 867,876— 867,877—867,878, and on which he wa allowed the astounding number of se enty basic claims. (The specification embodied in No. 979,275 were written and notarized as early as November 1904. and so recorded on the appli cation.)

Nine additional patents were als obtained covering the entire range o research through the Bunsen-burne open-flame experiments which pre ceded the introduction of the flam results in an evacuated incandescen tube. The extensiveness of these f original patents can best be realize when it is known that they involve a total of nearly two hundred basi claims, all related to ionic action an electron emission directly applicabl to devices for wireless reception pra tice . . . and not designed for any fo eign purpose — as were the Edison and Fleming inventions, upon which such extravagant glory and priorit has been lavished!

Interested in "heat" theor

The true picture of how Dr. deFo est accomplished his brilliant achieve ment involves a road long and tough It was done the hard way . . . not a simple a thing, as merely putting a "grid" on the inside of a Fleming Valve, as so many have been led t believe, largely because of the constan repetition of such stories. In all pro ability, if deForest had started . . first with an incandescent bulb . . in his series of investigations, h would not have arrived at the ultimat goal he did,—though this, by the way would have been his procedure if h had been "copying" or taking u where Edison or Fleming had left of

The old diaries which the young deForest kept during his college day at Yale reveal in numerous places ho

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great interest in atomic and oscillatory phenomena and his ambition to solve their mysteries in this then-little known or appreciated field of electricity.

During the very earliest days of wireless telegraphy and several years before the invention of the Audion tube, when this writer first became associated with deForest, his constant and oft-repeated ambition and effort was to "discover a better wireless detector" and he early realized that the bottleneck of the wireless development of that day was the weak and insensitive methods employed in wireless reception. This idea so engrossed his conscious and sub-conscious mind that when, in the flash of an instant, he saw a lighted Welsbach gas burner above his workbench flutter in unison with the oscillations from a nearby induction coil he was operating, his keen imagination caught the idea of the "possibility of heat" functioning as a means of Hertzian-wave detection.

Open-flame and B-battery

From that time on he never gave up the idea but pursued his investigation upon the theory of "heat" and these tests carried him through the various stages of his open-flame Bunsen-burner experiments. In these he obtained gratifying manifestations of signal-detecting qualities in certain areas of a flame if, and when an auxiliary current source (which he called a "B-battery") was inserted in the circuit. This type of "booster power" was used in the very first open-flame experiments and is so recorded in his first patents . . . never having been discarded throughout the remainder of his experiments. The extreme importance of this extra battery was not at first appreciated nor did anyone dream of the exalted position it would occupy in the modern electronic arts.

It was only because of the unstableness of an open flame and its susceptibility to draughts, that deForest shifted his investigation to other types of heat-producing mediums, in an effort to find this necessary steadiness. In casting about to locate such a means there seemed to be nothing quite so handy, practical and promising, as a lighted incandescent electric lamp. Anyone with less keen vision might have thought of the same thing. It was an obvious decision and simple deduction because the electric light bulbs then in use were of the carbon filament, 16-candlepower variety, and radiated considerable heat.

The act of incorporating within such an electric-light bulb, the same series of experiments carried on in the open-

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Originators of Shear Type Bonded Rubber Mountings

flame tests resulted in showing notic able improvement over that of th flame action, and it was in this manne that the step-by-step procedure pr gressed which ultimately led DeFores to his final success . . . the creatio of the first "three-element vacuu tube" . . . marking the really "Firs Milestone of the Electronic Era."

DeForest's guiding star throughou all his tests was heat and the ioniz tion of gases and other ionic actio as mentioned in his various patent The use of an incandescent bulb a employed at first, was only a mean toward this end, hence it would see quite conclusive he was in no way i terested in the "Edison effect" or th investigation of others along simila lines.

Original discovery

DeForest arrived at his goal ove an independent path and unknow trail . . . not by investigating "shad ows" or following rainbows. His di covery was truly one of the very fe that can be classified as distinctl original and made out of whole cloth It is significant that during thes memorable tests he never mentione to any of his associates, leastwise t to me, the names of Edison or Flem ing, nor were there ever in evidenc about the workbench, a sample, dra ing or patent papers of either of thes two devices he is supposed to hav copied or improved.

Get the record right

This evidence, condensed though i is, would seem to be sufficient to de termine who is entitled . . . withou question . . . to the honor of havin taken the first step toward the "Firs Milestone of the Electronic Era."

If we can agree with Mr. Ford tha "history is bunk" . . . let's de-bun these "Edison effect" and "Flemin Valve" versions of the creation of th radio tube . . . once and for all . . and not have this contamination con tinue to fill the pages of our leadin technical publications and current hi tory. Surely, we do not want it said of this generation, which must write the first pages of electronic genealogy that we smeared its conception, birth and first gasping breaths, with un truths and bigotry. The truth is a birthright that the electronic industry should hold near and dear,—seeing to it that electronic history is kept clean and clear.

The place to start this crusade of truth is in the pages of our current technical publications, from whence it will ultimately gravitate to the col umns of other mediums and into our school books.

Praise Performance of Radio in Combat

From the commanders of our troops in the four corners of the earth have come comments praising the operation of signal communications in actual combat, Major General James A. Code, Jr., Assistant Chief Signal Officer, speaking on behalf of Major General H. C. Ingles, the Chief Signal Officer, told the National Business Paper Editors in their meeting in Washington, Dec. 17.

Letters from commanding officers in Italy have come to the Chief Signal Officer stating that their signal equipment surpassed even the best they had enjoyed in maneuvers in this country. The Signal Corps equipment in battle has achieved performances in many instances "nothing short of astonishing", he declared.

Exceptional service

General Code described how the mobile field headquarters radio station, SCR-299, had been in the thick of battle on every front and had rendered exceptional service under most severe combat conditions. It has covered a range of 2,300 miles with satisfactory performance and was the main means of radio communications between American forces in Northern Africa. General Code said it had proved to be the real answer to the problems of long distance communications in the African and Italian theaters. He related a report from the Pacific Theatre in which a Signal Corps colonel had told how fortunate the American forces had been to get two SCR-299 stations into New Guinea because for two months it was the only form of communications and without it "we would have been almost completely isolated."

The voice-operated SCR-522, the Command Radio Set using very high frequencies for communication between aircraft or between aircraft to control towers, also has proved of great value and is employed in all fighter and bomber aircraft for command purposes. These sets are also being installed in light vehicles to provide a medium for air-ground liaison.

The new improved "Walkie-Talkie" set with a range tripling that of the former type and with remarkable tone quality, free from static due to the use of frequency modulation, is being shipped in large quantities to troops at the front, General Code reported. The midget microphone, worn on the upper lip, which eliminates outside noises and leaves the hands free, was adopted for use by the Army Ground Forces. He termed it

"rugged in construction and capable of superior performance in high noise levels."

General Code also described to the business paper editors how the Signal Corps had built 6 long wave radio stations in the Arctic region in 28 days and had constructed the 2,026-mile Alaska Military Highway Telephone Line which links the United States with Alaska and is considered one of the greatest engineering and construction feats.

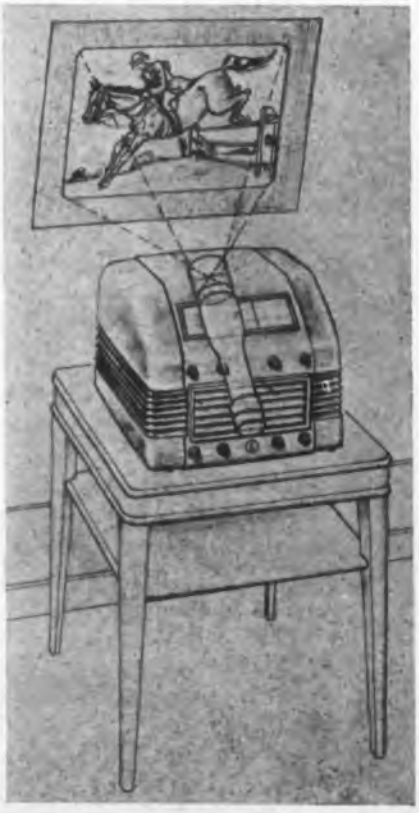
Emerson "Projection" Television Cabinet

A television instrument, shown recently at a conference of engineers of Emerson Radio & Phonograph Corp. presided over by Benjamin Abrams, president, is approximately 18 in. wide and 14 in. high, and will be a complete radio and television receiver with a three-inch cathode ray projection tube. The television image will be enlarged and projected to 15 by 20-in. proportions on an external motion picture screen, by means of a plastic lens system.

According to Mr. Abrams, this development, which will be made available to the public at no more than $150 when civilian production becomes possible, should go far toward building mass television audiences which are essential to the support of broadcasting operations.

"Ordinarily", said Mr. Abrams, "announcements of engineering developments in radio-electronics are withheld until they have been adapted to consumer products and are featured as 'innovations' by manufacturers. In the case of television, however, I feel that here is an art and a public interest which call for a pooling of all constructive thinking and research. This, I believe, is the way to effect a rapid and universal spread of television's manifold benefits. We are therefore making this Emerson development public as part of our contribution. Furthermore, it is our policy to encourage the same sort of work and ideas on television which brought about so many advances in the early stage of broadcast radio. It will be recalled that it was the radio amateurs who gave home radio its greatest early impetus.

"While most war-born radio and electronic developments will call for considerable reconversion, television receivers and television broadcasting can be brought into commercial operation almost immediately when materials for civilian production become available."



Emerson's projection type television home receiver

Recent Army-Navy "E" Awards

Richard H. Bird (Bird & Co.), 23 Moody St., Waltham, Mass.

Raytheon Mfg. Co. (four divisions), Newton, Waltham and Watertown, Mass., and Chicago, Ill. (star added).

Electronic Enterprises Inc. 67 Seventh Ave., Newark, N. J.

Erie Resistor Corp., 644 W. 12th St., Erie, Pa.

Landers, Frary & Clark, New Britain, Conn.

"The Relic"

A radio transmitter, which broadcast the 1937 solar eclipse from a tiny atoll in the South Pacific, is still in operation and recently was used in a news broadcast from Naples. Nicknamed "The Relic," the transmitter was used for special events broadcasts after its return from the south seas. It entered the service of its country in 1942 and was shipped to North Africa. It "made" the invasion of Sicily and was set up in Syracuse where it sent press copy back to Allied Force Headquarters for relay to the United States.

Sent to Bari soon after the invasion of the Italian mainland, the five-ton transmitter was eventually shipped to Naples. There, with the aid of an Italian generator, it broadcast on November 14 a news program from the Advanced Press Headquarters in Italy. This marked the first Allied radio transmission from the continent of Europe since Dunkirk.

IRC

PROMISES

MILLIONS MORE IN '44

NEW PLANT—To meet increased demands for IRC resistors it became apparent early last year that a new IRC Plant was the only solution. From the blueprint stage, in January of '43, the project became a functioning reality by Fall. Now both great plants are turning out huge quantities of resistance devices for war needs.

NEW STAR—Twenty-four hours a day . . . seven days per week, right through the calendar! That's been the pace at IRC ever since war was in the rumor stage. During the months of actual combat, while we couldn't work longer hours, we've worked successively harder to reach the seemingly unattainable quotas established for us by those charged with supplying our Fighting Forces. That we've done a creditable job is attested by the fact that our Army-Navy E pennant now flies a second white star "for great and continuing contribution to the cause of freedom."

ACKNOWLEDGEMENT—Despite the many problems of wartime construction and procurement, IRC's new plant was equipped and "in production" with minimum difficulty. To commemorate the spirit of cooperation which made this achievement possible and to give credit where credit is due, we've prepared a booklet entitled "Reporting on Plancor No. 1666." A copy will be gladly sent to interested executives.

INTERNATIONAL RESISTANCE COMPANY

425 N. Broad Street • Philadelphia 8, Pa.

SUGGESTS EARTH-GIRDLING "CONVEYOR BELT" PLAN FOR RADIO COMMUNICATIONS

• The great increase in demand for radio frequencies for communication and other purposes indicates an approach to the solution by way of more economical use of those wavelengths available. A system proposed and under study by the Engineering Department of the Federal Communications Commission is that of an earth-girdling group of transmitters operating at points near the equator and receiving the messages to be transmitted from stations located directly north and south of the intermediate pick-up receivers.

The "conveyer belt" of radio channels would handle the world's long distance communications through a system of relaying receivers and transmitters which would take traffic from a station in New York for example, and feed it into transmitter handling traffic westward to North Africa where it would be taken off the "belt" and relayed north to a station in England.

Multiple transmissions possible

By the use of carrier modulation it would be possible to multiplex transmissions and also by the use of scheduling traffic, the greatest utility factor could be realized for a given carrier frequency. The procedure for channeling wire circuits is well established through the use of tone multiplex and time division multiplex. A limited use of such arrangements has been made in radio circuits between certain points. The general procedure is to assign frequencies 5, 10 or 15 kc apart because of the wide variations in desired and undesired signal levels. A channel of 340 cycles will handle radio telegraph communication up to 100 words per minute and 5 kc is adequate for voice communication. Thus, a transmitter with a 59 kc band could operate 100 telegraph channels and 5 telephone channels.

Where 24-hour circuits are necessary one or more permanent channels would be assigned to handle the traffic while less busy circuits would be (patched) through on idle channels similar to telephone procedure.

Among the advantages claimed for the plan is the fact that north-south transmission paths are more stable and, therefore, a high degree of reliability could be established between originating stations and the relay receiver points along the "conveyer belt". Also, east-west communication at high frequencies is better near the equator than those paths which go through the auroral regions.

A chain of relay transmitters and pickup receivers would be located at points approximately 20 deg. north latitude around the world at such intervals as necessary to have a reliable circuit.

With all international communications being handled through the medium of this "belt" of channels some form of scheduling of communications would be necessary. For example, if a given circuit from New York to Australia was being used and none other was available, it would be necessary for those desiring communications to this point to be assigned times for handling their traffic.

The economy in use of frequencies is obtained first by limiting the frequency range required through the selection of the best transmission paths, second by bringing the channel spacing down to a value which would be impracticable in the case of separate transmissions for each circuit and third by providing for worldwide use of certain frequencies on the time sharing basis when the traffic load is not heavy.

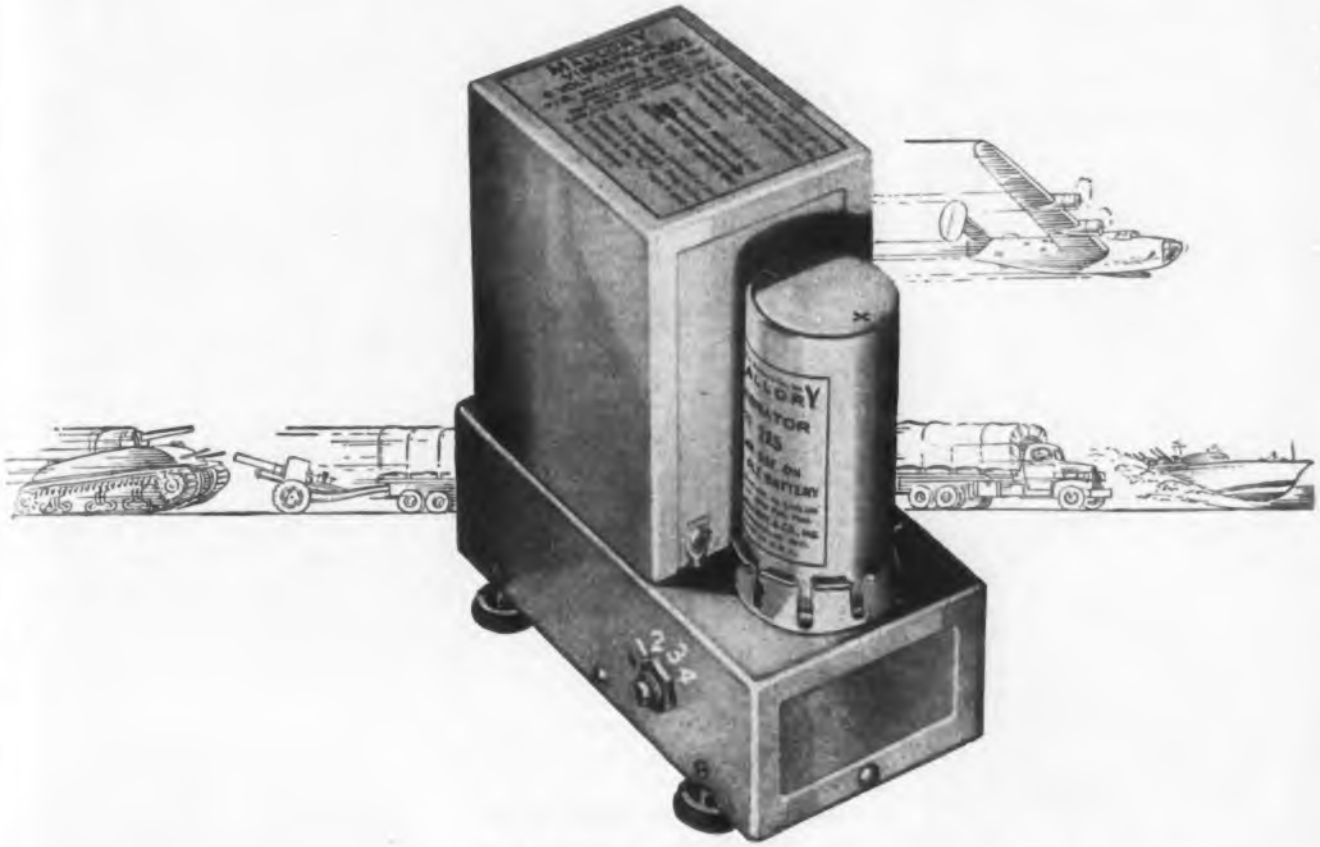
Wide-Angle P-E Scanning

One of the chief drawbacks to the use of phototubes and light beams as a safety device on power machinery has been the necessarily small size of the light beam or, if the beam is made intentionally large, the requirement that a large percentage of its cross section be obstructed in order to operate the protective relays.

This problem appears to have been solved by the development of a wide-angle mechanical scanner by E. D. McDowell of G-E's electronic division, which rapidly "looks at" a lighted surface spot-by-spot. In a laboratory set-up, a four-sided area was lighted along two sides. A rotating pyramid of mirrors located at the third side picked up the light blanketing the entire area, reflecting it to the phototube. If a hand, finger or other object entered the area from the fourth side, the P-E system operated in about one 200th of a second.

This new arrangement may widen the application of phototubes to operations now performed only by human vigilance. For example, light might be reflected from large, evenly coated sheets of metal or paper during a stage in processing or finishing.

Our Wartime Worries Are Your Peacetime Profits



This fast-moving mechanized war is a terribly exacting proving ground. It often crowds into a few hours the normal wear of months and years.

Take vibrator power supplies, for instance. They take a lot of punishment going over rough terrain in tanks and trucks. The stress and strain of operating in dive bombers is almost unbelievable. And in all instruments of war—from planes, to boats, to submarines—they are subject to extremes of temperature and atmospheric pressure as widely different as our far-flung battle lines.

To build vibrator power supplies to master these conditions involved many an engineering headache. But, by new designs and constructions, by better materials and imaginative experiments, Mallory succeeded in building them.

*Vibrapack is the registered trademark of P. R. Mallory & Co., Inc., for vibrator power supplies.

Today they serve on land and sea—above the clouds and below the waves—thoroughly tested, and completely dependable.

Born in the crucible of war, these same Mallory Vibrapacks* are ready to further your peacetime profits tomorrow. Write us about your application requirements.

MALLORY "Know How" Serves Your Vibrator Needs

Fully protected against corrosive fumes, extremes of atmospheric pressure and moisture-laden air, Mallory hermetically-sealed vibrators operate under ideal conditions for economy and long life.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

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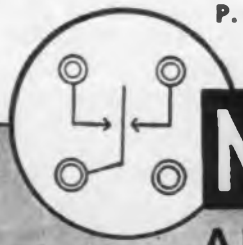
Buy Bonds and Stamps



P. R. MALLORY & CO. Inc.

MALLORY VIBRATORS

AND VIBRATOR POWER SUPPLIES

IRE-AIEE WINTER MEETING

(*Continued from page* 92)

Engineers, located in Boston. Prominent in the early work of the latter group were such men as John Stone, Lee de Forest and Fritz Lowenstein. Wireless Institute membership included John S. Murphy, R. A. Somerville, Joseph D. Fountain, Philip Farnsworth, G. W. Pickard and many others.

Between these two organizations there were but 70 members and it was from this nucleus that IRE sprang. At the time of its formation, initial work of organizing having been done by Dr. Alfred N. Goldsmith, John V. L. Hogan and R. H. Marriott, IRE had fewer than 50 members. Today, the Institute numbers among its members engineers is more than half a hundred foreign countries and has active Sections in 26 cities.

Each year IRE makes a number of awards. The Institute Medal of Honor is awarded in recognition of distinguished service in radio communication. It is awarded to one who has been responsible for an important advance in the science or art of radio engineering. The Morris Liebmann Memorial Prize likewise is presented to a member who during the recent past has made an important contribution in the field of radio communications.

MODULATED CARRIER

(*Continued from page* 103)

portion of the exponential curve where the rate of rise of voltage is approximately linear, and to choose a large enough value of applied voltage to make this possible. In the subject application this is advisable as a saw-toothed wave is more easily amplified than a flat-topped one.

Oscillator frequency

Oscillator frequency should be chosen sufficiently low so as to maintain operation within the limits of fidelity of the amplifier, but sufficiently high to permit use of the smallest value of filter capacitor in the output. These will depend on the amplifier used and the input voltage. In this connection it should be noted that the oscillator is very widely frequency-modulated. This may be understood with the aid of Fig. 6.

Two basic factors determine oscillator frequency: In Fig. 6 E_1 and E_2 represent two values of critical plate voltage which result from different values of grid voltage. The period of a single cycle is approximately the time required for the condenser voltage to reach the critical plate value. Since frequency is the reciprocal of the period, oscillator frequency will depend upon critical plate voltage, or upon grid voltage. The other factor which determines frequency is the rate of rise of plate voltage.

Plate voltage will rise at a rate which is controlled by R and C, the plate timing network, and upon the magnitude of the voltage applied to the network as shown in Equation (1). As a result, amplitude modulation of the carrier brings with it wide-band, non-linear frequency modulation. This is observable in the oscillogram, Fig. 3. The darker portion under the larger carrier amplitude indicates a lower frequency while the brighter portion indicates a higher frequency. A typical curve of frequency variation vs. grid voltage is given in Fig. 7.

Oscillograph as voltmeter

Fig. 8 shows a circuit which uses a cathode ray oscillograph as a dc vacuum-tube voltmeter. In this circuit the system is set to the desired overall gain as follows: Assuming correct values of V_3 and V_4, and setting the oscillograph at some suitable gain, V_1 is adjusted till only the tips of the carrier voltage are visible. An input voltage of the order to be measured is applied,

$$V_{input} = \frac{V_2 \times R_4}{R_3 + R_4}$$

and the oscillograph gain and V_1 are adjusted so that V_{input} causes a large visible change in carrier amplitude. Knowing the change in amplitude caused by V_{input} the oscillograph may be calibrated in inches per volt.

Using the 884, linear operation will be obtained with net negative values of grid voltage greater than 5 volts. The type 2050 thyratron may be used in place of an 884 with the advantage of a gain of about 200. The characteristic of a 2050 is linear over a range of critical plate voltages from about 200 to 600 volts, and corresponding control grid voltages from about -2.5 to -4.5 volts, with the shield-grid tied to cathode.

SERIES TUBES

(*Continued from page* 90)

A calculation of R^1_p from (10) gives a value as follows:

66,000 ohms = R_{p1} of 6F5
7,200 ohms = R_{p2} of 6J5
18,900 ohms = (1 − 20) x 900

92,100 ohms = R^1_p

The calculated μ is 100 (same as for 6F5) and Gm is 1080 micromhos.

A graphical measurement of R_p

4 Micro Switches

operate auxiliary wire cutting and reeling equipment...and reset this PRODUCTIMETER in 4 seconds

For sixty odd years the Durant Manufacturing Company of Milwaukee, Wisconsin, has been engineering and manufacturing rugged industrial type counters.

Durant has always been insistent upon quality of the parts which go into their product. Their use of Micro Switches in this Motor Reset Productimeter is a typical example of their fine engineering.

This Reset Productimeter measures predetermined lengths of insulated cable and automatically coils the cable on large reels. When the predetermined length has been wound, a Micro Switch inside the counter housing starts a small motor which resets the counter at the predetermined setting for the next operation. The reset cycle is approximately 4 seconds.

One of the Metal Clad Micro Switches shown adjacent to the motor operates a flying shears which cuts the cable. Another controls the mechanism which leads the severed ends into a waiting reel. The third starts the reel winding when it is set and ready to go.

This is but another example of the wide range of application, precision, speed, long life and absolute dependability of Micro Switch. It is typical of the vital role which Micro Switch is playing in industrial machinery of every type and kind.

New products now being designed will use hundreds of Micro Switches in hundreds of different ways. For Micro Switch can be built to meet any specifications required. The basic Micro Switch is only 11/16" x 27/32" x 1 15/16", and weighs less than an ounce. Thousands of special housings, actuators, and electrical characteristics are available now, and new features are being added every day.

Let Micro Switch engineers help you solve your design problems that call for the unusual in precision switching.

The basic Micro Switch is a thumb-size, feather-light, plastic enclosed, precision snap-action switch that operates on force differentials as low as ¼ ounce and movement differentials as low as .0002". It is listed by the Underwriters' Laboratories with ratings of 1200 V.A. loads from 125 to 460 volts A.C. It can be supplied in a wide variety of housings and a broad range of actuating mechanisms.

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from Fig. 2b gives 200,000 ohms, and a calculation by (10) gives 199.200 ohms. The transconductance of this hypothetical tube is 540 micromhos.

Several uses may be found for the circuit of Fig. 3. Since the two tubes are in series, twice the maximum rated voltage can be applied to the pair and a large output voltage can be delivered across R_L with small inexpensive tubes. While the maximum peak signal voltage available across R_L is determined by the supply voltage, the use of two tubes in series to obtain large output voltages requires high values of grid driving voltages due to reduced Gm. For this reason, the tube selected for T_2 should have a low μ and the resistance R_k should be small.

The coupling resistor R_k can be replaced by any type of impedance if provision is made for a dc path through it.

An example of transformer coupling is shown in Fig. 5.

The transformer secondary can be connected to make the grid of T_2 positive at the same time the grid of T_1 is positive. Thus as shown in the equivalent circuit of Fig. 5, the equivalent voltages add approximately 90 deg. out of phase.

The gain can be expressed as

$$\alpha = \frac{\mu_1 R_L}{R_{p1}+R_{p2}+R_L+jX_L(1-N\mu_2)} \qquad (11)$$

A combination of three tubes in series is shown in Fig. 6. The plate current of this group is:

$$i_p = \frac{\mu_1 E_{g1}}{R_{p1}+R_{p2}+R_{p3}+(1-\mu_2)R_{k2}+(1+\mu_3)R_{k3}+R_L} \qquad (12)$$

If all tubes are identical, and $R_{k2} = R_{k3}$, the expression for gain becomes:

$$\alpha = \frac{\mu R_L}{2R_k+3R_p+R_L} \qquad (13)$$

In every case of the series operation of these tubes, the cathode circuit of T_2 is above ground as far as the signal is concerned. If the tubes are operated from a common heater supply, the cathode to heater capacitance will act as a shunt load to high frequency components.

Another factor is the heater to cathode voltage. When a common grounded heater supply is used, the dc voltage from cathode T_2 to ground is also between cathode and heater of T_2.

Typical plate characteristics of series operated tubes of different types are shown in Fig. 4 and Fig. 7.

In Fig. 4, the input tube T_1 is a 6F5 and the control tube T_2 is a 6J5. Two cathode coupling resistance values, 900 and 6000 ohms, were used for these curves. Superimposed in color are the characteristics for a 6F5 tube used singly.

In Fig. 7, the input tube T_1 is a 6J5 and the control tube T_2 is a 6F5. Here also, the two curves are for R_k values of 900 and 6000 ohms. The curves in color are for the 6J5 operated alone.

The comparison of these characteristic curves gives the following results:

(1) The plate resistance of the hypothetical tubes comprised of T_1 and T_2, increases with the μ of T_2 and the value of R_k.

(2) The amplification factor of the hypothetical tube is the same as that of the input tube T_1.

(3) The transconductance of the combination is less than that of T_1 and decreases as the equivalent R_p increases.

(4) In the circuits shown, the gain of the combination approaches the μ of T_1 as a limit.

In the circuits and derivations, the effect of loading by the following circuits was ignored. This loading effect can be included simply.*

*Determining Gain in RC Circuits—Electronic Industries, November 1942.

CARRIER CURRENT

(*Continued from page 85*)

A number of telemetering methods provide a telegraph type of channel. These include:

(a) "Time duration" in which the length of the "mark" and "space" intervals (telegraph dashes) compared to a time base of say 15 seconds, determines the reading (that is, 7.5 seconds "mark" and 7.5 seconds "space" would read center scale).

(b) "High-rate impulse" in which the number of impulses (telegraph dots) per second determine the reading in an electronic or relay-operated condenser charge and discharge circuit.

(c) "Frequency variation" in which either an audio modulating frequency or the carrier frequency itself is varied in accordance with the reading, which is reproduced, usually by a bridge circuit, at the receiving end.

A separate carrier transmitter is used for each reading telemetered but this reading may be received by several companies at distances up to and over 300 line miles away. Typical transmitters are 25-watt, crystal-controlled on two frequencies 200 cycles apart. They are keyed alternately for the telegraphic "mark" and "space" intervals by a combination mechanical keyer and kw meter.

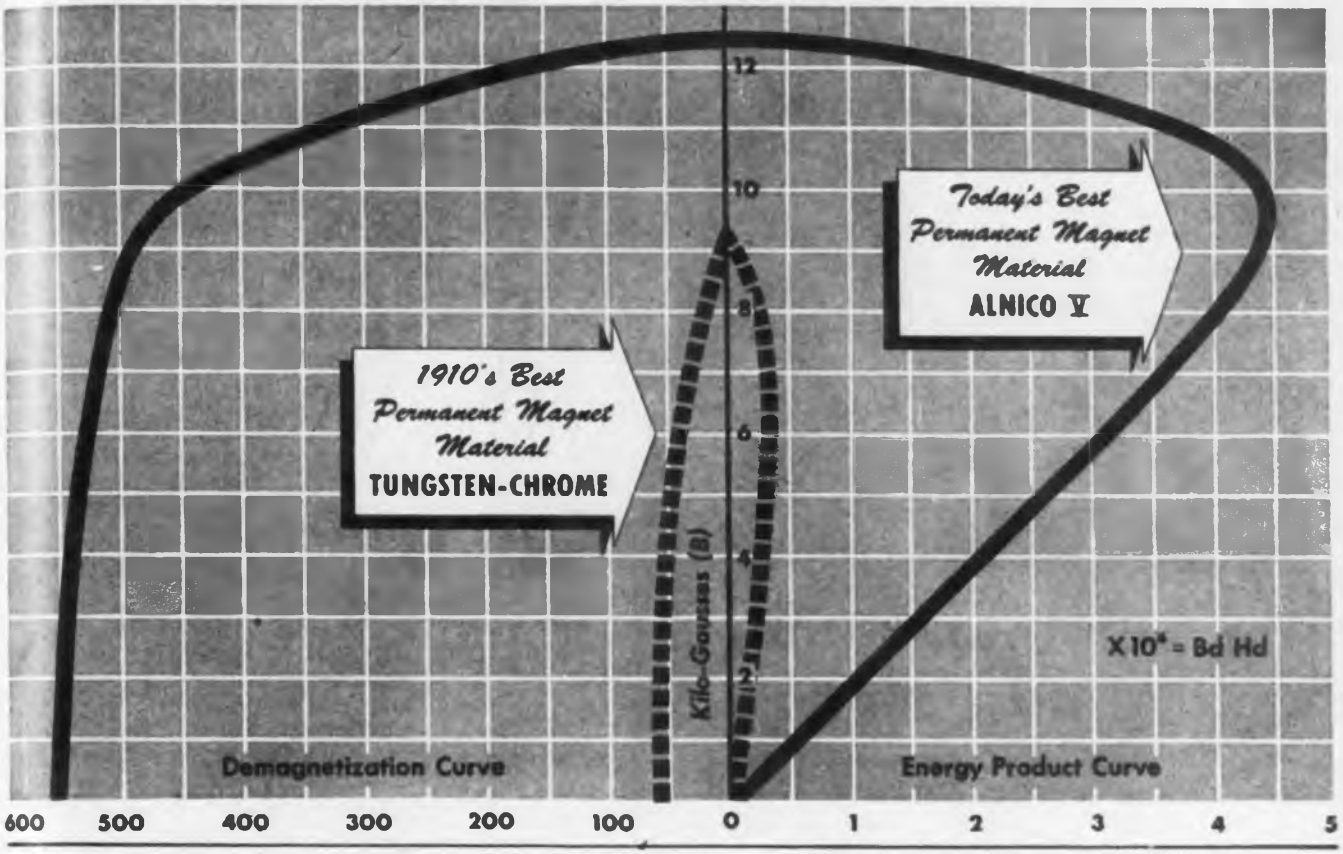
Receivers contain two narrow-band crystal filters, one responding to the "mark" frequency and the other to the "space" frequency, the net output controlling a polarized relay or a thyratron relay circuit which accurately follows the transmitter keyer. The crystal filters cut off at a rate of about .75 db per cycle near the band pass and telemetering channels are normally placed 1 kc apart without trouble.

Telemetered readings are also used for automatic generator control. Thus the output of a given plant, or part of it, may be automatically regulated to hold a predetermined load on a particular tie line, or to regulate at its proper value the net interchange between two companies over two or more tie lines. Three large generating plants are equipped for this type of regulation.

Many supervisory control methods (for remotely controlling plants or stations) are adaptable to transmission either by carrier or by wire lines. The application may involve one or two carrier channels or the use of a number of modulation frequencies for control purposes, usually between two points such as a power plant and a remote point.

One typical installation controlling a 15,000 kw hydro plant oper-

PERMANENT MAGNETS MAY DO IT BETTER



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Today's permanent magnets of Alnico V have a stored energy ten times that of 1910's tungsten-chrome magnets!

This energy increase, the economies in bulk and weight resulting from it, plus significent advances in design and fabrication, have made it possible to use permanent magnets in countless *new* products.

Specializing in this *one* industry for 33 years, our organization has assumed a leading role in permanent magnet developments. We've constantly originated new shapes, new applications, and new techniques in metallurgical control and precision manufacture. This experience should prove invaluable to you in the solving of your engineering problems.

Our engineers will be pleased to consult with you. Write us, on your letterhead, for the address of our office nearest you—and a copy of our 30-page "Permanent Magnet Manual".

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ates as follows: the control board has 32 positions which may be used one at a time to send coded impulses over a carrier channel. A second carrier channel provides communication, or any telemetered reading called for by the remote control operator. Thus, readings of tail water level, head water level, kw output, line loads, etc., can be obtained selectively by the operator.

The equipment shown in Fig. 9 in conjunction with the control station will perform any of the following functions:

(a) Telemeter three generators individually for kw-hrs, reactive-volt-ampere, governor gate position, kw output;
(b) Telemeter head water level, tail water level and line volts;
(c) Start, stop, transfer from generator to condenser operation, or control load of three generators individually;
(d) Operate or indicate position of three oil-circuit breakers on outgoing high-voltage lines;
(e) Provide control of reactive portion of plant generation;
(f) Provide carrier communication.

In effect, this hydro plant is operated entirely from a remote point and is unattended except for maintenance purposes.

The formation of ice on transmission lines has been one of the most difficult operating problems with which electric utilities in northern latitudes have had to contend. The occurrence of sleet, or conductor ice, is erratic both as to time and location. It may occur several times yearly over wide areas or be practically non-existent for several years in the same territory. Furthermore, a remote and inaccessible section of line may accumulate a heavy ice coating for a few miles only, when weather conditions elsewhere are well outside the sleet band.

The effect of even relatively light conductor ice formations may be quite serious. Although lines are designed to withstand the added weight and wind pressure when heavily loaded with ice, the oval-shaped coating causes the phenomenon known as "dancing" or "galloping" of the conductors at wind velocities as low as 15 miles per hour. This is due to the lift of the wind on the conductor and coating. Even at the wide conductor spacings used, such irregular "galloping" will cause conductors to come together and short circuit. Also when a heavy ice coating melts, it may fall from an entire span at one time and result in conductors coming together.

One solution of this problem has been to melt the ice by passing heavy current through the conductor, before the accumulation becomes hazardous. However, the in-

Electronic Parts: ENGINEERING AND PRODUCTION

The gadget above is a junction box for a co-axial gas-filled transmission line. It is one of a series of coupling units, end seals and other fittings for high-frequency transmission—designed and built by Lapp.

To this type of construction, Lapp brings several innovations and improvements. For example, such a line from Lapp parts is genuinely leak-proof. Every gasket is under spring loading, so there's no leakage created by vibration or thermal change.

Whether or not you're interested in gas-filled transmission lines, you ought to know about Lapp. Here is an organization of engineers and manufacturers with broad basic knowledge of ceramics and their application. With experience in hundreds upon hundreds of special-purpose electronic parts, we have been able countless times to improve performance, or reduce costs, or cut production time through the application of our specialized skills to design and manufacture of parts involving porcelain or steatite and associated metal parts.

For quick and efficient assistance on a war production subcontract—or for the competitive advantage Lapp-designed and Lapp-built parts will give to you in the postwar battle—an inquiry to Lapp now may pay you dividends. *Lapp Insulator Co., Inc., LeRoy, N. Y.*

Lapp

portant factor of not knowing when to start melting has prevented wide use of this method. Electronic sleet detection and improved weather forecasting gave new impetus to this solution.

Electronic sleet detection depends on the effect of conductor ice on carrier attenuation. It functions by measuring the relative values of received carrier relay signals under sleet as compared with normal line conditions. Sleet readings provide information on two things:

(a) The approximate amount of ice formation based on a comparison with normal sleet readings and previous recorded experience.
(b) The equally important factor of the rate at which the accumulation is taking place, or a "progress" report.

Sleet detection

If ice is forming rapidly, the system supervisor may elect to melt immediately, while if ice is forming slowly and the sleet curve levels off, he may elect to ride the storm out, depending of course on weather conditions to windward, wind velocities, and system conditions. The sleet readings are always interpreted only in conjunction with other weather information. Fig. 10 shows a record of carrier reception taken during a sleet storm.

A simple and practical method of melting ice from 132,000-volt lines consists of isolating one circuit of a double-circuit line for a distance of 100 to 150 miles from a generating plant and placing a three-phase short circuit on it after which it is closed in at full line voltage. Due to the reactance of, for example, 133 miles of typical line the short-circuit current is limited to 625 amperes, representing about 140,000 kva. Twenty minutes to half an hour is required to melt the ice before this circuit is placed back in service to carry the load, while the second circuit is melted.

Public address systems

Public address systems are finding increased favor for communication within power plants not only because of their speed and flexibility but because all points are automatically kept informed of what is happening during emergencies. The first installation was made in the generating plant at Twin Branch shown in part in Fig. 11. The layout includes 11 stations and 19 speakers in the control switchboard room, the turbine floor, boiler control board, burner deck, condenser pit, pump, and condensate panels.

Noise levels at certain points in a power plant may be so high that normal conversation is impossible, yet it may be necessary to make

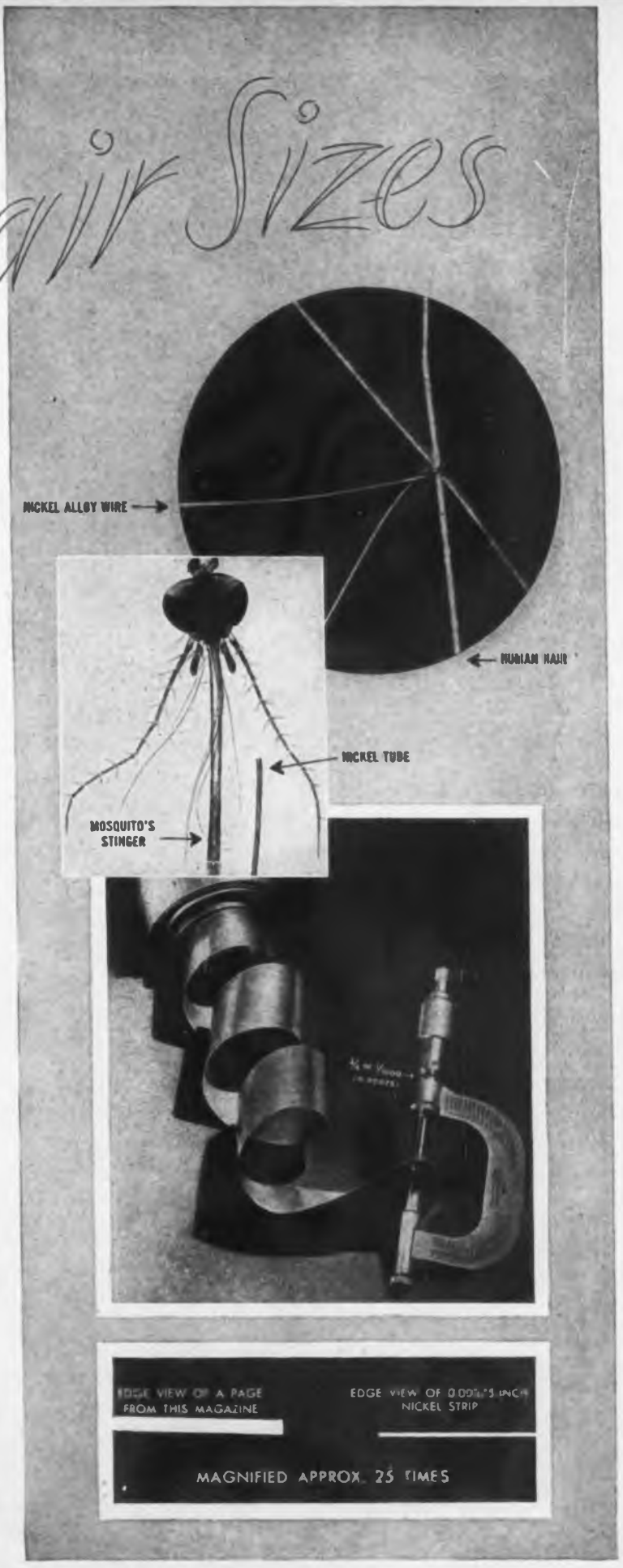
They wanted wire, tube and sheet in Split-Hair Sizes

...and found the strong, corrosion-resistant metals they sought among the INCO Nickel Alloys

Are you looking for metals in ultra-fine sizes for essential applications today...or for your new products after the war?

Do you want...in addition to the split-hair size ...metals with strength, toughness and high resistance to corrosion?

Then take a look at these examples of how INCO Nickel Alloys can be produced in practically any form or size you may want for applications that need a rustless corrosion-resisting material with high mechanical properties...



THE WIRE shown in the magnified photo above knotted around two strands of human hair is 0.0009" thick. A pound would stretch 80 miles. It is a regular commercial product of the Driver-Harris Co.

THE TUBING, smallest ever drawn, is compared with a mosquito's stinger. Outside diameter of this nickel tube is 0.0019"; inside diameter, 0.0004". Superior Tube Company produces commercial tubing in INCO Nickel Alloys as small as 0.010", outside diameter.

THE STRIP is .00075" thick . . . one-third the thickness of this page. It would take more than 1300 strips to equal an inch. This nickel strip is made by Somers Brass Company for regular commercial use.

In addition to their group properties of high strength, toughness and corrosion resistance, individual INCO Nickel Alloys have *specialized* properties for applications requiring high-temperature strength, special hardness, resilience, etc.

"Tremendous Trifles" a booklet which discusses the properties, sizes and forms of 8 INCO Nickel Alloys will be sent to you on request. Please give Company, Name and Title. Address:

THE INTERNATIONAL NICKEL COMPANY INC.
67 Wall Street, New York 5, N. Y.

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL
"KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
Sheet... Strip... Rod... Tubing... Wire... Castings

emergency adjustments or repairs at these points. With a properly designed public address system using directional speakers, operators or maintenance men can intercommunicate without waste of time or wig-wagging.

Vacuum tubes in automatic synchronizers (Fig. 12) reduce the burden on the sychronizing source from about 100 to 7.5 volt-amperes. Consequently, inexpensive bushing potential devices can be used instead of the high-voltage instrument potential transformers otherwise necessary. Only two low-power vacuum tubes are used in a measuring circuit which compares the voltages and phasing of the two systems being synchronized. The automatic synchronizer closes the two systems together:

(a) Only if the frequency difference is not too great;

(b) When the systems are coming into step, not going out;

(c) In advance of true synchronism depending on the rate at which the two systems are coming into step.

Such accurate synchronizing, which causes a minimum of disturbance to the two systems, cannot be attained consistently by manual methods.

Time standards

Time standards and a standard 60-cycle frequency are two elements being used for the automatic regulation of a number of interconnected power plants which may be separated by hundreds of miles. The frequency and time standards at all such plants must be highly accurate in order that the regulating mechanisms be properly coordinated. Plants where regulating mechanisms take frequency and "accumulated time error" into account require accurate standards of frequency and time.

Pendulum-type master clocks having an error of about one part in 200,000 have proved inadequate, even when checked and adjusted frequently against naval observatory time by radio time signals. Electronic frequency standards, such as used in radio laboratories and accurate to within 5 parts in 10,000,000, have proved satisfactory as a combination frequency and time standard.

A typical arrangement located at a large plant consists of a 60-kc temperature-controlled quartz-bar oscillator, multi-vibrators, 1,000-cycle clock, and 15-watt amplifier providing frequency-controlled 60-cycle output suitable for driving automatic generator controls and time error indicators.

In operation, daily checks are made against time signals using a

fixed tuned receiver. Based on these daily checks, manual corrections are made as often as required in the accumulated time setting as well as in the frequency adjustment of the standard itself. Maximum drift per day is held to about .04 seconds which is of the same order of magnitude as the deviation of time signals according to the corrections which are issued monthly by the Naval Observatory.

When two or more heavy load centers are interconnected, steps usually are necessary to insure the stability of the interconnected system. As a system approaches instability any system disturbance may cause energy to surge back and forth over the tie lines a number of times before reaching stability, and thus the maximum safe load carrying capacity is reduced. System stability may be improved if the automatic regulators controlling the synchronous condensers and generators respond quickly to voltage changes.

Electronic regulators and electronic exciters not only produce finer regulation normally but also respond more quickly during system disturbances. The response speed using an all electronic exciter is dependent only upon the inductance of the main field of the machine and the amount of voltage applied to it; with an electronic regulator, which controls the field of an auxiliary rotating exciter, the response time of the exciter field must be added; while in a mechanical regulator the inertia of moving contacts causes a further delay. However, the type of regulator chosen depends on a study of the particular location and system requirements.

A number of electronic exciters and regulators have proven themselves on the A.G.&E.Co. system for regulation of major rotating equipment. The all electronic exciter shown in Fig. 13, rated 777 amperes continuous (1500 amperes for one minute) provides field excitation for a 30,000 kva synchronous condenser having a field resistance of .21 ohms. The exciter output is obtained in a six-phase grid controlled rectifier using six 200 amp. ignitrons, Type FG-233-A. The firing of the ignitrons is controlled by six Type FG-172 thyratrons, which in turn are controlled by a vacuum-tube regulator.

Electronic regulators, which at present are more widely used than electronic exciters, normally use 12 or more tubes in a regulating circuit in which, for example, the output a pair of 6L6 tubes, controls an amplidyne generator, a small rotating machine in which an input of milliamperes controls an output of amperes. This in turn controls the field of the usual rotating exciter supplying field excitation to the power generator or synchronous condenser.

Another similar type of regulator uses FG-172 thyratrons to supply the field of the regular exciter. There are also, of course, a number of types of non-electronic regulators in common use depending on the characteristics desired in a particular installation.

Among other important applications used by electric utilities are:

(a) Mercury arc rectifiers and arc lights (which antedate radio)
(b) High-voltage cathode ray oscillographs for lightning studies.
(c) Power rectifiers and converters
(d) Regulated electronic battery chargers
(e) Closely regulated power supplied for testing
(f) High-voltage rectifiers and high frequency oscillators for breakdown testing
(g) Smoke precipitators
(h) Electronic timers
(i) Shaft eccentricity and bearing vibration recorders
(j) Intrusion alarms
(k) Fault locators
(l) Electronic motor controls
(m) Measuring instruments

MAGNETIC WIRE RECORDER

(*Continued from page* 118)

Overall response curve 50A recorder and reproducer operating at the low speed

Equalization curve for 50A recorder and reproducer amplifier

tively high frequency voltage at about 30,000 cycles. This completely demagnetizes the wire as it passes through and away from the field of this coil, much as a jeweler demagnetizes a watch.

Any magnetic recording system which used just the fundamental elements would give poor quality, due to the fact that the magnetization curve for iron is not straight,

WASHINGTON

Latest Electronic News Developments Summarized
by *Electronic Industries'* Washington Bureau

STUDY RADIO ELECTRONICS CONVERSION PLANS—The formulation of the reconversion program for industry was slated as one of the major tasks to be tackled by President Roosevelt after his return from the Cairo and Teheran conferences. The likelihood was that WPB would be the key governmental agency to supervise this work and WPB Chairman Donald M. Nelson would be at the helm. The radio and electronics manufacturing industry, which has to keep its nose to the grindstone of unprecedented war production, has to pretty well forget about reconversion problems for the moment in "sawing wood" on its production schedules for the Army and Navy. But most authoritative governmental leaders express the view to "Electronics Industries" that a plan of reconversion will be evolved in the next few months which should be acceptable to the industry and should mean an orderly transition from war production to normal peacetime operations. It was stressed that the industry converted in good order for war activities and, since it is now fairly well integrated because of its experience in war production, the return to peacetime operations should be made in the same orderly fashion.

PROBLEM OF EXCESS CRITICAL COMPONENTS—Because of the threat of future component bottlenecks in the radio-electronics production program, the WPB Radio and Radar Division has established a Joint Component Control Committee which will endeavor to utilize idle and excess inventories of critical components in prime contractors' stocks and redistribute them into the production stream. The accumulation of these surplus stocks of critical components has been due largely to contract cancellations, terminations, engineering changes and other uncontrollable reasons resulting from redesigning of outmoded communications equipment, together with cutbacks and over-ordering. The contractors and Army and Navy warehouses are being asked to submit complete inventory reports of idle and excess component stocks to the WPB Division which is going to prepare lists to be circulated to all prime and subcontractors and component manufacturers. In charge of the Component Control Committee's activities is Wesley L. Smith, who was the administrative officer for the past two years of the ANEPA Production Expediting Branch.

POSTWAR PLANNING—The program for the inventory and control of excess critical components, initiated by WPB Radio and Radar Division Director Ray C. Ellis, has considerable advantageous possibilities in postwar planning. It will mean that the excess components, which are known to exist in practically every producer's plant, will be put back into production circulation and thus, when the war ends, these surplus materials will not remain a threat to be "dumped" on the market and to hinder the return of component manufacturers to peacetime operations. To permit the transfer of these idle inventories to other prime contractors and in the case of critical components in outmoded equipment which would need redesigning and restamping by component manufacturers, a financing program through the RFC Defense Supplies Corporation is being considered. The component control will be operated through a small WPB committee set-up in Washington on which Army and Navy representatives would serve. The handling of the inventory transfers with manufacturers is to be decentralized and operated through the Division's field offices.

FUTURE OF RADIO-ELECTRONICS—Congress—at least its Senate Interstate Commerce Committee which handles radio legislation on that side of the Capitol—has received a good education in the future of the radio-electronics industry from a number of leading engineers in the field and topmost government technical experts. From these outstanding radio engineers the Senate Committee learned that frequency modulation, television, facsimile and electronics services are going to plan a tremendous role in the postwar life of the United States. The FCC will also have its work cut out in the postwar era both in its formulation of the new allocations in the spectrum in cooperation with the other government departments and industry and in tremendously increased regulatory duties over the new forms of broadcasting and communications, particularly in aviation radio, and over the non-communication electronic devices to prevent interference with the so-called public radio services.

TRIBUTE TO RADIO-ELECTRONIC MANUFACTURERS—A most glowing tribute to the vital role of radio-electronic communications in the war was paid in a recent address before a Washington gathering by Major General James A. Code, Jr., Assistant Chief Signal Officer, on behalf of Major General H. C. Ingles, Chief Signal Officer of the Army, who lauded the "American manufacturers whose brains and ingenuity have made possible the excellent performance of signal equipment in all Theatres of Operation." General Code stated that "it is no boast for me to say that our signal equipment is far in a way the finest in the world—the most modern in design and precision and the best in ruggedness and performance. But, it would not be so without the magnificent cooperation, great skill and untiring efforts of our associates and co-workers of industry. Not only have they produced this equipment in enormous quantities, but production schedules have been generally well maintained." Great offensives are pending and communications will play an important part in every battle because the fighting efficiency of our soldiers depends heavily on adequate signal communications. General Code emphasized that delivery schedules by manufacturers must be met, and even surpassed, if we are to outfight the enemy.

TRIBUTE FROM Motorola Radio

to the Men of the U. S. Army Signal Corps

It is no secret that our armed forces have the finest communications equipment in the world. What is even more important is the fact that this equipment—"the eyes and ears" of our fighting men—is in the hands of that even finer product of American Democracy . . . the men of the U. S. Army Signal Corps. *To them from Motorola Radio—a speedy Victory and a quick safe return!*

AFTER THE WAR . . . For the Signal Corps, Motorola Electronic Engineers pioneered in the development of the famous Guidon Set, the new Walkie-Talkie and the highly effective Handie Talkie—portable two-way communications systems. When Victory signals resumption of Civilian Radio production Motorola Engineers will add to their impressive list of "Firsts" in the development and production of Special Electronic devices and 2-Way F-M Communications Equipment.

Expect Big Things from Motorola—*THEY'RE IN THE MAKING!*

For the continued development and production of Radio Communications and other special Electronic equipment for our Armed Forces, the Motorola organization has been awarded two stars for their Army-Navy "E" Flag. Motorola is proud of the part it has been privileged to play in the speeding of Victory.

ARMY (E) NAVY

Motorola RADIO
FOR HOME & CAR
GALVIN MFG. CORPORATION · CHICAGO, ILLINOIS

but has considerable curvature near the origin. Recording on this type of a characteristic would have the same effect as amplifying on the curved portion of a vacuum tube amplifier characteristic.

Previous magnetic recording systems have overcome this difficulty by utilizing, not this portion of the B-H curve, but the portion of the hysteresis loop shown between "a" and "b" of the curve. This, of course, was done by first saturating the wire or tape with a dc field to point "C", then removing the field which carries the medium to condition "d", then applying a bias which takes it down to "e", and then recording about this bias, as shown. All these functions were contained in a single recording head.

After recording (after the wire or tape has passed beyond the influence of the recording field), the wire or tape is no longer in the conditions represented by a, e, and b, but rather is in the conditions represented by a_r, e_r, and b_r. It has been found that if the curve is straight between a, e, and b, that but a small amount of distortion will result due to this counter magnetization.

Principle of operation

In the General Electric wire recorder, this principle is not utilized, but instead a principle developed by Marvin Camras, of the Armour Research Foundation at the Illinois Institute of Technology is used. In this method none of these dc fields are used, but instead an equivalent result is obtained by mixing some of the same high frequency voltage which is used in the erase coil with the audio voltage in the recording head. By referring to the schematic it can be seen that both voltages are impressed simultaneously on the recording head.

Using a system such as this, the retained magnetism, B_r, plotted against H appears as shown in the curve. This is a straight line for a considerable portion of its characteristic. Consequently excellent recordings having low distortion can be made.

The reasons as to why this characteristic is so straight have never been adequately explained. Suffice it to say that the action of the high frequency excitation on the molecular magnetic particles seems to "jar" them loose sufficiently so that they no longer exhibit their reluctance to start lined up in a fixed direction. In other words, their reluctance, which may be likened to inertia, having been overcome, they line up in direct proportion to the audio magnetizing force, or in other words B becomes proportional to H.

Referring to the illustration of the complete machine there may be seen "fingers" or wire guides near each spool. These guides are attached to shafts which are mechanically connected to a level wind screw geared to the drive motor. These guides lay the wire down on the spools in uniform layers. The winding traverse is 50 turns per inch.

Mechanical construction

As shown in the interior view of the machine, all the drive mechanism is in the upper half, while the amplifier and electronic circuits are located on a chassis at the bottom. The two relays which may be seen operate brakes which serve to stop the rotation of the spools whenever the wire is stopped. This is to prevent the wire from becoming loose when the motor is stopped or reversed.

The two pulleys at the left have two steps. With this arrangement, the speed of the wire may be doubled if desired. This results in a better fidelity curve but, of course, reduces the length of recording on one spool to about a half hour. A response curve for the low speed is shown.

Referring to the schematic diagram, it can be seen that the amplifier is merely a straight-forward audio amplifier having three stages of amplification. The same amplifier is used for recording and for playback, all necessary circuit switching being accomplished with a single switch. J102 is the microphone jack which connects to the grid of V101. J101 is so connected that it provides a high impedance input, thus allowing the use of either a crystal or dynamic microphone.

The first tube, V101, is cathode biased. This first stage is a resistance coupled amplifier (C103, R104) which feeds into the grid of V102. The input of this second stage is varied by the use of the potentiometer, R115. The first stage audio input point requires about 0.25 volts for proper operation. This is a convenient point to connect the out-

Newest version of magnetic wire recorder in use

utah V-NEWS

RADIO INDUSTRY NOW PRODUCES FOR WAR—BUT PLANS FOR PEACE

UTAH EMPLOYEES BREAK PRODUCTION RECORDS FOR UNCLE SAM

FRED R. TUERK

Month by month, production records have been broken as Utah has gone "all out" for Uncle Sam, according to Fred R. Tuerk, President.

He points out that experience gained during the war period will be ably utilized in efficient peacetime production.

With emphasis on quality, the dependability of Utah parts, long a by-word in the radio and sound equipment industries, will be maintained.

YOU ARE PART OF UTAH'S POSTWAR PLANS

ODEN F. JESTER

"We're working for Victory and planning for peace now," stated Oden F. Jester, Vice-President in Charge of Sales of the Utah Radio Products Company, when queried recently on Utah's postwar plans. "Our experts are hard at work, developing plans for the future—plans that take utmost consideration of the needs of industrial concerns. Better products are on the way. In the Utah laboratory rapid strides have been made in adapting new electronic and radio developments for war uses—and making them available for the requirements of tomorrow."

CARTER DIVISION IN FULL SWING FOR WAR PRODUCTION— AND POSTWAR PLANNING

FRANK E. ELLITHORPE

Frank E. Ellithorpe, Sales Manager of the Carter Division of the Utah Radio Products Company, declared in a recent interview that Utah Jacks, Switches, Vitreous Enameled Resistors, Plugs, Wirewound Controls and other Utah-Carter parts are seeing service on wide fronts—in the air, on the sea and on the ground. They are playing an important part in adapting the new electronic and radio developments—in making them militarily and commercially usable.

Mr. Ellithorpe went on to state that Utah-Carter parts are proving that the engineering which created them and the manufacturing methods which are turning them out in ever-increasing quantities are worthy of the fighting men who depend on those parts. This same engineering staff and these same manufacturing facilities, Mr. Ellithorpe went on to say, will be converted to the development and production of the Utah products to meet the demands of industry for "tomorrow."

WAR DEVELOPMENTS AND THEIR PEACETIME MARKETS

The war has speeded discoveries and improvements in many fields, said W. A. Ellmore, Vice-President in Charge of Engineering of the Utah Radio Products Co. "Nowhere," he went on, "has this been more true than in the radio and communications fields. Today, electrical and electronic miracles are enlisted in the armed forces—but tomorrow they will be at the service of peacetime America." Mr. Ellmore further pointed out that because of the wartime research and improvements now going on at Utah, there will be greater enjoyment and convenience in the American home—greater efficiency in the American factory.

W. A. ELLMORE

UTAH RADIO PRODUCTS CO., 850 Orleans St., Chicago; Ill.

put of an amplifier or radio. R115 is the volume control for both input jacks.

The second stage amplifier tube, V102, is also cathode biased, and its output feeds the third stage through C107, R108, C106, and R116 which form a low-pass filter across the output of the second stage to serve as a tone compensator. Resistor, R116, is the variable element in this filter and determines the point of filter cut-off, and hence forms the tone control.

External speaker

The third (output) stage, V103, is cathode biased and has a transformer output which matches the speaker voice coil. There is also an output jack, J103, into which an external speaker or headphones may be plugged. If this is done, the jack automatically disconnects the speaker that is in the unit. The switch, S102, connects the internal speaker in the circuit only when it is in the "Listen" position. In the "Record" position of switch, S102, the audio output is connected through the audio equalizing network to the recording head, L104. This equalizing network, composed of C114, C115, R119, R120, R121, R122, R123, L102, and L103, gives a rising voltage versus frequency characteristic at the recording head. If this were not done, the current in the recording head coil, and thus the magnetizing flux, would decrease with the frequency, since the impedance increases. This would cause a serious loss in high frequency response. There are other reasons, also, why this compensation is needed. The equalization used is approximately 51 db from 200 to 3000 cycles. The equalization curve is illustrated. A secondary winding on T103 is connected in series between the equalizing network and the recording head. This winding is coupled to the high frequency oscillator circuit described previously.

When the "Record-Listen" switch is tuned to "Listen" for play-back purposes, the head is connected to the first stage as shown. Also, under this condition, the internal speaker is in the circuit.

Oscillator function

The high frequency oscillator, V104, operates at approximately 30 kc. This oscillator operates only when S102 is in the "Record" position. The oscillator tube is a type 6 V6GT, operated in a conventional Hartley circuit. One secondary winding is coupled to the recording head, and the other winding to the erase coil, L106. Approximately 30 volts are applied to the recording head, and 5.5 volts to the erase coil. The rectifier tube, V105, a 5W4GT, is connected in a conventional full-wave rectifier circuit. The dc voltage developed at the filter input is 270 volts.

The neon light, 1103, is used as a volume level indicator for recording. Audio voltage plus a dc biasing voltage is fed to the light through R118, C113, and R117. R117 is adjusted so that the light just flashes on the peaks of the audio when recording at the proper level. K101 and K102 are relays which operate the brakes on the wire spools. When the motor switch, S103, is thrown to forward or reverse, these relays are energized in turn release the brake shoes and close the motor circuit.

In case of breakage the recording wire may be tied in a knot. This is useful in case it is desired to "dub in" on the recording. This can be done by simply annealing the two ends with a match, soldering iron, or cigarette, and tying a simple square knot or seamstress' knot.

In conclusion it may be stated that this machine is entirely adequate for speech, even at the low speed, and fairly satisfactory for music at the high speed. With more refinements there is no fundamental reason why this machine cannot be made equally as good or better than the best recorders available today.

SELENIUM RECTIFIERS

(*Continued from page* 111)

Selenium rectifiers can be compared to transformers or to storage cells, in electrical flexibility. Not only individual stacks, but complete units can be connected in parallel or series as desired. Again, this simple fact is the root of a group of practical advantages:

A large installation may be divided into units of practical size to facilitate handling, and as a final step the individual units may be caster-mounted, which simplifies installation to the ultimate.

Initial installations may be expanded in capacity at any time, by adding on similar units in parallel.

Units may be shifted about to accommodate load requirements in revised plant layouts. This is analagous to the flexibility of individually motorized tools in a modern machine shop.

Flexibility in units

The flexibility principle is applicable also to individual equipments. For example, the equipment in Fig. 3 was developed to provide the electroplating and anodizing field with a universal power supply source. In electrolytic finishing a fairly wide range of dc voltage is required, depending upon the process: Tank plating, 1-6 volts; Barrel plating, and some types of chrome plating, 6-12

TAYLOR TALENT

ARC CHAMBER PARTITION

The orthodox way to manufacture the arc chamber partition, shown above in actual size, is to slice it from a rectangular, vulcanized fibre tube. Taylor forms it from a sheet—at a great saving in cost. Whatever your problem may be, if you think Laminated Plastics might help you to solve it, the smartest move you can make is to Take it to Taylor.

In the production of laminated plastics, the same raw materials are available to all manufacturers. The difference in the quality of the finished product arises out of the skill, the know-how, the talent of the manufacturer. His brains and equipment are the variable factors.

Here at Taylor, in the industry's most modern plant, Vulcanized and Phenol Fibre are made by the Verifibre Process—Taylor's name for quality control. Here, too, skill and inventiveness combine to improve manufacturing processes and simplify production, resulting in better products, more economically produced. The arc chamber partition, illustrated at the left, is a typical example of Taylor talent.

Present restrictions by WPB require that Vulcanized Fibre and Phenol Fibre be sold only under allocation. But if you have a product that's vital to the war, or if you are now doing post-war planning, our engineers will be glad to discuss your problems with you and to make specific recommendations.

TAYLOR FIBRE COMPANY

NORRISTOWN, PENNSYLVANIA
OFFICES IN PRINCIPAL CITIES
PACIFIC COAST HEADQUARTERS: 544 S. SAN PEDRO ST., LOS ANGELES

LAMINATED PLASTICS: VULCANIZED FIBRE • PHENOL FIBRE
SHEETS, RODS, TUBES, AND FABRICATED PARTS

Selenium Rectifiers Application Considerations

1. Wherever required dc voltages are low (up to approximately 100 volts), or wherever currents are high (over 25 amperes), selenium rectifiers should be seriously considered. When the combination of both low voltage and high currents occurs, the selenium rectifier must be considered.

2. Wherever the ac to dc conversion device should ideally be as static in operation as a transformer, the selenium rectifier is in the picture. The typically static features are: No moving parts, silence, independence of position, vibration, shock, altitude, etc.

3. Wherever minimum maintenance and freedom from replacement is essential, selenium rectifiers should be compared to alternative sources of dc.

4. Where minimum size and weight is important the selenium rectifier may be the best selection. This depends chiefly upon the ratio of current to voltage, and the higher this ratio the greater is the likelihood of the selenium rectifier proving to be be optimum choice.

volts; Sulphuric acid anodizing, 12-24 volts; Chromic acid anodizing, 0-48 volts.

The basic power supply unit illustrated incorporates eight separate rectifier sections, each rated at 6 volts 500 amperes. These sections may each be used individually (connected to different tanks), or may be used in parallel or series groups, to obtain any of the typical voltages listed. The combinations run into several hundred, but all groups are multiples of 6 volts up to a maximum of 48 volts.

Control and supervision is provided by separate control units, designed to suit the particular layout. Changes in layout may require modification of the control unit, or at most the purchase of a new control unit at a fraction of the cost of a complete new power supply source.

Maintenance and protection

Since there are no moving parts, the selenium rectifier itself requires no more maintenance or attention than the associated transformer. Maintenance is reduced to such minima as the lubrication of cooling fans if any, the replacement of supervisory lamps, and ultimately of such associated components as contacts on relays or magnetic switches.

Selenium rectifiers will fail under excessive temperature. Therefore, the key factor in all designs

Continuous Service Rating Data

TYPES 1550-1560-1570-1580-1590

Maximum Current in Amperes — Maximum Ambient Temperature 60° C

Type 1590

TYPE 1590

Catalog Number	10,000 kc.	3000 kc.	1000 kc.	300 kc.	100 kc.	Cap. Mfds.	Test Volts D.C.	Catalog Number	10,000 kc.	3000 kc.	1000 kc.	300 kc.	100 kc.
1590-200	.....	7.	4.5	1.5	.5	.01	8000	1590-217	.....	16.	20.	15.	8.
1590-201	.....	8.5	6.	3.	1.	.01	6000	1590-218	.....	16.	20.	15.	8.
1590-202	.....	6.	4.	2.	.7	.02	5000	1590-219	.....	18.	20.	17.	10.
1590-203	.....	10.	8.5	4.5	1.5	.03	4000	1590-220	.....	18.	20.	18.	12.
1590-204	.....	8.	7.	3.5	1.2	.04	4000	1590-221	.....	18.	23.	20.	12.
1590-205	.....	11.	11.	7.5	2.5	.05	4000	1590-222	.....	18.	25.	22.	12.
1590-206	.....	9.	8.	6.	2.	.05	2000	1590-223	.....	18.	25.	22.	12.
1590-207	.....	12.	14.	10.	5.	.1	2000	1590-224	.....	18.	25.	22.	12.
1590-208	.....	9.	10.	7.	3.	.1	1000	1590-225	.....	18.	25.	22.	12.
1590-209	.....	12.	14.	10.	6.	.2	600	1590-226	.....	18.	25.	22.	12.
1590-210	.....	12.	14.	10.	4.	.25	600	1590-227	.....	18.	25.	22.	12.
1590						.3	600	1590-228	.....	18.	25.	22.	12.
						.4	600	1590-229	.....	18.	25.	22.	12.
						.5	600	1590-230	.....	18.	25.	22.	12.
							600	1590-231	.....	18.	25.	22.	12.
							600	1590-232	.....	18.	25.	22.	12.
							600						12.

Aerovox mica transmitting capacitors are available in the widest range of types, capacities, working voltages. Type here shown is the bakelite-cased 1590 series for medium-duty high-frequency current-handling functions.

Backed by

the most complete CONTINUOUS SERVICE RATING DATA

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is the calculation of temperature rise, and provision of adequate cooling capacity to remove the btu's with celerity. The designer can further safeguard the equipment by incorporating thermostatic warning and automatic shutdown devices, and carefully specifying the load rating in terms of ambient temperature.

Stabilization and life

As previously mentioned, no physical or chemical change takes place with use, hence life is fundamentally unlimited. This has been confirmed, (as nearly as any prognosis involving the term 00 can be confirmed), by extrapolating performance curves from units in use during the last dozen years.

It has been observed that during use both forward and reverse resistance increase. This change ultimately stops, usually during the first five to ten thousand hours of use, after which no further change can be detected. After this the rectifier is completely stabilized.

In practice this change is usually expressed either in terms of a decrease in dc output voltage with fixed input, or as the required incremental increase in ac input to restore the dc voltage to its initial value. In either case the absolute increment is a function of the rectifier load, but in general it will be about 5 to 15 per cent.

The increase in forward resistance will necessarily increase the I^2R losses, and therefore the cooling design must allow for this so that full load current can be obtained at all times.

For equipments incorporating any type of voltage control device the stabilization change can be anticipated by designing the equipment to deliver rated voltage and current after stabilization, or in other words, designing the unit to have a capacity slightly above rated voltage when new.

If output voltage must be held within fixed narrow limits, and the rectifier unit is not equipped with variable voltage controls, it is customary to provide on the transformer one or two taps which may be used to correct for stabilization drop.

Efficiency characteristics

In single-phase rectifiers 65 per cent is a typical efficiency factor. In three-phase rectifiers, efficiencies as high as 85 per cent easily may be attained, but by increasing the loading factor it is possible to decrease cost and size considerably by accepting full load efficiencies of 65-75 per cent.

An interesting and sometimes very useful characteristic, is the load efficiency curve of heavy duty

(Farnsworth television in England 10 years ago!)

LONDON'S famed Crystal Palace was the scene, in 1934,* of the first foreign demonstration of the sensational Farnsworth electronic system of television.

In the years since, electronic television has been brought to an advanced state of technical excellence. It is assured a place as a huge post-war industry . . . *and right in your field.*

For tomorrow's television dealers will come from the ranks of today's radio retailers.

Right now, although our entire production is for war, Farnsworth is preparing your huge future market. Our advertising is directed to your customers, explaining the wonders of television, making people want television sets. For, after Victory is won, home television will come, close on the heels of television equipment for countless commercial, industrial and institutional jobs. And post-war Farnsworth television will have the benefit of our unusual wartime experience.

Farnsworth research for 18 years has pioneered the technical developments of this new art. And Farnsworth research will be of invaluable help to you in the coming age of television.

**Another of a series of advertisements depicting milestones in television's history.*

LOOK FOR the Farnsworth Television advertising in: November 27 *Collier's*, and November 15 and December 13 *Newsweek*.

FARNSWORTH TELEVISION

• Farnsworth Television & Radio Corporation, Fort Wayne 1, Indiana. Farnsworth Radio and Television Transmitters and Receivers; Aircraft Radio Equipment; the Farnsworth Dissector Tube; the Capehart, the Capehart-Panamuse; the Farnsworth Phonograph-Radio.

selenium rectifiers. A typical high current rectifier rated at 65-70 per cent efficiency at full load, will rise to 70-75 per cent at half load, and then drop slowly to 65 per cent at perhaps 10 per cent of full load. In applications where the load varies widely this maintenance of high efficiency can produce substantial economy in power consumption.

Applications

The selenium rectifier, at commercial power frequencies is substantially a pure resistance. In association with properly designed transformers, selenium rectifier units will show power factors of about 0.92 to 0.98.

Interminable lists make dull reading. In any case, many present applications of selenium rectifiers should not be mentioned until after the war. However, we can indicate the potential or actual applications indirectly by summarizing some of the factors discussed on page 214.

SQUARE WAVE MEASUREMENTS

(*Continued from page* 107)

(other than amplitude) one or more of the following things are happening:

(1) The amplitude relationship of the low frequency components to the high frequency components of the original square wave have been changed.

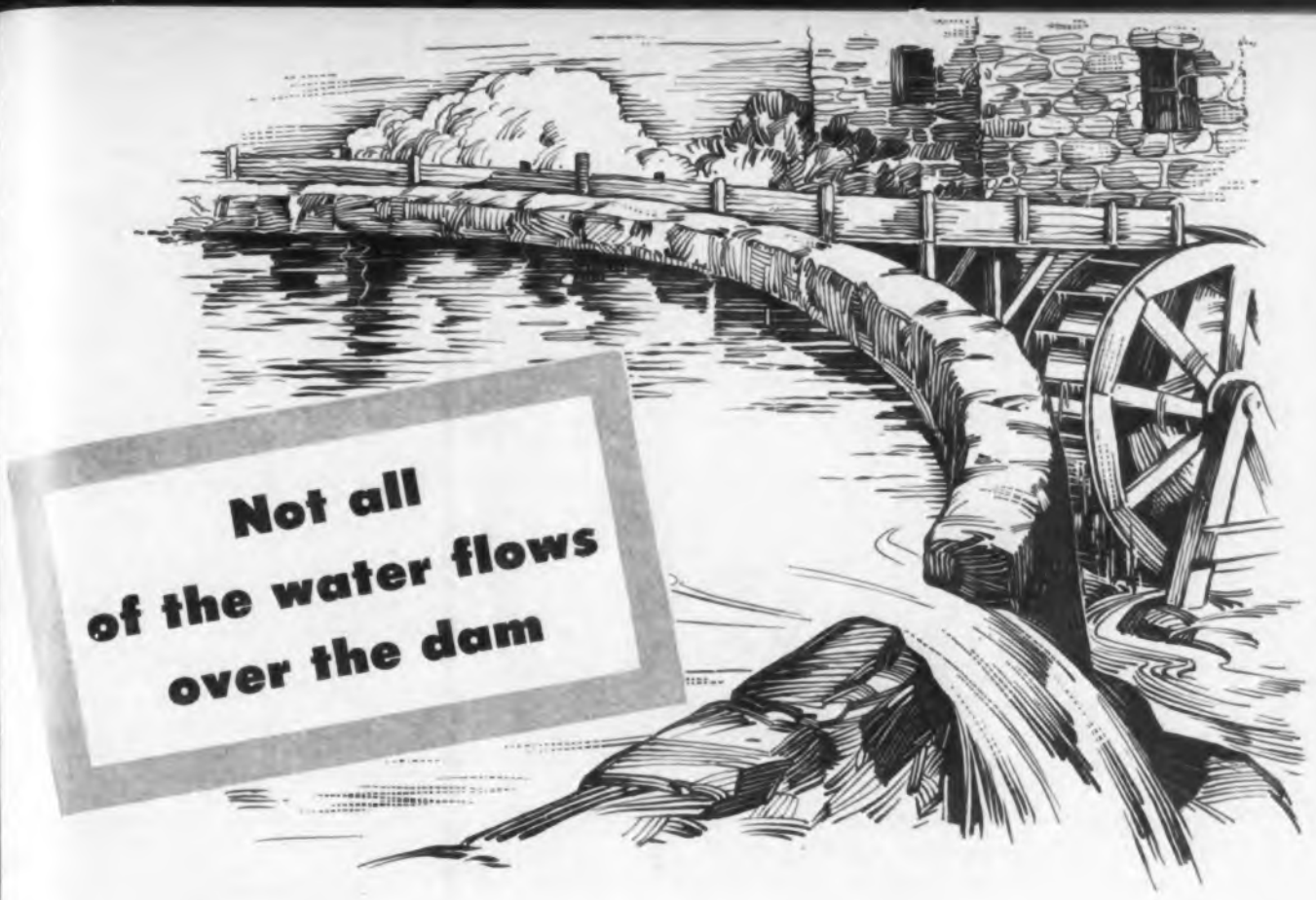
(2) The phase relationships of the low frequency components to the high frequency components of the original square wave have been changed.

In general, both of these effects take place to a greater or lesser degree.

Amplitude falls

If the high frequency components of a square wave are transmitted through the circuit, but the low frequency components are reduced in amplitude and shifted in phase, the pattern as seen on the oscillograph will have the same general steep rise of voltage as the original wave. However, since the low frequencies are attenuated, the horizontal portion of a square wave cannot be maintained and the amplitude of the reproduced wave falls off rapidly during the first half cycle. This is illustrated in the upper of the two oscillograph patterns shown.

A loss of the high frequency components of the square wave produces a slowly rising wave which approaches a sine wave in shape. In general, loss of low frequency



BEFORE it becomes just "water over the dam", every working hour, every problem solved, contributes in some measure to the reservoir of practical knowledge we call experience.

There is a wealth of such experience behind Simpson instruments and testing equipment. Into their making has gone all the knowledge acquired during the more than 30 years which Ray Simpson has devoted to the design and manufacture of electrical instruments—all the experience and know-how of a group of men who have long been associated with him.

The important thing today, of course, is that this enables Simpson to build instruments of proven accuracy and stamina, at a rapid rate. Each one has a full bridge type movement with soft iron pole pieces. For the first time this admittedly finer design has been made a matter of mass production —with all the resulting economies and speed.

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components is due to series capacity reactance, and/or shunt inductive reactance, while the loss of high frequency components is due to series inductive reactance and/or shunt capacity reactance.

As an example of the use of square waves in making measurements, the inductance and stray capacitance of a coil may be found as shown in the circuit diagram. With the circuit connected as (1), the high frequencies will be passed and the lows attenuated and shifted. After the initial rise of voltage (as shown in the upper oscillogram, the decay of voltage is exponential. The exponent of this common equation is $-tR/L$ or $-t/RC$ in case of capacity).

At some fundamental frequency of the exciting square wave, $R=2\pi fL$ (or $R=1/2\pi fc$) and the voltage at the end of the first half cycle will be $E^{-\pi}$ or 4.32 per cent of the initial voltage.

To measure inductance, vary the frequency of the square wave until the amplitude of the end of the half cycle is 4 per cent of the beginning of the half cycle. At this frequency, $L=R/2\pi f$ where R is the resistance value in ohms, and f is the frequency of the square wave.

As an example, with a square wave frequency of 25,000 cycles, and a resistance value of 8,000 ohms, the pattern shown in the upper oscillogram resulted which shows the decay of voltage to approximately 4 per cent. The value of L is $8000 \div 25{,}000 \times 6.28$ or 51 millihenries.

To find the stray capacity of a coil connect as shown in (2) on circuit diagram. The application of a square wave will produce a damped oscillation which appears on the horizontal part of the square wave as shown on the lower oscillogram. In the pattern shown, the coil makes 2.5 cycles during the time for a half-cycle of the square wave. Since the frequency of the square wave in this case was 25,000 cycles, the time for a half-cycle is 1/50,000 second. Therefore, in 1/50,000 second this coil oscillated 2-1/2 cycles or at a frequency of 125,000 cycles. The stray capacity which resonated the coil can then be found from $C=1\div(2\pi f)^2L$.

In the case of this coil, C=32.1 mmfd.

WOUND-CORE TRANSFORMER DESIGN

(*Continued from page* 115)

and the approximate gage of the material used for these ranges. The gage is indicated by the symbol number as tabulated below:

C-97	29 gage
C-94	.007 in. thick
C-98	.003 in. thick (or thinner)

The mechanical features inherent in these cores include ease of

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This is another example of the contribution of Ohmite Rheostats to precision accuracy in a wide variety of applications. Their time-proved design and construction insure permanently smooth, close control. There are ten wattage sizes from 25 to 1000 watts, in straight or tapered winding, in single or tandem units. Ohmite Engineers are glad to assist you on any problem.

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assembly, the variety of mounting which can be used, the readiness with which either core or shell type transformers can be used. A group of the mountings possible is shown in Fig. 6. All these assemblies are shown in skeleton form without terminal boards or containers. In this picture the 1st, 3rd, 5th and 6th assemblies are shown prior to mounting in containers. The other assemblies are open type units minus the terminal board. In none of these arrangements is the axis of the core perpendicular to the floor. This alternative, together with others which will suggest themselves, indicate the adaptability to different types of mountings.

Some of the advantages cited above may be observed by reference to Fig. 7. The transformer on the left is for use at frequencies in the range of 50 to 150 kilocycles. That on the right is for operation at exactly the same voltages and other operating conditions. The transformer at the left was made with thin gage silicon steel stampings while that on the right has a wound Hipersil core. The following advantages accrue from the newer development:

1. The volume of space occupied in the unit is reduced to about two-thirds.

2. Because of the smaller size it is possible to seal the new design hermetically, which was not possible in the older one.

3. The new design has lower losses and hence higher operating efficiency than the older one.

4. The new design is capable of operation over a wider frequency range.

The foregoing illustration is typical, and not merely an isolated instance, of the design improvements possible with Hipersil. Where quality is paramount, where losses must be kept at a minimum, where size and weight must be kept low and where new and difficult performance is necessary, this material aids the designe engineer tremendously.

TELEVISION

(*Continued from page* 122)

Received degree of Ph.D in Physics, University of Cincinnati 1926. Professor of physics and head of Department of Physics Mercer University. Physicist and consulting engineer, Harris Hammond interests, New York. Supervisor, War Research Laboratory University of Florida. Fellow American Physical Society. Fellow Am. Inst. Elec. Engineers. Fellow Am. Assn. for Advancement of Science. Associate IRE.

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Type PRS-9X, 30-40 MC Mobile Receiver with Dust Cover Removed.

Type PTS-22X, 30-40 MC Mobile Transmitter with Dust Cover Removed.

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SERIES 6	Includes Tunable and Multi-Channel Fixed Tuned Receivers for Mobile, Marine or Central Station application.
TYPE 11A	Single Frequency Crystal Controlled Station Receiver for frequency ranges up to 8,000 KC.
TYPE 11X	Crystal Controlled Mobile Receiver, for frequency ranges up to 8,000 KC.
TYPE PTL-10X	Instant Heating 10 Watt Mobile Transmitter, for frequency ranges up to 8,000 KC.
TYPE PTL-22X	Instant Heating 22 Watt Mobile Transmitter for frequency ranges up to 8,000 KC.
TYPE PTS-22X	Instant Heating 22 Watt Mobile Transmitter, range 30-40 MC.
TYPE PR-9X	Crystal Controlled Mobile Receiver, range 30-40 MC.
TYPE PRS-9A	Crystal Controlled Station Receiver, range 30-40 MC.

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and projected on a photosensitive screen, as in a regular Iconoscope, but from there on the system is radical. Each spot on the screen is assigned a frequency, and the light intensity gradations of each are handled simultaneously by continuously modulating a single broadcast carrier.

Analogies are apt to be confusing, but the plan is similar to that of broadcasting an orchestra where hundreds of separate "tones" are handled at the same time, many of which approach 10,000 cycles in frequency at times, but the sum total of which are still within a 10 kc band. If each tone of the audio spectrum is produced by a separate instrument and the orchestra platform is divided up so that the point where each tone originates follows a specific plan, the resulting music, if it could be called that, would indicate at all times the individual activity of the operators producing each tone.

However, in the Craig system, in order not to get involved in second order effects, all frequencies generated are kept within a single octave or less. Except when a motion picture scene is projected, there is no need for breaking up the scene in lines or frames at the transmitter. The projection of a still picture would be a continuous complex "tone" having thousands of components. As certain parts of the scene moved about, some of the components would wax and wane and others previously non-existent would become evident.

Giving specific values, the Craig system might assign 9 million cycles to the upper left hand corner and 11 million cycles to the lower right corner, with a gradual increment, divided as to the two directions, from one corner to the other. Thus every point on the screen would have its own definite frequency assigned to it, by which it can be tagged at all receiving positions, so to speak. In this series 10 million cycles would thus fall at the center of the screen. The output frequency might therefore contain most of the frequencies in the range of 9-11 megacycles.

This frequency could be heterodyned down to the band of 0-2 megacycles by well-known methods, so, the transmitter would then have to transmit a 2 megacycle modulation frequency.

Since, for satisfactory reproduction, there are possibly 250,000 picture elements in a television scene this requires that each receiver have a band-pass filter 8 cycles wide, that works in conjunction with locally developed scanning circuits.

Leaving the transmitter temporarily, we will follow the process

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through the receiver. The incoming signal, which, in the above example, is any selected carrier that will handle a 2 megacycle signal, is first amplified and applied to a mixer. Then, for the first time, scanning must be introduced since it is necessary to move a single cathode-ray spot over a large screen.

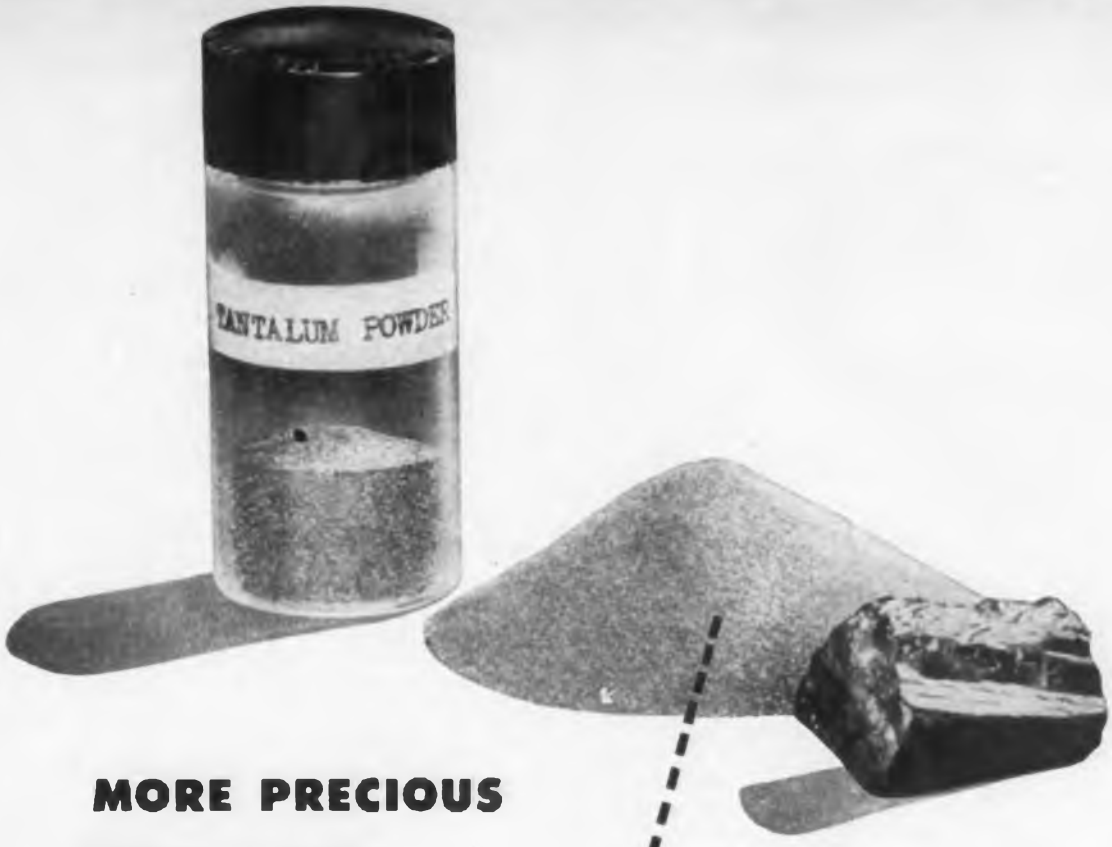
The scanning potentials are not unlike those in any television receiver but they must be correlated in both directions with a variable local-heterodyne oscillator. This oscillator swings through the whole range, say 15, or 30 times a second, or at another selected framing rate, and heterodynes the incoming modulation frequency into the narrow band-pass filter, having an eight cycle pass band. This scanning therefore continuously samples all parts of the modulation range, and as each component of the range is found, it modulates the cathode ray which "happens" to be at the particular part of the picture assigned to that modulation frequency, due to the interlock between the local scanning oscillators and the heterodyning oscillator.

One cycle band pass

There is no theoretical reason why the modulation band has to be 2 mc wide, assuming that means are available to convert parts of a picture to a series of frequencies. It will be evident though that if the band be cut to 250,000 cycles each receiver will have to have a pass band only one cycle wide.

A filter of the quartz crystal type, four cycles wide is already an item of commercial equipment (see "Electronic Industries"—'43 - 5 - 81) and the possibility of practical improvements in this is a matter of conjecture at this time. A method of interlacing in both directions was mentioned by Dr. Craig, which gives the effect of ¼ cycle selectivity with a one-cycle wide band filter. If such proves practicable, a reduction in the band requirements would be about 250,000 elements divided by 4, or around 60,000 cycles. It is on this basis that the band-pass requirements of a television system might prove to be as low as 25 to 60 kc, the values which reached the headlines.

It will be noted that the heart of the receiver is this band-pass filter that samples the amount of each frequency present in the modulated band. A filter that is as sharp as this one has to be, is of necessity of an extremely high Q, and there is a quite formidable problem in getting a crystal to start and stop quickly enough to accomplish its purpose before the scanning spot moves on to another picture element, a matter of about ¼ microsecond later. How the ac-



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Tantalum is one of the earth's rare and unique metals. Rare because it is mined in only a few spots in the world. Unique because it is the only metal that readily absorbs gases.

This ability of tantalum to soak up and retain gases—even while being subjected to intense heat—makes tantalum priceless in the manufacture of electron tubes.

Up until the time Heintz and Kaufman engineers built the first vacuum tubes with tantalum plates and grids, the electronics industry had to rely on chemical "getters" to absorb gases. These chemicals are not stable—the heat from an overloaded plate causes them to release gas suddenly, and the tube goes dead.

One of the reasons you will find so many Gammatrons in use where dependability is essential, is that all Gammatrons have tantalum plates and grids. They can and do take heavy overloads safely—punishment which would cause any other type of tube to cease functioning.

HEINTZ AND KAUFMAN LTD.
SOUTH SAN FRANCISCO • CALIFORNIA, U. S. A.

Gammatron Tubes

complishment of this was effected was not disclosed by Dr. Craig although a multistage filter was mentioned.

The key to the whole system, and the item that will determine the practicability of the whole plan is in the pickup tube, which must accept continuously moving scenes and deliver the whole gamut of frequencies with the unusual characteristics described above. In most respects the details of the tube proposed were not shown by Dr. Craig. Without actual diagrams and photographs of how such a tube would look, it is therefore difficult to describe the basic plan, without resorting to comparisons with known devices.

Gas pickup tube

The pickup screen is a large photosensitive screen of this type where the optical image is projected on the back of the emitting surface, such as has been described by Farnsworth and others. The resulting electron emission exists as a space-charge cloud immediately over the sensitive surface. At frequent intervals this cloud of electrons is caused to move toward the modulation grid by the application of suitable potentials on this grid which momentarily makes it an anode. The whole picture moves down the tube as an ionic sheet again in a manner similar to the electron beam used by Farnsworth in the Dissector tube, although the directing is accomplished by electrostatic means in the Craig tube. There is one great difference here though, the latter tube having this gaseous atmosphere, the electrons immediately produce ionization and it is the cloud of ions that bursts forth and moves as a whole along the tube. It is stated that they likewise are focusable and that their combined effect simulates a slow moving electron beam. In order to accomplish this the following electrodes are successively more negative.

The main reason for using ions is their slower speed and their comparatively leisure movement along the tube. Their path takes them through several parallel grids, perforated with enough holes to handle all of the picture elements in a scene, all holes being accurately aligned with respective holes in other grids. The first few grids are for focusing and the last three are the collector plates.

The focusing grids are in parallel planes so placed as to give a potential gradient that will give the gas ions a definite velocity of drift, and keep them focused in a straight line stream corresponding to each elementary area. Any secondary ions formed will acquire this same drift velocity. The pickup plates, also perforated, are arranged with holes aligned with respective holes in the focusing grids. They are, however, in non-parallel relation with respect to the anode and the focusing grids. The potential gradient between all grids and plates is such that the same velocity will be maintained throughout the travel. The tube is filled with a suitable ionizable gas or a small quantity of mercury vapor to produce a gaseous atmosphere within the tube.

Since all holes in grids and pickup plates correspond to the number and arrangement of the elementary picture areas selected for the system, these perforations would be of relatively small size by comparison with the effective image area.

The perforated pickup plates 8, 9, 10, in Fig. 1, formed of suitable insulating material such as glass, mica, or the like, are of step-like construction, so that the ionic sheet reaches the holes in the plates at successive intervals of time.

Pickup loops

Around each hole in these latter plates is attached one of a series of pickup loops, obtained by stamping out of thin permalloy a grid structure (Fig. 2) by means of a die, an extremely thin film of permalloy in the order of one-thousandth of an inch. This permalloy grid is then insulated with an extremely thin film of enamel, or similar insulating material, and then the equivalent of turns of wire around portions of the permalloy pickup loops is obtained by electro-plating a metallic deposit on both sides of the permalloy configuration. This electro-plated arrangement is shown in the inset in the figure.

This electro-plated equivalent of turns of wire can be put on by etching both sides of the permalloy structure with a conductor such as graphite which has been covered in all parts not desired to be electroplated by means of a very thin film of insulating material, then electroplating exposed portions on both sides, making sure that the edges are electrically continuous to form the electrical equivalent of turns of wire. Thus, we have what is equivalent to a magnetic core, through apertures of which the ions pass, this core being wound with turns of wire for pickup purposes, so that if a "burst" of electrons or ions passes through one of the apertures, it will induce in the permalloy a magnetix flux and this flux will induce an emf in the coil wound around the permalloy core. The loops of every third aperture are connected in series and are in turn connected to the amplifier as in Fig. 1.

Grid 3 is controlled in potential with respect to cathode LSC to cause the grid potential to become

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alternately positive and then negative with respect to the cathode. The potential of grid 3 is changed from negative to positive at periodic intervals, say 10 megacycles, to produce the "bursts" or clouds of electrons passing from cathode LSC through the apertures in grid 3 at spaced time intervals.

Operation of the arrangement shown in Fig. 1 is as follows: during the time intervals when grid 3 is negative with respect to cathode LSC, no electrons pass through the grid 3 and the tube is inoperative. During the very short "peaked" intervals when grid 3 becomes positive with respect to the cathode, electron streams pass through the apertures in grid 3, and the quantity of electrons in each stream is dependent upon the degree of illumination of the image areas on the cathode directly in line with the respective apertures in grid 3. It will be understood that the positive potential on grid 3 accelerates the electrons towards the grid and the momentum acquired by the electrons carries them through the apertures of the grid and into the space between grids 3 and 4 where they strike the gas atoms and ionize the gas by bombardment.

With a fixed speed of travel of the ions, each ion stream passing through the aligned apertures in these plates will generate a voltage wave in the input circuit of the modulator having a frequency depending upon the distance between corresponding holes in the pickup plates. Thus, a burst of ions passing through the aperture at the left end of the plates 8, 9, 10, will produce a wave having a frequency located at one limit of the frequency band of the transmitter, while a burst of ions passing through the aperture at the right end of plates 8, 9, 10 will produce a wave having a frequency located at the other limit of the frequency band of the transmitter.

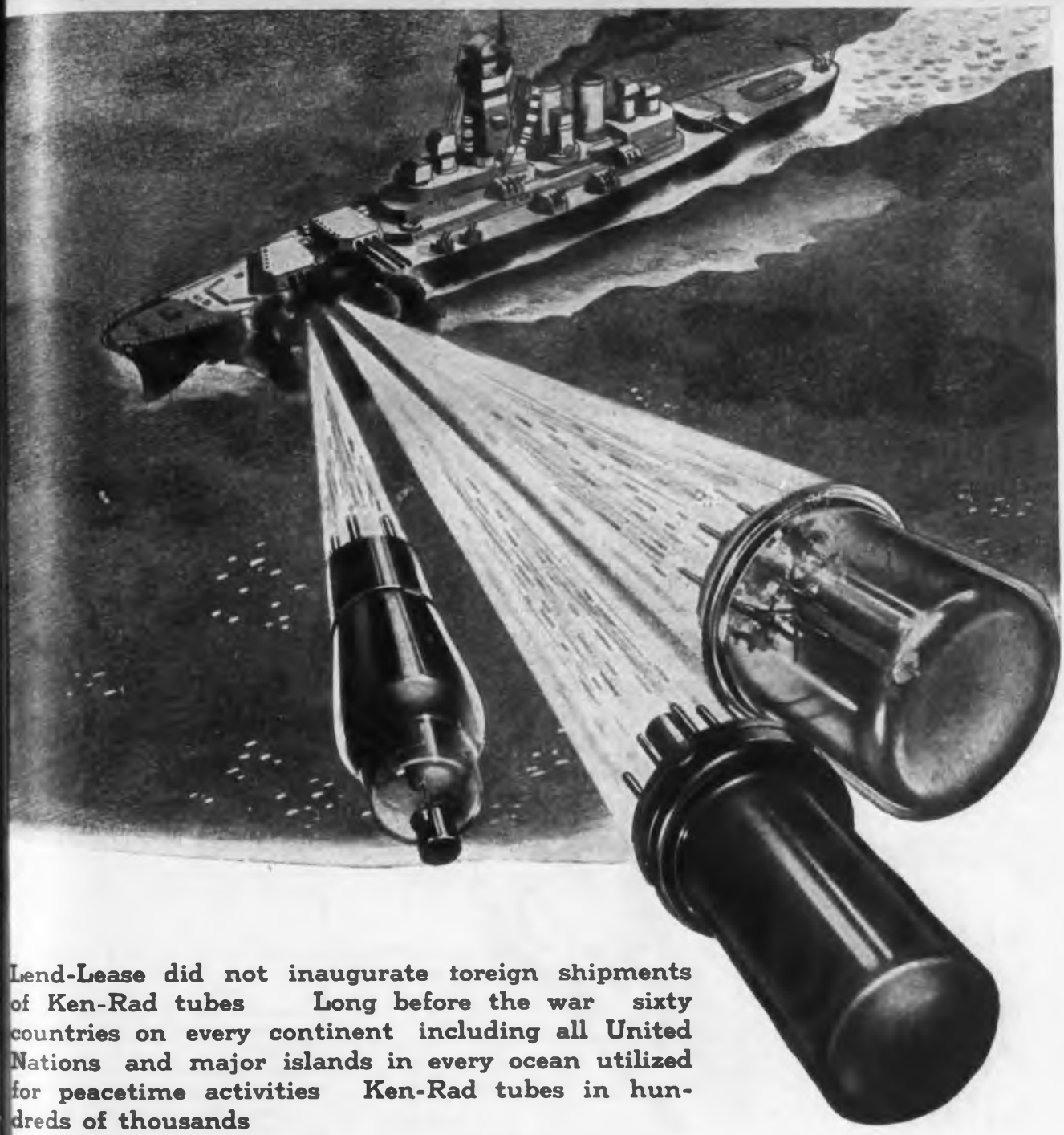
It may be evident that the receiver is complicated with a filter of rather extreme requirements, although the exact status of the problem can be found only by continued research. The need for amplification circuits with relatively modest band width requirements is of interest. The transmitter problem is mainly concerned with the pickup tube, and here again complications are evident.

RESISTANCE WELDING

(*Continued from page* 99)

about 30 deg. rise in the solenoid winding, a performance which makes it entirely practical to apply such a system to roll spot equipment or other high speed welding.

In the air pressure mechanism itself, it was desirable to maintain the anti-friction features already



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existing in single pressure machines, and to obtain a construction which had a minimum volume to be exhausted in order that we could obtain the required rapid exhaust. This result was achieved by using the so-called "double bellows air-lock," which is illustrated. It is between the main operating cylinder and the column which carries the welding electrodes. The sectional view of the double bellows system shows the relative position of the upper bellows O, the lower bellows N, and the exhaust valve when the column is in up position corresponding to the welding tips being separated. Note that valve V is closed, both bellows are filled with air in such a way that the force exerted by air in bellows O is in a downward direction on plate X, while the force exerted by air in bellows N on the plate X is in upward direction. The net force on the plate X is difference between the two and this force is applied against the bellows housing shoulder which can be seen at the point where the rod W runs into threaded hole in plate X.

Solenoid operation

Upon operation of the overhead air cylinder, the entire unit moves downward with the column until the downward motion is arrested by the welding tips coming in contact, at which point the plate X ceases its downward motion, since it is rigidly connected to the column through the rods W. The bellows housing continues down, so that the net force on plate X has now been transferred from the shoulder of the housing to the column, and hence to the welding tips. At this point, contact is established between the pin P and bar L, also bar R, which initiates the welding current.

From a manufacturing point of view, the final adjustment or calibration of this equipment must be made by some sort of adjustment at final inspection on each unit. There is under development a special type of equipment which will measure this same interval, giving a rapid and direct reading on an instrument without the need for a recording oscillograph. Final measurements of overall accuracy of the equipment have been very gratifying. As an example of the type of accuracy which can be obtained, time interval deviations are shown in the table taken from four different oscillographic films, which cover three and four consecutive operations.

These particular films demonstrate that there is no difference as a function of operating speed. We have also taken similar films before and after long periods of

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Accurately Control Fluctuating Voltage to ± ½%

Raytheon Voltage Stabilizers are available for incorporation in your product or equipment for almost any type of service. There are three designs —cased, uncased and endbell models—to meet your installation requirements. All Raytheon Stabilizers deliver controlled output voltage to ± ½% over their full rating. Write, outlining your needs —Raytheon Engineers will make recommendations.

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- Hold constant varying A. C. input voltage to ± ½%.
- Stabilize at any load within their ratings.
- Quick action . . . stabilizes within 2 cycles . . . variations cannot be observed on an ordinary volt meter.

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- Wide A. C. input voltage limits . . . 95 to 135 volts.
- Entirely automatic . . . no moving parts . . . requires no maintenance . . . connect it and forget it.

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operation and obtained similar results. Deliberate variations of line voltage of plus and minus 17 per cent have shown measured changes of plus and minus 1-1/2 per cent respectively.

Everything considered, it is felt that this type of equipment does permit the use of multiple pressure operation on a precision welding machine, and as such we consider it a step forward in the development of such equipment.

FIRE CONTROL

(*Continued from page* 106)

jectile in a curve, and the parallax error introduced by the necessary separation of the sighting mechanism and the guns.

Information concerning the direction, distance, speed, and course of the moving target is automatically conveyed to the gun director electrically, either by an optical sighting mechanism or other secret means. The director makes the necessary computations and positions the anti-aircraft guns automatically through Selsyn motors, at the same time transmitting the information on shell-timing to the fuse-setting mechanism.

A feature of such a set-up is the almost complete elimination of the possibility for human error, and its corollary, that personnel can be trained to operate the system effectively in a minimum period. The accuracy of fire marks a new and formidable high in anti-aircraft gunnery.

POSTWAR PROBLEM

(*Continued from page* 128)

sicians, and those engaged in the designing of scenery and costumes, and in the designing, manufacturing and selling of apparatus.

"This estimate is for television broadcasting stations and does not include that portion of the industry engaged in the manufacturing and selling of television receivers for the public. In television alone there is a potential market for, what I believe to be a conservative estimate, 25,000,000 television receivers in the next decade. This latter represents a dollar volume of approximately $3,000,000,000, and the employment of many thousands of persons in manufacturing, selling, and servicing; all of which becomes an important consideration in our postwar economy. Television is potentially a tremendous industry and a great entertainment, cultural, and educational medium for which I hesitate to predict the limits.

"There has been talk that television should be shifted to much

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0-A	61	74	114	150	
4	62	76	119	159	
5	63	77	120	160	1136-1
6	64	104	124	354	
8	65	108	125		No.
9	67	109	127		212938-1
0	68	112	149		

PLP		PLQ		PLS	
6	65	56	65	56	64
9	67	59	67	59	65
0	74	60	74	60	74
1	76	61	76	61	76
2	77	62	77	62	77
3	104	63	104	63	104
4		64			

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SKILLED REMLER ENGINEERS and technicians, plus complete tool and die, plastic molding and screw machine facilities permit complete follow through on prime or sub-contracts for the manufacture of components and complete communication equipment. Each step, from specified or original designs to finished job is rigidly supervised. Present contracts and schedules enable Remler to consider additional electronic assignments. Extensive facilities and improved techniques frequently permit quotations at lower prices.

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higher frequencies than now assigned, so that color can be added and wider channels assigned. When color television comes, it must be an all electronic system and under present war conditions, no one can say for sure when it may be. I would estimate that it would not be out of the laboratory until the latter part of the next decade.

"It is desirable, therefore, that the long-range plan for broadcasting consider the future operation of a large number of high power, clear channel stations operating on the standard band, strategically located to provide rural coverage in sparsely settled parts of the country. I would, therefore, visualize at the end of the coming decade our sound broadcasting services operating on frequency modulation in the large metropolitan centers, medium and small cities, and the rural coverage provided by clear channel stations on the standard band.

"With local and regional stations in the standard band being replaced by FM stations, space in the standard band could be provided to increase the number of clear channel stations, which, I visualize, as using powers of the order of 500 to 1,000 kilowatts instead of the now limited power of 50 kilowatts. An engineer does not regard 50 kilowatts as a large amount of power for so important a service as broadcasting. 50 kilowatts is approximately 67 horsepower, or less than the power under the hood of an American automobile. If some such long-range plan is not formulated now to integrate FM sound broadcasting with the present system, the economics of sound broadcasting may degenerate, particularly as it must face the competition of visual broadcasting during the coming decade."

"In television," pointed out E. K. Jett, FCC's chief engineer, "the allocation problem is foremost in our minds because, in addition to interference problems, we know that the present 18 channels and the standards governing this service are inadequate for an efficient nation-wide competitive system of television broadcasting. In my opinion, we should have at least twice this number of channels. The same is true of FM broadcasting in the band from 42 to 50 mc, which is sufficient for only 5 non-commercial educational broadcast channels and 35 commercial channels. Considering the problem of adjacent channel interference and the geographical separation required for co-channel operation, it is not unreasonable to ask for at least twice the number of channels for these services.

"In considering these postwar broadcasting services we must also

to lift another mist from the mind of man

War's necessity mothers tomorrow's blessing. War-born electronic devices which now strengthen and sharpen a war pilot's radio signal may, some happier tomorrow, guard the glory of a symphony.

Who knows the future of these discoveries which keep our pilots in clear communication, even through the deafening crackle of a tropical storm? Who knows what undreamed comforts, undreamed glories flicker in the electronic tubes? Or in any of the modern miracles so familiar to us at Sylvania?

New sound for the ears of the world. New knowledge for the eyes of the world. More mists of ignorance swept away! Those are the potentials which inspire us, in everything we do, to work to one standard and that the highest known.

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plan the necessary relay channels for network programs. It is my understanding that considerable advancement has been made since Pearl Harbor in developing frequencies above 300,000 kc for the distribution of such programs; also, the same networks may just as easily carry telegraph and telephone messages and compete with the services now furnished by the wire carriers. This will involve major questions of policy and may require amendments to the Communications Act.

Interference minimized

"We know, for example, that these relay stations will be installed on towers which will be spaced from thirty to fifty miles apart. The transmitter for each channel of communication will be of very low power, perhaps only a fraction of one watt. Interference will be minimized and efficiency increased through the use of directional beams, with the result that the same frequency may be utilized in many sections of the country.

"There is no reason why this nationwide network should not also carry network programs for standard broadcasting, FM facsimile, and private telegraph and telephone circuits for the press, stockbrokers and agencies that usually lease private wire facilities.

"There is much to be gained by allocating the same frequency bands to television service on an international basis, and also in adopting international standards for both program broadcasting and network relay systems. If these things are not done, it may be impossible to set aside common bands of frequencies for maritime and air navigational aids. Furthermore, if different bands and technical standards are used in different regions of the world, the problems with respect to the sale of apparatus and the exchange of international programs would be well-nigh unsolvable."

MULTIPATH PROBLEMS

(*Continued from page* 126)

The motion pictures of received scenes illustrated the rapidly changing patterns observed when the receiving position was in motion on the cruiser in regions where tall buildings such as are in the vicinity of the Harlem River offer interference.

It was pointed out that with a little experimentation with the antenna directivity and length the worst cases of multiple reflections could be minimized at a fixed receiving location, and that there exists a zone of best reception which extends from about five miles from the transmitter

PRINT IN BINDING

thirty miles or more, where such reflections are rarely noticed and where the signal strength was usually great enough to override local interference.

Motion pictures disclosing the quality of reception and types of programs now current in good locations around New York city were shown. A film of the program telecast the previous evening from Madison Square Garden was shown, as photographed from the screen of a Du Mont television receiver.

CIVILIAN RADIO

(*Continued from page* 128)

large department stores. Television must come gradually, feeling its way, if it is to achieve a solid foundation on which to expand technically and commercially. "There is no final technical word when you are dealing with the ether," he said. "There is no last frontier in the field of the unknown." Mr. Hirschmann emphasized the possibilities of dramatizing conventional merchandising claims by taking the television customer "backstage" in the manufacture, design, or history of the product being displayed. Television will provide a miniature show-window in everyone's home, said Mr. Hirschmann, but it will have to be "dressed" in dramatic, dynamic fashion if it is to be acceptable to the public.

WIDE READING

(*Continued from page* 124)

analyzer consisting of the two oppositely charged cylindrical plates P and R. Only electrons of a selected energy reach collecting cup E, the current to which is proportional to the number of electrons impinging on it.

Experimental curves of the electron current for elastic scattering as a function of the incident electron energy have been taken with the scattering angle as parameter; these curves are characteristic of the gas used, and are made the basis for determining the concentration of the component gases in a mixture of hydrocarbon gases. Method of analysis and apparatus required are described. Inelastic scattering may be used, or the current over a scattering angle of from 0 to 180 deg.

Alternatively, the electron current is measured as a function of the scattering angle, the incident electron energy being the parameter. These measurements can be carried out simultaneously if the collision chamber contains a sufficient number,—equal to the number of component gases,—of analyzing chambers arranged at suitable angles to the original beam.

When the angle of scattering and

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the energy of the incident electrons are both fairly large, it is possible to calculate the expected ratio of the probabilities of inelastic and elastic scattering for the molecular structure of a particular hydrocarbon gas. When replacing the cylindrical analyzer plates P, R, by a retarding field, this ratio can be determined. It is a function of the ratio of hydrogen atoms to carbon atoms indicating the atomic composition of the molecules investigated.

Further information on the molecular structure, the relative frequency of occurrence of the types of valency bonds between the carbon atoms, may be obtained by investigating the energy distribution of the inelastically scattered electrons. The methods may be applied to other types of gases.

On Antenna Theory

L. Brillouin (Quarterly of Applied Mathematics, Oct., 1943)

Assuming arbitrary current distribution in a straight, cylindrical antenna, expressions for the electromagnetic field satisfying Maxwell's equations are computed by the method of retarded potentials. The boundary condition that the electric field must be orthogonal to the surface of the metal wire and assuming the oscillations to be of cylindrical symmetry, yields a rigorous integro - differential equation the solution of which is the actual current distribution in the wire.

This equation is studied by successive approximation and the importance of the role played by both end faces is established; their exact shape should be taken into consideration very carefully unless the wire is very thin. Method and results are compared with previous computations.

Electron Gun for X-Ray Tube

J. J. G. McCue (Review of Scientific Instruments, November, 1943)

An electron gun designed to reduce the contamination of the target by evaporation from the filament and to minimize space charge which limits the target currents is described in detail. The arrangement has proved satisfactory.

Q of Powder-Cored Coils

V. G. Welsby (Electronic Engineering, London, Oct. and Nov., 1943)

Based on expressions derived in two previous articles published in the preceding issues of "Electronic Engineering" and reported in the November issues of this magazine it is shown that the Q of a powder-cored coil may be repre-

sented as $2\pi f \times (1 - f/f_r^2) \times (K+Af+Bf^2)$, f being the operating frequency, f_r the resonant frequency and K, A and B constants involving the various loss factors in wire, core and dielectric.

The influence of the three parameters on the shape of this Q curve is analyzed, design considerations are based on the analysis, and suitable graphs are shown and explained. Particularly, the equi-Q charts consist of lines of constant Q, for a certain type of core and wire, plotted on a graph with inductance and frequency as ordinates and abscissae respectively. The construction and use of these charts are discussed in detail. The factors determining the self-capacitance of a coil are treated.

On Transmission Line Theory

R. King (Journal of Applied Physics, November, 1943)

The article contains an extensive treatment of transmission line theory based on a complete hyperbolic solution to simplify the analysis of many complex problems. Formulas for general case and several computed curves for particular values of line constants are included. Some practical applications and related experimental determinations are discussed.

COSMIC RESEARCH

(*Continued from page* 96)

panel of the 88-tube amplifier. The view showing the counters in Fig. is looking from the south. The recording and printing mechanism (Fig. 5) is stationed inside the main laboratory, Fig. 6, and it is operated by a synchronous clock. Should any momentary interruption of the power supply occur, the apparatus is automatically cut out and must be manually reset. This is to avoid any uncertainty as to the correct interpretation of hour counts.

Field strength

There are other ways in which electronic devices have been adapted to investigations of the electronics of the atmosphere at the Needham Laboratory. One of the most important of these is the determination of field strength measurements whereby variations in radio transmission conditions have been continuously recorded at different frequencies. Already over 22,000 hours of field intensity measurements have accumulated on broadcast frequencies alone.

In the design of the apparatus for field strength recording, the Leeds and Northrup single pen recorder (Micromax), cuts into the avc circuit of a standard radio

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ceiver, Fig. 7, or in certain instances, into the diode detector of the receiving circuit so that a nearly logarithmic scale results in the graph showing variations in field intensities throughout the hours of operation.

To insure interpretation of the results on a standardized basis the receiving and recording units are periodically checked against a General Radio standard signal generator (Fig. 8). When standardizing, the output of the signal generator is connected to the terminals of the receiver, and known microvolts imposed upon the terminals of the receiving set in sufficient steps to cover adequately the entire range of the recorder.

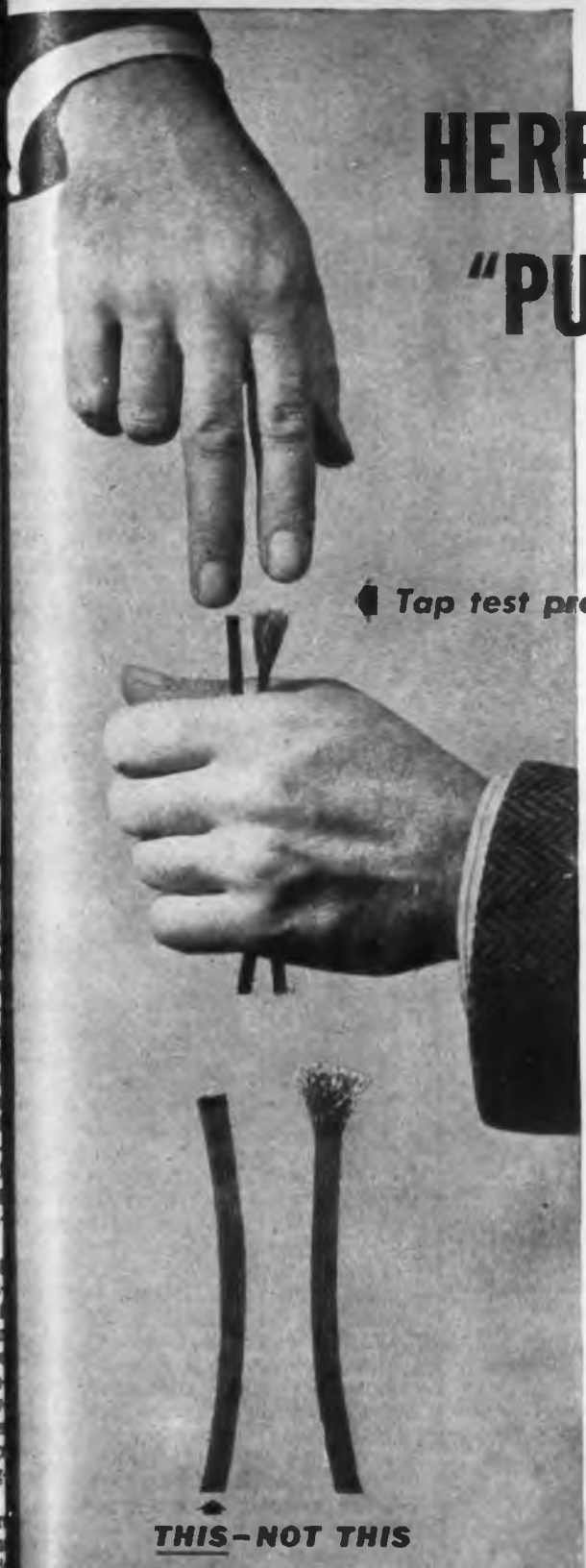
The response of the recording pen of tha galvanometer then indicates the chart reading corresponding to the predetermined number of microvolts to which the entire receiving equipment responds. A calibration scale in log microvolts is then made which is very nearly linear with the chart reading. This linear relationship facilitates the interpolation for intermediate values and forms the basis for the interpretation of the field intensity measurements.

Seasonal effects

It is on the basis of records of such field intensity measurements not only in the broadcast band but also at higher frequencies, that many important facts have been learned concerning diurnal, seasonal and sunspot effects that are so important for predicting usable frequencies at given times over given distances. In furthering this research, careful records are kept of all solar activity since the electronic behavior of the sun itself is an important factor in ionizing the upper atmosphere at communication levels.

Many striking records showing complete blackouts of communication conditions have accompanied marked auroral displays which in turn are found to be most active and violent at times of major sunspot occurrences. The accompanying diagram (Fig. 9) illustrates very well a series of relationships of considerable interest and significance.

If we take as a point of departure the days on which bright auroras have been observed for a decade and call this the zero day, we may plot occurrences of sunspots, magnetic disturbances, and the average daily radio field strengths for a week preceding and following the day of auroral occurrences. When this is done we see that sunspot numbers have been steadily on the rise from four days before the occurrence of the aurora, and that they have reached their maximum one day before the aurora take



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place. Thereafter solar activity subsides for one whole week.

If now we plot the disturbance in the earth's magnetism as it is observed by wanderings in the variations of the compass or small changes in the intensity of the earth's magnetic field, we find that four days before the aurora there is least disturbance, and that the maximum magnetic disturbance occurs on the day of the aurora. Thereafter the magnetic disturbances subside. We interpret this as meaning that the electrical charges in the upper air cause by induction the magnetic disturbance of the compass needle.

Next, if we plot the disturbance of short wave radio transmission we find that the least disturbed period is from four to three days before the aurora, and that there is a steady rise reaching a maximum disturbed condition about the day of the occurrence of the aurora; thereafter these disturbances subside.

When we come to the radio reception of medium frequencies such as is used in commercial broadcasting, we find again that transmission conditions are least disturbed four days before the aurora, and that the day of maximum disturbance is one or two days after the aurora happens; thereafter the disturbances to radio broadcasting diminish but are still relatively high for the next five or six days.

Sun spot effects

This demonstrates rather forcefully that when something happens on the sun we may expect a day later that charged particles emitted from these disturbed areas on the sun will reach the topmost region of the earth's atmosphere producing electrical discharges that create the auroral glow. Almost simultaneously with this display the compass needle is most disturbed and the radio reception at high frequencies such as are used in transoceanic communication is greatly disrupted. Another day elapses however before the effect penetrates to the lower region of the ionosphere some seventy miles above the earth that we call the E layer. The disturbances then become so great in this E layer as to cause very poor reception in the broadcast band which persists for several days thereafter. Often a week or more elapses before we again have normal conditions for radio reception in the broadcast band.

Other experiments in atmospheric electric phenomena are in progress. A Cambridge thread recorder connected in a simple circuit between a well-grounded rod and a sharp point at the top of a 60-ft. pole records continuously and

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ARMY E NAVY
ARMY E NAVY

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discharges of electricity between the ground and the sky, or vice versa. Rain and snow invariably are accompanied by such discharges, sometimes with marked reversals in direction or in sign. The recording galvanometer is capable of registering currents to the limit of 5 micro-amperes in either direction.

A record of a discharge occurring during a rainstorm on October 26, 1943 is reproduced in Fig. 10. In most instances the exact time of beginning and ending of rain will be marked by a sharp displacement in the record of the recording needle. Under unusual circumstances accompanying high winds and scudding clouds, discharges have occurred far exceeding the scale of the instrument and supplementary meters then used have recorded currents of as much as 50 micro-amperes for as long an interval as two hours, later to be interrupted at short intervals with sharp reversals in direction. Such occasions were not accompanied by any visible signs of thunderstorms.

Hourly values of the potential gradient of the atmosphere are also taken by the reading of a bifilar electrometer connected to a highly insulated rod projecting from the building some two meters above the ground. A small "collector" at the outer end of the rod containing a bit of radioactive ionium compound insures sufficient ionization at the end of the rod to contact the atmospheric potential at that point. Diurnal and seasonal variations of the potential gradient are being studied together with any long term trend and comparisons made with other ionic investigations (Fig. 11).

Negative ion determination

For the measurement of negative ions in the lower atmosphere, a modified form of Ebert ion counter has been set up (Fig. 12). A FP-54 pliotron tube replaces the conventional electrometer, the control grid being connected to an axial rod on which the atmospheric ions are collected. At hourly intervals a constant speed blower draws outside air along the axis of two coaxial cylinders, the outer of which is grounded and the inner of which carries a negative potential that deflects the negative ions of the incoming air stream to the central rod.

The collection of ions on this rod varies the charge on the control grid, which in turn alters the plate current of the tube, the variation of the plate currents being registered on a recording galvanometer. A preliminary calibration of the apparatus has been made by the comparison of readings with the data obtained from a manually

Adlake *Plunger-type* Mercury Relays

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DEPENDABILITY

Adlake Relay No. 1040—(for A.C.)
5½" high, 2⅗" wide, 2¼" projection. For panel mounting. Contact normally open or closed. Quick or time delay action. Contact protected by metal armor.

Automatic power control can be no more dependable than its relays. That is why the plunger type mercury relay is replacing other types. It is the most dependable relay thus far developed for many types of service, because dirt, dust, moisture, temperature changes, humidity etc. can not affect its hermetically sealed contacts.

ADLAKE Plunger-type Mercury Relays are available for either quick or time delay action . . . for A. C. up to 440 volts . . . for D. C. up to 115 volts (and higher, with outside resistors) . . . and contact capacity from a fraction of an ampere to 100 amperes. All operate on the same basic principle. All are armored against outside impact. All have *hermetically sealed mercury to mercury contacts* which are *positive, chatterless, noiseless* and *arcless.* For complete data, request bulletin.

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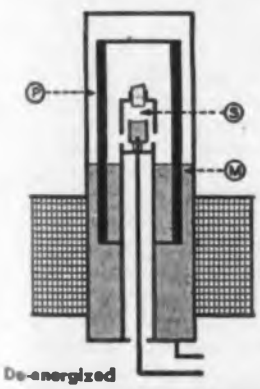
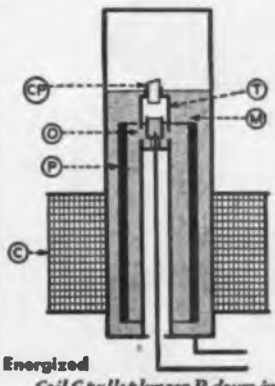
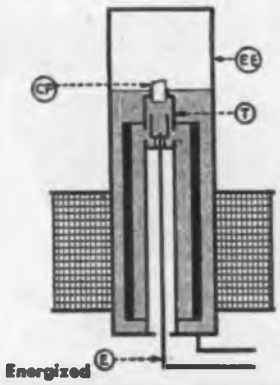
SIMPLE, UNFAILING, POSITIVE ACTION



De-energized
Plunger P is floating in mercury M. Space inaicated by S is filled with inert gas.



Energized
Coil C pulls plunger P down into mercury M. Mercury thus displaced enters thimble T through orifice O. Inert gas in thimble has not yet escaped through ceramic plug CP, thus effecting time delay.



Energized
Mercury now fills thimble T, is completely leveled off and mercury to mercury contact established between electrodes E and EE. Degree of porosity of plug CP determines length of time delay—and accurately.

The above and accompanying sketches are *not* mechanical drawings. They show how Adlake Relays work, not construction detail.

Adlake TRADE MARK

THE ADAMS & WESTLAKE COMPANY

ESTABLISHED IN 1857 — ELKHART, INDIANA — NEW YORK · CHICAGO

MANUFACTURERS OF ADLAKE HERMETICALLY SEALED MERCURY RELAYS FOR TIMING, LOAD, AND CONTROL CIRCUITS

read Ebert counter simultaneously operated. A circuit diagram subject to change with the development of the experiment is shown in Fig. 13.

In a previous issue of "Electronic Industries" some account was given of the observation of the apparent wandering of the beam of an air beacon as observed from measurements of the relative field strength of the A/N ratio. The continuance of these observations has not only established an apparent relationship to meteorological change but leads to the supposition that, in spite of the relatively long wavelength and comparative short distance involved, some factor involving conductivity in the lower reflecting layer of the ionosphere is not to be excluded as a possible parameter in fields measured.

The primary purpose of the Cosmic Terrestrial Research Laboratory is for the investigation of such relationships as may exist between cosmic phenomena exterior to an earth and such terrestrial phenomena as may result from or vary with changes in the earth's exterior environment. For the gathering of physical data to this end, electronic devices play and must inevitably continue to play an increasingly important part.

PLANNING FOR POSTWAR

(*Continued from page 87*)

The wartime experience of volume manufacturers struggling with precision products and precision manufacturers with large production runs will make very interesting reading some day. During this period we have had one customer, Uncle Sam, and profits have been limited by renegotiation and excess profits taxes—not by competition in a free economy. As we come back, which we surely will, to a system where industrial existence depends on proficiency of manufacture at a minimum of cost, some of us will have to re-learn old rules. others learn new ones. In either case, measure the new product by those rules and not by today's conditions.

The third internal factor is called "production considerations." Can we control this sort of an item production-wise? Can it be scheduled properly, and if not, can we make an organization that will be capable of handling its pre-planning? Will it absorb overhead or create more? Its peaks, do they flatten out some of our already sharp ones? The electronics industry has been singularly plagued by them.

Further, will this item originally or ultimately freeze our assets or be the straw on our business back that breaks us? In other words,

can we or do we want to invest in enough raw, process or finished inventory to schedule properly this kind of business? This may tinge of being a selling consideration, but fundamentally it is an internal factor because it is right in our plant where the trouble will happen—if we don't plan ahead.

Fourth, we briefly can discuss manufacturing considerations. In summarizing we can be brief but woe to the company that depends on a walk around the shop and a quick look-see to determine whether a product fits. Every item in the check list is important and each will suggest more. No manufacturing division ever got good by accident. It requires a vast amount of attention to detail.

Expensive to pioneer

If the shop is running relatively smoothly, why upset it with something that men, familiar with its functioning, will immediately scream "It can't be done here." Not that there isn't merit in saying, "the impossible just takes a little longer." But why not find out if it is going to take a little longer—or maybe forever—before proudly saying "they said it was impossible, but we can do it." It is expensive to pioneer. Research and development are absolutely essential to progress, but don't do it in the shop. Do it in the laboratory.

Only by the most careful analysis, and if the product is worthwhile, it is better to take the time to analyze it now than to risk possible losses later, can we know whether we should manufacture it in our shop. If so, will it prove profitable not only in and of itself but when related to our regular business? Time details and judgment are required. Better to pass over the product completely than to skimp here.

Importance of control

Fifth, and last of the broad internal factors is that of control; figure and money-wise. Do we have the kind of a system necessary to predict costs adequately?

Not so long ago a large manufacturing company was blessed, not with one, but three complete cost organizations—one for the accounting department, another for the sales manager and a third for the works manager. Each used different methods and went so far as to use completely different overhead factors.

Score of the results was kept by accounting, prices were not only arrived at, but also quoted according to the sales manager's private cost set-up and to cap the climax the works manager judged the op-

eration of his province by his own figures.

Fortunately, the inhabitants of this institution, which was subsidiary to a still larger enterprise, were ingenious enough to do a good job of convincing the parent company of their right to be virtually autonomous. Much greater personal harmony, however, would have resulted had agreement been reached to pool their surplus of records and then agree to believe the answers produced.

Far more companies, rather than having an excess of cost data have too little. In those cases, and to some degree others, great self-control must be exercised not to reach for a pencil and start putting down numbers. The fatal errors that can be committed by the keyman who says "well let's see, a tube costs 30 cents and the screws and brass can't be more than 5 cents—and all the other things, they can't be more than a dime—let's say fifty cents for the whole job. And a quarter for labor—I could make 10 an hour myself, but I'm being safe—and overhead, well let's say 60 per cent" and so on.

There may be some excuse for informed guessing on overhead based on hypothetical production quantities, but everything else should be known. The product that isn't worth running on a cost sheet isn't worth looking into.

Product, design, production, manufacturing and control are essential "internal factors." Each raises its own group of questions. In the light of full and adequate answers to these questions, judgment can be exercised. Even if the balance of the internal considerations is unfavorable, the merchandising aspects may be favorable enough to make it attractive anyway. The doing of the analysis job is what counts. The disappointment comes earlier and cheaper. And after all, there always may be another product that will record a higher score. The problem of every company in the electronics industry is not merely to find another product, but rather to find the optimum product, for its own particular situation.

RTPB PANELS

(*Continued from page 97*)

I. F. Byrnes (A), Radiomarine Corp. of America, 66 Broad Street, New York

Lt. Col. A. G. Simson (M), War Department, Pentagon Building, Arlington, Va.

C. J. Burnside (M), Westinghouse Elec. & Mfg. Co., Baltimore

R. N. Harmon (A), Westinghouse Elec. & Mfg. Co., Baltimore

Panel No. 2—Frequency Allocation

Dr. C. B. Jolliffe, Chairman, RCA Victor Division, RCA, Camden 2, N. J.

F. M. Ryan, Vice-Chairman, American

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Walter Merkle (M), Television Engineering Dept., Philco Corp., Philadelphia
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R. E. Shelby (M), NBC, 30 Rockefeller Plaza, New York
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Rudolf F. Wild (O), Brown Instrument Co., Wayne and Roberts Avenues, Philadelphia
E. W. Engstrom (M), RCA Laboratories, Princeton, N. J.

Panel No. 4—Standard Broadcasting

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John H. Barron (M), Earle Building, Washington
George C. Milne (M), Blue Network, 30 Rockefeller Plaza, N. Y.
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William B. Lodge (A), CBS, 485 Madison Ave., N. Y.
George C. Davis (M), Munsey Building, Washington
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Earl G. Ports (A), Federal Telephone & Radio Corp., 591-593 Broad St., Newark, N. J.
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D. H. Mitchell (M), Calvin Mfg. Co., 4545 West Augusta Blvd., Chicago

(Continued on following page)

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Royal V. Howard (M), Station KSFO, San Francisco
J. E. Tapp (A), Station KSFO, San Francisco
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D. D. Cole (M), RCA, Victor Division, Camden, N. J.
K. A. Chittick (A), RCA, Victor Division, Camden, N. J.
J. B. Coleman (M), RCA, Victor Division, Camden, N. J.
V. E. Trouant (A), RCA, Victor Division, Camden, N. J.
A. D. Ring (M), Ring & Clark, Munsey Bldg., Washington
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C. W. Finnigan (M), Stromberg-Carlson Co., Rochester

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Panel No. 6—Television Broadcasting

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I. J. Kaar, Vice-Chairman, General Electric Co., Bridgeport, Conn.
Dr. George Town, Secretary, Stromberg Carlson Co., Rochester
G. L. Beers (M), RCA-Victor Division, Camden, N. J.
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C. E. McClellan (A), Westinghouse Elec. & Mfg. Co., Baltimore
Jean Brand (M), Raytheon Mfg. Co., Waltham, Mass.
Howard Gates (O), Warwick Mfg. Corp., 4640-50 W. Harrison Street, Chicago
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J. A. Ouimet (O), Canadian Broadcasting Corp., 1440 St. Catherine Street, West Montreal
Norman Snyder (O), Ansley Radio Corp., 21-10 49th Avenue, Long Island City, N. Y.

Panel No. 8—Radio Communication

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H. H. Beverage, Vice-Chairman, RCA Communications, Inc., 67 Broad Street, New York
C. W. Latimer (M), RCA Communications, Inc., 67 Broad Street, New York
A. J. Costigan (M), Radio Marine Corp. of America, 75 Varick Street, New York
I. F. Byrnes (A), Radio Marine Corp. of America, 75 Varick Street, New York
Charles C. Harris (M), Tropical Radio Telegraph Co., 1 Federal Street, Boston.
P. D. Zurlan (M), Press Wireless, Inc., 435 N. Michigan Avenue, Chicago
Carl E. Scholz (M), Radio Corporation of Porto Rico, 67 Broad Street, New York
W. I. Harrington (M), Mutual Telephone Co., Honolulu, T. H.
G. P. Bosomworth (M), United States-Liberia Radio Corp., Akron, Ohio
T. P. Kinn (M), Westinghouse Elec. & Mfg. Co., 2519 Wilkens Avenue, Baltimore
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W. T. Bishop (A), Aircraft Accessories Corp., Fairfax and Funston Roads, Kansas City 15, Kansas
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Dr. D. E. Noble (O), Galvin Mf . Corp., 4545 Augusta Boulevard, Chicago

RTPB Television-Panel Committees

David B. Smith, of Philco, chairman of the Radio Technical Planning Board's Television Panel, has appointed chairmen of the Panel's various committees, as follows:

No. 1, Television Channels, chairman, D. E. Harnett, Hazeltine Electronics Corp., 5825 Little Neck Pkwy., Little Neck, N. Y.

No. 2, Synchronization Standards and Video Modulation, chairman, Dr. T. T. Goldsmith, Jr., Allen B. DuMont Labs., 2 Main Ave., Passaic, N. J.

No. 3, Review of Old Standards and Proposed New Standards, chairman, Dr. George Town, Stromberg-Carlson Co., Rochester, N. Y.

No. 4, Frequency Allocations and Service Limits, chairman, B. Ray Cummings, Farnsworth Television & Radio Corp., Ft. Wayne, Ind.

No. 5, Standards Good Engineering Practice for Television Transmitters, chairman, J. E. Brown, Zenith Radio Corp., 6001 Dickens Ave., Chicago.

No. 6, Relay Links, chairman, F. J. Bingley, Philco Corp., Philadelphia 34, Pa.

I. J. Kaar of General Electric is vice-chairman of the Television Panel.

(M) Member, (A) Alternate, (O) Observer.

Historic Firsts—Negative Feedback Amplifier

In the early days of vacuum-tube amplifiers, reports Bell Laboratories Record, it was recognized that more gain could be obtained if some of the output was fed back as additional input; but the result if the process was carried too far was "singing." Stable operation, it was commonly supposed, required a net loss in the loop formed by amplifier and feedback circuit. It was also believed that feedback in reversed phase afforded no advantage compensating its accompanying reduction in net gain.

The paradox of amplifier design was announced, however, in the early 1930's by Harold S. Black. His work in Bell Laboratories had led him to an epoch-making invention in electronics. He showed that many remarkable properties inhere in amplifier operation with a negative feedback which reduces the gain. Following his technic one designs an amplifier for more amplification than is required; and then, by properly sacrificing some of this potential gain, one obtains amazing constancy of amplification and stability of operation.

The resultant amplifier has increased linearity of characteristic with a hundredfold reduction in harmonics. Tube noises are greatly reduced. There is improvement in phase distortion, in the gain-load characteristic and in the amplifier's impedance relationships. These important advantages are obtained economically without excessive refinements on the designs of tubes and in the constancy of their power supplies.

Negative feedback also facilitates the equalization (within reasonable limits) of frequency distortion due to apparatus in the direct path of the signal current. Previously it had been necessary to introduce a network of inverse characteristic. In construction such networks range from difficult to impractical. With negative feedback, however, they are unnecessary because usually the desired result can be produced by inserting in the feedback circuit apparatus with the characteristics which are to be equalized and then properly increasing the amount of feedback.

The stability of negative feedback amplifiers is well illustrated by long carrier current circuits in coaxial or other cable.

MARINE RADIO

(*Continued from page* 109)

of radio frequency amplification, a regenerative detector and two stages of audio amplification. Since this receiver must be capable of operation, in an emergency, irrespective of failure of the ship's power supply, storage batteries are used for the filaments, and B batteries are available for the plate circuits. For routine operation, a small rectifier is used to furnish B supply.

Emergency equipment

The frame at the right end of the console houses a five frequency emergency transmitter for the 350-500 kc band, a transmitter selector switch, and facilities for charging and discharging the transmitter emergency storage battery. This battery, a heavy duty 12-volt unit, operates a small rotary converter in the emergency transmitter frame and has sufficient capacity for six hours of use. The emergency transmitter delivers approximately 40 watts to the antenna system. This transmitter uses six 1624 tubes and a self rectified master oscillator-power amplifier circuit with two tubes in the oscillator and four tubes in the power amplifier.

The main motor generator for the 200 watt intermediate and high frequency transmitters is mounted in the lower section of one of the frames and delivers 1400 volts dc for plate potential and 80 volts ac for filament potential as well as a source of 500 cycles for modulating the transmitters. A transfer switch enables this machine to be connected to either transmitter.

Since all transmitter tubes are of the quick heating type and because no rectifier tubes are used for plate supply, the transmitters may be placed on the air within five seconds after the need arises. This is an important advantage in wartime when it is necessary to transmit the SOS distress call quickly. The emergency transmitter, with its quick heating tubes and fast starting rotary converter may also be placed on the air under five seconds.

The console unit provides its own illumination. One of the lighting fixtures at the top operates from the shipboard main power supply, while the other fixture is powered from the 12-volt emergency battery.

Antenna array

A total of four antennas are used with the equipment. Any of the radio transmitters may be switched quickly to either the ship's main or emergency antenna. An auxiliary receiving antenna is used for standby during periods when the direction finder on the ship is in use, at which time the main antenna circuit is automatically opened. The intermediate-high frequency receiver is connected to a doublet for noise reduction on the high frequencies. This doublet is automatically connected to function as a "T" antenna when the receiver is used for intermediate frequencies (85-550 kc).

The console unit provides certain additional refinements necessary in a modern shipboard installation. For example, a "time signal" patch cord is used so that the operator may connect a receiver through to the bridge when the chronometers are to be checked against radio time signals. Compartments for stowage of message blanks, telephone receivers, etc. are provided behind the operating table. The typewriter well is reversible so that when the typewriter is removed, a continuous flush working surface is available.

Complete access to the transmitters, auto alarm, etc. is obtained through the use of hinged front panel construction. The main motor generator, the emergency rotary converter, fuses and other power supply components are accessible from the front through the doors beneath the operating table. The various transmitters and receivers are fully calibrated, and, with the tuning charts provided, it is possible for radio personnel to familiarize themselves quickly with the overall operation of the equipment.

Lightning Counter

A new device which counts lightning discharges has been developed by Dr. Leo Finzi of Westinghouse Electric & Mfg. Co., as a tool to help in the never-ending campaign against thunderbolt damage to power lines. Not much bigger than a playing card and weighing less than a whole deck, the thunderbolt counter has two strips of metal foil enclosed between two pieces of transparent plastic. One foil strip has a number of teeth cut in its edge. The point of each of these teeth is a few thousandths of an inch from the straight edge of the second strip. As part of the lightning current leaps across this gap, it makes a tiny spark which scorches a black spot on the clear plastic and burns away the tip of the tooth, so that the next discharge will choose the next tooth. The device is fastened near the bottom of a power line tower so the black dots burned on it can be counted to enable power companies to keep a record of the number of times each lightning arrester along their lines has operated.

Four Decades of Service

When Stephen M. Ryder, president of Chisholm-Ryder Co., Niagara Falls, N. Y., celebrated 40 years of still active service with his company, at the ripe age of 85, George Benson, manager of the company's Premax Division, presented him with a twin-diamond-studded Old Timers' pin.

Stephen M. Ryder, left, receiving diamond-studded service pin from Premax manager George Benson

RMA Winter Conference

Radio Manufacturers Association is to hold its mid-winter conference at the Stevens Hotel, Chicago on January 12 and 13. Work of the eight new committees having to do with postwar planning will be gone over and a comprehensive industry reconversion plan is to be presented and will be discussed with various government officials.

4½ Million "MR" Tubes for Home Radios

A definite program of increased production of critical types of radio tubes for civilian home radio sets has been set up by the Radio and Radar Division of the War Production Board, covering the first quarter of 1944. At least 4½ million tubes are scheduled for production. These include principally the following types: 12SA-7, 12SQ-7, 1H5, 1A8, 50L-6, 35Z-5, 35L-6, 80 and some others that are on the critical list. These tubes are to be marked "MR" indicating that they are intended for maintenance and repair work, and cannot be sold on priority rated orders, thus preventing their diversion to civilian channeeds under Order L-265.

Carton Communication

Somewhere in the Pacific, Petty Officer Samuel Lee reached for a replacement for a type 803 tube. He tore off the top of the carton and scribbled a note to his wife, a Ken-Rad worker: "Did you make this babe? Keep it up." We suppose the omission of the comma can be blamed on the heat of battle. Ken-Rad has used the story to good advantage in full-page local newspaper ads. So far as we know, this is the first time an electron tube's wrapper has been used for two-way communication.

As another part of the industrial relations program, employes serving in the armed forces have been sent a Christmas card consisting of a 20-in. five-pointed star, decorated with the autographs of hundreds of Ken-Rad wives and sweethearts.

MILITARY RADIO STANDARDIZING

(*Continued from page* 101)

(e) On the other hand, are there components included that are marginal in design, that is: Do the transformers, condensers, etc., have a sufficient factor of safety against excessive current or voltage to insure trouble-free operation? Are tubes being worked beyond their ratings?

While it is fully appreciated that the problem posed is not easy, it is believed that in the forward rush of the war the virtues of simplicity

(*Continued on page* 266)

Consumers' Need For Tubes Not So Great

Radio tubes constituted one of the items of civilian goods in the survey of "shortages" recently conducted by the WPB Office of Civilian Requirements, but of the nearly 5,000 persons questioned they ranked below ten or more other commodities in need. The present flow of radio receiver tubes to civilians under the plan evolved by the WPB Radio and Radar Division, amounts to around 2,000,000 a month and under current revisions of the radio production limitation order, L-265, an improved method of distribution between manufacturers and distributers has been effected. Eighty-nine per cent of the consumers surveyed had radio sets in their homes.

Civilian consumers ranked radio tubes a good deal below a number of other commodities, such as elastic tape, wash tubs, alarm clocks, electric irons, etc. By free mention, tubes ranked 15th, or 10 times mentioned per thousand questioned; by hardship rating, tubes were in the 13th place with 22 times per thousand; and by inability to buy, radio tubes were in the 9th ranking being mentioned by 56 persons per thousand.

The question of radio batteries was an important item in rural areas. Of 1000 farm households, 69 replied they could not buy batteries, but 78 reported that they had been able to obtain them.

Whether limited manufacture of radio sets for civilians and an increased output of receiver tubes is to be allowed are problems which the OCR has to present to the WPB Requirements Committee. Little chance of permission for resumed set manufacturing is seen at present.

Parts Standardization

Standard specifications for radio transformers and capacitors, evolved by the War Production Board, the American Standards Association and the radio industry, have proved generally satisfactory, the Radio Replacement Parts Industry Advisory Committee said at its recent meeting in Washington, WPB has revealed. Production using these standard specifications is covered by Order L-293. Standard specifications for radio volume controls also are being drafted.

The distribution of radio parts under the terms of Limitation Order L-265, which provides that civilian orders for electronic equipment need no ratings but are filled by manufacturers on a certificate showing that the components are needed as maintenance, repair and operating supplies.

WE's 6500 Sub-contractors

Western Electric Co., in a report to the War Production Board and the Smaller War Plants Corp., discloses that 50 per cent of the company's total sales of war materials to the Government since the United States' entry into the war had been produced by sub-contractors. In meeting its commitments to the Government, Western Electric currently does business with more than 6,500 sub-contractors and suppliers.

Three-Year Delivery to Turkey

Wartime shipments take a long time — but they sometimes get through. Thirty Winchargers shipped from New York on August 10, 1940, have just arrived at their destination at Istanbul, Turkey. A three-year journey—over devious routes by water and rail, through war torn countries, apparently left them undamaged. Initially shipped aboard the Greek steamer, Athinai, they were captured by the Italians and taken to Catania, Sicily. After protests by the Turkish Government, they were transshipped by rail and water to the Italo-Serbia border — thence to Bulgaria, and finally to Turkey.

are in danger of neglect. The Bureau has no desire at all to impair performance to secure pure simplicity, but is not at all convinced that all present complexities are necessary.

The earnest cooperation of all design agencies will be appreciated. It is now thought that the result of such action will be better equipment for the ultimate purpose which is victory.

STANDARDIZING

(*Continued from page* 101)

parts required in warehouses and theaters of operation, (e) salvaging tail-end stocks of components left in the hands of equipment manufacturers, and (f) improving field maintenance.

Motors alone worth price

General Ingles said to me a few days ago that in his estimation all of the time we had spent on the standardization program would be fully justified by our accomplishments in the standardization of electrical indicating instruments alone. But we are not content with this single accomplishment. We seek criticism, advice, and guidance of each and everyone responsible for production and the ways and means of obtaining more production. We seek the industry-and-servicewide adoption of our program. Time is no longer a linear function with us—it is curvilinear and descending at a rapid rate.

Standardization is mass production's most valuable tool, and it is through mass production that our Army and Navy have become the best equipped in the world. Let's keep it that way.

Standardization, like most everything else in our way of doing things, is not a one-man show, or even a single institution's responsibility. It must be properly coordinated and supported by the Services, Industry and WPB as well.

We Buy Two Nuts

NOTE: All Resemblance to Places or Persons Living or Dead Is Purely Coincidental.

INTER-DEPARTMENTAL MEMO
TO ALL EMPLOYEES — Outside of Production Dept., Model 0 Day & Night Bldg.
SUBJECT: Purchase Orders
FROM: E. O. APPROVED BY: P. S.
PER: F.V.F.

There seems to be some confusion in the minds of many of our employes as to the methods this company uses in the purchase of various parts and pieces supposed to be attached to tanks. The purpose of this memo is to clarify the SIMPLE procedure we follow. To illustrate our methods we will use a simple, hypothetical example.

What to do?

Suppose our company completes the fabrication of a tank. Just as we are about to push it out the door, a workman discovers that the engineering department in designing the tank failed to provide two nuts needed to hold the tail assembly in place. It now becomes necessary to acquire these nuts. So what does the workman do? After lunch he notifies his lead man, the lead man notifies the foreman, who calls the department clerk who issues a shop order (S.O.). This shop order is issued in quadruplicate. One copy goes to our general manager, one to the shop, and one to the outside production department. The other copy is thrown away. Now we have a shop order. (S.O.)

After traveling about the plant for a day or so, the shop order (S.O.) arrives at the P. O. Dept. To it, however, have been attached various papers, including 16 blueprints and an authority card. The authority card is of no special importance and can be ignored in this discussion. Its principal use is to have something to pin the shop order (S.O.) and blueprints on while in transit. These papers arrive at our department in the 8:00 A.M. mail at nine-thirty in the morning. Promptly at eleven-fifteen the same morning 17 E. O.'s, No. 426894-326-4-1 arrive. By adding the last five numbers together, we know at a glance that these 17 E. O.'s should be attached to the 16 blueprints on the nut order. What happened is that after the shop order (S.O.) was issued someone discovered the only tool available at the tail station for applying the nuts was a hexagon wrench, a summary situation not provided for in the blueprints.

Now we are ready to get bids. Bid requests are sent out to three nut factories, in accordance with government regulations. Only one

AS YOU NEVER DROVE BEFORE!

Many a soldier owes his life to a commander who drove him to the utmost in battle—*never let him slacken for a single fatal instant!* And after the war, many a worker will owe his economic safety to a leader who drove him continuously for higher Pay-Roll allotments for the purchase of War Bonds!

Despite higher taxes and prices, the average worker still has more money than ever before—particularly on the basis of the *family* income. With others in the family earning, too, just let the worker 'figure it out for himself', and he usually will realize that *now* he can put more into War Bonds than he has been doing.

That's why the Treasury Department has set new quotas for the current Pay-Roll Allotment Drive—*quotas running about 50% above former figures.* These quotas are designed to reach the *new* money that's coming into the family income. Coming from millions of new workers . . . from women who never worked before . . . from millions who never before earned anything like what they are getting today!

The current War Bond effort is built around the *family* unit, and the Treasury Department now urges you to organize your War Bond *thinking*—and your War Bond *selling*—on the basis of your employees' *family* incomes. For details, get in touch with your local War Finance Committee which will supply you with all necessary material for the proper presentation of the new plan to your workers through your labor-management committees.

Today about 30,000,000 wage earners, in 175,000 plants, are buying War Bonds at the rate of nearly half a billion dollars a month. Great as this sum is, *it is not enough!* So turn-to today! Get this new *family income plan working!*

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

YOU'VE DONE YOUR BIT—NOW DO YOUR BEST

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

This Space Is a Contribution to America's All-Out War Effort By

ELECTRONIC INDUSTRIES

bid comes back, so we decide to order the nuts from a local distributor whose service has been good.

The next step is to issue the actual purchase order. This operation is started by a group of persons in the write-up department, who, working together, produce a paper known as a requisition. On this paper the writers place various marks, signs, and blind figures. This is done by passing the paper back and forth until it is all filled out.

The requisition is then turned over to the hectowriter who types a master copy of the actual purchase order. This is done by simply copying the date shown on the requisition and then adding various quotations, phrases, paragraphs, priority ratings, terms; in fact, almost anything. A quotation from the Bible goes over big, and once we got good results on one where we used some stanzas from Barnacle Bill.

The master copy of the purchase order is then turned over to Mary who discovers 67 errors; she sends it back for correction, 49 of the errors are corrected, 18 missed, and 8 new errors made in making the correction.

The purchase order is now ready for the ditto machine. On this machine 382 copies of the order are produced. The first sheet though is usually spoiled, and is known as the first copy.

This is sent to the vendor along with a rule book, 17 acknowledgments, and a greeting card from our president. The other copies are distributed to the Army, Navy, Marines, General Pershing, Hitler, F.B.I., Errol Flynn, our supervisor, his secretary, her boy friend, and to our various departments. Sixteen copies are filed in various files scattered around in our own office. The purpose of this is obvious. Suppose you want a copy of an old purchase order. Instead of asking what file it is in, you just run around in a circle. The first file you fall over, just pull open a drawer, and there it is.

Forty-one copies of the purchase order go to a small group of men known as expeditors. These are furtive looking fellows who occasionally sneak in and out of the office.

The head expeditor has a very interesting job. Using a large map and a bunch of pins he plays a game called expediting. By sticking pins in various places on the map he knows just where every expeditor is located at the moment. As long as he does this successfully he wins, but whenever he loses a pin or an expeditor, he loses game and rubber.

As soon as the expeditors get wind that a new purchase order has been issued they fly into action: the unfortunate vendor who received the order now becomes the subject of guile, persuasion, threats, intimidations and a general harassment in an attempt to get his signature on a paper known as a delivery schedule. God help the vendor who signs the paper. From then on at every hour and at every turn he will be confronted by expeditors, pointing accusing fingers and demanding, "Where are those NUTS?"

Months go by, but in the meantime someone at the tail station finds two nuts that fit the tank gadget. Without authorization of the surplus parts department, he applies the nuts that fit the gadget and finishes the tank. The tank is pushed out on the field, disassembled, crated, uncrated, boxed and shipped to British South West Africa where it is now on the docks waiting for an American engineer to show the natives how to put the damn thing together.

So what do we do? Cancel the order for two nuts! Now to issue a cancellation—Oh Hell, what's the use?

Heat Transfer Fundamentals

Suggesting that where ordinary methods of heat transfer can be applied, electrical processes will not compete because the efficiency of power usage is little over 50 per cent and fuel is basically cheaper than electricity, Arthur D. Little, Inc., chemists and engineers, summarizes the "heat from within" technic and emphasizes the need for much development work. They say:

"Current can be pushed through 'non-conducting' materials, but economic operation requires use of a high-frequency current, one changing direction millions of times per second. Such heating is not competitive with steam heat, but it is rapid and easily controlled and speeds production cycles markedly. This high-frequency heating promises to become a major technic in difficult heating problems, both now and after the war.

"High-frequency heating has been used medically for some time

Electronics, the science based on the separation of electron and atom, has made possible the development of new instruments for war and will lead to revolutionary improvements in post-war living. It is the fresh and expanding vista that lies before the electrical engineer of today and tomorrow.—Dr. Joseph Slepian, Westinghouse.

in diathermy treatment of various disorders by raising the body temperature locally. The industrial application of the physician's "diathermy" dates from 1936, when it was applied to the drying of tobacco while still in the hogshead. The present intensified interest stems largely from the participation of the furniture industry in the plywood airplane and glider program. High-frequency heating enjoys the great advantage of having the heat produced directly in the material itself, and as rapidly as desired. Normal barriers to heat flow are not encountered, and the release of heat is uniform throughout the material, thus eliminating undesirable temperature differences.

Molecular distortion

"The heat is produced by distortion of the molecules of the materials by the rapidly changing electrical field. To produce an appreciable effect the field must change rapidly, millions of times per second, which is far beyond the range of mechanical means of generating alternating currents. Such currents are obtained, therefore, from a high-frequency vacuum tube system similar to a radio transmitter, but usually more powerful.

"The heating units employed are quite compact and in the smaller sizes are housed in a single cabinet containing all necessary tubes, transformers and condensers. With the exception of cooling fans and some small control motors there are no moving parts. They are built in heat output capacities from 500 watts to 300 kw, and since the average overall efficiency of power conversion is approximately 50 per cent, the equipment consumes about twice as much power as it releases as heat.

"Bonding together of thin wood sheets with synthetic resin glue to form plywood is particularly adaptable to high-frequency heating because of the plywood's poor thermal conductivity and of the need for rapid and uniform heating. Structural beams, propellers, wing and fuselage parts may all be made by the process and the improvement over the older methods is remarkable. Plywood is formed in large presses, which in making some types have been steam heated.

"High-frequency heating is at present applied to existing press equipment by inserting a metal sheet between two stacks of wooden sheets in the press. The metal sheet is connected to the power source and the other terminal to the press-body so that an electric field is set up between the metal sheet and the press, and through the wood, thus heating the wood. The press compresses and within a few minutes the work is finished."

WHAT'S NEW

(Continued from page 134)

Capacitor Dielectric

Lectrofilm is a new synthetic dielectric material for capacitors, developed after several years of General Electric laboratory research, and made of materials available in the United States. The product can be best applied to the manufacture of most radio-frequency-blocking and by-pass, fixed capacitors used in communications and other electronic equipment. The new product has a

greater combination of desirable properties than was previously available in any one dielectric material. It is available in both rolls and sheets and can be used in present capacitor production lines with very little change in equipment or method of manufacture.

Adjustable Overload Relay

An adjustable overload relay (2⅜ by 1⅞ in.; weight 9 oz.) has been made available by Guardian Electric, 1621 West Walnut Street, Chicago. By means of an adjustable core which varies the reluctance of the magnetic circuit, the relay may be arranged to operate on any current between the range of .20 and .75

amps. Contacts are rated 5 amps. at 115 volts, 60-cycles and may be had up to 3-pole double-throw. The coil may be wound to operate on any wattage between .32 and 4.5; resistance is 8 ohms. Vibration resistance, energized or de-energized, is eight times gravity. Insulation to ground, tested at 900 volts ac.

Low-frequency Crystal

The James Knights Co., Sandwich, Ill., has perfected a new type low-frequency crystal, developed by Maurice A. A. Druesne and James Knights. This patented crystal type can be ground to better than one part per million per deg. C. drift, has unusual activity, and has been made to vibrate both on the low and high modes so that dual frequency crystals of this particular cut can readily be produced. By contour grinding, the crystals can be lowered or raised in frequency, and consequently the exact adjustment of frequency is easily accomplished. The crystal can be used in either air-gap mountings or can be plated and clamped at the nodal point. Frequencies as low as 10 kc and as high as 300 kc have been produced with good results.

Tube Flaw Detector

A new, high-frequency, electronic flaw detector for production-line detection of longitudinal cracks and seams in nonmagnetic metallic tubing in an extensive range of diameters and wall thicknesses has been developed by the Special Products Division of the General Electric Co. The new instrument is capable of detecting and locating imperfections ⅛ in. long, 10 mils wide, and one-third of the wall thickness in depth, even though they are on the inside of the tubing and do not appear on either surface. Tubing to be tested is fed through a coil box whose coils are arranged in such a way that they surround the tubing. After the circuit constants for the particular size of tubing being tested are set by means of selector switches, power is applied to the coils which in turn induce eddy currents in the tubing. A flaw in the tubing causes changes in these eddy currents. An electronic circuit in the control unit de-

tects these changes and energizes a signal relay, thus disclosing to the operator the existence and location of the flaw. The detector consists of a control unit, which is standard for testing various sizes of nonmagnetic tubing, and a coil box which accommodates any one specific size of round, straight tubing of uniform outside diameter from ¼—2 in. inclusive. Additional coil boxes, which are fully interchangeable as to mounting, dimensions, and cable terminals, are available to accommodate any size tubing within the dimensions specified. The complete instrument is small, light, and easily installed. The power supply required for the electronic units is 100-125 volts, 60 cycles.

High Speed Motor

The world's fastest industrial electric motor—revolving 1000 times a second—has been built by a Pittsburgh research engineer to speed production of airplane engines and other precision-built war equipment. Designed by Robert M. Baker, of the Westinghouse Research Laboratories, the new motor could be used to drive high-speed grinders that put a mirror-like finish on hard-to-reach internal surfaces of plane and tank engines. Such grinders are now powered by larger, slower motors connected to the grinding wheel shaft by belts and pulleys. The new high-speed motor would drive the grinder directly, eliminating production delays for belt replacement and increasing grinding accuracy. The motor is 20,000 rpm faster than any electric motor now being built for industrial use.

Plastic Precision Instruments

Due to the shortage of metal material the Emeloid Co., Inc., Arlington, N. J., has perfected a material known as "Emeloid" which is light in weight, less costly, accurate and employs no precious metals or rare materials. Slide rules up to the most complicated artillery and navigation charting and calculating instruments have been made of this product.

Panel Light Assembly

A new panel light (light-shield) assembly is being manufactured by the Dial Light Co. of America, Inc., 90 West St., New York. The unit is designed to improve lighting of instrument panels, etc. The main design feature is the knurled head which is rotatable 360 deg., thus casting the light at any desired angle. The lamp housing is made of Navy specification

bakelite sealed with bakelite varnish, while the head is made of brass and may be finished with any desired plating. Lamp socket accommodates miniature bayonet base lamp which is easily removable from front of panel. The unit is compact and rugged, and requires an 11/16 in. panel hole for mounting.

Sound Distributor

The Langevin Co., Inc., of 37 West 65th St., has developed a new type of annular sound distributor, Type L-360. This distributor utilizes a different principle of sound distribution in that it combines molecular reflection and collision instead of collision alone as in other speakers. The use of this principle results in a uniformity of sound distribution both as to frequency and power over a horizontal plane of 360 deg. and a vertical plane of approximately 40 deg. It is 22 in. in diameter with an overall height of 25 in. It will handle power input of 20 watts when equipped with Jensen U-20 drive unit.

Insulation-Resistance Meter

A new electronic insulation-resistance meter for measuring the resistance of insulation in apparatus during manufacturing, has been developed by the Special Products Division of the General Electric Co. The instrument consists of a conventional electronic rectifier, a Thyrite bridge circuit, and an electronic-tube voltmeter. It is available in two types. One type has a scale calibrated from 1 to 50 megohms and measures resistance at 500 volts dc; the other type has a 0 to 20,000 megohm total range and measures resistance over four different resistance intervals — from 0-5 megohms at 0-250 volts dc and 5-200, 50-2000 and 500-20,000 megohms at 500 volts dc. Any range may be quickly selected by a panel-mounted rotary switch. The meter, operates on 115-volt, 60-cycle current.

Photoelectric Colorimeter

Lumetron photoelectric colorimeter Model 400-H, made by Photovolt Corp., 95 Madison Ave., New York, is operated by a dry-cell housed in the instrument casing.

It operates with a barrier-lever photocell which is connected to a taut-wire suspension galvanometer. The instrument is built into a portable wooden case 5 x 6 x 15 in. and does not require any external power connection.

Electronic Feedwater Control

Combustion Control Corp., 77 Broadway, Cambridge, Mass., has developed a series of electronic feedwater controls for maintaining constant boiler water levels automatically, and for guarding against high and low water hazards. Three probes are used in a fitting which may be mounted parallel to the water column, or directly on the boiler. These are wired to the electronic control which shuts off the fuel supply and sounds an alarm when the water falls to the level of the lowest of the three. The top and middle probes determine the high and low levels at which the boiler feedwater pump is turned on and off to maintain constant water level.

Transmitter Houses Can Be Attractive

This is the ultra-modern structure which houses the WSPD transmitter, fed from home studios in Toledo, O. Towers are in a triangular arrangement

ELECTRONIC TOMORROWS

"The Aroma of Fresh Coffee by Radio."—WCAU's Ad Writer Gets Carried Away by Fragrant Future

In radio programs of the future, when the hero mentions the aroma of the coffee he's drinking—or when the bride buries her head in her wedding bouquet—or when the announcer lauds the appetizing fragrance of "Korny Krunchies"—listening and visual audiences will enjoy the scent right with them. Scientists and engineers are conducting experiments that promise the transmission of radio waves bearing the aroma of coffee, the perfume of a rose, the salty tang of the seashore and many other scents.

Radio faces many new horizons—new vistas of realism and power. —Advertisement of WCAU, Philadelphia, in "Advertising Age."

Beryllium Copper Supply

A folder, published by Instrument Specialties Co., Little Falls, N. Y., sets forth the facts about the supply of beryllium copper in contrast to misleading stories which have appeared in the newspress. The folder, "Spiking A Rumor," analyzes the present status and the future prospects of the beryllium copper supply and mentions the methods that this company, manufacturer of beryllium copper springs, has used to meet deliveries.

Electronics for an Improved Postwar World

We read and hear much about the many gadgets that will make their appearance on the market in the postwar era as a result of wartime research and development in electronics. Dr. W. R. G. Baker, vice-president of General Electric, has recently appraised the character of this new science in these words:

"Electronics services fall into three broad classifications: communications, such as radio and television; the actual transmission and rectification of electric power; and the control of other devices or operations. Electronics is not going to be any vast new postwar industry with a tremendous dollar-volume, because the tube which is the heart and nerve is in itself only a small thing. Electronics is not going to revolutionize the methods of making paper or steel or bread, but it is going to help existing methods and increase production efficiency. Finally, electronics is not going to make obsolete your home, your household equipment, and your way of living—it is going to make that home a finer place to live in and you a happier individual."

Creative Plastics Corp., 963 Kent Ave., Brooklyn, N. Y., manufacturers of insulating grommets and fabricated plastic parts, has opened New York offices at 393 Seventh Ave.

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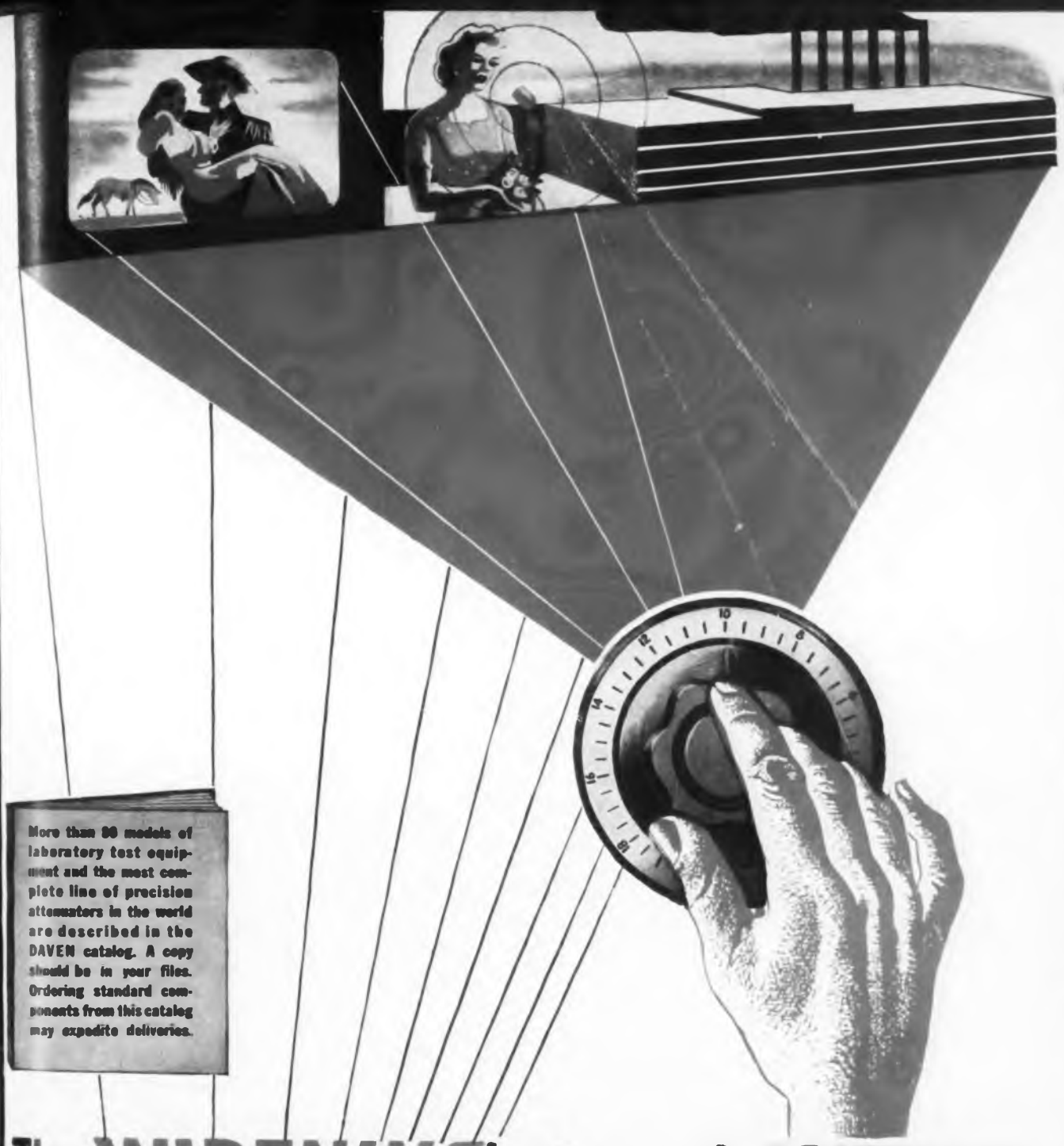

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