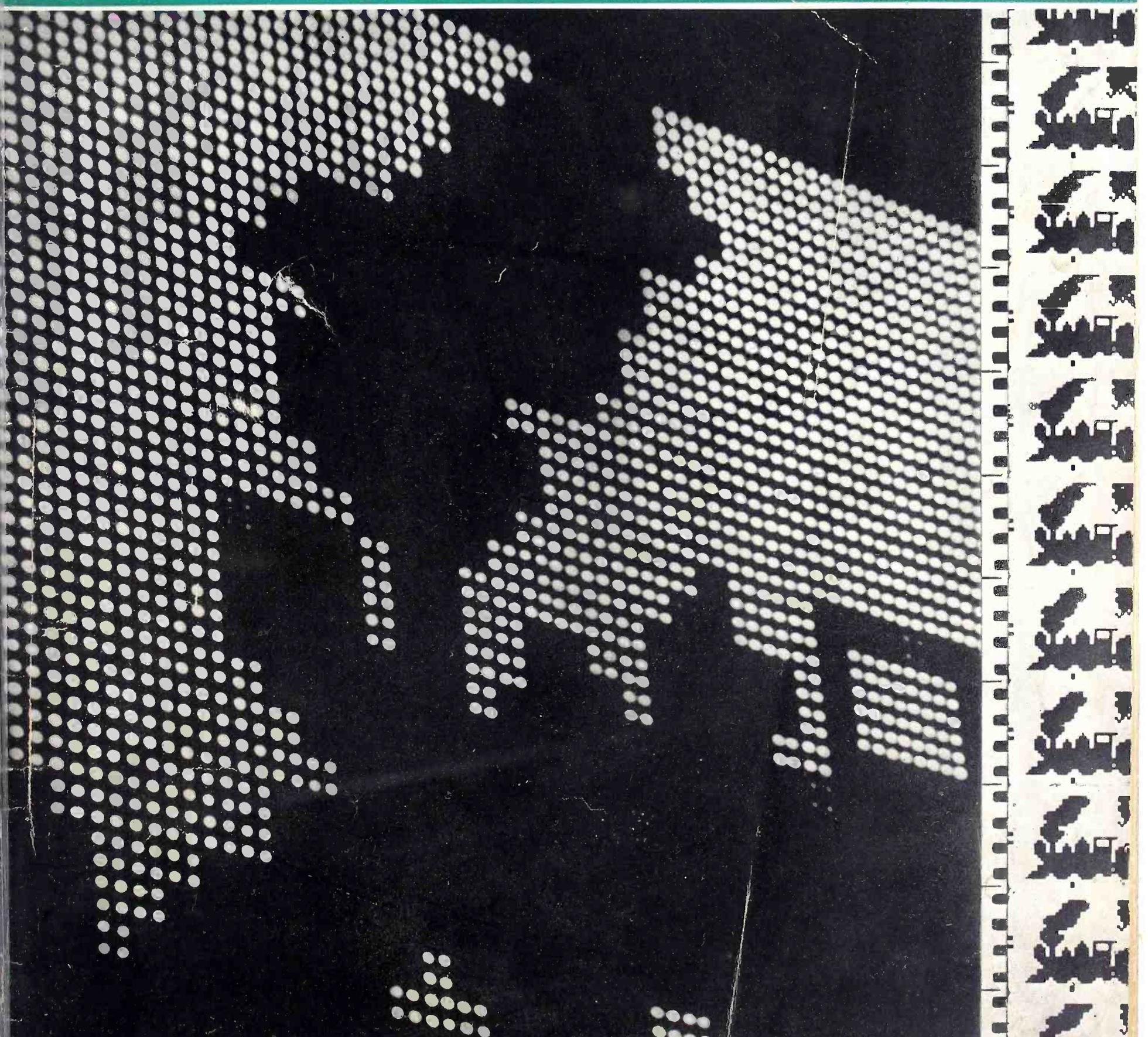


September 1937

electronics

radio, communication, industrial applications of electron tubes... engineering and manufacture



BROADWAY SPECTACLE
1026 Phototubes Control 4104 Lamps
(see page 21)



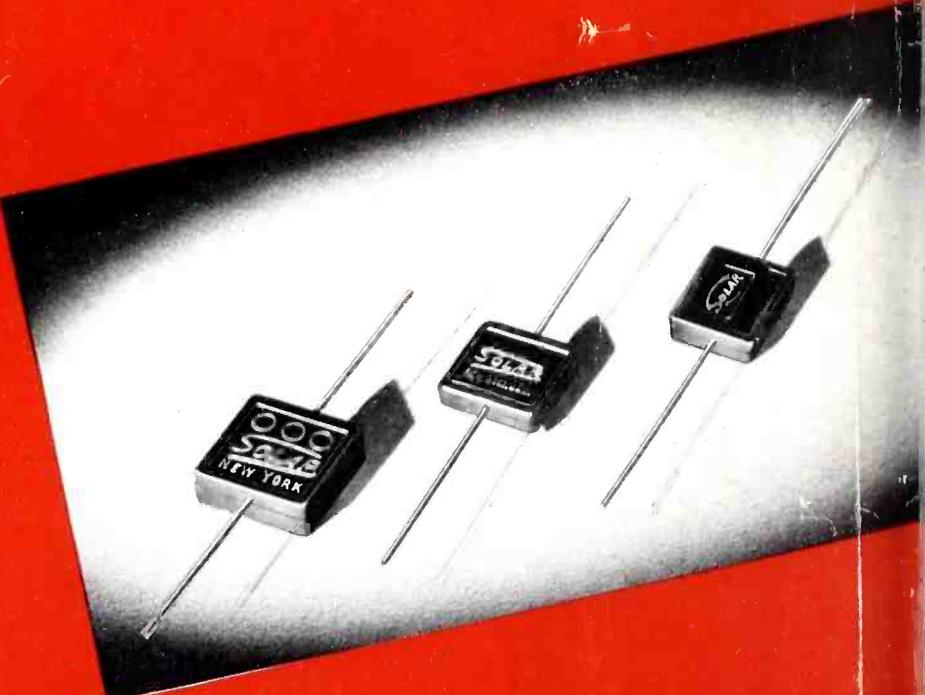
SOLAR WET ELECTROLYTICS
 Surge-proof; high effective capacity; remarkable idling characteristics

SOLAR DRY ELECTROLYTICS
 High voltage breakdown; low leakage; long life; freedom from corrosion; operate at low and high temperatures



SOLAR PAPER CAPACITORS
 High overload voltage; long life; excellent moisture seal; low R.F. impedance

SOLAR MICA CAPACITORS
 Low R.F. losses; capacity stable through wide temperature variations

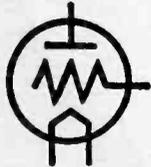


SOLAR TRIMMER AND PADDING CAPACITORS
 Low R.F. losses; constant capacity after setting; smooth adjustment; rugged mechanical construction



SOLAR MFG. CORP.
 399-601 BROADWAY, NEW YORK

electronics



RADIO . . . COMMUNICATION AND
INDUSTRIAL APPLICATIONS OF
ELECTRON TUBES . . . DESIGN . . .
ENGINEERING . . . MANUFACTURE

HOWARD EHRLICH
Executive Vice-President

H. W. MATEER
Manager

KEITH HENNEY
Editor

DONALD G. FINK
Managing Editor

BEVERLY DUDLEY
Associate Editor

HARRY PHILLIPS
Art Director

ELECTRONICS, September, 1937, Vol. 10, No. 9.
Published monthly, price 50c a copy. Subscription
rates—United States and possessions, Canada,
Mexico and Central American countries, \$5.00 a
year. All other countries, \$6.00 a year or 24
shillings. Entered as Second Class matter, August
29, 1936, at Post Office, Albany, N. Y., under
the Act of March 3, 1879.

Branch Offices: 520 North Michigan Ave., Chicago;
883 Mission St., San Francisco; Aldwych House,
Aldwych, London, W. C. 2; Washington; Phila-
delphia; Cleveland; Detroit; St. Louis; Boston;
Atlanta, Ga.

Contents Copyright, 1937, by
McGraw-Hill Publishing Company, Inc.

McGRAW-HILL
PUBLISHING COMPANY, INC

Publication Office
99-129 North Broadway, Albany, N. Y.
Editorial and Executive Offices
330 West 42nd Street, New York, N. Y.

James H. McGraw, Jr., President
Howard Ehrlich, Executive Vice President
James H. McGraw, Honorary Chairman
B. R. Putnam, Treasurer
D. C. McGraw, Secretary

Cable Address:
MCGRAWHILL, New York
Member A.B.P. Member A.B.C.

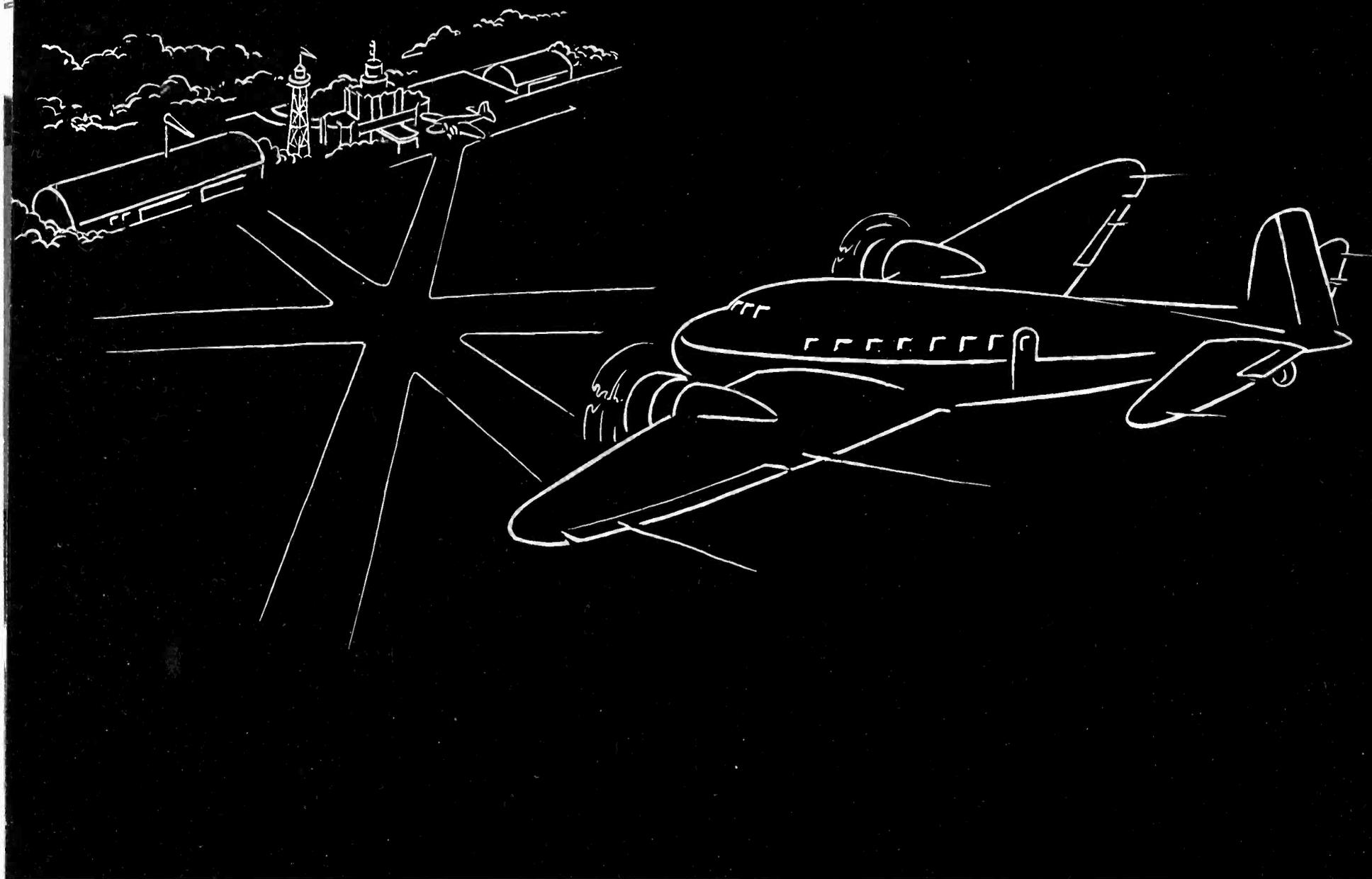
CONTENTS, SEPTEMBER, 1937

ELECTRONICS ON BROADWAY	Cover
Competing with the theaters is this enormous sign on the great white way in New York City. Animated cartoons nightly attract crowds of on-lookers. See page 21 for description	
SHIP-TO-SHORE RADIOTELEPHONE—By R. H. Riddle	9
A brief survey of this important extension of the telephone system with description of the apparatus and methods	
TELEVISION ABROAD—By M. P. Wilder	13
Marshall P. Wilder of National Union Radio Tube Company went abroad for his company to make a survey of television in England and Germany. A report on what he found	
PUSH-BUTTON TUNING SYSTEMS—By B. V. K. French	16
1938 receivers will see a new automatic feature—push-button tuning. A complete picture of the systems now in sight for this radio set advance	
CONDENSER DISCHARGE CHART—By J. B. Hoag	20
TUBE-CONTROLLED OUTDOOR SIGNS	21
The mechanism by which images projected on a screen made of hundreds of small phototubes are finally made visible to theater goers in New York	
RADIO AT THE NORTH POLE	22
A group of pictures taken at the top of the world showing the uses of radio communication	
SIMPLIFYING THE BROADCAST MAN'S JOB—By George Ing ..	24
Simplified control panel substituting rotary switches for the usual patch cords	
WELDING BY KATHETRONs—By Palmer H. Craig	26
Applications of Kathetrons to electric welding and voltage regulation	
COMPONENTS FOR 1938 RECEIVERS	Insert

DEPARTMENTS

CROSSTALK	7
REFERENCE SHEET	20
QUESTIONS AND ANSWERS	29
BOOK REVIEWS	30
TUBES AT WORK	32
ELECTRON ART	44
MANUFACTURING REVIEW	59
PATENTS	68
INDEX TO ADVERTISERS	72

SAFELY ACROSS THE SKY



AS the great commercial planes wing their way across the sky, the radio beacon keeps them safely on their course through rain, fog, or starless night. Guided to landing fields by invisible radio waves, the planes glide gently down the track to deposit their cargo of human lives in safety at their destination. Perfect functioning of radio equipment is essential to that safety — and Isolantite ceramic insulators contribute their share in assuring the highest efficiency of operation...In transmitting and receiving equipment at the field, in every radio circuit aboard the plane, Isolantite insulators minimize di-

electric losses and insure dependability of the entire system.

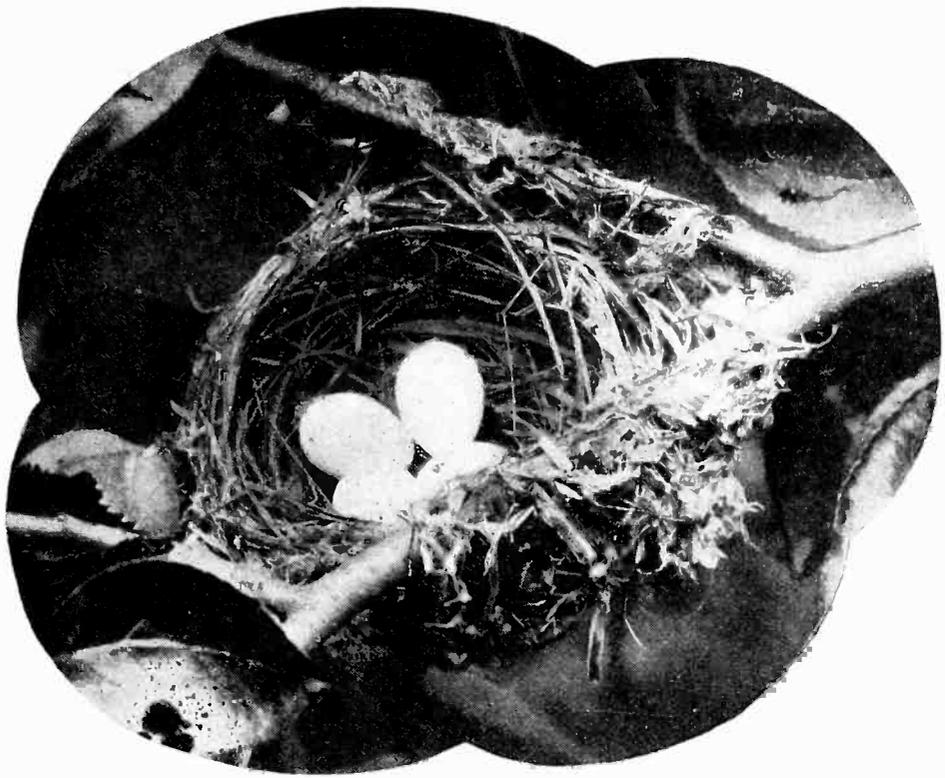
Long experience in the problems of ceramic insulator design enables Isolantite to place at the service of its customers its specialized knowledge of radio requirements. In all questions of insulator design or selection, Isolantite engineers will give their full cooperation.

ISOLANTITE INC.

CERAMIC INSULATORS

Factory: Belleville, N. J. • Sales Office: 233 Broadway, New York, N. Y.

Now—
**NESTED
CASES**



by **FERRANTI!**

Again leading the field, Ferranti offers NESTED SHIELDING, in quality transformers and inductors.

Wherever units are operating at extremely low levels or in exceedingly severe fields—WHY NOT CONSIDER NESTED CASES?

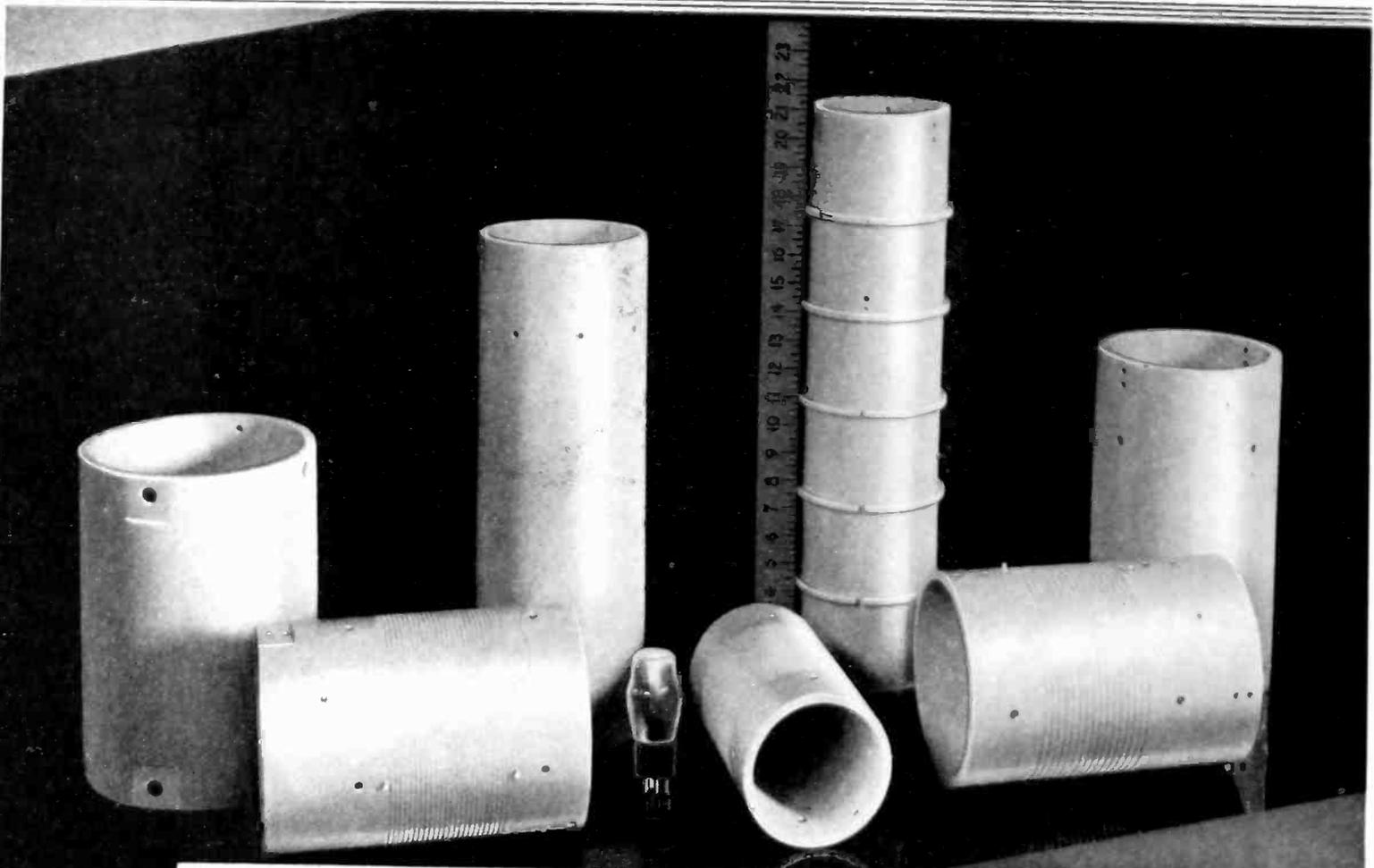
Any Standard or Special Ferranti Unit can now be supplied to order with NESTED SHIELDING.

Send us your specifications indicating operating levels and shielding required in db.

OUR ENGINEERING STAFF IS AT YOUR SERVICE.

FERRANTI ELECTRIC, INC.
RCA BUILDING, NEW YORK, N. Y.

CASTEATITE *What it is...What it does...*



FOR YEARS, the production of low loss radio frequency ceramic dielectrics has been confined to articles of small dimensions. This restriction has forced the use of inferior insulation or expensive composite construction for the larger insulating parts needed by the communication industry. Both of these objections are simultaneously eliminated with Casteatite, the name given the latest development of the laboratories of General Ceramics.

Casteatite is produced by **casting** low loss **steatite** ingredients instead of shaping articles by moulding or extruding. Large articles yield very readily to this method of fabrication which, in the high frequency insulator field, represents a triumph of modern ceramic engineering.

With Casteatite a single piece may be made

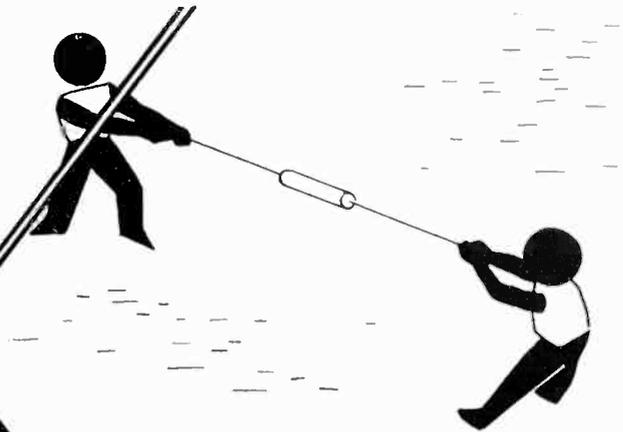
which will do the work of a score or more of small insulators. An entire switch plate for a 10 KW transmitter with stand-off insulators integrally cast in place is possible in Casteatite. Slotted bars and heads are no longer needed for large size inductance supports since they may be made, threaded, in a single piece of Casteatite. Integrally cast flanges on pillar insulators, bushings for supporting heavy loads, lead-in insulators and countless other insulating details are possible with Casteatite.

Casteatite offers many advantages to the designer of high frequency apparatus worthy of his investigation for it saves in space and cost, and produces a more perfectly coordinated assembly combined with high quality RF insulation.

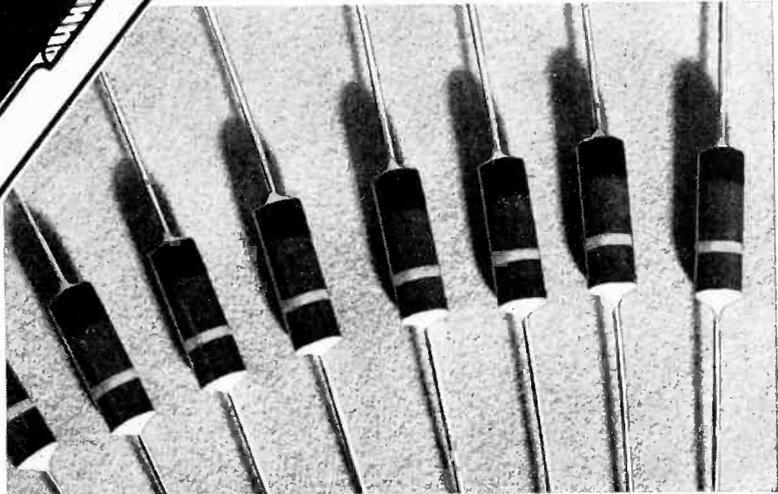
A bulletin describing Casteatite will be mailed upon request.

GENERAL CERAMICS COMPANY · 30 ROCKEFELLER PLAZA · NEW YORK · N · Y ·
DIELECTRIC PRODUCTS CORPORATION · Marketing Agents · 245 CUSTER AVENUE · JERSEY CITY · N · J ·

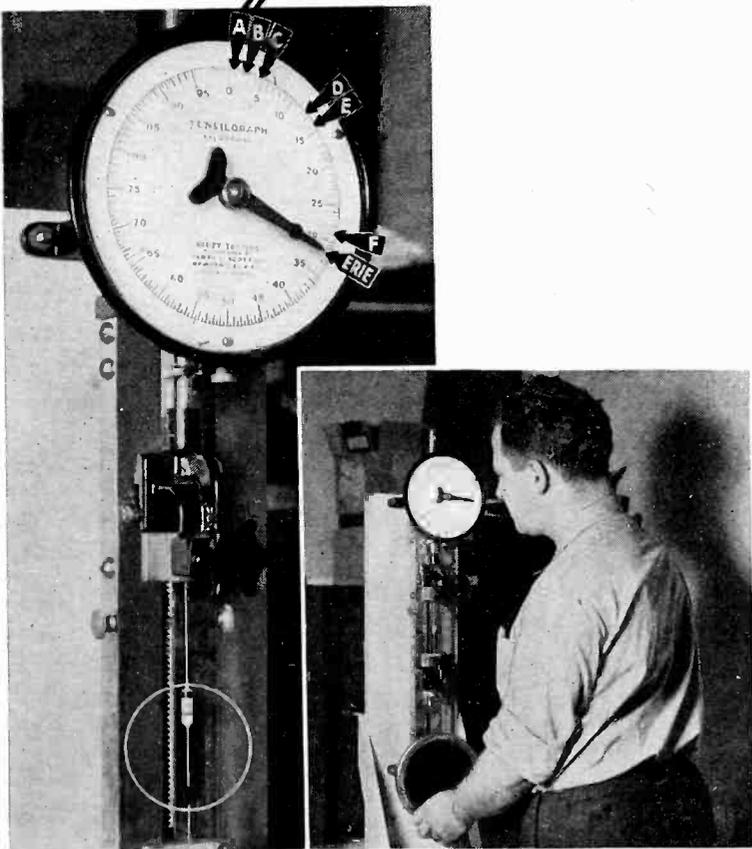
with **PATENTED**
ERIE *insulated* **RESISTOR**
CONSTRUCTION



GREATER



MECHANICAL STRENGTH



Recent tests conducted by our engineering department show that 1/4 watt Erie Insulated Resistors can withstand an average pull of 32 pounds before failure occurs. Because of the rigid construction of Erie Insulated Resistors, fracture occurs in the tinned-copper lead wires without damaging or open circuiting the interior of the unit. This type of wire is used because of its superior electrical properties and the ease with which it can be soldered.

Similar tests run under identical conditions on six competitive makes of 1/4 watt insulated units showed wide variations in mechanical strength. The average pull at which failure occurred in these units is indicated by the arrows on the testing machine illustrated at the left.

Patented construction of Erie Insulated Resistors gives you this extra margin of safety against open-circuiting during or after installation in the chassis.

CARBON RESISTORS
 AND SUPPRESSORS

**ERIE RESISTOR
 CORPORATION**

AUTOMATIC INJECTION
 MOLDING

TORONTO

ERIE, PENNSYLVANIA

LONDON

HIGH SURGE VOLTAGE?

**MALLORY CAPACITORS
GIVE LONGER SERVICE IN
SEVERE SURGE VOLTAGE
APPLICATIONS**



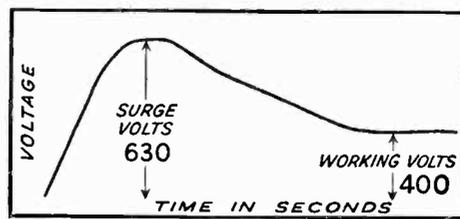
* An example *

A radio chassis submitted to the Mallory Research Department was found to have a 630 volt surge. This is unusually high and no ordinary capacitor would stand such abuse.

However with the Mallory units recommended for this application, the customer reports no field trouble in an experience record of over a year.

Due to the new Mallory barrier type separa-

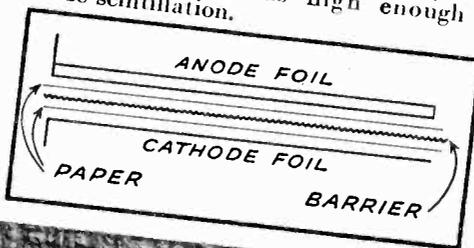
tor material, this customer saved considerable money in not having to redesign his chassis, nor purchase special high-priced capacitors.



...and why this is possible

Theoretically surge voltage failure in either wet or dry electrolytic capacitors is caused by the ignition of a minute quantity of mixed gases sometimes accumulating at the anode during severe overload, and where scintillation is encountered. If the gases cannot combine, surge voltage failures will not occur. Since one of these gases is generated at the anode side, and the other at the cathode side of the electrolyte, the use of this special high density material, as part of the separator, acts as a barrier and retards their mixture.

Compared to other types of separator material, capacitors having non-fibrous cellulose separators will have a much longer life even though repeatedly subjected to overloads high enough to cause scintillation.



REDUCE FIELD TROUBLE!

SPECIFY

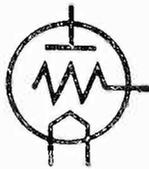
P. R. MALLORY & CO. Inc.
MALLORY

CAPACITORS .. ALWAYS!

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

ELECTRONICS

SEPTEMBER
1937



KEITH HENNEY
Editor

Crosstalk

► **FAIR EXCHANGE** . . . Newspaper accounts tell of an exchange of patents between the AT&T company and Philo T. Farnsworth. By this agreement each may use the patents of the other without payment of royalty unless one or the other decides to invade the particular field of the other. Thus Farnsworth gets valuable rights under telephone patents; on the other hand the telephone company carries out its long standing policy of protecting itself against any contingency in the future.

CBS seems to be greatly interested in Farnsworth (not financially, CBS says.) Much Farnsworth equipment has been moved to CBS headquarters in New York City. By the middle of 1938 things will be humming in television.

► **ALPHA TO OMEGA** . . . In advertising the New York Times Index, in the Times Book Review Section, July 4 this year, very large type was used to reveal the important fact that the first entry was AAA and the last was ZWORYKIN, VLADIMIR K. and that there were 350,000 other items in the book.

► **CROSS MODULATION** . . . Mr. R. L. Petersen who investigates reports of radio interference relates the following case of crossmodulation which may account for many apparently inexplicable situations.

"In house wiring, particularly in apartments, extension wall outlets are often installed with BX wiring after the house is built, and are wired to some convenient wall switch instead of to a lamp fixture. Since the wall switch box usually does not contain a neutral wire, the installer will usually use the BX armor as a ground return for the new outlet. After a period of use, corrosion of the BX armor at the flexible joints between turns in the armor produces a rectifying condition."

Mr. Petersen has cured a number of cases of interference by rewiring wall outlets so as to have a copper neutral connection instead of grounding through the BX armor.

► **NOW IS THE TIME** . . . to get in your subscription to the Circulation Department's offer of a service to those who want annual compilations of the monthly Reference Sheets. It will cost \$1 per year, postpaid if cash is sent with order. For further details contact H. C. Henderson, Circulation Department of Electronics.

► **450,000 WORDS** . . . In a report of this length, a document, recently made public by the President, entitled "Technological Trends and National Policy, Including the Social Implications of New Inventions," indicates electronics will play an important part in world progress of the next twenty years. Of the thirteen new technologies which seem to be gathering headway for a booming future, three are in the electronic field, two others are definitely allied.

The study was conducted by a subcommittee of the science committee of the National Resources Committee under the direction of William Fielding Ogburn of the University of Chicago.

The three divisions of electronics are:

1. Television.
2. Facsimile transmission.
3. Photoelectric cells—"the electric eye," about which the report says "indeed it brings the automatic factory and the automatic man one step closer."

► **HONOR** . . . In recognition of his long standing work with ultra-short waves for therapeutics, J. H. Hallberg of New York was one of the two recipients in this country of invitations to attend the International Congress for Short Wave in Physics, Biology and Medicine held at Vienna July 12

to 17th. On October 18, 1928 Mr. Hallberg took to the American Medical Association his beliefs that the medical science would do well to investigate the very short waves and their effects. Since that time many applications have been made; but in Europe actual uses have been most numerous.

► **PUSH-BUTTON** . . . Already on the market are several receivers with automatic tuning features. You push a button, or twirl a dial and the receiver automatically tunes in the station desired. This is not new; but this year it is hot. And next year, 1938, the bugs will be ironed out.

A rather complete resume of the methods used to bring radio still closer to the acme of a lazy man's delight will be found in this issue. Probably no one in the industry has a better grasp of the whole situation than B. V. K. French of P. R. Mallory.

► **ATTRACTIVE PROTONS** . . . The editors wish to draw attention to one of the finest examples of writing on scientific subjects to appear in many a moon: "What Holds the World Together" by George W. Gray in the current (September) issue of *Harper's Magazine*. Written for the intelligent lay reader it will nevertheless hold the interest of the most learned electronic specialist. It describes the discovery made last year by Tuve and his associates at the Carnegie Institution in Washington, of the attractive force between protons, the antithesis of the time-honored Coulomb's Law by which like charges repel one another. This force, tremendous in magnitude compared with the Coulomb forces, holds protons (and neutrons) in close proximity within each atomic nucleus, and in this sense "holds the world together." The story is accurately and fascinatingly told by Mr. Gray; it is worth the attention of everyone interested in electronics.



Toll operator putting through ship-to-shore call at 32 Walker St., New York City, from which position connection can be made with 34,000,000 telephones in 68 countries

By R. H. RIDDLE

THE first commercial ship-to-shore telephone service was officially inaugurated by the American Telephone & Telegraph Co. on Dec. 8, 1929, with calls being accepted to and from the *Leviathan*, at that time the only ship equipped for such service. The rate was \$21 for three minutes from the seaboard zone centered at New York, the regular toll charge being added for calls outside the zone.

Since then, the number of ships to which service is offered and the volume of traffic have steadily increased, and at the present writing the volume is approximately 700% above that of the first months of operation. The rate for three minutes to and from the New York area has been lowered to \$18 for ships at a distance of 1,500 miles or more and \$9 for ships within 1,500 miles.

It is interesting to note that approximately 75% of the calls originate on the ships and are made within the 1,500 mile zone. The heaviest traffic is usually handled as the ship nears New York, at which time many of the passengers wish to make last-minute arrangements for landing, or when a ship is delayed in crossing by storms or cannot enter the harbor because of fog and business affairs must be discussed or social engagements postponed. At such times calls are also accepted for and completed to persons waiting on the pier.

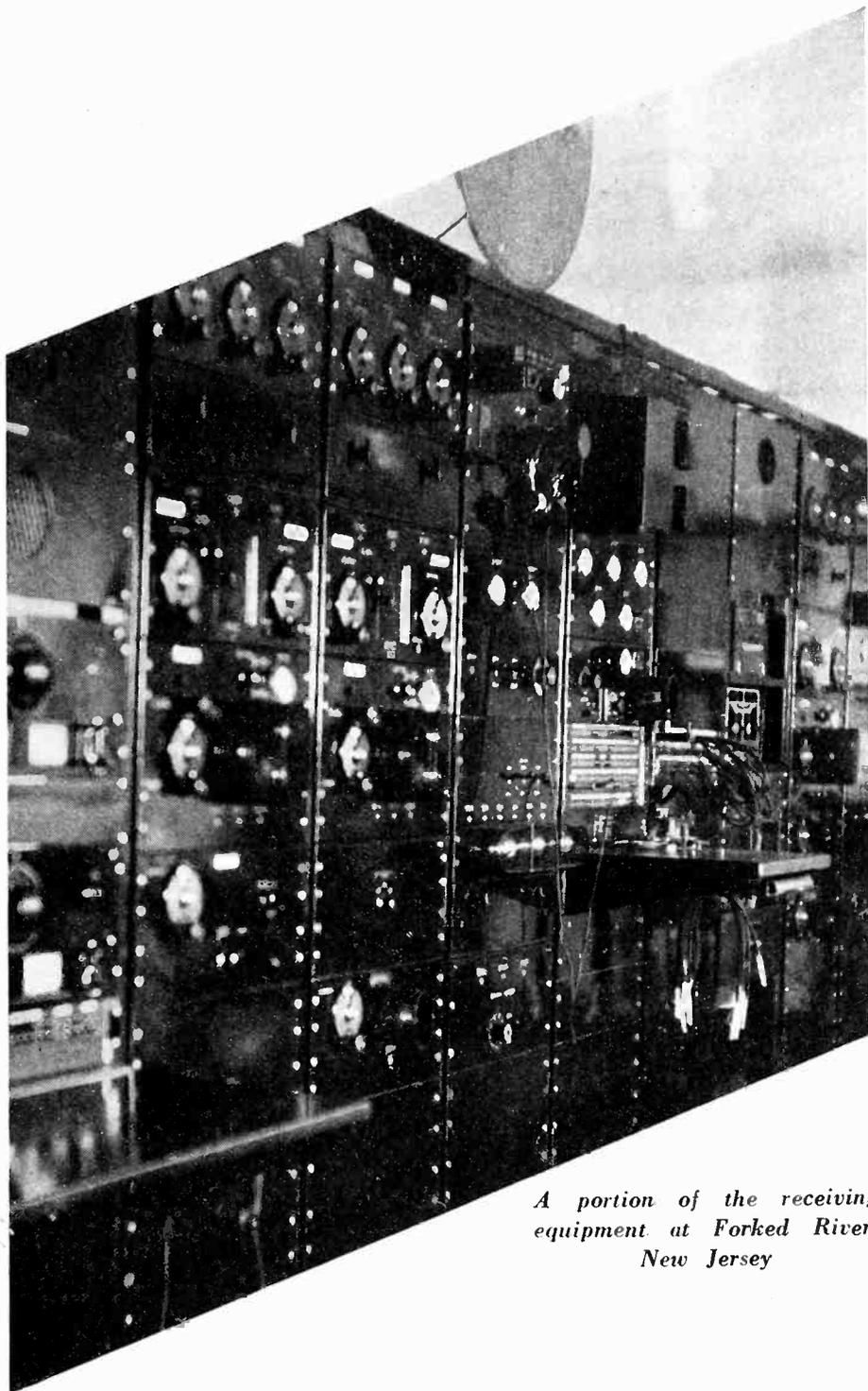
It is also interesting to note that throughout the day, traffic is heaviest in the early evening, especially immediately after dinner. This rush of evening business is ascribed by some of the operating

Ship-to-Shore Communication

personnel who have had radio operating experience to be at least partially the result of a general feeling that "all's right with the world" after a satisfactory repast.

The rendering of a ship-to-shore radiotelephone service presents an engineering and operating problem involving many factors not present in point-to-point radiotelephone or

in ship-to-shore radiotelegraph services. It is the purpose of this article to describe the system which links the transatlantic liners to the telephone facilities on the North American continent, with emphasis on features of both the shore and ship equipments that are peculiar to this type of service, particularly those features recently incorporated.



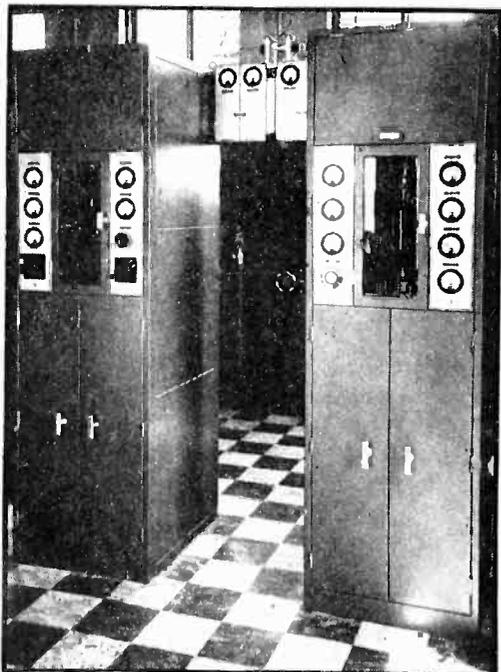
A portion of the receiving equipment at Forked River, New Jersey

The shore system has been developed by the American Telephone and Telegraph Company, and is operated by the Maritime Division of their Long Lines Department. The several ship equipments are operated independently by a number of radio operating companies, among which are the International Marine Radio Company, Compagnie Radio Maritime, Deutsche Betriebsgesellschaft für Drahtlose Telegraphie, Society Italiana Radio Marittima, and Marconi International Marine Communication Co., Ltd.

A general conception of the shore system may be obtained from the greatly simplified plan illustration of Fig. 1.

Requests for calls come to the ship-to-shore switchboard position, shown in the frontispiece, which differs little from an ordinary toll position except for special monitoring and timing facilities, but which is in the overseas section of the toll switchboard at 32 Sixth Avenue, New York, from which about 93% of the world's telephones may be reached.

Details of the calls are passed to or received from the ships, and the calls cleared via the control and receiving station at Forked River, N. J., and the transmitting station at Ocean Gate, N. J.



A feature of this low power (400 watt) Western Electric transmitter used in ship to shore communication is the ease with which frequency can be changed. By twirling the telephone dial, lower left meter panel of the right hand unit, any of ten carrier frequencies is automatically chosen

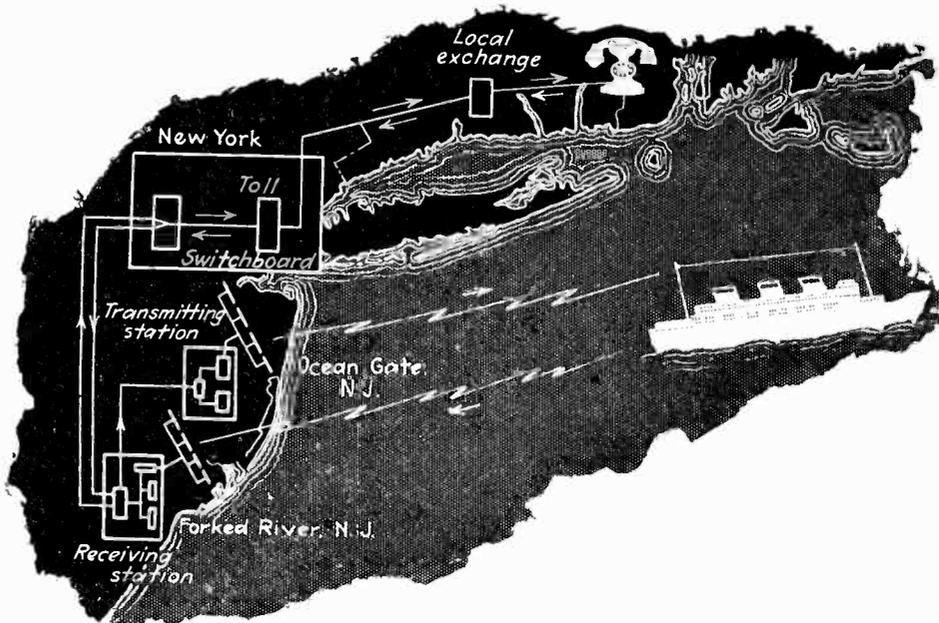


Fig. 1—Schematic diagram of the ship-to-shore communication circuit. The shore receiving station is at Forked River, the transmitter at Ocean Gate, N. J.

It will be noted from Fig. 1 that two one-way circuits (one for transmitted and one for received speech) are used between the control position at Forked River and the switchboard in New York, but that for connection through the switchboard to the normal two-way telephone system, the two are combined into one two-way circuit. The block schematic of Fig. 2 indicates how this combination is made by using a hybrid coil group in conjunction with the voice operated relay system of the control equipment, which alternately blocks the transmitting or receiving side of the circuit, as first one and then the other subscriber speaks, in order to prevent echoes or received noise from being re-radiated, or a singing path from being completed. As shown, the circuit is normal, with the transmitting side blocked and the receiving side clear but speech not being received.

Receiving Station

It is from the receiving position at Forked River that the technical operator coordinates the transmitting and receiving facilities, establishes contacts with the ships and makes the circuits available for service as they are needed and requested by the traffic operator. The receiving equipment consists of three receivers which may be used either for traffic, or for monitoring the frequencies not being used for traffic

and on which the ships may make unscheduled calls; a number of other receivers are used for monitoring only. Two of the traffic receivers are of the type in general use on the point-to-point circuits.¹ The third traffic receiver is a relatively small receiver recently developed. It is a light, compact unit (dimensions, approx. 1' 5" x 10"; weight, approx. 15 lb.) of high sensitivity, with the oscillator-modulator stage crystal controlled. The oscillator and high frequency input circuits are arranged for quick shift between two fixed frequencies. Block schematic diagrams of both receivers are given in Fig. 3.

A very useful feature of this equipment is the "noise reducer" in the receiving circuit. In effect, its operation is that of an automatic gain control in reverse. Speech is transmitted at the correct level without loss or gain. When no speech is being received and the only input is the background noise at a level of perhaps 20 db below the speech, the noise reducer introduces an additional 20 db attenuation. This additional loss lowers the noise to a level no longer disconcerting to the speaking subscriber and well below that at which the voice relay system operates.

Since the weak parts of speech are likewise reduced, the sensitivity of the reducer is adjusted to a compromise setting, determined by the noise level, which will give a maximum of noise reduction without ob-

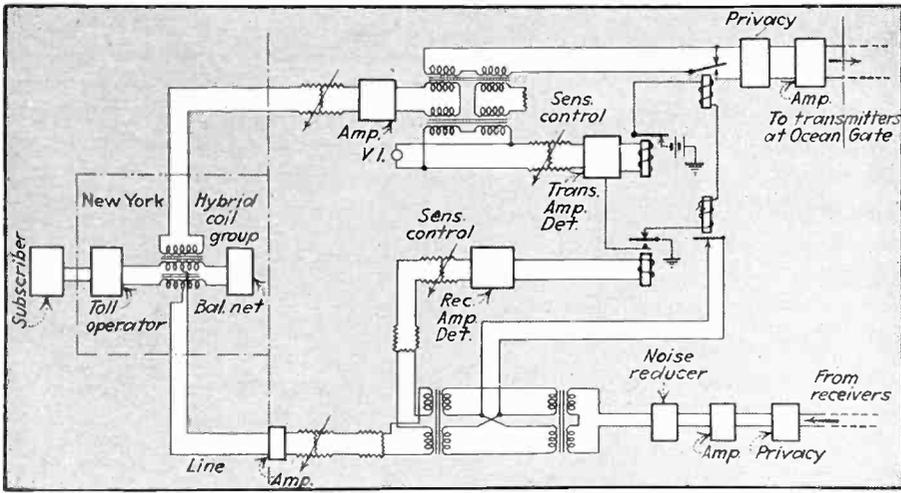


Fig. 2—Hybrid coil circuit through which two separate one-way radio circuits are combined into a single two-way communication circuit

jectionable degradation of speech quality. The result is a net improvement in circuit merit.

A special ship-to-shore feature of the receiving system is the carrier-operated receiver output relay shown in the circuit of the larger receiver. This relay, controlled indirectly by the carrier received from the ship, is necessary for satisfactory operation when a system is used on the ship to suppress the transmitting carrier during reception. The relay blocks the voice-frequency output of the receiver when the carrier is off, preventing the high noise resulting from the increase in gain by the automatic gain control from reaching the subscriber, and simplifying the adjustment of the voice-operated relays and the noise reducer.

Transmitters

At the Ocean Gate transmitting station, there is one transmitter capable of delivering approximately 15 kw. of unmodulated power to the antennas. It is of the type used on the point-to-point circuits² and has been in service since this station was placed in operation.

A second transmitter of approximated 400 watts unmodulated power, has recently been installed. In this smaller transmitter, Page 10, developed by the Bell Telephone Laboratories for this and similar services in which frequent changes of frequency are necessary and the time required for the change is an important operating factor, the long sought for ideal of very rapid automatic change of frequency has been realized. By means of a dialing and relay system incorporated in the

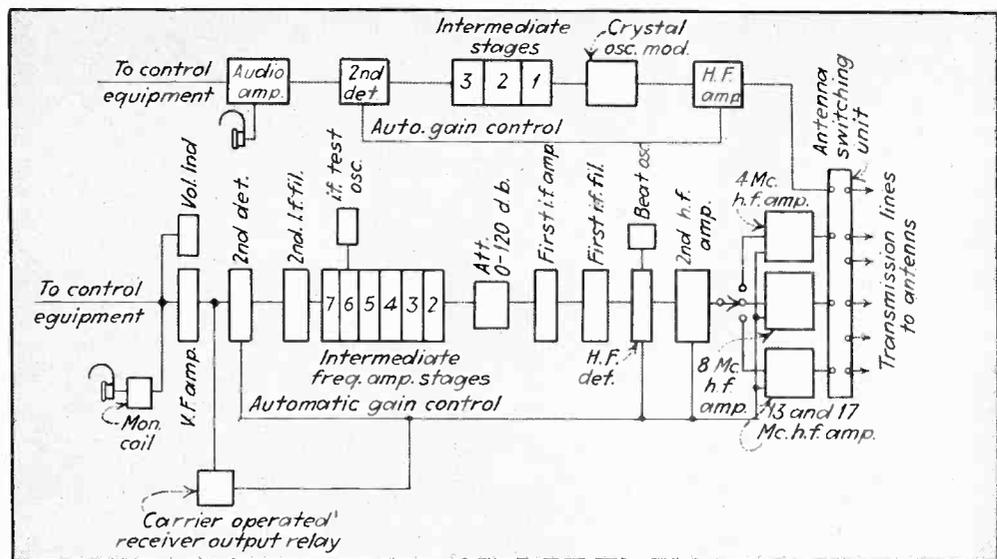


Fig. 3—Block diagram of the service receiver at Forked River

unit, any one of 10 pre-adjusted frequencies between 2 and 18.1 megacycles may be selected, the change made, and the carrier brought up again within the time required for the dial to return to its original position, about $\frac{1}{2}$ to $1\frac{1}{2}$ seconds.

At present, the dialing is done by the operator at the transmitting station. However, the dialing circuits are designed for either local or remote control and the control is soon to be extended to the Forked River technical operator's position. Also, it is planned to install auxiliary circuits so that, with a second dialing operation, the transmitter can be switched to the desired output circuit and antenna.

For the type of service in which the optimum frequency for any one ship varies from hour to hour, and in which contact must be made with any one of several ships as traffic demands, the enormous advantage of

this quick change feature is immediately apparent. If manual change must be used at either end of the circuit, a delay of several minutes is one of the factors the operators must consider in deciding to shift to another frequency which may be more satisfactory. When this 400 watt shore transmitter is being used to work the liner *Queen Mary*, the service with respect to rapid change in operating frequency approaches operating perfection, for the *Queen Mary's* equipment includes two short-wave transmitters with similar wave-change circuits. With such facilities available at both ends of the circuit it is possible to

make two or three shifts in frequency without seriously delaying traffic.

The various stages of the transmitter are a crystal oscillator, two intermediate buffer-amplifier stages (which may function either as amplifiers or doublers, depending upon the frequency used), a modulating amplifier and a power amplifier. With the exception of the oscillator and the final radio frequency amplifier, the tubes used in the high frequency amplifier units are of the screen grid type, thus eliminating the necessity for neutralizing, except in the power amplifier stage, which is properly neutralized at the factory.

The rectifier and amplifier unit contains all power transformers, grid bias and plate supply rectifying tubes with their associated filter circuits, control relays for the automatic energizing of the filament and high voltage circuits in proper se-

quence, all speech input and audio amplifier circuits necessary to completely modulate the transmitter, and a copper oxide rectifier which furnishes d-c power for the operation of a local microphone and all control relays.

Frequency Assignments

In order to give service simultaneously from both the American and European shore stations, separate pairs of frequencies are required for each shore station, and the ships change frequency depending on whether they wish to work with London or New York.

The requirement of being able to work as continuously as possible across the Atlantic was a determining factor in deciding upon use at each station of four pairs of transmitting and receiving frequencies—one pair for each of the distance ranges. The operating frequency used depends upon the ship's position and upon atmosphere conditions.⁸

Antennas

Two of the 4 and 8 megacycle transmitting antennas at Ocean Gate are of the Bruce type, and two are of the "H" type. Two of the 13 and 17 megacycle antennas are of the

"H" type and two of the "saw-tooth" type.

At Forked River, Bruce type antennas are used for reception on 4 and 8 megacycles; also an inverted "V" type on 4 megacycles within the 400 mile range of the ground wave. For reception on 13 and 17 megacycles, and occasionally on 8 megacycles when interference from motor boat ignition systems make it necessary, a rhombic type antenna is used which is very effective in reducing this type of interference, as the radiation appears to be largely vertically polarized.⁴

These antennas are not as sharply directional as those used in point-to-point service, since the entire geographical sector determined by the steamship lanes must be covered, and they are not all directed along the same great circle bearing, but each one directed on that section of the steamship lane for which its frequency gives the best signal.

The location of the stations directly on the coast was the result of tests⁵ indicating that overland attenuation of the ground wave, which is used for transmission out to distances of the order of 200 or 250 miles, is quite high for even a small amount of land. Results of

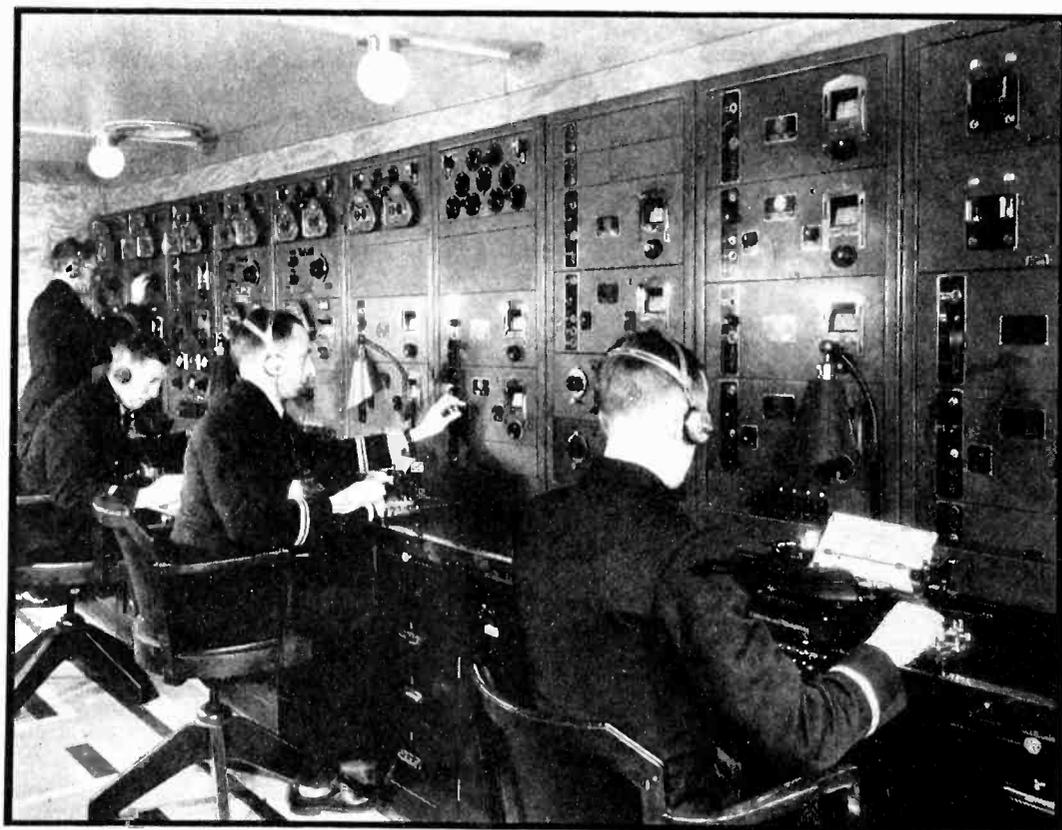
the tests made later at Forked River on 4392 kilocycles indicate that a mile of overland transmission results in 9 db less signal field strength than for transmission over one mile of water. Such a loss is equivalent to cutting down the power radiated by the transmitter to one eighth.

Ship Equipment and Installation

The equipment and installation on the Cunard-White Star *R.M.S. Queen Mary* was chosen for description here because it is the latest, and perhaps most elaborate, and because since it was designed to order in every detail, many features were incorporated which were impossible in adding to or modifying existing equipments for radio telephone service. This exclusive choice is in no way a reflection on the splendid equipments of ships, such as the *Normandie*, *Bremen*, *Europa*, *Rex*, *Empress of Britain*, and others.

The *Queen Mary's* equipment is the result of a number of years of development in the laboratory following the pioneering experimental work with the first ship-board radiotelephone installations. Pioneering work was done by the A.T.&T. on the liner *Leviathan* and the subsequent work and development and design by the Bell Laboratories. Many of the features of the *Queen Mary* equipment are the results of this work. Similar experimental and development work was carried out contemporaneously by Les Laboratoires Standard, Paris, Standard Telephones and Cables, London, and the International Marine Radio Company, London, subsidiaries of the International Tel. & Tel. Corp. on the liners *Olympic* and *Majestic*.

The equipment was manufactured by Standard Telephones and Cables for the operating company, International Marine Radio. The principal factors involved in the design of a ship's station such as that of the *Queen Mary* are: (1) The operation of both the radiotelegraph and radiotelephone services by the same operating staff and at times with the same equipment. (2) Simultaneous operation of the two services without mutual interference. (3) Radiotelephone conversation with-



Receiving position in the operating room of the *Queen Mary*

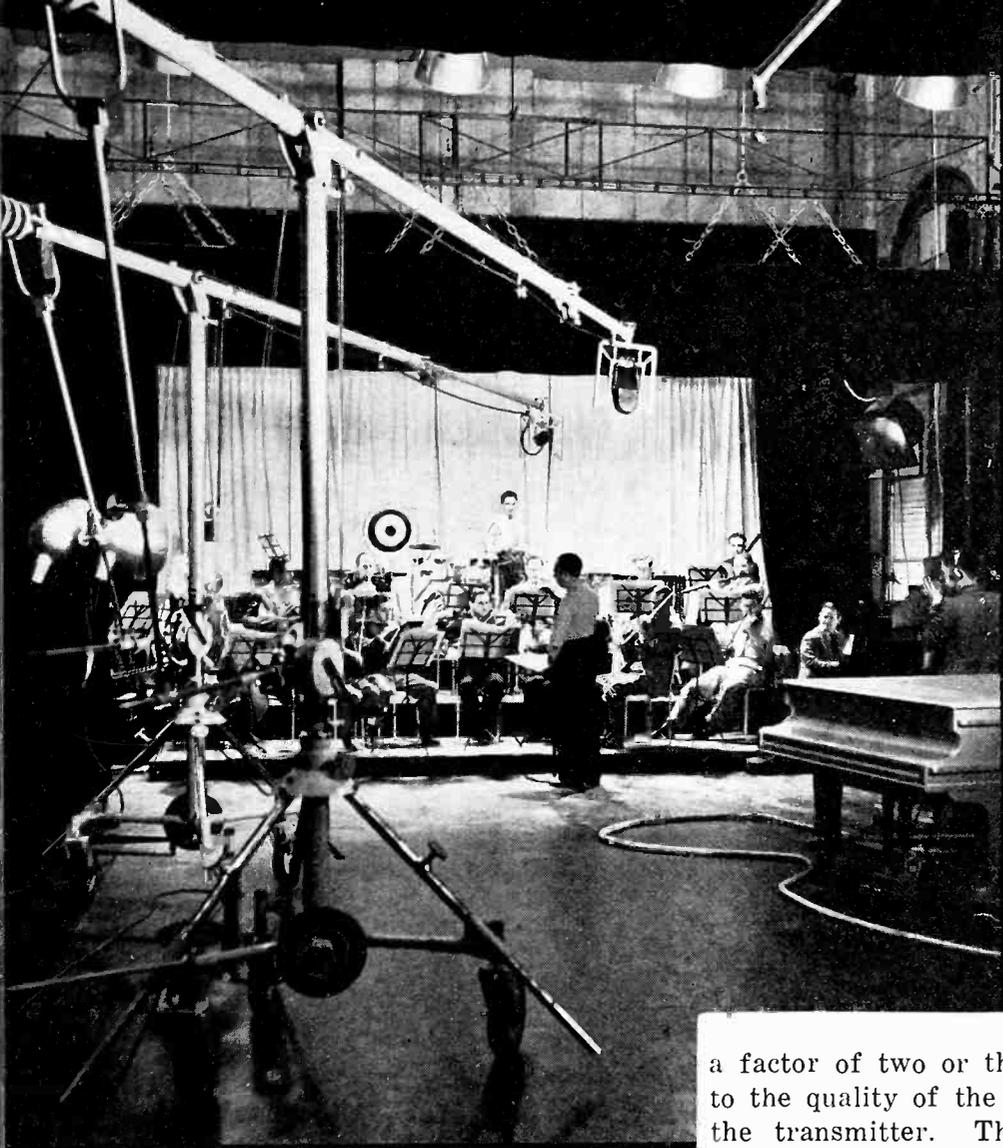
(Continued on page 58)

Television in Europe

Several weeks ago National Union sent Mr. Wilder to Germany and England to study television developments. His report contains important news of the situation abroad

By M. P. WILDER

National Union Radio Corporation
Newark, N. J.



"Telecasting" in Great Britain. The main studio at Alexandra Palace in London. The Emitron (Iconoscope) camera is at the extreme right

WHEN I arrived in Berlin, I was met at Frederickstrasse Bahnhof by Mr. Werner Slawy, Engineer in Charge of the Paul Nipkow Television Transmitter* which is maintained by the German Post Office authorities and serves the City of Berlin. This transmitter has an output of 15 kilowatts and radiates from a dipole on the top of a tower. At the base of the dipole is a metal ring the purpose of which is to alter the field so as to blanket the city more effectively.

The pictures were of a 180-line detail, twenty pictures per second not interlaced; and were black and white of ample brilliance. The tone and detail were excellent considering the number of lines transmitted. The detail in the horizontal direction exceeded that in the vertical by

* Named in honor of the inventor of the Nipkow disc who is still alive and living in Berlin. They always announce "This is the Paul Nipkow transmitter Wittsleben Berlin radiating, etc. . . ."

a factor of two or three times due to the quality of the amplifiers and the transmitter. This method of increasing the picture detail in the most important ordinate results in making 180-line pictures very much more satisfying than would be expected.

The next day I was taken to the studio and laboratory of the transmitter and shown the picture pick-up equipment amplifiers and monitors. The transmitter consisted of a mechanical scanner of a novel construction, employing a set of multiplier-type phototubes followed by an amplifier of unusual design.

The scanner itself was a lens drum (running in vacuum) from four points of which pictures could be scanned. Through one point a beam of light was passed and allowed to scan the studio directly beyond the control room. Two other points were used to scan film and a fourth was used to scan placards if desired. At each point electron multipliers amplified the signal and passed it on through a single stage d-c amplifier to modulate an oscillator. From this point the amplification was done at a "carrier" frequency of 2 megacycles and passed along a simple concentric transmission line to the transmitter 2000 meters away.

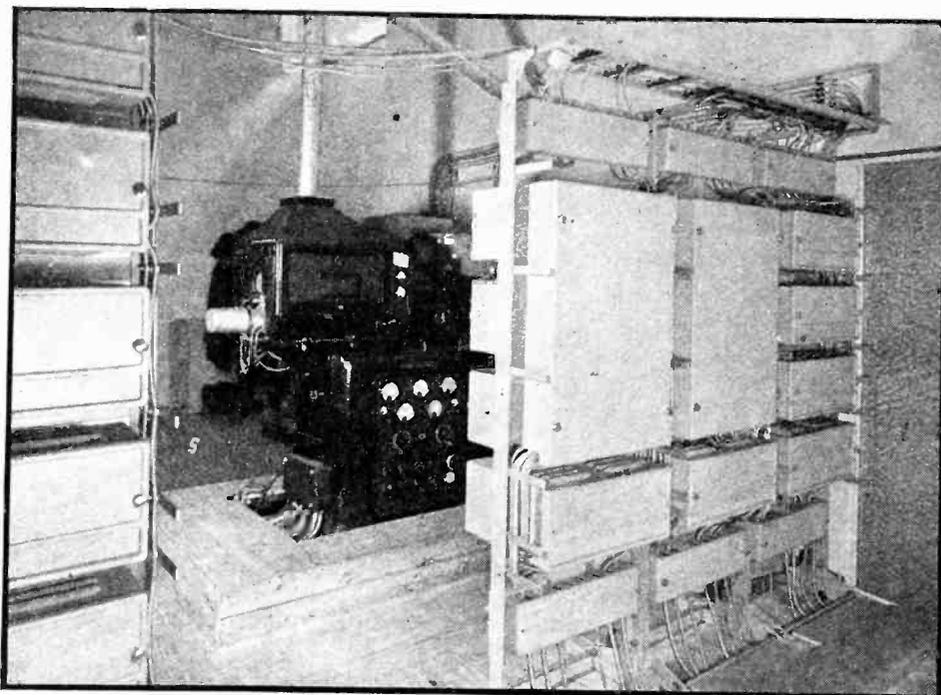
In the transmitter house this signal is demodulated and fed to the grid of a monitor, where it is studied

by the operator in charge and applied to the amplifiers of the transmitter modulator.

The amplifier was of unique design in that it was a d-c amplifier of the Loftin-White type, consisting of 5 stages ending in a two kilowatt output which was used to modulate the grid of a fifteen kilowatt water-cooled tube, the next to the last stage of the 47-megacycle high-frequency chain. This modulated output was further amplified by a final 15 kw. antenna stage and passed up the transmission line to the antenna.

The two outstanding features of the transmission were the use of a carrier for inter-studio transmission of the video signal which can be demodulated at any point where needed, and the use of a d-c amplifier to build up the video signal to the power of 2 kw. for modulating the r-f power amplifier stage. The stabilizing of the Loftin-White amplifier was achieved by using separate power supplies for each stage and voltage regulators of the gas-filled type. D-c modulation is used and the signals transmitted are of the positive variety.

The transmitter is soon to be rebuilt for transmission of 441-line interlaced transmission and will modulate positively, carry the d-c component, and follow the English procedure of transmitting a group of serrated impulses at the begin-



Television film scanner at the Fernseh A.G., Berlin, containing the electron-multiplier tube mentioned in Mr. Wilder's report

ning of the frame synchronization period. The Germans differ from the British in that they will transmit the d-c component straight through all amplifiers to the antenna rather than removing it part way along and then reinserting it at the antenna stage.

On July 7, Dr. Karl Rottgardt, Chief Engineer of the Telefunken Company, introduced me to Dr. Tillman who showed me through the Telefunken Company Laboratories. Dr. Tillman introduced me to Dr. Knoll who is the German authority on electron optics and in charge of cathode ray tube development at Telefunken.

After talking with Dr. Knoll I was introduced to Mr. Ortel who is the Telefunken expert on relaxation oscillators and television sweep circuits. Mr. Ortel spent considerable time explaining his magnetic sweep circuits, outlining circuits which operate "with the coil" and circuits which operate "against the coil." "With-the-coil" circuits are to be preferred as the back e.m.f. makes it difficult to drive current through the deflecting coils. In the preferred circuit, the coils actually aid in allowing this current to flow. Mr. Ortel expressed the opinion that in the design of high transconductance tubes for r-f use, the true factor of merit should be the quotient of the transconductance divided by the sum of the input and output capacities rather than aiming for high transconductance alone.

On Friday, I was invited to the

laboratories of the Fernseh A. G. which was formed by the German Bosch and the Zeiss Ikon under the direction of Dr. Rolf Moller and his colleague, Dr. Schubert. The development of television in this laboratory was being carried forward along many lines, all being for 441 interlaced scanning transmissions. Iconoscope cameras, Farnsworth Dissectors, Nipkow discs and intermediate film pickup are all being simultaneously developed by a force of 300 men in a very able manner. They prefer to scan film by a Nipkow disc as this allows automatic d-c level transmission and avoids difficulties due to charges leaking off unevenly from different parts of an iconoscope mosaic. The output of the Nipkow disc feeds into an electron multiplier. The pictures produced were interlaced 441-lines and reproduced on cathode ray tubes 25 inches in diameter at the screen end. Magnetic focusing and deflection were used with a final anode voltage of 15,000 volts. As the images were 14" x 16" and brighter than ordinary moving pictures the results were definitely as good as motion pictures in regards to detail because here again advantage was taken of the effect of increasing the horizontal definition to the equivalent of 600 lines by good amplifier design. The pictures were black and white. Means were available for complete flexibility in changing over from direct pickup and iconoscope to film scanner and Nipkow disc without loss of interlace. The

intermediate film scanner employed in the receiver and transmitter unit is a means of photographing, developing and transmitting the picture, as well as scanning, exposing, and developing an incoming picture. In the transmission case signals would be transmitted 16 seconds after the action. In reception, the film could be projected 16 seconds after reception. This was an electrical, optical, and chemical achievement of startling magnitude. Dr. Schubert expressed the opinion that this method would find adequate use in recording events to be broadcast at a time more suitable for the viewer's attention, and that a radio link would save transportation costs. The entire apparatus occupied a space of only six by three by six feet, a considerable reduction in space over his former machine.

Up to this point I had been shown conventional methods of signal reproduction, i.e., on a cathode ray tube. Projection reproduction, using a small bright tube and optical projection of the image to the desired size, is also under development. The Fernseh A.G. has developed excellent receivers and tubes for this purpose, and Dr. Moller demonstrated his projection tube receiver, projecting a picture 5.8 x 6.4 feet on a screen with detail equal to that on the cathode ray tubes previously shown.

Geometrical distortion was not present and the lens necessary to produce the pictures was of 16 cm. focal length and f number was 1.8. They were, of course, expensive lenses manufactured by Zeiss. The projection tubes used at Fernseh A.G. were flat on the end with an end diameter of 5" made of hard glass and focused and deflected magnetically. There was no burning of the screen and the cost of manufacture is no greater than that of a conventional 5" cathode ray tube. Excellent exhaust is required and care in insulation and screen material application are of vital importance. I consider those pictures, in color, tone, brilliance, and detail, to be the best I was shown.

Saturday, July 10, I returned to Telefunken, and gave a paper on "The Control of Electron Beams."

During the discussion which followed the lecture, Dr. Knoll showed a sample of his projection cathode ray tube, then demonstrated this tube in operation. The picture was very good but a still picture and, therefore, difficult to compare with Fernseh A.G. This tube differed from the Fernseh A.G. tube in that it was entirely electrostatically focused although magnetically deflected and used 25,000 volts for electron acceleration. Dr. Knoll, in answer to my question regarding the life of the screen material, quite definitely assured me that it had a life of 2,000 hours.

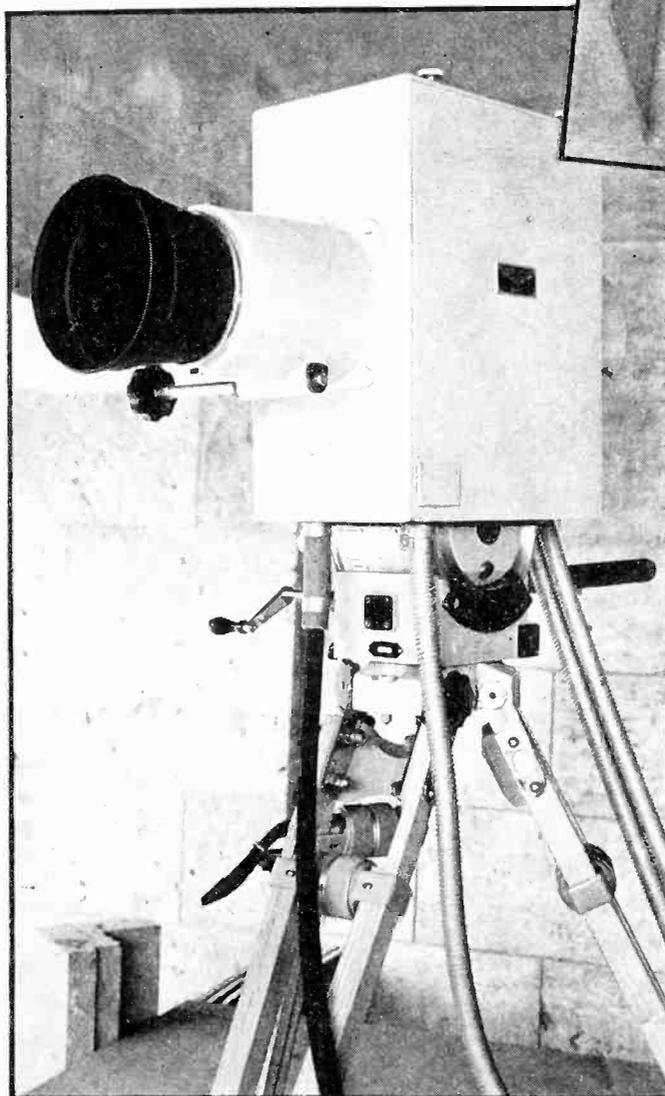
On Monday, July 12, I visited the Cossor Plant in London as the guest of that company and their Chief Engineer's Assistant, Mr. Puckle, who showed me the research and development laboratory. After lunch they demonstrated one of their receivers in operation on the London Alexandra Palace Transmission. Cossor manufactures tubes and receivers and is one of the largest manufacturers in England. These were the first I had seen of 405 line detail and were, of course better than the Berlin 180 line pictures though not up to the Berlin Laboratory demonstration. The receiver was a superhet, sight and sound, containing 18 tubes and allowed direct view of the picture on the tube end. The spot was focused and deflected electrostaticly. The afternoon was spent in the factory where I was shown the methods of manufacture used. The mounts were large, approx. 10" long and 1½" in diameter. The cathode was of the filament type with a point on the tip of the filament in the shape of a cup, less than a millimeter in diameter, and filled with emitting material. The electrons were focused similarly to ours and the beam deflected electrostaticly. The bulbs were 12" in diameter and shaped like a mushroom to increase strength against collapse. They were coated inside with lead sulfide by a simple precipitation method and were of soft glass. The screen was put on afterwards, held on by a silicate binder. The color was very close to black and white.

The Exhaust Department consis-

ted of 10 separate trolleys with room for twenty more in the line. Exhaust required 1½ hrs. per tube and six could be exhausted at a time. Their production was in large tubes and came to about 30 a week. These tubes retail for \$50.00 each.

The following day I was taken through the Alexandra Palace transmitting station and met Mr. Birkenshaw, the Chief Engineer. The transmitter there is the finest I have seen.

On Friday, I visited the Ediswan Plant where I viewed an excellent transmission from Alexandra Palace



Above a modern German television receiver with an exceptional large cathode-ray reproducer. The reflecting mirror system is similar to that used in this country

Left, a German edition of Philo T. Farnsworth's Image-Dissector direct pickup camera, made by Fernseh; note power cables and coaxial video line (black) entering amplifier compartment

on a television receiver employing magnetic deflection and magnetic focusing. The pictures were the best I saw in England and the best I had seen by radio anywhere. The scene was a direct pickup in the zoo and of remarkable contrast and detail; "exactly like a movie" is the best way to describe it. Mr. Price, the engineer in charge, showed me a set of tubes and diodes which are absolutely necessary for proper

operation of a television receiver. Tubes of this type are not obtainable in this country and are essential for the proper design of a receiver.

That afternoon I visited the Science Museum at Kensington Gardens where on demonstration are models of all the television receivers manufactured in Great Britain. There were ten different samples, and in general all seemed to operate very well.

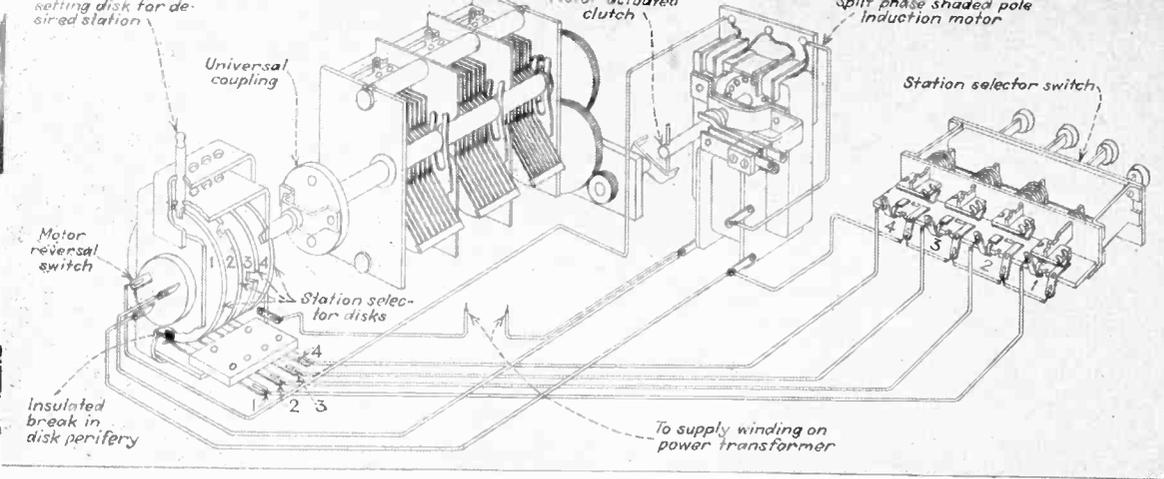


Fig. 1—Pictorial diagram of motor-tuned automatic station selector

Push-Button Station Selection

1938 will see radio receiving reduced to a lazy man's task. Push-button tuning, motor-controlled tuning, trimmer tuning—will reduce station selection to its simplest terms

By B. V. K. FRENCH

Engineering Dept.,
P. R. Mallory & Co., Inc.

THE present radio season will witness the introduction of automatically tuned radio receivers by practically every manufacturer. In the majority of cases these receivers will employ a method of station selection by means of a group of push button actuated switches.

It is interesting to note that the continued progress towards the ideal of simplification of the tuning requirements of radio receivers has been the result of a series of cycles in which improvements of mechanical design have in every case followed and been initiated by the introduction of new radio circuits. In the present case the development of automatic frequency controlled circuits, stabilized drift-free oscillators and expanding i-f amplifier circuits have simplified the design of automatic tuning devices by allowing considerable latitude in the mechanical precision of selectors.

These reasons in themselves are not sufficiently mandatory to cause the almost universal trend toward push button tuning. The appeal of simplicity of operation and the mystery to the lay mind of a radio receiver which tunes itself to any one of a desired group of previously selected stations are largely responsi-

ble for the present interest. Automatic tuning is not a recent development but has been available for a number of years in the deluxe models of several radio manufacturers. The emphasis, however, as far as push button selection is concerned has previously been placed upon their utility to enable the remote control operation. This season's models will feature the station selector buttons as an essential modification of the radio receiver itself with interest in the remote control as a desirable and optional accessory. This will allow automatic station selection as an available feature of moderately priced receivers as contrasted with its former use only in the highest priced models.

The possibility of the entire elimination of manual operation for continuous tuning is suggested by the use of a motor control knob in lieu of the usual tuning knob.

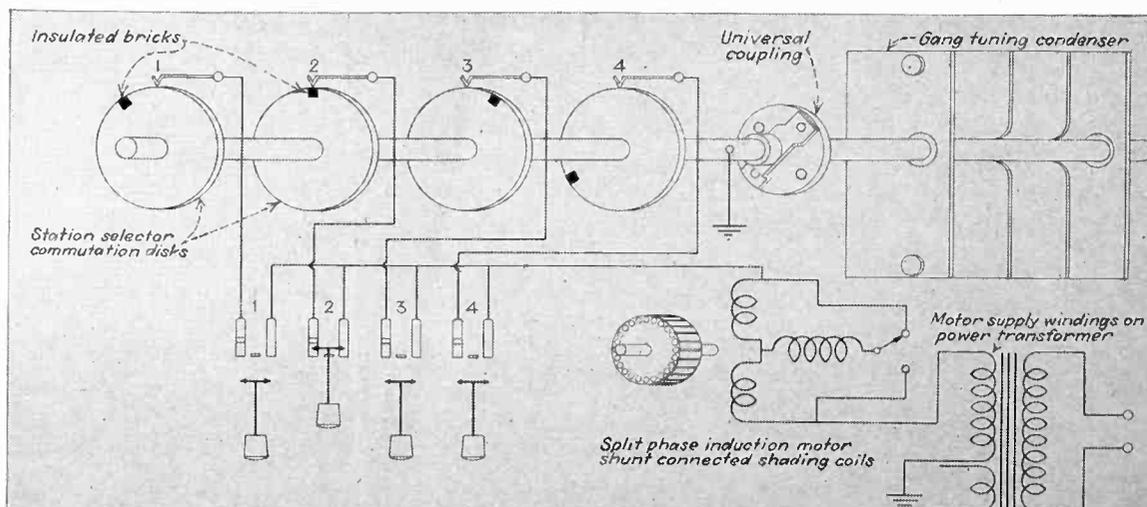
A completely detailed description of the methods and circuits of push button station selection to be employed this year is not possible since intensive development is still in progress and few models have been announced. However, an outline and brief description of some of the likely systems and their components is of general interest. Automatic tuning may be generally divided into two main classifications: I. Motor Tuned Systems, and II. Tuned Circuit Substitution Systems.

I. Motor Tuned Systems

General Circuit Elements. The general circuit elements of all motor tuned systems include a station selector switch, a driving motor which rotates the tuning mechanism through a quick acting clutch, a train of gears and a selector or commutator mechanism which serves to control the action of the motor.

The push button station selector switch (Fig. 1), comprises four single

Fig. 2—Schematic diagram of simple motor-tuned system



pole single throw switches which serve to select individual discs of the station selecting commutator. Sliding silver plated phosphor bronze shoes of the bridging type connect the pair of terminals at the rear of the switch as a plunger carrying the shoe holder is depressed. Depressing the plunger causes the latch bar to lift releasing any previously engaged plunger and then to drop into a notch holding the circuit in the closed position. The left hand button is shown in this position. The circuit thus closed through the switch and selector disc causes the motor to start rotating in a direction determined by the position of the reversing switch on the back of the selector assembly. The motor will rotate until the circuit is broken by an insulated portion of the periphery of the selector disc. If this insulated break is not reached before the condenser reaches its end of travel, the reversing switch will be actuated and the motor will reverse returning the condenser to the position corresponding to the break in the selector disc. The selector discs are friction driven so that it becomes a relatively simple matter to set a disc to the position of a desired station by locking it against rotation with a taper pin while tuning to the station manually. The pin is then withdrawn, permitting the disc to be driven by the shaft through friction washers. The various elements of the system are described below in greater detail.

1. Station Selector Switch. The station selector switches to be used can be classed in two groups:

Push button actuated "ladder" type switches.

This type has an inter-connecting latch bar which holds in engagement any depressed button until this button is released by the operation of another button. The circuits illustrated here use switches of this construction.

Electro-mechanical latching switch

Here the function of selection and motor control are combined in a switch mechanism disposed concentrically around the tuning shaft. A mechanical gate stops the motion of the gang condenser depending upon the setting of a group of levers which are operated by the equidistantly spaced push buttons on the front of the mechanism. The position of these stop levers may be pre-set and locked from the front of the device at any angle corresponding to the desired condenser setting. Electrical switching inside the mechanical gate disconnects the motor circuit and actuates the AFC release and audio muting circuits.

a. Types of push button mechanisms. Most of the variation in design of the push button type switch will involve the manner in which the latching mechanism is operated. A number of receivers will not employ the latch bar but will allow the individual buttons to return to their initial position after momentary contact is made by the act of depressing them. The

momentary closing of the circuit will actuate relay circuits whose contacts will hold closed until the selector mechanism breaks the motor circuit bringing the tuning condenser to the desired position.

The more usual switch will employ the latch bar to hold circuits closed during the motor operation and until another station selection is desired. A variation may be the use of a release button which does not control a circuit but which will unlock any previously held station and allow control of the motor tuning by a direction reversing switch replacing the usual tuning control.

b. Type of circuit arrangements. A station selector switch, recently introduced, admits of a wide selection of switching combinations. This is made possible by the use of a sliding shoe type of switch which inter-connects up to three individual terminals. The shoe may be insulated from or grounded

duction motors.

b. Split phase a-c motors with a capacitor circuit to obtain the necessary phase rotation.

c. Series wound commutator type motors of the so-called universal type.

d. Impulse actuated motors.

a. *Shaded pole a-c induction motors.* This is the present favorite since it presents an economical solution to the problem of de-clutching the motor from the drive system and allows of a simple switching circuit for reversal of direction of rotation. To provide for actuation of the clutch, the rotor of the motor is so positioned that when at rest it is axially displaced from the center of the magnetic field of the pole shoes. It is held in this position by a flat phosphor-bronze spring which also acts as part of a jack spring switch assembly—(see Fig. 1).

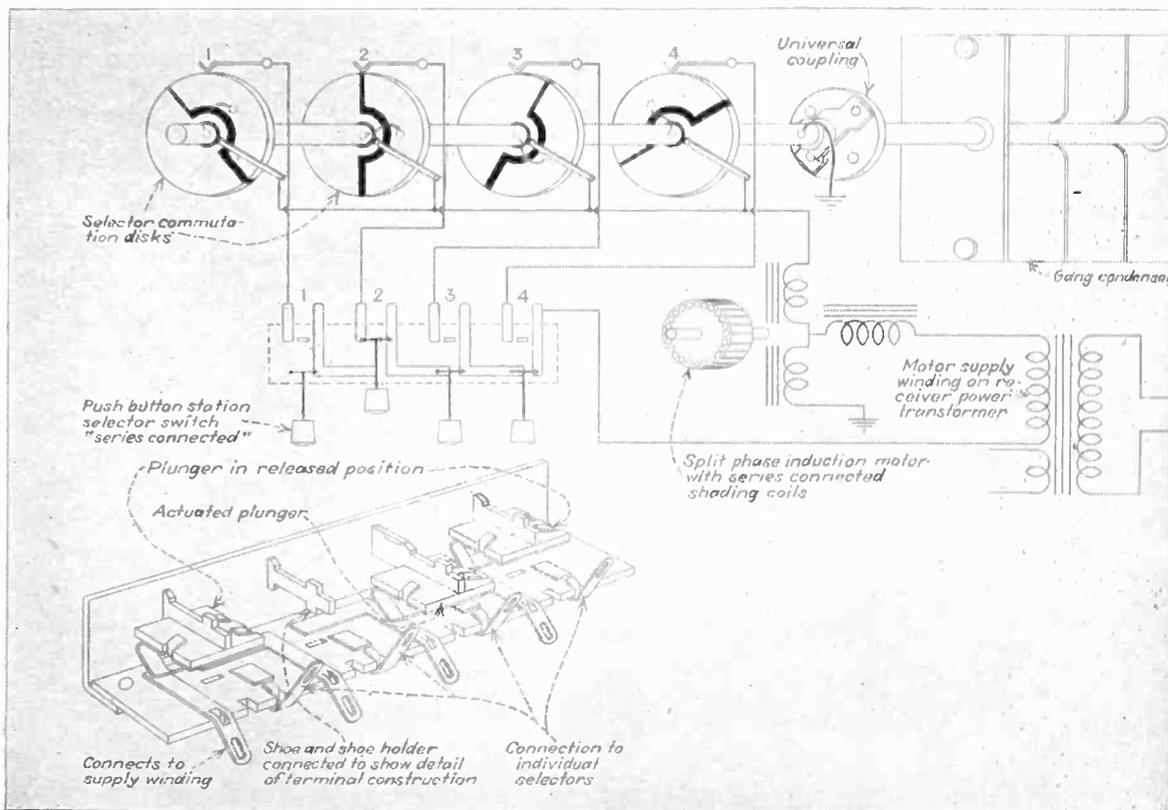


Fig. 3—Schematic of "homing" system employing series connection switch. Inset shows mechanical details of series-connected switch

to the frame. To further widen circuit possibilities, the switch is also available with a double row of terminals. Figure 4 illustrates these various terminal combinations together with a special type of series connection, using an L shaped terminal, whose function will be described in connection with selector mechanisms.

2. Motor. Recent developments in the field of fractional horsepower reversible motors offer a wide choice to suit the requirements of the designer. Four main classes of motors are under consideration:

a. Shaded pole a-c split phase in-

When the windings of the motor are energized the rotor is drawn into the magnetic field, closing the separated parts of the clutch and actuating the jack switch. The clutch performs a dual function in that it relieves the drive system of the motor load during the manual tuning and allows the motor to coast to a stop, permitting instant cessation of gang condenser rotation when the selector opens the motor circuit at the point corresponding to a desired station resonance point.

The jack spring switch is used to silence the audio system of the receiver during the sequence of motor tuning and to release the control of the AFC discriminator on the oscillator. This latter action is necessary

since, if the AVC circuit were active, a strong local station might hold control and prevent the selection of a distant station. The selective pole shading windings, which determine direction of rotation of this type, may be designed to be connected either in series or in parallel with the main driving winding.

(1) *Parallel connected pole shading coils.* Most of the motors which have been offered to the radio industry this season have been of this type or a variation of it shown in Fig. 2. It possesses the advantage of slightly higher starting torque than the series connected type (in models produced to date) but requires a more complicated switching and selection circuit if "homing" type interlocked operation is desired.

(2) *Series connected pole shading coils.* At least one commercial motor

economic reasons.

c. *Series wound commutator type (universal) motors.* A number of advantages may be cited for the adoption of this familiar type of motor. It can be designed to operate with adequate torque at lower speeds than the types described above, thereby simplifying the gear reduction system required. This low speed operation is also advantageous from the standpoint of mechanical noise which presents a design problem when employing the high speed induction type motors. When operated by d.c. supplied by a bridge rectifier of the cupric sulphide type, interesting possibilities of magnetic relay, latching and circuit holding devices are presented for solution of the problem of simplified remote control.

d. *Impulse actuated motors.* The impulse motor is a recent adaptation of

3. **Station Selector or Commutator.** Two general classes of station selection commutators have been employed for several years, namely the multiple disc type, as illustrated in Fig. 1, and the large single disc, multiple contact type. Both of these types will appear on this year's models with several variations of circuit switching at the selector, namely, a. Single circuit, b. Double circuit and c. Reversing switch type.

a. *Single circuit type.* This represents the simplest type of commutation mechanism and is usually constructed as shown in Fig. 1. The discs are electrically connected to the shaft and are driven by means of cupped bronze or brass friction washers. In the periphery of each disc is a short insulation section which serves to open the circuit when the disc has revolved to such a point that the contacting finger is resting upon the insulation. Usually an indexing means is provided diametrically opposite the insulated section for the purpose of alignment of the disc to the desired station tuning position, as previously described.

Although this offers the most economical solution to the selector problem, the design presents the disadvantage of being "non-homing," i.e., the condenser will not turn directly to the station if the motion of the system happens to have been in the opposite direction subsequent to the selection of the station desired. A reversing switch operating at the end of gang condenser rotation is required to return to the desired tuning position.

b. *Double circuit type.* Schematically this type of commutator may be represented by a SPST switch. Its main advantage is that it selects the correct direction of rotation to the station tuning position. An example of this type of circuit is shown in Fig. 3. The two metal sectors of the commutator have been represented as being positioned on the same side of the disc, although in practice a simpler construction is achieved by fastening them to opposite sides of the disc to avoid the grounding pig-tail shown. The operation of the commutator is as follows:

If push button 1 is operated, commutator 1 completes the circuit through shaft and pig-tail connections, energizing shading pole and causing the motor to rotate in a counter-clockwise direction; if button 3 is operated, commutator 3 completes the circuit through the sliding contact, energizing the other shading pole and causing the motor to rotate in a clockwise direction. The motor in every case turns the tuning capacitor directly to a position similar to that shown by commutator 2. At this point series connection is broken causing the motor to stop.

A similar type of circuit switching may be achieved by using two con-

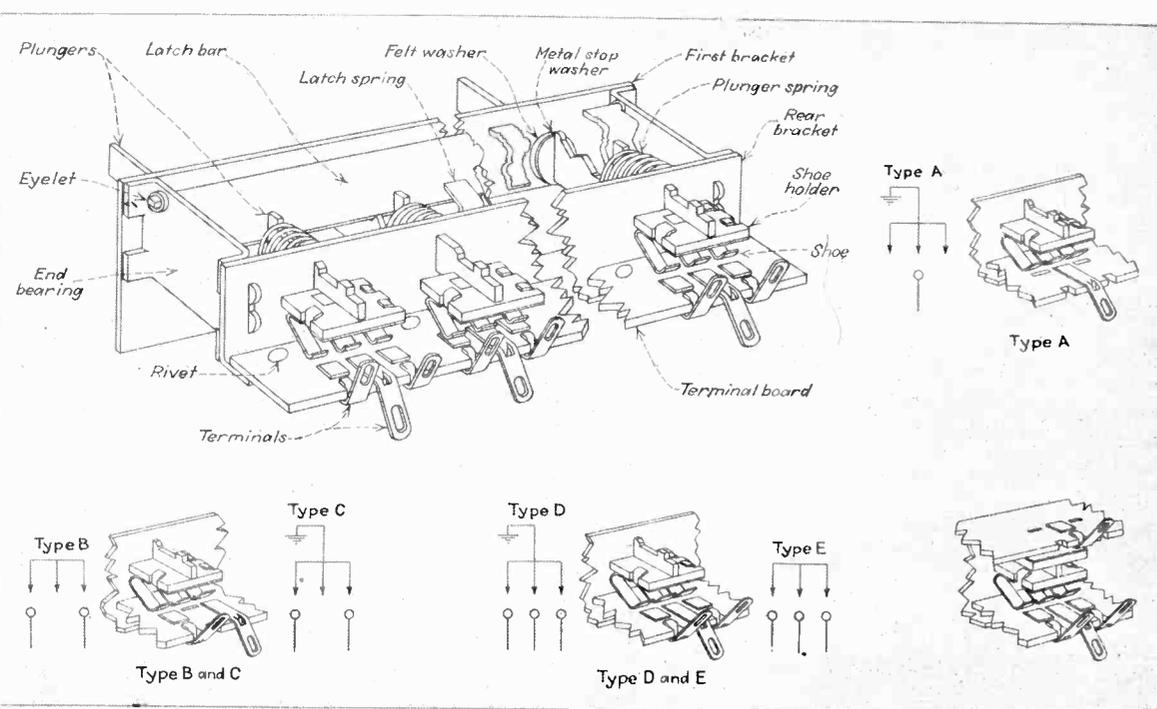


Fig. 4—Push-button selector switch, showing mechanical details and connection diagrams of five single row and one double row type

has its shading coils so connected that the entire motor drive circuit may be connected in series. This allows reversal of direction by the use of a SPST switch or its equivalent in the form of a selecting commutator.

Figure 3 shows an adaptation of this motor for the homing type of control, to be described later under selector mechanisms. This type allows considerable simplification of circuits and if satisfactory starting torque can be obtained or if the friction of gearing and force required to move the condenser can be reduced, should be of considerable economical advantage.

b. *Capacitor type split phase motor.* This motor is familiar because of its widespread use in connection with electric refrigerators and other home appliances. Early adaptations of automatic tuning employed this type of motor which offers interesting performance possibilities but has been abandoned at least temporarily for

a type of motive power which offers considerable promise as applied to the particular problems of automatic tuning. In this type of motor the rotation is not continuous but is intermittent as determined by a series of impulses obtained either from a vibratory interrupter or as half-wave pulses of rectified a.c.

A magnet or solenoid is used to obtain rectilinear motion when the pulsating voltage is impressed upon the windings. By means of a uni-lateral acting clutch or a pair of such clutches (for two-way operation) the pulsing motion may be converted to rotatory motion. If the motion due to this action is restricted in amplitude and the frequency of operation is relatively high, the action can be made as rapid as desired with the advantage of instant stop at the cessation of the impulse determined by selective commutation.

tacting fingers, placed diametrically opposite one another, which contact a single metal sector slightly less than 180° in extent. A contacting brush riding on this sector converts the disc into the equivalent of a single pole double throw switch.

c. Reversing switch type. When using a series wound, commutator type motor it becomes necessary to employ a selector whose circuit equivalent is that of a DPDT switch. This may be accomplished in a disc type commutator by using four contacting fingers disposed 90° from one another around the periphery of the disc in contact with two metal sectors slightly less than 180° in extent. These sectors are both insulated from the shaft and serve to connect alternately the adjacent contact fingers.

4. Selective and Remote Operation. If two buttons of Fig. 1 are depressed simultaneously the motor will run continuously. This may be avoided by employing a switching sequence of a series type. Fig. 3 shows this type of circuit, and it is readily apparent that if two buttons are depressed the selector disc connected to the button closest to the supply end of the switch will stop the motor since the current supply to the remaining switch terminals is interrupted at that point. This circuit offers obvious advantage in remote operation since it reduces the number of inter-connecting wires required between the remote push button bank and the receiver.

II. Tuned Circuit Substitution Systems

A. Condenser Substitution System.

An alternative system of automatic station selection consists of substituting pre-set tuned circuits for the variable capacitor tuned circuits. Control is shifted from the variable condenser to trimmer condensers mounted adjacent to the switch terminal of the push button selector switch by means of a transfer switch of some type.

One outstanding advantage of this type of system is its instantaneous action. Response to the desired station occurs immediately upon depressing the button.

Although it would seem that the number of positions would be limited by the minimum capacitance requirements of tuning at the high frequency end of the broadcast band, an interesting possibility greatly increases the number of stations which the system will receive. In the case of a six-button trimmer type system it is actually possible to so adjust the condensers as to obtain over fifty station selections by simultaneous operation of buttons, i.e., if two buttons corresponding to two sta-

tions at the high frequency end of the band are depressed and locked-in together a new tuning capacitance will be effective equal to the sum of the two condensers selected. This will tune the system to another station or will tune sufficiently close to a station channel to allow the AFC to function on that station. Any number of buttons up to six may be depressed simultaneously producing a multitude of possible station combinations. Many of these will be beyond the broadcast band in the low frequency aircraft weather band.

The restricted capacitance range of the individual trimmer condenser

position, Position 2 is the normal broadcast position with continuous tuning by means of the variable condenser, Position 3 is the short wave position also tuned by the variable condenser. In position 1 the terminal connected to the gang condenser stator is open and the grid, broadcast secondary and push button selected trimmer condensers are all connected in parallel. The upper bank of condensers serve to tune the oscillator grid circuit while the lower bank of condensers are effective in tuning the detector input circuit. The high potential sides of the condensers are connected in parallel, selection of the desired condenser being effected by connecting the low sides of the condensers to frame or ground.

Permeability Tuned Substitution. The use of a group of individual tuned

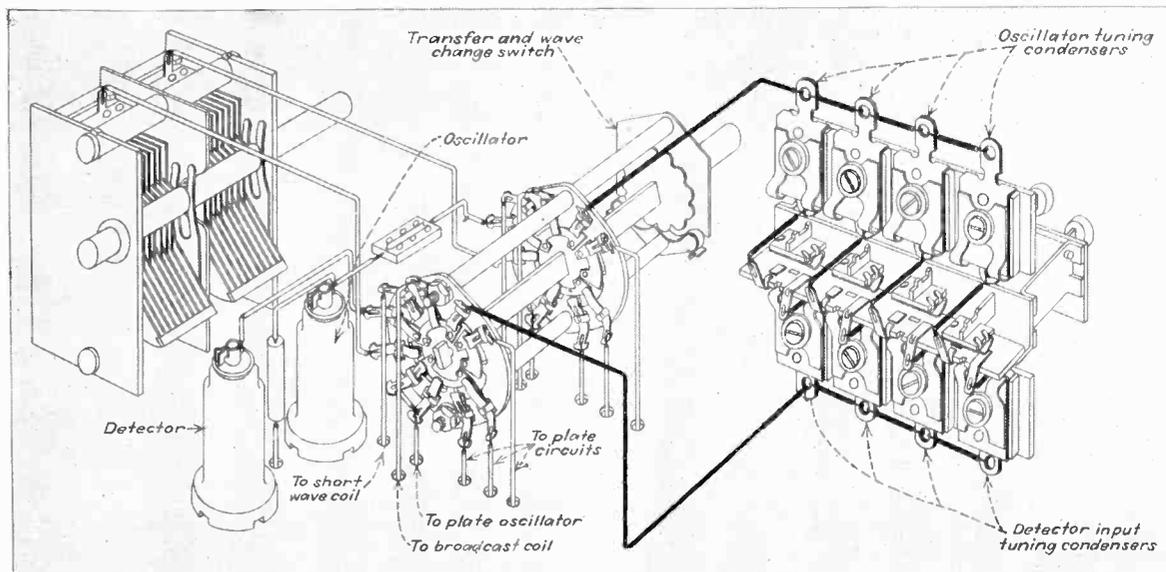


Fig. 5—Push-button condenser substitution system

makes it necessary to assign certain buttons for use at the high frequency end, other groups for use at the mid-frequencies and at the low frequency end. Overlap of tuning range occurs between these groups making possible the setting of the system to any desired station in the broadcast band although it is not possible to adjust all positions at one end of the broadcast band.

Description of System

Figure 5 shows in pictorial fashion the elements of a condenser substitution system. The various parts are separated in such a manner as to show the operation to advantage and therefore do not represent a desirable positioning of parts.

The circuit illustrated is that of a two band receiver with both push button and continuous tuning on the broadcast band. The wave change switch has three positions: Position 1 or extreme counter-clockwise is the automatic or push button broadcast

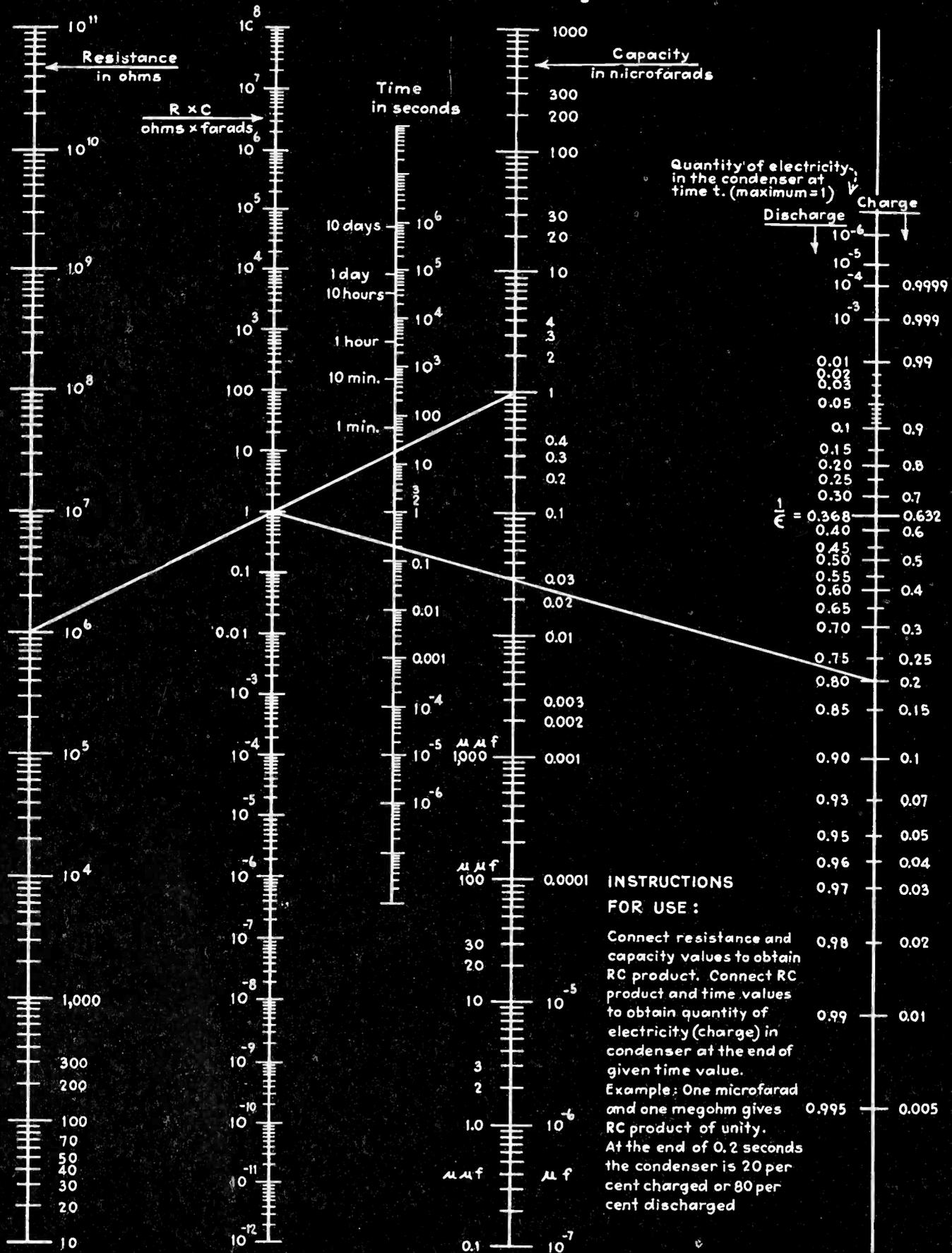
circuits in which the reactance variation required for pre-setting is accomplished by the motion of powdered iron cores within multi-layer coils is another possibility for automatic selection. This system would naturally be more expensive than the trimmer tuned system but would have the advantage of greater freedom from drift of tune due to the effects of temperature, time and humidity.

Both of the foregoing systems possess individual advantages. It is readily apparent that the Condenser Substitution System is inherently less expensive; on the other hand the appeal of motion automatically controlled may possess considerable sales advantage. It is as yet too early to predict which system will gain the ascendancy. The development trend indicates that automatic selection of radio programs with its attendant simplicity of operation has become a necessary adjunct of the modern radio receiver.

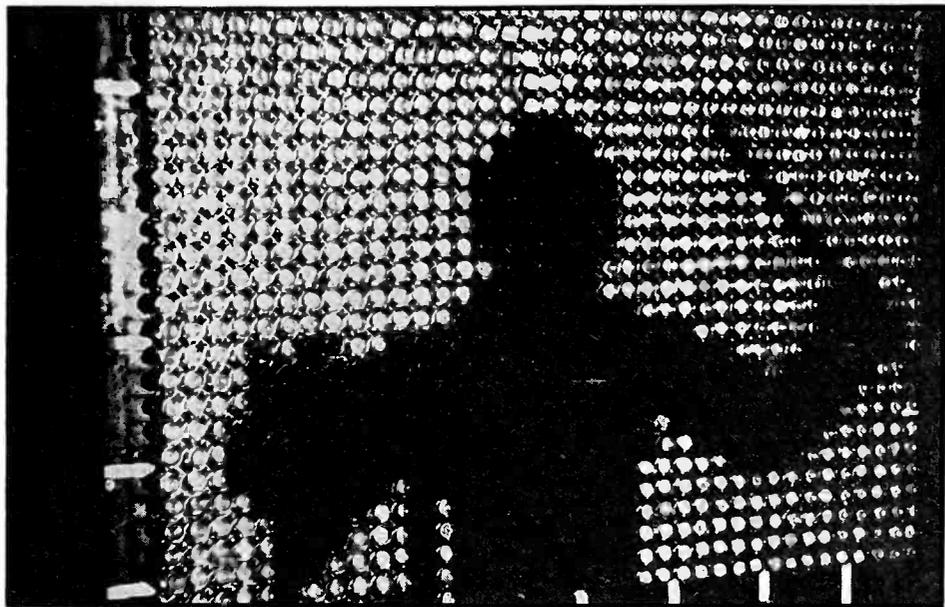
Condenser Discharge Chart

A nomographic chart for computing the charge or discharge of a condenser through a series resistor, in terms of time and the RC product

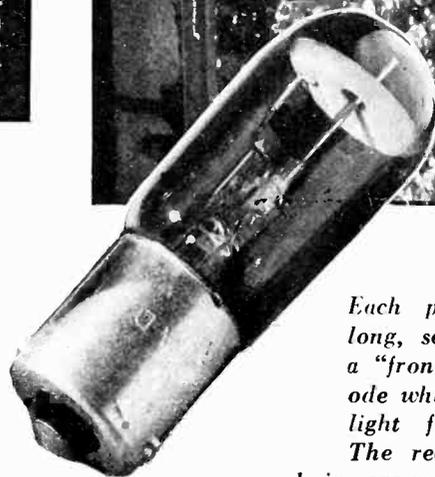
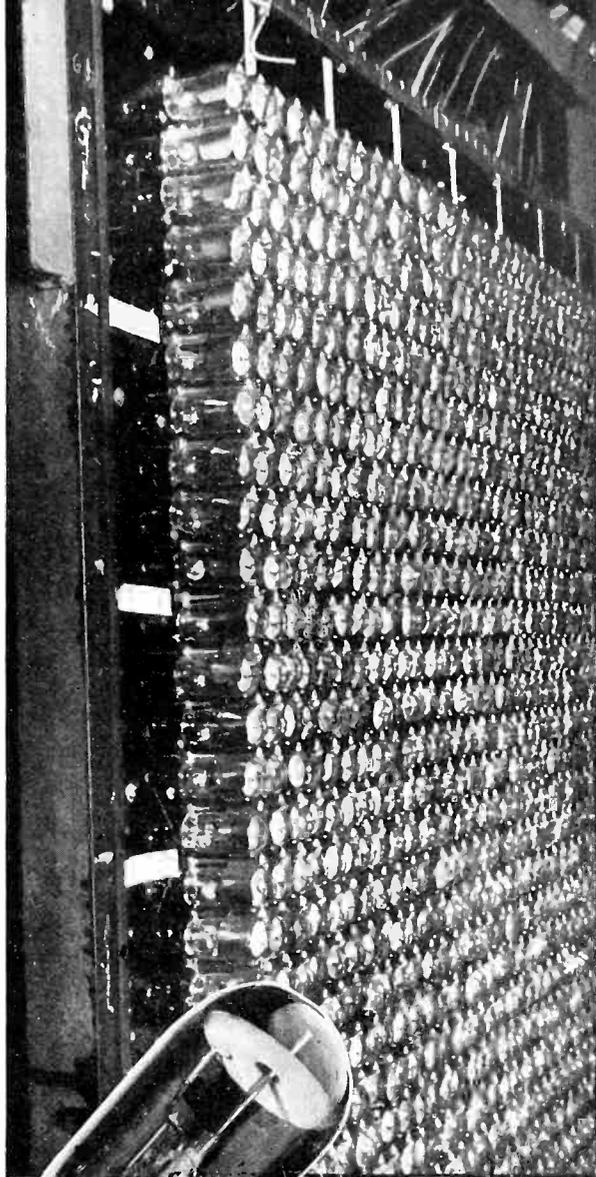
By J. B. Hoag
University of Chicago



Electronics on Broadway

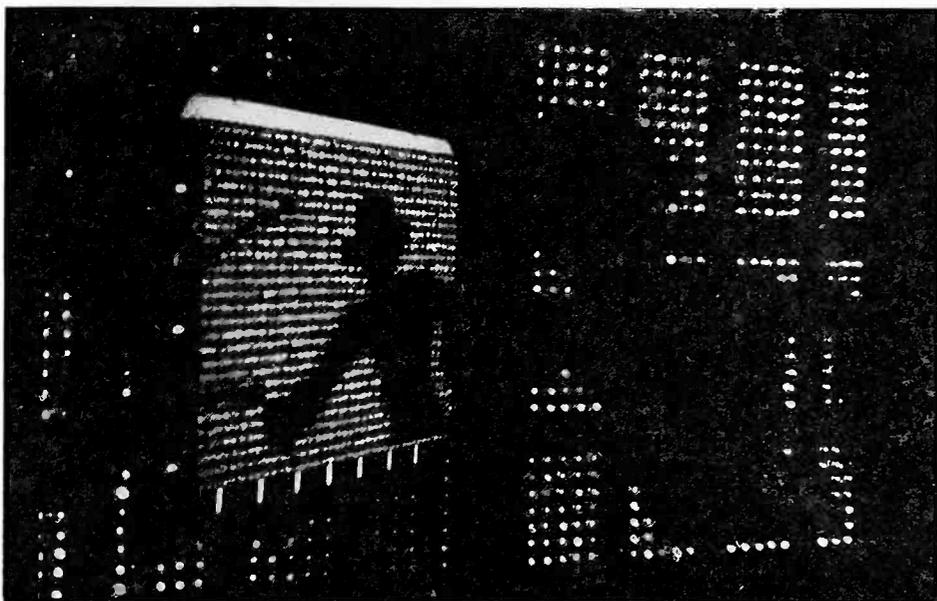


Before this bank of 1,026 caesium phototubes stands a motion picture projector specially equipped for projecting black-and-white animated cartoons (see strip on front cover) at a rate of 20 pictures per second. The picture, composed of squares, is registered accurately on the phototubes. Each phototube, when illuminated, provides a 10-volt "signal" across its coupling resistor. This signal, applied to the grid circuit of a triode mercury-vapor rectifier, causes conduction of 130 ma. at 155 volts from the anode of the tube to a group of 4 six-watt lamps on the signboard, thus reproducing that portion of the picture

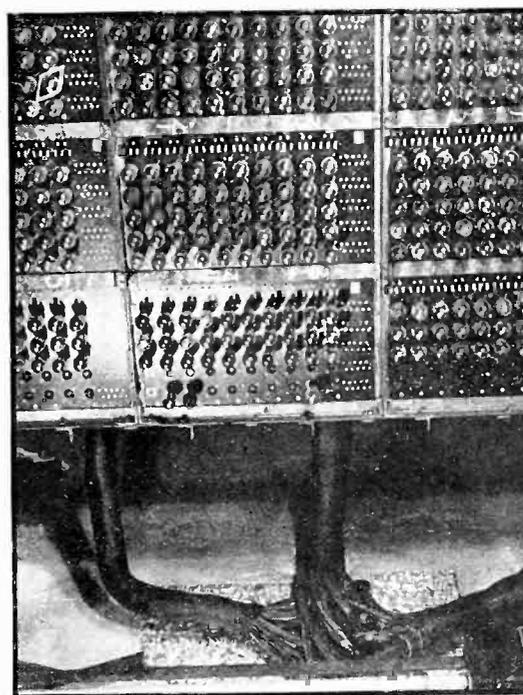


Each phototube (2 inches long, see inset above) has a "front-face" circular cathode which is exposed to the light from the projector.

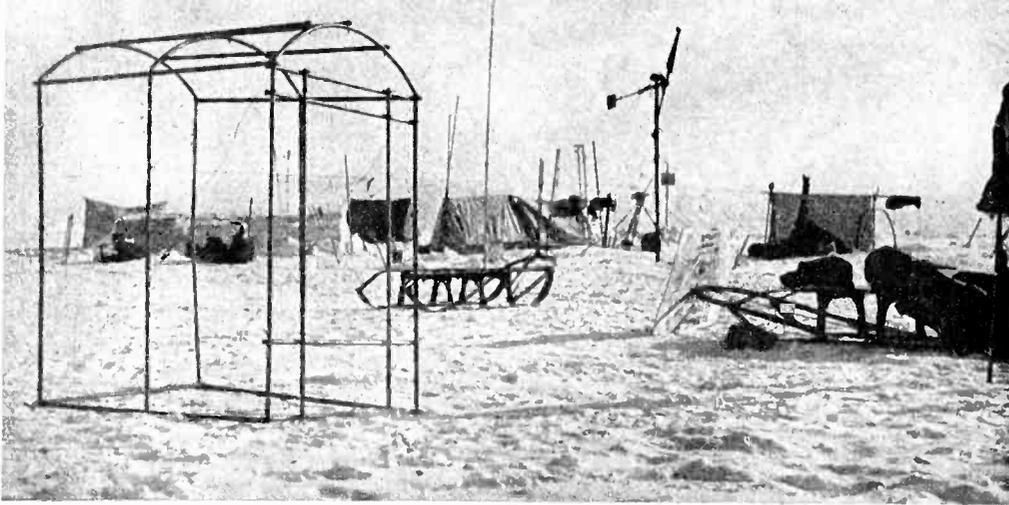
The rectifiers (below) are arranged in groups of 50, biased at between 8 and 9 volts, and are operated by simple amplitude control. The system is patented in all leading countries



As the frames of the motion picture are projected on the phototube bank, the glow of each grid-controlled rectifier reproduces the picture, as shown above. The tubes, in turn, feed current to the 4,104 lamps on the main signboard (see front cover), in groups of four. The lamp bank measures 30 by 20 feet and consumes an average of 10,000 watts of power. Since 60-cycle a.c. is used on the rectifiers, special arrangements are necessary to synchronize the projection rate with the supply voltage, otherwise only a blur will occur on the lamp screen. The system, developed by Kurt Rosenberg, is licensed by American Epok, Inc., to Douglas Leigh, New York outdoor advertising specialist



Soviet Radio at the North Pole



View of the camp on the drifting ice-floe at the North Pole. Note the wind-driven generator on pole, right of center



Antenna masts and guy-wires at the outskirts of the camp. The figure is the leader of the expedition, Otto Schmidt



Above, magnetologist Eugene Fyodorov, one of the four permanent dwellers of the expedition, takes readings at a meteorological station at the Pole. Below, radio center on Dickson Island, on the north Siberian Coast near the mouth of the Yenisei River, which acted as the base station for radio contact with the expedition



The wireless operator of the "ANT-25", testing the radio equipment which flew over the Pole to America in the first transpolar flight

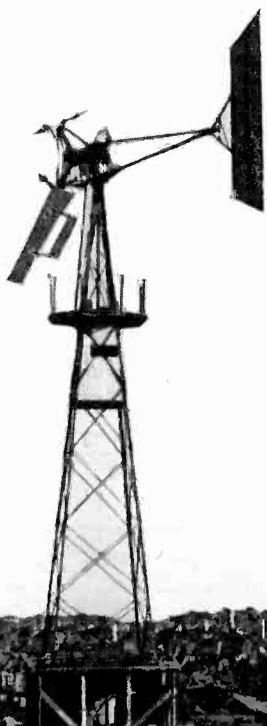




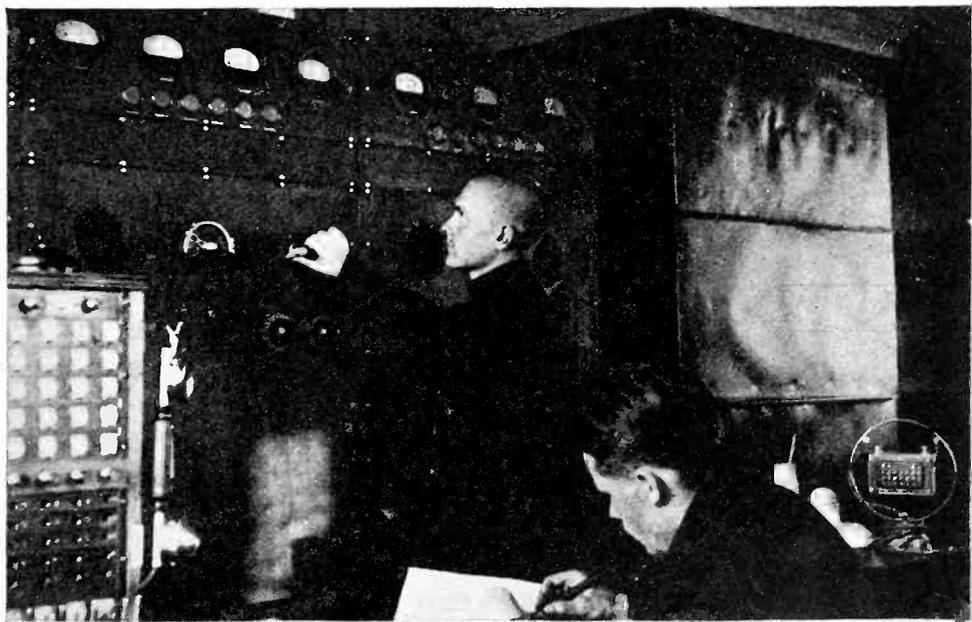
Three four-motored planes at rest on the ice-floe at the North Pole, the greatest "concentration" of aircraft achieved during the expedition



Left, Otto J. Schmidt, one of the world's outstanding authorities on arctic exploration, who headed the Russian expedition. Behind him may be seen the glassed-in nose of one of the planes, surmounted by a short antenna mast



Right, an interior view of the base station at Dickson Island, through which the expedition maintains contact with Russia and the rest of the world

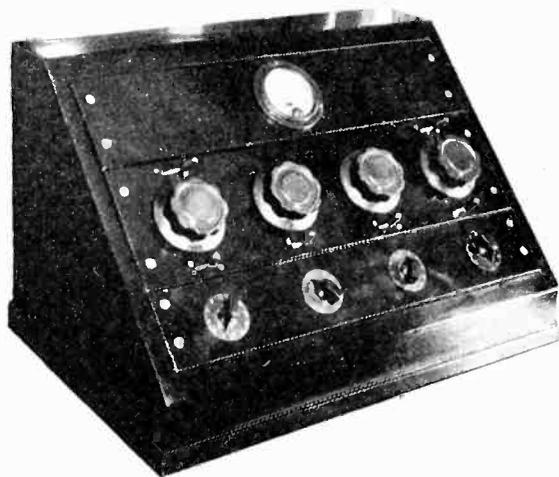


Simplifying BC Operators' Job

Simplified control panel at KONO eliminates patch cords, simplifies monitoring, provides "on the air" signal through use of rotary switches. Flexible arrangement with wide variety of applications

A SIMPLE type of mixing control panel, especially suitable for small broadcast stations because it permits of flexible mixing operations in a limited space is the subject of this article. In this mixer, all incoming lines for all faders can be selected without moving from the operating position, an important consideration when the control man does the bulk of announcing as is the universal custom of small stations. The elimination of the usual clumsy and unsightly patch cords, with the subsequent elimination of cord breakage and bad contacts in plugs and jacks, together with the simplicity of a rotary switch-operated control panel are other advantages of the panel described here.

The innovation in this new mixer



Control panel with four input microphone positions. The top panel contains the volume indicator, the middle panel contains the fader controls together with channel on-off switches, turntable selector, and 200-500 ohm switch for first microphone position. The lower panel contains the incoming line selector switches and replaces the more customary patch cords

By GEORGE ING

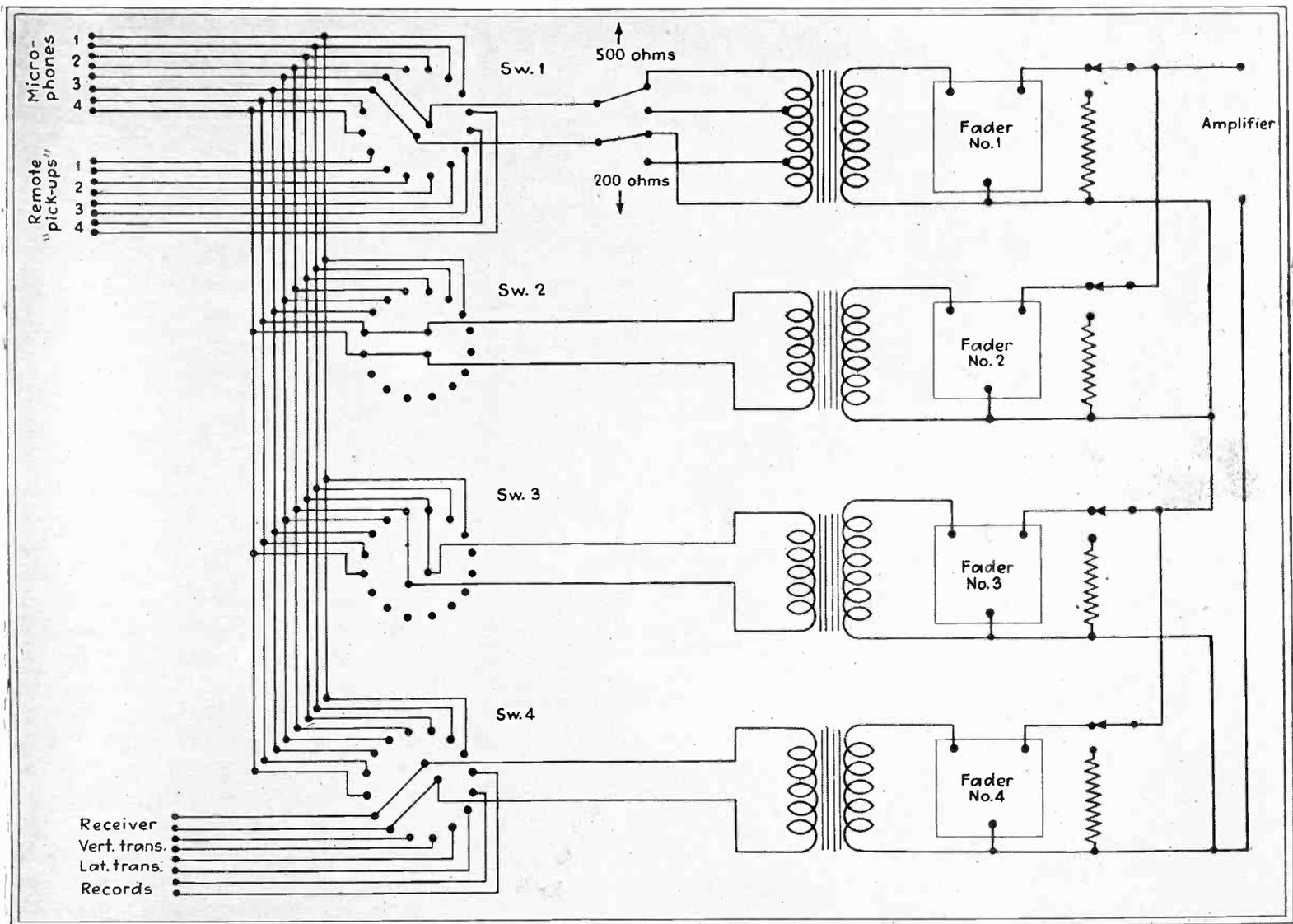
Engineer, KONO
San Antonio Tex.

consists in the use of rotary two circuit multi-contact switches (of the type used for band switching in all wave receivers) for incoming line selection instead of patch cords. The band selector switches as used in modern receivers have silver plated contacts and have been developed mechanically to such a point that they are very reliable and seldom give trouble from contact noises, even in sensitive, high gain amplifier circuits.

The control panel as developed for use at Station KONO is shown in the illustration and the schematic wiring diagram, together with the photograph, will indicate the simplicity and flexibility of control which may be effected. It will be seen from the schematic wiring diagram that any of the four microphones in use at any time can be connected to the amplifier circuit through the use of any of the four selector switches, together with their associated audio-frequency transformers and faders. In addition, microphone pick-ups in remote locations can be selected through the use of switch No. 1, whereas switch No. 4 can be used to supply program input from a radio receiver or transcribing device. At KONO, No. 1 fader is generally used for remote pick-up microphones, No. 2 for studio programs, No. 3 for control room announcement micro-

phones and No. 4 for transcription and records. If the occasion demands, No. 1 fader and No. 4 fader can be switched immediately in microphone position, enabling the use of four microphones simultaneously as in the case of a large studio presentation. Since all microphone lines are duplicated on all selector switches, any microphone can be used on any fader. The flexibility of this switching system will be evident from a brief summary of the possible combinations which can be effected through the rotation of the appropriate selector switches. No. 1 fader can be switched to all microphone positions in the studios or to one of four remote microphones. Faders No. 2 and 3 can be switched to microphone positions. No. 4 fader can be switched to all microphone positions or to (1) radio receiver output, (2) vertical transcription, (3) lateral transcription and (4) 78 r.p.m. records.

For the sake of simplicity in drawing the diagram, only eight positions on each selector switch are shown, but as many as eleven positions are available on standard two-gang switches and this is the number used at KONO. Seven microphones in two studios and control rooms are available at all times by a quick turn of the selector switch, while the four remaining contacts on each switch are used for other inputs as mentioned above. All of the input transformers have a primary impedance suitable for use with the usual telephone line of 500 to 600 ohms impedance. In addition, the transformer at position 1 has a tap for a 200 ohm primary impedance for all microphones used in the studio. Mounted below each fader is an on



Schematic wiring diagram of the microphone control panel at KONO. The four switches at the extreme left replace patch cords and serve as microphone selectors. The resistors at the right are thrown into the circuit when the faders are not used to keep the input impedance to the amplifier circuit constant

and off switch with compensating resistor. While it is, of course, generally impossible to switch from one microphone to another without going through intermediate positions, this has caused no difficulty due to "live microphone circuits". Difficulty from this possible source of trouble is obviated because either the fader itself or the fader on and off switch is turned off while the incoming line selection is made. The selector switch fulfills the same function as the patch cord plug with its jacks in conventional circuits and the fader is always turned off or its switch opened before plugging into a live circuit. The selector switch is used the same as a patch cord and plug would be in setting up the incoming line to be used in the forthcoming program. At the end of a studio program, for example, all that it is necessary to do is to fade out the studio microphone and fade in an announcing microphone. If it happens that the following program

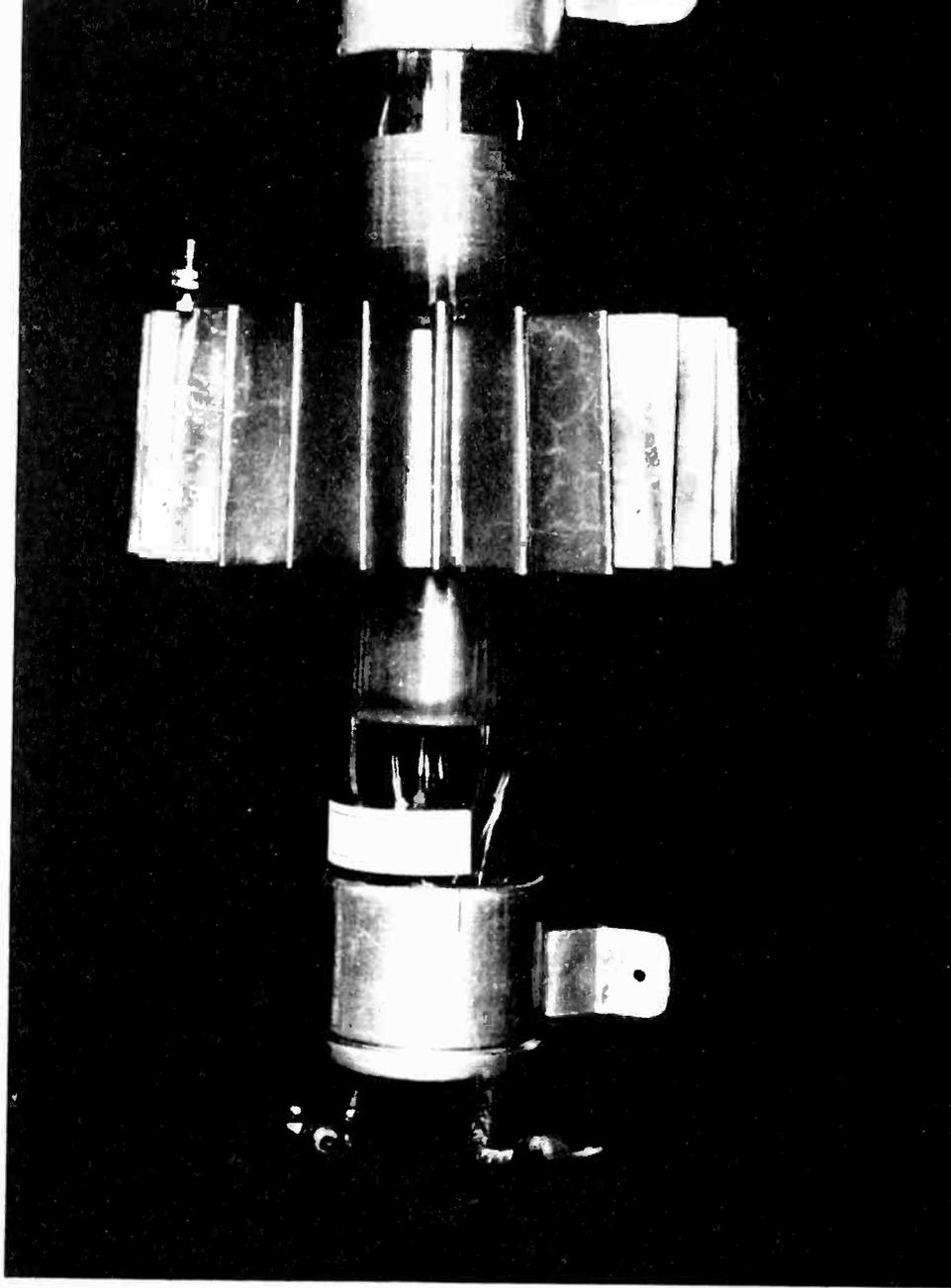
comes through the same fader as the one being used for the present program, the fader is merely turned off for an instant to permit using the selector switch. This is done during the station break and causes no delay.

Many variations of the fundamental idea depicted in this article are, of course, possible. For instance, large stations which have many remote programs may use a separate fader and selector switch to control as many as eleven remote microphone positions. If it is not desired to duplicate microphone incoming lines on all faders, it is possible to wire up the four faders so that forty-four incoming lines are at the finger tips of the control operator.

Although not shown in the schematic wiring diagram, another detail which might prove of interest to some station engineers has been added at KONO recently. Yaxley three-gang switches may be used for

each selector and the extra set of contacts may be used to control signal lamps which will light up at each microphone or remote position as the selector switch in the control room is turned to the number corresponding to that position. These lamps will serve as "on the air" signals to announcers in studios some distance from the control room or at remote pick-up points.

Another possible variation is to use a multi-gang selector switch ahead of the fader used for remote control pick-up. The contact not used for selecting the remote line may be used to connect the control room telephone to the monitoring telephone circuit, sometimes run parallel to each remote broadcast line, thus enabling communications to the announcer at the other end. As the selector switch is rotated to the remote point the telephone line is also automatically connected to the monitoring circuit running to that pick-up point.



A 25 ampere kathetron tube with external grid

THE earlier published work on this tube^{1,2} involved its use for voltage regulators which were load controlled; i.e., the tubes responded to changes in current through the regulator, but not to input line voltage variations. A great deal of work has been done recently in the application of this tube to voltage regulators of the potentially operated type. In most of this work a fundamental circuit as shown in Figure 1 is used wherein the kathetron is placed across the secondary of an impedance transformer whose primary is in series with the primary of a booster transformer. The reason for employing this circuit instead of arrangements wherein the kathetron would supply current to the d-c winding of a saturable core reactor is that in the impedance transformer method practically instantaneous response can be obtained. As shown by the oscillo-

grams in an earlier paper³, full regulation can be secured with this circuit within the first portion of one-half cycle. With the saturable reactor method, however, the d-c in the saturating winding builds up slowly due to the inductance of that winding and the regulation is not rapid enough for such applications as resistance spot welding wherein electronic timers are employed which pass only one or a few cycles at each pulse.

As explained in previous data on the kathetron³, it is usually preferable to change the amplitude of the grid voltage rather than its phase relation to the anode-cathode voltage for gradual and continuous control of the anode current. With kathetrons, it is unnecessary to employ a fixed d-c bias plus a variable a-c grid voltage, or a fixed alternating voltage plus a variable d-c bias to obtain gradual and continuous anode current control. All that

Welding and

By PALMER H. CRAIG, Ph.D.

*Inveex Corporation,
Bethlehem, Pa.*

is necessary is to produce a fixed phase relationship between the grid voltage and the anode-cathode voltage and then vary the grid amplitude, the grid voltage being in all cases an alternating voltage without d-c bias. By grid voltage is meant either the grid-cathode voltage or the grid-anode voltage, since the grid voltage may be impressed at either of these two places. Normally an increase in grid voltage making the grid more negative with respect to the cathode during the part of the cycle in which the plate is positive with respect to the cathode will result in a decrease in anode current. However, it is possible to obtain the reverse effect; namely, to increase the anode current by an increase in grid voltage under the proper conditions. It is also possible to obtain gradual control of the anode current by shifting the phase relationship of a fixed amplitude grid voltage with respect to the anode-cathode voltage.

Since the preferred means of control of kathetrons involves a control of the amplitude of the alternating grid voltage whose phase remains fixed with respect to the anode-cathode voltage, it is necessary to provide a source of grid voltage in Fig. 1 which will not vary with respect to the tube voltage. This voltage must then be varied in amplitude as a function of the output line voltage in order to produce a voltage regulator which is potentially operated. Further, the phase of the grid voltage must hold a fixed relationship with the tube voltage, and since the phase of the voltage across the impedance transformer in Fig. 1 varies constantly with respect to the output line voltage, this line voltage cannot be used as a source of grid voltage. Obviously, a voltage from across the impedance transformer cannot be

Voltage Control Using Kathetrons

The Kathetron, previously described in *Electronics*, is applied to welding control and voltage regulation circuits. Necessary conditions for this type of service are discussed

used for grid control without special modification since its amplitude varies all the way from a high value when the tube is not passing current to a very low value when the tube is passing full current. This difficulty can be overcome, however, by taking a voltage from the transformer and applying it to a constant current pentode circuit as shown in Fig. 2. The voltage across resistor R_c is then constant irrespective of the current passed by the kathetron. This voltage may then be used to produce oscillation in the circuit of the type 42 tube

former can be varied in amplitude by means of any one of several well known methods. One of these methods involves the use of a rectified potential from the line voltage bucked against a constant or reference potential and this is impressed on the grid of the vacuum tube to control the amplitude of grid voltage. Because it is sometimes easier to vary the amplitude of the grid voltage than it is to vary the phase relationship of that voltage by means of well known phase shifting bridges, the circuit of Fig. 2 sometimes possesses some advantages

ing the impedance transformer would have a high impedance. Actually, however, when the kathetron in that circuit is passing full current the impedance on the impedance transformer is almost as low as would be obtained when the secondary of the transformer were shorted. To examine this fact more carefully, oscillograms were taken of the grid voltage and anode-cathode voltage when the anode current was varied gradually in Fig. 1 by means of shifting the phase of the grid voltage. With the tube out so that no anode current is being passed the

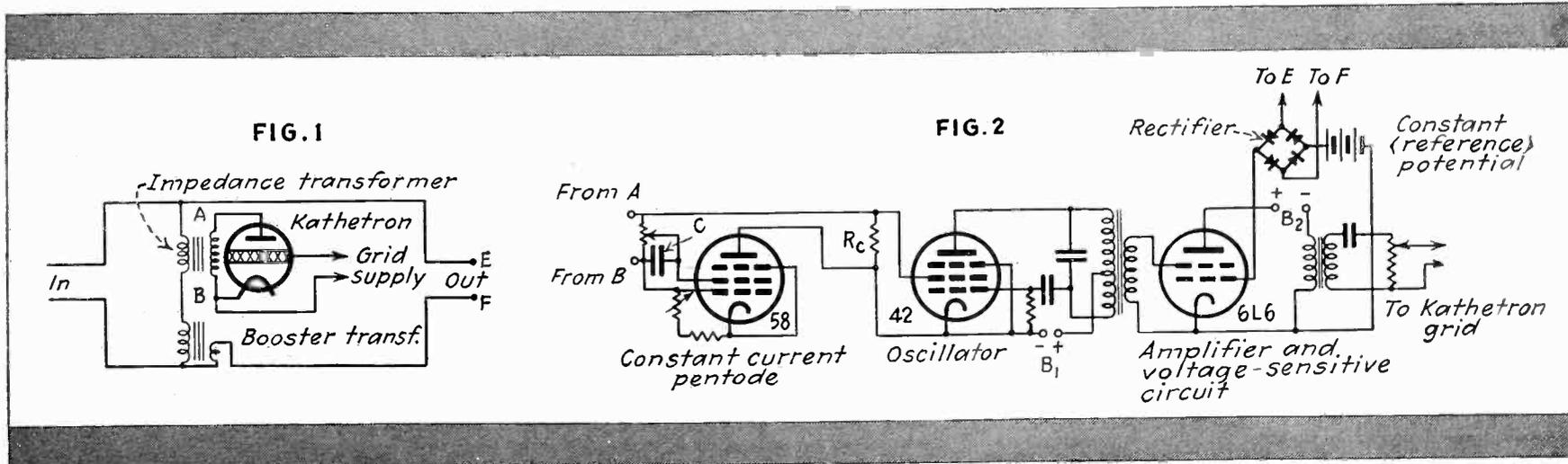


Fig. 1—Fundamental schematic wiring diagram for kathetron

Fig. 2—Voltage regulator circuit for use with kathetrons

so that the output of the transformer feeding the grid of the kathetron will always be in phase with the tube voltage of Fig. 1 and its amplitude will be independent of the tube current in Fig. 1.

Another method is to employ an oscillating gaseous tube especially designed to produce a sine wave rather than a saw-toothed one. Such an oscillator has been described in a previous issue of *Electronics*.⁴

The output of the grid trans-

over other methods. The result is a voltage regulator which produces full voltage correction within one-half cycle and the accuracy of which is almost anything that could be desired.

It might be considered that since the tube conducts during only half of the cycle it would be impossible to produce an extremely low impedance with arrangement of Fig. 1 since during the half of the cycle that the tube is not conduct-

ing the impedance transformer would have a high impedance. Actually, however, when the kathetron in that circuit is passing full current the impedance on the impedance transformer is almost as low as would be obtained when the secondary of the transformer were shorted. To examine this fact more carefully, oscillograms were made in the research laboratory show the interesting fact that the amplitude of the half cycle for which the anode is negative, decreases so as to be practically symmetrical in any case with the tube drop during the half cycle in which the anode is positive. Further, the intercept on the time axis of the half cycle in which the anode is negative decreases as the anode

current increases. The net result is that the tube is passing current through practically the entire cycle and not simply through the half of the cycle in which the anode is supposed to be positive. This is an effect on which less data have been published than would seem to the author to be justified, and it allows one to use a single half wave tube across an impedance transformer and obtain almost no impedance in that transformer when the tube is passing current to its full capacity. Oscillograms show that with no grid control the negative half cycle disappears entirely while the tube seems to be passing current through the entire cycle. The author has presented other data involving this phenomenon.⁶

Figure 3 illustrates a circuit in which the kathetron is constructed of a pool type mercury arc with an external grid. This arrangement allows large peak current such as are necessary for resistance welding and the voltage regulation may be accomplished by means of the circuit shown. Voltage regulation is extremely important in certain types of welding, particularly in stainless steel welding where to meet certain specifications it is necessary that the diameter of the discoloration of the weld shall not exceed more than 80% of the thickness of the stainless steel. In order to obtain a weld which passes this specification

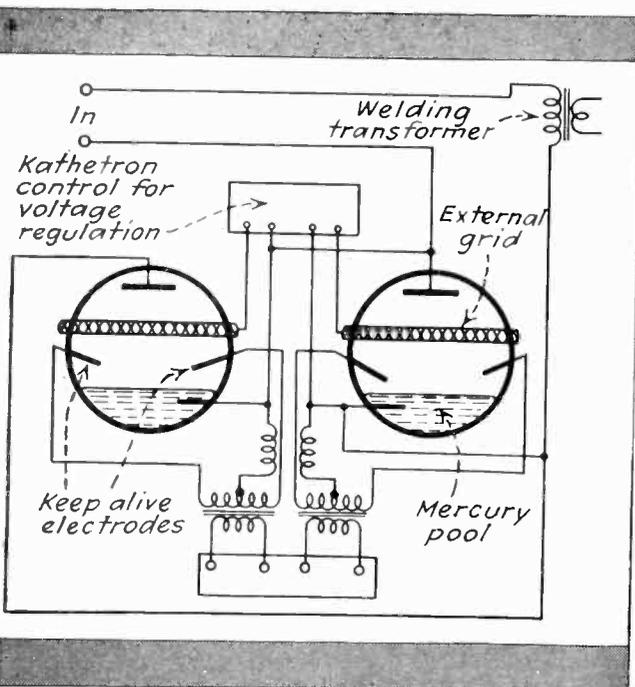


Fig. 3—Welding application of pool type mercury arc cathetron

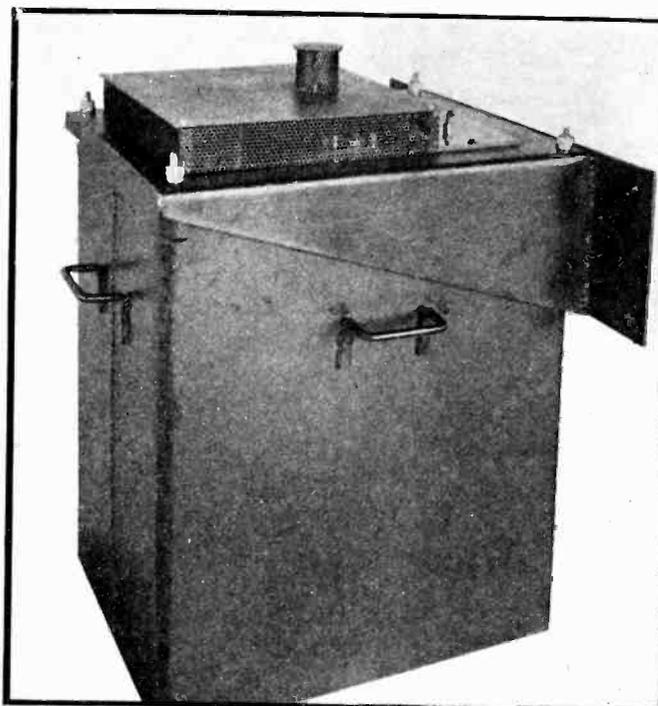


Fig. 4—Exterior view of kathetron voltage regulator installation

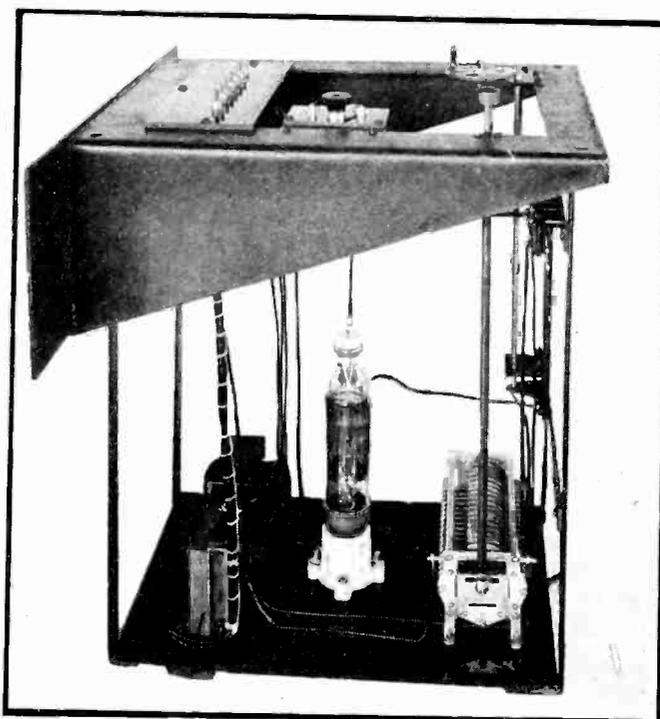


Fig. 5—Simplicity is the keynote of the interior of the voltage regulator

and still produces sufficient fusion, it is necessary to control the voltage of the welding process very accurately, and frequently it is more economical to do this by means of a voltage regulator than by using extremely large transformers and lines necessary to accomplish this purpose without voltage regulation.

The tube portion of an actual installation of a kathetron voltage regulator with an output of 200 KVA installed in the plant of a prominent automobile body manufacturer is shown in Fig. 4 and Fig. 5. A kathe-

tron 25 ampere tube which was employed in a similar application is shown at the head of this article, the external grid serving both as a grid and as a means for dissipating the heat from the tube to the oil bath in which it was immersed.

¹The Kathetron—A Control Tube with External Grid, by P. H. Craig, *Electronics*, March, 1933, pp. 70-72.

²Electronic Voltage Regulator, by P. H. Craig and F. E. Sanford, *Electrical Engineering*, February, 1935.

³U. S. Patents, 1,992,146; 2,001,836; 2,001,837; 2,001,838; 2,054,496.

⁴Generating Sine Waves with a Gas Discharge Tube, by W. E. Koch, *Electronics*, March, 1935, pp. 92-93.

⁵U. S. Patent, 2,054,496.

Questions and Answers

By SAMUEL WEIN

1. Phila, Pa.—*Method of forming grids for selenium cells.*

[A.] Make a mixture of 75 per cent of 200 mesh talc with 25 per cent graphite powder. Mix thoroughly. To this add about 30 or 40 per cent of a thermo setting resin. A relatively large quantity of solvent is added and the mixture is sprayed or painted on the surface. This is now permitted to dry and is baked. This mixture may be used as an ink and applied to the surface with a "cut." This mixture may be used as a resistance material as well. The resistance varies as the percentage of graphite powder used.

2.—*I use glass in one of my instruments, and use a piece of tin-foil for contact. With time, the tin-foil wears off, causing considerable difficulty. Understand that it is possible to deposit by some method a film of gold, silver or platinum on glass and that it will stick to it.*

[A.] Silver and gold paints can be applied to glass or glazed porcelain, fused into the surface, and ought to give sufficient electrical conductivity. If not, more gold or silver can be built up and the conductivity increased by electroplating on top of it. Silver and gold paints are sold by B. F. Drakenfeld & Co., 45 Park Place, New York City. If platinum is desired, such may be obtained from Hanovia Chem. & Mfg. Co., Chestnut St. & N. J. R. R. Ave., Newark, New Jersey. They call it No. 05 Bright Platinum Mixture. Considering the fact that this has a great surface covering area, the intrinsic cost is not prohibitive for contact purposes.

3. Newark, New Jersey—*Understand a partial insulator has been used as a relay in connection with a photo tube without resorting to amplification.*

[A.] A slab of limestone is polished on one side and on the other side is pasted a piece of tin-foil which serves as one electrode. If a polished piece of flat metal is placed against the polished stone, and if 90 or more volts connected in series through it with a microammeter, a small current in order of about one microampere will flow through the circuit, and the metal will be held tightly to the polished stone surface. If a phototube is inserted in the circuit, just so long as light falls on the cell, the metal plate will cling to it, interrupt the light, the metal will fall off, and can be made to close a contact, etc. Experiments with higher voltages showed that $\frac{1}{2}$ pound weight in metal will be held against the polished stone surface. The phenomenon is known as the Johnson-Rahbeck effect.

4. Washington, D. C.—*I want to measure the degree of vacuum electrically. Give circuit, etc.*

[A.] The method depends on the use of a Pirani gauge, i.e.: two tubes in a Wheatstone bridge. One of the tubes is a fine platinum wire in an evacuated bulb, and the other bulb is the same, except that it is open, and connected direct to the vacuum system. These two tubes and two other resistors are connected in the bridge circuit (all legs of the bridge having the same resistance) except the open bulb. As a bulb is being evacuated, the resistance changes in proportion, and a consequent voltage drop appears across the bridge, and this is read off on a milliammeter. Six volts are used in the circuit.

5. New York City—*Can you suggest a compound that will serve as an insulating material I want to prepare?*

[A.] If you make a dilute solution of sodium silicate (water glass) and add that to a solution of magnesium sulphate, a heavy and gelatinous mass will precipitate out. This is magnesium ortho silicate (synthetic talc). Wash with running water and add to the mass powdered mica, slate, asbestos, etc., and mix thoroughly. This mass may be spread out into thin sheets or cast into shapes by means of pressure and heat. A low loss (for high frequency work) socket and base is commercially made of such a compound as the above.

6. Akron, Ohio—*Several years ago there appeared a "wet" rectifier known as the "Silite". Is it available, and what is it made of?*

[A.] The Silite rectifier was made by the Kodak Co. of Cincinnati. It was made of a silicon rod steeped in a solution of sulphuric acid containing some ferrous sulphate and a trace of phosphoric acid. The other electrode was metallic lead.

These rectifiers gave a heavy d.c. output and were made expressly for battery chargers. They were discarded because (1) prejudice against devices using liquids, and (2) the dry disc rectifiers supplanted them. However, the rectifier was efficient and dependable over a period of time.

7. Cambridge, Mass.—*Can you suggest a material that will respond to magnetic flux?*

[A.] Bismuth and tellurium films change their electrical resistance with magnetic flux. Tellurium is the more sensitive of the two.

Tellurium may be electrolytically deposited on lead from the following solution:

Tellurium dioxide	300 grams
Hydrofluoric acid	500 grams
Sulphuric acid	200 grams
Water	1 liter

The anode is metallic tellurium in a slab form, and the cathode must be lead. The current density is 1.6 ampere per square cm. (15 amp. per sq. ft.), at 1 volt. This will deposit a thick or thin deposit of fine grain. A second electrode may be sputtered on the free side of the tellurium film which serves as the other electrode.

It is interesting to add that tellurium films also serve as rectifiers as well as thermo-couples.

8. New York City—*I want a material that will rectify a.c. to d.c. at low current values.*

[A.] If you get a "radio crystal" such as is procurable in radio supply houses, these will serve rather nicely for converting a.c. to d.c. at low current values. The cost of these crystals is very low indeed. Better still, crystals of fused silicon can be had from Electro Metallurgical Co., 30 East 42nd Street, New York City, or Carborundum from the Carborundum Company of America, Niagara Falls, N. Y. A crystal can be cast into a cup of fusible or type metal, and a "cat's whisker" contact serving as the other electrode. Either one of these will serve as a low current density rectifier and will be useful for meter purposes. There are no patents on the use of these (silicon or Carborundum) as a rectifying material, or in connection with a d'Arsonval meter movement to read d.c. from a.c. Such patents as did exist have long since expired, viz:

G. W. Pickard, U.S. Pat.	837,616	1906
G. W. Pierce, U.S. Pat.	897,117
G. W. Pierce, U.S. Pat.	923,700	1909
G. W. Pierce, U.S. Pat.	1,866,351
G. W. Pierce, U.S. Pat.	1,961,825

9. Boston, Mass.—*Am seeking an inexpensive transparent material that will not crack as a result of sudden temperature changes.*

[A.] Plexiglas is a synthetic resin made by

Rohm & Haas Co., Inc.
222 West Washington Sq.
Philadelphia, Pa.

It is much more transparent to light than are the more common grades of glass, and is many times lighter. Can be machined and worked like metals and wood.

When subjected to elevated temperatures (100° C.) it will become plastic, and if a sudden air blast is allowed to fall on it, the material will not crack nor show signs of strain. For exhibition models where the inside of the unit is to be shown, this material is suggested. A transparent piece may be glued or fastened to a colored or opaque piece and so enhance the effect of the unit.

NEW BOOKS

Communication Engineering

(Second edition)

BY W. L. EVERITT. *McGraw-Hill Book Co. 1937. (727 pages. Price \$5.00)*

PROFESSOR EVERITT'S text has had wide acceptance in colleges and universities. It covers the fundamentals of communication circuits and practice with emphasis on the solid foundations upon which all apparatus is built. The mathematical background is put forward rather than a description of equipment. The text is solid. It covers more than radio; is divided broadly into five sections dealing with a general resume of the function of networks and the theorems dealing with these networks followed by specific types of networks encountered in communication whether by space or by wire. Thus the succeeding sections deal with linear bilateral impedances (lines, filters, coupled circuits, transformers, equalizers and bridges); networks using unilateral and nonlinear impedances (modulation and demodulation, detection, amplification, oscillation); radiation; and finally coupling between electrical and mechanical circuits.

The new edition contains a new chapter on equalizers, rewritten chapters on radio frequency amplifiers and on electromagnetic coupling, revised chapters on detection and modulation and an extended chapter on radiation including computation of antenna arrays.

This edition, as well as the first, will be found of considerable value to students of both radio and telephone engineering. In addition the fundamental nature of the text makes it valuable to men in the field.—K.H.

Handbook of Broadcasting

BY WALDO ABBOT. *McGraw-Hill Book Co. 1937. (423 pages. Price \$3.50)*

ALTHOUGH the author declares in his first words that this book is for the student of broadcasting and not for the technician, this reviewer feels that he underrates his book. It is undeniably interesting to a dyed-in-the-wool technician who has never seen a program broadcast. To the man who understands his impedances and his arrays and who wants to know about, or who has a secret yen to get into, the program end, this is the book he should peruse.

The book explains in language simple enough for a sponsor to understand what makes his message go out and

what makes it get into the listeners' ears. Then it tells about transcriptions, about how to talk to "mike," how to write, produce and broadcast material on the radio. There are chapters on broadcasting as a vocation, how to keep the sponsor happy, etc.

Technical men would learn a lot about the broadcasting business by reading such a book, even if they won't learn how to push amperes into an antenna.—K.H.

Lehrbuch der Hochfrequenztechnik

BY FRITZ VILBIG. *Akademische Verlagsgesellschaft, Leipzig. (Price Rm 32.80, 775 pages)*

THIS is a compendium of information covering a wide range of topics primarily in the field of radio communication. While a number of mathematical derivations are brought into the introductory sections of the text, the treatment is largely descriptive, aided by a wealth of illustrations—performance curves and apparatus photographs. Particularly noteworthy is the bibliography of some hundred pages, arranged according to chapters, which includes references to technical literature extending well into 1936. A detailed index of fifty pages makes the subject matter especially accessible.

One of the two main divisions of the text (219 pp.) is devoted to the properties of closed and open circuits. The analysis covers free and forced oscillations in simple circuits, together with the properties of lines and networks. Derivation of the electro-magnetic field equations and their solutions serve as an introduction to the consideration of propagation through space and the radiation from antennas, which are treated from both theoretical and practical viewpoints. The second main division (294 pp.) is devoted to tubes and tube circuits. This starts with the general properties of high vacuum tubes and their construction, and proceeds to circuit applications. Chapters are devoted to amplification, oscillation, regeneration, rectification (both signal and power), modulation, and to transmitting and receiving circuits. The remaining pages are devoted to a miscellany including common frequency broadcasting, picture transmission, and television.

The wide range of topics treated together with the extensive bibliography make the book useful as a reference text.—E. PETERSON.

Aids to Service Men

MATERIAL of use to radio service men recently received by the editorial department of *Electronics* comprises two books by John F. Rider and trouble shooting gadgets from Alfred A. Ghirardi. These two well known authors continue to supply factual and workable data for the many of thousands of engineers and self-trained men who keep America's radio receivers on the job.

The Rider books are *Alternating Currents in Radio Receivers*, and *Aligning Philco Receivers*. The first costs 60 cents, the second \$1. The first teaches the fundamentals of a-c theory and tells how, by means of an oscilloscope, one may study complex and simple waveforms. The second book tells in general how to handle alignment problems and follows this with detailed data on the many models of receivers Philco has brought out. Both are useful little books.

The Ghirardi gadgets handle home radios in one booklet, auto sets in another. Each contains over 400 "spots" where trouble occurs and a mechanical system is worked out whereby the service man can find the symptoms and corrections easily in the book. They sell for 50 cents each and should be useful adjuncts to the serviceman's tools.—K.H.

Legal Restrictions on the Contents of Broadcast Programs in the United States

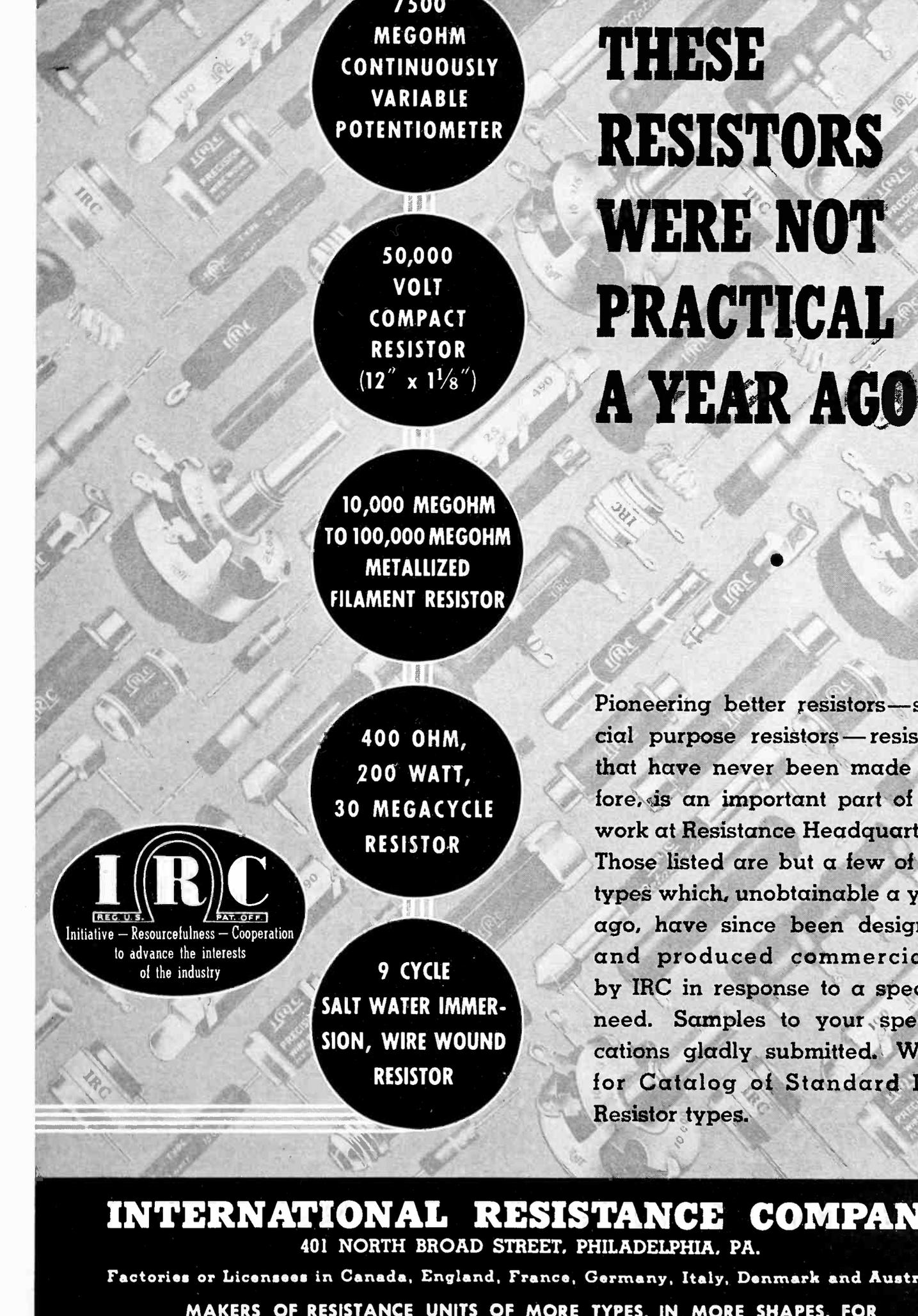
BY LOUIS G. CALDWELL. *Report of the Second International Congress on Comparative Law; the Hague, August 4-10, 1937.*

THIS REPORT, limited to a discussion of legal restrictions of radio broadcast programs is divided into five main sections; division of powers between the Federal Government and the state governments, constitutional guarantees of free speech and free press, Federal regulations of contents of broadcast programs under standard of "public interest, convenience, or necessity", state restrictions on contents of broadcast programs, and finally, legislative trends. Many legal opinions are quoted and 18 pages of references are given in this 75 page report.—B.D.

Servicing With Set Analyzers

BY H. G. MCENTEE. *Radiocraft Publications Inc., New York, (Price \$0.50, 64 pages).*

FOR THE SERVICE MAN. Discusses construction and features of the various types of analyzers rather than using analyzers for locating troubles in radio equipment.—B. D.



THESE RESISTORS WERE NOT PRACTICAL A YEAR AGO..

7500
MEGOHM
CONTINUOUSLY
VARIABLE
POTENTIOMETER

50,000
VOLT
COMPACT
RESISTOR
(12" x 1 1/8")

10,000 MEGOHM
TO 100,000 MEGOHM
METALLIZED
FILAMENT RESISTOR

400 OHM,
200 WATT,
30 MEGACYCLE
RESISTOR

9 CYCLE
SALT WATER IMMERSION,
WIRE WOUND
RESISTOR



Pioneering better resistors—special purpose resistors—resistors that have never been made before, is an important part of the work at Resistance Headquarters. Those listed are but a few of the types which, unobtainable a year ago, have since been designed and produced commercially by IRC in response to a specific need. Samples to your specifications gladly submitted. Write for Catalog of Standard IRC Resistor types.

INTERNATIONAL RESISTANCE COMPANY

401 NORTH BROAD STREET, PHILADELPHIA, PA.

Factories or Licenses in Canada, England, France, Germany, Italy, Denmark and Australia

MAKERS OF RESISTANCE UNITS OF MORE TYPES, IN MORE SHAPES, FOR
MORE APPLICATIONS THAN ANY OTHER MANUFACTURER IN THE WORLD

TUBES AT WORK

TUBES go aloft to gather data of great value in weather forecasting, as explained in detail by Mr. Pear. A tube micrometer aids in crime detection work, an oscillator is used to hunt electric eels, and a phototube controls ink drying in high speed printing

Radio Meteorographs

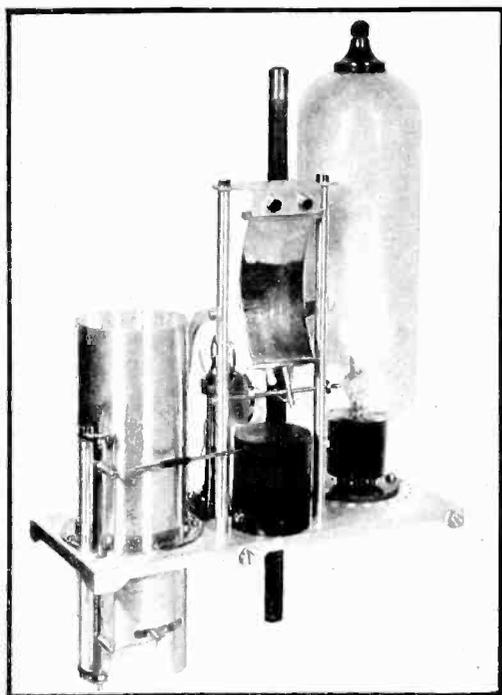
By CHARLES B. PEAR, JR.

Blue Hill Observatory, Milton, Mass.

ONE OF THE PROBLEMS which meteorologists have long been trying to solve is how to make observations of the state of the atmosphere at great heights above the earth. Early methods included observations of the clouds and from the tops of high hills and mountains. Later attempts were made with kites which carried recording instruments. For the greatest heights balloons carried the instruments. These carried notices offering rewards for their safe return in the hope that they would be found after falling when the balloon reached its elastic limit and burst.

This latter method has been quite valuable for research purposes but is limited because it is a matter of weeks, months, or even years before the record is returned, if ever. In order to be useful for forecasting the record must be evaluated and ready for use within about two hours or less.

The need for this upper-air data has become so acute during the last few



A German form, using variable frequency indication. The entire radio transmitter is contained in the tube at the right, surrounded by glass wool

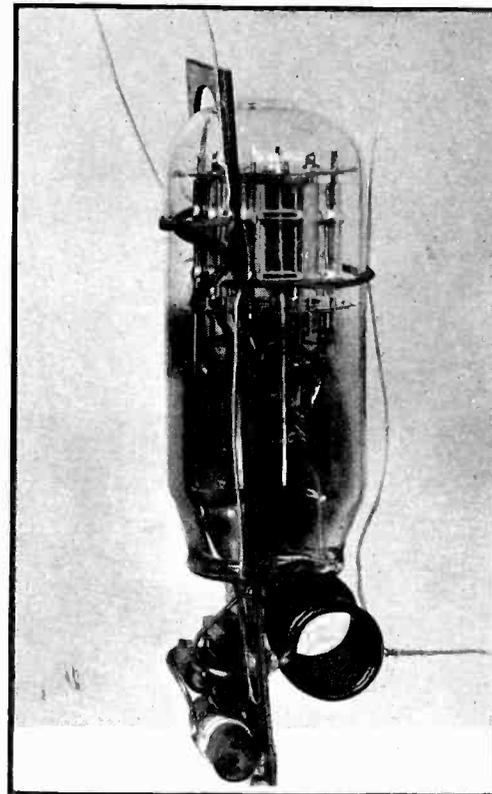
years that airplanes are sent up every day to 17,000 feet at some 21 stations in this country and at many more in other countries. This need has been brought about largely by the increased understanding of the importance of changes in the upper atmosphere which has come with the more general acceptance of the Norwegian methods of three-dimensional analysis of weather maps in forecasting.

The latest product of this search is the radio-meteorograph, a very light instrument carried by 4-foot balloons and employing a radio transmitter which sends back the record as fast as its component instruments measure it.

This device can be made to do all that the airplane can and more. Recent tests of the Harvard instruments made in conjunction with the M.I.T. Meteorological Dept. have shown that it is possible to obtain records in all kinds of weather, although icing of the balloons does offer some difficulties. The average height of the series of 25 flights was more than 50,000 ft. as compared to less than 17,000 ft. for airplane observations, and the former figure does not represent the maximum attainable. This seems to be high enough for forecast purposes however, since the air above that level is so rarified that its movement is not supposed to be able to have much influence on surface weather.

The instrument carried by the balloon is composed of two parts; a meteorograph and a radio transmitter. The meteorograph contains an aneroid barometer which measures the atmospheric pressure, from which the height can be determined, a bimetal thermometer, a hair hygrometer which measures the relative humidity and some means for making these instruments affect the radio signal so that they can be interpreted at the ground. Several methods for doing this have been used more or less successfully, especially in Europe. The most common of these is the Olland telemeteorograph or some modification of it. In its simplest form this consists of an arm rotated at a constant speed by a clock which in its rotation makes connection successfully with a fixed contact and with variable contacts moved by the instruments whose readings it is desired to transmit. These connections can be made either to start or stop the transmitter, and the receiver arranged accordingly. The instrument is calibrated in terms of the time be-

tween the fixed contact and the variable ones. This is the principle used almost without exception in this country, being employed with refinements in the work done at the Blue Hill Observatory of Harvard University, by Krick at the California Institute of Technology and by Ackerman at Univ. of Minn. Another principle sometimes employed, notably by Vaisala and by Duckert in Europe, involves a switch operated by a fan turned by the air moving past the instrument as it rises. This switch connects four different condensers in the tuned circuit of the radio transmitter, thus varying

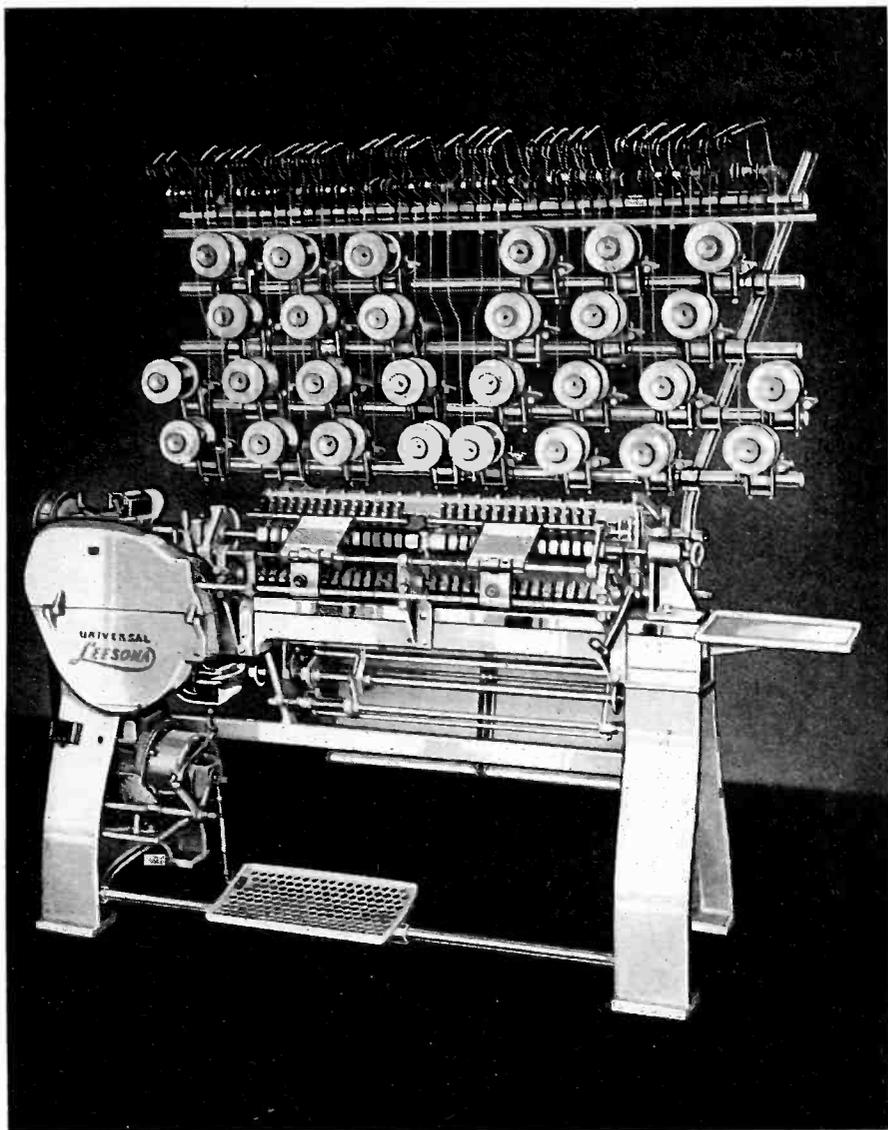


Transmitter used at Blue Hill. The tube, specially made for the purpose, contains two triodes (similar to type 30's but with 1.5 volt filament). It is powered by the batteries at lower left

its frequency. One of these condensers is fixed, as a reference, and the others are varied by the meteorological instruments. In receiving, a series of dots is heard on four frequencies one of which remains nearly constant, the other three varying widely as the instrument rises. This of course necessitates the use of a wide band of frequencies. Mr. Harry Diamond of the National Bureau of Standards is working on a new scheme in which all the measured values are reduced to variable resistances. These are switched in and out of the circuit of a relaxation oscillator by a contacting arm which is moved by an aneroid barometer bellows expanding as the balloon rises. This relaxation oscillator is used to modulate the r-f oscillator and signals are recorded by measuring the modulation frequency with a recording frequency meter. The switching is so

(Continued on page 34)

UTAH RADIO PRODUCTS CO.



Increases
**COIL
PRODUCTION
WITH
UNIVERSAL
"LEESONA"**
No. 105 DUO-MULTIPLE
WINDER

The only machine of its kind in the radio industry—a Universal Duo-Multiple Winder—is now producing coils at the Utah factory! This installation is of importance to every purchaser of radio parts incorporating wire wound construction. This machine winds better coils, and saves labor as well. You get finer radio parts without price penalty. See details below.

It always pays to specify Utah parts. If you use speakers, transformers, resistors, relays, vibrators, chokes, control switches, jacks, plugs—any parts Utah manufactures, address Department E 9 for specifications and quotations. Write today!

28 COILS WOUND *Simultaneously!*

Operating from two separate rolls of insulating paper, this machine will automatically produce up to 28 electrical windings simultaneously. The individual paper rolls insure smooth inserts, preventing wrinkling of paper insulation which often takes place when one wide roll is used.

Failure of insulating papers is minimized by the use of upper paper handling rollers free from corrosion—transmitting properties.

Sharp bends and wire strains are eliminated by a new type of wire handling equipment, which adds immeasurably to coil life.

Tighter, more precise windings are made, because spools are vibrationless, and the wire is under control at all times—even when the machine is stopped abruptly.

The "lay" of the wire turns is perfectly uniform, due to a new type of heart-shaped cam with spring insert, which insures against "dwell" at the end of the traverse.

The coils used in Utah parts reach a new standard of excellence.

Utah coils are uniformly perfect, and longer-lived.

UTAH RADIO PRODUCTS COMPANY

TORONTO
ONTARIO, CANADA

CHICAGO, U. S. A.
16 YEARS OF LEADERSHIP

BUENOS AIRES
(UCOA RADIO PRODUCTS CO.)

MODULATION PARTS...

for Radio Transmitters



Left—AmerTran inverse feed-back modulation transformer for service in a 50 Kw. high-level broadcast transmitter.

HAVE you considered the advantages of inverse feed-back in the modulation system of a broadcast transmitter? If properly engineered, you obtain lower distortion . . . more linear modulation . . . an improved signal to noise ratio.

AmerTran engineers coordinate properly the leakage inductance and capacities in a transformer design so as to insure desired performance characteristics. Modulation transformers for inverse feed-back circuits have a progressive phase shift—normally 30 degrees from 30 cycles to 10 kilocycles. Frequency characteristics are uniform within 0.5 dB throughout the same range. May we send you complete data on equipment for your requirements?

**AMERICAN TRANSFORMER
COMPANY**

178 Emmet St., Newark, N. J.

AMERTRAN

*Manufactured
Since 1901 at
Newark, N. J.*

TRANSFORMERS



PRODUCTS

American Transformer Co. manufactures transformers for every industrial, electronic and laboratory application in sizes up to 10,000 Kva. and for potentials up to 132 Kv. Other products: voltage regulators, test sets, rectifiers.

Tubes at Work

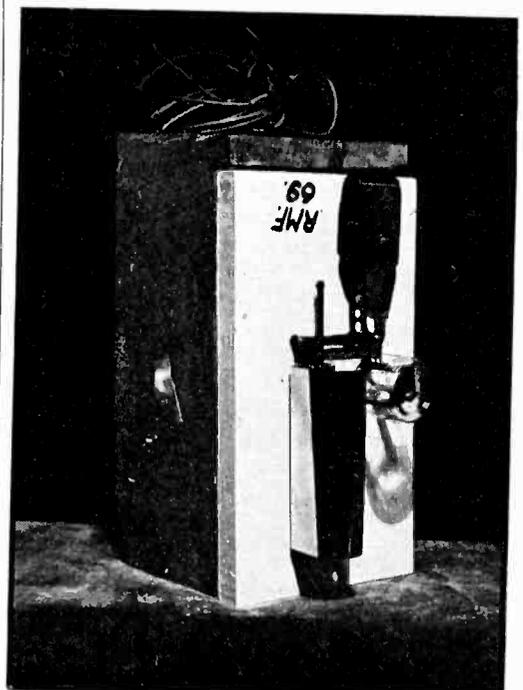
(Continued from page 32)

arranged that a continuous record of temperature is transmitted with breaks which indicate the humidity and occurring at pre-determined pressure intervals. Mr. Diamond has just developed a simplified instrument to tell the height of the top of the clouds. This has a photo-cell in the relaxation oscillator circuit so that its frequency changes sharply as the top of the clouds is reached.

There are several other systems, of which the most important are that of Bureau, used in France which is similar to the Olland type, and that of Moltchanoff, which has had considerable success in Russia, and which makes use of a very complicated and delicate mechanism to key the transmitter.

In all of these the radio transmitter consists of one or two small triodes connected in a simple oscillator circuit. The power inputs are less than 5 watts, power being supplied either by very small storage batteries or by small dry cells. One of the real problems encountered is to protect batteries and clock from the extremely low temperatures ($-70^{\circ}\text{C}.$) found at great heights. This may be done by enclosing the instrument (not the temperature measuring element) in some transparent material which allows the sun to heat it. If ascents are to be made at night some insulation such as balsa wood is used and chemical heating may be provided. In spite of such precautions the time that the oscillator will operate is much less than what would be expected at normal temperatures.

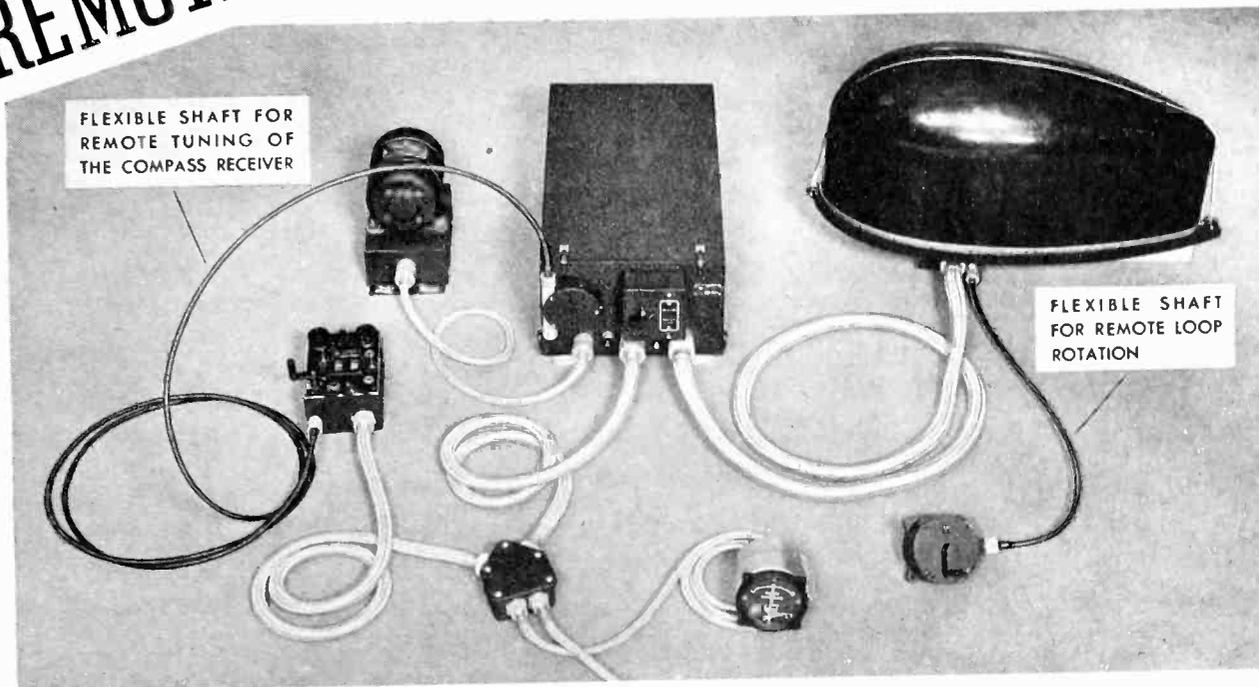
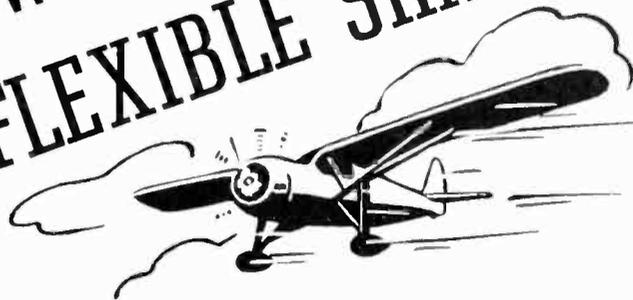
The wave-lengths used are between



Complete radio meterograph without radiation shield



FAIRCHILD uses S. S. WHITE RADIO REMOTE CONTROL FLEXIBLE SHAFTS



FAIRCHILD RC-4
RADIO COMPASS
Product of
Fairchild Aviation, Inc.
Woodside, New York,
N. Y.

The fact that so many prominent manufacturers of radio equipment use S. S. WHITE Remote Control Flexible Shafts, is evidence that these shafts efficiently and reliably fulfill the purpose for which they were specially developed.

Possessing the essential characteristics* for sensitive remote control, the wide selection of S. S. WHITE Radio Shafts satisfies every requirement of Automobile, Aircraft and Broadcasting Radio equipment.

Full information about these shafts will be promptly furnished on request. Engineering cooperation for working out specific applications is also offered without obligation. Just send us the details.

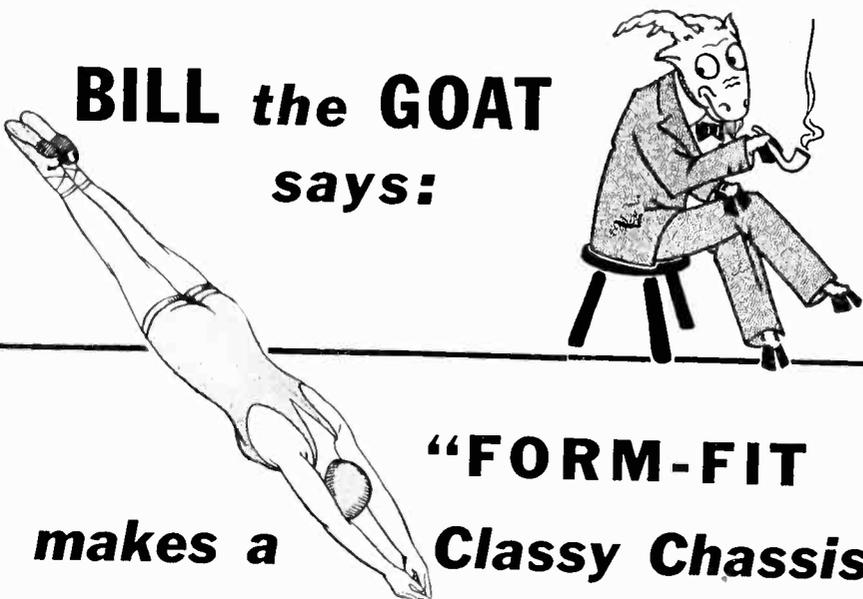
* Ask for bulletin giving these characteristics

The S. S. WHITE Dental Mfg. Co. INDUSTRIAL DIVISION

10 East 40th St., Room 2310E, New York, N. Y.

FLEXIBLE SHAFTS for POWER DRIVES, REMOTE CONTROLS and COUPLINGS

BILL the GOAT
says:



**"FORM-FIT
makes a Classy Chassis"**

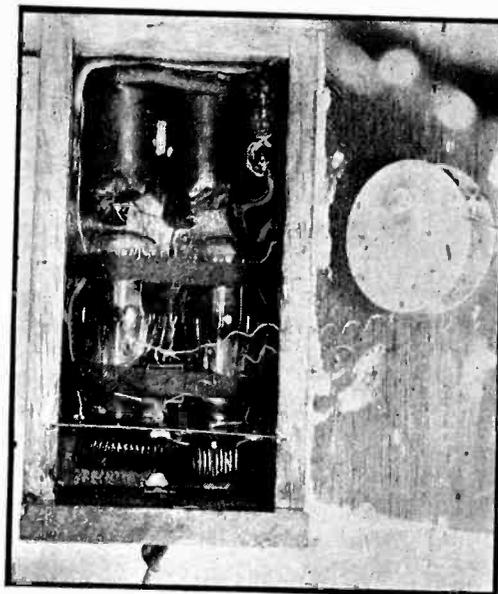
**... AND SO DO GOAT
FORM-FITTING TUBE SHIELDS!**



GOAT RADIO TUBE PARTS, INC.
314 Dean Street, Brooklyn, N. Y.



70 cm. and 100 meters. The Ultra-high frequencies seem to be the most promising as they are (at present) free from interference both of the man-made and natural varieties. Also the oscillating circuits and antennae are smaller and consequently lighter. However, direction-finding on these frequencies has not yet given sufficient accuracy to be satisfactory, so the investigators interested principally in this are using longer wave-lengths. Very little of value has been accomp-



Interior view, showing radio transmitter and clock

FOR ORDINARY OR UNUSUAL CONDITIONS

For years DUNCO Timing Devices have been specified by those who demand unusual performance, and they can be relied upon to give utmost satisfaction for you—no matter how severe or exacting the conditions.

Consult our engineers—no obligation.

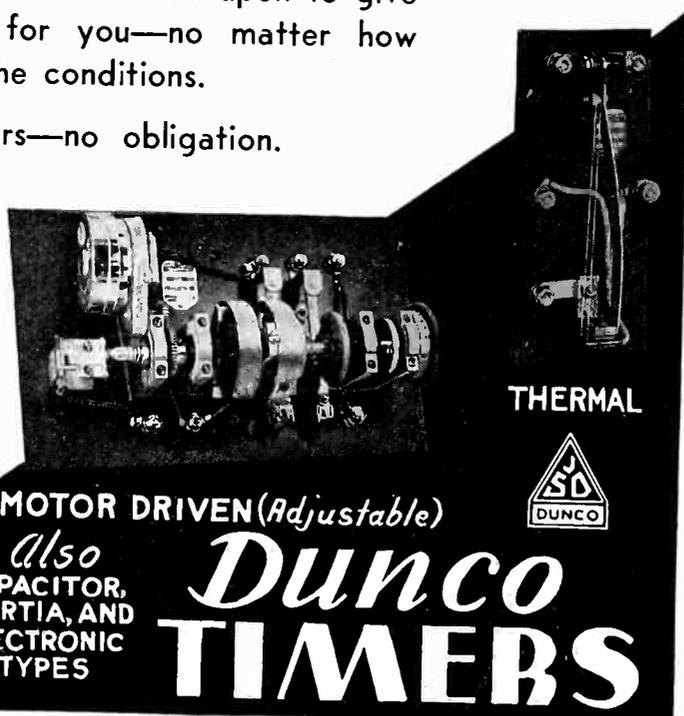
STRUTHERS DUNN, INC.

148 N. Juniper St.
Philadelphia, Pa.

*Manufacturing Specialists of
Electrical Control Equipment*



AIR DASH POT



THERMAL



MOTOR DRIVEN (Adjustable)

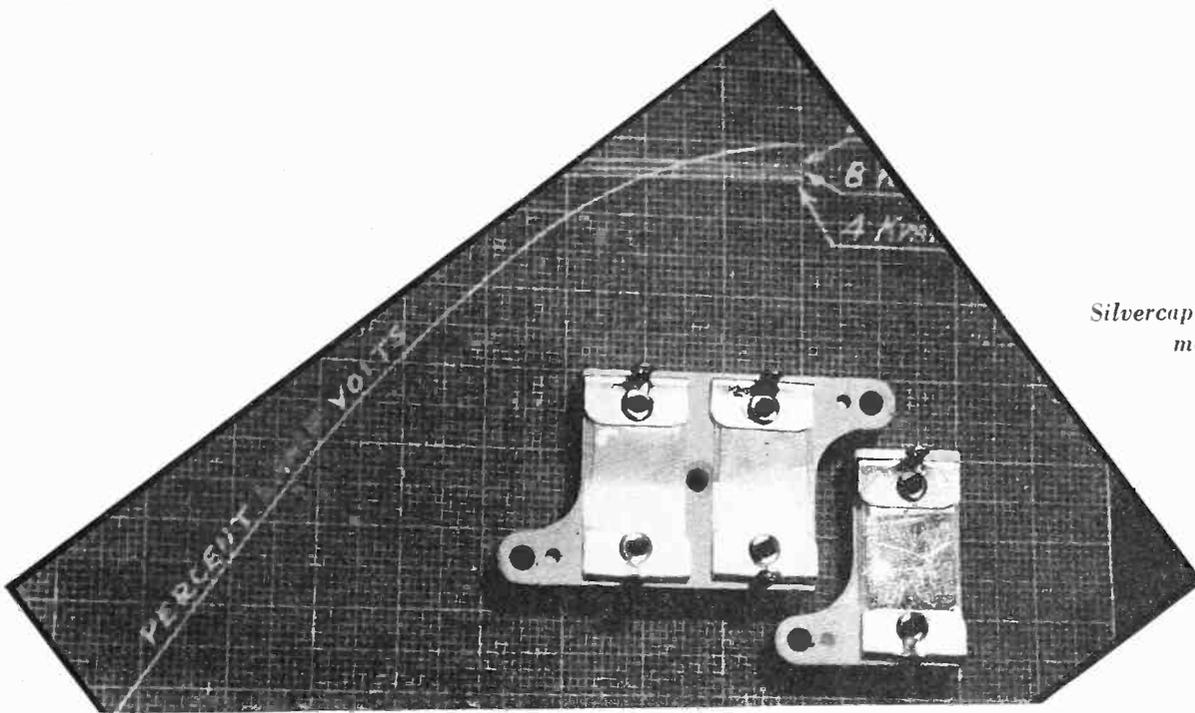
Also
**CAPACITOR,
INERTIA, AND
ELECTRONIC
TYPES**

**Dunco
TIMERS**

lished in this field, partly due to a lack of activity and partly to the difficulties involved in reducing errors to a small enough value so that readings at considerable distances can have any meaning. This is a very important field for investigation since it is probably the only method by means of which anything can be learned about the movement of air in the upper levels of storms. These movements of air are, of course, of the utmost importance to the weather forecaster.

The methods of receiving and recording the signals from these tiny transmitters depend on their frequency and the system of modulation used. For lower frequencies superheterodyne receivers are obvious while for the ultra-high frequencies superregenerative receivers are better due to their high sensitivity and wide acceptance band which such elementary transmitters, subject to wide temperature changes, make necessary.

The received signals are put through relay circuits and made to operate a recorder. For the Olland type meteorograph this recorder may be a drum turned by a synchronous motor at the same speed as the moving arm in the transmitter. The received signals cause a mark to be made so that the positions of these marks around the drum correspond to the positions of the moving contacts in the meteorograph. The pen of the recorder follows a spiral down the drum so that



Silvercap fixed condensers for permeability tuned i.f.'s

Components for 1938 Radio sets

A radio set is no better than its component parts—new items in the components line, please better engineered if not radically improved receivers for next year



FACED with another year in which sales of radio sets for home and automobile use will set new records, components manufacturers are preparing to play their share in the manufacturing season soon to begin. Early forecasts indicate that 1938 receivers will differ from last year's sets in mechanical details. They will be easier to tune, thanks to some more automatic features and to slanting panels; they may be somewhat better in tone quality but electrical features will probably not differ greatly.

Receiver manufacturers clamoring aboard the automatic-tuning wagon have discovered that few parts for these systems are available. Yaxley furnishes several types of mechanical switches—most ingenious devices; Utah has a small motor and several of the old line motor people are developing small motors, but in general the parts people are not inclined to load up with tools on these automatic tuning gadgets until they know whether

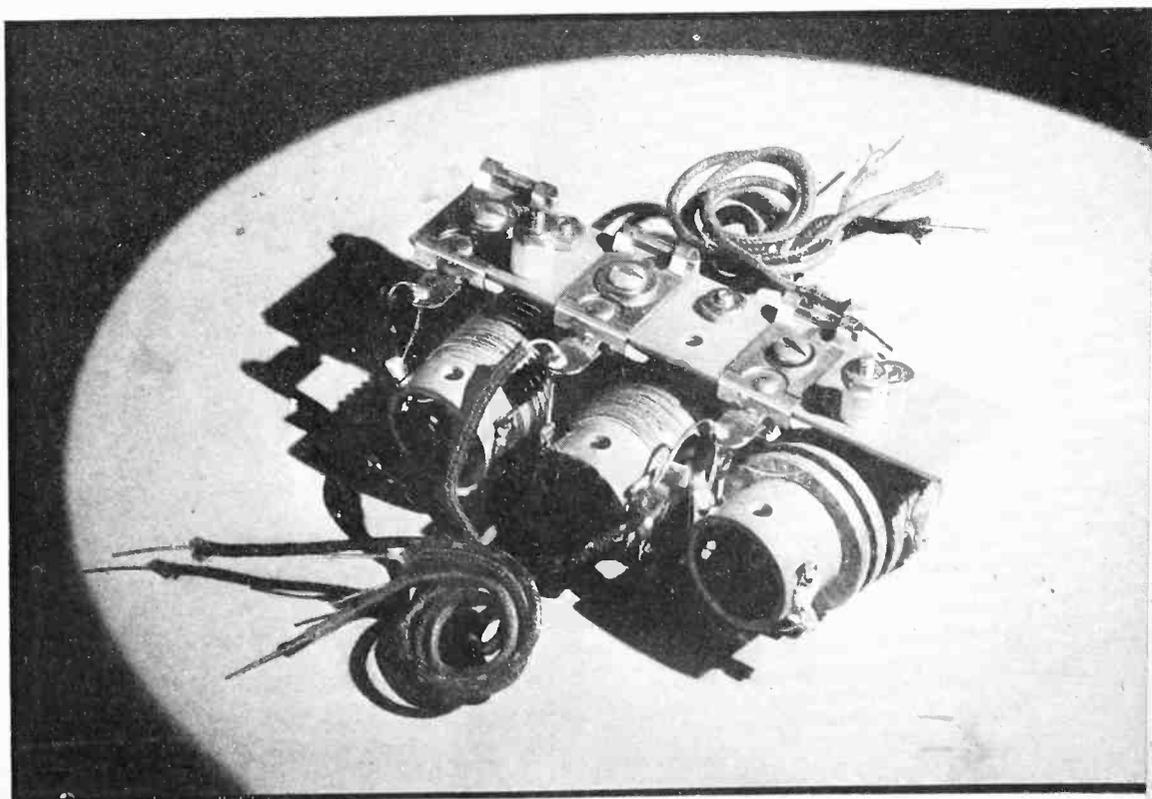
there will be worth-while sales.

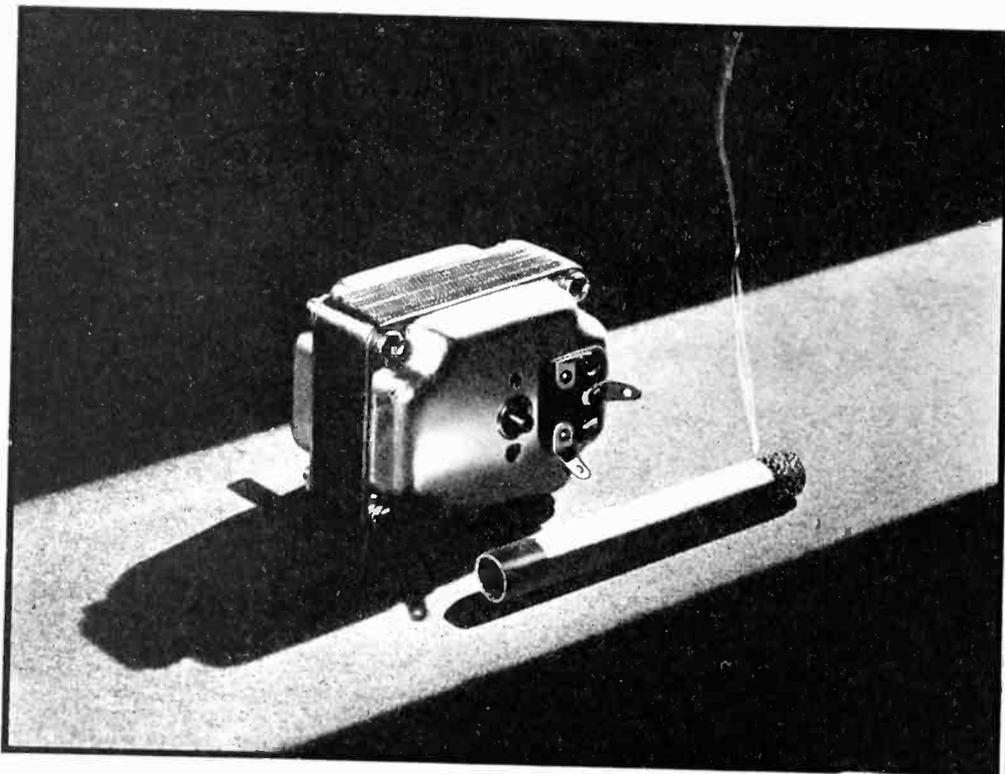
While it is a bit early to give a general survey of what is available for automatic tuning systems, the old "regulation" components have already had their overhauling and are getting ready for the market. In the survey that follows it must not be assumed that only those companies mentioned are developing new material. The season is yet young, and many new products are not yet ready for description.

Although 1938 electrolytics will be smaller than any previously used,

they will not look must different. Internally, however, there have been changes. A trend toward glass rectifier tubes and away from metal tubes in power supply systems places a responsibility upon the designer of the set and manufacturer of the filter condenser. The rectifier tube must operate satisfactorily in conjunction with the first filter condenser if the set is not to go to the service shop when it is turned on after a long idleness. The change from metal to glass rectifiers will cause demand for the regulating

3-band, 3-gang r-f and i-f Gen-Ral coil-condenser assembly





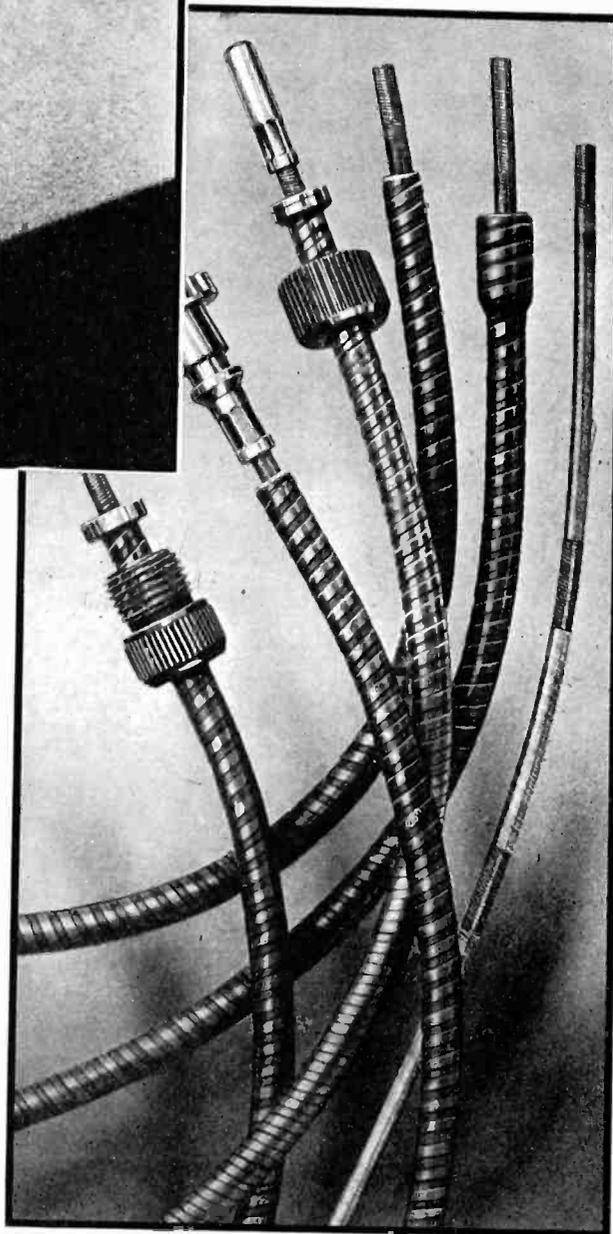
Shaded pole induction motor (Utah) for remote control and automatic tuning control receivers

type of condenser which limits the voltage peaks that develop on first turning on a filament-type rectifier. The glass rectifiers will probably be filament types.

And so the condenser internals have changed. There are new electrolytes, new methods of etching foil, new methods of avoiding leakage. Mallory reports that a chassis submitted by a customer showed a voltage surge of 630 volts although the working voltage was 400. He was supplied with a barrier type of condenser, and avoided a redesign of the chassis. Theoretically surge voltage failure in either wet or dry electrolytic capacitors is caused by the ignition of a minute quantity of mixed gases accumulated at the anode during severe overload, and where scintillation is encountered. If the gases cannot combine, surge voltage failures will not occur. Since one of these gases is generated at the anode side, and the other at the cathode side of the electrolyte, the use of a special high density material, as part of the separator, acts as a barrier and retards their mixture. Compared to other types of separator material, capacitors having non-fibrous cellulose separators will have a much longer life even though repeatedly subjected to overloads high enough to cause scintillation.

The decreased size is demonstrated by the Solar units photographed. Both have the same capacity but the smaller unit is of

Flexible shaft from S.S. White for auto radios



recent design. These are wet electrolytics; in a can 1 inch by 1½ inch, 8 microfarads to be operated at 500 volts can be packed; or 38 microfarads for 100-volt operation. Temperatures as low as -20 deg. Centigrade do not put this new type out of commission. A new formation process reduces leakage to the point where excess leakage is not encountered when voltage is reapplied after a long idle period.

An interesting Mallory condenser is a unit specially designed for reducing intercircuit coupling in auto radio chassis. Coupling effects noted in ordinary multiple section capacitors are caused by voltage drop in the cathode foil and an improper

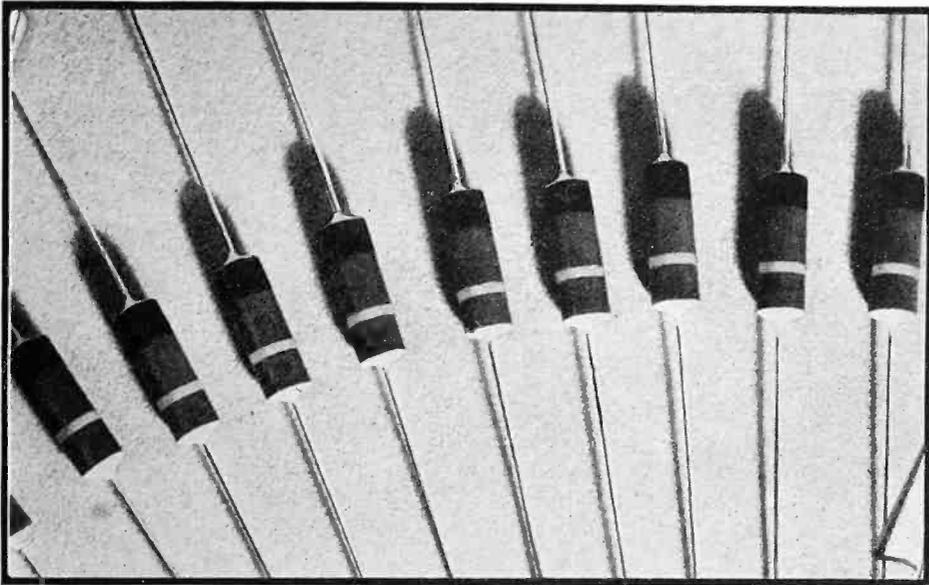
sequence of the anode plates. In fact, the entire matter is due mainly to mechanical rather than electrical design. The voltage drop in the cathode was corrected by the proper placing of the cathode tabs. Each tab was assured positive contact to the container by a special rivet. The plate sequence was arranged after careful analysis of the circuit. A much improved r-f impedance characteristic was obtained through the proper relation between cathode and anode tabs.

The method of connecting the cathode to the container eliminates coupling difficulties. Vibrator hash is at a minimum as the first filter section has an extremely low r-f

impedance at from 10 to 20 megacycles, which is the region of vibrator electrical noise. An actual saving of \$0.13 per chassis was accomplished over the cost of the two separate capacitors originally

average radio set will bring close to \$100 this year which is a considerable mark-up from last year's average price. Part of this is due to increased costs of sets due to greater labor and material costs—

closely related to the dimensions of speaker. Both act to enhance the overall performance. When such speaker systems will arrive in home sets is a question—but the trend points this way.



Popular are the ceramic sealed compact resistors. These particular units are made by Erie

specified. In addition a paper by-pass capacitor was eliminated and the chassis assembly cost reduced.

This capacitor is not a stock item. It is, however, of standard construction and was designed by Mallory engineers based on circuit information supplied by the customer.

Although high humidity and high temperatures encountered in many applications compel the condenser to be sealed against moisture, as by aluminum cans, Mallory engineers have developed a cheaper construction by varnishing a paper specially selected for the job. High temperature sealing wax is used at the ends; paint will stick on the outside of the varnished surfaces.

Small-Size Parts

Small size is noted in the controls to be used this year. Volume controls not much larger than a wrist watch are common. Just why the set manufacturers demand such small items is not exactly clear, except for small sets. But they *must* be small and they must also be versatile. Special controls for special purposes are the vogue—and 1938 looks like a year of special purposes.

For the very small sets, loudspeakers must of course be small. This is not new nor is it a trend. Fortunately it looks as though the

but it is also true that customers are looking at and buying bigger and better sets. They know the little fellows are small in tone as well as small in size.

The really new thing in speakers, too new for the early 1938 sets in fact, is the line of speaker enclosures which Jensen will market. These boxes tightly enclose the loud speaker and have apertures which are

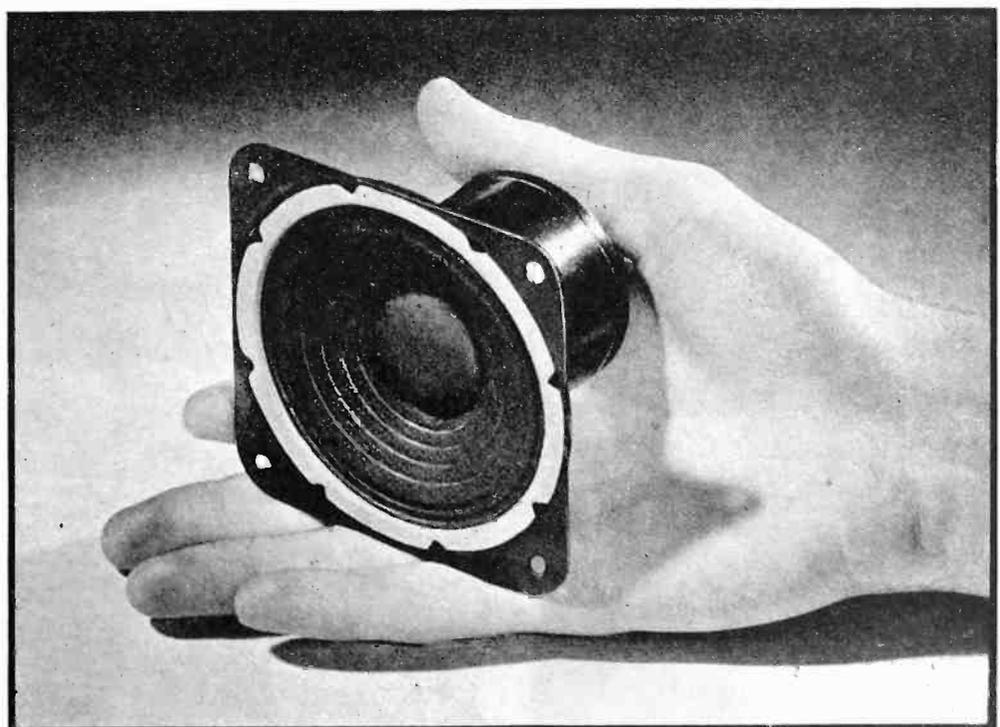
Resistors

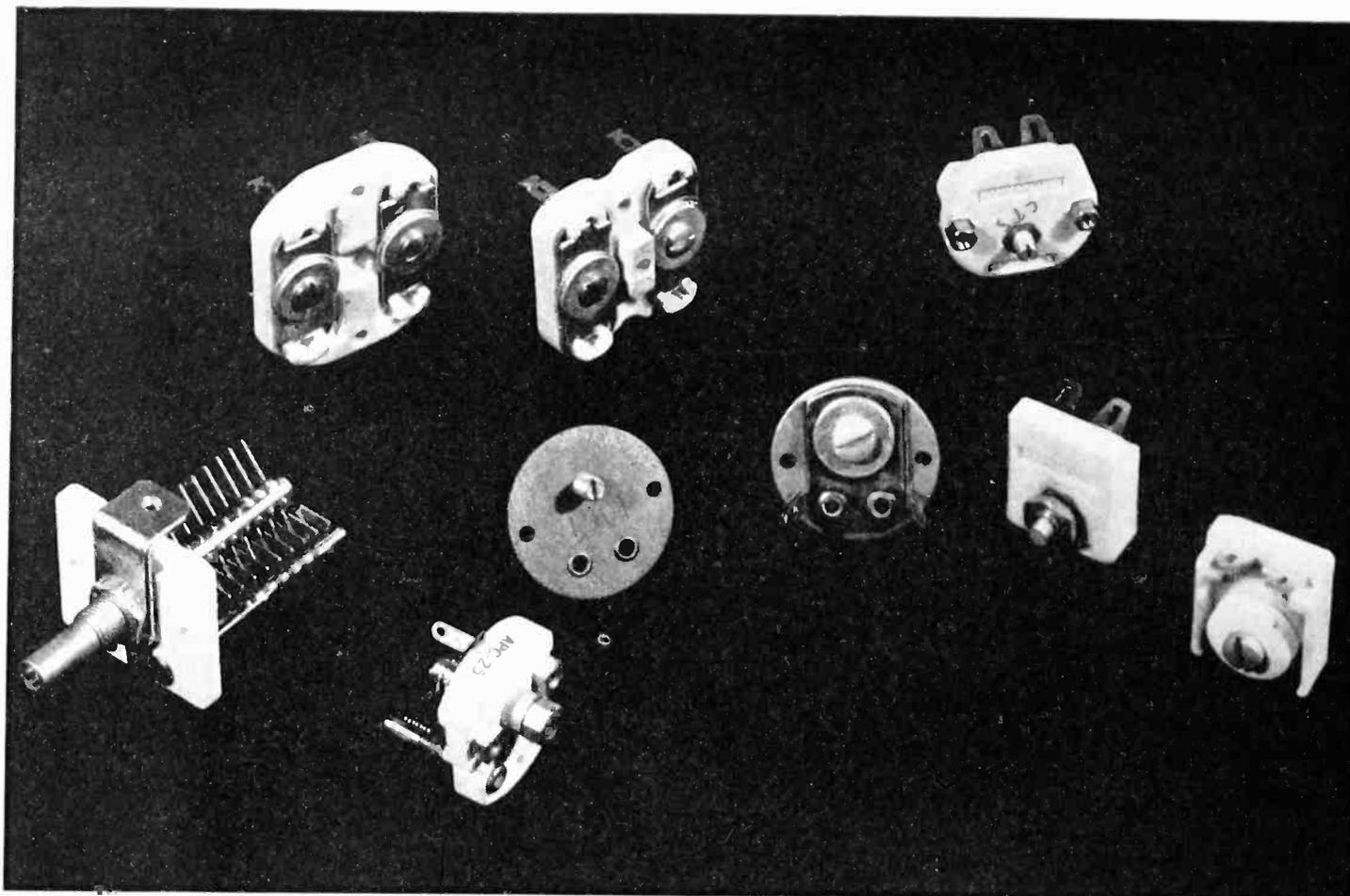
It would take a very large adding machine to sum up the total number of resistors that have gone into home and auto radios during the past five years. Say ten resistors per set, say 8 million sets for 1938. Punch two keys and you get 80 million resistors for the year. Carbon resistors, metallized resistors, wire wound—all have gone through a continued evolution. Fixed resistors, variables—these two have made constant changes toward greater stability as regards temperature, voltage, humidity, power dissipation, noise. For the following material the Editors are indebted to International Resistance, Speer Carbon, Centralab, Erie, Globar and others.

A trend seems to be pointing directly at insulated fixed resistors. Although only three years old they are now made by four or five manufacturers and in 1938 will probably account for the largest proportion of units for receivers, especially for auto sets. This trend seems to be universal and in considerable proportion.

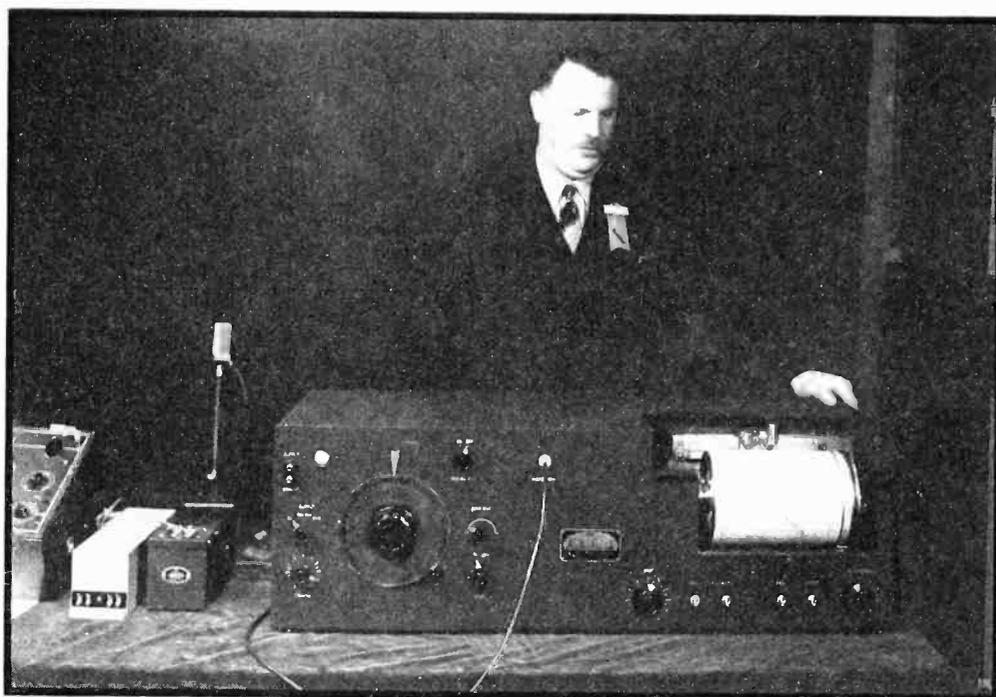
IRC has augmented, recently, its pioneer insulated line of the metal-

A handful of Oxford speaker. It has a cut-off of 300 cycles so that considerable hum can be left in the power supply





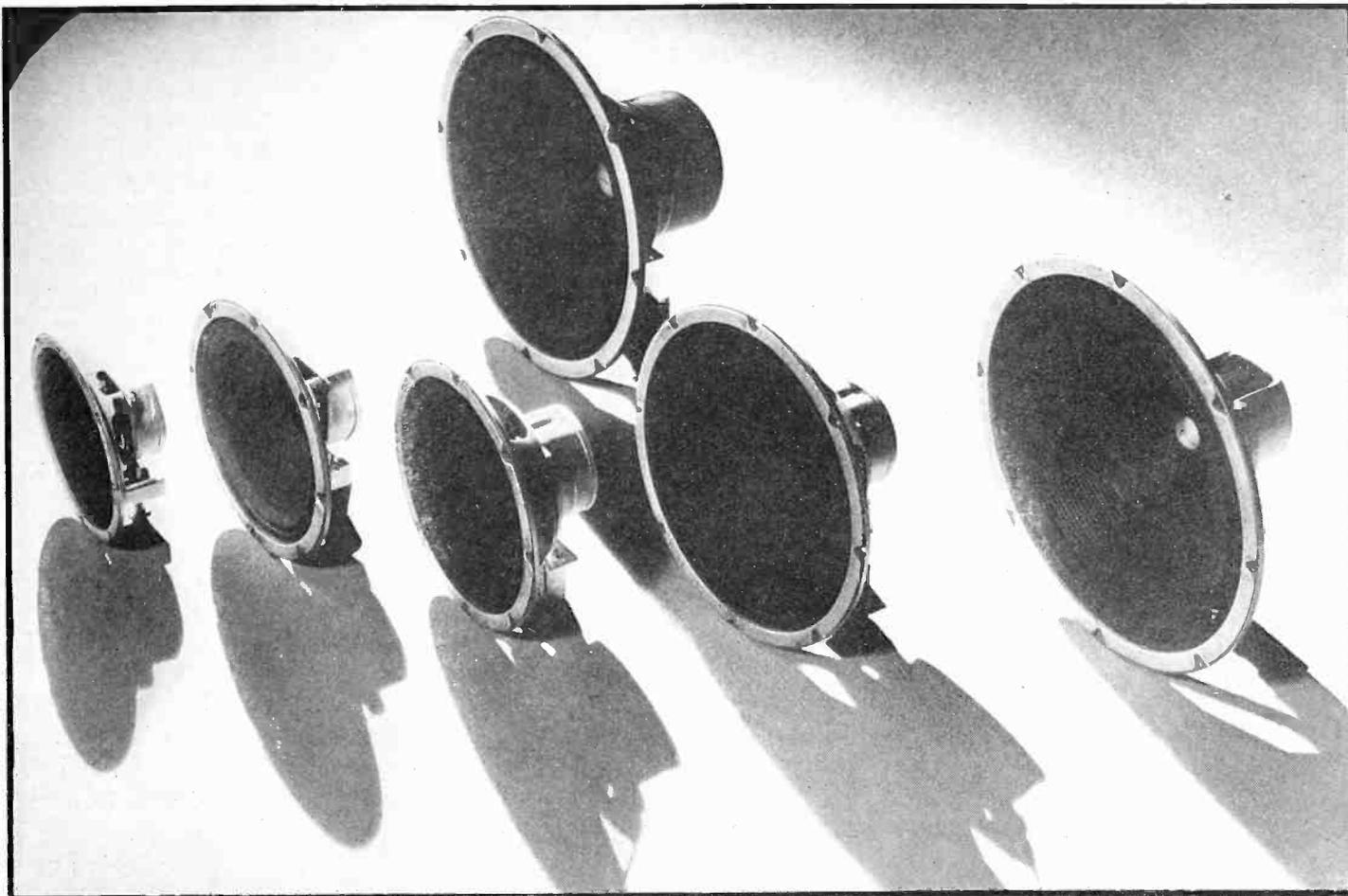
Trimming, padding, tuning condensers of Hammarlund. Note the Isolantite insulation, cadmium plated brass plates



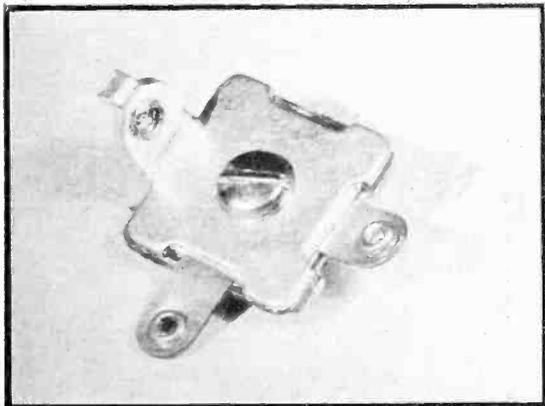
Components are best engineered when good measuring equipment is available. This Tobe Deutschman automatic recorder for speakers or other characteristic measurement has attracted much attention



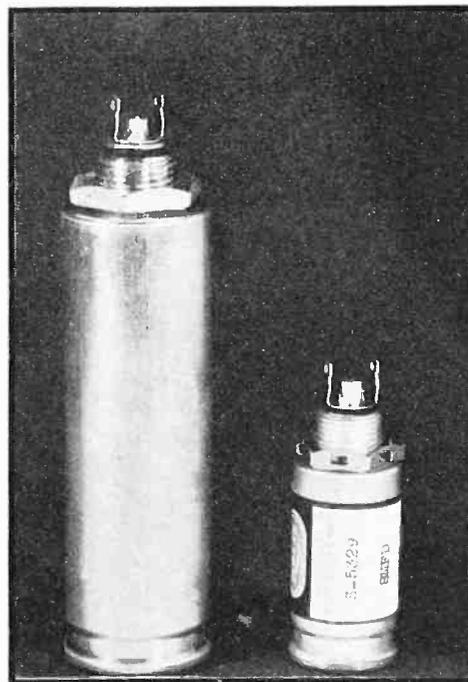
Q men checking up on components. W. D. Loughlin, H. A. Snow, Boonton Radio with well known Q meter



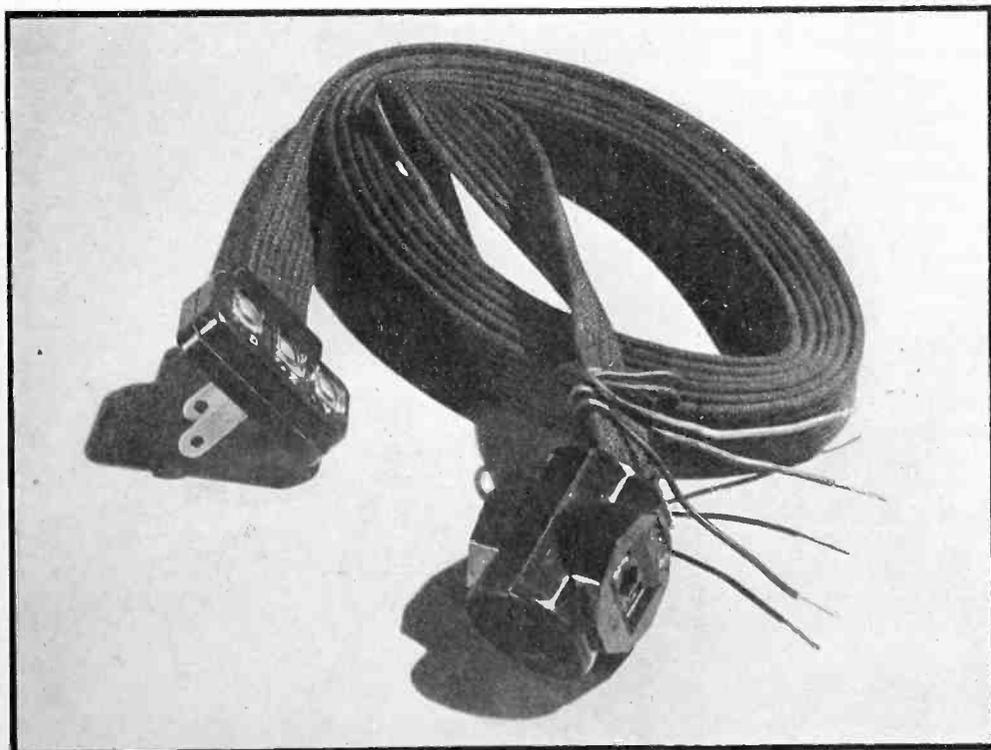
*A battery of Rola permanent mag
and energized loud speakers*



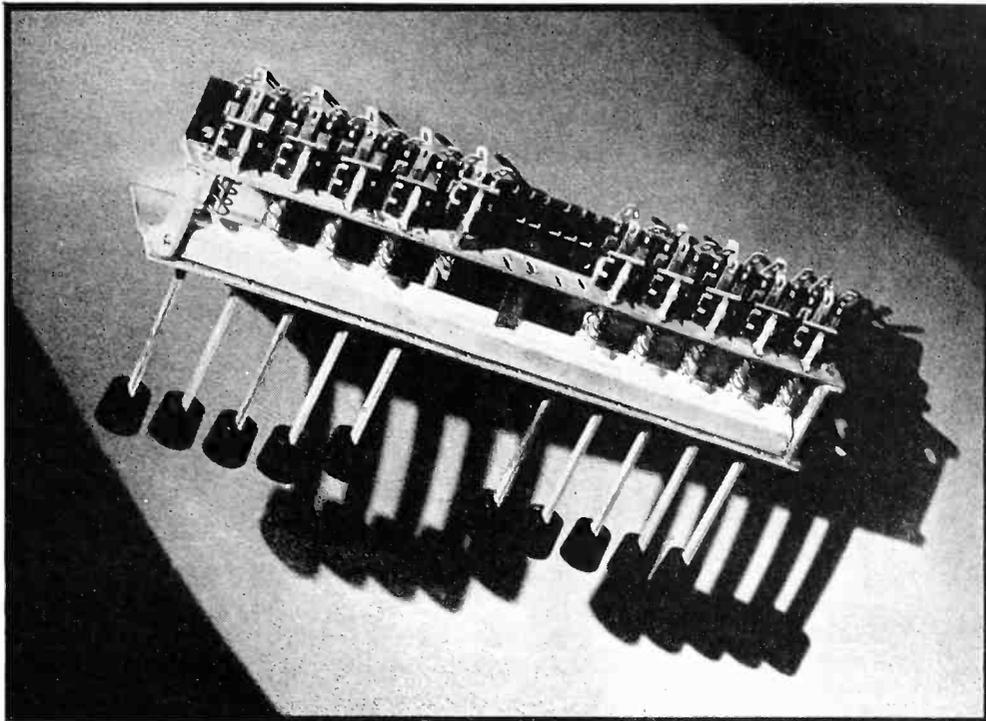
*Condenser for i-f systems. Of
mica, by Aerovox*



*All manufacturers are reducing
electrolytic sizes. These Solar
units have identical capacity and
voltage characteristics*

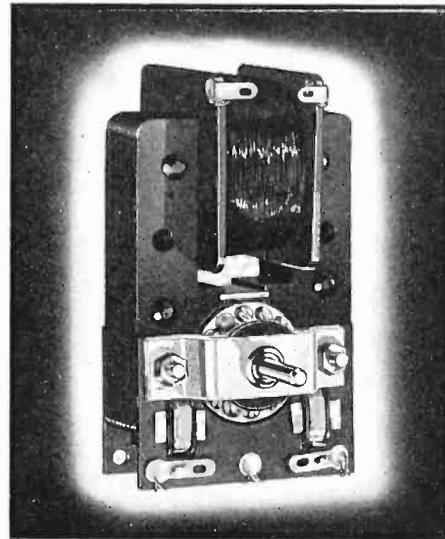


*For the remote control radio an
Alden under-rug cable*



Push-button tuning comes in this year. This Yaxley unit will handle 10 stations

For 1938 sets, an Alliance motor for tuning



justment screw. Dual units are available. One point about the use of such condensers is the fact that the capacity is concentrated and of low loss, thereby reducing stray capacity from leads, etc.

One of the Hammarlund condensers shown uses a very heavy Isolantite compression washer which provides a low capacity between the rotor plates and ground. The QTD's are used in i-f transformers in AFC circuits. The CTR condenser has double threaded adjustment screws which affords adjustment from either end. Long leakage paths are provided in some units by cut-outs.

Ballasts

Several set manufacturers are offering receivers which may be operated on 6 volts d.c. or on 100 volts a.c. There are also a few operating either from 2 volts or from 6 volts and others are operable from other voltage combinations.

Amperite has made available a new ballast for 2-volt sets. This has better regulation than those heretofore available. For example, a battery variation of from 2.2 to 3.0 volts is reduced to a variation of 1.9 to 2.2 volts. Another new ballast is for a.c.-d.c. sets. By the use of a starting resistor, overloading of pilot lamps is avoided. Instead of applying 110 volts to the set when it is first turned on, only 70 volts is applied. After three or four seconds the starting resistor is cut out by a thermostatic strip and the

full line voltage is applied to the receiver. The Amperite regulator in the a.c.-d.c. ballast will keep the tube voltages within plus or minus 5 percent with a line voltage variation of from 95 to 135 volts. The same ballast may be used whether the set used needs 45 or 65 volts for the filaments.

Controls for Auto Radio

Flexible shafting has been one of the factors that has made automobile radio receiving so popular (estimates are that well over a million new sets will go into cars this year). When it comes to material of this nature, S. S. White Dental Manufacturing Company has established itself very firmly. This company provides set manufacturers with complete shaft and casing combinations with shaft end fittings, casing ferrules and threaded nuts attached—or they supply only shafting and casing in mill lengths or cut to length desired. S. S. White does not make remote control heads or other attachments used with auto radios; for certain manufacturers, however, the company manufactures standard end fittings.

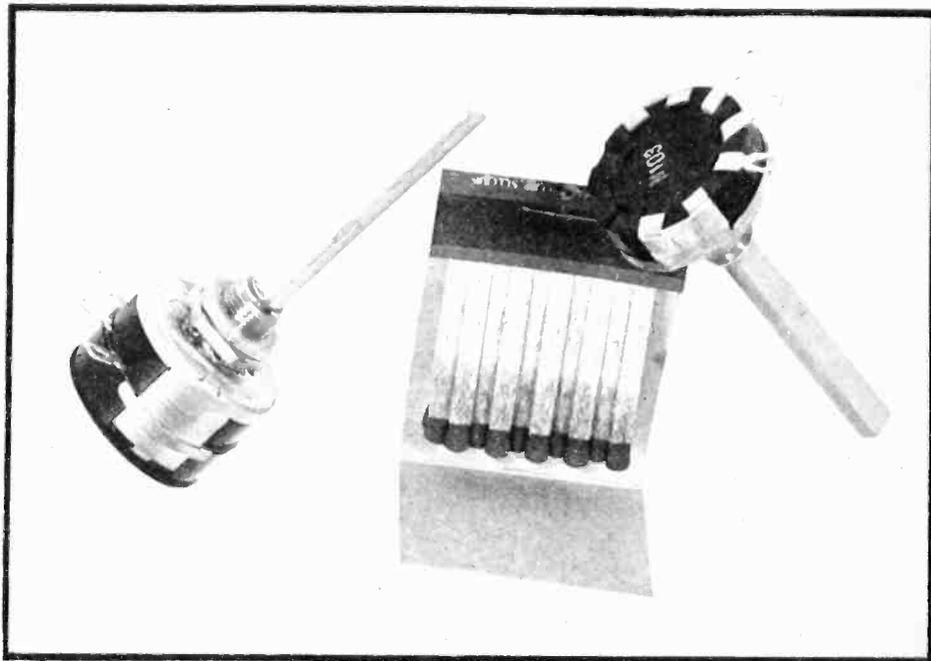
Two sizes of flexible shaft are available, one is of 0.130 inch diameter and the other of 0.150 inch diameter. They have somewhat less torsion deflection than shafts previously made in these sizes. The smaller diameter shaft seems to be the more popular, partly because of the fact that the gear ratio in the

average remote control head has increased, which decreases the torque on the flexible shaft.

Both sizes of shafting are supplied in cut lengths with either square or octagonal swaged ends and also with accurately formed square ends so that separate end fittings are unnecessary. Casings for these shaftings are metal and so constructed that they act as a proper guide for the flexible shafting. If too flexible and unable to support its own weight, the casing will impair the efficiency of the shafting—so that the design of the casing is an important part of the flexible shafting business.

Tuning Connectors

For want of a better name, two products of Alden have been described below as "tuning connectors." One is for use with the "magic eye" type of tuning indicator; the other is to connect remote control equipment to the radio sets controlled. One of the tuning indicator tube connectors has an ingenious construction of sunken contacts and a protecting molded shield so that it is impossible to come into contact with the tube prongs when they are inserted into the con-



Small in size, as is the mode, are these controls of Centralab.

necter. This unit was devised to satisfy the Underwriters.

Another unit does not have this protective feature. Both are provided with a one megohm resistor in the connector. It is connected across the contacts or across tube terminals 2 and 4. An integral molding makes the completely insulated pocket for the resistor as well as for each individual contact.

An insulated phenolic disc guides the tube prongs into the connector and snaps into place. The disc can be removed for making instantly available, at one glance, all of the soldering of each contact and the resistor. With the assembly methods used in attaching leads to the contacts used in this connector, and also in the connector for connecting speakers, any inspection of soldering is superfluous.

From the speaker angle, the Alden converter is made in three, four, five, six and seven terminals, held firmly in place by one sheet-metal screw and a lock washer; the leads go directly to the prongs so that they are soldered all in a single operation and the lead wires are completely insulated.

There are no speaker cords dangling from speakers which can in shipment, ruin the diaphragm.

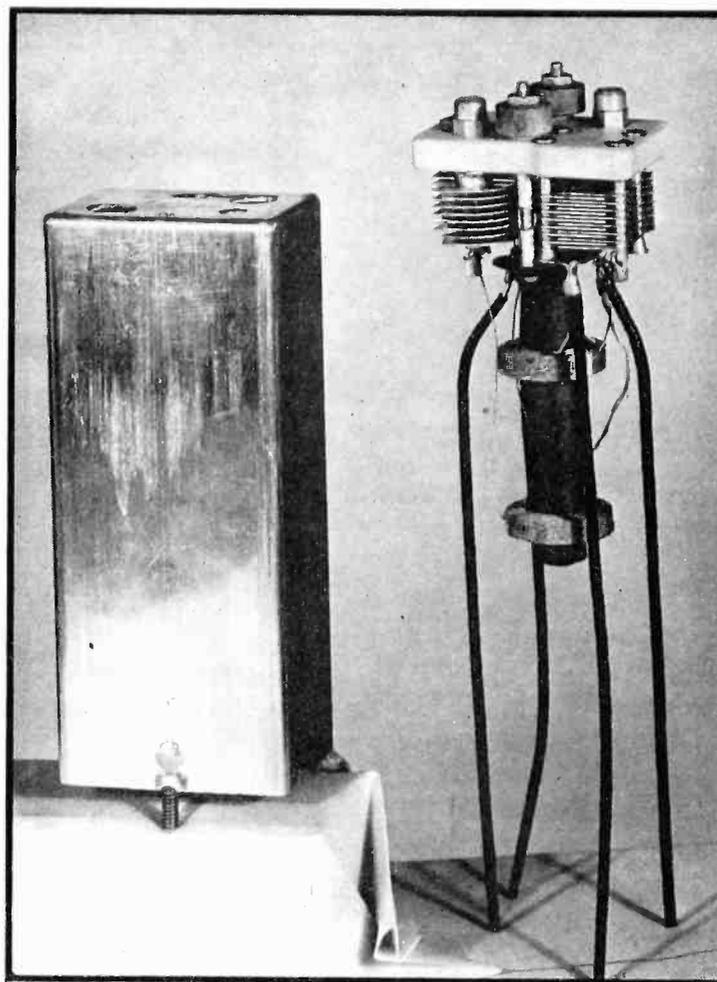
The cables for use with remote control radio receivers are made up in 4- and 5-wire types. These connectors act for arm-chair models as an a.c. power supply, a ground connection, spaced apart from either of which is a single antenna lead or two leads for use with a doublet.

Other Alden cables are for automotive use where trouble in the past has been had with imperfect grounding of shields.

In preparing this early season survey of the new components, the Editors have had the aid of not only those manufacturers whose products

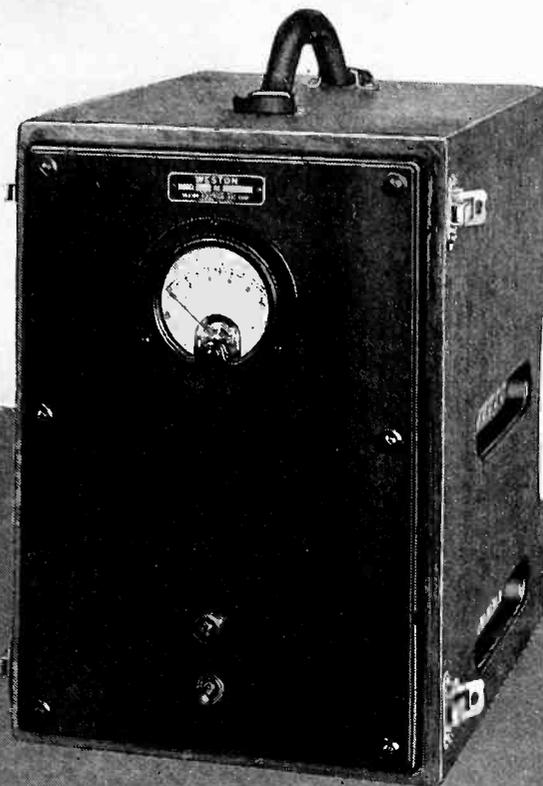
are either described or illustrated here, but of others whose new components may not be ready for the market at the present time, or who had merely background data to provide. Among these manufacturers are Ohmite Manufacturing Company, Continental Carbon Company, Sprague Specialties Company, Cornell-Dublier Corporation, Electronic Laboratories, The Muter Company, Globar, Condenser Corporation of America, Hugh H. Eby, General Transformer Corporation, Speer Carbon Company, William Brand & Company, Micamold Radio Corporation.

The cooperation of these manufacturers is hereby acknowledged. There is probably no other industry than radio in which the personnel which supplies the parts and the personnel that uses these parts are so well known to each other. Nor is there any other industry in which changes can come so fast or so completely.



Double tuned air dielectric capacitor. Note the heavy ceramic insulation. A Sickles coil

A proved device which measures and records exceedingly minute electrical quantities . . . and permits split-second, automatic control by means of electrical impulses otherwise too small for practical use.



THE
WESTON
MODEL 721
PHOTOELECTRIC
POTENTIOMETER

Possessing a unique electronic balancing circuit which permits wide application of potentiometric sensitivity to continuous measurement and control of rapidly varying electrical quantities . . . or other variables which can be translated into electrical units.

The Model 721 WESTON Photoelectric Potentiometer provides an entirely new and proved method of potentiometric measurement and control.

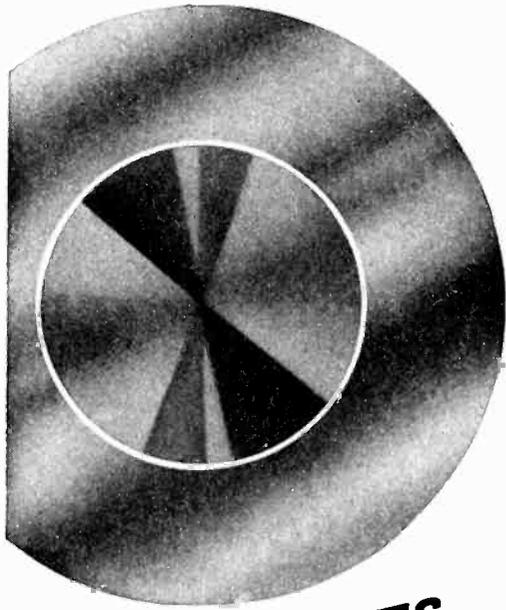
Operating electronically rather than mechanically, Model 721 acts as a continuous amplifier of electrical input variations *too minute and too rapid in their fluctuations for practical utilization by any other means*; and produces a proportionate output of direct current of an order sufficient to operate indicating, recording or control instruments. Balancing is continuous and response to change is virtually instantaneous. Instruments operating on this amplified output can be calibrated in terms of the primary quantity—current, temperature, conductivity, concentration, etc.

Already, Model 721 has been successfully adopted for voltage and current regulation in standardization laboratories . . . for critical problems in temperature recording and control . . . for electrochemical investigations and process control . . . for frequency recording, for amplification of "Photronic" cell output current, etc. And the steady recognition of the possibilities of Model 721 indicates almost limitless applications for scientific and industrial purposes.

A bulletin is available which contains a complete technical description of Model 721, and lists many applications where this unusual device can be employed to advantage. A copy will gladly be sent on request . . . Weston Electrical Instrument Corporation, 618 Frelinghuysen Avenue, Newark, New Jersey.

WESTON
Instruments

COLLOIDAL GRAPHITE...



SMALL PARTS LUBRICANT

Just as oils charged with "dag" colloidal graphite lubricate effectually the large type of machinery that operates under heavy loads, so do they play an important role as lubricants for fire alarm systems, fans, news and financial tickers, automatic telephone exchanges, vacuum cleaners, ironing machines, etc.

Mechanisms receiving infrequent attention about scientific laboratories and which, therefore, develop wear or undue play are best lubricated with graphited oil as the dry graphite continues to lubricate after the carrier is consumed.

It follows, then, that if the friction parts of the following apparatus are once protected by a veneer like layer known as the "graphoid" surface, their efficient operation over long periods is assured:

Clocks	Small Motors
Relays	Time Switches
Meters	Small Generators
Calipers	Recording Devices
Bearings	Variable Condensers
Stop-cocks	Clock-spring Mechanisms
Variometers	Special Fine Mechanisms
Automatic Tuning Equipment	

Write for Technical Bulletins C210, 230, 102, 200 giving further details.

ACHESON COLLOIDS CORPORATION, PORT HURON, MICH.

REG. U.S. PAT. OFF.
dag
COLLOIDAL PRODUCTS

the fixed contacts fall along a line one above the other on the drum and the variable ones change their positions according to the changes of the measuring instruments. If the fixed contacts do not fall along a straight line it shows that the clock in the balloon is not holding a constant speed which must be corrected for. Dr. Lange of Blue Hill Observatory has developed an improved type of recorder in which paper is fed from a roll and the recording pen moves across it and is caused to mark the paper whenever a signal comes in. This makes quicker evaluation of the record possible.

The balloons for lifting these instruments are generally of latex rubber, although cellophane has also been used. Commonly, more than one balloon at a time is used, the number depending on the altitude desired. The more balloons for the same lift the further each can expand before bursting, hence greater altitude can be reached. The ceiling of a rubber balloon is determined by the maximum size to which it can expand without exploding. Furthermore, a single balloon is never used unless a parachute be provided. This is to diminish the possibility of the falling instrument damaging anything that it might hit. (See the movie "Let's Get Married") At Blue Hill the ingenious trick of putting a parachute inside a single balloon has been devised. Thus the parachute is protected from the possibility of becoming loaded with ice and when the balloon bursts it is released to lower the instrument.

The recent series of 25 ascents made by The Blue Hill Observatory of Harvard University checked the results obtained simultaneously by airplane ascents, and in addition went much higher, and every day. In view of this the Weather Bureau shortly advertised for bids for flights using radio-meteorographs as well as for airplane flights, at the various aerological stations for next year. As a result the airplane, at Boston will be replaced by radio-meteorographs during the coming year. There will also be a series of ascents by the Weather Bureau at Washington.

References

Bulletin of the American Meteorological Society, March 1937. A. E. Bent—Radio Equipment for the Harvard Radio-Meteorographs. K. O. Lange—The 1936 Radio-Meteorographs of Blue Hill Obs. H. Diamond—W. F. Hinman, Jr., F. W. Dunmore—The development of a Radio-Meteorograph system for the Navy Department.

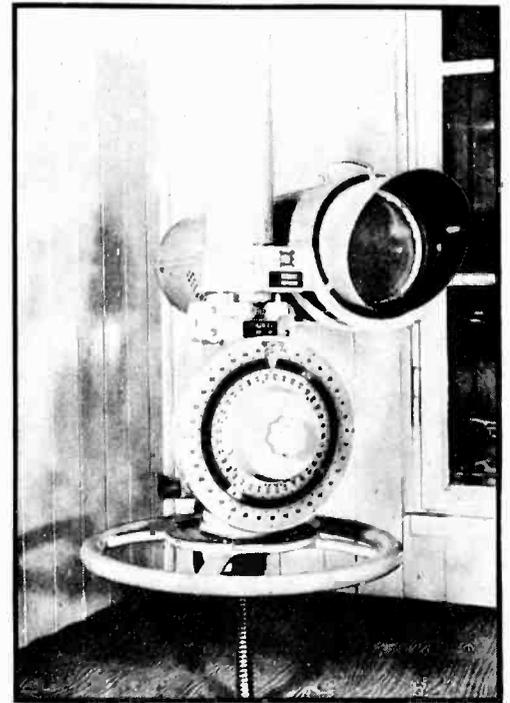
H. Diamond, W. F. Hinman, Jr., F. W. Dunmore—A Simplified Radio-Meteorograph for determining cloud heights and thickness. Bull. of Am. Met. Soc. April-May, 1937. pp. 180-181.

K. O. Lange—Radio-Meteorographs, Bull. of Am. Met. Soc., May, 1936.

Corriez et Perlat—La Méthode radiogoniométrique de l'Office Nationale Meteorologique pour la mesure de la direction et de la vitesse du vent par temps couvert. La Meteorologic, August, 1935, pp. 368-384.

Über Radiosonde Konstruktionen, denkschrift, Internationale Aerologische Kommission, Internationale Meteorologische Organisation, Berlin, 1937. 85 pages. (Contains pictures and descriptions of all types in use all over the world, as at time of publication.)

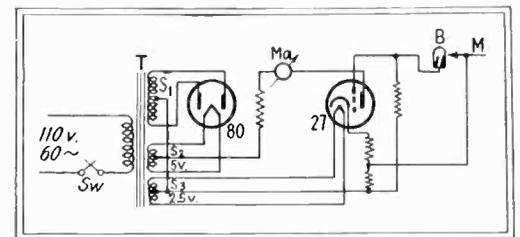
CATHODE-RAY COMPASS



The indicator of this Telefunken direction-finding loop is a cathode ray tube, which gives an "average" reading in the presence of rapidly changing wave-front phases which occur during sunset and sunrise hours and which make for inaccurate aural indications

Electronic Micrometer Measures Depth of Grooves in Bullets

AN ELECTRONIC MICROMETER, whose connections are shown in the accompanying diagram, has been devised by C. F. Wilson of the Crime Detection Laboratory, Northwestern University, Chicago, for use in determining the depth of rifling depressions in bullet identification. The bullet is mounted



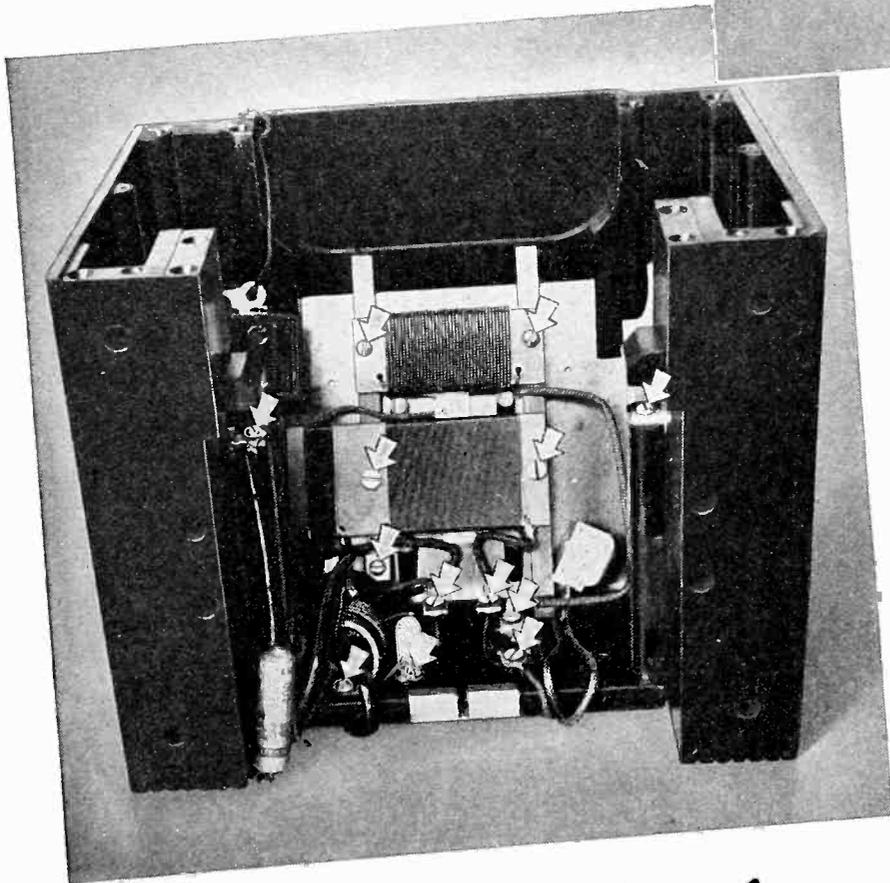
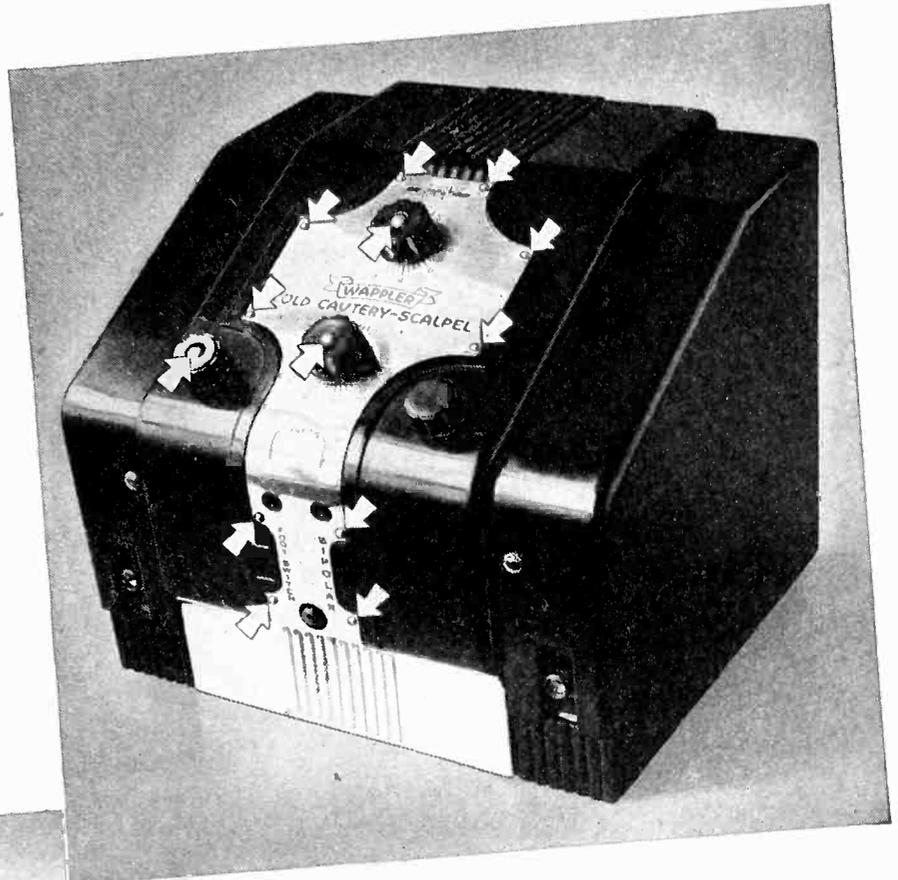
Groove-depth micrometer

so that its axis is at right angles with the arm of a micrometer. The measuring micrometer contains a small stylus which explores the depth of the groove on the side of the bullet. The micrometer screw is rotated until contact is indicated by a sudden change of plate current in the milliammeter. The measurement is repeated several

An Assembly Method that helped MAKE "A \$250 PRODUCT" TO SELL AT \$85 should be worth investigating for your work

AT ONE TIME doctors had to pay from \$250. to \$700. for a Cold-Cautery-Scalpel. Now they can get this efficient and reliable "Wappler" instrument for only \$85. Even the country practitioner can own one since American Cystoscope Makers, Inc., applied mass production principles and intelligent thought to the design of such equipment.

In this achievement the maker states that Parker-Kalon Hardened Self-tapping Screws played an important part. "They enabled us to save quite a sum on the cost of molds because inserts in the plastic parts could be avoided . . . They simplified the attachment of parts to the molded housing, saving much assembly labor and greatly increasing production speed . . . The fact is that stronger fastenings also were secured, for these



unique Screws hold more securely than machine screws in either inserts or tapped holes." It is no wonder that this manufacturer says—"Now when an assembly is to be made on any of our products we first consider Hardened Self-tapping Screws."

Let us help you investigate this cost-cutting method of assembling metal and plastics

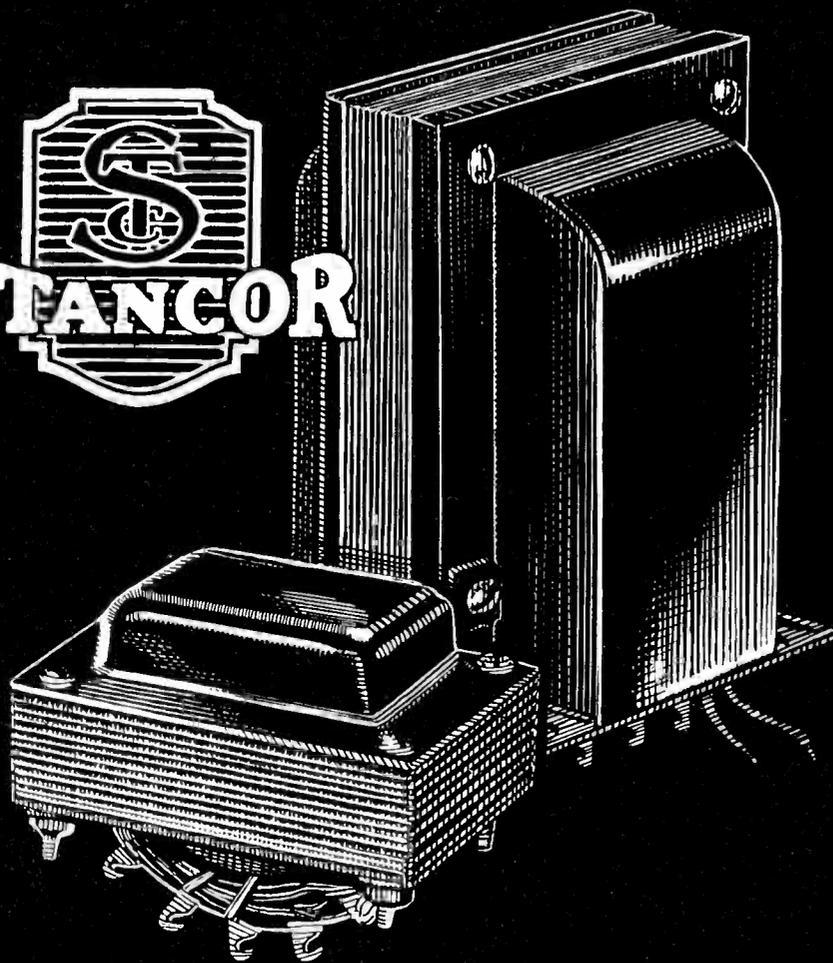
On your own work it is likely that fastening jobs could be simplified and economies effected by using Hardened Self-tapping Screws in place of ordinary devices. In 7 out of 10 cases where metal or plastic assemblies are required this method can be used to advantage for all or part of the fastenings. A Parker-Kalon Assembly Engineer will call on request to go over your fastenings with you and point out all opportunities. A letter to us obtains this service without obligation.

PARKER-KALON CORPORATION
196 Varick Street New York, N.Y.

PARKER-KALON *Modern* FASTENING DEVICES

TYPE "Z" HEX CAP A HARDENED SELF-TAPPING SCREW FOR EVERY KIND OF ASSEMBLY TYPE "A" TYPE "U"

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS



THE line of Stancor Transformers covers the whole scope of characteristics in common use. But the standard transformers of today were the laboratory transformers of yesterday . . . a large part of which were developed by Stancor engineers in co-operation with the engineering departments of manufacturers of electronic equipment of all descriptions.

YOUR TRANSFORMER PROBLEM IS OUR PROBLEM, and we will make it our business to apply our highly specialized experience and our carefully controlled manufacturing in arriving at an economical solution.

**STANDARD
TRANSFORMER
CORPORATION**

850 BLACKHAWK STREET, CHICAGO

times and the average micrometer reading noted. The bullet is then rotated to a position midway between grooves and the micrometer reading again taken in the same manner. By successive measurements around the periphery of the bullet, the depth of each individual groove and the spaces between them can be determined.

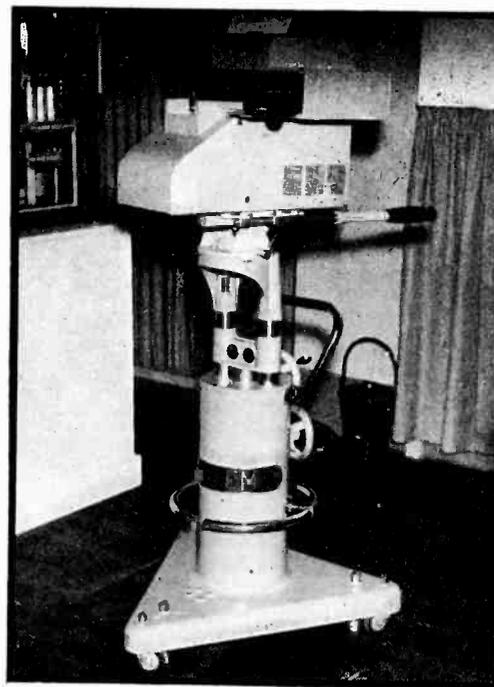
• • •

Thousand-Cycle Generator Used In Fishing for Electric Eels

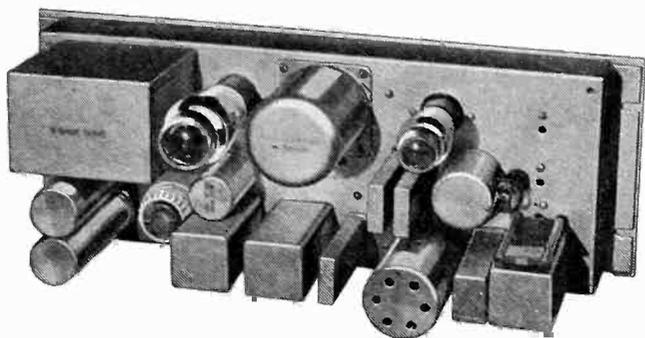
DR. C. W. COATES of the New York Aquarium has made a study of the electric fish, *Electrophorus Electricus*, commonly known as the electric eel, and has found that these animals are able to develop anywhere from 300 to 500 volts at 40 watts for considerable periods of time. They are found in the river bottoms of the tributaries of the Amazon in South America. Investigating the electric output of these fish, Dr. Coates dipped the contacts of a pair of headphones into the tank in which several specimens were captured. He found a continuous series of static-like sounds, which might be interpreted as the means of communication between the eels. He then devised a type of relaxation oscillator which provided 1,000-cycle output at 500 volts, across the terminals of a discharge condenser. This voltage was applied directly to the water of the tank and it was found that the eels could be lured thereby from one side of the tank to the other. This

• • •

BRITISH TELECAMERA

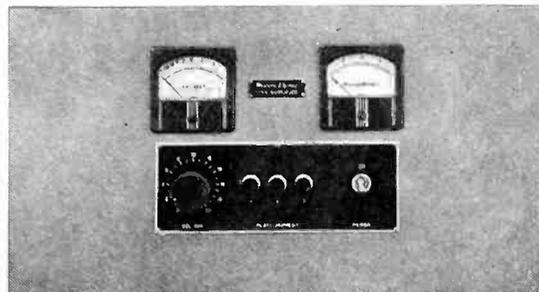


The latest model television pickup camera, of the mosaic variety, exhibited at the Science Museum by Marconi—E.M.I. whose system is now standard in Great Britain

106 A

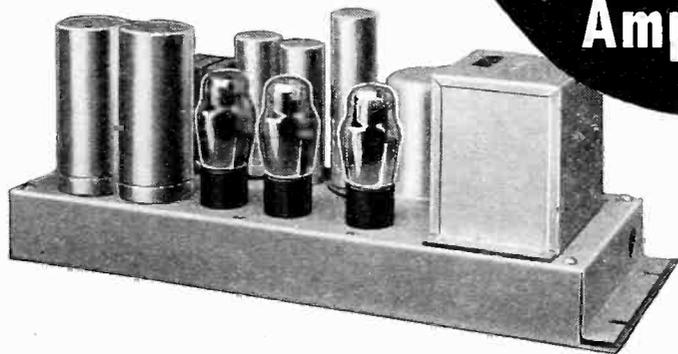
2 Stage line amplifier

Incorporates Western Electric system of Stabilized Feedback. Impedances: input 600 or bridging (10,000); output 600. Frequency response: flat within ± 1 db from 30 to 10,000 cycles. Gain: approximately 45 db. Gain Control: range 38 db. Power supply: completely self-contained, operating from 105-125 volts, 50-60 cycle AC. Distortion level: less than 1% at 400 cycles for 20 db output. Noise level: -60 db unweighted, -75 db weighted (as the ear would hear it) at maximum gain. Occupies only 7" of standard rack space.

105 A

3 Stage, high gain unit

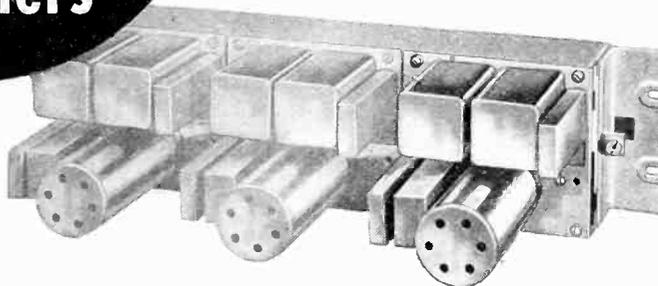
Stabilized Feedback. Impedances: 30 and 600 ohms input, 600 ohms output. Frequency response: flat within ± 1 db from 30 to 10,000 cycles. Gain: approximately 70 db. Gain Control: range 38 db. Power supply: completely self-contained, operating from 105-125 volts, 50-60 cycle, AC. Distortion level: less than 1% at 400 cycles for 20 db output. Noise level: -55 db unweighted, -65 db weighted (as the ear would hear it) at maximum gain. Includes v. i. and plate meters. Occupies only 10½" of standard rack space.

94 type

High level amplifier

The 94C gives remarkable performance as a bridging amplifier due to Stabilized Feedback. Gain: approximately 45 db. Output power stage for driving permanent magnet or other loud speakers to a volume adequate for any normal service. Noise level: better than -40 db unweighted, zero level being 6 milliwatts. Impedances: 600 ohms or bridging (25,000) input, 8 or 500 ohms output. Frequency response: flat within ± 1 db from 40 to 10,000 cycles. Power supply: completely self-contained, operating from 105-125 volts, 45-65 cycles, AC. Either metal or glass tubes. Dimensions: 19x7x7½.

NEW
Western Electric
Speech Input
Amplifiers

104 A

Single stage pre-amplifier

A high quality, low cost, fixed gain unit—extremely compact and economical to operate. Gain: approximately 29 db. Frequency response: flat within 1 db from 30 to 10,000 cycles. Impedances: 30 or 250 ohms input, 30 or 500 ohms output. Dimensions: 5¼ x 4⅞ x 6¾.

Three 104A's on 998 type mounting plate (as shown) occupy only 5¼" space on standard relay rack.

For details: Graybar Electric, Graybar Bldg., N.Y

Western Electric

Distributed by GRAYBAR Electric Co.

In Canada: Northern Electric Co., Ltd.



RADIO TELEPHONE BROADCASTING EQUIPMENT



RELIABLE RESISTORS

VITREOUS enamel resistors fixed, tapped and adjustable. Many varieties are available to fulfill any conceivable requirement.

Our 12 years of specialization in this field enable us to offer complete assistance in the handling of special applications.

Literature covering resistors and rheostats gladly sent upon request.

Write for further information . . . and remember the mark  means reliable rheostats and resistors.

HARDWICK, HINDLE • Inc.

136 PENNINGTON ST.—NEWARK, N. J.

- ★ Life-Like Reproduction
- ★ Better Transient Response
- ★ "Aero-Stream" Beauty
- ★ Shure "Balanced-Tracking"

- ★ Low Needle-Point Impedance
- ★ Low Record Pressure
- ★ High-Lift Arm
- ★ Cone Grip Needle-Chuck

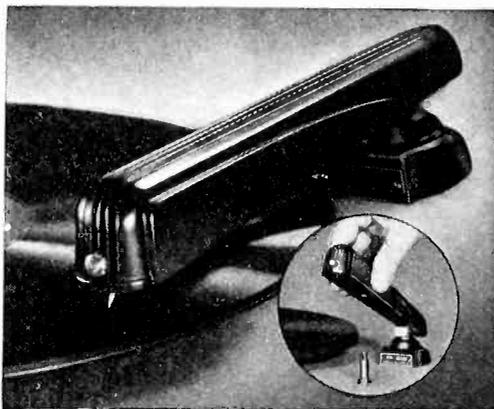
- ★ Shock Proof
- ★ Double Ball Bearings
- ★ Counterbalanced
- ★ Non-Resonant

RECORDS LAST LONGER SOUND BETTER

with the **ZEPHYR**

THE Shure ZEPHYR Crystal Record Reproducer combines many new exclusive advancements in pickup design with the inherent advantages of the piezo-electric crystal. It accurately and faithfully reproduces the full frequency range of modern records. Gives more accurate, more life-like reproduction of the recorded original. "Exclusive" "Balanced-Tracking" minimizes tracking error . . . reduces record wear . . . gives longer record life. High output level gives excellent performance with radio receivers and moderate-gain amplifiers.

MODEL 99B. "Aero-Stream" Shure ZEPHYR, complete with 3½ ft. cable, mounting screws and motorboard template (no arm-rest included), List Price **\$12**



A NEW modern ARM-REST specially designed for the Zephyr is now available. No thumb screws or other adjustments. To lock, simply press tone-arm over Arm-Rest . . . releases when lifted. List Price, 50c



"Balanced-Tracking"

No other pickup has the scientifically determined "needle-tilt" principle which provides built-in "Balanced-Tracking" in the ZEPHYR. This keeps the needle tangent to and centered in the record groove, thus materially reducing record wear and increasing record life.



SHURE BROTHERS
225 W HURON ST., CHICAGO, U.S.A.
CABLE ADDRESS: SHUREMICRO
MICROPHONES & ACOUSTIC DEVICES

Write for Bulletin 143MB today!

Shure patents pending. Licensed under patents of the Brush Development Company.

"eel caller" has actually been used in South America to lure the fish into nets, after they have been discovered by an exploratory set of headphones.

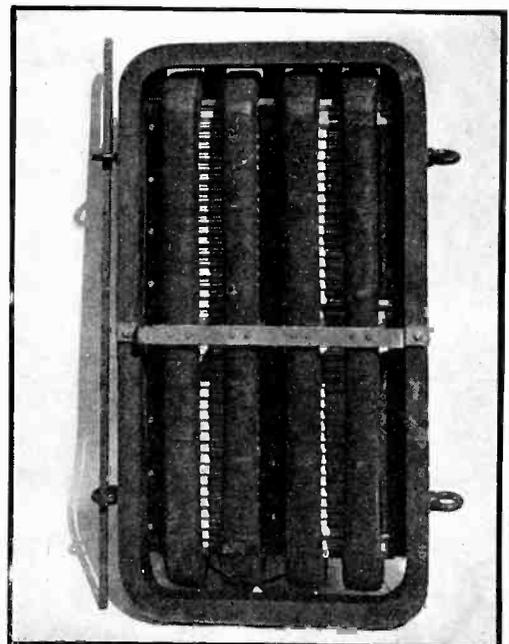
.

Phototube Aids High Speed Printing

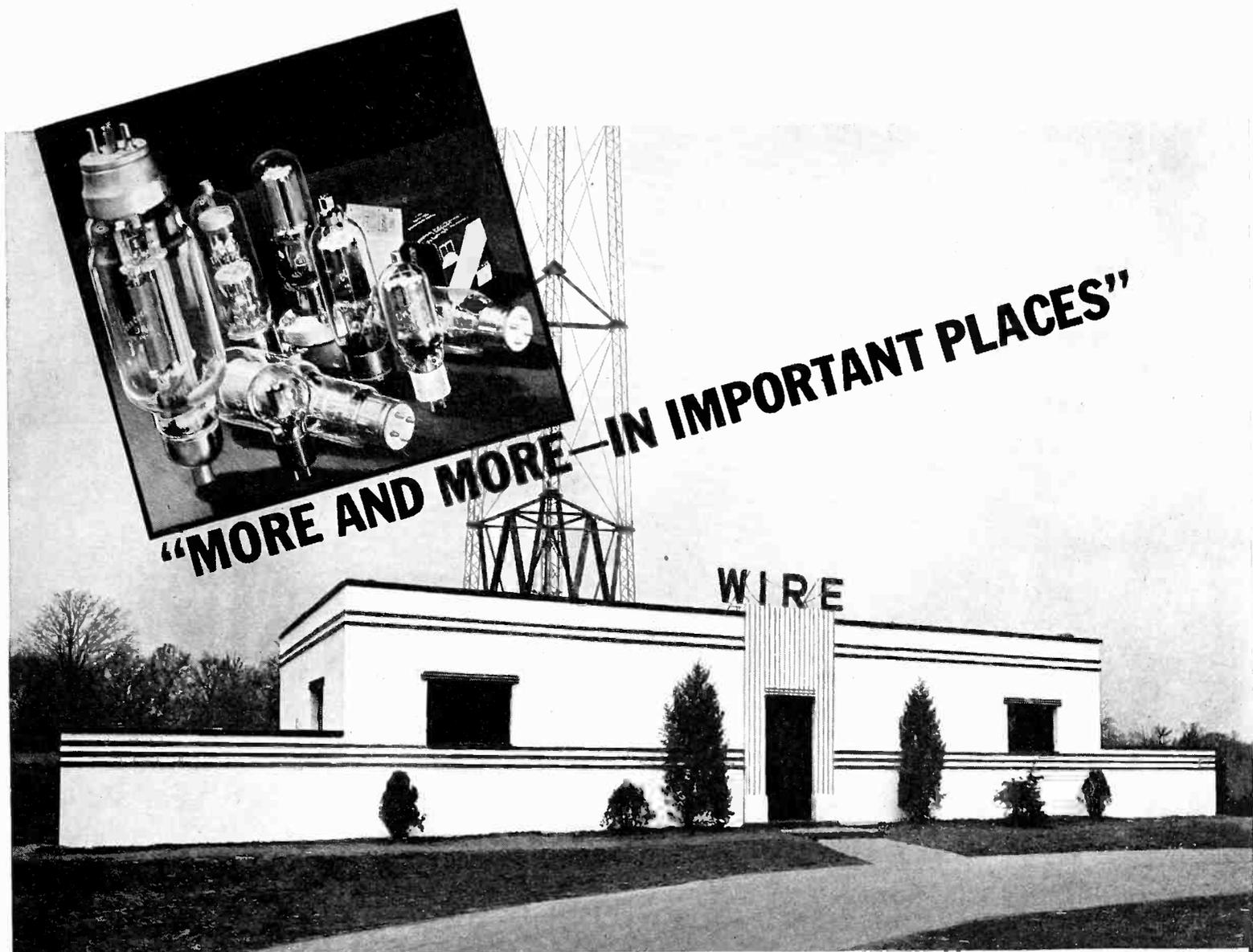
IN HIGH SPEED PRINTING, when sheets are printed much faster than the eye can count them, the sheets are piled one upon the other immediately after printing. If the ink is not dry, the pressure in the pile will result in the transfer of ink from the front of one sheet to the back of the other. This difficulty, known to printers as "offset", has resulted in the use of quick-drying ink, but in high speed work, additional preventative means are required. One method consists in spraying each newly printed sheet with a dry mist of fine particles from an automatic gun. It is necessary, however, that this gun be shut off immediately after the paper is covered. The gun aids the ink to "set" before the next sheet drops on top of it.

In order to control the timing of the gun, a phototube is fixed so that the passage of the paper through a light beam controls the gun. In this way the spraying is restricted to the proper timing interval between printing impressions. By this means it is possible to increase the speed of presses far beyond former limits and so reduce the cost per printing impression.

RIBBON LOUD-SPEAKER



The inverse of the ribbon-type microphone, this German loud-speaker consists of four magnet coils which supply the field and two aluminum ribbons. The speaker is three feet high and operates with an input power of 1000 watts



"MORE AND MORE—IN IMPORTANT PLACES"

MODERN STATION

This modern mid-west station is fast making an enviable name for itself among national radio advertisers. A basic station of the Red Network, it is on the air with 5,000 watts.

Since 1935, WIRE has been using **United Transmitting Tubes** — another instance of the fast-growing recognition of these tubes by radio centers of importance. Every day adds new significance to the United slogan—"More And More — In Important Places."

Write to Dept. B for complete new technical manual.

UNITED ELECTRONICS COMPANY

Manufacturers of United Transmitting Tubes

42 SPRING STREET

CABLE: UNELCO

NEWARK, NEW JERSEY

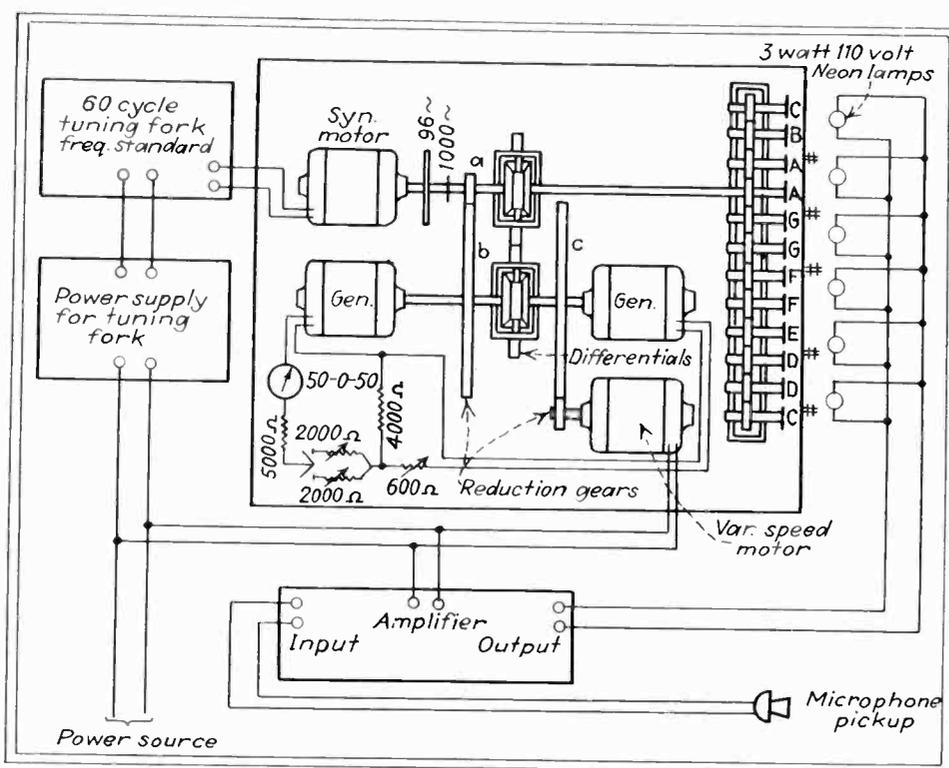
THE ELECTRON ART

EACH month the world's technical literature is scanned to see what physicists and engineers are doing with tubes, for presentation in tabloid form to Electronics' readers.

Using Tubes for Tuning Pianos

IT MAY BE going too far to say that the days of the ordinary piano tuner are numbered and that an electrical

is to be determined, is received by a microphone and amplified. The amplifier has sufficient gain and power to flash six 3-watt 110-volt neon lamps at the frequency of the sound under test. The neon lamps are placed in



Block diagram of stroboscopic method of determining frequency

robot which will accomplish all operations automatically is at hand. Nevertheless, an indication of the greater need for precision (totally beyond that capable by unaided human means) and the introduction of electric equipment, including tubes, for accomplishing in scientific manner the prosaic job of piano tuning is indicated in an article entitled, "A Chromatic Stroboscope," by O. L. Railsback, which appears in the July issue of the *Journal of the Acoustical Society of America*.

In this article the author describes the construction and use of a flexible and direct reading stroboscope by which the pitch of a piano or other musical instrument may be determined with considerably less than one-tenth of one per cent error.

The essential features of the complete chromatic stroboscope are shown in the attached schematic diagram. The sound, whose pitch or frequency

a suitable position to illuminate the surfaces of twelve stroboscopic disks made in the conventional manner. The twelve stroboscopic disks are driven by a synchronous motor operated from

a 60 cycle tuning fork frequency standard, to which slight increases or decreases in speed may be added by means of a second variable speed motor and a system of differentials as shown. Two generators are connected in a balancing circuit in which a zero center meter is connected in order to read speed deviations from the value established by the synchronous motor. The synchronous motor drives one of the stroboscopic disks directly. The other disks are driven by a series of gears connecting each disk shaft with the next adjacent disk shaft with the ratios 49:37 and 24:30. These ratios reduce to the value 1.0594595 which is accurate to within 3½-parts in a million of the twelfth root of two, which forms the basis for the musical scale. Since there are twelve disks all of the halftones of the musical scale will be provided by stationary patterns when the synchronous motor is driven at proper speed and the incoming sound picked up by the microphone is of the proper frequency.

A rather novel and flexible gear system for accurately determining the speed of any or all of the stroboscopic disks is described by the authors. Essentially the standard speed is provided by a synchronous motor. Through the use of a variable speed motor, reduction gears, and differentials, slight variations in speed to either increase or decrease that of the synchronous motor may be provided. The deviation of the actual speed of the shaft driving the stroboscopic disk from the speed of the synchronous motor is obtained through the use of two electric generators differentially connected so that the difference in speed between the synchronous speed and the actual speed of the disk may be determined by the current flowing through the generator circuit and measured by a zero center electrical meter.

The synchronous motor is intended to operate at 60 cycles. However, since variations in the supply frequency of as much as 1/10 of 1 per cent or more may be expected on large power distribution systems, the synchronous motor is not driven from the power supply but from a 60 cycle tuning fork having a low coefficient of thermal expansion.

Frequencies of the Equally-tempered Scale. A = 440 C.P.S. Frequency Ratio for Half-tone Interval = 1.05946309

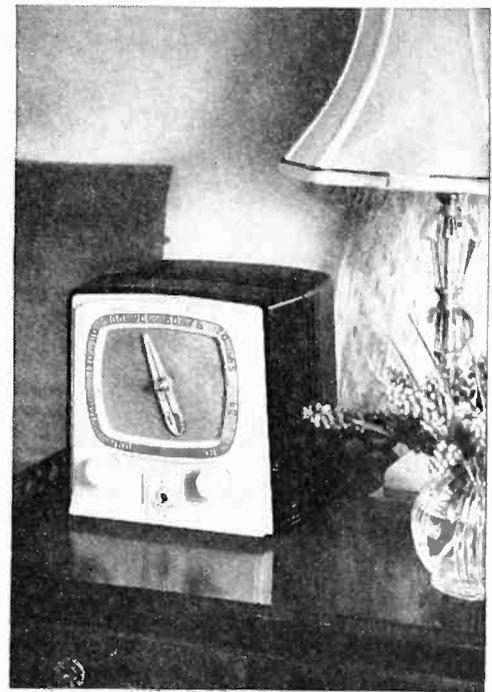
C	16.352	32.703	65.406	130.81	261.626	523.25	1046.50	2093.00	4186.01	8372.02
C#	17.324	34.648	69.296	138.59	277.18	554.37	1108.73	2217.46	4434.92	8869.84
D	18.354	36.708	73.416	146.83	293.66	587.33	1174.66	2349.32	4698.63	9397.27
E ^b	19.445	38.891	77.782	155.56	311.13	622.25	1244.51	2489.02	4978.03	9956.06
E	20.602	41.203	82.407	164.81	329.63	659.26	1318.51	2637.02	5274.04	10544.08
F	21.827	43.654	87.307	174.61	349.23	698.46	1396.91	2793.83	5587.65	11175.30
F#	23.125	46.249	92.499	185.00	369.99	739.99	1479.98	2959.95	5919.91	11839.82
G	24.500	48.999	97.999	196.00	392.00	783.99	1567.98	3135.96	6271.92	12543.85
A ^b	25.957	51.913	103.83	207.65	415.30	830.61	1661.22	3322.44	6644.87	13289.74
A	27.5	55	110	220	440	880	1760	3520	7040	14080
B ^b	29.135	58.270	116.54	233.08	466.16	932.33	1864.66	3729.310	7458.62	14917.24
B	30.868	61.735	123.47	246.94	493.88	987.77	1975.53	3951.07	7902.13	15804.26
C	32.703	65.406	130.81	261.626	523.25	1046.50	2093.00	4186.01	8372.02	16744.03

The above table, prepared by F. E. Hunt, of the Physics Laboratories of Harvard University, gives the frequencies of all the semi-tones in the equally tempered physical scale which lie within the auditory area, (up to 17,000 cycles). Older tables have been based on the frequency of A as 435 cycles per second, whereas the physical standards now accepted is 440 cycles per second; as in the above table.

For Quality Styling in Radio Sets

THE universal use of Bakelite Molded for popular-priced radio cabinets indicates how well this material meets the dual requirements of distinctive styling at low manufacturing costs.

Bakelite Molded is available in a wide range of attractive colors and mottles; and may be readily formed into almost any shape or design. Through its use, cabinets often may be designed in one piece, and com-



pletely produced in one operation of the molding press.

In the molding operation, all through-holes, lugs and metal inserts are permanently incorporated, and a final lustre is imparted to all surfaces. The uniform accuracy with which Bakelite Molded cabinets can be produced, and the resulting simplifications in assembly, provide further economies in production.

Other characteristics of Bakelite Molded, that make it highly advantageous for cabinets, are its mechanical strength, lightness in weight, electrical insulation value, and high resistance to marring from abrasion, handling, and furniture polish or soap and water.

Manufacturers and designers of radios are invited to obtain detailed information. Write for comprehensive booklet 13M, "Bakelite Molded."

(Left) 4-tube Emerson Radio with 2-piece cabinet of rich mottled brown Bakelite Molded. (Above) From the same molds, different color-styling is obtained by producing the cabinet body from lustrous black Bakelite Molded. Molder, Associated Attleboro Mfrs., Inc.



BAKELITE CORPORATION, 247 PARK AVENUE, NEW YORK, N.Y.
BAKELITE CORPORATION OF CANADA, LIMITED, 163 DUFFERIN STREET, TORONTO, CANADA West Coast: Electrical Specialty Co., Inc., 316 ELEVENTH STREET, SAN FRANCISCO, CAL.

BAKELITE

REGISTERED U.S. PAT. OFF.
The registered trade marks shown above distinguish materials manufactured by Bakelite Corporation. Under the capital "B" is the numerical sign for infinity, or unlimited quantity. It symbolizes the infinite number of present and future uses of Bakelite Corporation's products.

THE MATERIAL OF A THOUSAND USES

ELECTRONICS — September 1937

45

**Buy with Confidence -
Nationwide Acceptance**

REMLER

HI-FIDELITY TRANSCRIPTION UNIT



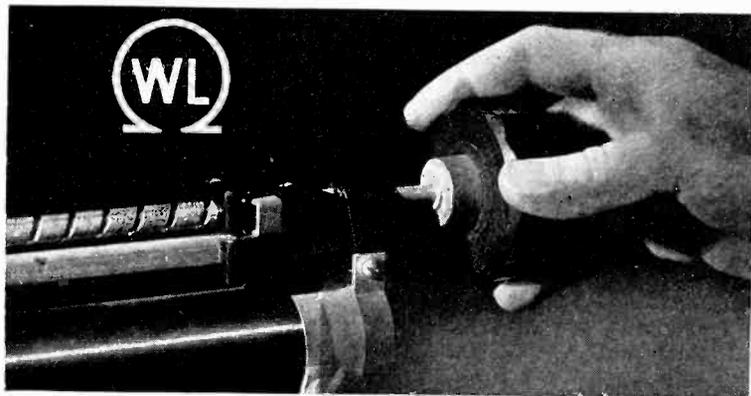
Famous Remler quality . . . sturdily constructed with precision accuracy to stand up under the grueling test of continuous service. Improved mechanical-filter drive system provides constant speed and freedom from wow at either 33 $\frac{1}{3}$ or 78 R.P.M. FEATURES: True synchronous motor, condenser starting, mounted on rubber. Exclusive roller-bearing planetary speed reduces drive for 33 $\frac{1}{3}$ R.P.M. Speed change by simple lever. Oil-damped mechanical filter in drive shaft. Heavy 16" "flywheel" platter. High fidelity lateral pickup and

equalizer gives response within 3 db. from 45 to 6600 C.P.S. Ball-bearing mounted long radius pickup arm, with adjustable needle pressure— $\frac{1}{2}$ oz. to 6 oz.

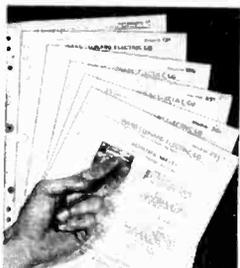
Available in cabinet or as a unit for mounting in control table. All parts mounted in heavy cast iron framework assuring permanent alignment and simple installation. The price is unusually low. Send for complete information.

REMLER COMPANY, LTD., 19th at Bryant, San Francisco

REMLER—THE RADIO FIRM AS OLD AS RADIO



... this Rheostat gives
Continuous Control



Bulletin 8001 tells the story. Send for it.

Instrument makers, chemical and electrical laboratories in schools, colleges and industry need the continuous precision control of these sliding contact rheostats with micro drives. Ward Leonard Tubular Rheostats are available in a wide variety of mountings, sizes, non-inductive windings.

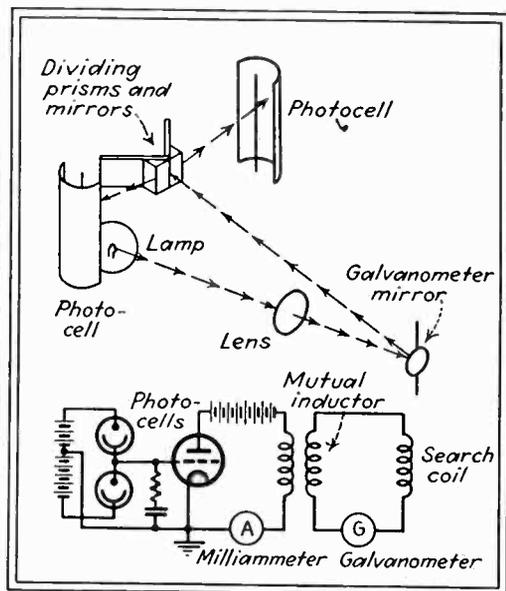
Visit our booth No. 224 at the Power & Mechanical Engineers Show, Chicago, October 4-9.

Electric Control Devices Since 1892

WARD LEONARD ELECTRIC COMPANY
32 SOUTH STREET, MOUNT VERNON, NEW YORK

Hysteresigraph Using Phototubes

WRITING IN the July issue of the *General Electric Review*, R. F. Edgar describes a hysteresigraph using phototubes as well as other electron tubes in an article entitled "A New Photoelectric Hysteresigraph." The hysteresigraph described is a d-c instrument which may be used to test either laminated or solid specimens in the form of rings or bars. The heart of the instrument is a photo-electric fluxmeter which is responsive to slow changes in flux linking a search coil, and provides an indication which remains constant without drift so long as the flux linking the search coil remains constant. A simplified diagram for the optical and electrical portion of the photoelectric fluxmeter is shown in the attached schematic diagram. In



Phototube hysteresigraph

series with a search coil and a galvanometer is the secondary coil of a mutual inductor. By means of an optical system and two phototubes connected in a vacuum tube circuit, the galvanometer deflection is maintained at zero. The current in the primary coil of the mutual inductor is automatically varied so as to induce the voltage in the secondary coil which is equal and opposite to any voltage which may be induced in the search coil by a change of flux interlinking it. The change of interlinkage in the secondary coil caused by the change in primary current is then equal and opposite to the change of interlinkage in the search coil. The variation in primary current is, therefore, a measure of the flux variation in the search coil. Since the galvanometer remains at the zero position, its suspension torque is not apt to cause drift, and the primary current varies only when the flux linkage in the search coil varies.

In the optical system, the beam from the galvanometer mirror is focused upon a set of mirrors and prisms which divides it into two parts and reflects each part separately into a

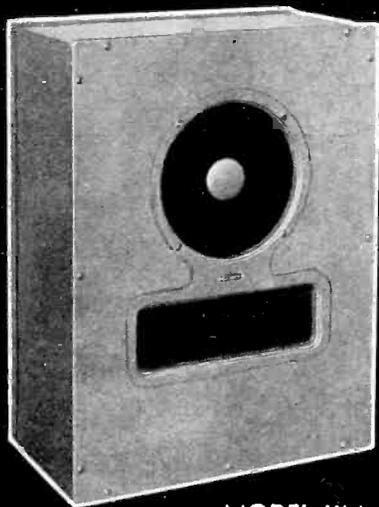
Another Contribution to the Art by Jensen The Bass Reflex Principle

☐ Briefly, this new acoustic principle involves the function of an acoustic network through which back-side radiation from the cone type of loudspeaker is made to add usefully to the acoustic output from the front-side. Thus that energy, previously a source of destructive interference and difficult to dissipate satisfactorily in open-back loudspeaker cabinets and baffles, becomes a source of useful acoustic output. And, by suitable acoustic network design this added output occurs through a range of low frequencies not heretofore possible to produce by practical method. In short, one or more octaves of low frequency response range is added to what has previously been accepted as maximum loudspeaker and baffle ability.

This accomplishment not only involves consideration of acoustic networks in simple form but also those of more comprehensive nature which are Jensen developments and which constitute new art. Application of this new *Bass Reflex* principle is practical in every known use of direct radiator loudspeakers and we predict that henceforward consideration of the principle will be mandatory if the best possible acoustic results are to be achieved in treatment of loudspeakers and associated cabinets or baffles.



☐ We offer the details of this new development as a Jensen Engineering Service to those manufacturers who are prepared to incorporate the principle in their manufactured product. The service may either involve consideration of simple acoustic networks or of those more comprehensive ones; the determining factor usually being that of finished product cost against performance objective. Specifications are provided to insure suitably designed cabinet enclosures, loudspeaker design and audio frequency analysis of the receiver itself. Those interested are invited to write and ask for a date at which the work can be undertaken.



MODEL KM-12

☐ Jensen built *Peri-Dynamic* Reproducers, incorporating *Bass Reflex*, are offered the trade for all manner of applications concerned with the Reproduction and Reinforcement of sound. Models are available with either 8, 10, 12 or 15 inch speaker equipment. List prices range from \$12.50 up. The list price of Model KM-12, illustrated at left, is \$34.25 complete with 12-inch PM12-C speaker.

KM and KV Models are shipped in kit form with enclosure designed for easy assembly in the job. They are ideal for public address, radio and similar uses.

☐ Jensen built *Peri-Dynamic* Reproducers, incorporating *Bass Reflex*, are offered the trade for all manner of applications concerned with the Reproduction and Reinforcement of sound. Models are available with either 8, 10, 12 or 15 inch speaker equipment. List prices range from \$12.50 up. The list price of Model KM-12, illustrated at left, is \$34.25 complete with 12-inch PM12-C speaker.

Models C and D Jensen Imperial Reproducers range up to \$310 list. Some models are with dual speakers and variable filter networks. All incorporate the *Bass Reflex* Principle and are offered in beautiful, modernistic cabinets. For Broadcasting Station monitoring, laboratory reference work, homes, schools, or any use where the best possible quality of reproduction is an essential, these Reproducers are recommended.

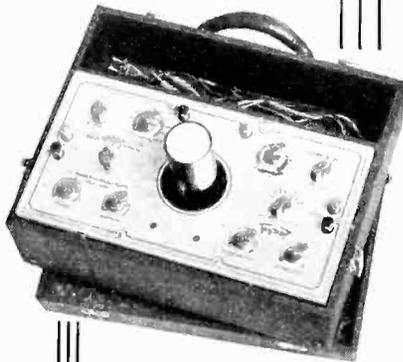
Write for complete information on all Models.

JENSEN RADIO MANUFACTURING COMPANY
6601 SOUTH LARAMIE AVENUE

CHICAGO, ILLINOIS

"The Name Insures the Quality"

For the
First
Time



... A PRACTICAL
OSCILLOSCOPE

Model
1690
In Metal
Case
DEALER
PRICE
\$47.00

- Exclusive Turret Type Tube Mounting for adjusting Screen to any angle for Direct View . . .
- Extremely Brilliant Pattern
- Linear Sweep 15 to 20,000 Cycles
- 2" Cathode Ray Tube

Meets Every Requirement of Servicing Engineers for Visual Study and Adjustment of Radio Receiver Circuit Problems

ADVANTAGES

This new Triplet Oscilloscope is complete. In addition to radio servicing, it has invaluable applications in radio transmitter, sound equipment, industrial and educational fields.

The cathode ray tube with exclusive Triplet turret type mounting can be moved up or down or to either side for adjustment of the screen to an angle always in direct alignment with the user's line of vision. Adjustable shield can be pulled out to protect beyond the screen for easy reading in brightest daylight.

The Oscilloscope incorporates separately controlled resistance coupled vertical and horizontal amplifiers. Vertical and horizontal plates can be either direct coupled with amplitude control, or through amplifiers with amplitude control. Can be used with any type frequency modulated Signal Generator. 60 Cycle A.C. operated.

Linear sweep from 15 to 20,000 cycles. Sweep (either internal, external or 60 cycle) may be used through amplifier or direct with amplitude control. Positive lock. All controls on panel. No interactional controls.

Model 1690—Contained in black leatherette case (as shown above) with removable cover. Built-in compartment for accessories.

DEALER NET PRICE...\$51.00

Model 1690—also furnished in black wrinkle finish metal case (same as above less black leather carrying case and cover).

DEALER NET PRICE...\$47.00

A TRIPLET DELUXE MODEL



The Triplet Elec. Instrument Co.
239 Harmon Ave., Bluffton, Ohio

- Please send me more information on Model 1690 Oscilloscope.
- Please send me Catalog New Triplet DeLuxe Line.

Name

Address

City State

phototube. The light, one phototube and consequently the phototube current, will increase whereas that of the other phototube will decrease when the mirror of the galvanometer deflects. The phototubes are connected to the grid of a vacuum tube in such a way that any unbalance in the divided light beam between the two phototubes causes a change in the grid voltage which is amplified and produces a change in the current to the primary of the mutual inductor. The direction of the current flow in the primary of the mutual inductor is such that any change caused by the deflection of the galvanometer light beam causes a change in flux linking the secondary coil of the mutual inductor, tending to correct the galvanometer deflection and restore the original light balance.

While a slight deflection of the galvanometer is of course necessary to initiate the correct change of plate current, this required deflection is very small and the final position when the new balance is obtained is almost exactly the same as the original position.

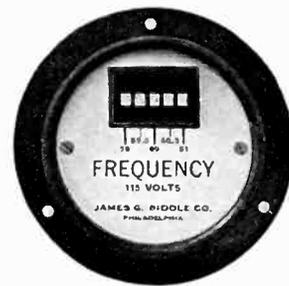
The complete photoelectric hysteresigraph consists of two fluxmeters as briefly described above, combined with a cathode ray oscillograph. Magnetic deflection coils fitted to the oscillograph tube are connected in the plate circuit of the fluxmeter so that one fluxmeter causes vertical deflection of the electron beam and the other causes horizontal deflection. The search coil of the first fluxmeter is linked by the specimen under test and that of the second lies adjacent to the specimen but is not linked by it, so that one fluxmeter measures induction changes and the other magnetizing force changes.

The hysteresigraph has been found particularly useful in the study of magnet materials and in obtaining data for magnet design. Recent developments and improved materials have brought about the use of permanent magnets in applications not previously considered practical, particularly in applications where the magnet may be subjected to varying external reluctance or strong demagnetizing magnetomotive force.

• • •

"Batalum" Getters

FROM THE July issue of the RCA Review comes the first authentic information to appear in print concerning the batalum getters which have been in a process of development for well over a year at the RCA plant at Harrison, N. J. The article by E. A. Lederer and D. H. Wamsley, "Batalum, A Barium Getter for Metal-Tubes," outlines the requirements of getters for vacuum tubes, gives a brief historical resume and outlines the requirements of getters. It is pointed out that the



Dependable

MINIATURE
FREQUENCY
METERS

"FRAHM" Frequency Meters indicate by means of accurately tuned vibrating steel reeds which have the remarkable ability to hold original calibration for a very long time. Simple. Rugged. Unaffected by wave form or ordinary voltage or temperature changes. Made in both miniature and large sizes for any frequency between 15 and 500 cycles per second. Types for front-of-board or flush mounting, also for portable use.

Ask for Bulletin 1415-E.

JAMES G. BIDDLE CO.
ELECTRICAL AND
SCIENTIFIC INSTRUMENTS
1211-13 ARCH ST. PHILADELPHIA, PA.

DYNAMOTORS

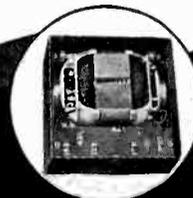


A DEPENDABLE
POWER SUPPLY

Dynamotors, gen-e-motors and converters produced by this pioneer manufacturer of power supply units afford the last word in this type of equipment for air craft, police, marine and auto radios, public address systems, etc. Compact and light weight. Sturdily constructed to assure long, dependable service. For complete information address.

PIONEER GEN-E-MOTOR CORPORATION

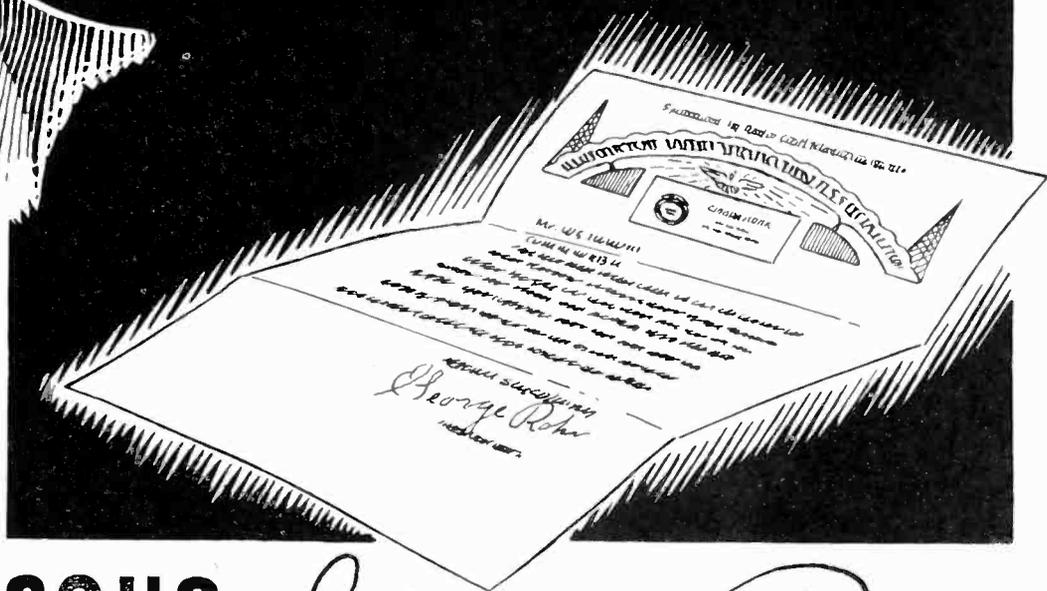
Dept. No. R-41, 466 WEST SUPERIOR ST.
CHICAGO, ILL.



GEN-E-MOTORS



“Centralab is the difference between a satisfied customer and a dissatisfied one.”



says

George Rohr.



**THE SMOOTH
CENTRALAB
CONTROL**

offers maximum resistor length for case diameter . . . close uniformity between resistors . . . accurate tapers . . . uniform current distribution . . . better power dissipation and longer life.

Mr. George Rohr of 67 Thorne St., Jersey City, N. J. hands us the above bouquet along with some other very flattering statements in a recent letter!

Thanks, Mr. Rohr . . . thousands of other radio men feel the same way about Centralab.

In fact, set manufacturers and experimenters as well as service men have for years shown their preference for Centralab . . . and they have said it with generous orders. We suggest, you too, specify **CENTRALAB.**

CENTRALAB DIV. OF GLOBE-UNION INC., Milwaukee, Wisc.
Canterbury Rd., Kilbourn N. W., England 118 Ave., Ledru-Rollin, Paris

Centralab
CRL



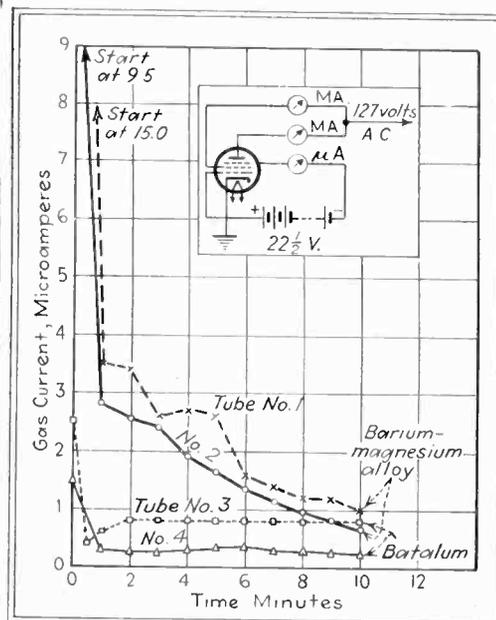
BAREX Embedded Getters

Our experience in specializing in the manufacture of just one product—the Embedded Getter—is illustrated by the fact that we produce more different sizes, shapes and compositions of getters than any other manufacturer in the world.

KING LABORATORIES, Inc.
205 Oneida St. Syracuse, N. Y.

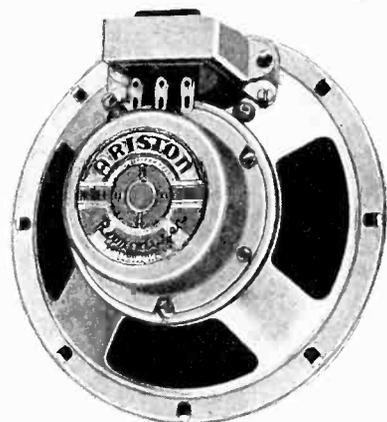
requirements for a good getter are: (1) the getter deposit should consist mainly of barium metal; (2) complete control with respect to time and quantity of getter flash is essential; (3) complete control over place of deposition of getter flash is essential; (4) it is preferable to flash getter while metal envelope is cold after completion of degassing and exhaust; (5) low vapor pressure of getter deposit at highest temperatures encountered during final processing and operation of tubes is essential.

The batalum getter (the word "batalum" is derived by a contraction of barium and tantalum) consists essentially of a length of tantalum wire coated with a mixture of barium



and strontium carbonates. Barium and strontium metal are obtained from the carbonate by heating the tantalum wire electrically through terminating the wire at two pins in the base of the octal socket. The carbonates of barium and strontium are changed to the respective oxides at 800° C. to 1100° C. The tantalum wire reduces the oxides to produce barium and strontium metal at a temperature above 1200° C. The barium and strontium evaporated from the tantalum wire can be directed where desired by means of small deflecting plates or "boxes" which, in practice, are used to support the coiled filament of the batalum getter.

The batalum getter as now used in receiving tubes consists of a 0.006-in. tantalum wire in the form of single helical coil. The coil is sprayed with the double carbonates of barium and strontium and mounted in a shield or small metal box. A circuit is made from the ground lead through the coil to the header. On the exhaust machine, suitable contacts are provided to introduce current for breaking down the carbonates to the oxide. The technique is much the same as used in preparing the oxide-coated cathode. After the tube is exhausted, the getter is flashed on the aging panel, the flashing and again aging schedule being chosen to insure the best gas cleanup.



ARISTON QUALITY PRODUCTS

Electro dynamic and permanent magnet speakers
5" — 6 1/2" — 8"

Dry and wet electrolytic condensers, by-pass condensers. Any size, any combination, any capacity.

Write us YOUR requirements

ARISTON MANUFACTURING CORPORATION
4049-59 Diversey Avenue Chicago, Illinois

MICROHM WIRE WOUND RESISTORS

MICROHM WIRE WOUND RESISTORS are built on the foundation of a QUALITY PRODUCT and can be used as a component with the finest of precision instruments. Manufacturers interested in maintaining the QUALITY of their apparatus recognize this merit of QUALITY, demand and use only MICROHM WIRE WOUND RESISTORS. Precision Resistor Company manufactures a complete line of all types of wire wound resistors and is equipped to meet the most rigid specifications.

Write for catalog and prices

PRECISION RESISTOR COMPANY

332 Badger Ave. Newark, N. J.
Manufacturers of custom built PRECISION and INDUSTRIAL WIRE WOUND RESISTORS.



TYPE R 1/2
Watt (Actual
Size) Res. 5
to 500000 ohms.
Accuracies as
close as 1/10
of 1%.

The Bigwigs Say

Three of the Thirteen coming business booms are in the field of **ELECTRONICS**

According to the 450,000-word document recently made public by the President, entitled "Technological Trends and National Policy, Including the Social Implication of New Inventions," the field of electronics will play an important part in world progress of the next twenty years. Of the thirteen new technologies which seem to be gathering headway for a booming future, three are in the electronic field—two others are definitely allied.

The study was conducted by a subcommittee of the Science Committee of the National Resources Committee under the direction of William Field Ogburn of the University of Chicago.

The three divisions of electronics are:

- 1. Television** — which the report states has arrived at a satisfactory technical stage and only awaits capital and organization to get under way.
- 2. Facsimile transmission** — in which the report prophesies radio newspapers, transmitted during the night, ready for the reader when he gets up in the morning.

3. Photo-electric cells—about which the report says in part, "Indeed it (the electric eye) brings the automatic factory and the automatic man one step closer. It may be used to regulate automobile traffic, to measure the density of smoke, to time horse racing, to read, to perform mathematical calculations." Of course it describes the already general uses.

The two definitely allied divisions are:

- 1. Steep flight airplanes** — Craft able to take off from small areas such as flat roofs in the hearts of cities. Naturally the control of such takeoff and landing, as well as the plane's flight will be controlled by the electron tube.
- 2. Tray agriculture** — The technique of growing plants in tanks of water containing nutrient chemicals. In this technique the electron tube takes the place of sunlight and will very probably be used in the control of administration of chemicals.

electronics Covers This Field

We are in a position to prove that every company, every man of importance in the intricately varied field wherein the electron tube is used is a paid subscriber to **ELECTRONICS**. The circulation, expanding at average of about 30 percent a year, is self levelling with the growth of the industry.

Whether it be a manufacturer or a research laboratory—there you find **ELECTRONICS**, studied by the executives and the engineers who need this one source of information on the development of this great industry.

We believe we are able to say "our business is different" and make it stick. It is different because nobody knows just what is going on in the electronic development laboratories of the world. If *you* could look into all of them you could find sources for new business which would probably amaze you.

ELECTRONICS looks into every one of these sources of future business. You can carry your message through these unknown doors by advertising in this—the greatest exploring medium in one of the fastest growing businesses in the world.

Don't sell your future in this business short. Build for it by consistent, month-by-month advertising exploration in the one paper which covers the field.

electronics

ABC

A McGraw-Hill Publication

ABP

330 WEST 42nd STREET, NEW YORK, N. Y.



TURBO OIL TUBING

takes the
"baptism of fire"

A well known testing laboratory submitted TURBO Oil Tubing to the "flame test" and checked our findings that TURBO burns slower than any insulating material of its kind.

This fact makes TURBO Oil Tubing especially desirable for use where heat and high voltages are encountered. It is the thorough, deep impregnation of high grade insulating varnishes plus baking over and over again that makes TURBO so flame resistant, tough, resilient and of great dielectric strength.

You may have a standard, full-length strand of either TURBO Oil Tubing or Saturated Sleeving for testing in your own plant. Specify inside diameters and colors interested in and, remember, we ship all orders—regardless of quantities—on the day received.

WM. BRAND & CO., 268 4th Ave., New York In Chicago
217 N. Desplaines St.

Photograph of test wherein TURBO Oil Tubing proved it burns 8 times slower than any other like product.

AUTOMATIC ELECTRIC RELAYS

A WIDE VARIETY OF TYPES FOR
EVERY INDUSTRIAL USE

The Automatic Electric line of relays includes quick and delayed action types, sensitive and heavy duty types, mechanical locking types, polarized relays, etc. Available for operation on D.C. or A.C. circuits, any voltage, any contact combination. Also stepping switches, electric counters, solenoids, keys and other electrical control accessories. Write for complete illustrated catalogs.

AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1023 WEST VAN BUREN STREET CHICAGO

WAXES • COMPOUNDS • VARNISHES for ELECTRICAL INSULATION

Zophar offers prompt service on Insulating Compounds for a wide variety of electrical applications, including:

... insulation for CONDENSERS, TRANSFORMERS, COILS, power packs, pot heads, sockets, wiring devices, wet and dry batteries, etc. Also WAX SATURATORS for braided wire and tape. WAXES for radio parts.

Special compounds made to your order.

ZOPHAR MILLS INC.

130-26th St. Brooklyn, N. Y.

FOUNDED 1846

Tube Characteristics with Constant Current Curves

S. ALTON EVEREST, in his article "Making Life More Simple" in the July issue of *Radio*, sets forth the advantages of specifying tube characteristics by means of a family of constant current curves.

According to the author, the chief advantages of using the constant current curve to represent the complete family of tube characteristics are: (a) the grid and plate characteristics are shown plotted on the same set of coordinates; (b) operating with a given plate voltage and bias places the operating points in a definite location on the chart; (c) the dynamic characteristic is a straight line drawn through this operating point for any mode of operation, Class A, B, or C; (d) with a moderate familiarity with these charts, it is possible to determine the adaptability of a particular tube to a particular function; (e) the μ of the tube is indicated by the slope of the line.

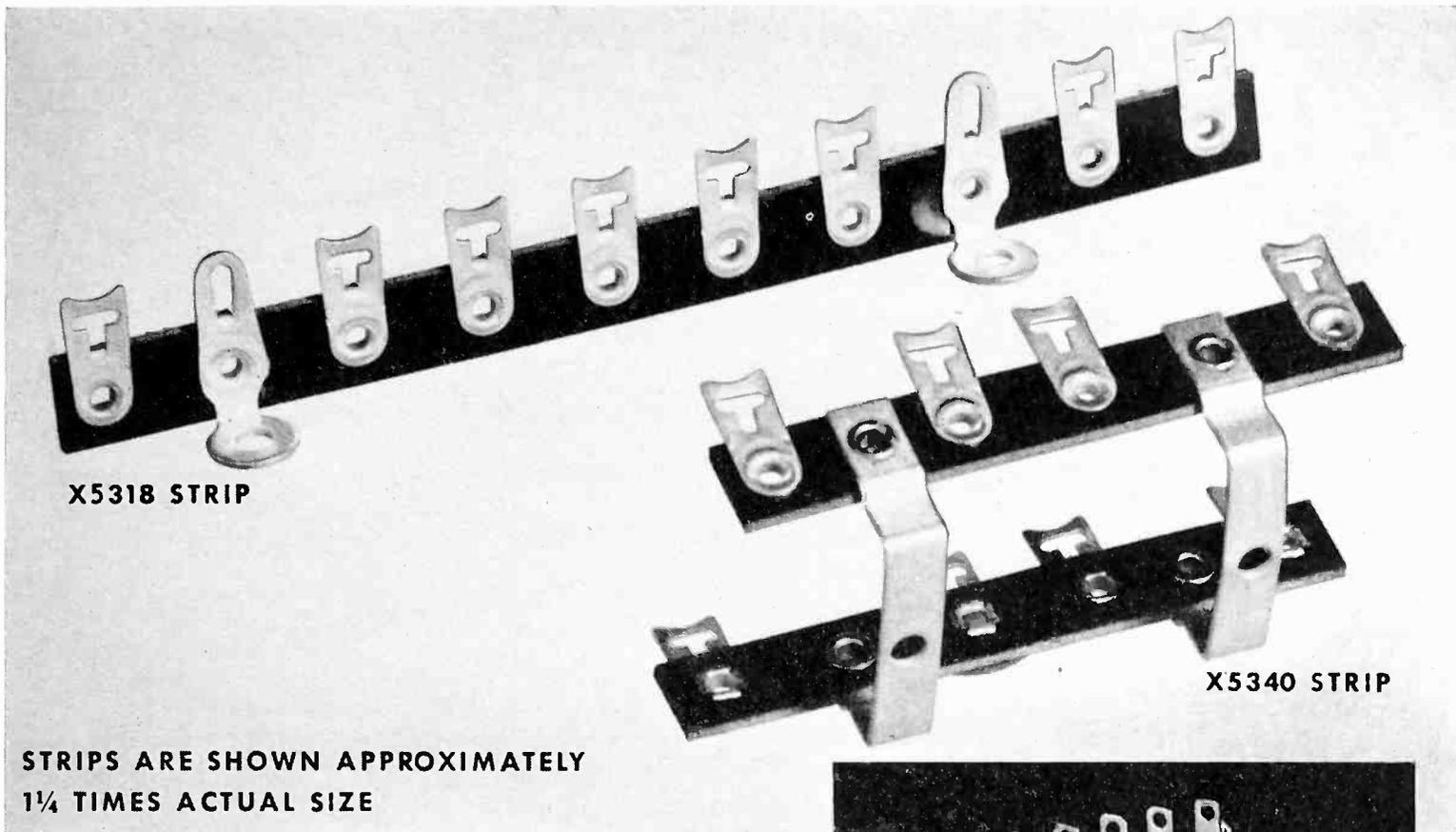
The use of constant current lines as representing the tube characteristics, was first suggested by Maurompseff and Kozanowski, in the July, 1935, issue of the *Proceedings of the Institute of Radio Engineers*. These constant current characteristics are especially suitable for use in calculating the operation of Class C amplifiers. Through the use of the usual plate family characteristics, Class C amplifier operation is a rather laborious and tedious job. However, through the use of the constant current curve and a load line calibrated in proportion to a sine scale, the wave shapes of the current flowing in the plate circuit can be easily determined as well as can all of the other essential characteristics of amplifier operation.

This method of representing tube characteristics has much to recommend itself.

Spinning Atoms and Spinning Electrons

IN ONE OF HIS delightful articles in the series of Contemporary Advances in Physics, Dr. Karl K. Darrow writes on "Spinning Atoms and Spinning Electrons" in the July issue of the *Bell System Technical Journal*. This thirty-first paper in the series was presented at a lecture before the American Physical Society at Chicago, November 27, 1936, and before the American Institute of Electrical Engineers at New York on May 6, 1937.

Naturally any discussion of atomic physics, aside from the exceptionally rudimentary, can (and usually does) soon get into the realm of complexity. But considering the subject that it treats, this latest lecture by Dr. Darrow is highly entertaining and interesting and will probably appeal to those who do not like their atomic physics "too technical."



X5318 STRIP

X5340 STRIP

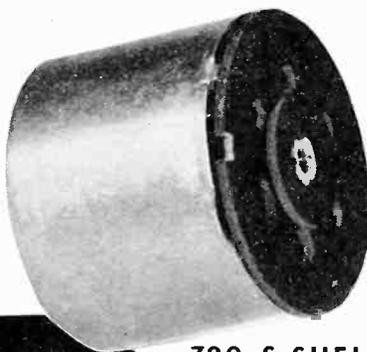
STRIPS ARE SHOWN APPROXIMATELY
1¼ TIMES ACTUAL SIZE

Each component part is fabricated and each unit is assembled entirely by CINCH under the most careful supervision.



3811 SOCKET
3711 PLUG
3790 SHELL

ABOVE: Note particularly part X5340 and X5318 with T slotted concave top lug providing space for maximum number of wires. Hundreds of variations, all styles in stock give you prompt action on your needs. For insulated mounting strips, binding posts, bias cell holder strips, get "CINCH" strips.



720-S SHELL

760-S PLUG

ABOVE: right Nos. 3711, 3811 and 3790, note compact arrangement, eleven prongs in a 1½" mounting center. Completely shielded, interior of shell thoroughly insulated, convenient eyelet on cap for soldering braided cable shield; two bronze spring clips, which snap through chassis when plug is inserted, grounding plug and cable to chassis. The socket has full floating CINCH solder coated contacts and a ¼" bakelite cover insulator plate. LEFT: Cinch efficient, dependable socket No. 760-S, with 720-S shell, most popular for Cathode Ray tube such as 6E5.

CINCH
MANUFACTURING CORPORATION
2335 WEST VAN BUREN STREET
CHICAGO, ILLINOIS

Originated and designed by CINCH, each component part of these strips, sockets, and shells is fabricated and each unit assembled completely by CINCH. Your assurance of satisfactory performance.

Cinch and Oak Radio Sockets are licensed under H. H. Eby socket patents

SUBSIDIARY OF UNITED-CARR FASTENER CORP., CAMBRIDGE, MASS.

NOW IS THE TIME TO ACT!

Because Electronics has been unable to supply the persistent demand for extra copies of the Reference Sheets, an additional service which enables subscribers to secure a complete set on an annual basis has been inaugurated.

Electronics Yearly Service gives you an extra copy of all Reference Sheets contained in Electronics during the calendar year. These will be reprinted on heavy paper, assembled and punched ready for insertion in the notebook.

Many subscribers have already taken advantage of this service to conveniently keep their files of Reference Sheets up to date.

Although the publication date is December 1st (to include the latest chart) sets can be supplied only to subscribers who have placed their orders by that date.

If you have not already made arrangements for a set to be reserved for you, why not do it now? By using the convenient coupon below you will be assured of receiving the charts without further thought. To put off making your reservation may result in your order being received after the charts are printed.

The small cost will assure you of a complete file without the necessity of cutting the charts from each issue.

By sending payment of \$1 with the order, thereby eliminating bookkeeping and collection costs, we will pay the delivery charges.

Use Coupon Below and Make Checks Payable to Electronics Yearly Service

Electronics

330 W. 42nd St., New York City

Enter my order for **ELECTRONICS REFERENCE SHEETS** for 1937 at \$1.00.

Here is my check. Send sheets postpaid. Bill me \$1.00 plus small delivery charge.

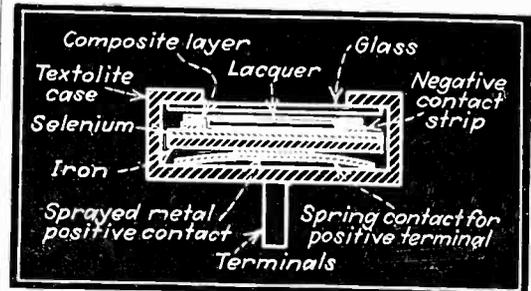
Name

Address

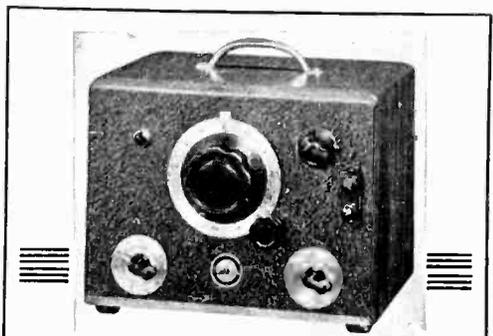
City State

Light Sensitive Cell

UNDER THE TITLE of "The Light Sensitive Cell" in the General Electric Review for August, R. H. Mighell outlines the construction, performance, and characteristics of a blocking-layer type of cell presumably manufactured by the General Electric Co. The light sensitive cell is of the iron-selenium type and its construction of this cell is indicated in the attached illustration.



Ten graphs showing the characteristics of this cell under various operating conditions are given. These include the current-illumination characteristics, open circuit voltage, illumination characteristics, available power, current temperature characteristics, fatigue, and the spectral sensitivity of the cell. The article also discusses series and parallel connections of several cells, the frequency response, atmospheric effects, sturdiness and application of the light sensitive device.



The General Radio control equipment for precision

+

The solid Walnut cabinet for simple beauty and ruggedness

+

The finest interior construction for stability

+

Advanced engineering and research
= Model VC I

Beat Frequency Oscillator 0-15,000 cycles. The Swing to high-fidelity makes this formula a necessity to solve the problems in

- The production line.
- The service booth.
- All corners of the laboratory.

\$35

net complete
Descriptive Literature

THE TELEVISO CO.
127 N. Dearborn St.,
Chicago, Ill.

Engineering manufacturers of allied electronic products

audio radio medical



Everything
under
Control

from **MELT**
to **MICROSCOPE**

This business of making Cathode Sleeves is an exacting one. Today our specifications on raw material require a degree of perfection that a few years ago refiners might have been unable to meet. Then, every one of the many stages of manufacture here at Superior is under the control of metallurgists and craftsmen who make a fetish of accuracy. But in spite of all this extreme care, final inspection sometimes brings to light minor defects which our customers never get a chance to discover for themselves. There have been no complaints about this practice.

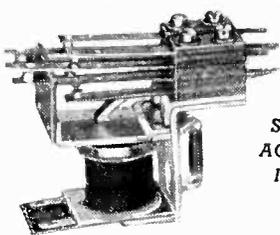
SUPERIOR TUBE CO.
NORRISTOWN, PA.



MANUFACTURERS OF SEAMLESS
AND LOCKSEAM CATHODE SLEEVES
AND FINE SEAMLESS TUBING IN
VARIOUS METALS AND ALLOYS

SUPERIOR TUBING

THE SPRING



Series 110
AC-DC Relay
Illustrated

IS A GREAT INVENTION but Relays by GUARDIAN MAKE MACHINES MORE RESPONSIVE

The catapult and the bow saved the day for many a medieval mortal. But where instant response is needed, as in modern machines, tricky combinations of springs and levers are fast giving way to RELAYS by Guardian. They are compact, positive in action, and

are not subject to wear like complicated mechanical contrivances. You'll find them used a dozen different ways in modern machines.

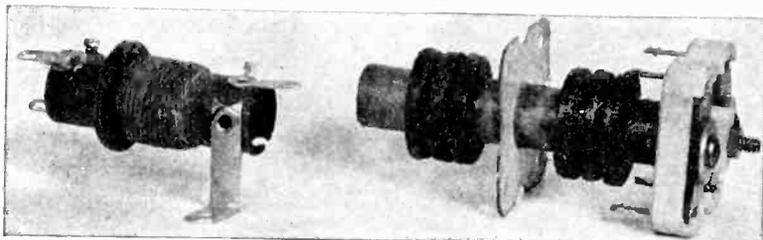
For your guarantee of Precision Built Controls, specify the units that carry this symbol



GUARDIAN ELECTRIC

1625 W. WALNUT STREET CHICAGO, ILLINOIS

OF SPECIAL INTEREST TO RADIO MFRS.



We are ready to make prompt delivery in any quantity, of IF Transformers, Oscillators, RF Windings, Transmitter RF Chokes and RF Chokes. All types, your tolerance. Send samples or specifications for quotation. Export inquiries invited.

PRECISION INDUCTANCE CORP., 591 Broadway, New York



Frequency Measuring Service

Many stations find this exact measuring service of great value for routine observation of transmitter performance and for accurately calibrating their own monitors.

MEASUREMENTS WHEN YOU NEED THEM MOST
at any hour every day in the year

R.C.A. COMMUNICATIONS, Inc.

Commercial Dept.

A RADIO CORPORATION OF AMERICA SERVICE

66 BROAD STREET

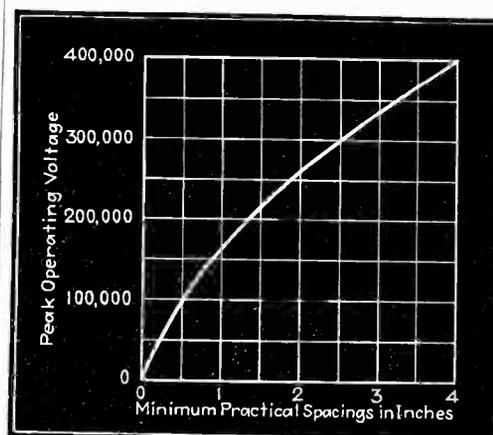
NEW YORK, N. Y.



High Voltage Rectifiers

M. J. GROSS and Z. J. Atlee discuss "High Voltage Vacuum Tube Rectifiers—Physical Factors Influencing Their Design" in the August issue of the *Journal of Applied Physics*. It is pointed out in this article that of the many physical factors pertaining to vacuum tubes, a few can be selected as being principally involved in high voltage rectifier design.

It is shown in this article that while the field strength is undoubtedly influenced by the shape of the electrodes, microscopic surface irregularities, the kind of surfaces involved, and the aging or the past history of the surfaces of the electrode are of considerable importance also and frequently overshadow the effect of the electrode shape. The minimum spacing between electrodes for stable operation is given in the figure.



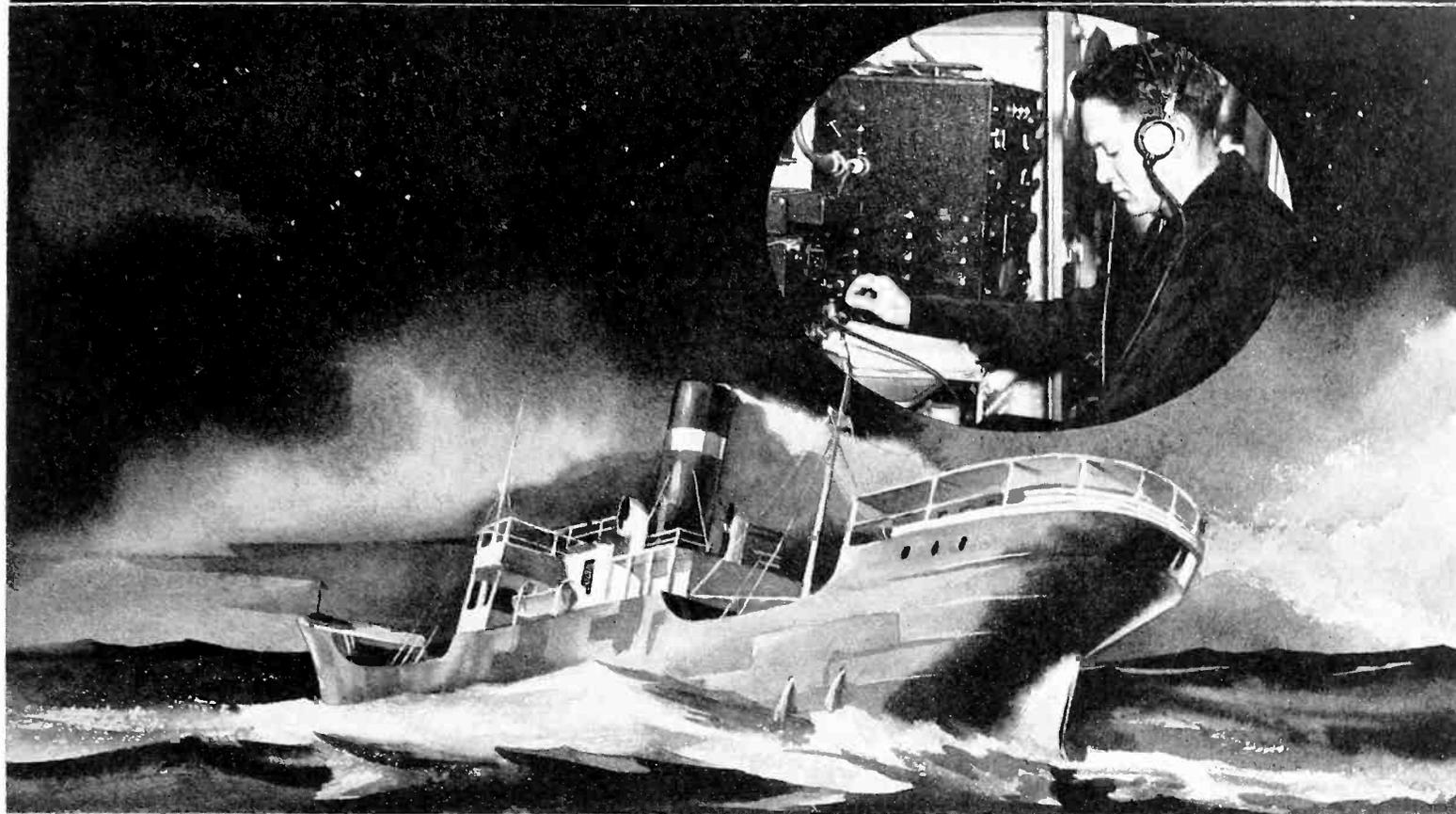
Electrode spacing for high voltage rectifiers

The authors show that the vacuum required in high voltage tubes is no greater than that required for low voltage rectifiers and that the real problem for high voltage tubes is one of degassing the various parts of the tubes sufficiently during exhaust. An example is given by which undesirable electrostatic mechanical forces tending to make the filaments bend have been overcome. Designs for reproducible voltage drops in the tubes and envelope surface phenomena are also discussed briefly.

Power Level Indicators

THE PRINCIPLES and characteristics of the various types of power level indicators used in sound recording are described by F. L. Hopper in a paper entitled "Power Level Indicators for Sound Recording," in the August issue of the *Journal of the Society of Motion Picture Engineers*. Copper oxide, various vacuum tube systems including the peak reading meter, thermocouple, and recording type of power level indicators are treated generally. Volume indicators using neon tubes are not discussed in the article although brief mention of this type of indicator is presented in the discussion following the paper.

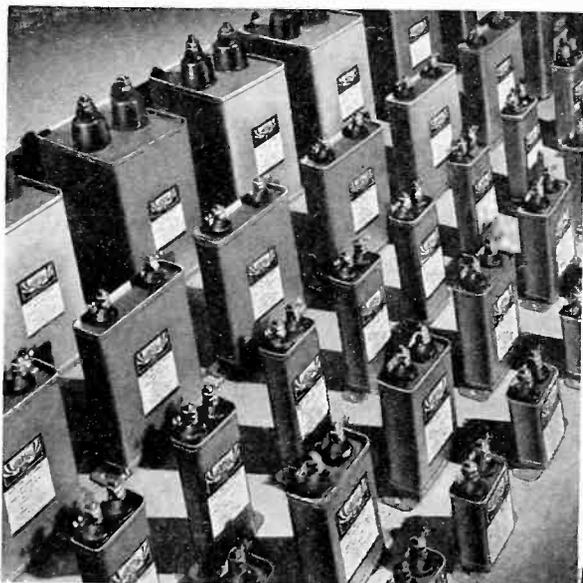
Latitude 20.5 S. . . . Longitude 131 W.



But the Mainland's at His Finger Tips

TYPE TJ DYKANOL TRANSMITTING CAPACITORS

This outstanding series of C-D capacitors has been widely adapted for both industrial and broadcast high voltage applications. New universal mounting clamp permits either vertical or horizontal installation of these capacitors. Other types described in detail in catalog 150.



THE steamer a thousand miles out today is within speaking distance of home, of weather bureau and Coast Guard. The air liner . . . alone in a strange world of clouds and darkness . . . is guided by a voice from the ground. Sound transmission has made the earth "a small world after all".

Playing a vital role in man's conquest over distance and time is CORNELL-DUBILIER. The success of transmitting equipment depends upon the quality of the capacitors used. Aware of the importance of capacitors radio engineers everywhere standardize on C-D. They know that in Capacitors, CORNELL-DUBILIER is another name for DEPENDABILITY.

They know, because for more than twenty-seven years C-D capacitors have stood the test of time under the most trying weather and circuit conditions. Such unfailing service has won for CORNELL-DUBILIER international acceptance. A fitting tribute to C-D capacitors.

And a salute to the training, the craftsmanship and persistence of CORNELL-DUBILIER engineers.

Complete catalog material available on request.

CORNELL-DUBILIER ELECTRIC CORPORATION
Hamilton Boulevard South Plainfield, N. J.



CORNELL-DUBILIER

ELECTRIC CORPORATION

South Plainfield, New Jersey

Ship-to-Shore Communication

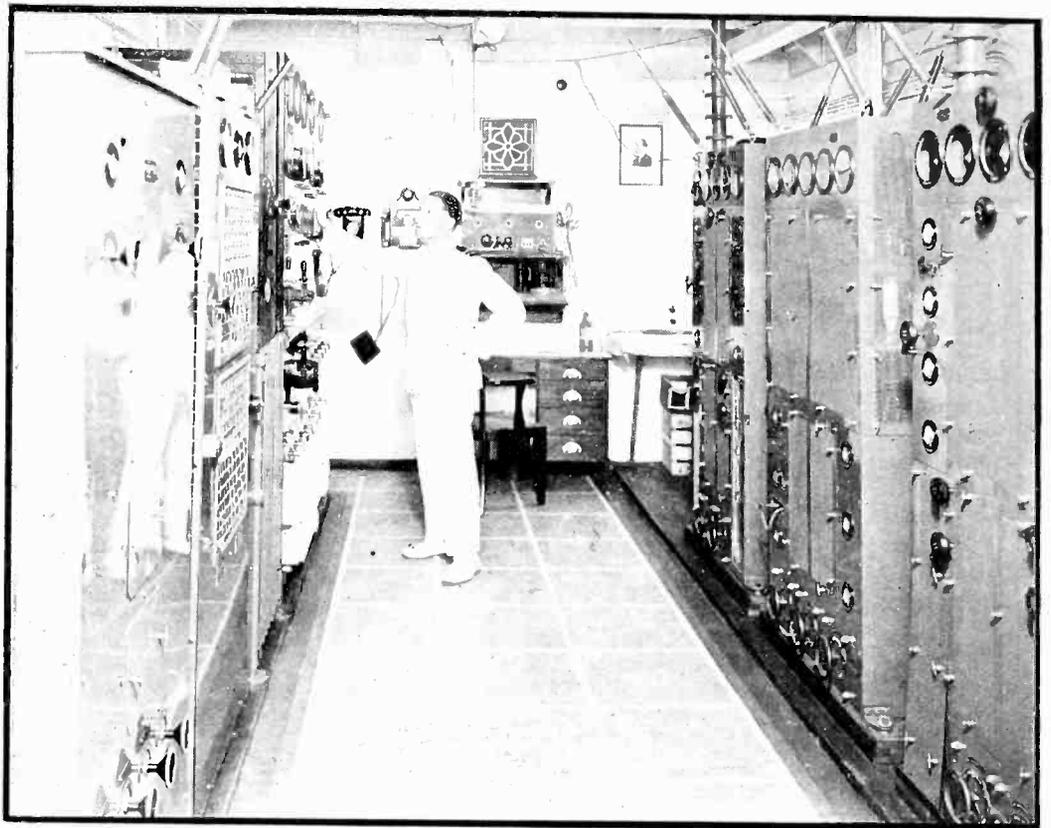
(Continued from page 12)

out interference, during reception, from reradiation of the transmitter power from the ship's stays and structure. (4) Connection to the 400 cabin telephones through a two-wire system. (5) Time required for numerous wave changes for both telephone and telegraph operation.

These requirements were met in the design and installation of the *Queen Mary's* equipment as follows:

(1) Installation of the two short-wave telephone and telegraph receivers, the long-wave and medium-wave telegraph receivers, and the transmitter and the telephone circuit control equipment, in the combined operating and receiving room on the sun deck, with transmitting keys and typewriters at all four operating positions.

(2) Installation of the four corresponding transmitters, two short-wave telegraph-telephone, and one medium-wave and one long-wave telegraph transmitter 400 feet aft on the same deck; incorporation of the following features in the short-wave receivers, which are otherwise of standard superheterodyne design; (a) Preselector unit, which serves to match the receiver to the aerial transmission line, increase selectivity, suppress voltage from the medium and long wave telegraph transmitters, and balance out noise currents if an open wire type transmission line is used; (b) a single h-f stage of high efficiency to insure low tube-noise-to-signal ratio and to give adequate second channel suppression; (c) high tension voltage and beating oscillator frequency held constant by "Stabivolt" gas tube; (d) plug-in coils for maximum efficiency, ganging of coils for speed and correctness, and automatic lighting of the corresponding tuning scale; (e) automatic gain control with symmetrical time constant for telephony and a symmetrical constant for telegraphy; (f) resonance tuning meter for both telephony and telegraphy; (g) output limiter to attenuate static crashes; also, limiting the power of the long and medium-wave transmitters to 3 kw. to



Radio Room of the *Empress of Britain*

avoid shock excitation of the receiving antennas; separation of the transmitting antennas from the receiving antennas by as great a distance as possible; and connecting the receiving antennas to the receivers through impedance matching transformers, concentric transmission lines, a switching panel equipped with screened jacks and patch cords, and concentric cables.

(3) Bonding points of variable contact in the stays and structure; and provision of a voice-operated relay system which keys the transmitter, suppressing the carrier when it is not being modulated.

(4) Provision of complete control terminal equipment, including a hybrid coil and relay system, similar to that of the shore system.

(5) Incorporation of instantaneous wave-change dialing circuits in all transmitters, with remote control from the operating positions.

The short-wave equipment may be quickly and easily converted for either telephone or telegraphy, and as traffic conditions require, may be working exclusively on telegraphy, or be clearing telephone calls to both sides of the Atlantic simultaneously. During the maiden voyage, 175,000 paid words of telegraph traffic were

handled, 291 telephone calls completed and 11 hours and 32 minutes of broadcast programs transmitted.

The ships on the Atlantic runs to which the service is offered are the *Aquitania*, *Berengaria*, *Bremen*, *Columbus*, *Conte di Savoia*, *Deutschland*, *Empress of Britain*, *Europa*, *Hamburg*, *Hansa*, *Queen Mary*, *Ile de France*, *Reliance*, *Caledonia*, *New York*, *Normandie*, *Rex*, *Transylvania*, *Monarch of Bermuda*, and *Queen of Bermuda*. Calls are also accepted, through West Coast facilities not described here, for the *Chichibu Maru* in the Pacific.

1. "Transoceanic Telephone Service," *Bell Tel. Sys. Tech. Pub.*, Monograph B-497, July, 1930; or *Transactions of A. I. E. E.*, Apr. 1930 Vol. 49, pp. 621-643.

2. "Transoceanic Telephone Service," *Bell Tel. Sys. Tech. Pub.*, Monograph B-497, July, 1930; or *Transactions of the A. I. E. E.*, Apr., 1930, Vol. 49, pp. 621-643.

3. C. N. Anderson and I. E. Lattimer, "Operation of a Ship-Shore Radiotelephone System," *Proc. I. R. E.*, March, 1932, Vol. 20, pp. 401-433.

4. E. Bruce, "Developments in short-wave directive antennas," *Proc. I. R. E.*, August, 1931.

5. R. A. Heising, "Effect of shore station location upon signals," *Proc. I. R. E.* 20, 77-87; January, 1932.

F. G. Loring, W. L. McPherson, and W. H. McAllister, "Survey of Marine Radio Progress, With Special Reference to R. M. S. *Queen Mary*," submitted to the British Institution of Elec. Eng., January 12, 1937.

6. C. N. Anderson and I. E. Lattimer, "Operation of a Ship-Shore Radiotelephone System," *Proc. I. R. E.*, March, 1932, Vol. 20, pp. 401-433.

MANUFACTURING REVIEW

News

◆ During his recent visit to Europe, Allen B. DuMont, cathode-ray tube specialist of Upper Montclair, N. J., addressed some 60 French engineers on the subject of cathode ray oscillographs and new applications of the resonoscope.

◆ As a result of increased demand for industrial capacitors, the South Plainfield plant of the Cornell-Dubilier Electric Corp., has taken over the condenser manufacturing equipment and sales staff of the Electric Machinery Manufacturing Co., Inc., of Minneapolis.

◆ Orland Murphy, president, announces the organization of Electrical Winding, Inc., 16 No. May St., Chicago, to specialize in the design and manufacture of all types of transformers, solenoids, chokes, magnets, and similar equipment. The company is set up to design coils and mountings for any specific purpose, or to work from manufacturers' specifications.

◆ Ground was officially broken on August 2 and work commenced on the construction of new studios for WGY at Schenectady, N. Y.

◆ Sales of the Western Electric Co. for the first six months of this year were

\$97,355,000, it was announced today by Edgar S. Bloom, president. This figure compares with \$65,651,000 for the corresponding period last year, an increase of 48 per cent.

◆ A financial statement released by David Sarnoff, president of the Radio Corporation of America, shows a net profit of \$2,404,329 for the second quarter representing an increase of \$1,927,240 from the corresponding quarter of last year. After allowing for preferred dividends, paid or accrued, there remains \$3,030,292 earned on the common stock for the first six months of this year, the equivalent of 22 cents per share.

◆ The B-L Electric Manufacturing Co., St. Louis, Mo., announces the appointment of Carl E. Peters, secretary, and Irvin W. Veigel, treasurer of the company, according to Charles J. Wrape, president of the company.

◆ The responsibility for the development of lines of activity which either are new in the art or which have not been previously undertaken by the company has been centralized by the Westinghouse Electric & Manufacturing Co. with the formation of a New Products Division.

Heading up the New Products Division is H. M. Wilcox, manager, H. W. Tenney, engineering manager, and George F. Begoon, sales manager.

◆ After being in charge of the development work on variable resistors for the Central Radio Laboratories, A. R. Morton has recently become affiliated with the Newark Transformer Co., of Newark, N. J.

◆ The annual report of the Sparks-Withington Co., Jackson, Mich. released August 12 shows net sales of \$6,892,670 and net profit before Federal income taxes of \$588,063 for the fiscal year ending June 30.

◆ Television plans of the Columbia Broadcasting System advanced on two fronts with the announcement on August 20th that Gilbert Seldes has been appointed television program director for CBS and that the company is establishing a television program center in the Grand Central Terminal Building.

◆ The announcement of a new corporation, the Wisconsin Amplifier Co., Kenosha, Wisc., has been made by H. M. Mills, president, and E. G. Kertz, secretary and treasurer. The company will manufacture sound equipment.

New Products

Two New Phototubes

TWO NEW PHOTOTUBES of simplified construction available at reduced cost have been announced by the Radiotron Division of the RCA Manufacturing Co., Harrison, N. J. Both types are caesium coated. The 921 phototube is a gaseous tube, while the corresponding vacuum phototube bears the number 922.

The gas phototube has a maximum anode supply voltage of 90 volts, a maximum anode current of 20 microamperes and may be operated with an ambient temperature up to 50 deg. C. The gas amplification is not more than 10 and the sensitivity in the audio frequency range is between 90 and 100 microamperes per lumen. The vacuum type tube operates at a maximum anode supply of 250 volts, delivers a maximum current of 30 microamperes, and has a sensitivity of 20 microamperes per lumen. Like the 921, the 922 may be operated at ambient temperatures up to 50 deg. C. maximum.



As shown in the illustration, the tubes are small in size and require a special clip-in mounting. Bearing a list price of \$2 each, these tubes should find extensive application in industrial use where control by varying a light beam is desirable.

Antenna Outlet

A CONVENIENT and attractive outlet for noise reducing or doublet antennas which eliminates the usually unsightly wiring connections, characteristic of most radio receivers installed in the home, has been announced by the General Electric Co., of Bridgeport, Conn. The outlet affords a compact means of separable attachments for ground, antenna (two-wire) and power leads for a radio set.

Dielectric Measurements

THE TYPE 106-A dielectric unit just introduced by the Boonton Radio Corp., Boonton, N. J., assists in the precise measurement of Q, power factor, or dielectric constants of insulating material and small condensers. The dielectric unit is used in combination with the type 100-A Q-meter which it matches in general appearance. This combination will measure differences in circuit Q as small as 2 per cent, with an accuracy of about 5 per cent.

electronics

Catalog & Literature Service

Manufacturers' literature constitutes a useful source of information. To make it easy to keep up to date, "Electronics" will request manufacturers to send readers literature in which they are interested.

1. **Tube Catalog.** A complete catalog and specifications book has been issued by the United Electronics Co., 42 Spring St., Newark, N. J. This book covers some thirty-four models of electron tubes designed for all types of transmitting equipment.

2. **Photo Tube Application.** A four-page folder from the United Cinephone Corp., 43-37 33rd St., Long Island City, N. Y., gives a list of photo-cell applications which appeared several years ago in *Electronics*. Copies of this particular issue of *Electronics* are no longer available.

3. **Mercury Rectifier.** Folders are available from Herman A. Devry, Inc., 1111 Armitage Ave., Chicago, describing a mercury vapor rectifier tube having an average d-c output of 15 amp. maximum.

4. **Tubes.** A single page folder describing a mercury rectifier 2-RA-6 tube has been released by the Continental Electric Co., of Geneva, Ill.

5. **Ballast Tube Catalog.** The Muter Co., 1255 South Michigan Ave., Chicago, Ill., has just issued a complete replacement catalog for parts jobbers and servicemen.

6. **Tube Parts.** Bulletin No. 4 describes and illustrates a wide variety of metal tube parts manufactured by the Goat Radio Tube Parts, Inc., 314 Dean St., Brooklyn, N. Y.

7. **Phototube Relays.** A folder from the Electronic Products Co., St. Charles, Ill., describes a photo control unit consisting of a photocell and relay assembled in a complete unit.

8. **Schering Bridge.** A modified Schering bridge has been developed for measurements of specific inductive capacity and power factor of dielectrics, by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. This bridge is described in catalog E-542 (2).

9. **Test Oscillator.** The Boonton Radio Corp., Boonton, N. J., have available a single page descriptive bulletin on their type 10-A converter test oscillator.

10. **Radio Parts Catalog.** The 15th anniversary edition of the Radio Parts Catalog and listing a complete line of condensers has just been published by the Aerovox Corp., 70 Washington St., Brooklyn, N. Y.

11. **National Products.** A 20-page catalog devoted to receivers, and receiving and transmitting components has just been released by the National Co., 61 Sherman St., Malden, Mass.

12. **Pyranol Condensers.** A 6-page folder describing liquid dielectric condensers, together with some of their more important technical characteristics and available sizes is listed in bulletin GEA-2027-A of the General Electric Co., Schenectady, N. Y.

13. **IRC Resistors.** A spiral bound catalog describing their line of fixed and variable resistors for radio receiving, transmitting, as well as industrial purposes, has just been released by the International Resistance Co., 4018 No. Broad St., Philadelphia.

14. **Rheostats.** A number of variable resistance units having power ratings from 10 watts to 150 watts are described in an illustrated catalog No. 237, issued by Hardwick, Hindle, Inc., 40 Hermon St., Newark, N. J.

15. **Beetleware.** A loose-leaf technical book on the application and physical characteristics of Beetleware is available from the Beetle Products Division of the American Cyanamid Co., 30 Rockefeller Plaza, New York.

16. **Porcelain Insulators.** Bulletin No. 137, a 14-page booklet covering porcelain insulators, is available from the Lapp Insulator Co., Inc., LeRoy, N. Y.

17. **Monel Metal.** "The Engineering Properties of K Monel" is the title of bulletin No. 9 issued by the Development and Research Division of the International Nickel Co., 67 Wall St., New York City.

18. **Beryllium Applications.** A 28-page bulletin illustrated in color gives the physical characteristics, general information, application, fabrication and related information concerning beryllium copper. This booklet is available from the Riverside Metal Co., Riverside, N. J.

19. **Stellite Booklet.** A new edition of the booklet, "Hard Facing with Haynes Stellite Products" has now been issued by the Haynes Stellite Co., Kokomo, Ind., a unit of Union Carbide & Carbon Corp.

20. **Coaxial Cable.** A single page folder describing coaxial cables for use in antenna, transmission, and coupling problems is available from Victor J. Andrew, 7221 So. Francisco Ave., Chicago.

21. **Transmitting Equipment.** Several folders are available from Doolittle & Falknor, Inc., 7421 South Loomis Blvd., Chicago. One of these is on concentric transmission lines, a second on mobile transmitters, the third on broadcast transmitters, the fourth on aircraft transmitters and a fifth bulletin on relatively low power transmitters operating between 250 and 15,000 kc. per second.

(Continued on page 61)

ELECTRONICS

September

Please request manufacturers to send me, without obligation, literature identified by numbers circled below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42
43	44	45	46										

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

CITY..... STATE.....

22. **Drafting Equipment.** A 12-page booklet describing various types of modern tracing and reproduction cloth and paper is available from the Charles Bruning Co., 102 Reade St., New York City.

23. **Questionnaire.** "Electro Voice Fun Department" is the name of an advertising brochure published by the Electro Voice Manufacturing Co., 24 East Colfax Ave., South Bend, Ind. A feature of this sheet is a list of twenty questions (with answers on the reverse side) relating to technical aspects of radio.

24. **Instantaneous Record Processing.** A new listing of recording blanks and processing charges for the production of original or duplicate recording on records from 10 to 16 in. diameter, as well as a listing of accessories applied by them, is available from the Audi-Tone Oscillator Co., 1336 Fairfield Ave., Bridgeport, Conn.

25. **Controlling Equipment.** A number of individual bulletins, for insertion in their catalog and covering primarily electrical control equipment have been released by the Ward Leonard Electric Co., of Mount Vernon, N. Y.

26. **Electrical Catalog.** An 81-page catalog, No. 101, has just been issued by the Trumbull Electric Manufacturing Co., Plainville, Conn.

27. **Properties of Ceramics.** The American Lava Corporation, Chattanooga, Tenn., has just issued a table giving the physical properties of the more important ceramic materials which this company manufactures.

28. **Special Purpose Tubes.** Bulletin No. 12 of the Lamp Division, Westinghouse Electric & Mfg. Co., Bloomfield, N. J., describes two tubes for industrial applications.

29. **Paging System.** A four-page folder describing intercommunicating system has been issued by the Babaco Company, 447 W. 19th St., New York City.

30. **Transformers.** Bulletins L-34 and L-37, the latter listing a new line of transformers, may be obtained from the Phelps Dodge Copper Products Corp., 2375 East 27th St., Los Angeles, Calif.

31. **Lacquers.** Bulletins No. 4527 and 4917 describe insulating varnishes and lacquers made by the Roxalin Flexible Lacquer Co., Elizabeth, N. J.

32. **Oscillograph Bulletin.** A bulletin illustrating and describing the features of their 5-inch oscillograph is available from the Allen B. DuMont Laboratories, Inc., Upper Montclair, N. J.

33. **Electric Switches.** R. W. Cramer & Co., 67 Irving Place, New York City, has issued a new catalog of synchronous and electrically wound time switches.



12X REMOTE AMPLIFIER



ON THE FIRING LINE
for two years without any change in basic design, the Collins 12X Remote Amplifier continues to be the dependable standard in an increasing number of broadcast stations.

COLLINS RADIO COMPANY

C E D A R R A P I D S I O W A
NEW YORK, N. Y. 11 WEST 42 STREET

Callite Products HAVE TESTED, PROVEN QUALITY

TUNGSTEN

- ... Rod, Sheet, Wire and Special Shapes
- ... Hard Glass Welds

MOLYBDENUM

- ... Rod, Sheet, Wire and Special Shapes
- ... For Grids, Round or Flat
- ... For Grids, Supports, Heating Elements
- ... Hard Glass Welds

KULGRID

- ... For Grids, Round or Flat
- ... Kulgrid "C" Tungsten Welds

CONTACTS

All Sizes and Shapes For All Applications

- ... Tungsten - Molybdenum
- ... Silver and Platinum
- ... Special Alloys
- ... For High Conductivity
- ... Precious Metal Laminated
- ... Silver and Platinum on Base Metals

CALL-LUX FLUORESCENT MATERIALS

- WITH -
Measured Characteristics

- ... For All Applications

Callite Products

Division of EISLER ELECTRIC CORP.
544 - 39th STREET • UNION CITY, N. J.



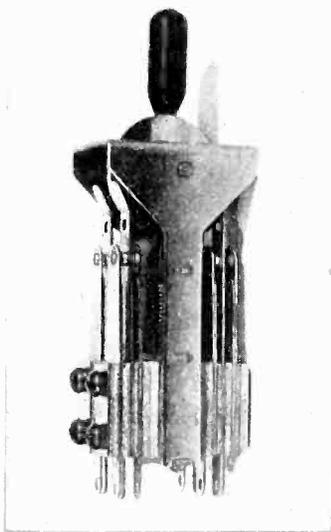
Which
FUSE • CLIP • MOUNTING
for your job?

Manufacturers should have this display card showing LITTELFUSE Products — helps engineers, designers, draftsmen — saves time all around. Make sure that the fuses, clips and mountings you buy are Littelfuse Products — it's your assurance of high quality. A request on your letterhead will bring this helpful display card and complete Littelfuse Catalog.

LITTELFUSE LABORATORIES
4248 Lincoln Ave. Chicago, Ill.

**GENERAL CONTROL'S
GCL
CAM LEVER SWITCH**

Now Accepted as The
Standard for Heavy Duty
and Hard Service



Non-Corrosive
No Bounce
10 A. 125 V. A.C.
2 A. 125 V. D.C.
Assembly Possibilities Unlimited
Lock or Non-Lock

Proof of Acceptance

The following customers have ordered
and reordered:

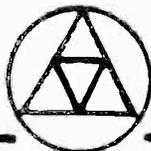
- Bendix Radio Corp.
- The Bristol Co.
- California Inst. of Tech.
- C. & G. Radio Supply Co.
- Champion Lamp Works
- Ken-Rad Tube & Lamp Corp.
- Radio Receptor Co., Inc.
- Tung-Sol Lamp Works
- Wide World Photos, Inc.

WHY NOT YOU?

Write for Full Information

SPECIAL PRODUCTS DIVISION

We offer engineered service for
your control problems—timing,
process regulation, counting, test-
ing, peak demand limitation,
automatic switching, etc. Ask for
details.



GENERAL CONTROL CO.
Cambridge, Mass.

MAIL COUPON TODAY

GENERAL CONTROL CO., Cambridge, Mass.
Gentlemen:
Kindly send me full information: on the Cam
Lever Switch ; details of your service on special
Engineering Problems .

Name

Position

Company

Address

Measuring Instruments

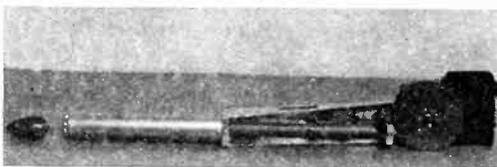
A NEW PANEL instrument with illum-
inated dial has recently been produced
by the Simpson Electric Co., Chicago.
The dial is made of translucent ma-
terial and illumination is provided by
a 6-volt lamp, giving well diffused
lighting. The instruments are avail-
able in both d-c and a-c current and
voltage types as well as thermocouple
meters in all standard ranges.

Automobile Antennas

A NEW LINE of attractive radio anten-
nas for both automobile and home
use has just been brought out by the
Insuline Corp. of America, 25 Park
Pl., New York City. They feature
ease of installation and high electrical
efficiency, and are furnished complete
with mounting fixtures and hardware.

Antenna Reel

LEAR DEVELOPMENTS, INC., 125 W.
17th St., New York City, has brought
out a new weighted antenna reel for
aviation use, available in either elec-
trically or manually operated types.



The electrically operated reel is com-
pletely automatic; not only does it eject
the antenna to a predetermined length,
but as the plane descends for landing,
retracts it completely and positively.

**Tantalum Electrolytic
Condensers**

THE RESEARCH STAFF of Fansteel Metal-
lurgical Corp., North Chicago, Ill., an-
nounces the perfection in the form
of a porous electrode of tantalum sheet
suitable for use in electrolytic
condensers.

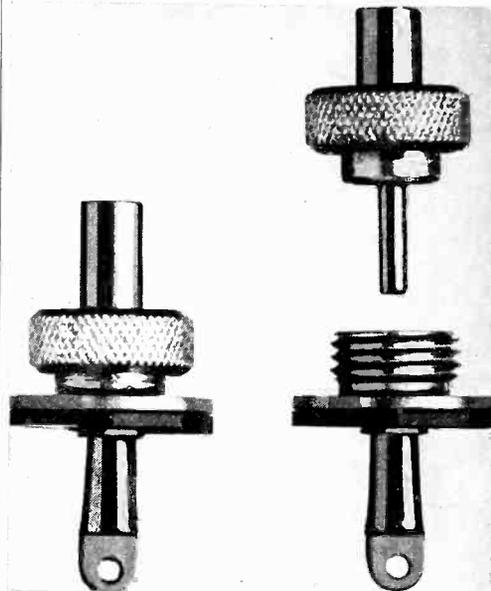
Microphones

A SMALL SIZE high fidelity velocity
microphone has been announced by the
Electro-Voice Manufacturing Co., 334
East Colfax Ave., South Bend, Ind.

Electric Welding

"FLEXI-WELD" a recent development of
the American Coach & Body Co., 9503
Woodland Ave., Cleveland, enables
electric resistance spot welding to be
done with ease in difficult or relatively
inaccessible places. The "Flexi-Weld"
spot welding outfit may be used in a
variety of methods including numerous
radio applications.

PLUGS—SOCKETS



Type No. 101 shielded single contact plug
and socket.

One type from our line of several
hundred electrical plugs and
sockets. We also supply manu-
facturers with terminal panels,
standard or to blue print.

Write for bulletins on complete line

HOWARD B. JONES

2300 Wabansia Ave.,
Chicago, Ill.

**HYVOL
HIGH-VOLTAGE
CAPACITORS**



Handy, inexpensive oil-filled
capacitors for high-voltage
heavy-duty filter circuits.

★

Compactness due to new
exclusive HYVOL — the
super-dielectric oil.

★

Inverted screw mounting.
Same size as usual elec-
trolytics. 1 1/2" dia. by
either 2 7/8" or 4 1/2" tall.

★

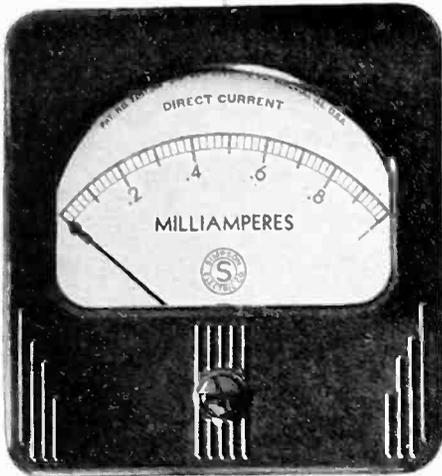
2, 3 and 4 mfd. 600 v.; 1
and 2 mfd. 1000 v.; 1/2 and
1 mfd. 1500 v. D.C. working.

★

DATA

Typical of many new items
in big 32-page catalog just
issued. Ask for copy.





This handsome, streamlined instrument is available with translucent dial illuminated from the rear by a built-in 6-volt lamp.

The greatest value ever in panel instruments!

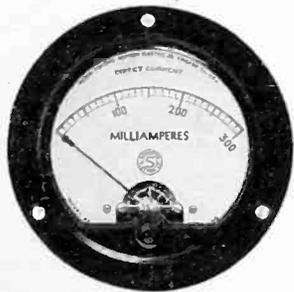
IF you know panel instruments, you know that "bridge-type" construction and soft iron pole pieces are the first prerequisite of accuracy and permanency in equipment of this type.

Simpson instruments bring you these essential features, and countless other refinements, at a price no higher than you have formerly paid for just the ordinary run of panel instruments. Behind these finely built instruments is Ray R. Simpson, formerly president of Jewell Electrical Instrument Company, and collaborating with him in the designing and building of the new Simpson line are many of the men who once took an active part in building the Jewell reputation for precision and ruggedness.

This unsurpassed experience, coupled with modern production methods and new, ingenious designs, has resulted in a line of instruments that represent what many engineers have termed the greatest value ever in electrical metering devices.

Whether you want meters for original equipment on devices you manufacture, or for testing in production lines, it will pay you to investigate "the instruments that stay accurate" The Simpson line covers a wide range of instruments. Two of the many are illustrated here.

Write for Complete Description and Prices
SIMPSON ELECTRIC CO.
 5218 W. Kinzie Street, Chicago



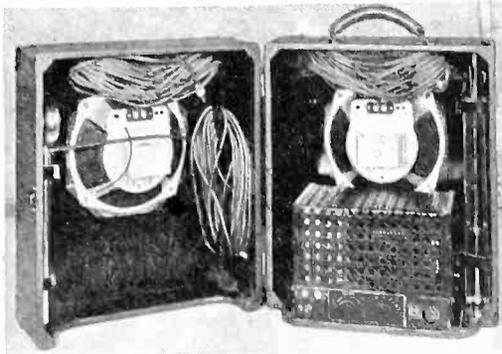
A typical round case instrument, made in many types and ranges.

SIMPSON

Instruments that **STAY** accurate

Portable Sound System

A **PORTABLE** sound system which may be set up wherever desired in a short time is announced by the Philco Radio



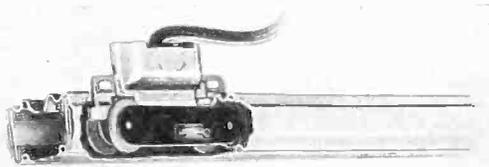
& Television Corp., Philadelphia, Pa. The complete system weighs 35 lb., uses two 8-in. dynamic speakers and contains the high gain high power amplifier in the bottom of the case.

Circuit Breakers

A **NEW LINE** of branch circuit breakers has been announced by the General Electric Co., Bridgeport, Conn. They eliminate fuse replacement and the practice of hazardous over-fusing. They are designed for single pole operation only in 15, 20, 25, 30 and 35 ampere sizes.

Flexible Distribution System

A **FLEXIBLE** and mobile electrical distribution system designed for general lighting and light duty power applications is announced by the Bulldog Electric Products Co., 7610 Jos. Cam-



pau Ave., Detroit, Mich. This Trol-E-Duct consists essentially of section lengths of formed steel ducts enclosing copper bus bars partially wrapped in insulating material. With this new conductor it is possible to move light and tools where and when wanted.

Noise Filter

A **LINE NOISE** filter, to be connected between noise reducing appliance and the power line or between the radio receiver and the power line is announced by the Aerovox Corp., 70 Washington St., Brooklyn, N. Y. Housed in a sturdy metal case with cracked enamel finish, this readily portable device comprises various forms of filters, thrown into the circuit by means of a selector switch, together with attachment cord, plug and connectors.

Compressed Gas Condenser TYPE 174

SMALLEST SIZE PER MMF. VOLT



This model is 500 mmf. Height 28"

INVESTIGATE these **UNIQUE** compressed gas condenser **ADVANTAGES**

FOUR CAPACITIES: 250, 500, 1000 and 1500 mmf.
TWO RATINGS: 40,000 and 32,000 rms working volts.

CONTROL: External, continuously variable.

LOSSES: Lower than equivalent air condensers.

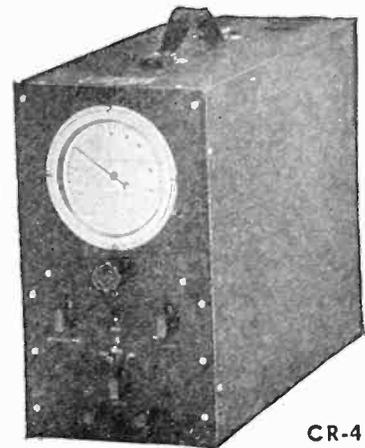
ALSO: Lower distributed inductance, complete shielding.

HEINTZ AND KAUFMAN
 SOUTH CALIFORNIA LTD. SAN FRANCISCO U. S. A.

An Exceptionally Accurate Instrument

for this price range

Price
\$103



Type

CR-4

Audio Oscillator

Widely used by leading Universities and Industrial Laboratories.

Prove its accuracy to yourself. If interested we will ship you one for inspection.

Literature and Specification sent upon request.

UNITED SOUND ENGINEERING CO.



Manufacturers of Electronic Equipment
 2235 University Ave., St. Paul, Minn.

ASTATIC

New Acorn Model T-3 CRYSTAL MICROPHONE

With Tilting Mount for Uni- or Non-directional Pickup Without Disturbing Frequency Response

New pride of Astatic line. Single diaphragm type microphone suitable for high class Public Address, Broadcast, Recording or Amateur use. Amazing directional characteristics. Acoustic feedback definitely reduced. Necessary wires concealed to retain beauty of this attractive, heavily chrome plated, acorn shaped microphone. Complete with Astatic exclusive interchangeable cable connector and protector. Fully guaranteed.



LIST PRICE \$25.00

TRU-TAN MODEL O-7 CRYSTAL PICKUP

Astatic Offset Head reduces tracking error to a minimum



NEW DESIGN
LOWER PRICE

Designed by Astatic engineers as a new, low-priced companion of the now famous B-10 and B-16 Tru-Tan Pickups. Model O-7 is guaranteed to give highly satisfactory performance with records to 12". Exclusive Axial cushioning prevents speaker-pickup feedback. Higher output level. Requires only short mounting space. Standard black finish. Special finish on request.

LIST PRICE...\$12.00
Model B-10...\$17.50
Model B-16...\$27.50
Replacement Cart-
Replacement Cartridges for
all Pickups.....\$6.00

Licensed Under Brush Development Co. Patents

Dept.
A-3

ASTATIC MICROPHONE LABORATORY, Inc. YOUNGSTOWN, O.
Pioneer Manufacturers of Quality Crystal Products

WRITE
FOR
DETAILS

★
Smoothest operation. Full 300° effective rotation.

★
Very, very quiet. Suitable for most critical uses.

★
Permanent resistance values.

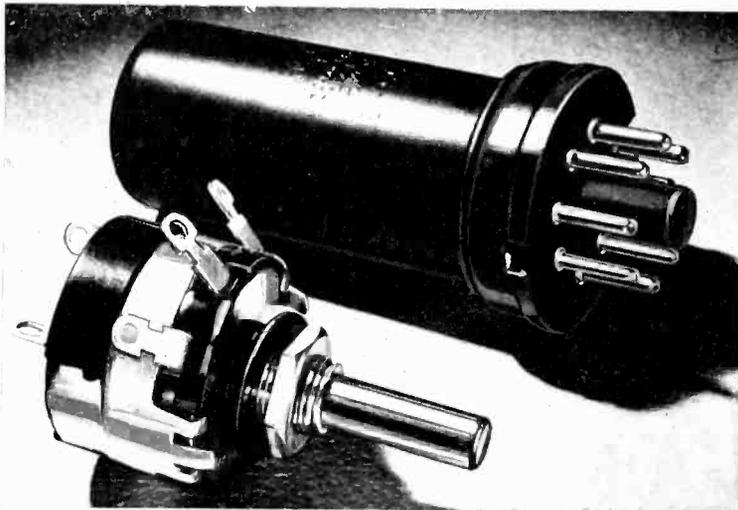
★
Exceptional immunity to moisture.

★
Tinned terminals. Easily soldered. Solder can't get in.

★
Any ohmage, taper, taps, switch. Single or tandem units.

★
Fully competitive prices.

★



MIDGET CONTROLS

Genuine Midget Controls, designed from scratch, of which we are really very proud. ● We invite your examination, test, comparison and consideration. ● Samples on request to manufacturers.

Write for DATA on these new Midget Controls, on your business letterhead. Also for our loose-leaf engineering catalog.

CLAROSTAT Manufacturing Co. Inc.

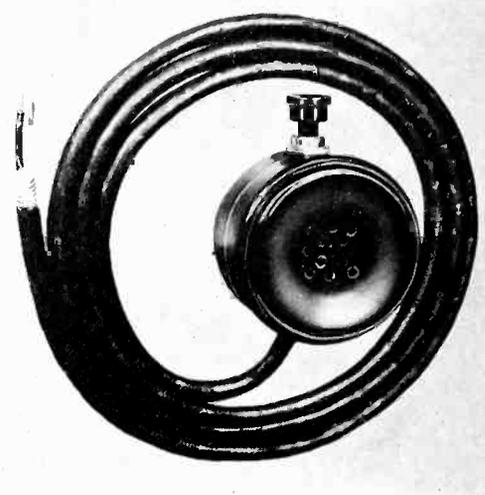


285-287 NORTH SIXTH STREET
BROOKLYN, NEW YORK, U.S.A.

• OFFICES IN PRINCIPAL CITIES •

Aircraft Microphone

A COMPACT and light-weight aircraft microphone of molded bakelite with



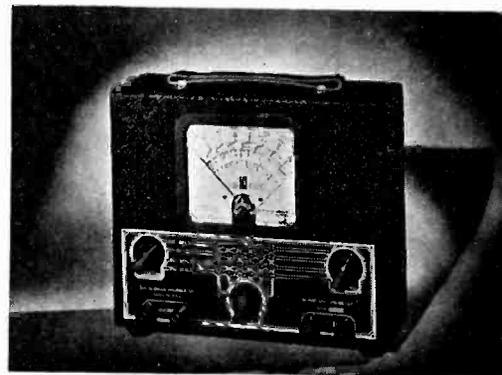
shielded cable has been developed and it is being manufactured for the Universal Microphone Co., of Inglewood, Calif.

Cathode Ray Oscillograph

A 5-IN. CATHODE RAY oscillograph, incorporating many of the best features evolved so far in the art, is announced by the Allen B. DuMont Laboratories, Inc., Upper Montclair, N. J. The usual return trace is eliminated. A removable calibrated scale permits accurate determination of voltage or current values.

Set Analyzer

THE CLOUGH-BREngle Co., 2815 West 19th St., Chicago, announce their model 120 analyzer which is especially suitable for measuring voltages in high impedance electrical circuits. The



sensitive unit is a 20,000 ohms-per-volt meter with 6 d-c ranges. The a-c resistance is as high as 7,000 ohms-per-volt and four resistance ranges are available in addition to the a-c ranges.

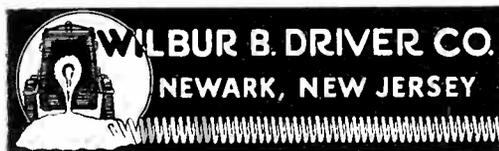
Resistors

RECENT DEVELOPMENTS announced by the International Resistance Co., 401 North Broad St., Philadelphia, include a small size wire-wound resistor, a power control having a rating up to two watts, and multi-gang metalized control.



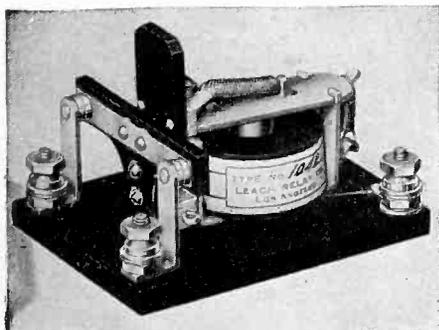
SYLVALOY

- New manganese-free silicon-nickel filament alloy.
- Minimizes chipping and flaking of oxide coating. Popular for oxide-coated tubes—particularly -80 type.
- Permits operation at lower temperature. Increases tube life.
- Just another of the radio filament materials produced by alloy specialists to meet critical requirements of tube manufacturers.



LEACH LR RELAYS

POSITIVE PROTECTION



For Your Power Tubes. These light duty overload trip relays have a wide field of use as safety devices on electronic apparatus. Operation is unusually dependable. Scores of nationally known concerns rely on Leach Relays for protection.

Leach Relay Company

5915 Avalon Boulevard,
Los Angeles, Calif.

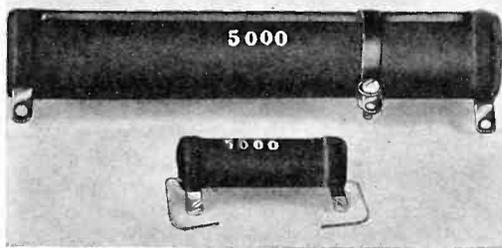
SEND
COUPON

Leach Relay Co., 5915 Avalon Boulevard, Los Angeles, Cal.
Please send me your catalog.

Name Company Address City

Power Resistors

A COMPLETE LINE of cement coated resistors in ratings from 10 watts to 100 watts has just been announced by the Micamold Radio Corp., 1087 Flush-



ing Ave., Brooklyn, N. Y. The resistance wire used has a low temperature coefficient and is hard soldered to the lugs at the ends to which electrical contact is made.

Cabinet Material

GENERAL PLASTICS, Inc., North Tonawanda, N. Y., announce a new molding material, Durez 113 black for radio cabinets. This material has a smooth luster and permits hard buffing without danger of showing filler spots.

Carbon Resistors

CARBON RESISTORS with bakelite molded jackets, providing additional protection against moisture, short circuits, and other contingencies, are now offered by Aerovox Corp., Brooklyn, N. Y.

Set Tester

A NEW set tester will complete facilities for a-c and d-c voltage, current and resistance analysis with a sensitivity of 25,000 ohms per volt for the d-c ranges is announced by the Triplet Electrical Instrument Co., Bluffton, Ohio. The instrument also includes a condenser tester, free point tester and decibel meter.

Multi-Meter

THE MODEL 541 multi-meter manufactured by the Supreme Instruments Corp., Greenwood, Miss., provides twenty ranges of resistance, voltage, or current, either a-c or d-c and uses



only one selector switch. Other recent developments of the Supreme Instruments Co. include the model 551 analyzer, 501 tube tester, model 502 tube tester, and model 529 frequency modulator.

If you haven't used the latest
PRESTO Green Seal DISC

SEND FOR A FREE SAMPLE TODAY

See for yourself the radical improvements that have been made. Note the perfect smoothness of the surface . . . the uniform cutting quality throughout the record.

New air conditioning and purifying processes have made the Presto Green Seal Disc absolutely free from grit and other hard particles which dull the cutting needle and produce surface noise. Users of Green Seal Discs now record from 20 to 30 hours with a single sapphire cutting needle.

TRY DISCLUBE

. . . the liquid hardener, sold exclusively with Presto Green Seal Discs. Disclube protects the delicate sound impressions in the record groove . . . makes it possible to play recordings 50 to 100 times without serious wear.

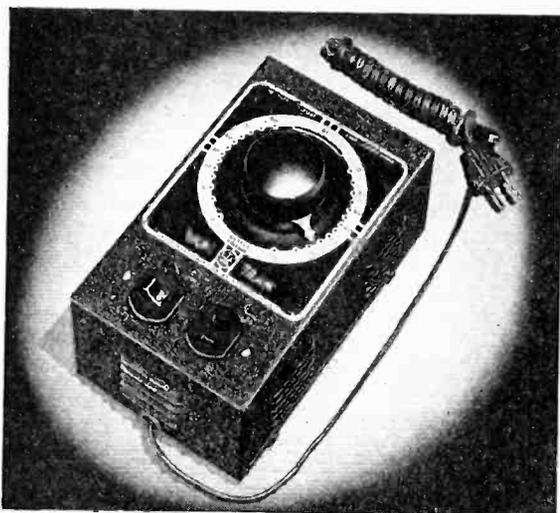
A blank Green Seal Disc and a 2 oz. bottle of Disclube will be sent without charge to any person or firm equipped to make instantaneous recordings.

PRESTO RECORDING CORPORATION

143 W. 19th St., New York, N. Y.
Export Division (Except Australia & Canada)
M. SIMONS & SON CO., INC.
25 Warren St., N. Y. Cable: Simontrice, N. Y.
Australia & New Zealand Agents & Stockists
A. M. CLUBB & CO., LTD.
76 Clarence St., Sydney, N. S. W., Australia

V A R I T R A N ★ ★

VOLTAGE CONTROL UNITS



FEATURES

- ★ Smooth control
- ★ High efficiency
- ★ Excellent regulation
- ★ Low cost

APPLICATIONS

- ★ Motor control
- ★ Heat control
- ★ Rectifier control
- ★ Light control
- ★ Line voltage control

Automatic VARITRANS are available to maintain line voltage constant. Details and prices on request.

The UTC VARITRAN makes possible continuously variable output voltage, using a sliding contact riding over the turns of an auto-transformer.

Standard units are designed for 115 volts input, 0-130 volts continuously variable output.

Model V-1. 570 Watts—5 amp. maximum rating, complete with cord, plug and switch, net. \$10.00

Model V-2. Same as V-1, but uncased, with terminal trip for rack or panel mounting, net. \$9.00

Model V-3. 850 watts maximum rating, 7.5 amps., uncased, with terminal board and provisions for mounting, net. \$14.00

Model V-4. 1250 watts, — 11 amps., maximum rating, uncased, net. \$20.00

Model V-5. 2000 watts maximum rating, 17.5 amps., uncased, net. \$32.00

Other sizes

UNITED TRANSFORMER CORP.

72 SPRING STREET

NEW YORK, N. Y.

SIGMA RELAYS

MODEL 2-A

A 12 milliwatt, D. C., semi-sensitive instrument for general electronic and industrial uses.

Controls 150 watts, noninductive load, at 115 volts, A. C., on single-pole double-throw silver contacts.

With coil resistances up to 2,000 ohms.....	List Price
With higher coil resistances.....	\$5.00
	5.50

MODEL M

Embodies Tobe Mu-Switch. Input, 50 milliwatts, D. C., Controls 1 kilowatt, noninductive load, at 115 volts, A. C., on single-pole double-throw contacts.

With coil resistances up to 2,000 ohms.....	List Price
With higher resistances.....	\$7.00
	7.50

Both models are mounted on 5-prong base to plug into standard tube socket.

SIGMA INSTRUMENTS, INC.

388 TRAPELO ROAD

BELMONT, MASS.



One pair of New Series "1K" Cannon Cable Connectors (up to 37 poles) for airplane, Radio and Signal equipment.

CANNON builds over 600 plugs for sound and airplane service!

★ Write or Wire for Catalog ★

CANNON ELECTRIC DEVELOPMENT CO.

- ★ 420 West Avenue 33, Los Angeles, California
- ★ EASTERN SALES OFFICE, 220 Fifth Ave., New York, N.Y.

CANNON PLUGS



Sound System

A MOBILE sound system operating from either 6 volts d-c or 110 volts a-c, equipped with four speaker receptacles with changeover switch to match speaker load to amplifier has been announced by the Webster Electric Co., of Racine, Wis. Other recent announcements of this company include a pre-amplifier mixer, carrying cases for portable amplifiers and speakers, and another completely portable sound system.



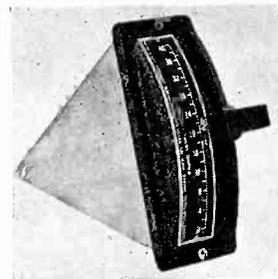
nounced by the Webster Electric Co., of Racine, Wis. Other recent announcements of this company include a pre-amplifier mixer, carrying cases for portable amplifiers and speakers, and another completely portable sound system.

Rectifier Tube

THE CONTINENTAL ELECTRIC Co., of Geneva, Ill., announce their new mercury vapor rectifier tube, type 2-RA-15. This tube has a filament voltage of 2½ volts, a current consumption of 16 amperes with an average d-c. output of 15 amperes. It is designed for low-voltage applications such as projectors and arc welders.

Attenuator

A "VERTICAL" MIXER attenuation operating by means of a vertical rather than rotary motion is announced by the Tech Laboratories, 703 Newark Ave., Jersey City, N. J. Easier operation, better control and maintenance are some of the advantages claimed for the new mixer attenuator which is available in impedance values from 30 to 500 volts.



ation, better control and maintenance are some of the advantages claimed for the new mixer attenuator which is available in impedance values from 30 to 500 volts.

Band Pass Filter

A BAND PASS FILTER which is intended for aircraft reception and will enable the pilot to listen exclusively to one or the other of two stations is being introduced by the Western Electric Co., 195 Broadway, New York, for use with existing airplane radio receivers.

Vacuum Tube Switch

FOR USE in radio transmitters and other vacuum tube circuits the mark-time vacuum tube switches in which



a plate circuit is closed a predetermined time after the filament circuit has been closed, is available from M. H. Rhodes, Inc., Rockefeller Center, New York City.

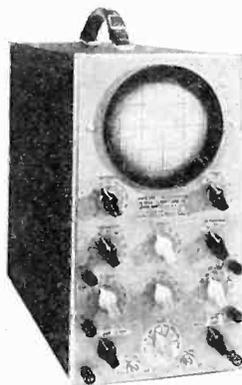
Direction Finding Loop

A NEW AND SIMPLE type of shielded loop which can be located for direction finding service is being introduced in the aviation field by the Western Electric Co. Although designed primarily for use with the Western Electric 14 and 20 type receivers, it is suitable for other types of sets.

I-F Transformers

AN INTERMEDIATE FREQUENCY transformer having a broad flat top response about 8 kc. wide, three tuning condensers adjustable from the top of the shield can is announced by Aladdin Radio Industries, Inc., 466 West Superior St., Chicago.

NEW...



TYPE 168

DU MONT TYPE 168 5-INCH ALL-PURPOSE OSCILLOGRAPH

This latest Oscillograph truly represents Du Mont's long experience in oscillograph design. All controls including horizontal and vertical positioning controls are on the front panel. Two stages of amplification are available on the vertical plates with switching such that the vertical plates may be used direct with one or two stages. The gain with a single stage is 70 and with two is 450. Terminals are provided at the rear of the unit

for direct connection to the deflection plates of the Du Mont type 54-XH five inch cathode ray tube which incorporates the features of a hair line trace, high intensity and long life. The two power supplies of 400 volts to the sweep and 1100 volts to the cathode ray tube eliminate all interaction of controls. A high gain sweep expanding amplifier allows observation of waves of much higher frequency than the fundamental frequency of the sweep.

For complete details on this modern flexible Oscillograph, write

ALLEN B. DU MONT LABORATORIES, INC.
UPPER MONTCLAIR NEW JERSEY

TERMINAL *does it* BETTER

THER radio suppliers handle quality lines . . . quote prices which are competitive . . . carry comprehensive stocks.

Why then, has TERMINAL become THE source of supply for hundreds of radio engineers — dozens of broadcast stations? The answer is simple — TERMINAL DOES IT BETTER.

The swift, reliable service — WHEN YOU NEED IT, the friendly, cooperative spirit which prevails, the RIGHT prices, the complete stocks — all add up to BETTER SERVICE AT TERMINAL. Every item guaranteed — and backed with a liberal adjustment policy.

Make TERMINAL
your first and last stop

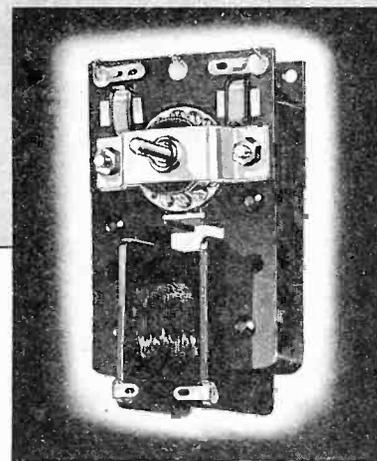
Authorized RCA distributor

Did you get your copy of the latest Terminal Radio Catalog? Copy gladly mailed on request.

TERMINAL RADIO CORP.

80 CORTLANDT STREET N. Y. C.
BILL FILLER • ADOLPH GROSS

A MINIATURE
REVERSIBLE
Coverplant



WE Wish to Announce to Radio and Design Engineers that we have developed a reversible motor that will meet your most exacting specifications.

Designed in accordance with Underwriters' requirements, this motor incorporates features found in no other motor of its type.

Reversal is easily accomplished by a simple control switch in a low power circuit.

Long and trouble-free life is assured by use of perfectly straight shafts, centerless ground to production tolerances of .00025 inch, journaled in graphited bronze bearings surrounded by a large oil reservoir.

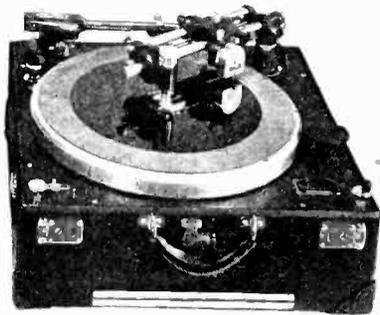
Both unidirectional and reversible styles are immediately available from stock.

Quotations on motors in quantity lots will be made on inquiry to

THE ALLIANCE MFG. CO.

ALLIANCE, OHIO

SOUND RECORDING EQUIPMENT



Designed, engineered and manufactured with laboratory precision by men with long recording experience who understand recording problems—these instruments will meet the most exacting professional requirements—yet they are priced within the range of every potential user.

Sturdy in construction—simple in operation—with many NEW and EXCLUSIVE mechanical and electrical features.

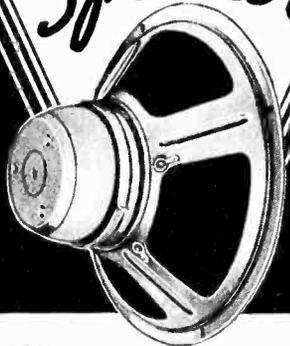
We invite you to consult us freely concerning your recording problems. Write for photos, including complete descriptive literature, data and prices.

Also manufacturers of the famous ALLIED blanks for instantaneous recording. Literature and price list sent upon request.

Allied Recording Products Co.
126 West 46th St., New York, N. Y.
Cable Address: Allrecord

CINAUDAGRAPH

Speaker



CINAUDAGRAPH Magic Magnet Speakers

—extensively utilized by all leading radio receiver and P. A. equipment manufacturers—are available in a complete range of sizes from 5½ to 18 inches, to meet your every radio requirement.

If you demand utmost dependability and fidelity of reproduction from your equipment—in-sist on Cinaudagraph P. M. speakers. Carried in stock by all progressive distributors. Free descriptive literature on request.

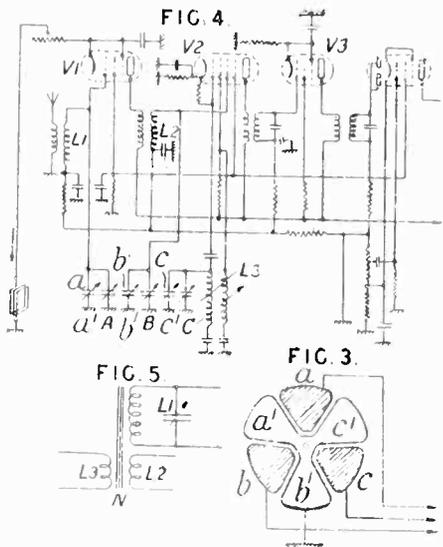


CINAUDAGRAPH CORPORATION
Speaker Division • Stamford, Conn.

British Patents

Radio Circuits

Automatic tuning. A manually tuned receiver is provided with supplementary automatic devices actuated by a fall of anode current when resonance

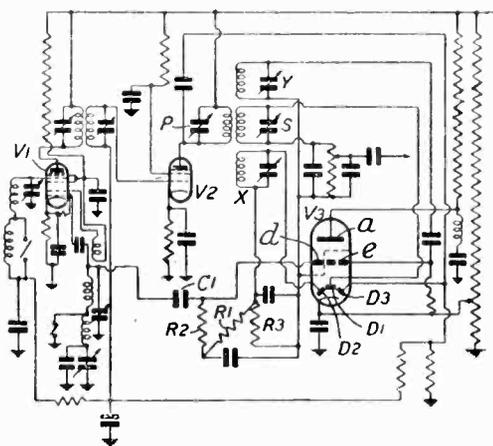


is approached, giving final accuracy of tuning. British Thomson-Houston Co. No. 459,658.

Automatic tuning. The tuned circuits of an error detector are energized from the screen-grid circuit of an i-f amplifier, whereby drifting of the natural frequency of the two circuits is compensated. E. K. Cole, 461,443.

Selectivity control. Selectivity is controlled by a switch opened or closed in dependence on received signal intensity. Resistances are used to dampen circuits and to increase the band width and are thrown into or out of operation by means of an automatically controlled relay. E. K. Cole. No. 461,910.

Automatic tuning is effected by an error detector comprising circuits tuned above and below the true I.F.,



these circuits being coupled or connected with separate grid electrodes of a tube arranged in parallel electron streams, whereby varying bias on the grid controls their d-c potential. No. 460,055. E. K. Cole.

PROFESSIONAL SERVICES

Rates on Application

BLILEY ELECTRIC CO.

Designers—Manufacturers

Quartz Crystals for standard or special radio frequency applications.

Inquiries Invited.

200 Union Station Bldg.
Erie, Penna.

CHARLES EISLER

EISLER ENGINEERING CO.

Consulting and Designing Engineer

Electric Welding Machines for Metal Tubes

Electric Welding Problems, High Vacuum

Compound Pumps, Soft and Hard

Glass Working Equipment, Radio and

Electronic Tube Machinery

753 So. 13th St.

Newark, N. J.

ELECTRICAL TESTING LABORATORIES

Characteristics and

Life Tests of Vacuum Tubes

Tests of photo cells, glow lamps, crater lamps.

Tests of electronic and optical devices.

30th Street and East End Avenue

New York, N. Y.

Phone: Butterfield 8-2600

THAD. R. GOLDSBOROUGH

REGISTERED PATENT ATTORNEY

Patent and Trademark Soliciting

Consulting Service

Patent Sale and License Negotiations

201-205 McLachlen Building

Washington, D. C.

INTERNATIONAL ELECTRONICS, INC.

AMERICAN CONSULTING ENGINEERS TO FOREIGN MANUFACTURERS

Designs Specifications

Electrolytics Tubes Resistors

Transmitters Receivers

145 W. 45th Street

New York, N. Y.

The Solution of Your Problem

in the field of Electronic devices may be found through enlisting the services of the Consultants whose cards appear on this page.

This is a highly specialized field and specialists are therefore better able to undertake the rapid developments necessary to keep in step with modern manufacturing progress.

Tube construction. A frequency-changer having four grids. The capacity of the oscillation control grid to the r-f injection grid is less than the capacity of the second or reaction grid to the r-f injection grid, so that the latter grid is at a node of potential relative to the potentials on the other two grids, and the oscillating circuit is not coupled with the r-f circuit. The fourth grid may be used for AVC and a fifth grid as a positive screening grid. J. H. O. Harries, 461,282, and No. 461,310.

Selectivity control. The signal amplitude of a radio receiver is maintained constant from a certain point of the receiver onward, the selectivity being controlled from that or a subsequent point in dependence on the strength of undesired signals at the point from which the control voltage is derived. Murphy Radio, Ltd. 462,832.

Impedance networks. Two patents to Hazeltine Corp., Nos. 462,873 and 462,874 on wide-range band-pass filters comprising several constant-k derived filters each passing a separate frequency band, etc.

Tube sockets. Radio receiver comprises several similar tube sockets each accommodating a base having at least seven pins, wherein some of the pins of some of the tubes are dummies. The invention facilitates tube servicing and cheapens production by arranging a so-called "universal" tube. E. K. Cole, 462,991.

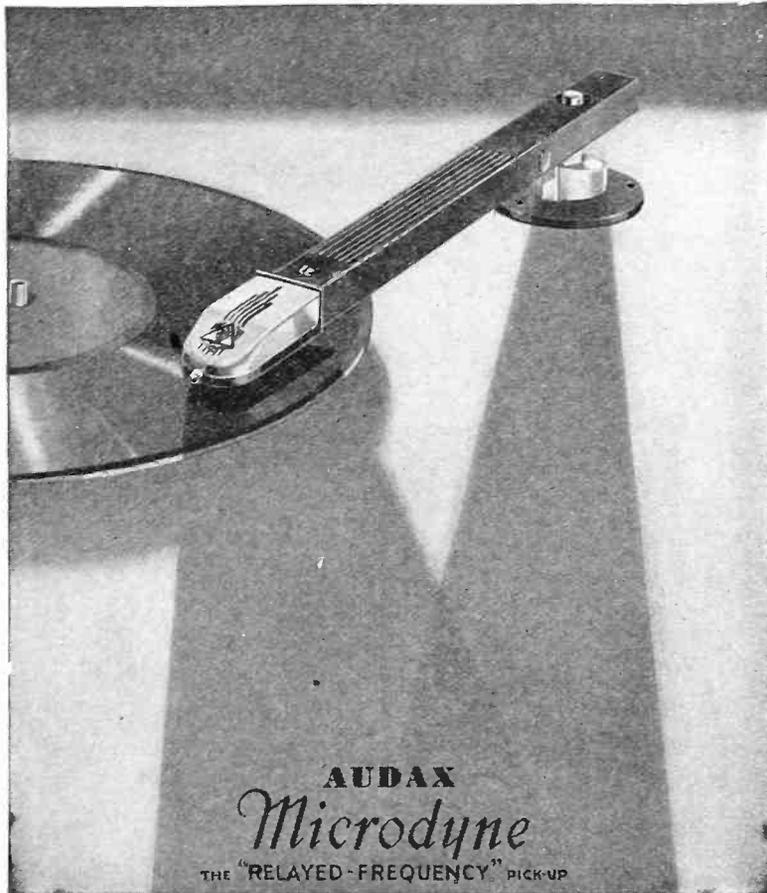
Tuning system. A tunable image-frequency rejector circuit is gang-controlled with the input and local-oscillator circuits. Marconi Co. No. 463,070.

Feed-back circuit. In a high-frequency amplifier or oscillator a band-pass input circuit is provided and energy is fed back from the output of the amplifier to the band-pass input. The band-pass circuit is provided with a series resistance in the second oscillatory circuit from which the amplifier or oscillator is fed in such a manner that a 90-deg. phase shift is produced in the feed-back circuit. Marconi Co. No. 463,233.

Noise limiter. Interference is prevented by means which render a signal path inoperative and include an auxiliary amplifier and rectifier operative by voltages exceeding predetermined limits. A. N. Mann. No. 463,903.

Noise limiter. In a voice-frequency signal receiver employing a current limiting tube and having means for disabling the receiving tube upon receipt of a selected sub-multiple of the signalling frequency, the tuned circuits fed by the limiting tube are all coupled through rectifiers to the grid circuit of the receiving tube. Siemens Bros. & Co. No. 462,862.

Automatic tuning. An error detector supplies a pair of saturable-core



"The Standard by Which Others

Are Judged and Valued"

MICRODYNE literally saved the day for many radio stations this Summer when, because of climbing temperature and sticky atmosphere, ordinary pick-up equipment failed. You can always depend upon MICRODYNE for genuine *facsimile* realism and wide-range consistency . . . the most significant wide-range development, in fact, since the advent of pick-ups in 1926.

A pick-up for every need from the humblest midget to the most exacting transcription demands. Each AUDAX model delivers wider range, truer fidelity and greater stability than you can get elsewhere at the price.

\$9.50 to \$350.00 list

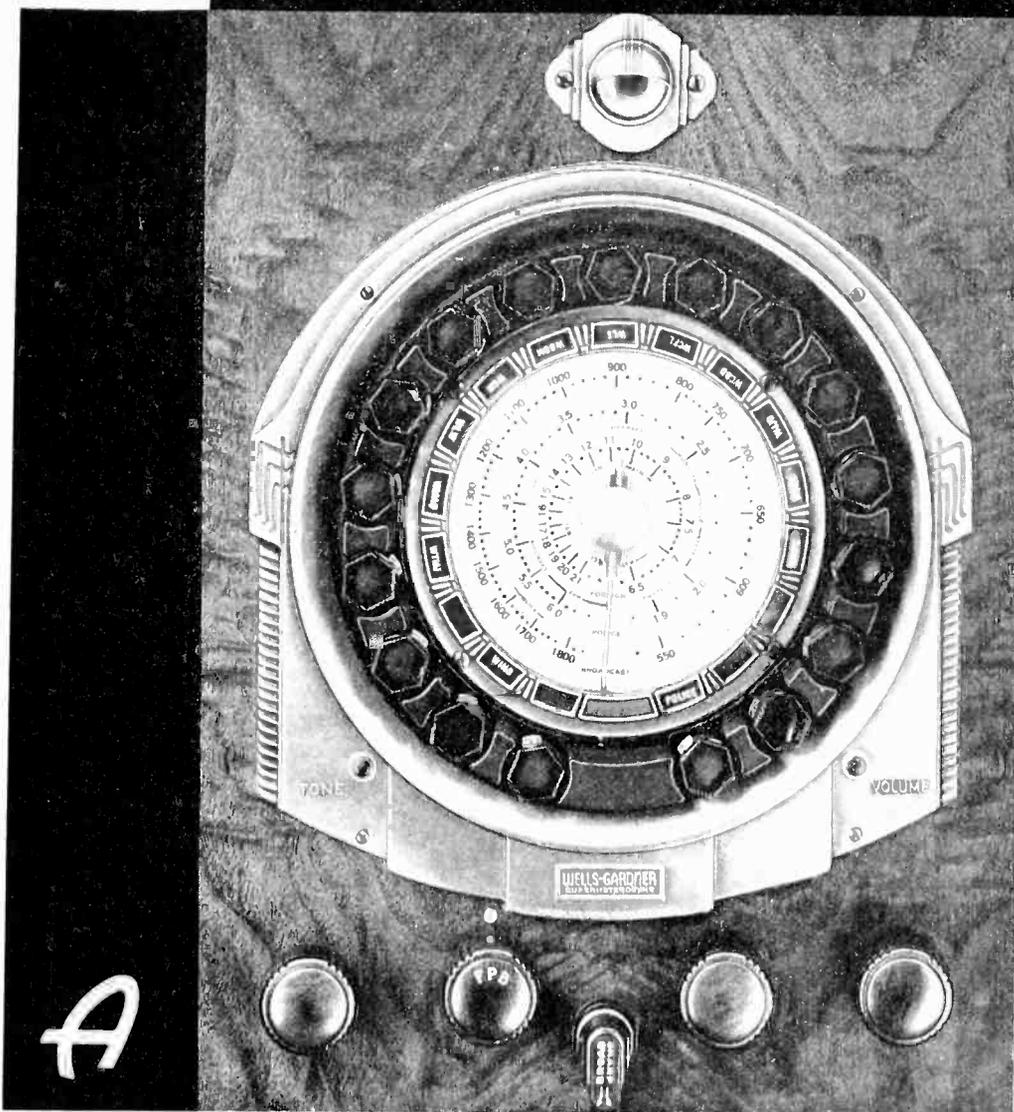
THE NEW AUDAX PRO 10-A CUTTER FOR PROFESSIONAL RESULTS IN FINE INSTANTANEOUS RECORDING

Write for copy of "PICK-UP FACTS"

AUDAX COMPANY
500 Fifth Avenue **New York City**

"Creators of High Grade Electrical and Acoustical Apparatus Since 1915"

For their new Telephone Dial receiver, Wells-Gardner commissioned American Emblem Co. to design and fabricate this unusual Escutcheon, the Bronze Dial Ring and Housing for the flashing "Eye."



Fitting Frame for YOUR "MASTERPIECE"

Regardless of the smart cabinets your designer turns out and the selected woods that go into their construction, the choice of escutcheons is of definite importance to the final effect. Properly designed and carefully fabricated, they provide the finishing touch that makes for appreciated beauty. They should be in harmonious accord with the designer's ideas and serve as an unobtrusive frame for the focal point of interest—the dial. Because our mass production facilities enable us to turn out quality work at attractive prices, you will find that many of the leading names in radio order escutcheons made by American Emblem. For complete data write today for booklet "AE".

We extend you a cordial invitation to visit our showroom at: 500 Fifth Ave., New York, which is under the direction of our president, Mr. George B. Ogden.

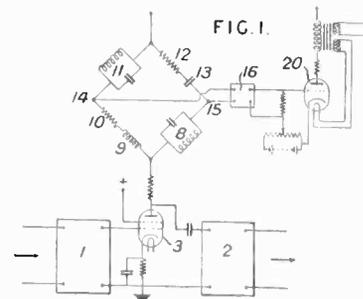
In Chicago, Mr. J. D. "Jack" Lindsay, a well known figure in the radio industry, is in charge of our office at 540 N. Michigan Boulevard, Room 323.

AMERICAN EMBLEM COMPANY, INC.
BOX 116L, UTICA, NEW YORK
Offices in Principal Cities

reactors which control the direction of rotation of an electric motor driving the tuning control devices. British Thomson-Houston Co. No. 461,228.

Multi-range receiver means interlocked with wave-range switch for changing the sensitivity and/or the AVC characteristics and/or the fidelity curve in different positions of the switch. Marconi Co. 462,323.

Automatic tuning. The tuning-indicator is operated by the output from one diagonal of a reactance bridge, the other diagonal of which is fed from a carrier frequency stage of the receiver, the bridge being in balance



when the received frequency band is coincident with the predetermined pass band of the appropriate amplifier while any departure from tune causes the bridge to be unbalanced. Marconi Co. No. 462,328.

Automatic tuning. A radio-receiver is held in tune with a desired signal by a control current derived from the signal circuit by means of a low-frequency amplifying tube which acts to disable the tuning knob and automatically resumes its normal function when the receiver is in tune. E. K. Cole. No. 462,475.

DC amplifier. A two-stage circuit, the coupling between the stages being so related to the mutual conductance of the second stage, that the ac component of the anode current of the second stage, is always opposite in phase and substantially equal in magnitude to the ac component of the anode current of the first stage, so that the signals are prevented from reaching the supply circuit. G. E. Co. 462,564.

Wave-Guide. This patent relates to the transmission of high-frequency waves over a wave-guide of dielectric material (including air bounded by a conducting sheath) and comprises improved means for coupling the terminal apparatus to the guide, means for producing transverse electric waves in the dielectric, and the use of a crystalline dielectric. Standard Telephones & Cables. No. 462,804.

Scanning system. The framing saw-tooth oscillation is combined with a square-topped wave to produce an oscillation which produces intercalated scanning or the square-topped wave may be replaced by a saw-tooth wave, the line and frame oscillators being then interlocked. Farnsworth. No. 459,400.

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:
10 cents a word, minimum charge \$2.00.
Position Wanted, (full or part-time salaried employment only). ½ the above rates, payable in advance.
Proposals, 40 cents a line an insertion.

INFORMATION:
Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads. Replies forwarded without extra charge.
Discount of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals)

DISPLAYED—RATE PER INCH
1 inch\$6.00
2 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch
An advertising inch is measured vertically on one column. 3 columns—30 inches—to a page. *Contract rates on request.*

(Copy for new advertisements must be received by the 29th of the month to appear in the issue out the following month)

POSITIONS WANTED

TECHNICIAN: Now permanently employed CBS basic in eastern state desires change for better. Married, 27, Christian, go anywhere on reasonable notice. 8 year radio background. Radiotelephone and Radiotelegraph First. Copy Transradio, design, and construction. All round radio man used to responsibility. Prefer network affiliate. References. PW-119, Electronics, 330 West 42nd Street, New York City.

CHIEF ENGINEER 500 watt broadcast station desires change. Airways preferred. Education, three years university, seven years broadcast engineering experience, both telephone and telegraph licenses. PW-120, Electronics, 520 No. Michigan Ave., Chicago, Ill.

ELECTRICAL ENGINEERING GRADUATE. B.S.E.E. degree, University of Arkansas. licensed radiotelephone operator, first class. Year experience as operator station KUOA. draftsman for University of Arkansas, and receiver servicing. Five years' short-wave transmitter construction and operation. References. Desires any position with chance for advancement. Jack W. Davis, Box 453, Fayetteville, Arkansas.

REPAIRING

METER REPAIR. Accurate and dependable service. Standard types of meters repaired in 24 hours. Repairs priced so that anyone can afford them. Write for price quotations. Braden Engineering Co., 305 Park Dr., Dayton, Ohio.

WANTED

ANYTHING within reason that is wanted in the field served by Electronics can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

Sound Equipment Manufacturer

Well located, good factory equipment, with excellent expansion possibilities, due to present owners other active interests desires active manager with \$5,000 to \$10,000 investment. Part or entire interest may be bought. PRINCIPALS ONLY.

BO-118, ELECTRONICS,
330 West 42nd St., New York City.

PRACTICAL HOME STUDY COURSE FOR RADIO AND COMMUNICATION ENGINEERS

Primarily for men who have completed High School or equivalent education and wish to grow with their profession. Consists of over 50 lessons in book form, each with exercises, exercise answers, and examinations to be graded. Course covers elementary mathematics necessary to handle alternating current circuit theory, a general treatment of bilateral networks and of unilateral networks. Very reasonable—payable monthly. Write for the information booklet.

CARL E. SMITH
Radio Sta. WHK Cleve., Ohio

REBUILT INSTRUMENTS of GUARANTEED ACCURACY

We Believe
No Instrument is BETTER than its
CALIBRATION

Therefore

We maintain a STANDARDS laboratory, where every instrument is checked before shipment, and guaranteed to be accurate within the original makers specifications.

New Bulletin Now Ready

LOUIS J. WINSLOW

200 Pennsylvania Ave., Hillside, N. J.

VACUUM TUBE EQUIPMENT

Formerly Production Units of
JOHNSONBURG RADIO CORPORATION

Including:

Power Transformers
Motor Generator Units
Hydrogen Furnaces
Filament Coating Units
Hofmann Exhaust Units
Lepel Bombarders
Weston & Rawson Meters
Biddle Slide Wire Rheostats
International & Eisler Pumps
York Soldering Machine
York Base Brander

PRICES ON INQUIRY

A. E. LYLE, Box 567, Newark, N. J.

DEPENDABLE

New and Used

ELECTRONIC TUBE EQUIPMENT

A complete line of equipment for the manufacture of Radio Tubes, Neon Tubes, Incandescent Lamps, etc.

Write for Bulletin showing savings from 25 to 75%

EISLER ELECTRIC CORP.
534 39th Street, Union City, N. J.

HIGH GRADE NEW AND USED ELECTRON TUBE EQUIPMENT

*Huge Stock of Equipment of
Every Type and Variety*

KAHLE ENGINEERING CORPORATION
Specialists in Equipment and Methods for the
Manufacture of Neon Tubes, Radio Tubes, Incandescent Lamps, Photo Cells, X-ray Tubes, etc.
941 DeMott St., North Bergen, N. J.

MAGNET WIRE

All Insulations
BRAIDS AND CABLES—RUBBER COVERED
WIRE—LAMP AND HEATER CORDS.

JOB LOTS OUR SPECIALTY
WIRE MACHINERY

B. D. LAND
37 GRAND ST., NEW YORK CITY
Walker 5-4687

ELECTRONIC TUBE

NEW • EQUIPMENT • USED

For the manufacture of Electronic, X-Ray, Power, and Radio Tubes, Incandescent Lamps, Neon Signs, etc.

Write for full information
ELECTRONICS MACHINE CO.
751 13th Street, Newark, N. J.

REPAIRING AND FOR SALE

REAL THRIFT

Our reconditioned 49 and 04A type tubes, have lasting qualities that make them an outstanding value. Save half on your replacement cost.

49 type—\$75 04A type—\$45

Our work fully Guaranteed.

We solicit a trial order.

National Radio Tube Co., Inc.

3420 18th St. San Francisco, Calif.

Meters repaired, made more serviceable. Conversion to higher sensitivity as high as 10 microamperes for Weston type 1 or 24-57.
Sensitive vacuum thermo couples
For Sale used Weston panel meters
Rawson microammeters, Brown pyrometers.

Reasonable Prices
Precision Electrical Instrument Co.
561 Broadway, N. Y. C.

Meters Repaired, Tested, Rebuilt
Specialists on all makes and types
Designers and Manufacturers of
Special Equipment and Devices
Used Meters Bought, Sold, Exchanged
Correspondence invited

ASSOCIATED RESEARCH, INCORPORATED

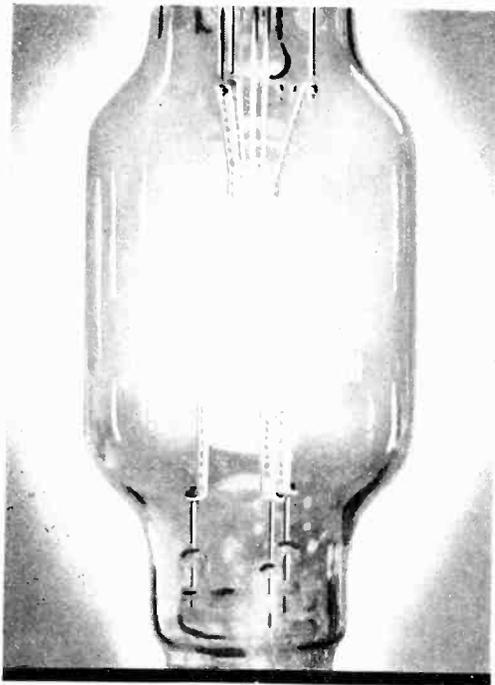
16 N. May Street, Chicago, Illinois

WANTED

CASH WAITING

We pay highest prices for your surplus laboratory equipment as meters, rheostats, bridges, decade boxes, etc. Submit your lists of what you have to offer.

AMERICAN ELECTRICAL SALES CO.
65-67 E. 8th St. New York, N. Y.



**Two Air Cooled Tubes
Working Manila
with 10,000 Watts
at 14,860 Kilocycles
Impossible?
Not with Tantalum!**

Enviably performance records are being made by the new Type 3054 GAMMATRON, manufactured by Heintz & Kaufman, Ltd. A pair of these tubes is in continuous 24-hour-a-day service, transmitting from San Francisco to Manila, operating at 14,860 kc. the greater part of the time, delivering 10 kilowatts of radio frequency energy to the transmission line. The normal plate dissipation of one tube is 1500 watts.

Tantalum plates and grids are used in this as in other Gammatrons. Tantalum has the effect of a continuous vacuum pump, absorbing and holding stray gases, maintaining the high vacuum necessary for high frequency performance. Another great advantage of tantalum is that plates and grids can be reclaimed from burnt-out tubes and used repeatedly.

The services of the Fansteel technical staff are available to interested tube manufacturers.

ELECTRICAL CONTACTS of tungsten, molybdenum, platinum, silver and alloys, designed and made by Fansteel, afford extra dependability in relays and other electronic operated devices.

FANSTEEL
METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS

TANTALUM	COLUMBIUM
TUNGSTEN	MOLYBDENUM
ELECTRICAL CONTACTS	

INDEX TO ADVERTISERS

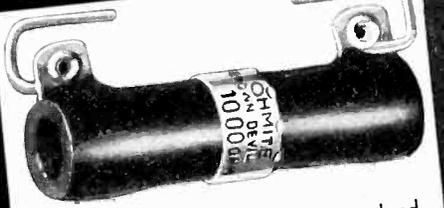
Acheson Colloids Corp.	38
Aerovox Corporation	62
Alliance Manufacturing Co.	67
Allied Recording Products Co.	68
American Automatic Electric Co.	52
American Emblem Co.	70
American Transformer Co.	34
Ariston Manufacturing Corp.	50
Astatic Microphone Laboratory, Inc.	64
Audak Company	69
Bakelite Corporation	45
Biddle Co., James G.	48
Brand & Co., William	52
Callite Products Division	61
Cannon Electric Development Co.	66
Centralab Div. Globe-Union Co.	49
Cinadagraph Corp.	68
Cinch Manufacturing Co.	53
Clarostat Mfg. Co.	64
Collins Radio Co.	61
Cornell Dubilier Corp.	57
Driver Co., Wilbur B.	65
Du Mont Laboratories, Inc., Allen B.	67
Dunn, Inc., Struthers	36
Eric Resistor Corporation	5
Fansteel Metallurgical Corp.	72
Ferranti Electric, Inc.	3
General Ceramics Co.	4
General Controls	62
General Radio Co. Inside Back Cover	
Goat Radio Tube Parts, Inc.	36
Guardian Electric	56
Hardwick-Hindle, Inc.	42
Heintz & Kaufman, Ltd.	63
International Resistance Co.	31
Isolantite, Inc.	2
Jensen Radio Mfg. Co.	47
Jones, Howard	62
King Laboratories, Inc.	50
Leach Relay Co.	65
Littelfuse Laboratories, Inc.	54
Mallory & Co., P. R.	6
McGraw-Hill Book Co.	61
Ohmite Manufacturing Co.	54
Parker Kalon Corp.	39
Pioneer Gen-E-Motor Corp.	48
Precision Inductance Co.	56
Precision Resistor Co.	50
Presto Recording Corp.	65
RCA Communications, Inc.	56
RCA Manufacturing Co. Back Cover	
Remler Co., Ltd.	46
Shure Brothers	42
Sigma Instruments, Inc.	66
Simpson Electric Co.	63
Solar Mfg. Co. Inside Front Cover	
Standard Transformer Corp.	40
Superior Tube Co.	55
Televiso Company	54
Terminal Radio Corporation	67
Triplett Electrical Instrument Co.	48
United Electronics, Inc.	43
United Sound Engineering Co.	63
United Transformer Corp.	66
Universal Signal Appliances	70
Utah Radio Products Co.	33
Ward Leonard Electric Co.	46
Western Electric Company	41
Weston Electrical Instrument Corp.	37
White Dental Mfg. Co., S. S.	35
Zophar Mills	52
Professional Services	68

SEARCHLIGHT SECTION
Classified Advertising

EMPLOYMENT	71
HOME STUDY COURSE	71
WANTED TO PURCHASE	71
EQUIPMENT FOR SALE	
American Electrical Sales Co.	71
Associated Research, Inc.	71
Eisler Electric Corp.	71
Electronics Machine Co.	71
Kahle Engineering Corp.	71
Land, B. D.	71
Lyle, A. E.	71
National Radio Tube Co., Inc.	71
Precision Electrical Instrument Co.	71
Winslow, Louis J.	71



The wire-wound resistor is only an inch and three-fourths long by a quarter of an inch in diameter. It can be used in any application where a resistor up to one watt rating is called for. It is small enough to be used in practically any radio circuit and for that reason enjoys wide popularity in that use.



The "Brown Devil" is the standard radio replacement resistor. Available in 10 and 20 watt sizes and in a large number of resistance values. A wire-wound, vitreous enameled resistor of the very finest construction.



These solenoid chokes have been engineered so as to avoid either fundamental or harmonic resonance in the amateur bands. In four sizes to cover the six main amateur bands. For more complete details write for Bulletin 106.

SEND FOR YOUR FREE COPY OF THE NEW OHMITE CATALOG DESCRIBING THE COMPLETE LINE OF OHMITE RHEOSTATS, RESISTORS AND TAP SWITCHES.

OHMITE
MANUFACTURING COMPANY
4825 W. FLOURNOY ST.
CHICAGO, U.S.A.



Direct Reading in **Power Factor and Capacitance**

NOW you can measure directly the two most important characteristics of *any* condenser . . . its power factor and its capacitance.

The new G-R Type 716-A Capacitance Bridge has a direct reading range of 100 μpf to 1 μf for capacitance and 0.002% to 6% for power factor at 1,000 cycles.

When used in substitution methods the direct reading con-

trols greatly simplify the balancings and the necessary calculations, and increase both power factor and capacitance ranges.

This bridge is invaluable for capacitance and power factor measurements on: air condensers . . . paper condensers . . . mica condensers . . . ceramic and all other types of insulation . . . cables . . . slabs of solid dielectric . . . liquids in cells . . . ground capacitances in generators, motors,

transformers and other electrical devices.

The bridge is self-contained and can be used at other frequencies between 60 cycles and 10,000 cycles.

**Type 716-A Capacitance Bridge,
Relay Rack Model . . . \$335.00**

**Type 716-A Capacitance Bridge,
Cabinet Model \$360.00**

• Write for Bulletin 167-E.

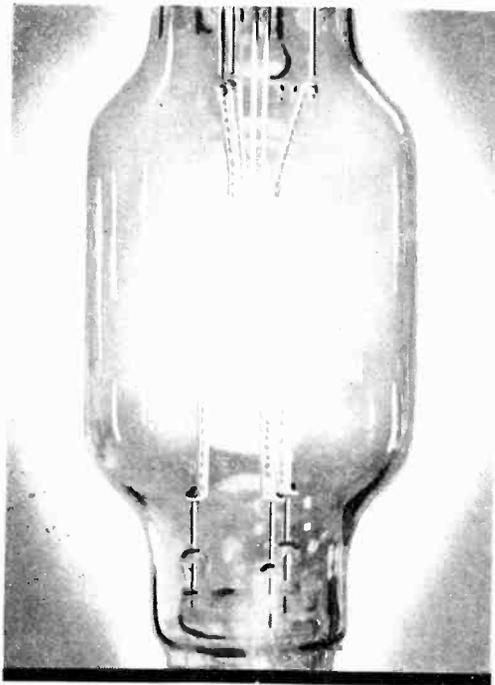
GENERAL RADIO COMPANY

Cambridge, Massachusetts

BRANCHES: New York Los Angeles San Francisco

MANUFACTURERS OF RADIO AND ELECTRICAL LABORATORY APPARATUS

ELECTRONICS — *September 1937*



**Two Air Cooled Tubes
Working Manila
with 10,000 Watts
at 14,860 Kilocycles
Impossible?
Not with Tantalum!**

Enviably performance records are being made by the new Type 3051 GAMMATRON, manufactured by Heintz & Kaufman, Ltd. A pair of these tubes is in continuous 24-hour-a-day service, transmitting from San Francisco to Manila, operating at 14,860 kc. the greater part of the time, delivering 10 kilowatts of radio frequency energy to the transmission line. The normal plate dissipation of one tube is 1500 watts.

Tantalum plates and grids are used in this as in other Gammatrons. Tantalum has the effect of a continuous vacuum pump, absorbing and holding stray gases, maintaining the high vacuum necessary for high frequency performance. Another great advantage of tantalum is that plates and grids can be reclaimed from burnt-out tubes and used repeatedly.

The services of the Fansteel technical staff are available to interested tube manufacturers.

ELECTRICAL CONTACTS of tungsten, molybdenum, platinum, silver and alloys, designed and made by Fansteel, afford extra dependability in relays and other electronic operated devices.

FANSTEEL
METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS

TANTALUM	COLUMBIUM
TUNGSTEN	MOLYBDENUM
ELECTRICAL CONTACTS	

INDEX TO ADVERTISERS

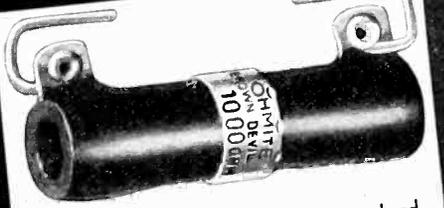
Acheson Colloids Corp.	38
Aerovox Corporation	62
Alliance Manufacturing Co.	67
Allied Recording Products Co.	68
American Automatic Electric Co.	52
American Emblem Co.	70
American Transformer Co.	34
Ariston Manufacturing Corp.	50
Astatic Microphone Laboratory, Inc.	64
Audak Company	69
Bakelite Corporation	45
Biddle Co., James G.	48
Brand & Co., William	52
Callite Products Division	61
Cannon Electric Development Co.	66
Centralab Div. Globe-Union Co.	49
Cinematograph Corp.	68
Cinch Manufacturing Co.	53
Clarostat Mfg. Co.	64
Collins Radio Co.	61
Cornell Dubilier Corp.	57
Driver Co., Wilbur B.	65
Du Mont Laboratories, Inc., Allen B.	67
Dunn, Inc., Struthers	36
Erie Resistor Corporation	5
Fansteel Metallurgical Corp.	72
Ferranti Electric, Inc.	3
General Ceramics Co.	4
General Controls	62
General Radio Co. Inside Back Cover	
Goat Radio Tube Parts, Inc.	36
Guardian Electric	56
Hardwick-Hindle, Inc.	42
Heintz & Kaufman, Ltd.	63
International Resistance Co.	31
Isolantite, Inc.	2
Jensen Radio Mfg. Co.	47
Jones, Howard	62
King Laboratories, Inc.	50
Leach Relay Co.	65
Littelfuse Laboratories, Inc.	54
Mallory & Co., P. R.	6
McGraw-Hill Book Co.	61
Ohmite Manufacturing Co.	54
Parker Kalon Corp.	39
Pioneer Gen-E-Motor Corp.	48
Precision Inductance Co.	56
Precision Resistor Co.	50
Presto Recording Corp.	65
RCA Communications, Inc.	56
RCA Manufacturing Co. Back Cover	
Remler Co., Ltd.	46
Shure Brothers	42
Sigma Instruments, Inc.	66
Simpson Electric Co.	63
Solar Mfg. Co. Inside Front Cover	
Standard Transformer Corp.	40
Superior Tube Co.	55
Televiso Company	54
Terminal Radio Corporation	67
Triplett Electrical Instrument Co.	48
United Electronics, Inc.	43
United Sound Engineering Co.	63
United Transformer Corp.	66
Universal Signal Appliances	70
Utah Radio Products Co.	33
Ward Leonard Electric Co.	46
Western Electric Company	41
Weston Electrical Instrument Corp.	37
White Dental Mfg. Co., S. S.	35
Zophar Mills	52
Professional Services	68

SEARCHLIGHT SECTION
Classified Advertising

EMPLOYMENT	71
HOME STUDY COURSE	71
WANTED TO PURCHASE	71
EQUIPMENT FOR SALE	
American Electrical Sales Co.	71
Associated Research, Inc.	71
Eisler Electric Corp.	71
Electronics Machine Co.	71
Kahle Engineering Corp.	71
Land, B. D.	71
Lyle, A. E.	71
National Radio Tube Co., Inc.	71
Precision Electrical Instrument Co.	71
Winslow, Louis J.	71



The wire-wound resistor is only an inch and three-fourths long by a quarter of an inch in diameter. It can be used in any application where a resistor up to one watt rating is called for. It is small enough to be used in practically any radio circuit and for that reason enjoys wide popularity in that use.



The "Brown Devil" is the standard radio replacement resistor. Available in 10 and 20 watt sizes and in a large number of resistance values. A wire-wound, vitreous enameled resistor of the very finest construction.



These solenoid chokes have been engineered so as to avoid either fundamental or harmonic resonance in the amateur bands. In four sizes to cover the six main amateur bands. For more complete details write for Bulletin 106.

SEND FOR YOUR FREE COPY OF THE NEW OHMITE CATALOG DESCRIBING THE COMPLETE LINE OF OHMITE RHEOSTATS, RESISTORS AND TAP SWITCHES.

OHMITE
MANUFACTURING COMPANY
4825 W. FLOURNOY ST.
CHICAGO, U.S.A.



Direct Reading in **Power Factor and Capacitance**

NOW you can measure directly the two most important characteristics of *any* condenser . . . its power factor and its capacitance.

The new G-R Type 716-A Capacitance Bridge has a direct reading range of 100 μf to 1 μf for capacitance and 0.002% to 6% for power factor at 1,000 cycles.

When used in substitution methods the direct reading con-

trols greatly simplify the balancings and the necessary calculations, and increase both power factor and capacitance ranges.

This bridge is invaluable for capacitance and power factor measurements on: air condensers . . . paper condensers . . . mica condensers . . . ceramic and all other types of insulation . . . cables . . . slabs of solid dielectric . . . liquids in cells . . . ground capacitances in generators, motors,

transformers and other electrical devices.

The bridge is self-contained and can be used at other frequencies between 60 cycles and 10,000 cycles.

Type 716-A Capacitance Bridge,
Relay Rack Model . . . \$335.00

Type 716-A Capacitance Bridge,
Cabinet Model \$360.00

• Write for Bulletin 167-E.

GENERAL RADIO COMPANY

Cambridge, Massachusetts

BRANCHES: New York Los Angeles San Francisco

MANUFACTURERS OF RADIO AND ELECTRICAL LABORATORY APPARATUS

ELECTRONICS — *September 1937*

SMALLER IN SIZE
LOWER IN PRICE
WITH NO SACRIFICE OF
ELECTRICAL PERFORMANCE



ACTUAL
SIZE

Highlights of **NEW RCA PHOTOTUBE SERIES!**

Now RCA offers a brand new Phototube series—built in a new way! These tubes are called the Cartridge Type. They are much smaller—only $1\frac{3}{4}$ " long. Simplified construction has resulted in manufacturing economy—and *you* get the saving in the form of considerably lower price—only \$2 list. Yet in spite of small size and low cost these exceptional new tubes do not sacrifice electrical performance! New methods of manufacture enable RCA to give you this new series!

These tubes provide high sensitivity and low interelectrode capacitances.

They can be mounted easily with either end up so that either terminal is insulated by the tube's glass envelope. In addition, their construction assures low leakage in *both tube and circuit*. Write today for full technical details about this RCA development.

● Reproduced above in actual size is RCA-922. This is a vacuum-type tube. Sensitivity: 20 microamperes per lumen. Interelectrode capacitance: 0.6 micromicrofarad. RCA-921, which looks essentially the same as the tube illustrated and is the same size, is a gas-type tube. Sensitivity: 100 microamperes per lumen—interelectrode capacitance: 1.1 micromicrofarads.



Radiotrons

RCA MANUFACTURING COMPANY, INC., CAMDEN, N. J.

A SERVICE OF THE RADIO CORPORATION OF AMERICA