electronics

radio, sound, communications and industrial applications of electron tubes · · · design, engineering, manufacture

IRE Convention, Philadelphia, May 28-30

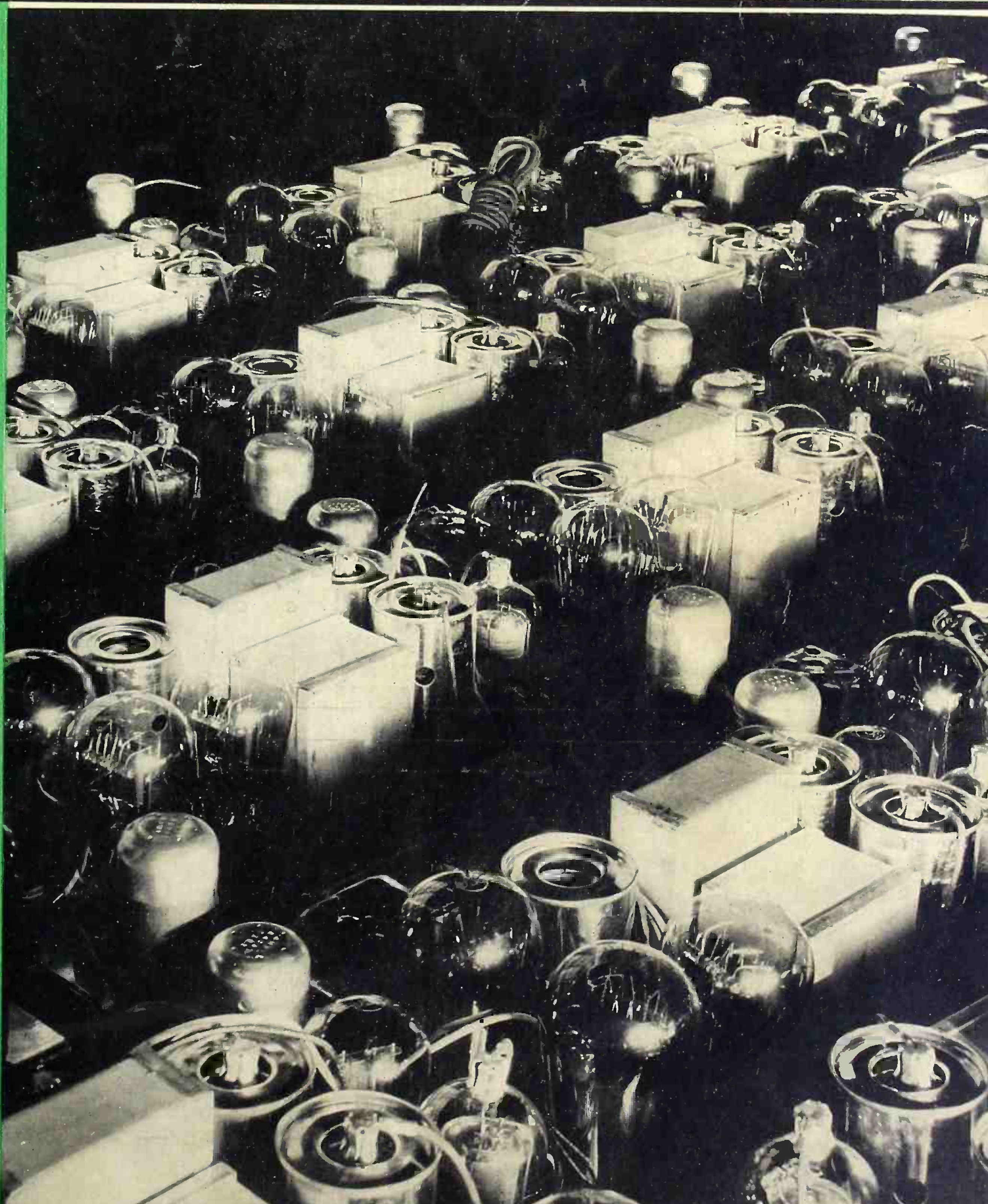
Microphone switching

Transformers for auto-radio

New silent film-recording system

Designing the radio cabinet

Progress in broadcasting



McGRAW-HILL PUBLISHING COMPANY, INC.

Price 35 Cents

MAY, 1934

An Open Letter to Radio Tube Manufacturers

May 15, 1934

Dear Mr. Tube Maker:

Have you been operating your plant for many months at little or no profit--possibly even at a loss? Have you been wondering for some time how you could meet the increased costs imposed on your business by various codes and turn your losses into profit--or increase your profits?

If so, we offer you a positive solution to your problems in the form of a fine, pure metal for internal vacuum tube parts at half the cost! Because of its purity it is more uniform and reliable. It is lighter in weight. It has a higher heat resistance. It has less occluded gas. It welds more easily and may be adapted to any shape, form or condition. It may be had in softer temper for deep drawing, bending and forming. It has a higher heat conductivity and getter cups flash better. Plates are more rigid--yet will withstand more heat. Less gas means less ionization and longer life. Thus you may produce a tube of greater uniformity, strength, efficiency and life.

There is an old saying that the best is cheapest in the long run but it is not often that the cheapest is best in the long run. This is true of the new metal. If you are using 25,000 lbs. of strip and wire in a year, your saving in cost will be about $12,000 annually. If you are buying 120,000 lbs. you can save over $60,000 a year. This is quite a lot of money and worthy of your serious consideration!

Frankly, wont a better material that will save you from $1,000 to $5,000 a month (or more) help to turn your losses into profit or increase your profits handsomely?

If you agree, please get in touch with us so that you may benefit from the use of this new material--SVEA METAL.

Very truly yours,

SWEDISH IRON & STEEL CORPORATION
17 Battery Place--New York City

ELECTRONICS, May, 1934. Vol. 7, No. 5. Published monthly, price 35c. a copy. Subscription rates—United States, $3.00 a year. Canada, including duty, $3.50 a year. All other countries, $4.00 a year or 16 shillings. Entered as second class matter April 4, 1930, at Post Office at New York, N. Y., under the Act of March 3rd, 1879. Printed in U. S. A. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.C. Copyright 1934 by McGraw-Hill Publishing Co., Inc., 330 West 42d Street, New York, N. Y.

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electronics

O. H. CALDWELL
Editor

KEITH HENNEY
Associate Editor

McGRAW-HILL PUBLISHING COMPANY, INC.

New York, May, 1934

NRA MEMBER U.S. WE DO OUR PART

radio
sound pictures
telephony
broadcasting
telegraphy
counting
grading
carrier systems
beam transmission
photo cells
facsimile
electric recording
amplifiers
phonographs
measurements
receivers
therapeutics
traffic control
musical instruments
machine control
television
metering
analysis
aviation
metallurgy
beacons
compasses
automatic processing
crime detection
geophysics

Keep faith with "High Fidelity"

THERE is much virtue in the proposal for "high fidelity" in radio reception *all the way from broadcast transmitter to the listener's receiver.*

Of course, some hurdles still bar the way to its full accomplishment. Interference from adjacent channels, inadequacy of wire-line transmission, need for studio and microphone improvement, distortion from over-modulation and transmitter background noise—these are some of the things that now obstruct fulfillment of the vision.

But today, within the daytime reliable-service range of a number of the great clear-channel stations, there is good "high-fidelity" reception during daylight hours, and occasionally during night hours.

RIGHT now, therefore, high-fidelity receivers can be properly introduced into these areas, bringing the listener all the advantages of full tone beauty and realism. Such receivers might even be equipped with means for reducing the band-width to "medium fidelity," for use at times when wide-range reception is not available.

As broadcast improvement goes on, these high-fidelity areas will grow, opening up larger and larger markets for high-quality receivers.

The term "High Fidelity" should be kept untarnished, for use in connection with this future development. "High Fidelity" has come to mean definite things to radio engineers, to the radio industry, and to some members of the public—to mean a standard of performance well described in the tentative definition issued by the RMA Engineering Division:

> HIGH FIDELITY—A receiver rated as a high-fidelity receiver must have an audio frequency range of at least 50 to 7500 cycles, with total variations in acoustical output not exceeding 10 decibels and with at least 10 watts of electrical power output, with total distortion not exceeding 5 per cent.

TO apply the term "High Fidelity" to a receiver measuring short of this definition of a competent high-fidelity set, will be to perpetrate a degree of fraud on that part of the public which has come to expect superlative reception and reproduction as the result to be obtained.

"Sterling" is a term with a definite *quality* meaning, when applied to silver. "High Fidelity" should be the counterpart of "sterling," applied to radio reception.

Let us keep faith with "High Fidelity."

RADIO ENGINEERS

Television, ultra short-waves and system fidelity among the topics to get special attention

OUTSTANDING and novel features are planned for the convention of the Institute of Radio Engineers to be held at the Hotel Benjamin Franklin, Philadelphia, Pa., May 28 to 30th.

Television will be brought up to date in a series of papers by Camden engineers; the latest status of the ultra short-wave will be thoroughly covered; the responsibility of the radio engineer toward "high fidelity" from broadcast transmitter to listener's receiver, will be discussed; new adventures in high-power broadcasting using 500 kw., will be treated from the engineering viewpoint, and tribute will be paid to an outstanding European engineer, Dr. Balth van der Pol, of Eindhoven, Holland, vice-president of the I.R.E., who will visit America for the convention.

Such a wealth of valuable program material for the convention was obtained by Dr. William Wilson, New York, chairman of the papers committee, that it was necessary to arrange for parallel convention sessions in order to cover the ground while allowing for full discussion.

No symposiums as such have been planned for the Philadelphia convention, but some of the sessions group themselves by topics in such a way that connected themes run through these meetings. Actual demonstrations of apparatus and effects will also be a feature of the Philadelphia program, adding interest and graphic illustration to the papers. Several novel inspection trips have been planned, the high point probably being the evening visit to the new $10,000,000 building of the Franklin Institute, and a special demonstration of the Fels Planetarium, where by means of elaborate projection apparatus, the exact appearance and movements of the stars and planets are reproduced.

Following is the convention program day by day:

President C. M. Jansky, Jr.

Monday, May 28

9:00 A.M.

Registration, and opening of exhibition rooms for inspection.

10:00 A.M.-12 Noon

Official welcome and technical session, Crystal Ballroom. Addresses by C. M. Jansky, Jr., President of the Institute; W. F. Diehl, Chairman of the Convention Committee; Harold Pender, Dean of the Moore School of Electrical Engineering, University of Pennsylvania; and W. R. G. Baker, Vice-President and General Manager, RCA Victor Company, Inc.

"A Lapel Microphone of the Velocity Type," by H. F. Olson and R. W. Carlisle, RCA Victor Company, Inc., Camden, N. J.

"Westinghouse KYW in Philadelphia," by R. N. Harmon, Westinghouse Elec. and Mfg. Company, Chicopee Falls, Mass.

"Nonlinear Theory of Maintained Electrical Oscillations," by B. Van der Pol, Philips' Incandescent Lamp Works, Eindhoven, Holland.

10:00 A.M.-12 Noon

Official greetings at ladies' headquarters.

12 Noon-2:00 P.M.

Luncheon and inspection of exhibits.

2:30 P.M.-4:30 P.M.

Ladies' inspection trip to WCAU studios.

Vice-president B. van der Pol, of Eindhoven, Holland

2:00 P.M.-4:00 P.M.

Technical Session, Crystal Ballroom

"The WLW 500 Kilowatt Broadcast Transmitter," by J. A. Chambers, Crosley Radio Corp., Cincinnati, Ohio, G. W. Fyler, General Electric Co., Schenectady, N. Y.; J. A. Hutcheson, Westinghouse Elec. and Mfg. Co., Chicopee Falls, Mass., and L. F. Jones, RCA Victor Company, Inc., Camden, N. J.

"Comparative Analysis of Water-Cooled Tubes as Class-B Audio Amplifiers," by I. E. Mouromtseff and H. N. Kozanowski, Westinghouse Elec. and Mfg. Co., East Pittsburgh, Pa.

"Some Engineering and Economic Aspects of Radio Broadcast Coverage," by G. D. Gillett and Marcy Eager, Consulting Engineers, Washington, D. C.

3:00 P.M.-4:00 P.M.

Technical Session, Betsy Ross Room

"Some Chemical Aspects of Vacuum Tube Production," by R. E. Palmateer, Hygrade Sylvania Corporation, Emporium, Pa.

"Contact Potential," by R. M. Bowie, Hygrade Sylvania Corporation, Emporium, Pa.

"Hot-Cathode Mercury Rectifier Tubes for High Power Broadcast Transmitters," by H. C. Steiner, General Electric Co., Schenectady, N. Y.

4:00 P.M.-6:00 P.M.

Annual meeting Sections Committee, Independence Room.

AT PHILADELPHIA

Wealth of important program material will require parallel convention sessions May 28 to 30

4:00 P.M.-6:00 P.M.

National Association of Broadcasters' Engineering Committee Meeting, Lafayette Room.

8:00 P.M.

Trip to the Franklin Institute, Fels Planetarium, etc.

Tuesday, May 29

10:00 A.M.-12 Noon

Technical Session, Crystal Ballroom

"Theory of Electron Gun for Cathode-Ray Tubes," by I. G. Maloff and D. W. Epstein, RCA Victor Company, Inc., Camden, N. J.

"Cathode Ray Oscillograph Tubes and Their Applications," by W. H. Painter, and P. A. Richards, RCA Radiotron Company, Inc., Harrison, N. J.

"The 'Sound Prism'," by Knox McIlwain and O. H. Schuck, University of Pennsylvania, Philadelphia, Pa.

Technical Session, Betsy Ross Room

"A Mechanical Demonstration of the Properties of Wave Filters," by G. E. Lane, Bell Telephone Labs., Inc., New York.

"Control of Radiating Properties of Antennas," by C. A. Nickle, R. B. Dome, and W. W. Brown, General Electric Company, Schenectady, N. Y.

"Measurement of Harmonic Power Output of a Radio Transmitter," by P. M. Honnell and E. B. Ferrell, Bell Telephone Labs., New York City.

"Frequency Standards and Frequency Measuring Equipment," by J. K. Clapp, General Radio Co., Cambridge, Mass.

"North Atlantic Ship-Shore Radiotelephone Transmission During 1932-1933," by C. N. Anderson, Bell Telephone Labs., Inc., New York City.

12 Noon-3:00 P.M.

Trip to RCA Victor plant, Camden. Luncheon will be served at the plant through courtesy of the RCA Victor Company.

3:00 P.M.-5:00 P.M.

Technical Session, Crystal Ballroom

"An Experimental Television System."

Introduction—E. W. Engstrom.

Transmitter—R. D. Kell, A. V. Bedford, M. A. Trainer.

Relay Circuit—C. J. Young.

Receivers—R. S. Holmes, W. L. Carlson, W. A. Tolson, RCA Victor Company, Inc., Camden, N. J.

7:00 P.M.

Informal Banquet.

Wednesday, May 30

10:00 A.M.-12 Noon

Technical Session, Crystal Ballroom

"The Design and Testing of Multi-Range Receivers," by D. E. Harnett and N. P. Case, Hazeltine Corporation, New York.

"High-Fidelity Receivers with Expanding Selectors," by H. A. Wheeler and J. K. Johnson, Hazeltine Corp., New York.

"Acoustic Testing of High-Fidelity Receivers," by H. A. Wheeler and V. E. Whitman, Hazeltine Corp., New York.

"A Common Source of Error in Measurements of Receiver Selectivity," by E. N. Dingley, Jr., Bureau of Engineering, Navy Dept., Washington, D. C.

10:00 A.M.-12 Noon

Technical Session, Betsy Ross Room

"Recent Studies of the Ionosphere," by S. S. Kirby and E. B. Judson, Bureau of Standards, Washington, D. C.

"An Analysis of Continuous Records of Field Intensity at Broadcast Frequencies," by S. S. Kirby, K. A. Norton, and G. H. Lester, Bureau of Standards, Washington, D. C.

"Modern Methods of Investigating Ionization in the Atmosphere," by G. L. Locher, Bartol Research Foundation, Swarthmore, Pa.

"Seasonal Variation in the Ionosphere," by J. P. Schafer and W. M. Goodall, Bell Telephone Labs., New York.

10:00 A.M.-5:00 P.M.

Ladies' sight-seeing trip, including visit to Valley Forge, where luncheon will be served.

2:00 P.M.-4:00 P.M.

Technical Session, Crystal Ballroom

"Development of Transmitters for Frequencies Above 300 Megacycles," by N. E. Lindenblad, R.C.A. Communications, Inc., New York City.

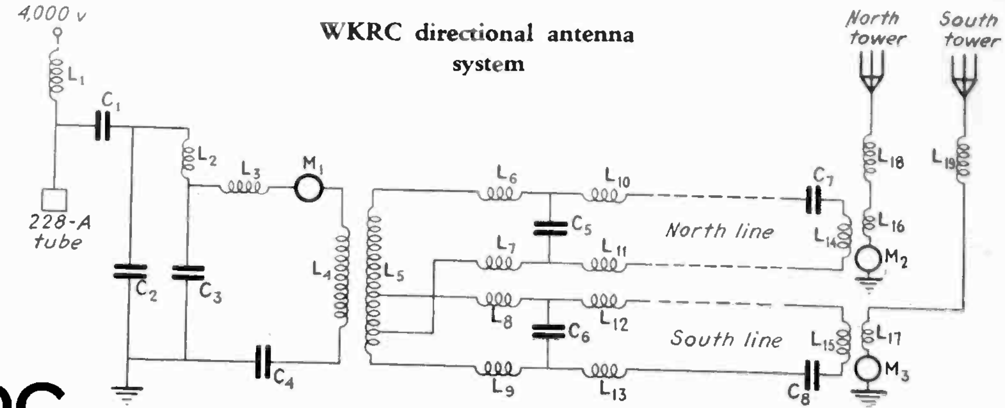
"An Electronic Oscillator with Plane Electrodes," by B. J. Thompson and P. D. Zottu, RCA Radiotron Company, Inc., Harrison, N. J.

"Transmission and Reception of Centimeter Waves," by I. Wolff, E. G. Linder, and R. A. Braden, RCA Victor Company, Inc., Camden, N. J.

Philadelphia is on Eastern Daylight Saving Time.

Chairmen of Philadelphia convention committees—Standing, E. B. Patterson, entertainment; A. F. Murray, exhibits; Knox McThorin, registration. Seated, E. W. Engstrom, papers; H. W. Bylers, treasurer; W. F. Diehl general chairman; Jesse Haydock, publicity; E. L. Forstall, program. Not in picture, Mrs. W. H. W. Skerrett, ladies entertainment; Harry Sadenwater, entertainment.

Broadcast transmission progress at CBS



WKRC directional antenna system

By A. B. CHAMBERLAIN

Chief Engineer
Columbia Broadcasting System

THE Columbia Broadcasting System has been very active during the past year in making improvements in its transmission system. Some of the outstanding improvements made during this period follow:

New electro-dynamic (moving-coil) and velocity microphones were placed in regular operation at key program origination points including stations WABC, New York; WBBM, Chicago, and WCAU, Philadelphia.

Associated speech-input equipment was replaced or modified, resulting in a much broader frequency characteristic, together with less combined audio frequency harmonic distortion.

Telephone lines used for program transmission, together with associated terminal equipment, have been and are continually being improved with respect to audio frequency characteristic, harmonic and phase distortion.

A complete a.c. operated, low-voltage copper-oxide rectifier power supply unit has been installed at the CBS New York Master Control. It has a capacity of 105 amperes at 15 volts. This equipment has some very desirable operating characteristics including cleanliness, quietness of operation, reduced maintenance and automatic regulation. It is so designed that the voltage at the output does not vary more than plus or minus 0.3 volts, from 20% to 120% load. The amount of ripple present is 0.55 milli-volts or—89db (down) from output voltage. Additional filters are used in the low-level studio speech input equipment supply circuits. This filter attentuates the ripple component an additional 40 db. It also serves as an isolation network resulting in greater stability of operation. Ripple is defined as the r.m.s. value of the residual superimposed a.c. in the d.c. output. The equipment is so installed as to allow for optimum flexibility and reliability in operation.

A new experimental relay broadcast transmitter has been placed in operation at Wayne, New Jersey, at the site of the regular 50 kw WABC-WBOQ broadcast plant. This short-wave transmitter is modern in every respect, including direct frequency control, screen-grid tubes and high level Class B modulation. Its operating characteristics are on a par with a modern broadcast transmitter. The transmitter is designed for operation on any one of six frequencies. All tuning controls and adjustments necessary can be made from the transmitter panel front, and operating frequencies can be changed in several seconds' time. The station operates with the call W2XE and broadcasts WABC programs on a regular daily schedule using the frequencies 6120, 11830 and 15270 kc sec. In order to insure optimum performance, separate antenna systems have been provided for each of the above frequencies. In this way, CBS feature programs, broadcast experimentally by W2XE, are heard regularly at remote points all over the world.

International programs, originating on many continents, are transmitted to this country and transmitted over CBS with increasing frequency and fidelity of transmission. Great progress is being made in the improvement of directional antennas, short-wave transmitters and receiving systems used for this relay broadcast work. An outstanding example of short-wave relay broadcasting has been the regular Saturday night program of the Byrd Antarctic Expedition. Although the ship used a high-fidelity telephone transmitter of only 1 kw rating and a conventional antenna, successful contacts and transmissions were maintained during the ship's journey from Panama to Little America via New Zealand. The signal at times has been transmitted over a path more than 10,000 miles long—as, for instance, from the ship, when 1,000 miles southeast of New Zealand to Hawaii, thence relayed by radio to San Francisco and again relayed by radio to Riverhead, Long Island. From Riverhead the program was transmitted over wire-


WABC "master control" room. More than 500 national and international programs are switched from this point weekly

line to the WABC studios and then by wire-line to 55 CBS stations from Coast to Coast.

Portable ultra-high frequency transmitters and receivers were designed and built and are being used for general experimental work in connection with special broadcast pickup service work. Other portable transmitting and receiving equipment designed to work on intermediate frequencies was modified and used successfully on relay broadcasts from air-craft, boats at sea, and from other remote points where telephone wires were not available. This equipment is capable of high fidelity transmission and is an important adjunct to the engineering facilities of network key stations.

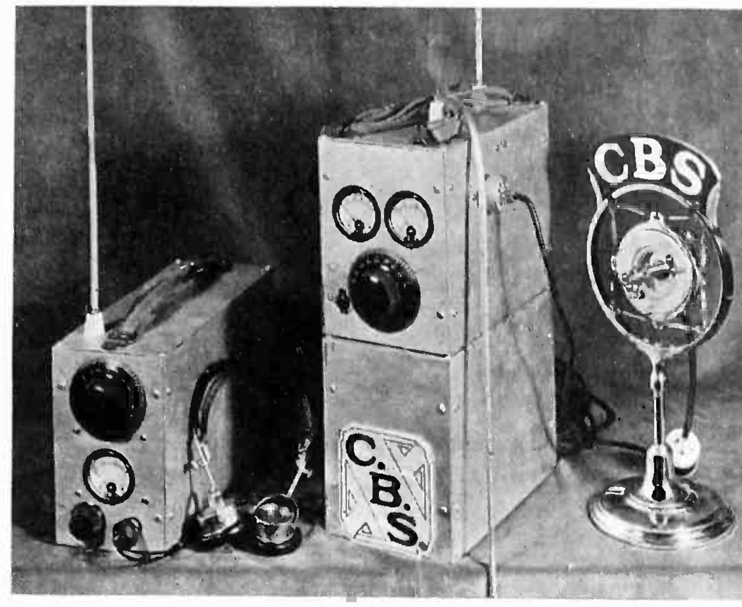
Directional antennas in operation

Directional antenna systems have been installed at two CBS stations—WJSV, Alexandria, Virginia; and at WKRC, Cincinnati, Ohio. These antennas are in operation at the present time. The purpose of employing such systems is to fulfill specific interference-reduction requirements consistent with the rendering of maximum public service.

The WJSV antenna system consists of two vertical conductors suspended between two 150-ft. steel towers, insulated at their bases. The antennas are $\frac{3}{8}$ wave apart ($\theta=135°$) and the current in the West antenna leads the current in the East antenna by $\frac{1}{8}$ wave ($\theta=45°$). The 10-kw WJSV transmitter is located about four hundred feet from the antenna system and power is transmitted from it to the antenna system by means of a conventional 600-ohm two-conductor open-wire line. The field intensity distribution in a horizontal plane looks like a flattened cardioid, with the minimum signal in an easterly direction. The horizontal space pattern—at one mile—is: E=10 mv/m: N = 580 mv/m; W=300 mv/m; S = 500 mv/m; with 10 kw antenna input power. Optimum reduction of signal was desired, in this case, at a point one mile east of the station. It can be seen that a reduction in signal intensity of approximately 50:1 has been obtained. In order to determine the stability of the system an accurate automatic signal intensity recorder was installed one mile east of the WJSV antenna system which records the signal strength of this station continuously. This equipment has been in operation twenty-four hours a day since July, 1933. The automatic field intensity receiver is a.-c. operated and is specially designed so that its sensitivity is independent of variations in ambient temperature, humidity and line voltage.

The stability of the WJSV antenna system has been found to be satisfactory and fulfills the requirements of the case.

The directional antenna system at station WKRC is erected on the roof of the Hotel Alms, Cincinnati, Ohio, and consists of two self-supported, insulated, narrow-base steel towers 154 ft. high and $\frac{1}{8}$ wave apart. (Space, $\theta = 45°$). The current in the North antenna leads the current in the South antenna by 140° ($\theta = 140°$). In order to obtain the proper phasing, artificial (double π) lines were used in connection with the relatively short transmission lines erected on the roof. The lines themselves, being approximately 110 feet long, each had a phase angle of approximately 30°; the additional 80° was obtained by properly adjusting the built-out sections. A standard 1 kw transmitter is used, properly coupled to parallel transmission lines of a conventional type. The surge impedance of the line is 450 ohms. The impedance and phase angle of the physical lines and the



Ultra high-frequency portable transmitter and receiver, working on 40-60 megacycles

artificial lines was obtained by measuring the sending end impedance Z_o, with the far end of the line open circuited and short circuited giving Z_{oc} and Z_{sc} respectively. From transmission line theory, the surge impedance is then:

$$Z_o = \sqrt{Z_{oc}Z_{sc}}$$

and the phase angle is

$$\theta = \tan^{-1}\sqrt{\frac{Z_{sc}}{Z_{oc}}}$$

With this arrangement in use, the field intensity distribution in a horizontal plane is such as to satisfy the general requirements of this case. The signal north of the station is that of an efficient 1 kw transmitter. Towards the south, east and west the field intensities correspond to an antenna input power of 500 watts. A considerable amount of data concerning the operating characteristics of directional antennas was obtained during the design, construction and adjusting of the two systems described above.

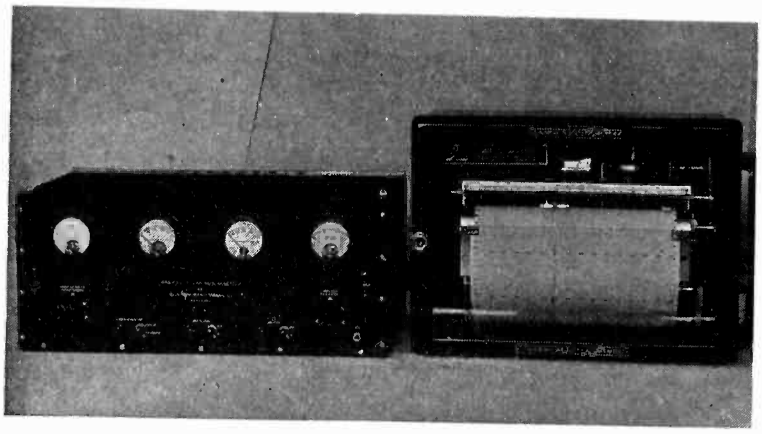
During the past year many other equipment modifi-

▲

Fields for further improvement in broadcasting practice

Studio pickup technique.
Microphones and associated equipment.
Telephone line program transmission.
Transmitter modulation characteristic.
Antenna radiation efficiency.
Frequency, harmonic and phase distortion.
Over-all transmission system "noise" reduction.
Volume range capability of system.
Methods of monitoring program transmission both visually and aurally.

WKRC 550



Automatic field-intensity recorder used for continuously monitoring WJSV

cations were made to improve the CBS transmission system as much as possible. It is Columbia's aim to be among the "pace-setters" insofar as progress in the art is concerned, and at this time we are looking forward to, and working for further improvements in:

(1) Studio pickup technique.
(2) Microphones and associated equipment.
(3) Telephone line program transmission.
(4) Transmitter modulation characteristic.
(5) Antenna radiation efficiency.
(6) Frequency, harmonic and phase distortion in transmission system.
(7) Over-all transmission system "noise" reduction.
(8) Volume range capability of system.
(9) Methods of monitoring program transmission both visually and aurally.
(10) Performance of average broadcast receiver.

The three most important problems of those listed above are undoubtedly

(a) Antenna radiation efficiency,
(b) Satisfactory methods of visually and audibly monitoring broadcast transmission.
(c) Improved performance of receivers.

It is recognized that the propagation characteristics of conventional antennas used for broadcast transmission leave much to be desired. The vertical-mast type antenna more than one-half wave high electrically, such as those now used at stations WABC-WBOQ, WCAU and WNAC-WAAB, results in a considerable improvement over the older conventional types usually designed to operate with electrical lengths of from 90° to 135°.

The mast antenna gives a radiation efficiency increase of from 40 to 100%, depending upon the type of antenna which it replaces, upon the character and size of ground system employed, and upon the ground conductivity for several wave-lengths in all directions.

The vertical-mast type antenna, although an improvement, does not represent the ideal broadcast antenna. At the present time many studies are being made to determine methods of improving antenna systems.

Means for more satisfactory monitoring of programs, both audible and visual, are being provided. Loudspeakers have been greatly improved during the past year and are capable of high fidelity performance provided they are used in rooms properly designed, acoustically. Work is progressing on visual monitoring equipment and it is expected that we will soon have automatic peak volume controls, peak volume indicators, automatic recording volume indicators and possibly a suitable automatic volume control. The proper use of such devices will, undoubtedly, improve broadcast transmission and allow more efficient use of the restricted volume range imposed upon the system. It is possible to transmit a greater volume range by utilizing a method devised by Stuart Ballantine. This device is called an automatic volume range compressor and expander and is capable of compressing a 70 db volume range to 35 db, at the beginning of the transmission system, and restore or expand it to the full 70 db. at the end of the system. The practical value of this device has not been demonstrated in a broadcast system as yet, but deserves serious consideration.

Transmission characteristics

The following broadcast transmission characteristics are considered to be excellent at the present time:

1. Frequency characteristic ± 2 db, 30 to 8,000 c.p.s.
2. Combined harmonic distortion 5% maximum.
3. Transmitter modulation capability 100%.
4. Noise or/and hum modulation 0.1% maximum.
5. Volume range capability 50 db.
6. Antenna efficiency 100%. (Based on F.R.C. ideal antenna—265mv/m effective field intensity at one mile, 1 kw antenna input power.)
7. Frequency tolerance ± 5 c.p.s.

Economically, conditions are steadily improving. The present is an appropriate period, therefore, from a psychological standpoint, to attack the many problems which face the industry. The importance of attacking them in a systematic manner cannot be over-emphasized. The work already done as a part of the regular program of the Joint Committee of the I.R.E., N.A.B. and R.M.A. is a step in the right direction.

Improved fidelity in the transmission and reception of broadcast programs will result in greater listener interest, greater interest in radio by national advertisers, consequently, more and better programs.

As a result of such improvement, the sale of broadcast receivers will undoubtedly increase, and thus the entire radio broadcast industry greatly benefited.

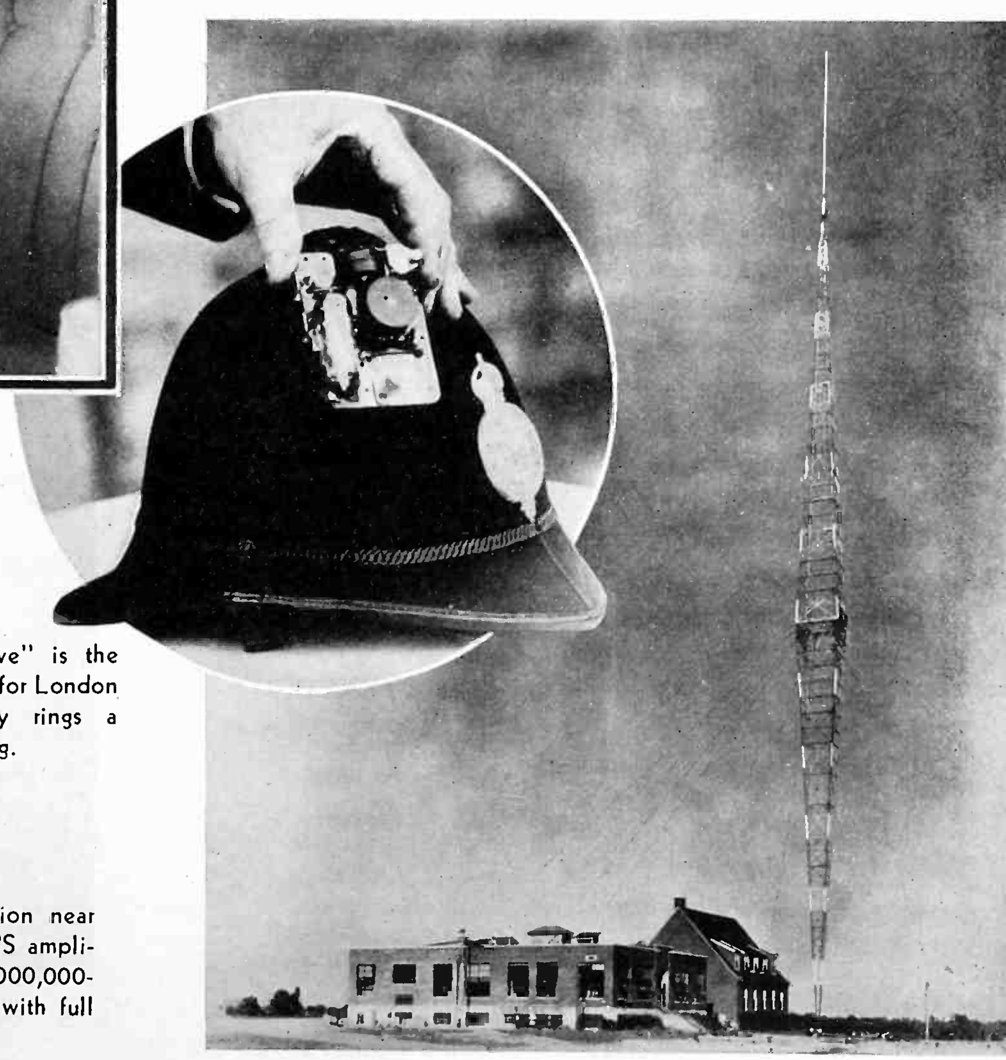
WHENEVER I am confronted with a new problem in designing, I find it valuable to draw up a chart going as far back as possible, and showing the important steps in the development of this specific product. It is often surprising to discover from a careful study of such a sequence that there is a definite direction which might almost be called evolution, and which indicates clearly and inevitably what the next link in the chain will be. It is a very valuable approach to a new design. It eliminates a good part of the guess work.

—RAYMOND LOEWY

RADIO ADDS NEW 1934 SERVICES

John V. L. Hogan, prominent New York radio engineer, demonstrates his new "radio pen" facsimile, which delivers a 40-line-per-inch screen at the rate of 2½ inches per minute.

This 1934 automobile radio receiver, with handy controls alongside the user, can also be plugged in on 110-volt 60-cycle house current.



A tiny Marconi "valve" is the feature of this head-set for London policemen. A relay rings a bell for calling.

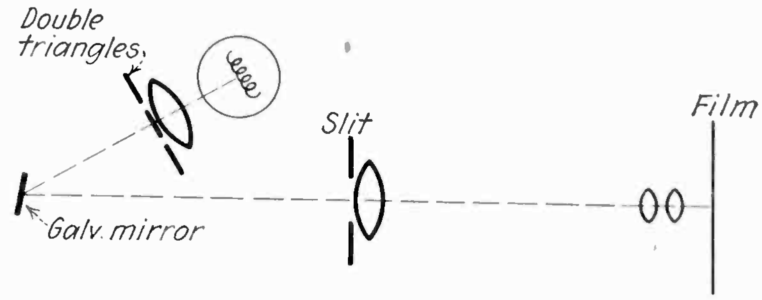
WLW, Powell Crosley's 500-kw broadcast station near Cincinnati. Someone has computed that WLW'S amplification, from microphone to antenna, is 70,000,000-000,000,000 times. Went on the air May 2 with full power during evening hours.

Noiseless recording

with double-triangle slit, and double-cathode photo-cell

By G. L. DIMMICK and H. BELAR

R. C. A. Victor Company, Camden, N. J.



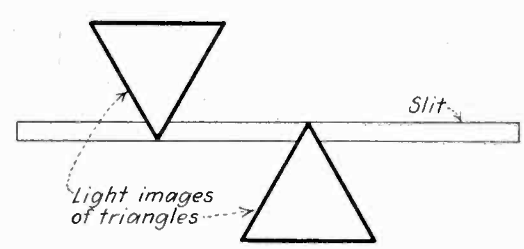
The recording optical system

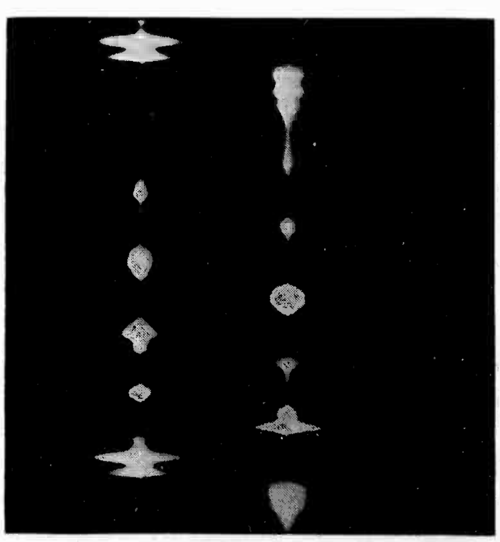
THE reduction of ground-noise from film recording has engaged the attention of engineers for many years. The incentive for this work has been the increase of the volume range that it is possible to record, and the reduction of the extraneous background noise below the threshold of hearing. Both of these factors are tremendously important in creating an illusion of realism, which, of course, is the ultimate function of any reproducing system. Several methods have been devised which reduce ground-noise to a limited extent. It is the purpose of this paper to describe a practical "variable-area" sound-recording system which permits the reduction of ground-noise to an absolute minimum, without introducing distortion. This system does not require any auxiliary recording equipment, nor does it require special care in recording or processing.

There are two principal sources of extraneous noise from film recording. The average transmission of the exposed portion of the variable-area track is constant, but the transmission through the area occupied by the scanning beam (0.001 in. x 0.084 in.) varies at audible frequencies. This is the result of a random distribution of the silver grains and groups of grains. Ground-noise produced in this way is in the form of an extremely high-pitched hiss which sounds very much like the hiss due to "thermal agitation" in resistors and that due to "shot effect" in vacuum tubes. It has been shown that this type of ground noise increases with the density of the film, until a maximum is reached at a density of about 0.7. At the recommended print density of from 1.3 to 1.4 the hiss due to this cause is very small. Foreign particles and scratches on the transparent portion of the sound-track form the most annoying source of ground-noise. The photo-electric cell is unable to distinguish between the reduction in light due to a decrease in width of the transparent portion of the track and the reduction in light which is due to opaque particles in the clear track.

In the recent "bias" system for noise reduction, a portion of the signal is rectified and caused to operate either a shutter vane or a bias winding on the recording galvanometer in such a way that the clear part of the track is reduced to a width which will just accommodate the modulation. When there is no modulation the clear track shrinks to a width of about five mils. This system affords a considerable reduction in ground noise, and is a major improvement upon previous systems. The bias system is, however, inherently limited in the extent to which it can reduce film noise without introducing distortion. If the bias current were allowed to actuate the galvanometer freely without the use of a timing circuit, an audible distortion would be superimposed on the signal because the envelope of many sounds occurring in nature is a wave of audible frequency. If the timing circuit were not fast enough the narrow track could not accommodate the first part of a sound track which occurred suddenly, thus causing the first part of this sound to be distorted. In practice, the bias system is utilized only to reduce noises to such an extent that the accompanying distortion is negligible.

A new type of sound track which permits the reduction of ground noise to the theoretical minimum is shown in the accompanying illustration. Only the area actually occupied by the sound waves is transparent, which means that the ratio of ground noise to signal is constant, regardless of the amplitude. The recording optical sys-





Slit, light images of triangles, and resulting sound-track tem used to make this track is also shown. The only change which has been made in the standard Photophone recording optical system is the replacement of the single triangular mask, by a mask having two triangles. An optical image of these two opposing triangles is formed at the slit after being reflected from the galvanometer mirror, as shown in the optical diagram. The apex of each triangular image is coincident with the center of the slit and spaced half the width of the sound track apart.

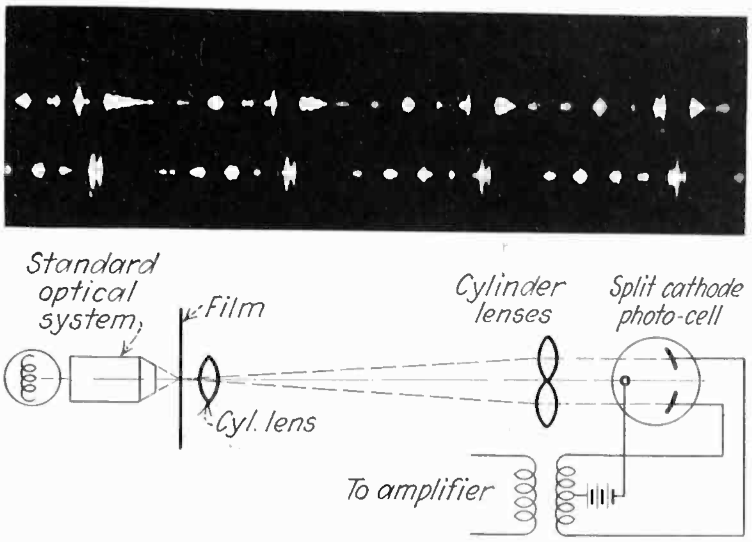
When a signal is impressed upon the galvanometer the triangular light beams vibrate in a vertical plane and record two symmetrical tracks, one of which carries the positive half, the other the negative half of the sound waves. The axes of the two tracks are located a quarter of the total track width from each edge. The purpose of this is to assure proper scanning of the low modulation and the proper separation of the two halves of the reproducing light beam in spite of either a slight weaving of the film or a slight mis-alignment of the track. The axes of the two half tracks might be made to coincide at the center of the track, but it would be practically impossible to separate them later. The axes might also be placed at the two outside edges of the track, but then there would be less assurance of proper scanning.

Only sound-wave area is transparent

In practice, the recording system is quite simple to operate and adjust. The points of the two triangles may be made to coincide with a line parallel to the slit by a rotary adjustment of the barrel containing the aperture. The points are brought to the center of the slit by a vernier adjustment of the galvanometer around its horizontal axis. If for any reason the latter adjustment were either not made correctly or thrown off by accident there would not be any distortion introduced. The only effect would be a slight increase in ground noise.

Both optical and electrical systems for reproducing this type of sound track are illustrated. A beam of light 0.084 in. long and 0.001 in. wide is projected on the film by means of a standard reproducing optical system and a 10-volt 5-ampere lamp. A cylindrical lens forms an image of the width of the sound track upon the two cylindrical lenses. In the other plane, light from the reproducing optical system is allowed to expand to a height of about an inch. The two lenses each form an image of lens upon the two cathodes and of the photoelectric cell. By means of this arrangement the two images of the lens are separated and each contains the light transmitted through half the track, since the center of the track coincides with the dividing line between the two adjacent cylindrical lenses. This system produces variations in the intensity of the light striking the cathodes corresponding to variations in the width of the clear portion of the sound track. The cathodes are connected to the primary terminals of the transformer. The secondary is connected to the reproducing amplifier. It is obvious that the two halves of the sound waves which were recorded 180° out of phase are re-combined in the proper phase by the push-pull transformer.

In addition to its inherent freedom from ground noise the push-pull sound track has other advantages of equal importance. The finite width of the recording light beam and the spreading of the photographic image of the recording light beam are responsible for filling in



Sample double sound track (note alternate wave loops), and below, circuits of reproducing system

the valleys and for reducing the density of the peaks of the high-frequency waves. The push-pull track improves this condition in two ways. The negative is composed only of peaks which are separated from each other by clear spaces equal in width to a half wave length. In order to make a good print it is necessary to make the peaks quite dense. In the conventional type of variable area recording a compromise between light peaks and dense valleys must determine the density of the negative. Elimination of the valleys from the negative makes it possible to increase the negative density and thereby obtain better prints.

Another important advantage of the push-pull sound recording system is the elimination of a type of distortion which results from the improper processing of variable-area films. When high frequencies recorded on a sound negative are attenuated because of the finite width of slit and limited resolution of the film, a reduction of the average transmission is also obtained. If this condition were allowed to remain, a certain amount of distortion would accompany all high-frequency sounds which varied in amplitude at audible frequencies. The distortion would be in the form of an extraneous noise produced by the envelope of the high frequencies. By the proper choice of negative and print density it is possible to eliminate this distortion from any type of variable-area track. The push-pull system completely eliminates all of this distortion which is not already printed out. The positive and negative waves of the high frequencies are 180° out of phase and so are added in the push-pull transformer, but the envelopes of amplitude for the two tracks are in phase, thereby cancelling the distortion in the transformer.

Complete elimination of "ground-noise"

FULL definition of the various shadings of volume, and fidelity of reproduction over the complete audible range of sound are some of the improvements promised by this new development presented at the Atlantic City convention of the Society of Motion-Picture Engineers in April.

High-fidelity broadcast transmitter performance

By EDMUND A. LAPORT

Consulting Radio Engineer, Montclair, New Jersey

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In connection with the present interest in high-fidelity, it is worth while to review what is now possible from the standpoint of transmitters, not implying that the majority, or even a small per cent, of stations on the air are capable of such performance.

Mr. Laporte is an engineer with wide experience in the design and construction of broadcast transmitters. He installed the Milan, Italy, station, and one of the best known high-quality transmitters in New Jersey was erected under his supervision.

▼

AUDIO RESPONSE—The first matter of interest in high-fidelity transmission is audio response. In modern designs, practically uniform response between 30 and 10,000 cycles has actually been achieved. Three sample audio response curves are shown in Fig. 1 made on stations in daily operation which were installed and tested by the author. The curves shown are for the station characteristic, that is, from the input of the line-terminating equipment to the antenna.

Latest designs of studio speech input apparatus are usually like the lower curve of Fig. 1. Latest designs of microphones have characteristics about like this also.

AUDIO DISTORTION—Waveform distortion in the transmitting equipment is being constantly reduced. Specifications of the FRC call for less than 10 per cent combined audio harmonics. Some of the most advanced designs of transmitting apparatus have much less than this figure. One of the most recent highpower transmitters gave the characteristic shown in Fig. 2. At the very low and the very high modulation frequencies, distortion is usually much greater than for the middle audio range. While distortion of the higher frequencies is of small importance aurally, it becomes very important from the standpoint of cross-talk, and also interchannel interference.

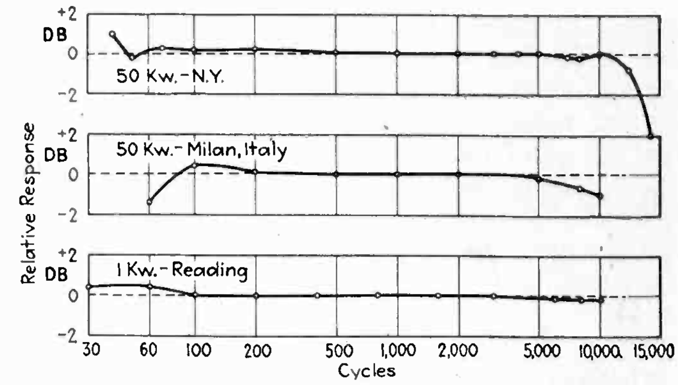


Fig. 1—Over-all characteristics of modern transmitters

PERCENTAGE MODULATION—Full 100 per cent modulation has been an everyday reality now for three or four years, though much of the apparatus claiming this feature produces considerable distortion at high modulation percentage. Recent important advancements have been made in maximum modulation without excessive distortion, as Fig. 2 shows. The most important improvements lately accomplished in low distortion high-percentage modulation has been at the low frequency end. Plate modulation using Class B modulators seems to be superior to Class B radio frequency systems in low-distortion, high-frequency modulation, especially at the lower frequencies.

SYLLABIC MODULATION—Until recently very little attention has been paid to the syllabic modulation characteristics of transmitting apparatus. Transmitter performance has always been demonstrated under steady-state modulation conditions. Telephonic modulation, however, is not in any sense a steady-state phenomenon, in that it is introduced in "chunks" or syllables, the components of which are continuously changing in frequency, amplitude and waveform. For

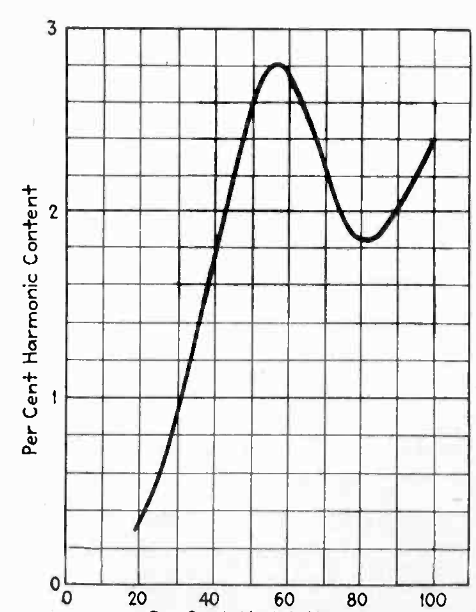


Fig. 2—Arithmetic sum of all harmonics (2nd to 12th) at 200 cycles

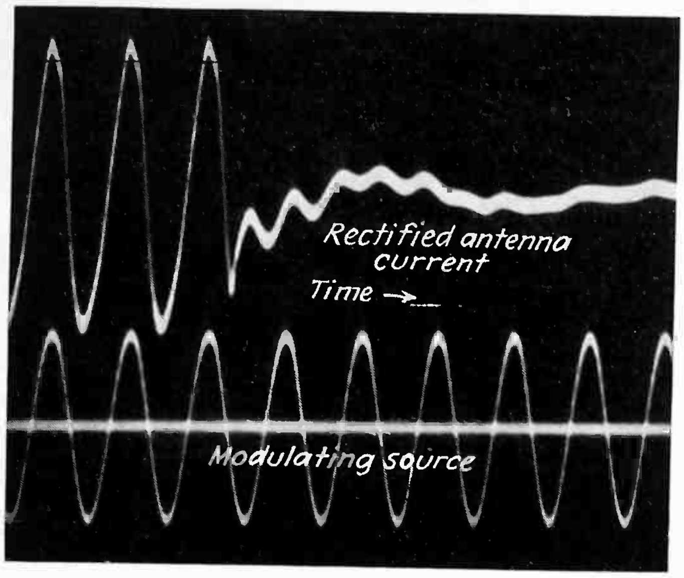


Fig. 3a—Transient occurring with sudden removal of modulation

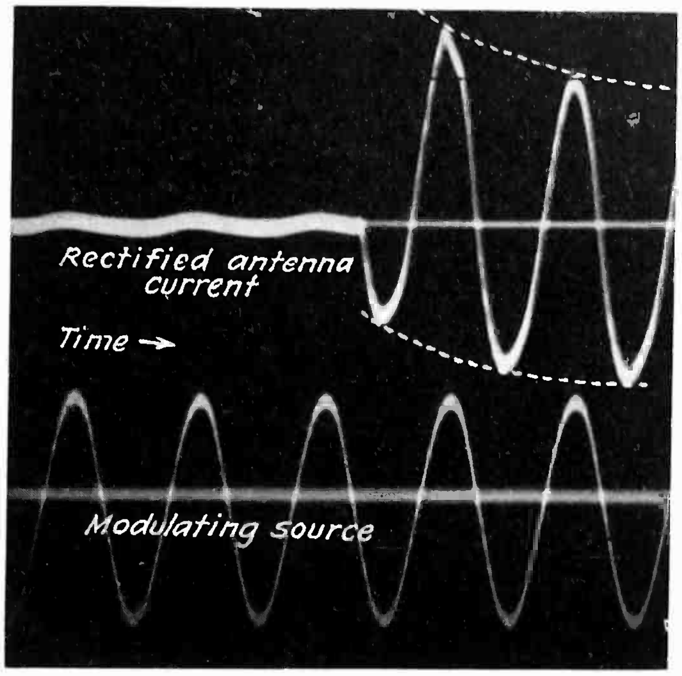


Fig. 3b—Transient on start of modulation

high-fidelity transmission it is necessary to have a transmitter characteristic such that it is essentially free from transients resulting from the sudden introduction or removal of modulation, or from transients which result from sudden changes in amplitude or frequency. The presence of transients, especially oscillatory transients, under these conditions produces serious distortion. Figure 3-a and 3-b show the presence of such transients at the removal and the introduction of modulation, respectively. Those shown resulted from switching the modulation source, a tone oscillator, and are not very bad as transmitters go. Figure 4 shows the result of improvements in the same transmitter, where the starting transient is nearly eliminated.

Syllabic modulation transients are due to low power factor in various parts of the audio amplifier chain. The presence of large amounts of leakage reactance, especially in interstage couplings, is detrimental to good modulation in this respect. Elimination of these transients is obtained when all power-transfer elements are made to have pure-resistance characteristics.

A form of syllabic modulation transient is introduced when a transmitter is operated in such a manner as to cause to varying power demand upon the plate supply. With such variation, filter transients result unless special attention is directed to a highly stable design of filter. Grid bias circuit regulation also plays an important part in connection with syllabic modulation.

STABILITY—This factor usually refers to the complete absence of parasitic oscillations in a piece of equipment. Instability in audio amplifiers produces howling or motor-boating. Instability in a transmitter may produce many interesting but troublesome effects. Parasitics may be of very high frequency, of a frequency nearly that of normal operation, or be of very low (sometimes audio) frequency. Many a transmitter is stable on carrier but unstable during various portions of a modulation cycle. If a power-amplifier breaks into a 50-kc. parasitic oscillation on peaks of modulation (not an uncommon occurrence), the 50-kc. sidebands thus generated are splashed over the five adjacent channels on each side of the assigned channel and produce a serious form of interchannel interference.

Factory-made transmitters today are completely stable before they are turned over to service by responsible factory engineers. Probably as much study and experience has been required to attain transmitter stability as any other transmitter characteristic. Complete stability is essential to high-fidelity transmission, both from the standpoint of the station's own transmissions, and its interference with the transmissions of other stations on adjacent or other channels.

RIPPLE—Commercial transmitting equipment now is generally capable of holding carrier ripple at least 50 db below 100 per cent modulation level. On a recent ultra-high power station it is rumored in engineering circles that ripple is 70 db down. Such a low level of transmitter noise theoretically permits a useful program range of at least 50 db, which should allow better symphonic rendering by reducing program compression.

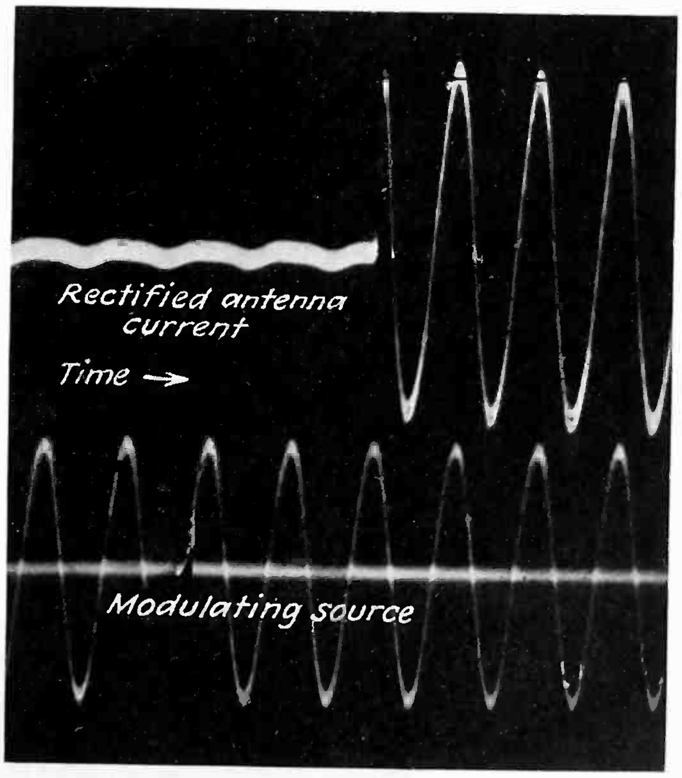


Fig. 4—Result of improving transmitter to eliminate transients

Selecting the right radio cabinet design

By JOHN VASSOS
Industrial Designer

LET us consider just what a radio really is. Outside of its delicate and complicated mechanism, it has one thing to offer and only one—sound. First, the instrument must give perfect sound and second, it must be simple to operate. Some super-functionalists have brought forth the idea that as long as the radio is so delicate and precise, why not expose its mechanism under glass? My answer to this is—if instruments of beautiful precision should be exposed to the public gaze, why did not nature give us a skin of cellophane-like texture? Certainly the functioning of our stomach, gizzard, kidneys and that most interesting and fascinating object, our alimentary canal, is of far more interest than radio tubes, condensers, etc. Let's not be swept aside by such adventures, amusing as they are to argue about. And, seriously speaking, glass is a poor conductor of sound. Science has not yet produced any synthetic material that equals the mellowness of wood.

At the present time, the most perfect sound can be obtained by mounting a large speaker on a board two inches thick, six feet by six feet in dimension, placed at least eighteen inches away from the wall to create the proper baffle and air vibration. This is high fidelity so far as sound is concerned but such an instrument is certainly out of the question in a living room, unless the room were designed and constructed especially for it.

However, it is far more desirable and faithful for the radio cabinet designer to have this premise in mind to begin with, rather than the idea of reproducing a Gothic cathedral. And the recent expressions of "geometrically inspired" radio cabinets that affect modernism by reason of their mechanical appearance, lack the essential quality of the true radio—that of freeing sound from the speaker. In the case of the Gothic, it is a question of imitating period furniture; in the second—that of imitating modernism. Both are affectations. And neither is a true radio.

I don't feel in the least dismayed about the outcome of radio design, nor do I see a successful outcome impossible to accomplish. The radio is an essential of life to-day, just as the piano was, a generation ago an essential in our cultural life. All of us know the struggle the piano went through before it arrived at its final identity as a piano. Originally it was a piano, pure and simple. Then it began to be decorated until it was almost unrecognizable. At one time, some Victorian examples of piano design were so disguised that it was impossible to tell whether it was a table, a sideboard or a casket in the room. Anything but a piano! But at last the piano itself emerged. And difficult in shape as the piano is, even to-day, it is thoroughly accepted in a room by reason of its function, with a minimum of unnecessary decoration.

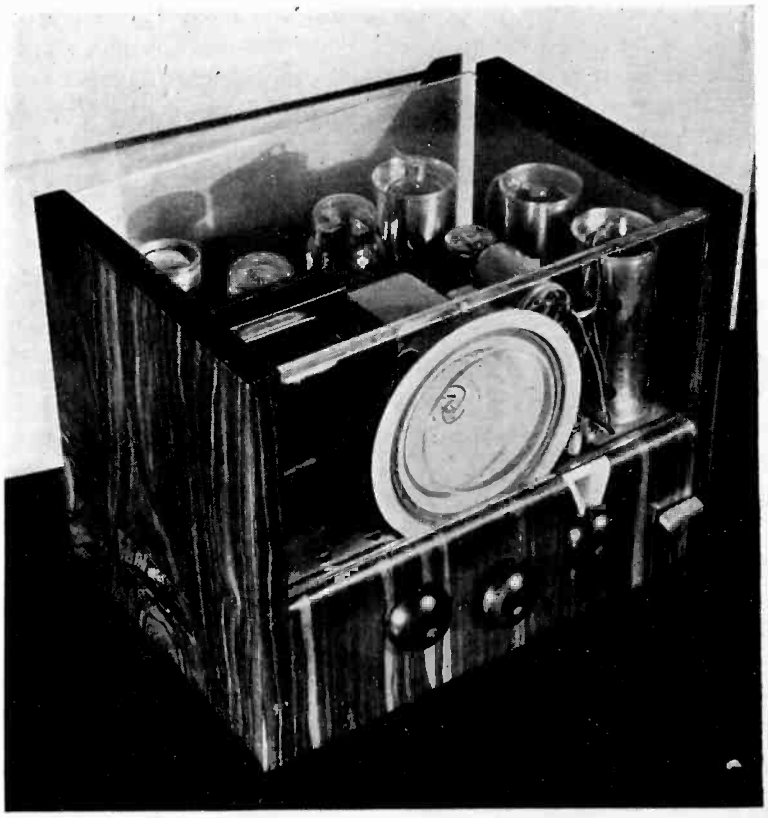
And also before our very eyes—and a little ahead of radio—we are seeing the evolution of the automobile, from its beginning as a horseless carriage, down to the present air-flow car.

Designers know what the future automobile will look like and so do the manufacturers; and the same is true of radio. But the change must be gradual, for another very important duty of the industrial designer is to take care that his company remain in business.

There is no question but that this patient designer who can see the necessity of temporizing, will be and is criticized by some of his colleagues. But happy indeed would be that mythical state where the designer would have the opportunity to work unhampered by any thought of sales, of manufacturing costs, of merchandising problems, or of educating the public.

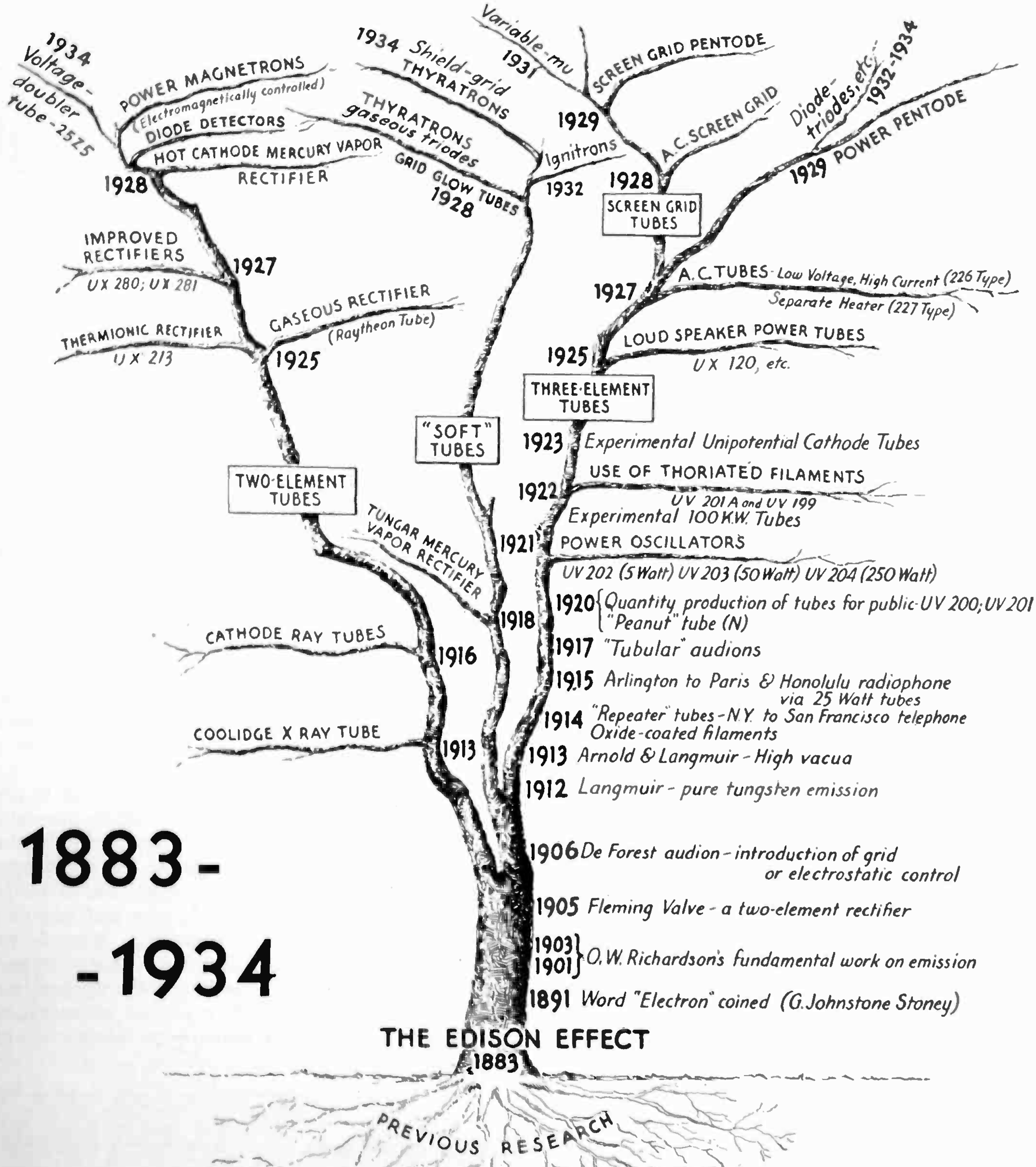
The most a designer can hope to do for radios in the next few years is to clean the surface, and clear the radio of over-decoration, while still retaining that so-necessary "eye value" and preparing its form for the proper installation of the perfect speaker. The radio set has weathered the horrors of the modernistic, and I have no doubt but that it will muddle through neo-classicism, geometric modern, and romantic modern before it evolves into its true identity. But by that time, perhaps we'll have television and any number of other inventions for the designers to work on.

Decoration is not industrial design. In the true analysis, the industrial designer must seek to co-ordinate and uncover the basic value and function of the thing on which he is working and to give it its proper dress.

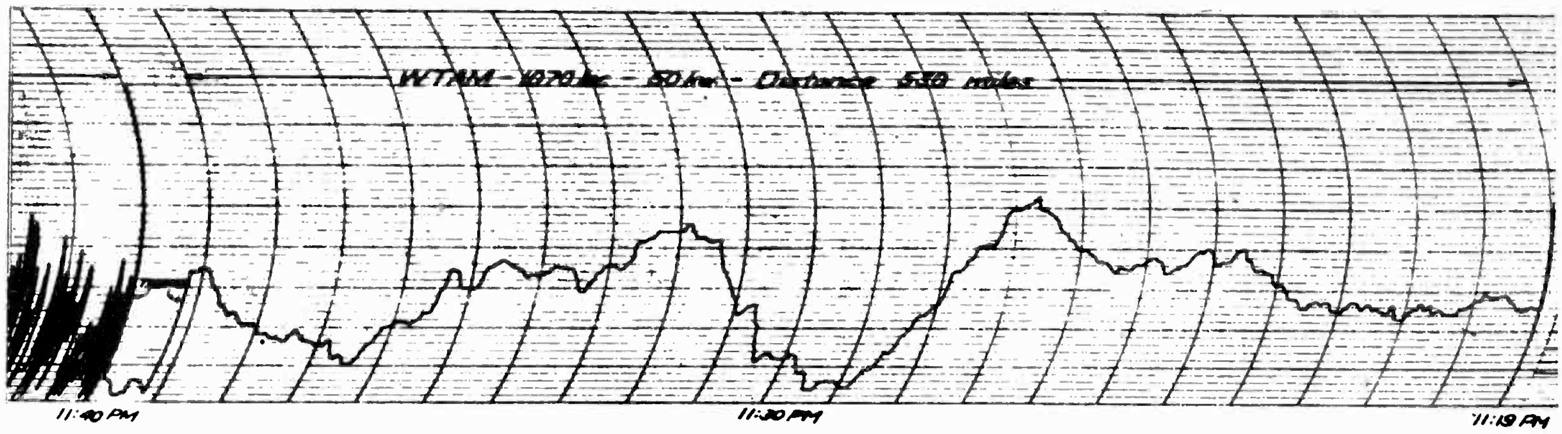


Radio cabinet of glass, macassar and ebony designed by Joseph Aronson, exhibited at Rockefeller Center during April

EVOLUTION OF THE THERMIONIC TUBE



So rapid are the changes in the tube art that the chart showing the Family Tree of the Thermionic Tube, first published in Electronics, May, 1930, is out of date. Therefore, recent additions have been made showing the new branches to this fast-growing tree. Such tubes as the variable-mu, voltage-doubler, the many combinations of triodes and diodes and pentodes were unthought of in 1930—but will be found on the tree above.



Automatic recording of field strength

BY C. M. JANSKY, JR.,

Jansky & Bailey, Consulting Engineers, Washington, D. C.

IN MAKING studies of the primary and secondary service areas of broadcast stations, we have been using graphic recording instruments to provide a record of the changes in intensity in field strength at various points, in this way studying the intensity of signal laid down by the station under examination, the effects of other stations and of interference in the original station's signal, and also the effects of fading on station performance.

This effect of fading is well shown in the accompanying records, which were made from a point near Columbia, S. C., late at night during February of the present year. First we tuned in on Station WTAM on 1,070 kc., located 500 miles away, and obtained the record of slow swings in fading shown at the top of the page. In these curves, clock time begins at the right and runs from right to left. In the WTAM record, the received quality was good, and the swings in intensity were so slow that with a good automatic volume control, the changes in intensity would hardly be noticeable to a casual broadcast listener. Yet as the recording instrument shows, the intensity, while averaging about 600 microvolts per meter, at times reached peaks of 1,000 microvolts, at other times dropping to 200 microvolts or lower.

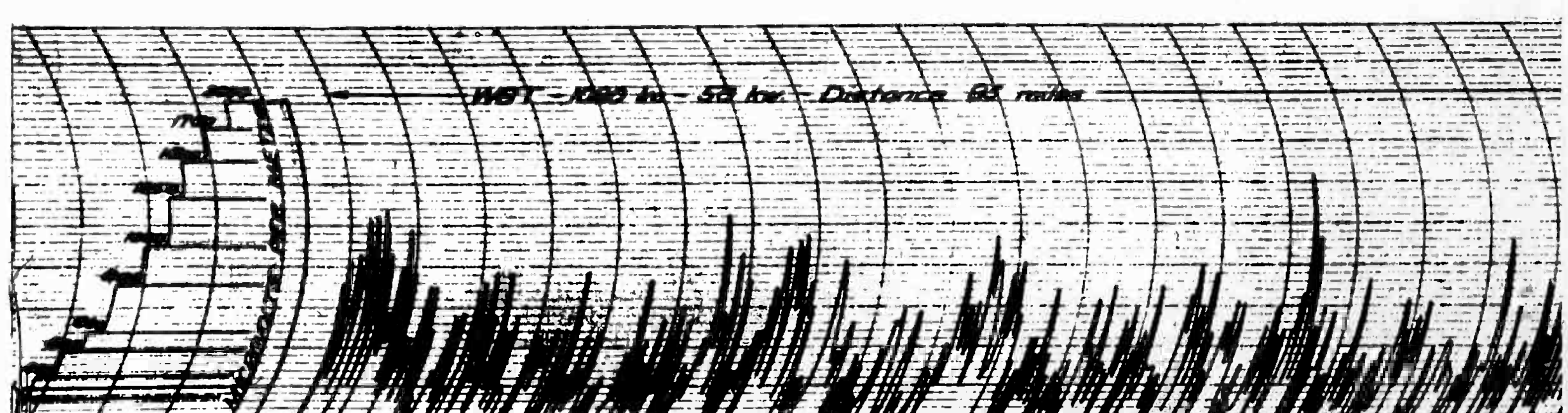
Immediately after making the WTAM record shown we tuned in on the adjoining channel on station WBT (50 kw.) on 1,080 kc., located 93 miles away. Here although the average field strength was in the neighborhood of 500 microvolts per meter, there were rapid swings of fading, carrying the intensity at times down to less than 50 microvolts per meter. Momentary peaks ran as high as 1,250 microvolts. The rapid fading of WBT shown was also accompanied by sound-distortion effects which were objectionable.

Thus these curves strikingly illustrate a point which the writer years ago brought to the attention of radio engineers—that under night conditions the program service range of a broadcasting station may actually be better at 500 miles than at 90 miles, providing the station has adequate power to deliver a good signal.

The field-intensity measurements shown were made with apparatus of our own design carried on an automobile, using a vertical antenna. Records can be made with either a vertical or a loop antenna.

The special receiver is provided with a special amplifier, which drives the Esterline-Angus recording instrument delivering the automatic record shown. The intensity-measuring apparatus is calibrated from time to time by means of known signals. Such a calibration is shown at the left of the lower curve, and indicates the calibration made at the end of the test on WBT, which calibration agrees accurately with the calibration made at the beginning of the measurements on WTAM (not shown here).

The use of automatic recording instruments presents many advantages over the old method of manually putting down readings made by an operator. In the case of the automatic graphic instrument, there is no question as to the values observed, and with such an instrument it is possible to follow rapid changes and swings which could not be noted by an observer. Records may be made continually for any length of time. In one case we made a continuous recording covering five hours of operation. The apparatus is ready for operation as soon as the car stops, and can instantly go into service making its automatic record.



Power transformers for automobile radio vibrators

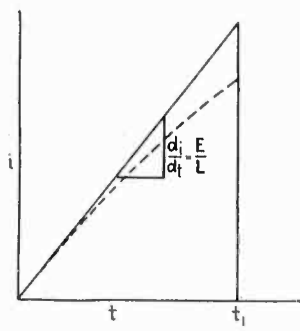
BY V. C. MacNABB
Chief Engineer
Rudolph Wurlitzer Mfg. Co.

THE design of power transformers to step up the voltage produced by the mechanical interruption of direct current (by such a vibrator as used on automobile sets for example) requires entirely different treatment than the conventional power transformers used on alternating current circuits.

The design of the transformer itself in combination with the vibrator determines the voltage and current waves produced and is not dependent upon a prime source of fixed wave shape such as the sine wave available from a 60 cycle a-c generator. Some of the problems involved in the design are the production of a wave form of good rectifying characteristics, good efficiency and, above all, which permits a long life to the contacts which are doing the interrupting. It so happens that if the transformer is designed to satisfy the last requirement the other two are taken care of.

The theory behind the operation of any d-c interrupter which makes and breaks the current for the primary of an iron-core inductance, the secondary of which is connected to a load of approximately unity power factor is as follows: When the contact is made the primary current increases from zero at practically a uniformly increasing rate over the first part of the transient according to the formula $i = Et/L$. This curve is illustrated in Fig. 1 (the solid line) and indicates what would happen if it were possible to build a perfect inductance which had no resistance or loss of any kind. At some time t_1 the contact is opened and the current falls rapidly to zero. Under this ideal condition the voltage curve illustrated in Fig. 2 is the battery voltage across the primary divided by the primary turns. This voltage exists in every turn of the secondary circuit and supplies current to the secondary load in accordance with the resistance of the secondary load.

The criterion for proper operation of this transformer is that the contact should open at such a value of primary current that the primary power obtained from the battery up to the time t_1 is equal to the consumption of secondary power in that time. If the contacts are opened at that instant there will be no excess energy stored in the iron and therefore the contacts will not be called upon to discharge or dissipate any stored energy and therefore they will not spark. If the primary inductance had been made lower so that in the time t_1 a much larger amount of energy had been taken from the primary battery than was needed in the secondary circuit this excess energy would have been stored in the iron and would have been dissipated as sparking at the contact when it was opened. On the other hand, if the inductance had been higher than the ideal, insufficient energy could have been derived from the primary battery in the given time so the power available for the consumption in the secondary would have been lowered.



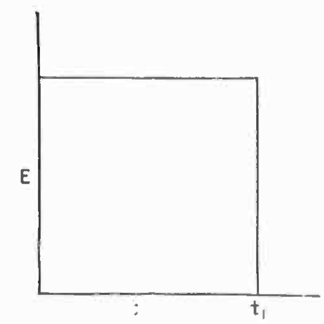


Fig. 1 (left)—Rate of increase of current with time.
Fig. 2 (right)—Voltage curve in ideal case of no losses.

Using the above hypothesis, a formula can be derived for the primary turns as a function of the iron circuit, the same as may be done in the design of a power transformer in use on alternating current. A few simplifying assumptions need to be made; (1) that there is no exciting current;—i.e., that the current required to produce the flux in the iron is either negligible or zero, (2), that the primary and secondary of the transformer are coupled 100 per cent, (3) that the primary resistance is zero and (4), that there is no distributed capacity. These assumptions however, are not intended to imply that the transformer does not have losses.

Let E_2 = — sec. volts
I_2 = sec. current
η = efficiency of trans.
I_{1a} = average primary current
I_{1m} = peak primary current
K = per cent time contacts are closed
f = frequency of vibrator
P_1 = primary power
E = primary voltage
S = cross sectional area of iron
B = flux density
t = time contacts are closed

$$P_1 = \frac{E_2 I_2}{\eta} \quad (1)$$

$$I_{1a} = \frac{P_1}{E_1} \times \frac{1}{K} = \frac{E_2 I_2}{\eta E_1 K} \quad (2)$$

$$I_{1m} = 2I_{1a} = \frac{2E_2 I_2}{\eta E_1 K} \quad (3)$$

From $e = \frac{d(N\psi)}{dt}$ under assumed conditions

$$E_1 = \frac{N\psi}{t} = \frac{NBS}{t} \quad (4)$$

$$I_{1m} = \frac{2E_2 I_2}{\dfrac{\eta NBSK}{t}} \quad (5)$$

$$f = \frac{1}{t} \times \frac{K}{2} \quad (6)$$

$$I_{1m} = \frac{E_2 I_2}{\eta NBSf} \quad (7)$$

$$I_{1m} = \frac{Hl}{\Lambda} \quad (8)$$

$$\frac{Hl}{\Lambda} = \frac{E_2 I_2}{\eta NBSf} \quad (9)$$

$$BH = \frac{E_2 I_2}{\eta Sfl} \quad (10)$$

The number obtained for the right side of equation 10 is equated to the product of BH and the solution of these two quantities is obtained from the saturation curve of the iron to be used. This is a trial and error process and involves selecting a point on the BH curve and finding if the product of B and H at this point is higher or lower than the number obtained from the formula and then progressively picking different points until the right one is obtained. The value of N or primary turns is then obtained by substitution of the value obtained for H into equation 8 using the maximum current value obtained from equation 3.

It may be found that the point on the saturation curve which is the proper value of B and H is well above the knee of the curve and the peak flux density is much higher than is ordinarily used in power transformers. This high flux density, which means a high exciting current, does no harm because these transformers considered from the heat standpoint are very liberal in design to satisfy other conditions, and therefore a little loss in the transformer does not mean anything as regards heat. Furthermore, the increased core loss is of little consequence. However, it may be found that with the iron stack selected for the first try the flux density is very high and the ampere turns per inch high and the primary turns required to satisfy the conditions will be so great that it will be impossible to get sufficient wire in the window space available. For proper design of a vibrator transformer, more iron is needed to handle the same amount of power than would be required on a.c. because of the entirely different conditions of design. For example, the same amount of iron will handle three or four times the wattage on straight a.c. than will give proper design on an automobile vibrator transformer.

The above formula and design were worked out on the basis that the primary of the transformer has zero resistance. To approximate this condition unusually large primary wire would have to be used which would make the transformer for commercial automobile sets bulky and expensive. Actually if economical design is followed the IR drop in the primary will be an appreciable percentage of the primary voltage when the primary current has reached its peak just before the contact opens. Therefore, instead of the plot of the current being a straight line as in Fig. 1 it will be a curved line such as the dotted line drawn in Fig. 1. This means that the primary current will not have reached the ideal peak value at the time t, if the transformer primary is designed according to the above formula. An approximate way of correcting for this is in the formula for the maximum primary current by making the primary voltage equal to the battery voltage minus the IR drop or

$$E^1_1 = E_B - I_{1m} R$$

$$I^1_{1m} = \frac{2E_2 I_2}{\eta K(E_B - I_{1m} R)}$$

$$\text{Then } N^1 = \frac{Hl}{I^1_{1m}}$$

I_{1m} is of course, a function of E, but the above approximation will give sufficiently accurate results.

This allows the primary turns to be reduced in number and the primary current to go to a higher value. This value, multiplied by the primary voltage associated with the pure inductive component of the battery voltage $E_L = E_B - I^1_{1m} R$, allows the peak primary power to go to the value required by the secondary load. The ideal condition of no distributed capacity is unattainable and when a contact closes the secondary voltage oscillates and may reach peak values ten times the normal desired secondary voltage. These peaks may be reduced by shunting the secondary with either a resistance or condenser of the proper value, either of which will lower the effective shunt impedance of the tuned circuit. The resistor generally used is one which has a low resistance when connected across a source of high voltage and a high resistance across low voltage.

With a tube rectifier a shunt of some kind is necessary until the tube warms up. When the tube becomes hot the first filter condenser acting through the low impedance of the tube is a shunt for the oscillating current, even if no resistance load is present.

Figure 3 shows the wave shapes appearing under various circuit conditions. In (a) the 200,000 resistor used to tap off the voltage for the oscillograph acts as a sufficient load to cut the peaks so that they reach only twice the normal value. In (b) the effect of an 0.02 μf condenser in reducing the peaks is shown. Curve (c) shows the effect of the electrolytic condenser acting through a tube with unilateral conductivity. The positive swings of the oscillation are prevented but the negative swings persist. In (d) it is seen that with no condenser directly across the secondary the choke and tube act as a very high impedance to the oscillations and do not damp them. Curve (e) shows the results obtained in a properly designed power unit for an automobile receiver.

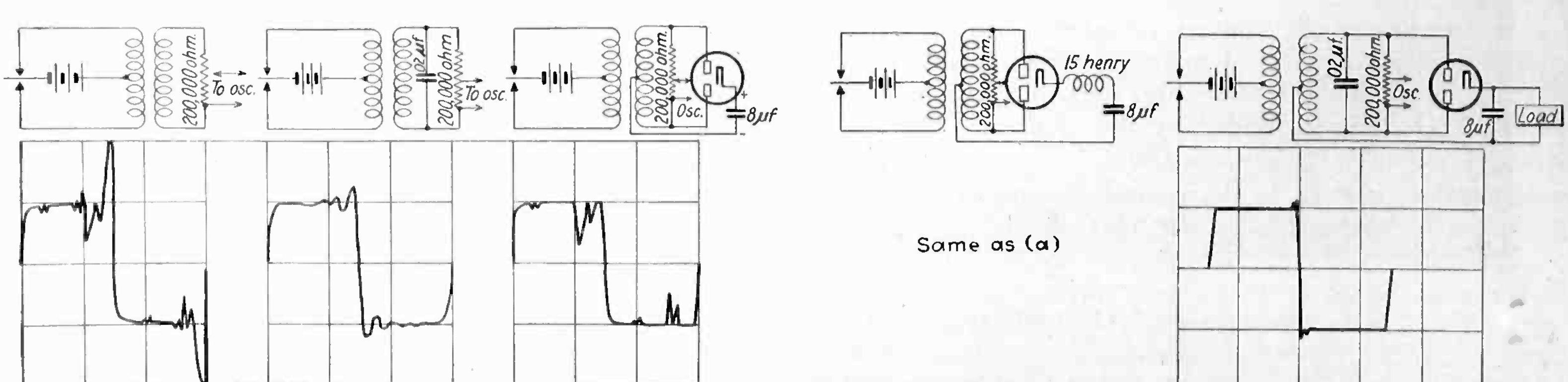
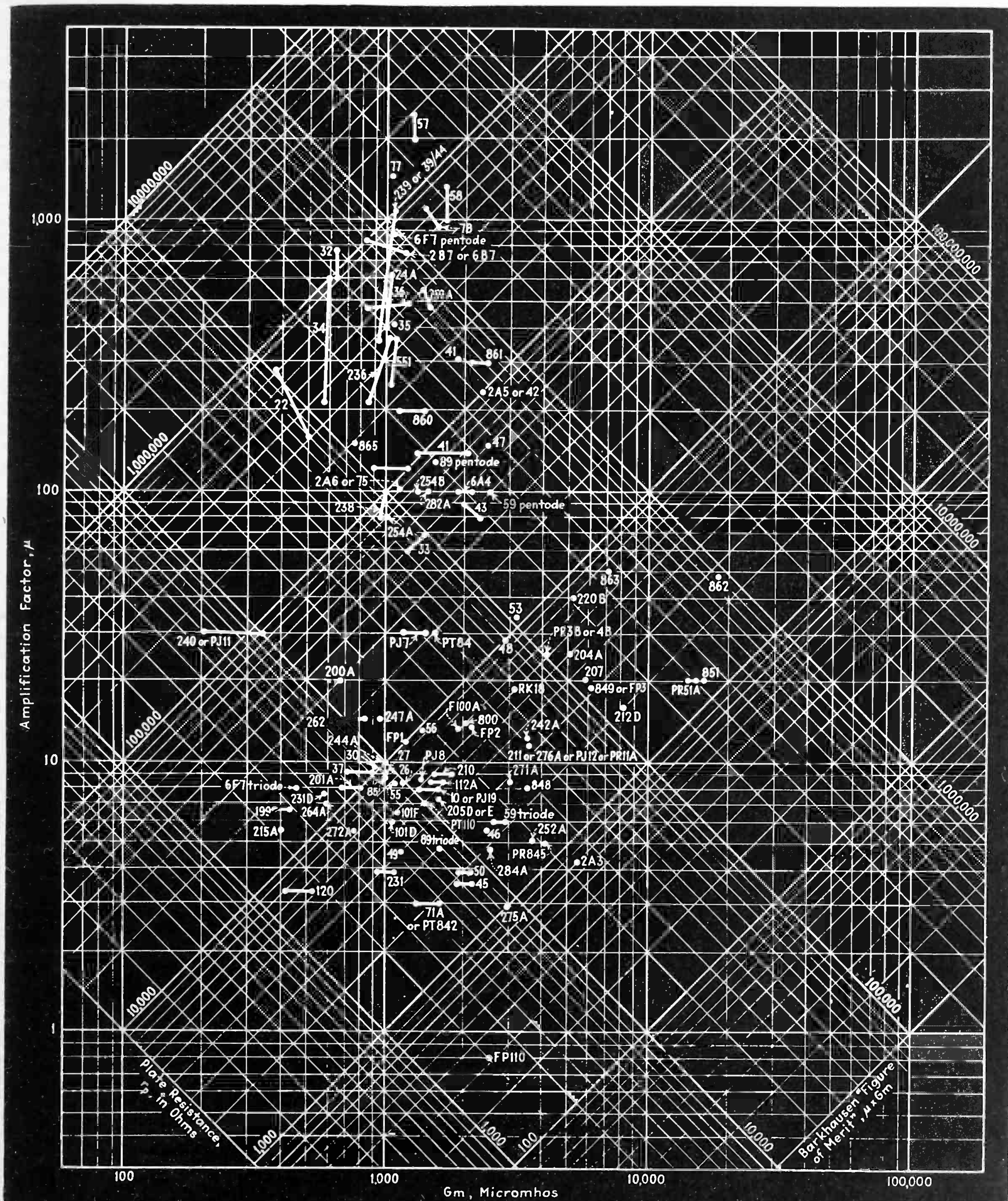


Fig. 3—Effect upon wave shape of varying circuit conditions, as shown by cathode ray oscillograph.

Characteristics of 1934 Tubes



Important electrical constants of many of present-day vacuum tubes will be found on the above chart prepared by Professor H. R. Mimno of Harvard University. His remarks on the origin of this method of showing tube constants will be found on page 158 of this issue of Electronics, in which he uses the term "Sp" for mutual conductance.

Microphone switching systems

for broadcast stations

BY LOUIS W. BARNETT

Station WLW, Cincinnati, Ohio

PROPER studio equipment for handling programs involves not only means to easily and quickly control the volume from pick-up microphones but rapid switching facilites to turn the output of one or another microphone into its proper channel. The large studios are well equipped with intricate switching mechanisms of many kinds; many smaller stations, however, have not been able to spend the money for expensive equipment of this nature.

The paper below describes a microphone switching system for stations having two, or more, studios; a system that can be constructed by the station personnel; and one which will effect rapid and smooth handling of programs, aiding the program engineer to get his microphone faded in at the proper time; and preventing any one studio from being cut-off the air by another studio so long as the first studio's program is not complete. That is, the circuits shown make it impossible to interrupt any program in progress in one studio by an announcer in another studio before the proper cue is given or before the circuit is released by the engineer or announcer in charge of the program.

Push-button switching of microphones and channels is the quickest of all methods insuring a fast-moving technical set-up. It is a pleasure to operate such a system, for it is possible to fade the proper microphone in and out at the precise desired moment, thereby making perfect the continuity of speech and music. The system to be described should appeal to stations of small means because it is not costly to build, and operates as well as expensive equipment if proper care is taken in construction.

Figure 1 shows the fundamental circuit employed in a typical push-button switching circuit. Here are push-button closed and open circuits, a signal light showing operated position and a relay having holding contact and microphone circuits. By pushing the "on" button the relay contacts are closed and held through the holding contact across the push-button circuit. The "off" button is the closed circuit key and is to destroy the potential on the holding contact. In the operated position the signal light is on and shows a completion of the audio circuit. A series of four such circuits comprise one studio channel operating four microphone positions or input circuits. In Fig. 2 a four-position channel is shown along with a four-studio interlock system which prevents more than one studio operating into the same channel at the same time. A change in the fundamental lay-out may be made to operate more than one studio at a time into separate channels. By operating any one of the four interlock positions in Fig. 2 potential is placed on the proper relays and the circuit in the relay legs of the other circuits are opened so the potential may not be available for energizing another studio set-up at the same time one studio is on the air. The circuit shown in Fig. 2 was designed to work four studios into four channels.

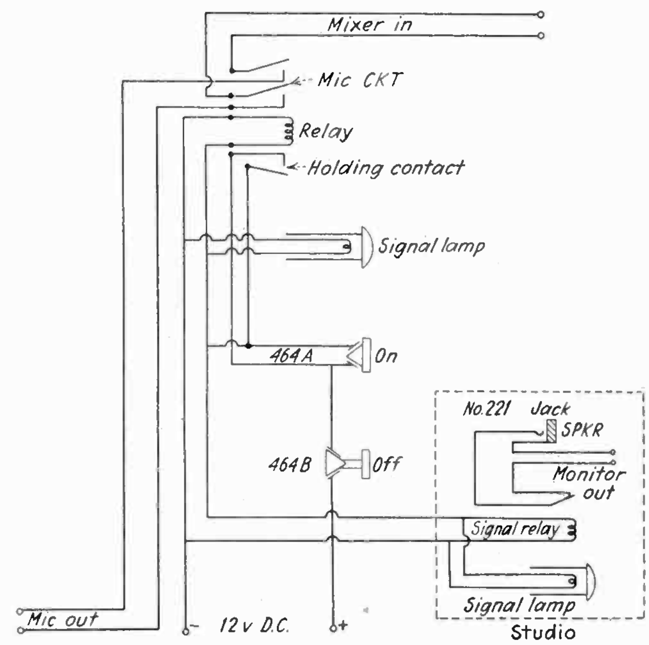


Fig. 1—Fundamental switching circuit.

In case it is desired to use any studio for audition purposes the circuit will have to be altered slightly by placing a shorting key around the relay, cutting off potential to the audition point. The circuit shown in Fig. 2 is more elaborate than will be required in most small or medium powered stations. It has four amplifier channels and four separate mixer set-ups, connected in such a manner that one studio only may be on-the-air at one time. The interlock feature is very desirable in small stations, but may be altered to switch mixer outputs instead of making and breaking relay potential in case only one amplifying channel is to be used in the last leg of the circuit. The local studio microphone circuits in Fig. 2 are shown in only one studio, but are the same for each. General Radio 652 MA faders are used in the four position mixer circuits. The more recent type 653 series will be found much more satisfactory if used with velocity or dynamic microphones without pre-amplifiers. It is a common practice, however, to use a separate pre-amplifier with each microphone of these types due to the very low level obtainable from them—usually in the neighborhood of —80 to —90 db.

It is very important that compensating resistors are used in all mixer circuits when the fader is to be cut out of the circuit when the microphone is not in use. In Fig. 2, 50 ohm "bug" resistors are used to compensate for removal of the 652 MA faders in each leg of the relay circuit and are to keep the impedance as near constant as possible when only part of the series faders are in the circuit. The relay action is so fast when placed in the operated position while in use during a program that the removal of a microphone from the circuit is not noticeable. The time taken for the relay contacts to travel from the microphone circuit to the resistor circuit is so short that the slight change in impedance is not discernible. Two sets of push buttons are shown to be in every studio and control room set-up, but the studio push-button circuits may be left out if all the microphone switching is to be done in each separate control booth.

The interlock keys may be used only in the master control room or may be carried on each separate control room panel, according to the wish of the engineer in charge of construction. Each studio has a loud speaker to signal the artists and announcer when a previous program is about to end. If studio A is on the air, all the loud speakers in all the other studios will be operating, but when studio A announcer or operator depresses his "off" button his audio circuits will become dead and another studio may take control by depressing its interlock button. The complete cycle of operation to go on the air from any studio is as follows: first depress the individual interlock button (in case of studio A—depress "interlock A-On") which throws current on studio A relay circuit, then any of the microphone buttons in studio A may be depressed and the corresponding signal light will flash on and stay until this circuit is released. It will be impossible for any other studio circuits to be put into action while studio A is on the air, because all potential has been removed from all other interlock circuits through the automatic relay circuits. In Fig. 2 all interlock circuits are in the master control room and the interlock buttons for the individual studios are placed in each of the respective studios. In some layouts no interlock buttons will be provided in each separate studio because of the complicated wiring necessary, and all interlocking will be done by the master control operator. It is policy with the Chicago N.B.C. studios that channel set-up be made by the announcer going on duty. He is given a small picture lay-out of the control box in the studio with circles marked around the buttons to be pushed before the start of the program to set up the proper channel. This may be taken care of by the operator in the control booth, and such is done in the Chicago studios of Columbia.

Figure 3 shows a two studio set-up using a small control box in each studio and in which all microphone switching is done by the announcer on duty. One key is used to control the announcer's microphone and the other is used to control all of two or three program microphones as originally installed. The interlock system in Fig. 3 is used only to destroy or breakdown either of the circuits in the two studios. In case of an error in switching by the announcer the interlock circuit is opened and all signal lights immediately go out, signaling to the announcer on duty in his respective studio that an error had been made in the original set-up and his keys must be returned to normal postiion and the set-up be remade. Only about two seconds are required to complete the cycle of operation. In Fig. 3, when the Annc 479 A key is in the operated position the announce microphone circuit is completed through to the fader in the control room. When the Pgm 479 A key is in the oper-

[*Please turn to page 170*]

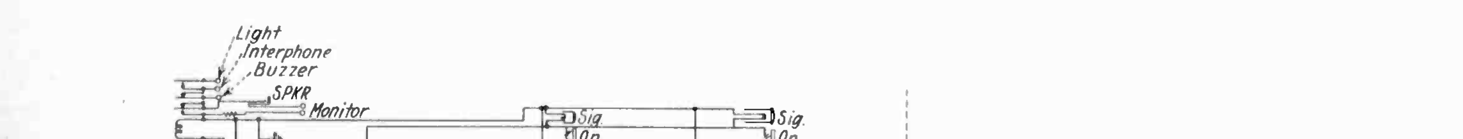


Fig. 2—Four-studio interlocking switching system. The local microphone control circuit is shown complete in studio A; the others are identical in form

HIGH LIGHTS ON ELECTRONIC

Gigantic welded pipe tested with X-ray

To PROVE THE soundness of the welds in the mammouth pipe now being fabricated for the Boulder Canyon Project by the Babcock & Wilcox Company, mobile X-ray apparatus of 300,000-volt capacity is used. Ordinarily, in the fabrication of boiler drums and pressure vessels, the work thus examined is brought to the X-ray machine; but, in this case, the reverse procedure is necessary, because of the tremendous sizes of the pipe, some of which are 30 ft. in diameter and made of plates as thick as $2\frac{3}{4}$ inches.

Sections of these large-diameter pipes 12 ft. long are fabricated by joining together, by fusion welding, three suitably curved plates of the largest size that can be rolled with existing steel-mill equipment. Two such lengths, joined to a stiffener ring between them, comprise an erection-section weighing approximately 170 tons and having the equivalent of three longitudinal seams and two circumferential or girth seams. The deposited weld metal of the seams must be of proved soundness, because of the pressure to which the pipes will be subjected—as high as 300 lb. per sq.in., with allowance for water hammer—and the enormous quantity of water in the world's largest artificial lake, the flow of which must be controlled by and through these conduits.

The X-ray photographs show clearly such defects as marked porosity, slag inclusions, and incomplete fusion, even though these defects be present in such slight degree as to permit the explored weld to pass the most rigid codes.

In fabricating the required 14,500 linear feet of pipe, ranging in diameter from $8\frac{1}{2}$ to 30 feet, more than 400,000 linear feet of welded seams will be made, and their exploration by X-ray will consume more film than has been used for all other industrial purposes in this country to date.

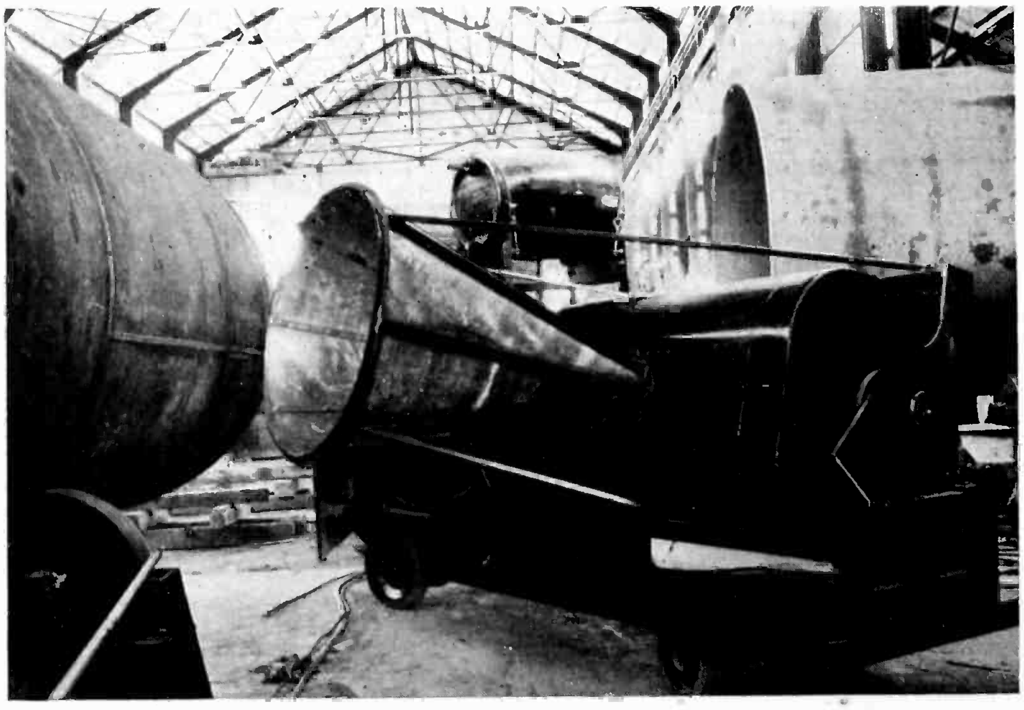
✦

Time switch starts station WLW

BY AUTOMATICALLY turning on the cathode heaters of the rectifier tubes a half hour before the 500-kw. Crosley Station WLW in Cincinnati goes on the air, a General Electric time switch allows an extra half hour of sleep for the operators of America's largest radio station. By the time the operators arrive, the rectifier tubes have received their required thirty-minute warm-up and are ready for the day's broadcasting.

At a scheduled time, a standard T-13 time switch turns on the current and energizes the 220-volt a-c coil of a contactor, the poles of which connect the a-c supply to the primaries of the six cathode-heating transformers. This switch utilizes a Telechron timing motor identical with those used in the synchronous clocks on which depend WLW's accurate time schedule.

Automatically controlled, the unmodulated carrier power delivered to the antenna is 500 kw., and the instantaneous power on peaks of modulation is 2000 kw. Approximately 74 tubes are required in the complete transmitter, including 32 in the existing 50-kw. transmitter.



X-raying the $2\frac{3}{4}$-in. plates of the Boulder Dam steel conduits for faulty welds

Door for invalids at Warm Springs, Ga.

AT GEORGIA HALL, Warm Springs Foundation, Warm Springs, Ga., the resort for "infantile-paralysis" (poliomyelitis) patients, in which President Roosevelt has been interested, a self-opening photo-cell door has just been installed.

There are two light beams, one at each approach to the door. Upon interrupting one beam the door opens and is held open by a delay mechanism, until the second beam is intercepted, which causes the door to close. If, however, the second beam is not intercepted in a reasonable length of time, the door closes anyway, automatically. The Stanley door mechanism is air-operated.

✦

Microphones in the cemetery

MANY PERSONS ARE PURSUED by an unreasoning fear that they may some time undergo a temporary coma simulating death, and be actually buried alive, only to "wake up" and find themselves interred in a coffin five feet underground.

One victim of this fear of being buried alive, has made advance arrangements with his undertaker and cemetery, by means of which a sensitive microphone will be installed inside the coffin and connected with loudspeakers in the cemetery caretaker's dwelling nearby. This microphone circuit is to be kept continuously energized for at least a year after interment, during which year it is to be regularly tested by sounding a small gong in the coffin.

With an electronic channel thus provided as a means of calling for help, the "customer" feels that if buried prematurely he needs only to turn to the mike and call the rescue squad to his relief. The microphone-equipped coffin and the running of the line to the cemetery plot have all been completed and tested in advance, by the future possible user, giving him full assurance that everything will be in order when the time for use comes.

Amplification of recorded music has also been a new feature of chapel services in modern cemeteries. Organ numbers, as played by great performers, can be switched on for any ceremonies. One particularly progressive cemetery has provided outdoor plug-in outlets in various parts of the cemetery grounds, so that during the ceremonies at the grave and the actual interment, lovely music can be supplied, coming from a background of trees.

DEVICES IN INDUSTRY + +

Applause-meter in amateur theatrical contest

To DETERMINE THE RELATIVE popularity of amateur actors and entertainers appearing before its outing audiences, the employees' organization of the Philadelphia Rapid Transit Company made use of an applause-meter principle to measure the intensity of applause during a seven-second period following the appearance of each team.

A double-button carbon microphone was hung over the audience, and the output of this fed to a two-stage amplifying set, according to L. E. Summers, assistant operating manager of the PRT subway-elevated division, who supervised the sound-measuring equipment.

The meter to record the applause presented quite a problem. It was necessary that it respond with reasonable accuracy to a wide range of frequencies; that it have a scale sufficiently large to be observed easily by the judges and other interested persons; that it respond to a very feeble current flow, and that it be extremely "dead beat" in order that the peak reading might be readily determined. In view of these requirements, the use of any available type of a.c. meter did not seem practicable. Therefore, the experimenters decided to rectify the output, and then measure it with a d.c. meter which could more completely fulfill the foregoing requirements. A "Kuprox" copper-oxide, full-wave rectifier was connected between the secondary of the output transformer and the meter. A large, station-type d.c. ammeter with illuminated scale, such as is ordinarily used on power house and substation switchboards, was selected. The meter was originally designed to indicate a maximum current of 800 amperes when bridged across a shunt. For this special purpose the element of the meter was directly connected to the output of the rectifier, and when so used indicated "full scale" with a current flow of 33⅓ milliamperes.

A Union Switch & Signal Company SLV 13 relay, together with a U. S. & S. Company SV 20 speed control relay set at seven seconds, started the system and lighted the lamp over the stage, cutting off after seven seconds. Also, during the seven-second interval, by means of the SLV 13 relay, the output circuit of the public-address system was opened to prevent the P.A. microphone picking up the applause and intensifying volume of applause through the P.A. horns.

It was noticed that shrill whistling had greater effect than the volume of sound warranted. If experiments are continued next year, an attempt will be made to filter out the high frequencies caused by whistling, and to confine the record to the lower frequency sounds produced by hand clapping, a type of applause in which anyone may participate, and which varies directly with the number of people applauding and the vigor of their actions.

✦

Protecting a million-dollar painting

WHEN THE FAMOUS painting, Whistler's "Mother," was on view at Dayton, Ohio, the million-dollar canvas was guarded by a series of electronic protection devices, installed under the direction of Gisbert D. Bossard, president of the General Kontrolar Company, of Dayton.

A system of infra-red "black light" beams, with all generating and light-sensitive equipment installed in the walls, made it impossible for anyone to approach or disturb the canvas without sounding several alarms, including a police siren that could be heard for several blocks outside.

A second space-control protection made it imposible for any human body to approach the painting, without the siren sounding. A third system of invisible light focussed on the painting and its frame, reported even the slightest movement of the picture itself.

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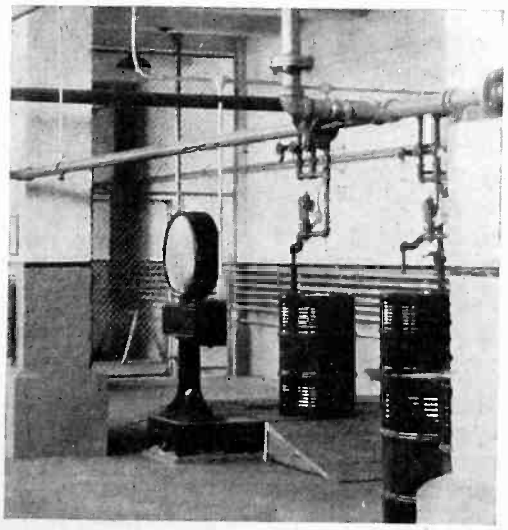
Barreling of alcohol speeded by photo-cell



AT THE GREAT PLANT of the New England Alcohol Company, at Everett, Mass., with an output of 3,000,000 gallons of alcohol per year, made from molasses, a photo-cell on a scale beam permits the automatic filling of the steel barrels in which the alcohol is shipped. Barrels being filled are seen as the two dark objects at the right of the scale dial near the bottom of the accompanying picture.

The steel barrels are put on the scale platform by hand, and a tare-beam setting automatically makes allowance for the weight of the steel container. When the predetermined weight of alcohol has flowed into the barrel, the deflection of the scale pointer intercepts a photo-cell which, through relays, controls the shut-off valves in the supply lines leading from the large overhead tanks. The installation was made by R. R. Collins of the Lummus Company, 50 Church Street, New York City.

✦

Photo-cell is faster than bullet

THE ALLEN-BRADLEY COMPANY, Milwaukee, Wisconsin, has been displaying a novel convention exhibit in the form of an air-gun, the projectile from which passes in front of a photo-cell controling a picture 30 ft. away, in the line of fire. This picture shows Chicago's Public Enemy No. 1, and the purpose is to aim the gun at the picture and shoot a bullet through the Public Enemy's forehead.

But as the gun is fired, the bullet passes in front of the photo-cell which works a relay, withdrawing the picture, and so the Public Enemy seems to dodge out of the way of the bullet, which then strikes a bull's-eye.

The effort is to aim the gun and fire the bullet to hit the figure. But invariably the photo-cell impulse "gets there first" and the picture is pulled out of the way, so that the bullet hits only the target.

✦

Loud-speakers or machine-guns?

DURING THE PARIS riots of February last it is alleged that the three trumpet warnings required by law were duly given to the crowd before the troops fired, but that these warnings were inaudible. As a result, at the suggestion of *Toute la Radio,* one of the progressive French radio papers, it is now proposed to equip the police with mobile public-address systems, so as to allow of the human voice dominating any crowd-noises, firstly in persuasion and then, if this proved ineffective, in warnings.

The machine designer looks at electronic industrial control

By ROBERT W. CARSON
Product Engineering

ELECTRONIC equipment offers several important advantages for use in industrial electrical control. Exposed arcs are eliminated since power is conducted within an electronic tube by ionized gases. No mechanical inertia or time lag is involved. The operation of electronic tubes is silent. And there are no current-interrupting surfaces to keep clean and in adjustment. With these advantages, in addition to the flexibility of control possible with tube operation and the small amount of operating power required, electronic devices have large commercial possibilities.

In electric motor controls, for example, electronic tubes can perform functions now performed by magnetic contactors with less noise, with no time lag and with less power in the control circuit.

In heater or furnace controls, sensitive relays can be replaced by tubes, increasing the sensitivity and reducing contact pressures in thermostatic controls.

In mechanical controls, limit switches, safety devices, register controls, automatic gauging devices, and other controls for machine tools and special manufacturing machinery electronic tubes can improve the performance and add to the functions of the machines.

Considering the advantages offered by electronic controls in all these applications, but little progress is being made at the present time in adopting electronic devices as original equipment. And the mechanical designer holds well defined reasons for leaving electronic controls alone, the most important one being that tubes and control units designed for radio use are not suitable for industrial applications.

For industrial service, ordinary radio tubes are too fragile, are too easily broken, and are too difficult to insert in sockets. They do not last long enough, particularly when subject to vibration. Tubes are too hard to service, too much equipment is needed, and too much skill is required.

From the factory superintendent's point of view, electronic controls look too much like radio sets; they are not sturdy, the parts shake loose, and cannot be repaired by the factory maintenance men. When something goes wrong with the control, the difficulty cannot be found readily.

Who then is in the most favorable position to develop more suitable industrial devices and tubes?

Should the mechanical designer learn tube design? Or should the tube designer learn to build electrical controls? Although several texts are available on the subject, the art of designing electronic tubes is too involved, and too specialized as well, for a mechanically-trained designer to gain a working knowledge in a reasonable time. On the other hand, the background and experience of the tube designer is so restricted—because of the highly specialized nature of the art—that the important factors of maintenance and service in machine operation will be underestimated.

On one side of the fence is the tube designer. His job, he thinks, is complete when he has filled in a list of blanks beginning with type number and ending with filament watts.

On the other side is the mechanical designer who appreciates in an abstract way the wonders of the electronic tube, and knows specifically the shortcomings of the radio tube in an industrial control.

But until each of these men get one leg over that fence, no fortunes will be made from industrial electronic controls.

Because of this diversity in point of view, joint action between the radio tube designer and the electrical control designer will be necessary, and each must have a conception of the limitations and requirements imposed on the other. In the first place, the mechanical designer must understand the fundamental principles underlying the operation of electronic devices. This should not be difficult since there are several good books on the subject. Then, the tube designer must learn the requirements of industrial controls. There are no texts on this subject—the tube designer will have to learn by contact with machine builders, by studying the requirements of various types of electrically operated power devices, by observing them in service and by discussing maintenance problems with machine users.

Obviously, the tube designer will have more difficulty in getting his leg over the fence, but once each designer understands the field of the other, their combined efforts should result in tubes and equipment entirely suitable for industrial use.

New requirements for tubes in industry

The new equipment must embody several fundamental changes both in tubes and complete devices for industrial electronic controls. Special requirements both as to performance and physical construction must be incorporated in the new tubes. Complete control devices must be developed using circuits specifically designed for industrial tubes, and likewise constructed to meet the particular needs of industrial applications.

Some of the new requirements of the industrial electronic tubes will be entirely different from the demands made of radio tubes. In the first place, longer service life is essential for industrial tubes. In radio use, the limited life of tubes may have some commercial advantage, but the life of the equipment with which industrial controls are associated is measured in years instead of hours. A tube for an electronic motor control, for example, should have an expected service life equal to that of the motor.

[*Please turn to page 170*]

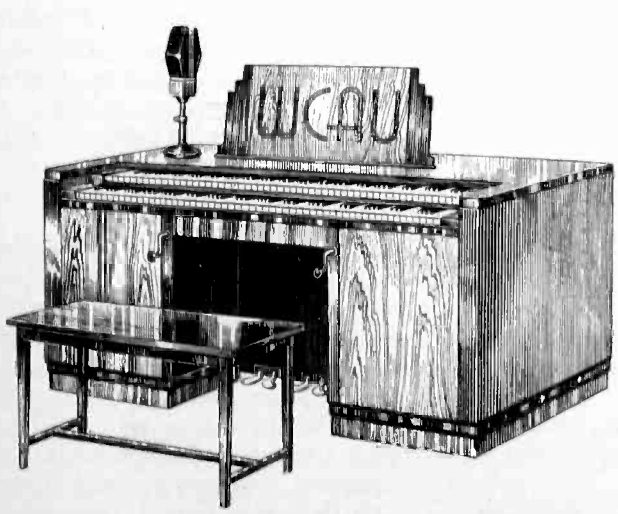
WCAU's photocell organ

Wide-film "pitch" and "tone-quality" sound-tracks

ONE of the centers of radio interest in Philadelphia which will undoubtedly attract the attention of visiting radio engineers during the I.R.E. convention this month, is the new broadcasting studio of Station WCAU, on Chestnut Street. Not only are the acoustic arrangements and decorations unique, but the studio building also has laboratories where experimental work is carried on by Dr. Leopold Stokowski, J. G. Leitch, technical director WCAU, and others.

At the present time a novel electronic organ is being developed in these laboratories, by Ivan Eremeeff, Russian inventor and experimenter in electronic musical devices. With this organ, Dr. Leon Levy, president of the WCAU company, expects to broadcast organ music of known and also hitherto-unknown tone qualities. Dr. Levy and Mr. Leitch feel that conventional pipe-organ music has never been broadcast in an absolutely satisfactory manner, owing to difficulties in sound distribution, resulting in inefficient "pick-up" by the microphone.

The accompanying sketches illustrate the new electronic organ which, in size, can be compared to the average office desk. The complete instrument is composed of two individual units each operating with its own keyboard. Cranks are provided for changing the tone quality of the sound for each keyboard, in place of "stops." The conventional bass organ pedals are omitted to reduce bulkiness, and such notes are included in the full-scale keyboards, so that a pianist, as well as an organist, can play the instrument without further training.



The complete electronic organ is no larger than a standard office desk

The compactness of the electronic organ is an advantage over the cumbersome pipe organ and it is easily moved about through the standard size studio doors. The instrument has a self-contained standard amplifier and speakers of high and low frequency range, with microphone outlets for announcing, and for the purpose of utilizing the instrument outside of the studios if necessary. Ordinarily, however, the output of the organ is plugged directly into the studio mike outlets and the sound is not heard in the studio but only as it comes over the air.

In the diagrammatic illustration of the single unit, *A* is the timbre or "quality" film, and is stationary excepting at intervals, when reset as desired by means of the cranks mentioned. *B* represents the uniformly-running, endless "pitch" film. *C* is a key operated shutter or light valve, which forms a part of the motorized diminishing device provided for producing a "fading" effect of the tones when desired. Such diminishing takes place when the springs of the shutters are held against the moving diminisher rollers.

When staccato and organ effects are desired, the

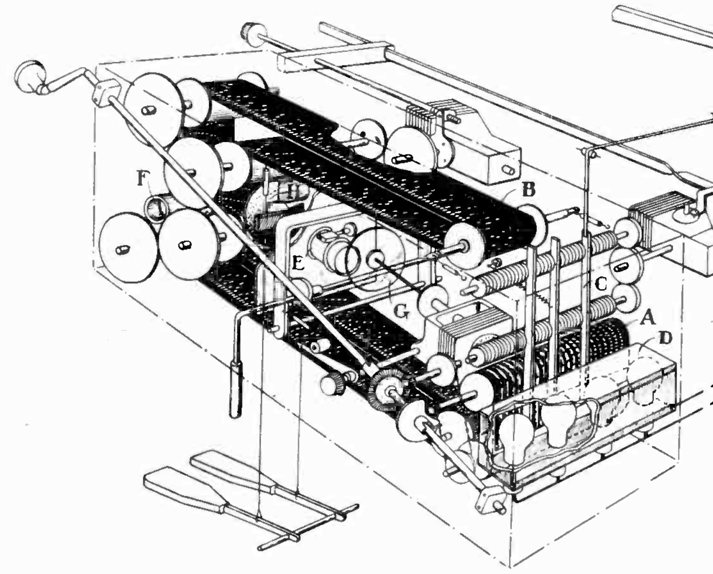


Diagram of one of the units, showing "quality" film A and "pitch" film B. Photo-cell pickup is at F

springs are released, and the diminishing rollers do not return the shutters to normal position, but allow them to fall back by their own weight. The light source *D* selectively illuminates predetermined tracks of the wave patterns of the quality film *A* when the cooperative shutters are raised by key action. Lens *E* focuses the images of illuminated wave patterns on corresponding tracks of the pitch film *B* whose running slits scan these wave patterns, permitting the passage of light to the tubular photo-cell element *F*. The current of *F* is then amplified to the level which is suitable for studio microphone outlets.

The tremolo device *G*, with pedal shown, produces a variable speed tremolo beat. When the pedal is depressed, the translucent disc dips and cuts off a small percentage of the intensity of the light beam passing through lens *E*.

The volume control *H*, also shown with its pedal, consists of a graduated translucency disc, placed in the path of the light beam as it issues from the other side of lens *E*, for the purpose of dimming the image falling on the pitch film *B*, thus controlling the volume of the output.

Tube classification chart

ON PAGE 151 OF THIS issue of *Electronics* is represented a chart worked out by Prof. H. R. Mimno, and published here through his courtesy. The following notes from Prof. Mimno explain the chart.

"This type of classification chart was suggested by S. J. Zilitinkewitsch[1], who classified about 30 European tubes and several of the earlier American tubes. An equivalent method was developed independently by F. W. Gundlach[2]. At the Cruft Laboratory, Harvard University, we adopted the European method, and have found it very useful when applied to the large group of current American tubes. A brief descripiton was presented at the December 1933 meeting of the I.R.E. at Cambridge.

The Barkhausen "Figure of Merit." $\mu_p S_p$, is a useful tube parameter which should receive more attention in American technical literature. For example, it measures the merit of the tube when used as a voltage amplifier in connection with a tuned transformer[3]. In general it characterizes the effectiveness of the design of the tube for a number of common applications. Note that many of the newer types of tubes have a high "Figure of Merit." Of course there are some new tubes such as the FP-110 and FP-54, which are designed for certain definite special applications where the "Figure of Merit" is of minor consequence.

Since $r_p = \mu_p/S_p$, the lines of constant r_p would be straight lines radiating from the origin, if plotted on a simple Cartesian coordinate system with μ_p and S_p as coordinate axes. On such a plot the lines of constant "Figure of Merit" would be given by a family of rectangular hyperbolæ. The use of logarithmic coordinates for μ_p and S_p permits a wider range of tubes to be represented without excessive crowding. The same change of scale converts the radial and hyperbolic loci into an auxiliary rectangular logarithmic coordinate system, rotated 45 degrees from the main system. This simplifies the construction of the chart and makes it relatively easy to read.

A single point on the diagram represents the Amplification Factor, Mutual Conductance, Plate Resistance, and Figue of Merit of one tube when operated under rated conditions. Wherever the manufacturers commonly recommend a range of operating conditions we have indicated this range by a short line on the chart.

Note that the tubes group naturally in several characteristic clusters. Small triodes appear on the lower portion of the chart. Large "power" tubes are found in an area which is somewhat higher and displaced to the right. Many of the multielectrode tubes may be found in the upper portion of the chart."

[1]S. J. Zilitinkewitsch: *Physikalishe Zeitschrift der Sowjetunion*, vol. 3, p. 606, 1933.
[2]F. W. Gundlach: *Elektrishe Nachrichten Technik*, vol. 9, p. 354, 1932.
[3]E. L. Chaffee: "Thermionic Vacuum Tubes," p. 303 (McGraw-Hill, 1933).

▲

SAM BROWNE BELT RADIO

A miniature radio receiving set invented by Ralph O. Gordon of Los Angeles, to be worn by policemen on their beat. The set is worn on a Sam Browne belt with an earphone attached to the cap, the whole weighing less than three pounds.

▼

Spark suppressors' effects—finis

THE FOLLOWING COMMUNICATION from Arthur L. Albert, assistant professor of electrical engineering at Oregon State Agricultural College, closes the matter of the effect of spark suppressors on automobile performance, so far as the editors of *Electronics* are concerned—at least until new data comes to hand.

"I have seen your article in February 1934 *Electronics* entitled *Effect of Spark Suppressors* on Auto Performance, and note you are interested in comments on the subject.

"Mr. W. H. Paul, Instructor in Mechanical Engineering, and I made a number of laboratory dynamometer tests to determine the effect, if any, of spark plug suppressors on the power output and efficiency of a modern six-cylinder automobile motor. We obtained a number of complete sets of suppressors from each of five different manufacturers, and, in some instances, these manufacturers submitted several different complete sets of various resistances, ranging from 5,000 to 50,000 ohms.

"Our motor was mounted on a testing block and was tested at low speed and light load, intermediate speed and load, and at high speed and heavy load. We could accurately measure fuel consumption and load conditions.

"As a result of our tests we found that the suppressors had no measurable effect on the performance of the motor, and I assure you we tried every legitimate possibility to make them cause trouble.

"I believe you will find that some of the manufacturers of suppressors have made quite thorough tests on the performance of motors equipped with their suppressors and have found little or no detrimental effect."

✦

First iron-core-coil receiver Stromberg-Carlson Model 68

BY ALBERT R. HODGES

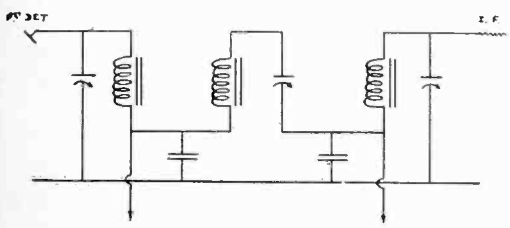
The use of iron cores to improve the selectivity and gain of high-frequency coupling devices is comparatively new. In fact, the use of iron in radio transformers has been until recently accompanied by a loss in selectivity and gain, thus making its use advantageous in untuned radio-frequency transformers designed to cover a wide band of frequencies. Furthermore, the inherent inefficiency of ordinary iron-core inductances resulted in greater stability.

Since eddy-current losses vary roughly with the square of the frequency, many attempts have been made to reduce these losses in iron cores intended for high-frequency transformers. Of these efforts, the work of W. J. Polydoroff, of the Johnson Laboratories, Incorporated, in Chicago, has been outstanding. He developed a new type of iron core employing finely divided pure iron, the particles being insulated from each other by a suitable material. This material may be compressed into any desired form, and the particle size may be chosen in accordance with the frequencies at which the finished device is to be used.

TUBES AND CIRCUITS + +

A material such as this has many uses in radio receivers. Its adaptability to permeability tuning is thoroughly covered by Mr. Polydoroff's paper in the May, 1933, issue of the *Proceedings of the Institute of Radio Engineers* and in Ralph H. Langley's article entitled "Tuning by Permeability Variation" in *Electronics* for July, 1931. The design of intermediate-frequency transformers using cores of this material is discussed by Alfred Crossley in the November, 1933, issue of *Electronics*. Mr. Polydoroff comments on iron-core in *Electronics* for January 1934.

Inductance coils using iron cores require fewer turns for a given value of inductance. For this reason they are



Circuit used in iron-core-coil receiver

smaller physically, and more efficient electrically, since copper and distributed capacity losses are lower. A compact and efficient inductance is obtained by mounting a universal-wound coil on a tubular core. The strong magnetic field surrounding this type of coil makes it possible to obtain a desired degree of coupling in a transformer by moving one coil only a slight amount from the position of zero magnetic coupling. If desired, the movable coil can be shifted in the opposite direction to obtain magnetic coupling which opposes any capacitive coupling which may be present due to stray capacity or to an intended coupling capacity. Or, on the other hand, the magnetic coupling may be made zero, and the transfer of energy from primary to secondary provided for by capacitive coupling at either the high- or the low-potential ends of the coils.

In addition to the flexibility in degree and type of coupling which may be realized, transformers using iron cores of the type described increase the selectivity or gain or both of the receiver in which they are employed, by a substantial amount. For instance, measurements on transformers designed for use at the usual intermediate frequencies indicate that both the gain and the selectivity may be roughly doubled over that previously obtained with air-core transformers. This permits better performance for a given number of tubes, and the improved results obtainable are of special value in all-wave receivers

The new Stromberg-Carlson Model 68 All-Wave receiver is the first commercial set to use iron-core intermediate-frequency transformers. This receiver employs an intermediate frequency of 370 kc., and the iron-core coils have a Q of about 175 at this frequency, which is substantially higher than that of commonly-used types of air-core coils. In this receiver, electrostatic coupling at the low-potential ends of the coils is used.

In high-fidelity receivers, in which the width of the band passed by the i-f amplifier is a matter of relatively great importance, these coils possess unique advantage. A manual or automatic adjustment of the coupling provides a very satisfactory way of obtaining variable selectivity to meet changing conditions of reception.

Iron-core coupling devices have advantages for antenna and interstage circuits. For instance, an iron-core antenna coupler was substituted for the air-core unit in a well-known make of auto radio. No other changes were made in the receiver. The actual measured overall gain increased four times, and there was a noticeable improvement in the signal-to-noise ratio.

In auto radios where compactness and efficiency for a given bulk are of paramount importance, iron-core coils are useful because they are not only smaller for a given value of inductance, but are more efficient than an air-core coil of the same inductance.

✦

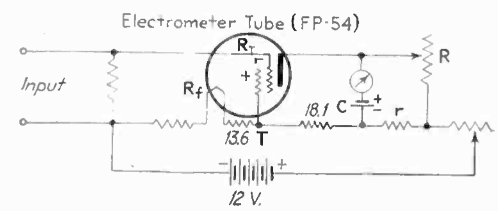
Interphone system using light wires

An ingenious use of the house wiring system as a carrier for interphone communication has been developed by the manufacturers of Universal microphones. The circuit as used consists simply in a microphone, a modulator and an oscillator coupled to the house wires through small capacities. The modulated signals are taken from the housewires and put into a radio receiver of conventional type.

This method of "wireless" communication may remind readers of the Blatterman system of remotely controlling a radio receiver from any place within the owner's dwelling by using the light wires to carry the output of a mobile oscillator to a superheterodyne receiver. The power wires carry the oscillator frequency which is to be mixed with the incoming frequency at the receiver station. Thus the remote tuning unit could be plugged into any socket of the house or apartment. Volume was controlled by varying the amount of oscillator voltage fed into the house wires.

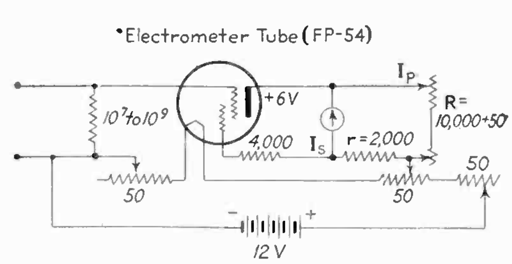
Improved single tube balanced d-c amplifier

The literature has become very voluminous on high gain amplifiers and d-c amplifiers. In the *Review of Scientific Instruments* 4:532-536, 1933, L. A. DuBridge and H. Brown of Washington University discuss an improvement on the Soller balanced single-tube circuit. The two circuits are shown in the figure.



Soller's balanced circuit

In the Soller circuit the galvanometer may be brought to zero by the adjustment of R. The battery C may be dispensed with if the galvanometer has a suitable high resistance. Experience shows that there is a certain value of the heating current at which the zero balance of the galvanometer circuit remains undisturbed even if the heating current changes slightly. Fluctuations due to changes in the filament emission of the thoriated tungsten filament remain a source of error. $(R_f + T)$ and r form two arms of a Wheatstone bridge, R and the internal resistance R_T the two other arms.



Single-tube circuit of DuBridge and Brown

In the improved circuit the galvanometer will indicate zero providing that $R/r = I_s/I_p$, and if the filament emission changes spontaneously, grid and plate current change in about the same ratio. (In practice a shunt is used with the galvanometer). Moreover the balance thus secured is independent of changes in battery voltage on condition that the change in I_s with filament current be R/r times the change in I_p with filament current, which happens to be the case for a filament current of 87 ma, or nearly the rated current. It may first take 15 or 20 minutes to establish equilibrium; 60,000 to 80,000 mm/volt are readily obtained.

electronics

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O. H. CALDWELL, *Editor*

Volume VII —MAY, 1934— Number 5

Time for industry stimulation!

PROMOTION and stimulation of radio business will be the keynote of the June 11 to 14 conventions of the Radio Manufacturers Association and the Radio Wholesalers Association," according to the official announcement of these gatherings just issued. An elaborate program is being arranged to celebrate the tenth anniversary of the RMA, and there will be many get-together sessions at which good fellowship will promote understanding between the groups who make and who sell radio receivers.

But above all else, this is the year for the radio industry to get together to draft and agree on *plans for the promotion of radio-set sales.* Too long the industry has drifted along merely on the impetus of highly competitive selling. This strong individual competitive influence will always be needed. But there is a place now for a co-operative background of public education and public interpretation, aided by which each manufacturer and distributor can swell the output of his own efforts.

Let the listener decide!

IN a recent letter to the RMA Engineering Section, a well known radio engineer stated his doubts regarding the profit possibilities of high fidelity receivers. As proof of his beliefs he cited the fact that the public shows its lack of interest in high fidelity by purchasing by the millions receivers sounding like toy pianos.

Profits in the radio industry have never been certain; usually they have been negative quantities.

And as for the public rejecting a high-fidelity radio, it seems fair to state that it has never had a chance to hear one. The public wants music in the home, cheaply, and has purchased the best it could afford. It has purchased the poor with the good, because it all sounded alike.

If the average listener wants only one octave below middle C and three above it, all the experience of musicians and composers for several hundred years has been wasted. It is exceedingly difficult to believe that man is still so primitive he wants only bass-drum tone quality—and not much of that, provided it is loud!

Give the listener a chance. He may surprise the industry.

Needed—a campaign for better antennas

FOR YEARS an antenna has been any old piece of wire strung up any old place with any old kind of insulation. And for years the increase of man-made static has accelerated.

The year 1934 will be a year of tremendous public interest in short waves; late in the year may see the first high-fidelity receivers. Both shortwave sets and high-fidelity, wide range sets suffer more than broadcast reception from natural and man-made static. Short-wave signals are weak and may come across thousands of miles of space, high-fidelity receivers will pass to the loud speaker tones (and noises) now lost in the narrow-band receivers universally employed.

Already the antenna problem has become acute. Set manufacturers are encouraging listeners to use two antennas; a high, long wire, well insulated and brought to the receiver through a shielded transmission line; and another high, shorter antenna, brought to the short-wave set through a transposed lead-in.

A campaign on the part of radio set manufacturers, dealers, service men — all the radio industry—to encourage listeners to put up high, clear well insulated antennas will hasten the day of noise-free short-wave reception from all parts of the world; and the day of high-fidelity, wide-range—real-music in the home.

Radio cabinets of infinite variety

THE wide latitude which the present rich variety of materials allow to the designer of radio receivers for the home, was well expressed by Dr. Alfred N. Goldsmith, speaking at a conference under the auspices of the National Alliance of Art and Industry at New York.

Solid wood and metals, as well as ornamental veneers, synthetic insulating materials, and paints or other surface treatments afford numerous opportunities for ingenuity and for the securing of handsome effects. It is at this point that the originally purely functional design can be converted from an object of utility into an object of art.

However, it should be pointed out here, that, just as in architecture, correct radio and phonograph designs start on the basis of the nature of the device itself and of its convenient use. These elements having received due consideration, the artist then has full scope for his inspiration and resourcefulness.

WLW's 500-kw. improves service; blanketing nil

FEARS that operation of a 500-kw. broadcast station would have any objectionable effects on the listeners, have now proved groundless, and it is evident that such a great transmitter only *improves service for all* by providing a field intensity which overrides noise and static.

Powel Crosley is to be congratulated on this latest advance into higher power. Power to him has always been merely relative, and as he successively opened the first 50-watt and the first five-watt stations, he recognized the new service values created by higher wattage.

The new 500-kw. WLW has tripled the former signal strength, has expanded the secondary service area, and has overcome static and interference. On the other hand, the bogey of "blanketing" of listeners' receiving sets, raised by a few timid souls, has now been disproved by the careful preliminary program of actual operation.

WLW has set a mark for the rest of the clear-channel stations to measure up to!

NEWS NOTES

Associated Press facsimile picture transmission — Newspapers of the Associated Press have approved the plan to tranmit pictures by wire facsimile, using the A. T. & T. process. Pictures up to 11 by 17, half a newspaper page, will be sent at average rates of 11 square inches per minute.

Engineering Division RMA defines "All-wave" sets—The RMA Board on April 18 approved the Engineering Division's definitions to guide the public in buying receivers as follows: Standard broadcast—540 to 1,500 kc. All-wave —540 to 18,000 kc. Broadcast and shortwave or "dual wave" with short-wave range covering a ratio of maximum to minimum frequencies of at least two-and-one-half to one in the range of 4,000 to 20,000 kc.

Hazeltine-Atwater Kent settlement—A complete settlement of all outstanding patent litigation between the Hazeltine Corporaion and the Atwater Kent Manufacturing Company, is announced by the former. All actions have been withdrawn, and the Atwater Kent company is granted licenses under the Hazeltine and Latour patents, while the Hazeltine Corporation acquires power to grant licenses under the radio patents owned by Atwater Kent.

RMA Tenth Anniversary Convention, Chicago, June 11-14 —The tenth anniversary of the Radio Manufacturers Association will be celebrated during its annual convention at the Hotel Stevens, Chicago, June 11 to 14. The Radio Wholesalers Association will also meet at Chicago, June 12 and 13. The RMA directors will confer on Monday, June 11, and in the evening President Fred Williams will tender a dinner to past-presidents and officers. At 10:30 a.m. Tuesday there will be a joint meeting of the RMA and RWA, followed by afternoon meetings of the RMA set, tube, and other divisions. The RMA membership meeting will be held on Wednesday morning, and in the evening the Radio Industry banquet will be held, with Paul B. Klugh presiding. Thursday will be given over to golf at the Calumet Country Club.

CHICAGO'S ELECTRONIC "FRISKER"

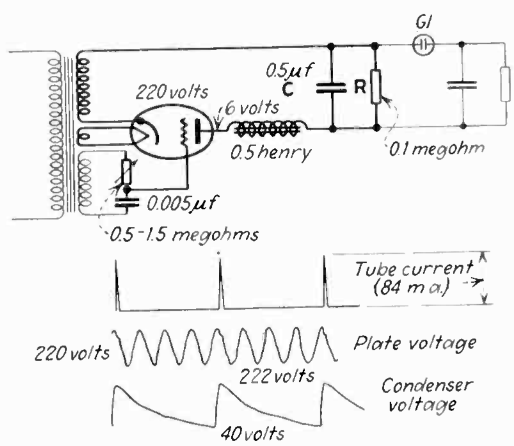
Prisoners taken into the Chicago Detective Bureau can now be "frisked" for concealed weapons by means of this magnetic exploring device, with tube amplifiers operating an alarm. The main wall-plate detects the presence of any iron or steel, even a saw-blade on a prisoner, and the small exploring coil permits localizing the metal body or weapon

REVIEW OF ELECTRONIC LITERATURE

HERE AND ABROAD

Frequency reduction with grid controlled discharge tubes

[K. Kluge, German National Physical Laboratory] When the a.c. induced in the grid circuit allows the arc to start at a certain phase angle, the current charges the condenser C in the plate circuit until the potential approaches the supply voltage. The discharge stops and the condenser discharges across the shunting resistance R until the drop in potential allows the plate to carry the arc. By taking CR large, the starting of the discharge can be delayed for several complete cycles, and by properly choosing the phase angle the current can be reduced to a short pulse every third or fourth wave of about 100 ma. When the power station gives carefully controlled frequency, the device is useful for obtaining time markings, or,



Frequency reduction 4:1

when used with a glow discharge tube, *Gl*, for stroboscopic purposes. Grid-controlled discharge tubes filled with argon, work satisfactorily.—*Phys. Zeits.* 35, (7); 275-278, 1934.

New insulating materials for radio frequencies

[H. Handrek, Hermsdorf-Schomburg, Ins. Laboratories.] Using magnesium silicate (talc or soapstone, 3 parts magnesium oxide, 4 parts quartz, one water) as a basis in place of aluminum silicates (as for porcelain) it has been possible to obtain Calite, Calan, Frequentite, and Frequenta, masses of great mechanical strength, low dielectric losses and porosity at the same overall density. The kilned mass showing only a small amount of glass consists of enstatite crystals. By increasing the proportion of magnesium oxide an artificial mass, Ultra-Calan, is obtained, which has as low a loss angle as quartz (10^4 tan d equals 1 between wavelength 100 m. and 30 m; and 1.1 between 6 and 3 m.) The dielectric constant is 7.1 compared to 4.7 for quartz. The density is 2.7, the crushing strength 8,000 kg. per sq.m., the coefficient of thermal expansion 8.6 x 10^{-6}. The Hescho and the Steatite Co., using titanium oxide, have also succeeded in producing a solid dielectric (Condensa or Kerafar having a dielectric constant of 40 or 50 (with 10^4 tan d equal to 10 at 100 m.). The dielectric constant decreases 1% between 1 and 1,000 kc. This ceramic material, kilned at 1,400° C., can be drawn, cast turned or pressed into the desired form.—*H. F. Techn. El. Ak.* 43 (3): 73-75, 1934.

Currents in grid-controlled discharge tubes below the starting potential

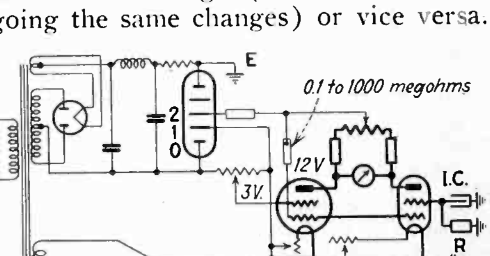
[W. Koch, General Electric Research Laboratory, Berlin] When the grid potential is not sufficiently high to allow the arc to start at the given plate voltage, the grid-controlled discharge tube behaves as a three electrode vacuum tube. The potential which the space near the cathode acquires under the influence of the grid and plate voltages may be negative (reversing field, traversed by the fastest electrons) or positive (space charge equation, 3/2 power law). The presence of gas increases the vacuum tube currents between grid and plate. At the more strongly negative grid voltages the logarithm of the plate current increases linearly with the grid potential (pure Townsend ionization current), but closer to the starting point the increase becomes more rapid (space charge effects), but does not tend to infinity, as expected at the starting point.—*Zeits. techn. Physik* 15 (2): 64-68, 1934.

Barrier plane photocells

[G. Liandrat, University of Lyons.] A detailed review shows that none of the proposed theories fully explains the observed facts. Cuprous oxide as well as selenium give an internal photo effect as well as a barrier plane effect in which the electrons may travel in the direction offering the greater resistance. In cuprous oxide the long wave limit of the internal effect is about 4.1 micron (0.3 volt) but to send an electron from the oxide to the mother copper requires 0.6 volt (1.4 micron). A difference of the same order is found for selenium. The barrier plane measures not more than one millionth cm. The internal effect is rather slow, the barrier plane effect is practically instantaneous, due no doubt to electrons being thrown into the metal, giving it a negative charge, which may drive a certain number of the electrons back into the oxide. The drop in the current observed in the first two minutes during which the cell is illuminated is due to the cell heating up under the influence of the infra-red light. A nearly complete list of 100 references given as foot-notes accompanies the article. All routine photometric work should be done with these cells rather than by the eye.—*Revue Gen. Electricité* 18: 415-424, 467-473, 1934.

Improved bridge for a-c operation

[E. Hasche, X-ray Laboratory, Virchow Hospital, Berlin.] The changes in the two space charge grid (electrometer) tubes used as one pair of resistances in a Wheatstone bridge are studied by means of a sensitive galvanometer measuring the sum of the plate currents which flow at the same time through the other pair of resistances. The reading of this meter is first brought to zero by means of an auxiliary e.m.f. in its shunt. The bridge galvanometer is so connected that when the internal resistance of tube 1 changes the deflection is in the same direction in both galvanometers, and in opposite direction when a change occurs in tube 2 (to which the unknown potential is applied, case 2, more frequent). In rare cases the bridge galvanometer remains at rest, whereas the plate meter indicates a change (both tubes undergoing the same changes) or vice versa.



I.C. = Ionization chamber

Case 2 can be eliminated by providing the coil of the bridge meter with a winding so that the changes are the same in both coils but of opposite direction. Errors due to case 3 and 4 are reduced to one-half. A point can be found where the filament current has little effect upon the results.—*Annalen Physik* (1916: 665-679. 1934 *El. T. Z.* 55 (11): 267-269, 1934. See also M. Reed, *Wireless Engineer* 11: 175-178, April, 1934.

Vacuum tube bridge for measuring X-ray and Ultraviolet

[E. Hasche, X-ray Laboratory Virchow Hospital, Berlin] Two space charge grid tubes (electrometer tubes T 113 Osram) are used as one pair and two high resistances as the other pair of arms in a Wheatstone bridge circuit. The voltages are taken from a glow discharge tube which has several electrodes and is placed in the output circuit of a power pack. Adjusting the grid voltages gives a rough balance. One of the electrometer tubes has a 10 cm. long neck through which the lead to the control or second grid is brought in from the central electrode of the ionization chamber in which the X-rays produce ions. The grid to cathode resistance of the tubes lies between 10 and 100 million megohms. Moisture has no effect but dust particles must not be allowed to settle on the glass. A grid resistor is placed in parallel with the ionization chamber to give the proper bias (6×10^{11} ohms for a 100-ohm galvanometer, 10^{13} ohm for a 750-ohm galvanometer). After prolonged use the sensitivity of the electrometer tubes decreases the balance being restored by adjusting the shunt of the bridge galvanometer. After the first 26 hours, the sensitivity has dropped by 20 per cent, after 400 hours by an additional 35 per cent with no further change during the next 230 hours.—*Zeits. techn. Physik.* 15: 68-72. 1934.

Mixed layer photocells

[R. Fleischer and P. Gorlich, Dresden Institute of Technology] The improvement observed in the sensitivity of cesium—cesium oxide (thick layer) on silver cells when cesium and other metals, silver in particular, are forced in a finely divided state into the salt or oxide layer to form a so-called mixed layer, is confirmed (*Zeits. f. Phys.* 74: 604-623, 1932. *Physics* 2:12, 1932.) The foreign metal facilitates the replacement of the electrons furnished by the sensitive layer. The cesium particles may be forced into the layer by keeping the completed cell for a quarter of an hour at a temperature of 160 deg. C., or by using a glow discharge through cesium vapor followed by short heating. The sensitivity begins to increase as soon as an invisible film of the inactive metal is laid down upon the cesium-cesium oxide mass and grows rapidly as the silver diffuses. In the light of a 400 watt lamp the cells give 50 microamp. per lumen. The sensitivity reaches peaks at 2800 A. (6 millicoul. per cal.) 3750 A (21 millicoul. per cal.) and in the infra-red between 7200 and 8500 A (25 millicoulomb per cal.). The long wave limit lies between 1.1 and 1.3 micron in rubidium cells near 0.95 micron. The sensitive film gives a distinct detector effect and a front wall effect.—*Phys. Zeits.* 35: 289-292, 1934.

British tubes to rival American types

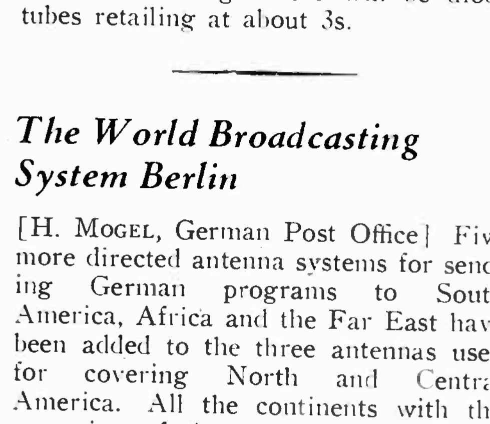
Many new tubes which British tube manufacturers will release shortly will result in American importers such as Philco, Majestic and Wurlitzer being seriously challenged in the auto radio and universal set fields for the first time. Complete ranges of 13 volt, .2 amp. tubes are being produced for radios for use from A.C., D.C. mains or car batteries.

Constructional features will be a reduction in size—resulting in one case at last in abolition of the customary pins in favor of side contacts on the base.

Tube makers as a whole are veering to the view that multiple tubes are more trouble than they are worth. Therefore, among additions to the standard 4 volt A.C. mains range there will be diode tubes retailing at about 3s.

The World Broadcasting System Berlin

[H. Mogel, German Post Office] Five more directed antenna systems for sending German programs to South America, Africa and the Far East have been added to the three antennas used for covering North and Central America. All the continents with the exception of Australia now receive a two hour broadcast. The five waves used (Madrid Conference) are 15.2 Mc. and 9.56 Mc. (Asia), 9.56 Mc. (Africa), 15.2, 11.76 and 6.02 Mc. for America. Because short wave receivers are less perfect than those available for national broadcasting, the antennas are provided with "reflectors," which are exact copies of the antennas, placed $\lambda/4$ apart. They consist of up to 8 wires



arranged in the same plane one above the other and one beside the other to form 4 half-wave dipoles in a line, all dipoles being supplied in exact phase (H8/4R antennas). The strength in day-time is 64 times that given by a simple vertical dipole. Modern high frequency cables connect the two remodeled 20 kw. transmitters to the antennas.—*El. T. Zeits.* 55 (11): 265-267. 1934.—*T.F.T.* 23 (2): 38-46. 1934.

Primary and secondary electrons in three electrode tubes

[H. A. Schwarzenbach, University of Zurich.] The plate current consists of the primary electrons coming directly from the filament and, either plus the secondary electrons set free at the grid and drawn to the plate when the potential of the plate is higher than that of the grid, or minus the secondary electrons set free at the plate when the plate is at a lower voltage than the grid. To determine the proportion of primary electrons at various plate potentials it is necessary to measure the heat generated in the plate in unit time, by the radiation from the filament, and the grid and the impact of electrons. A short-wave tube with tungsten filament and grid and plate of molybdenum or nickel is suitable, the radiation from the plate or its change in magnetic susceptibility being a measure of the energy received. The investigation reveals a flat trough in the primary electron current, in the range where the plate current plotted as a function of plate voltage has a deep valley, while a relatively rapid increase occurs near the point where plate and grid voltage become equal. The finite velocity of the secondary electrons probably explains the facts.—*Helv. phys. octa.* 7: 108-148, Jan. 1934.

Electron influence upon inter-electrode capacity

[E. Muhrer, Dresden Institute of Technology, Barkhausen Laboratory] The a.c. traversing a condenser (three-electrode tube with cylindrical grid and plate), to which a d-c and a small a-c voltage (100 Mc.) are applied at the same time, is decreased below the theoretical value owing to each electron staying a finite time T between the electrodes. They cause a decrease in the dielectric constant (or increased inductance) equal to $1 - 4Ne^2 (pT - \sin pT) / mp^3T$, where N is the number, about 100 million of electrons per unit volume, and p equals 6.28 f. Besides this lagging component there is also an ohmic component in phase with a.c. voltage, corresponding to the conductance $Ne^2 (1 - \cos pT)/mp^2T$. The density N is given by the space charge equation, and the maximum decrease to be expected is $3.6a^2/b^2$ per cent, when b is the distance grid-filament and a the distance grid-plate, and Tf approaching zero. Experimental values agree with the formula in the range where the current is saturated and where the grid potential is small compared to the plate potential. Over the rest of the range the decrease is three or four times larger than calculated.—*H. F. Techn. El. Ak.* 43: 1-12. Jan. 1934.

+ NEW PRODUCTS

THE MANUFACTURERS OFFER

Rheostats with solid-wall porcelain tubes

In its new catalog, No. 1370, describing "Jagabi" rheostats for laboratory and industrial use, the James G. Biddle Company, 1211 Arch Street, Philadelphia, Pa., illustrates its products of the sliding-contact, screw-drive, double, graded, metal-enclosed, non-inductive, and general types.

Attention is also called to the use of solid-walled porcelain-tube construction to replace the porcelain-enameled iron-tube construction formerly used. This has eliminated trouble due to insulation breakdown between the winding and tube, owing to thin, cracked or chipped enamel.

The porcelain tube, which has a glazed surface both inside and out, has great mechanical strength and is unaffected by the relatively high temperatures at which these rheostats may be operated. Also, owing to the absence of iron, it permits the standard, helically-wound rheostats to have lower inductance—which is of considerable advantage when using alternating current.—*Electronics.*

✦

Inverter full-wave vibrators

The American Television and Radio Company, St. Paul, Minn., has developed its new ATR full-wave vibrators in both the inverter and self-rectifying inverter types. For these it claims dependability and long life, efficiency above 70 per cent, freedom from sticking or arcing, permanent contact adjustments, operation over wide ranges of battery voltage, silent performance, compactness, and durable construction. The vibrator unit is housed in a lead container which in turn fits into a container of tin lined with sponge rubber and fitted with a plug so that the entire assembly can be handled as conveniently as a radio tube. The net weight of each unit is less than two pounds.—*Electronics.*

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Recorders

Two types of semi-professional recorders have been placed on the market by the Universal Microphone Company, Inglewood, Calif., to be used by broadcast stations, agencies and sponsors, for air checks, making permanent records of radio programs, personal recordings, and other purposes.

The recorder models come equipped with a volume indicator, volume control, off-and-on switch and a Universal combination pick-up and recording head. There are two speeds, 33⅓ and 78 rpm. One type records on blank aluminum discs up to 12 inches; the other up to 16 inches.

The recorders are mounted on natural-finished wood ready for use on 50-60 cycles, 110 volts. Two impedances are provided, 400 and 5000 ohms. There will also be a single model, and a dual turntable for continuous recording.—*Electronics.*

✦

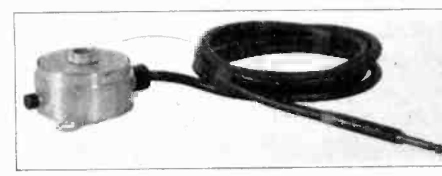
Universal test instruments

The Sound Engineering Corporation, 416 North Leavitt Street, Chicago, Ill., has combined three separate and highly useful test instruments, to form the latest thing in analytical test sets. The components are:

1. The No. 90 multi-range universal a.c.-d.c. voltmeter, milliammeter and ohm-meter, providing seven voltage ranges, five current ranges and three resistance ranges, as well as means for measuring inductance, capacitance and impedance.
2. The No. 91 point-to-point analyzer, for rapidly testing sets, circuits and tubes.
3. The No. 92 modulated electron-coupled oscillator, covering the entire band of frequencies from 90 to 1,600 kilocycles without using harmonics; when required harmonics can be used to cover the higher frequencies.—*Electronics.*

Transmitter for airplane use

A new airplane-type transmitter has been perfected by Automatic Electric Company, Chicago, Ill., designed to exclude all extraneous sounds and to operate with high efficiency under the difficult conditions of vibration and noise encountered in airplane operation. This transmitter is designed to be used both for intercommunication between pilots or between pilot and observer, and also for radio transmission to ground stations.



Its current-carrying capacity is rated up to 400 milliamperes for intercommunicating use, but it is recommended that not more than 100 milliamperes be used when operated in conjunction with the radio apparatus, since best transmission results at approximately that figure. A button is provided for quickly switching the microphone in and out of the circuit as desired. A rubber-covered cord is supplied with the transmitter, together with a plug which is standard with most commercial companies.—*Electronics.*

✦

Amplifier for public address

The Gates Radio & Supply Company, Quincy, Ill., has developed a new model (550) output amplifier, for public-address and centralized sound operation, which has various improvements known in high-quality amplifier design, high quality, and complete absence of alternating current hum.

By using three audio stages a very high gain is developed, and with type 2A3 tubes in the push-pull output stage, this gain is easily handled with a minimum of distortion at high volume. For centralized sound installations the amplifier will handle a large number of magnetic speakers or several dynamic speakers.

The input of the amplifier has an impedance of two hundred ohms with a third tap provided for carbon microphone. Output impedances of 8, 16 and 500 ohms, to match all types of speakers, are available.—*Electronics.*

Television transmitter

TELEVISION LABORATORIES, LTD., of San Francisco and Philadelphia, have licensed Heintz & Kaufman, radio manufacturers at San Francisco, to construct television transmitting equipment under the Philo T. Farnsworth patents for television by aid of cathode-ray tubes.

Heintz & Kaufman are the manufacturers of all the code-communication equipment used by Globe Wireless, Ltd., a subsidiary of the Dollar Steamship Company. They also have recently been licensed to use the radio patents held by the Westinghouse Electric & Mfg. Co., and have specialized on short-wave radio for many years.

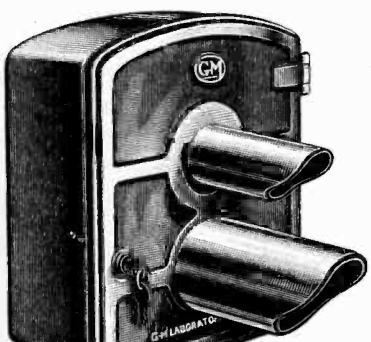
Pictures are now being transmitted over wide channels in the neighborhood of 5 meters. The received images are reproduced as a black-and-white motion picture and contain 90,000 elements (300 lines) repeated at the rate of 24 pictures per second. Pictures and accompanying sound effects are transmitted on the same wavelength and reproduced from the same cabinet.—*Electronics.*

✦

Outdoor photoelectric relay

G-M LABORATORIES, INC., 1731 Belmont Ave., Chicago, Ill., announce the manufacture of a new weatherproof photoelectric relay for outdoor use. Completely enclosed in a cast aluminum case with a hinged gasketed cover, this relay can be fitted with tubular visors to protect the lenses in front of either the cell and lamp, or both, to overcome the difficulties normally caused by rain, snow, sleet and the effects of extraneous light.

Any one of a variety of photoelectric



circuits can be furnished with this unit to provide the best operation for a given photoelectric installation. Light from a lamp behind the upper visor is focused on a weather-protected mirror 20 feet distant, and reflected onto a photoelectric cell behind a lens in the lower visor. Any interruption of the light beam signals a watchman in charge of the entrance where the unit is located. The circuit is designed for operation on standard 110-volt lines.—*Electronics.*

Wave-band switch

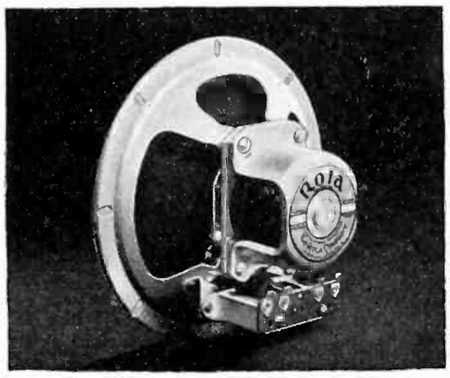
THE H. H. EBY MANUFACTURING COMPANY, INC., 21st Street and Hunting Park Avenue, Philadelphia, offers a new model "34" wave-band switch. A few characteristics of this new switch are: Compact design. Definite indexing. Sturdy construction. Low capacity. Single hole mounting. Silver-plated contacts. Low contact resistance. Special solder lug features; ability to stand rigid life tests.

The switch is furnished in all combinations, from single-pole single throw, to four-pole double throw.—*Electronics.*

✦

Dustproof speaker unit

THE ROLA COMPANY, 2530-70 Superior Avenue, Cleveland, Ohio, announces a new series of dustproof units, especially designed for automobile radio receivers.



This new construction embodies a dome center cap, entirely new spider construction and novel acoustic filter assembly, which protects the voice coil and air gap against the entrance of metallic particles of dust and other foreign substances. This, however, in no way restricts the free movement of the voice coil.

The same construction is now being applied to household sets, in order to eliminate the very troublesome problem of metallic particles picked up in the assembly of receiving sets, which eventually find their way into the loud speaker.—*Electronics.*

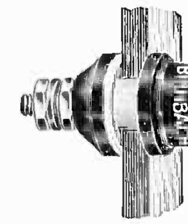
✦

Standoff insulators

THE BIRNBACH RADIO CO., INC., 145 Hudson Street, New York City, now offers a complete line of small porcelain standoff insulators. Novel features and unique design make these standoff insulators desirable for first-class construction of receiving, transmitting, and test apparatus where a maximum ruggedness and insulation must be had with a minimum cost and labor.

Such insulators are ideally suited for mounting on metal panels, as they require only one hole for mounting, to make possible connections on the bottom of the subpanel, thereby eliminating unsecured wiring.

The body is a good grade of porcelain and is thoroughly glazed with the smooth finish necessary for high-frequency work. These insulators are supplied in several sizes ranging from



⅝ in. to 1¼ in. high, and come complete with nickel-plated brass hardware. The ⅞ in. and 1¼ in. sizes are supplied with jacks, making these insulators desirable for plug-in coils, chokes, and all types of high-voltage apparatus.—*Electronics.*

✦

Midget relay

STRUTHERS DUNN, INC., 148 North Juniper Street, Philadelphia, Pa., has placed on the market a new midget three-wire relay to meet the growing demand for a relay of a smaller size than anything hitherto produced.

Three-wire relays are used in conjunction with three-wire thermostats, or other similar regulating instruments for the automatic control of heat, refrigeration, humidity, pressure, etc. These relays are provided with an instrument protecting resistor. The instrument makes, but never breaks, the current.

A feature of this particular relay is its small size, the base being 2¾ in. by 1⅞ in. The contacts are rated to carry and break 6 amperes at 110 volts, alternating current, non-inductive load.—*Electronics.*

✦

Speech-input control

THE SYNCHROPHONE has been developed for radio-broadcast operation by the Metaphone Devices Corporation of Salem, Ind. It synchronizes a system of mechanism controls, by various operations of the machine with a common control including the microphone, reproducers, fading control, and the starting and stopping of the motors, all of which is under a monitor-controlled speaker, co-ordinated to the broadcast. Two No. 518 automatic turntables are installed in the Synchrophone. The reproducer arms are automatically balanced to allow the proper needle pressure. The arms are suspended on double ball- bearings, introducing minimum friction in the swing of the arms. The reproducer head may be quickly unscrewed by the unscrewing of a single thumbscrew, allowing the use of either lateral or hill-and-dale pick-ups. A Weston Model 301 galvanometer, calibrated in decibels, serves as an external volume indicator meter.—*Electronics.*

Transformer-commutator voltage regulator

THE TRANSFORMER-COMMUTATOR principle for voltage control in alternating-current circuits, as developed by the American Transformer Company, 178 Emmet St., Newark, N. J., provides small increments of voltage without sudden changes and without interrupting the circuit, equaling all other types of equipment for flexibility and smoothness of control. It may be designed to regulate up to 100 per cent of the input voltage in steps of 1.2 volts or less, or it may be built to cover a smaller voltage range if desired. The equipment is available for manual, semi-automatic or full-automatic operation and may be constructed for either indoor or outdoor use.

Important among the advantages of the Amertran voltage regulator is its high electrical efficiency, which equals that of a transformer of equal size. In addition, this type of regulator exerts practically no effect upon power factor. It has very low exciting current and does not cause wave distortion or interference to radio receivers. It is now available in sizes from 0.25 to 200 kva. (equivalent transformer capacity), for single- or three-phase circuits, and for controlling potentials up to 2,400 volts.

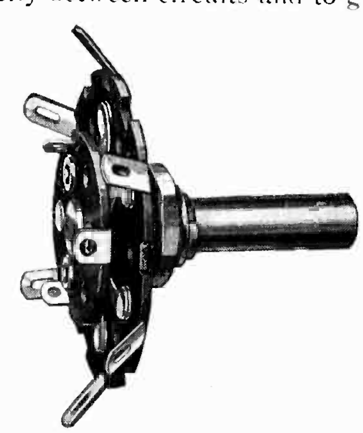
In the radio industry such regulators are used by vacuum-tube manufacturers for controlling voltage to ageing racks, life-test racks and high-frequency furnaces. In broadcasting stations regulators are being used to maintain the input voltage to plate transformers at a constant value and to reduce power without shutting down the transmitter. —*Electronics.*

✦

Short-wave switch

A NEW, INEXPENSIVE short-wave switch, small in size, yet very flexible and efficient, is now being made by C. R. C., Incorporated, at Beloit, Wis.

Heavy silver-plated wiping contacts, positive indexing action, low contact resistance, noiseless operation, low capacity between circuits and to ground,



and single hole mounting are among the important features.

Any circuit combination from single-pole twelve-position, to four-pole three-position can be furnished.—*Electronics.*

Fuse retainer and antenna coupler

THE LITTELFUSE LABORATORIES, which have moved to new and larger quarters at 4507 Ravenswood Avenue, Chicago, Ill., have produced a new fuse retainer and antenna coupler, for automobile-radio use.

This No. 1070 fuse retainer takes the regular 3 AG automotive fuse and hangs directly in the "hot" line, leading to the automobile radio. It takes auto cable up to $\frac{5}{32}$ in. diameter, and the shielding, where necessary, can be attached to the retainer. Fuse renewals are made by turning the small bayonet lock.

When used as an antenna connector, the fuse is omitted, and the contact buttons are placed directly together instead of at the fuse ends. Contact is maintained by a strong spring pressure.—*Electronics.*

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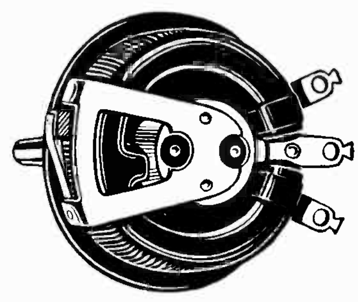
Power rheostat

A POWER RHEOSTAT of unique design, this unit is very ruggedly constructed. The shaft and bushing are insulated.



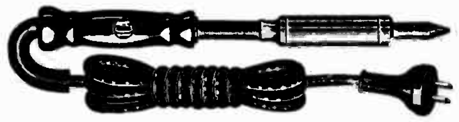
The wire winding is rigidly held in place by vitreous enamel which also covers the refractory base. The contact shoe, of special metal graphite composition, contacts the wire-wound element on the outside diameter. The rating is 50 watts with total resistance in circuit, and standard resistance values are provided ranging from 1 to 5,000 ohms. The manufacturer is Electrad, Inc., 175 Varick Street, New York City. —*Electronics.*

✦

Soldering irons

THE 50-WATT AND 75-watt soldering irons made by the Insuline Corporation of America, 23 Park Place, New York City, are arranged with heating elements wound on high-heat-resisting bobbins of machined and threaded Lavite. The resistor coils of special material are then impregnated and covered with a non-hygroscopic ceramic compound, which seals in the heating element, preventing oxidization and assuring unusually long life.

These irons are quick acting, heating up to regular operating temperatures in three minutes. A special air chamber separating the heating element from the outer housing reduces heat losses ordinarily radiated toward the handle. The iron is thoroughly insulated, and protected against grounding.



Heavier 100-watt irons are also provided with duplicate soldering tips, which are removable without possibility of freezing in the iron.

Fifty-watt and 75-watt irons, \$3; 100-watt iron, \$4.—*Electronics.*

✦

Multi-cathode photocell

THE CONTINENTAL ELECTRIC COMPANY, St. Charles, Ill., announces a new photocell, Cetron Type CE-15. This cell has been developed particularly for use in electric pipe organs and other devices where it is desired to put a number of light spots on the cathode.

The dimensions of the cell are as follows:

Overall Length	7 in.
Width of Bulb	$1\frac{1}{8}$ in.
Length of Cathode	$4\frac{1}{2}$ in.
Effective width of Cathode	$\frac{5}{8}$ in.
Center of Cathode to bottom of base	$4\frac{1}{4}$ in.

Among the advantages of the Cetron CE-15 is that of economy in the use of cells inasmuch as one cell of this type will replace several of the more conventional type. It has an unusually high current output and an excellent frequency response over the entire audio range. A special mounting of the anode eliminates all shadow effects. — *Electronics.*

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Plug-in inverter element

PATENT RIGHTS have been issued to P. R. Mallory & Co., Indianapolis, Indiana, covering the "plug-in" feature of the Mallory Elkonode. The number of this patent is 1,943,240. The Mallory Elkonode is the heart of the Mallory-Elkon B Eliminator which makes all auto radios modern and all-electric by changing the direct current of the storage battery to an essentially alternating current of the desired voltage.

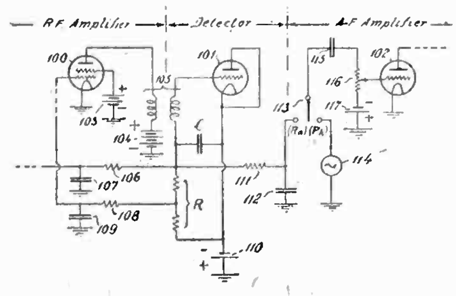
The newly issued patents cover the "plug-in" feature of the Elkonode which has been so designed that the unit can be slipped in and out of the socket as easily as a tube. A five-prong base is provided so that the unit may be mounted in any standard five-prong socket and all electrical connections have been made in this tube-like base; these self-rectifying Elkonodes can be supplied either for 6, 12 or 32 volt service.—*Electronics.*

U. S. PATENTS

IN THE FIELD OF ELECTRONICS

Discharge tube amplifier. Multi-stage amplifier using non-magnetically controlled ionization discharge tubes having ionization electrodes so shaped and so positioned and polarized relative to each other that the discharges occurring between said ionization electrodes exhibit negative resistance characteristics. August Hund, Wired Radio, Inc. No. 1,951,416.

Peak detector. A two-element detector connected to a carrier frequency circuit by means of a condenser shunted by a resistor and by a voltage responsive device having an impedance much higher than that of the resistance. H. A. Wheeler, Hazeltine Corp. No. 1,951,685.



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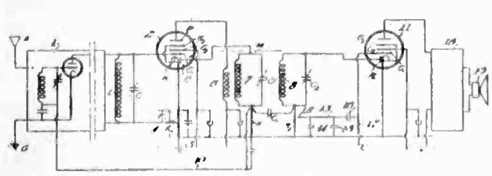
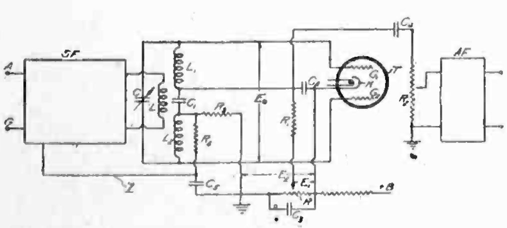
Automatic volume control. Two patents granted to P. O. Farnham assigned to R.F.L., Inc. No. 1,953,553 involving a multi-stage radio frequency amplifier, the final stage working into a demodulator, the rectifier elements of the gain control included in the tube of the final amplifier stage. The second patent, No. 1,953,554, involves a method for rectifying one side of the amplified r.f. voltage to obtain an a.v.c. voltage, and rectifying the other side to obtain a modulation frequency output voltage.



No. 1,953,553

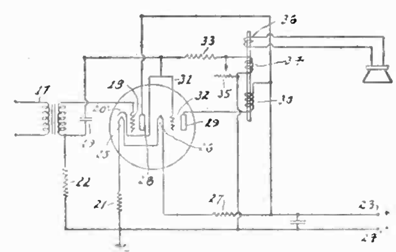


No. 1,953,554

Frequency control system. Method for regulating the frequency of a source of alternating current. Henri Chireix, Paris, France. No. 1,952,701.

Remote control. Device for rotating a tuning shaft including several electromagnets spaced around the axis of the shaft. David Satinoff, Samuel Satinoff, Morris Chernow and J. B. Sherman, New York, N. Y. No. 1,953,435.

Direct coupled amplifier. A tube comprising two sets of triode elements, the load of the first set being directly across the grid and cathode circuit of the second set, and including an impedance coupled to the output circuit of the second set. J. G. Aceves, assigned to Revelation Patents Holding Co. No. 1,953,455.



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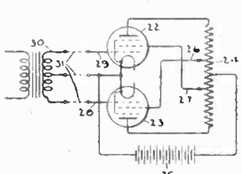
Modulation system. Modulation circuit employing a light sensitive cell as modulating means. Tomomasa Nakashima and Kenjiro Takayanagi, Hamamatsu-Shi, Japan. No. 1,953,769.

D-c a-c amplifier. A circuit of the push-pull type, the load being a resistance. E. Y. Robinson, G.E. Co. No. 1,953,775.



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Amplification, detection, etc.

Constant impedance system. Direct-coupled amplifier with coupling impedance variable as to signal currents but maintained constant with respect to d.c. The means is a condenser variably connected to parts of the impedance. G. J. Kelley, RCA. No. 1,954,779.

High frequency amplifier. Prevention of input circuit oscillating with respect to ground; preventing any change in output capacity affecting input tuning. C. S. Franklin and E. Green, RCA. No. 1,954,589.

Tuned filter. Feed-back from plate to grid consisting of an anti-resonant circuit tuned to desired frequency in series with a series-resonant circuit tuned to same frequency. W. S. Hinman, Jr., Falls Church, Va. No. 1,954,295.

Frequency control. Standard and power oscillators coupled to a common circuit and an electrostatic device connected to output of common circuit and actuated by the combined frequencies for imparting angular movement to tuning element under conditions of change of fundamental frequency. R. M. Page, Washington, D. C. No. 1,953,973.

Anti-fading circuit. Modulating carrier wave with keying frequency and a harmonic of it. J. Sedlmayer, Siemens & Halske. No. 1,954,185.

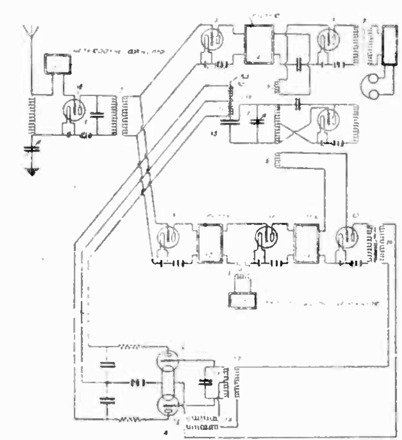
Oxide detector. Use of metal oxide detector in place of thermionic detector with resistance to keep its input resistance constant regardless of the impressed voltage. W. P. Place, Union Switch & Signal Co. No. 1,954,059.

High frequency transformer. Layer wound coils separated on a dowel and with short circuited ring member between coils in field of one of which is a fastening device of low resistance. W. L. Carlson, R.C.A. No. 1,954,470.

Linear voltage generator. An electrical current generator comprising a means for creating a magnetic field, a set of electrode rails in the field and a means for creating an electrical discharge between these electrodes. The rails have a configuration that varies the distance between the discharge and a detecting means as a predetermined function of the illumination on said detector. A. M. Nicholson, Communication Patents, Inc. No. 1,951,525.

Television apparatus. A cathode ray tube system with a means for adjusting the tube for either a constant speed ray traversal with variable brightness or a constant brightness with variable speed traversal system. Fritz Schröter, Telefunken. No. 1,951,533.

Frequency control system. A receiving system wherein the frequency of a local carrier is controlled to bear a desired relation with respect to the frequency of received carrier energy. Wilhelm Runge, Telefunken. No. 1,952,463.



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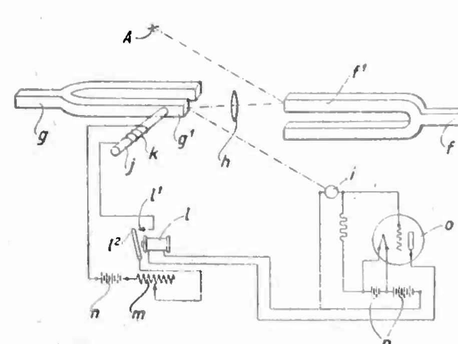
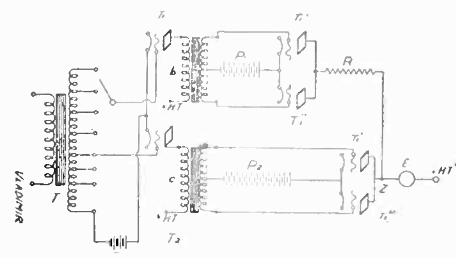
Transmission regulator. A transmission line having a pilot wire and a gain and loss system which delivers an e.m.f. varying in accordance with the change in resistance of the pilot wire. H. A. Affel, A.T.&T. Co. No. 1,952,524.

Stabilizing system. A tuning fork carrying a mirror reflecting a beam into a light sensitive device controlling an amplifier which in turn controls the frequency of oscillation. Hans Martin, assigned Carl Zeiss. No. 1,951,666.



Facsimile system. An electric system for identically reproducing a given phenomenon. Vladimir Yanouchewsky, Le Chesnay, France, assigned to Etablissements Edouard Belin. No. 1,951,781.



Electrooptic control system. A circuit employing a medium for partially transmitting a beam of light in a photocell with a split anode and method of varying the distance of the reflecting surface from the transmitting medium. A. M. Nicolson, Communication Patents, Inc. No. 1,951,523.

Printing spoken sounds. A method of translating spoken sounds into printed words by transforming the individual sounds of speech and combinations of integral sound formants, absolutely fixed in their height, for every speech sound different from every other combination, into corresponding combinations of plus and minus currents, and then translating these combinations of currents into actuating impulses which control a printing apparatus. Rudolf Tiefenbacher, Essen, Germany. No. 1,951,454.

Electron compass. A compass with an indicating device partially energized and an electron tube, the flow of electrons being controlled by the position of the device in the earth's magnetic field. J. D. Tear, G.E. Co. No. 1,952,899.

Patent suits

1,879,863, H. A. Wheeler, Volume control, filed Jan. 19, 1934, D. C., S. D. N. Y., Doc. E 77/152, Hazeltine Corp. v. Parmelee Transportation Co. et al. Same, D. C., E. D. N. Y., Doc. E 7177, Hazeltine Corp. v. Parmelee System, Inc.

1,573,374, P. A. Chamberlain, Radio condenser; 1,618,017, F. Lowenstein, Wireless telegraph apparatus; 1,231,764, same, Telephone relay; 1,702,833, W. S. Lemmon, Electrical condenser; 1,811,095, H. J. Round, Thermionic amplifier and detector; Re. 18,579, Ballantine & Hull, Demodulator and method of demodulation; 1,896,780, F. B. Llewellyn, Modulating device; 1,403,932, R. H. Wilson, Electron discharge device; 1,465,332, H. D. Forest, Vacuum tube amplifier; 1,531,805, R. C. Mathes, Oscillation generator; 1,658,346, same, Amplifier circuit, filed Jan. 26, 1934, D. C., S. D. N. Y., Doc. E 77/170, radio Corp. of America et al. v. Espey Mfg. Co., Inc., et al.

1,251,377 (a), A. W. Hull, Method of and means for obtaining constant direct current potentials; 1,297,188, I. Langmuir, System for amplifying variable currents, filed Jan. 27, 1934, D. C., N. D. Ill., E. Div., Doc. 13/694, General Electric Co. v. A. I. Blanc et al.

1,251,377 (b), A. W. Hull, Method of and means for obtaining constant direct current potentials; 1,297,188, I. Langmuir, System for amplifying variable currents; 1,707,617, 1,795,214, E. W. Kellogg, Sound reproducing apparatus, filed Jan. 26, 1934, D. C., S. D. N. Y., Doc. E 77/171, General Electric Co. v. Espey Mfg. Co., Inc., et al.

1,128,292, E. H. Colpitts, Electric wave amplifier; 1,432,022, R. A. Heising, Circuit connection of electron discharge apparatus; 1,483,273, D. G. Blattner, Circuit for heating the filaments of audions; 1,493,595, same, Amplifying with vacuum tubes; 1,504,537, H. D. Arnold, Power-limiting amplifying device; 1,544,943, E. O. Scriven, Electric wave repeater for multiplex transmission, D. C., S. D. N. Y., Doc. E 50/176, Western Electric Co., Inc., et al. v. General Talking Picture Corp. Dismissed without prejudice (notice Jan. 26, 1934).

1,231,764, F. Lowenstein, Telephone relay; 1,618,017, same, Wireless telegraph apparatus; 1,403,475, H. D. Arnold, Vacuum tube circuit; 1,403,932, R. H. Wilson, Electron discharge device; 1,465,332, H. D. Forest, Vacuum tube amplifier; 1,573,374, P. A. Chamberlain, Radio condenser; 1,702,833, W. S. Lemmon, Electrical condenser; 1,811,095, H. J. Round, Thermionic amplifier and detector; Re. 18,579, Ballantine & Hull, Demodulator and method of demodulation, filed Jan. 27, 1934, D. C., N. D. Ill., E. Div., Doc. 13,695, Radio Corp. of America et al. v. A. I. Blanc et al.

1,251,377, A. W. Hull, Method of and means for obtaining constant direct current potentials; 1,297,188, I. Langmuir, System for amplifying variable currents; 1,477,898, C. W. Rice, Amplifying system, filed Jan. 9, 1934, D. C., S. D. N. Y., Doc. E 77/188, General Electric Co. v. E. Hauser et al. Doc. E 77/82, General Electric Co. v. J. D. Mendelson et al. Consent decree for plaintiff (notice Jan. 10, 1934).

1,710,073, 1,714,191, S. Ruben, Electrical condenser; 1,891,207, same, Electrolytic condenser, filed Jan. 12, 1934, D. C., S. D. N. Y., Doc. E 77/128, Ruben Condenser Co. et al. v. Dumont Electric Co. et al.

1,573,374 (a), P. A. Chamberlain, Radio condenser; 1,618,017, F. Lowenstein, Wireless telegraph apparatus; 1,231,764, same, Telephone relay; 1,702,833, W. S. Lemmon, Electrical condenser; 1,811,095, H. J. Round, Thermionic amplifier and detector; Re. 18,579, Ballantine & Hull, Demodulator and method of demodulation; 1,403,932, R. H. Wilson, Electron discharge device; 1,465,332, H. D. Arnold, Vacuum tube amplifier, D. C., S. D. N. Y., Doc. E 77/83, Radio Corp. of America et al. v. J. D. Mendelson (Metro Mfg. Co.) Consent decree for plaintiff (notice Jan. 10, 1934).

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1,351,377, (a) A. W. Hull; 1,282,439, I. Langmuir, Filed Dec. 13 1933, D. C., N. D. Ill., E. Div., Doc. 13623, General Electric Co. v. McMurdo-Silver, Inc.

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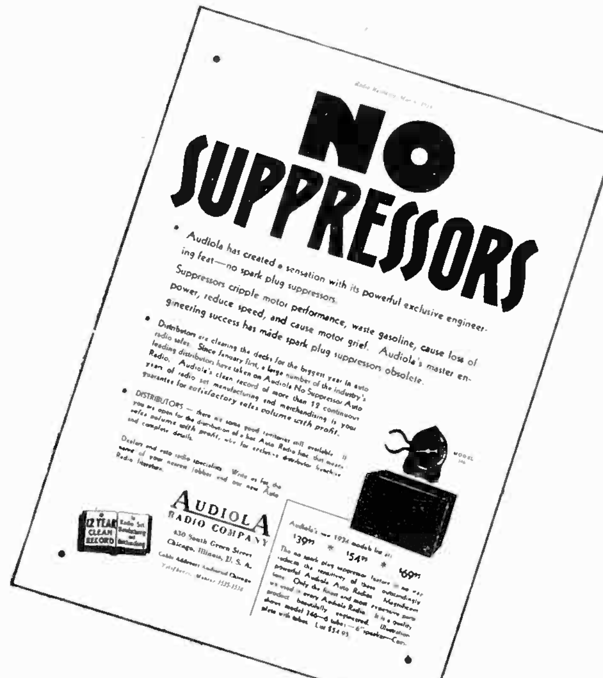
Adjudicated patents

(D. C. N. Y.) Hazeltine patents, No. 1,648,808, for wave signaling system, claim 19 Held invalid, or, if valid, not infringed. Hazeltine Corporation v. Sears Roebuck & Co., 5 F. Supp. 674.

(D. C. N. Y.) Hazeltine patent, No. 1,755,114, for unicontrol signaling system, claims 12, 14, 16, 17, 19, 23, and 24 Held not infringed. Hazeltine Corporation v. Sears Roebuck & Co., 5 F. Supp. 674.

(D. C. N. Y.) Hazeltine patent. No. 1,755,115, for variable condenser, claims 1, 2, 3, 8, and 9 Held not infringed. Id.

SILENCE Auto Radio . .
. . . as AUDIOLA does . .


NO SUPPRESSORS

• Audiola has created a sensation with its powerful exclusive engineering feat—no spark plug suppressors.
Suppressors cripple motor performance, waste gasoline, cause loss of power, reduce speed, and cause motor grief. Audiola's master engineering success has made spark plug suppressors obsolete.

• Distributors are clearing the decks for the biggest year in auto radio sales. Since January first, a large number of the industry's leading distributors have taken on Audiola No Suppressor Auto Radio. Audiola's clean record of more than 12 continuous years of radio set manufacturing and merchandising is your guarantee for satisfactory sales volume with profit.

AUDIOLA RADIO COMPANY
430 South Green Street
Chicago, Illinois, U. S. A.

12 YEAR CLEAN RECORD

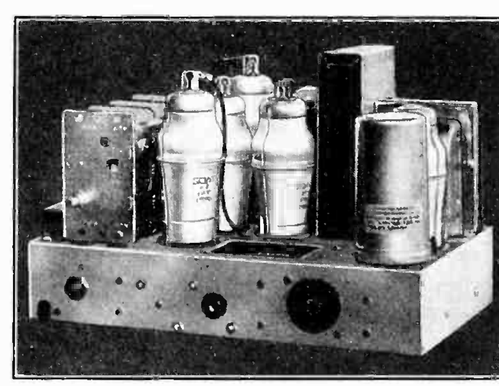
$39.95 * $54.95 * $69.95

Reproduction of Audiola full page advertisement in Radio Retailing, March, 1934.

Audiola is featuring the fact that no suppressors are used in its auto radio and that its tone and performance are free from noise.

May we add this point . . . AUDIOLA uses 5 Goat Shields per set . . .

There's a reason—Goat Form-Fitting Tube Shields are of steel and therefore shield against magnetic as well as electrostatic disturbances such as are caused by the ignition coil and generator. When you consider the better tube performance achieved through the use of Goat Shields in spite of the proximity of the radio chassis to the sources of man-made interference, it is apparent that Goat engineers are offering an outstanding contribution to auto radio and its wider acceptance.



Chassis of AUDIOLA AUTO RADIO in which tubes are shielded with Goat form-fitting Tube Shields.

In addition, the effectiveness of Goat Form-Fitting Tube Shields is achieved at low cost and with definite economies in space requirements.

Goat Shields are available for all types of tubes. Consult Goat on your shielding problem. Send for the new Goat engineering catalogue just off the press.

GOAT RADIO TUBE PARTS

GOAT RADIO TUBE PARTS Inc.

314 Dean Street., Brooklyn, N. Y.

Microphone switching systems

[*Continued from page 153*]

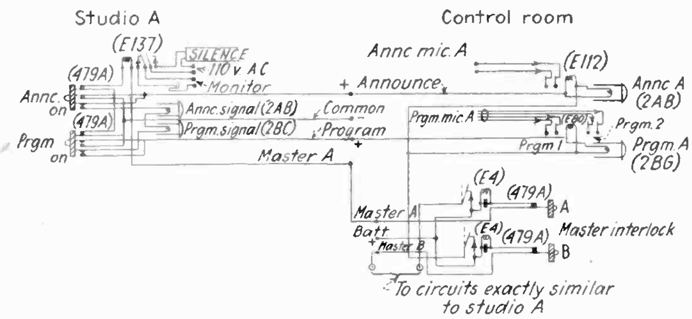


Fig. 3—Studio and microphone interlock switching system.

ated position all program microphones are completed through to their respective fader circuits in the control room. Figure 3 gives the simplest interlock circuit in use and the most dependable for two-studio operation. If it is desired also to control microphone set-up in the control room, adjunct keys may be added to the studio keys and placed in the control room. They must include the interlock feature in order to destroy the studio set-up in case of an error in switching. This extra control circuit, however, is hardly necessary as the announcer has only two keys to operate and if care is taken no mistakes will be made in switching.

Figure 4 gives the most elaborate circuit for individual control room and studio switching circuits. The whole circuit is shown from studio microphones through all attenuating resistors, jacks, relays and out into the mixer circuits. The studio speaker circuits are also shown with compensating resistors used when the circuit is operated so that the same drain will be placed on the monitoring amplifier and the level will not tend to increase when one or more speakers are cut out of the circuit. The fundamental circuit in Figure 4 differs from the others in that a relay is used to break all potential from the holding contacts on all relays. A shunt resistance of 3,600 ohms center-tapped is shown across the mixer output so that if any microphone circuit happens to be above ground potential—due to unbalance of the mixer circuits—a balanced filtering network will be provided on the output and possibility of one microphone channel feeding through into one of the other fader circuits will be lessened. It may also be noticed that jacks are provided in all relay-in, relay-out, mix-in, and mi-

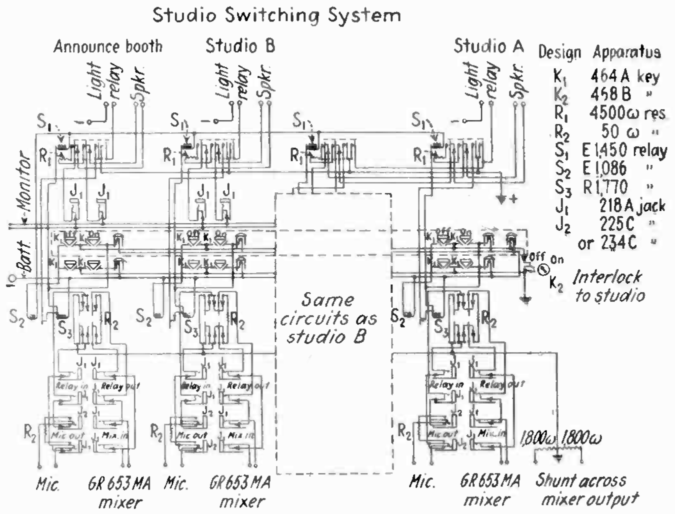


Fig. 4—Circuit for individual control room and studio switching control.

crophone-out circuits so that if a relay happens to fail in operation a patch cord may be placed around the circuit temporarily disabled, and operation carried on through the mixer circuit.

Electronic industrial control

[*Continued from page 156*]

As another requirement, the exposed glass bulb must be eliminated in industrial tubes when possible; whether an all-metal tube or a metal inclosure is used, the glass must be out of sight. For psychological reasons alone the industrial tube must bear no resemblance whatever to the familiar radio tube. To withstand handling, vibration, heat and widely varying service conditions an entirely new mechanical structure will be necessary.

Power frquencies will seldom exceed 500 cycles—most uses will be for direct current or commercial frequencies of alternating current. Complications in design and manufacture essential for tubes used for radio frequencies, are not necessary for industrial controls.

Other methods of making electrical connections to industrial tubes must replace the prong base. Easy removal of the tube will offer no advantage since the tube will have an indefinite life. In fact, a prong base encourages theft, and vibration tends to shake the tube out of the socket.

Assuming that suitable industrial tubes are available, the radio set designer will have to develop an entirely new point of view in designing industrial controls. In fact, radio experience may disqualify a designer for industrial equipment. Performance requirements for industrial devices are well defined and readily measured. Likewise, "selling points" are based on accurately measurable qualities, and maintenance records ordinarily obtained will inform the user whether the device lives up to its specifications. Form and shape requirements differing greatly from those in radio are necessary, and the requirements vary with the field of application. Also, equipment must be readily demountable for use in other locations, and readily removable units must be provided for the parts requiring servicing. Accessibility to these parts and to necessary adjustments is an extremely important consideration to the machine user.

Resistors, rheostats and condensers such as now used in radio will have to be re-designed for longer life and sturdier construction. External wiring connections of more serviceable construction, as well as heavy, rigid mounting bases and enclosures, will be needed. Wiring must be heavier, better insulated and better secured.

Power in industrial controls is supplied at much higher currents and lower voltages than is common practice in radio power equipment. This consideration will necessitate an entirely new approach to the industrial control problem making it still more difficult for the tube designer to meet the mechanical designer on common ground. Yet, these two designers must get together if the advantages of electronic control are to be made available to industrial equipment in an acceptable form.