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AUGUST 1939

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VOLUME 19
NUMBER 8

RAY D. RETTENMEYER
Editor

•Editorial Comment•

THE Federal Communications Commission has recently assigned new call letters to a number of short-wave international broadcast stations, and it is anticipated that additional call letter changes will be made at an early date. For example, the call letters of W2XAF have been changed to WGEO, while W6XBE is now known as KGEI.

These changes, we believe, serve two purposes. In the first place it permits easier identification because of the simplification of identifying letters. A more important fact, however, is the Commission's recognition that international broadcasting should no longer be on an experimental basis. The FCC's action in this matter should do much to encourage international broadcasting and to foster goodwill.

WE understand that Frank R. McNinch has resigned as Chairman of the Federal Communications Commission because of ill health. His resignation will become effective September 1.

James L. Fly, general counsel for the Tennessee Valley Authority, has been named as successor to Mr. McNinch. The appointment of Mr. Fly will be for the remainder of the unexpired seven-year term.

AS we have pointed out before, receiver manufacturers might secure additional outlets for their sets if they were to build receivers with special period and modernistic cabinets to be retailed exclusively by furniture stores. These special models should have considerable sales appeal since they would be designed to go with specific sets of furniture.

DON'T forget the annual conventions of the Institute of Radio Engineers (Hotel Pennsylvania, New York City, Sept. 20-23) and the Associated Police Communications Officers (Kansas City, Mo., Oct. 2-5). Both gatherings promise to be of outstanding importance. Watch for further details in September COMMUNICATIONS.

•Contents•

COVER ILLUSTRATION

A view of the Lagoon of Nations at the New York World's Fair. This photograph was taken in the room from which the stereophonic sound lights, and water are controlled. Note turntables in the foreground. Photo courtesy Bludworth, Inc.

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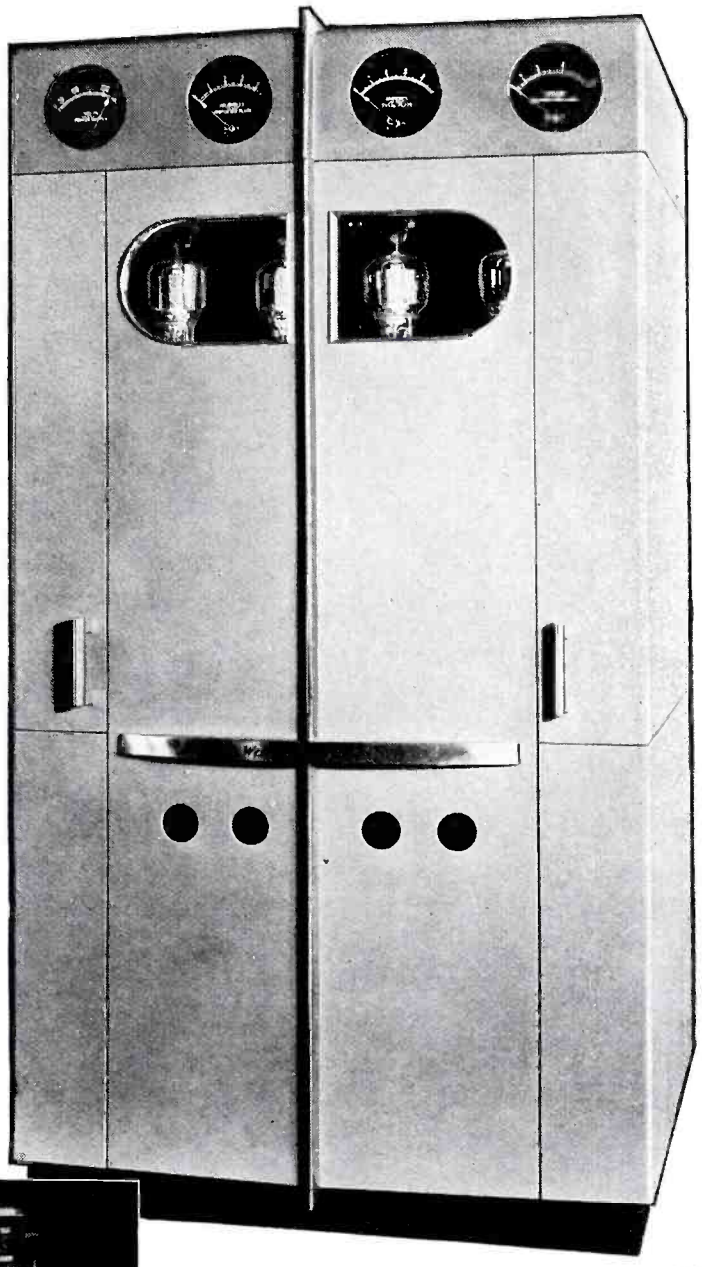

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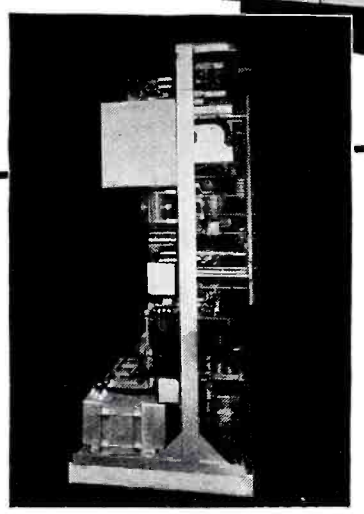

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● A TECHNICAL PROGRAM covering all important branches of radio engineering is now in preparation by the I.R.E.'s Convention Committee. For details see the September issue of COMMUNICATIONS.

● THIS INVITATION is extended to all interested engineers and physicists. You will be required to register, but there will be no registration fee or other charge for admission either to the Radio Engineering Show or to the technical sessions of the Convention.

SEPTEMBER 1939

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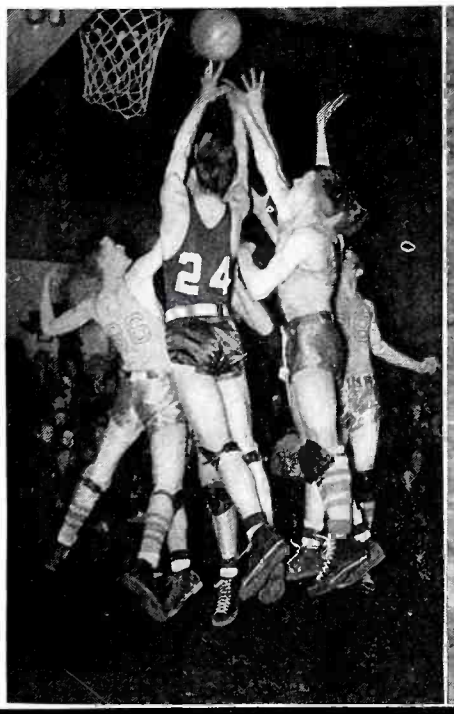

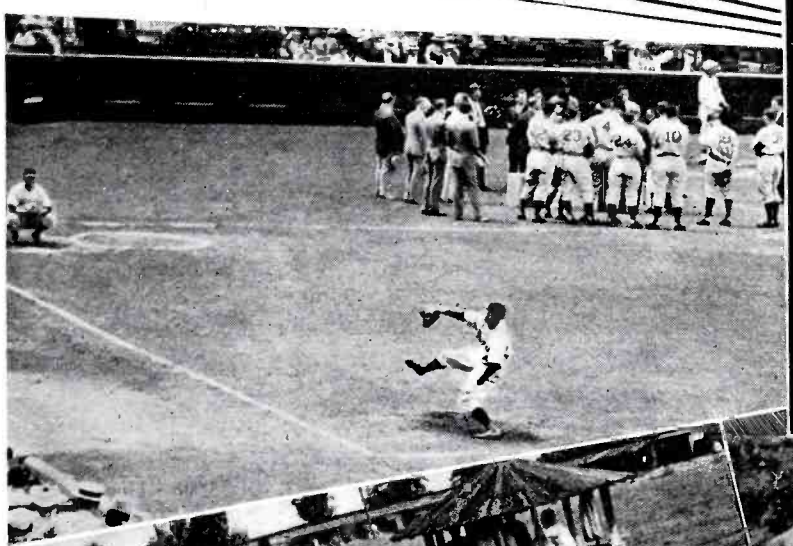

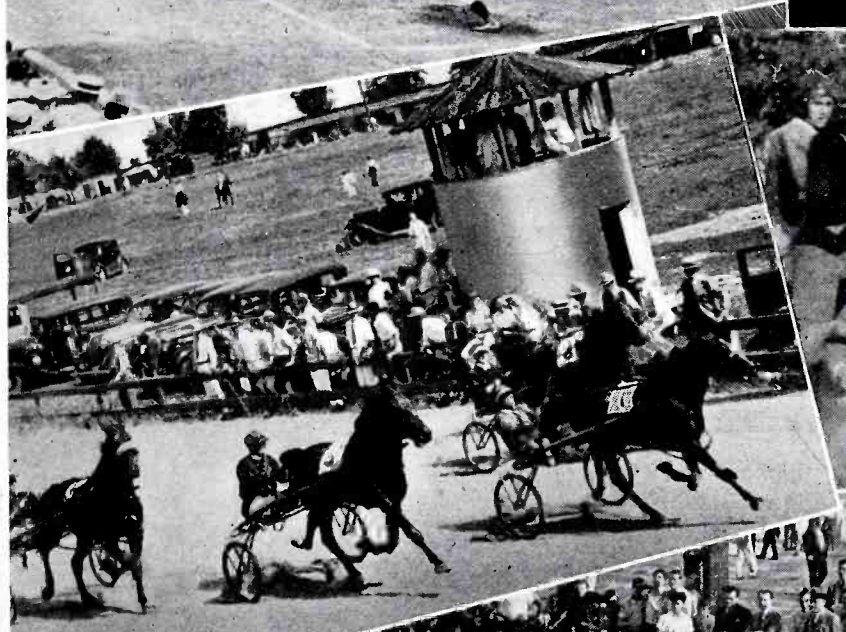

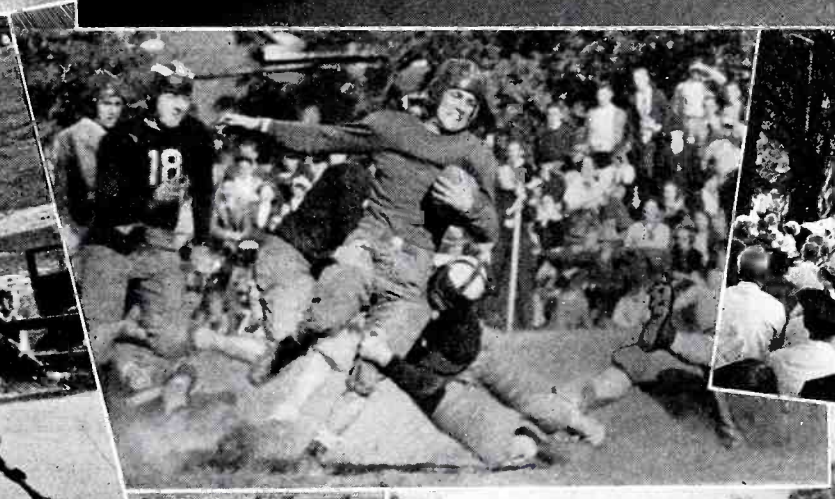

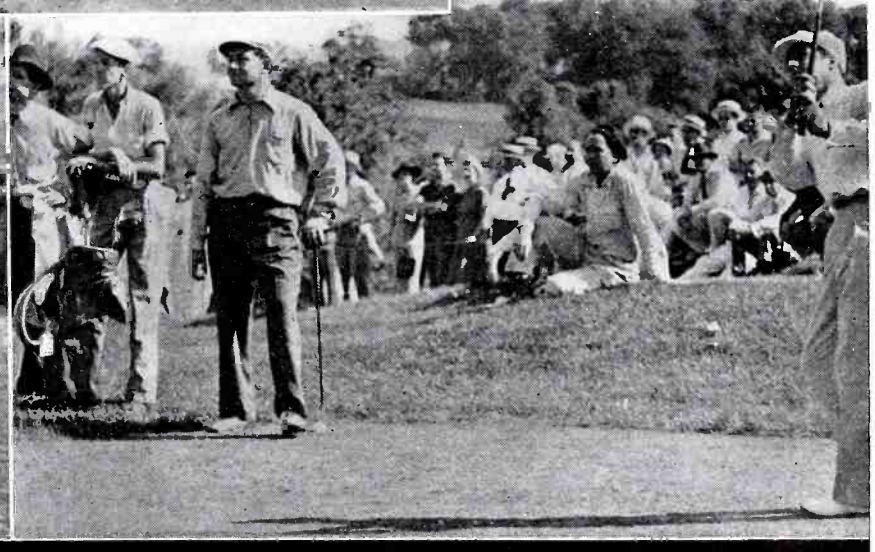

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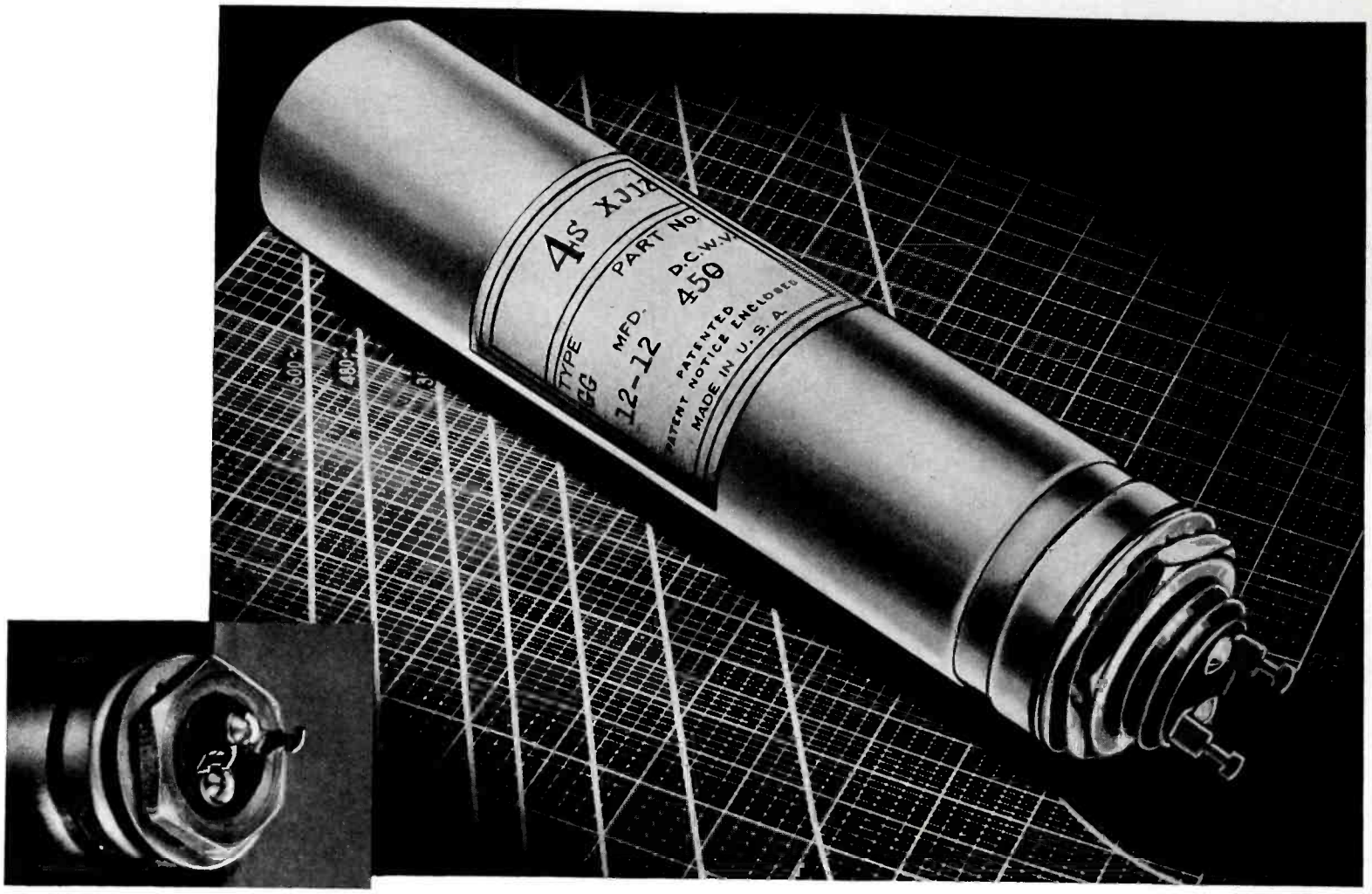

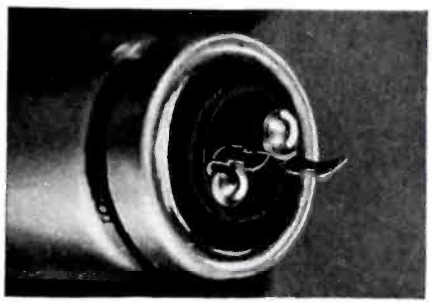

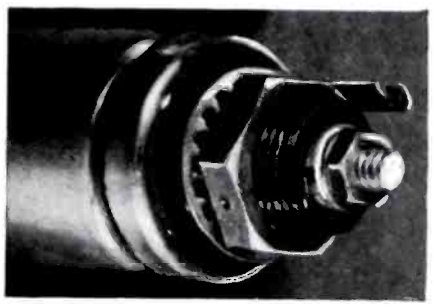

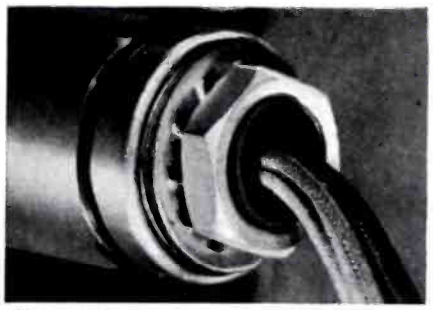

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COMMUNICATIONS

FOR AUGUST, 1939

ELECTRON BEAM DEFLECTION METHODS

By F. ALTON EVEREST
Dept. of Elect. Eng.
OREGON STATE COLLEGE

IN an electronic television system which uses a cathode-ray tube as the reproducing element, we have seen that the electronic density of the electron beam is made to vary with the signal corresponding to the variations of light and shade of the image being transmitted. In order that the visual intelligence be successfully received, it is necessary that the electron beam of the reproducing tube be made to traverse the area of the screen which corresponds exactly to the area being scanned at that instant at the transmitter. Exact synchronism must be maintained between the two extremities of the system, a subject which will be covered next month. In addition to this, means must be provided whereby the electron beam can be deflected to any part of the fluorescent screen. This is the subject to be covered in this installment. As mentioned in Part IV, the two possible methods of obtaining a deflection of the electron beam are the electrostatic and the electromagnetic methods.

Electrostatic Deflection

In the case of electrostatic deflection, the beam of electrons leaves the gun and passes between two parallel (at least considered parallel for this analysis) deflecting plates arranged horizontally. The electric field set up between these two plates causes the beam to be bent upward and downward in a vertical plane. The beam next passes between another similar pair of plates arranged at right angles to the first pair. An electric field set up between these two plates causes the beam to be deflected in a horizontal direction and by means of the composite forces acting upon the beam by the two pairs of plates, it may be deflected to any part of the fluorescent screen. These forces acting upon the beam arise, as pointed out before, from the fundamental action of charged bodies: like charges repel, and unlike charges attract. The beam, being composed of negative electrons, will be deflected toward the plate which is positive at that instant.

The amount of the deflection is given by

$$x = \frac{E_d l y}{2E_a d} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where E_a is the potential applied between the deflecting plates, E_a is the accelerating anode potential, and the other symbols are as explained in Fig. 1. Equation (1) is derived from the equation of motion of an electron travelling in the y direction, considering the charge on the electron and the mass of it due to its velocity. The trajectory of the electron is rectilinear before entering the electrostatic field between the deflection plates and after emerging from it, but while it is travelling between the plates, its path is curved. From the mathematical statement of equation (1) we can see that the deflection x is directly proportional to the deflecting voltage E_d, the length l of the electrotatic field traversed by the electron, and the distance from the plates to the screen. It is inversely proportional both to the deflecting plate separation and the accelerating anode potential. Of these parameters, all are fixed quantities for a given cathode-ray tube except E_d and E_a. The greater E_a, the greater the velocity of the electron travel and the less time the electrostatic field between the plates has to act on it. For this reason a "stiff" beam (one accelerated by a relatively great anode voltage) requires a relatively large deflecting voltage for a given deflection.

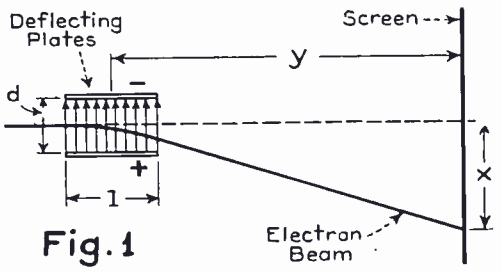


Fig. 1

Illustrating the principle of electrostatic deflection.

Showing how electromagnetic deflection is accomplished.

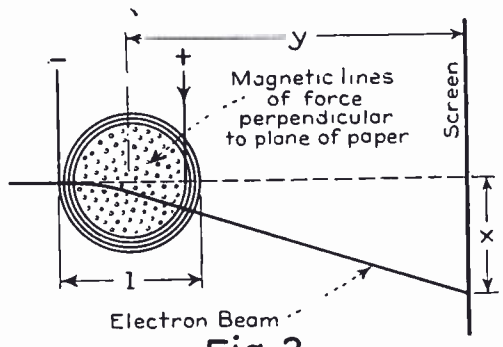


Fig. 2

Part V of a series of articles on the fundamentals of television engineering.

Electromagnetic Deflection

The electron beam can be compared to a current flow in an extremely flexible conductor. If this beam traverses a magnetic field, a force will act upon the beam tending to move it. This phenomenon is exactly the same one which causes electric motors to turn, the well-known "motor action" based upon Ampere's law. Consider an electron beam entering a perfectly uniform magnetic field whose direction is from the observer into the paper in Fig. 2. By means of the old familiar left-hand rule (remembering that electron flow is opposite to the conventional current flow), the direction of the deflection can be determined. The amount the beam is deflected is given approximately by:

$$x = \frac{0.3\,Hly}{\sqrt{E_a}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where H is the field strength in gauss

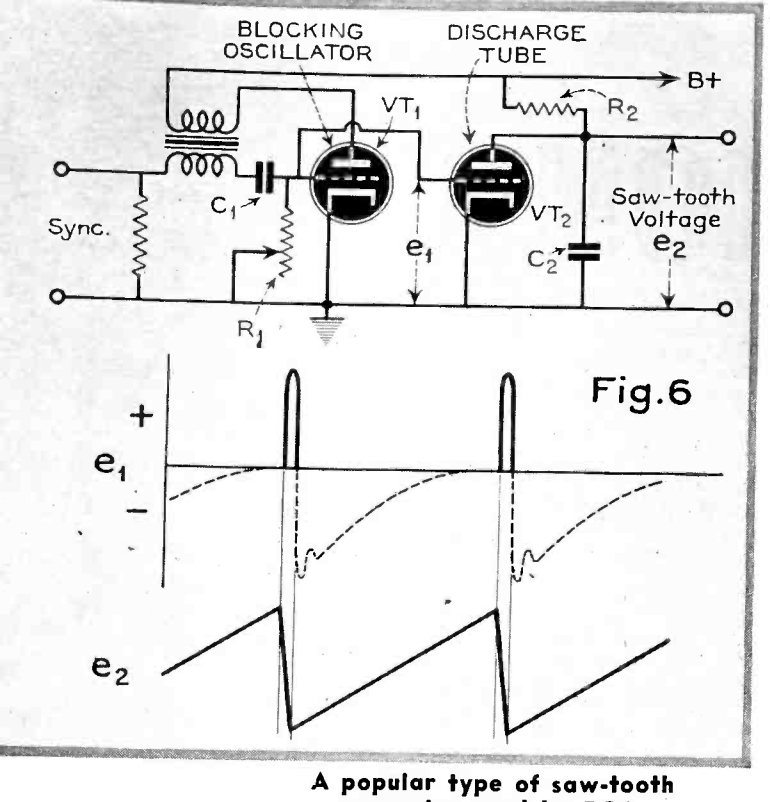


Fig.6

A popular type of saw-tooth generator used by RCA.

and the other symbols as explained in Fig. 2.

It should be emphasized that equations (1) and (2) are only approximate due largely to the fringing effect and the resulting non-uniformity of the electric and magnetic fields.

Sawtooth Generating Systems

In order to obtain uniform spot travel along a line and equally spaced lines over the whole raster or scanning pattern, the potentials that must be applied to the deflecting plates must be of saw-tooth waveshape. This shaped wave can most easily be produced by a circuit such as that shown in Fig. 3 in simplified form. The condenser C is charged from the d-c source at a rate determined by the resistor R. When the voltage across the condenser terminals, and thus across the gas triode VT_1, has attained a certain value which is determined by the grid voltage E_c, VT_1 will become conducting and discharge the condenser C very rapidly. Thus, we have a voltage which increases at an essentially constant rate up to the firing point of VT_1 and then rapidly decreases to zero and again begins a new cycle of ascent producing a saw-tooth shaped wave. The frequency may be varied by varying R or changing the value of C, and the amplitude may be adjusted by varying E_c. To obtain an essentially linear ascent, the crest saw-tooth voltage must be only a relatively small percentage of the applied d-c voltage, because the voltage built up across C is an exponential function of time. The resistor R may be replaced by a pentode tube whose plate current is essentially independent of its plate voltage. In this way, the tube acts as a constant-current device making the saw-tooth ascent linear over a greater proportion of the applied voltage. The limitation of this saw-tooth oscillator utilizing a gas triode is that the firing point of the tube varies slightly with aging, temperature, etc., causing somewhat erratic operation, and that there is a very definite upper frequency limit due to the finite deionization time. Newer gas triodes using gases other than mercury vapor have overcome many of these disadvantages, and it is possible to use this type of saw-tooth generator for the line scan for modern high-definition pictures which is 13,230 cycles per second.

While the mercury-vapor type of gas triode only was available, its limitations caused much work to be done along the line of high-vacuum saw-tooth generators. Fig. 4 shows a circuit[1,2,3] which has proved to be very satisfactory as to stability and high-frequency operation. In fact, high-vacuum generators have been made to operate at frequencies as high as one megacycle, which gives them a distinct advantage over the gaseous type even for oscillographic uses.

In Fig 4, VT_1 is the high-vacuum triode which acts as the discharger of the condenser C and VT_2 has the duty

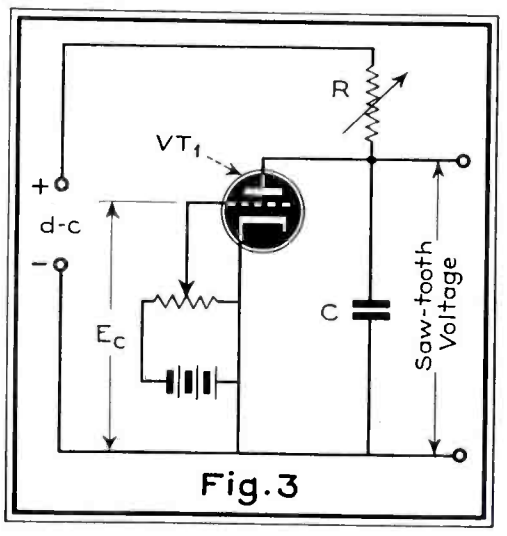


Fig.3

A simplified circuit for producing saw-tooth voltage.

of aiding this discharge operation. The actual discharge and charge circuit is shown with heavy lines to facilitate an understanding of the circuit. Let us follow a cycle of operation through, starting with the condenser C discharged. At the moment the 300-400 volts d-c are switched on, the full voltage appears across R causing the cathode of VT_1 to be highly positive with respect to ground. The grid of VT_1 assumes the potential of the lower end of R_2 which depends entirely upon the plate current flowing through VT_2 which in turn is determined by the screen voltage setting on R_3. The grid of VT_1 can thus easily be made highly negative with respect to its cathode. This results in VT_1 being non-conducting while C is being charged. As the voltage across the terminals of C increases, the plate voltage of VT_1 ultimately attains a value which causes VT_1 to become conducting in spite of its high negative bias. As the plate current of VT_1 flows through R_1, voltage drop appears which is coupled to the grid of VT_2 through the C_1-R_6 circuit driving it in a negative direction which in turn decreases the voltage drop on R_2. The grid of VT_1 thus becomes less negative allowing more and more plate current to pass. The grid of VT_1 goes positive, and the condenser C is discharged very quickly through VT_1. When the voltage across C decreases enough, the VT_1 grid again gains control and the cycle repeats. The resistor R_1 controls the discharge time which is aided by the gain of VT_2. Resistor R_2 controls the amplitude of the sweep. A pentode can be used as a constant-current device in place of R if the refinement is justified. Synchronization can be obtained by injecting the pulse on the suppressor grid of VT_2 or replacing R_3 by a triode with adjustable cathode resistor and injecting the pulse on the grid of this tube. The values of components for 10,000-cycle operation as suggested by Parr[3] are included in Fig. 4.

A simpler single-tube circuit of the blocking oscillator type is shown in Fig. 5[3]. The condenser C is charged in the usual way from a d-c source either through a resistor R or a pentode tube. The discharge tube is connected across C, the primary of a transformer being in the plate circuit and the secondary in the grid circuit and the two windings closely coupled. The tube is biased beyond cutoff by R_3 which is by-passed by C_2 to provide a smooth bias voltage for the tube. The method of action is as follows: the grid is biased beyond cutoff and the condenser charges until the plate voltage is great enough to allow current to pass through the tube even with the high bias. The plate current flowing through the primary of the transformer induces a voltage on the grid which bucks the

Circuit for obtaining balanced saw-tooth for electrostatic deflection.

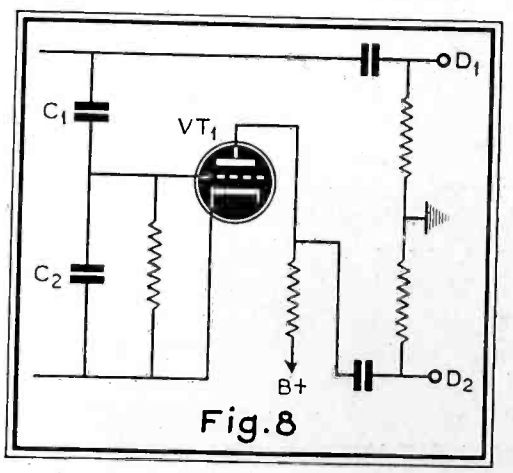


Fig.8

bias from R_3. This process rapidly continues, until the condenser is discharged and the cycle repeats. The resistor R_2 is connected across one of the windings of the transformer and adjusted so that the tube will not oscillate continuously but will produce essentially a single pulse of current. Synchronization may be realized by inserting the pulses into a third winding. The resistor R_3 controls the amplitude, and R the frequency of the saw-tooth. Typical values of constants suggested by Parr[3] are included in Fig. 5.

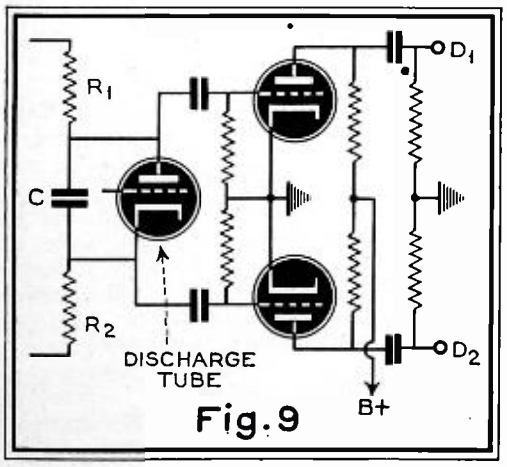
There are several other types of saw-tooth generators but none as much in use in this country as that used by RCA as illustrated in Fig. 6.[5,6,7] Here again the ascent of the saw-tooth wave is obtained by charging the condenser C_2 through the resistor R_2 from a d-c source. The tube VT_2 is normally biased beyond cutoff so that it does not influence the charging cycle. However, at certain intervals determined by the selection of constants and the synchronizing signal, the blocking oscillator incorporating VT_1 delivers a large positive pulse to the grid of VT_2, causing it to have a very low impedance and discharging the condenser C_2 after which a new cycle begins. The wave-shape of e_1 is shown in Fig. 6, the broken portion in the negative region serving only to drive VT_2 farther beyond cutoff. The solid positive pulses, however, are the ones causing VT_2 to discharge C_2. The phase relationships between the discharge pulses of e_1 and the output saw-tooth wave e_2 is as shown in Fig. 6.

Electrostatic Deflection

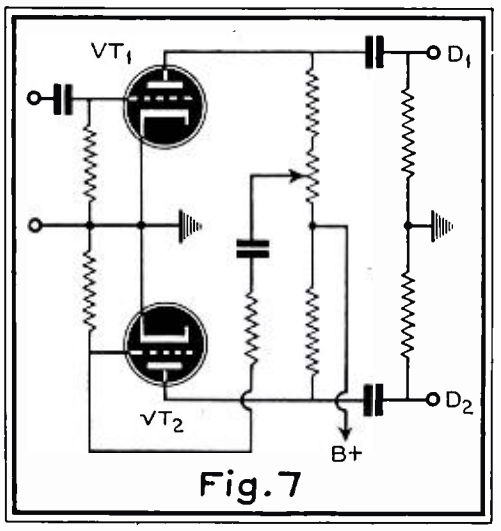
It has been pointed out that in charging a condenser through a resistor (the case in many of the saw-tooth generators described), the condenser can be charged only to a small percentage of the + B voltage if linearity is to be obtained. There are two ways to get around this limitation, one to use a pentode in place of the charging resistor and the other is to amplify the relatively low saw-tooth generated with the charging resistor. In either case, more component parts are required.

One thing that must be met in electrostatic deflection is the distortion arising when the saw-tooth voltage is applied to the plates asymmetrically, or unbalanced to ground. Many of the small oscillograph cathode-ray tubes have one horizontal and one vertical plate bonded within the tube, but the larger tubes, especially those in television service, always have separate contacts for all deflecting plates. The two types of distortion arising when the deflection voltages are asymmetric are: (1) a variation of sensitivity produced by the deflection voltage which adds or subtracts from the accelerating anode voltage, and (2) an inter-modulation of the two pairs of plates. Both forms of distortion are avoided if balanced deflecting voltages are used. The effect of these distortions is the degeneration of the normal rectangular raster to one of trapezoidal shape. To avoid this, a push-pull amplifier stage should be used to apply the deflecting voltage to the plates.

Figs. 7, 8, and 9 show three means of attaining a balanced saw-tooth for electrostatic deflection. Fig. 7 is a conventional circuit, VT_1 being a straight amplifier of the unbalanced input, and VT_2 is the phase-inverter stage by obtaining its driving voltage from the plate circuit of VT_2. For line scan, the fundamental frequency is 13,230 cycles for RMA standards and to transmit faithfully 10 harmonics, the design of the circuit must be carefully considered.[8]

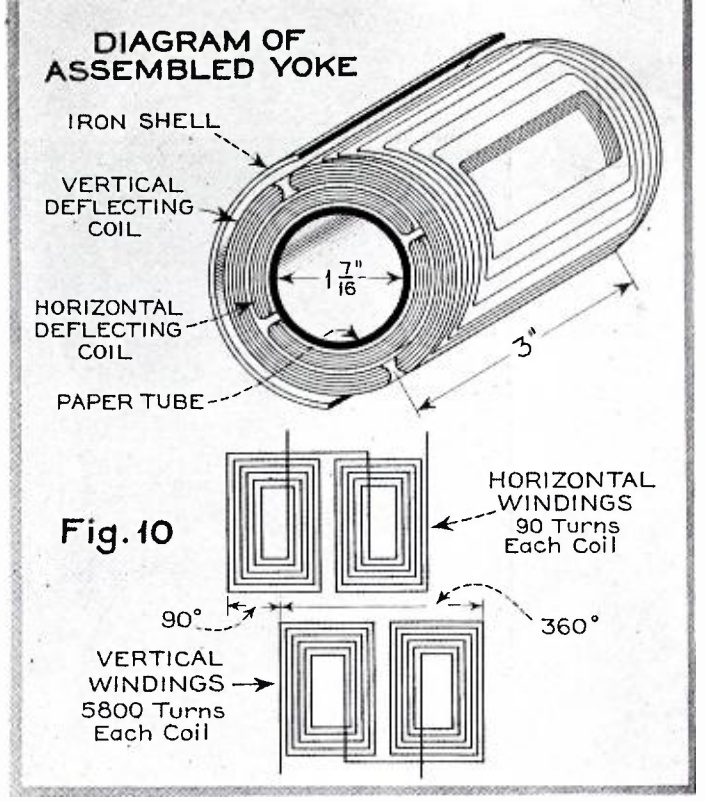


A saw-tooth circuit for electrostatic deflection.



Circuit for attaining balanced saw-tooth for electrostatic deflection.

Fig. 8[9] uses the voltage directly from the saw-tooth generating condenser C_1 to apply to one deflecting plate D_1. The other voltage in correct phase relationship is obtained from a stage whose excitation is derived from a small condenser C_2 inserted in series with the main condenser C_1. As a 180° phase relationship exists between the grid and plate circuit of VT_1, the plate D_2 will receive a faithfully balanced voltage if the circuit is properly designed. C_2 is so proportioned that a voltage is delivered to the VT_1 grid which is the voltage appearing across C_1 divided by the actual gain of VT_1.



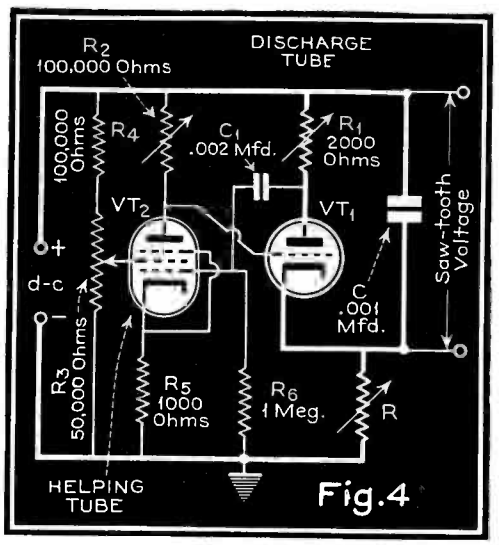
An assembly of horizontal and vertical deflecting coils are used in RCA receivers.

Fig. 9[9] shows a circuit which is inherently balanced to ground. This is accomplished by dividing the charging resistor into two equal parts, R_1 and R_2, and placing one on either side of the saw-tooth generating condenser. To vary the charging rate (and thus the frequency) either R_1 or R_2 may be made adjustable within small limits without seriously disturbing the balanced conditions.

Electromagnetic Deflection

To obtain the same effect on an electron beam magnetically as the saw-tooth voltage applied to a pair of plates does electrostatically, a saw-tooth of current must be driven through some deflecting coils mounted on the neck of the cathode-ray tube. Such an assembly including both the horizontal and vertical pairs of coils is shown in Fig. 10 as used in RCA receivers.

Usually a saw-tooth of voltage is generated by one of the methods described and used to drive an amplifier which delivers sufficient current to deflect the beam. If the resistance of the deflecting coil circuit is great compared to the inductive reactance of the coil, no difficulties will be encountered. Such a situation exists in the horizontal deflecting circuit. However, in the vertical magnetic deflection system, the inductance of the coils cannot be neglected, and the saw-tooth voltage applied to the grid of the output tube must be adjusted so that a saw-tooth of current actually results. This is accomplished by inserting a pulse during the discharge part of the original saw-



Saw-tooth voltage circuit. Discharge and charge circuit shown by heavy lines.

tooth forcing the current to decay within its allotted time[5].

As the current suddenly changes during the flyback part of the saw-tooth wave, a high-voltage transient condition is induced which limits the number of turns that can be used on the deflection coils[6]. The television receivers using magnetic deflection usually employ a diode across the primary of the horizontal output amplifier which damps out this condition.

Electrostatic vs. Electromagnetic Deflection

In the final analysis in the commercial field, the deflection system which is the most economical should be used. A few of the factors entering into this will be brought up.

Magnetic deflection is accomplished by lower voltage circuits than electrostatic deflection which would tend to make the cost of the component parts less for the magnetic system.

As far as distortions are concerned, it might be mentioned that there is a great possibility of cross-modulation between the two magnetic fields as well as between the two sets of deflecting plates, and it is believed that proper design in either case minimizes this factor.

Great care must be exercised in the construction of the electrostatic type of tube as to the alignment of the plates. The construction of the magnetic tube is inherently simpler and cheaper, and any skew in the deflecting system can be adjusted at will.

As pointed out in equations (1) and (2), the sensitivity of the magnetic tube varies inversely as the square root of the accelerating potential and in the electrostatic tube inversely as the accelerating potential. This means that fluctuations in the E_a of the magnetic tube would be less noticeable than in the other.

All in all, the two systems seem to be pretty well matched and usually the decision will rest upon such factors as the control of patents, convenience, and cost. Usually, however, the electrostatic system is somewhat more adapted to the needs of the amateur constructor.

(To be continued)

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(3) Parr, "Hard Valve Scanning Circuits," *Television* (London) (I) August, 1938, p. 475, and (II) September, 1938, p. 541.

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(5) Engstrom and Holmes, Television Deflections Circuits," *Electronics,* January, 1939, page 19.

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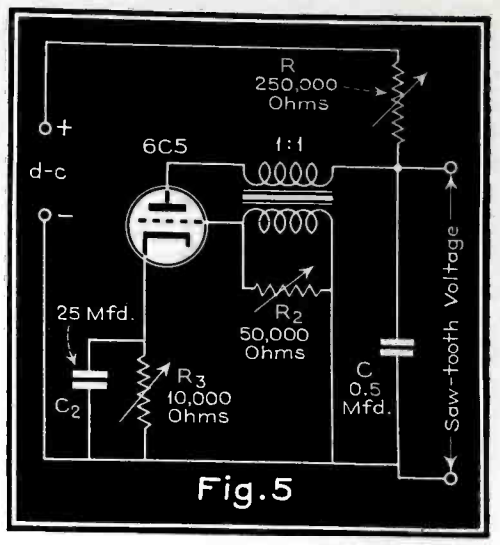


A simple one-tube circuit of the blocking oscillator type.

TELEVISION APPLICATION

Abraham and Straus, Inc. and Bloomingdale Bros. Inc., New York City, have applied to the Federal Communications Commission in Washington for a license to construct a station for transmitting television programs. The application for the license was filed by Metropolitan Television Inc., a subsidiary of two stores which was specially organized for the transmission of television programs. The Allen B. DuMont Laboratories, Inc., are listed as consulting engineers in the application of the Federal Communications Commission.

THORDARSON BULLETINS

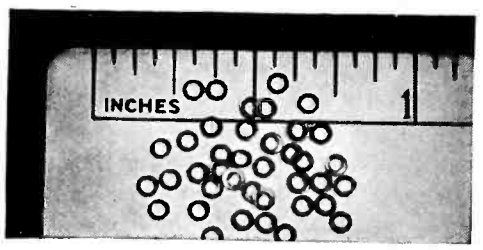
Two new bulletins may be secured from the Thordarson Electric Mfg. Co., 500 W. Huron St., Chicago, Ill. Catalog No. 600-D covers the Thordarson line of amplifiers, while No. 500-D broadcast units, including audio, driver, modulation, plate, filament and current limiting units.

WESTINGHOUSE BULLETIN

Westinghouse have just issued a bulletin dealing with motor starters. The points emphasized in this publication are installation costs, operating costs, compactness and safety. It is available from the Westinghouse Electric and Manufacturing Co. Inc., East Pittsburgh, Pa.

MIDGET WASHERS

An order of washers so small as to be counted among the world's tiniest fabricated products, was recently turned out by the Wrought Washer Mfg. Co. of Milwaukee, Wis. These washers, stamped from phosphor bronze to exceedingly close tolerances, measure .069 x .041 x .005 inches. It would require the combined area of over 700 of these minute washers to cover the top of a silver dollar. A quarter of a million of them would weigh less than a pound.



Magnified approx. 1½ times.

AMPEREX 892 TUBE

Amperex Electronic Products, Inc., 79 Washington St., Brooklyn, N. Y., manufacturers of power vacuum tubes, have recently received approval from the Federal Communications Commission for the Amperex 892 tube. This tube is designed for use in the final stages of commercial radio transmitters with grid bias modulation.

FERRANTI COMPONENTS

Ferranti Electric, Inc., manufacturers of transformers, reactors, filters, equalizers, etc., for the electronic industry, have in recent months been closely identified with the development and supply of equipment manufactured in accordance with C. A. A. requirements. This work not only includes transformers and reactors but also special filters and like apparatus. They have developed a number of light weight components which are particularly applicable in the aircraft and allied industries.

SYNTHANE FOLDER

"Practical Methods of Machining Bakelite-laminated and How to Apply Them in Your Own Shop" is the title of a new folder issued by the Synthane Corporation, Oaks, Pa. Instructions for machining Bakelite-laminated are given in the form of a condensed chart suitable for hanging on the wall. Many illustrations show how various machining operations are done at the plant. Of additional interest to readers is a brief comparison of the circumstances under which Bakelite-laminated should be machined by the purchaser or prefabricated by Synthane.

BOOK REVIEWS

FUNDAMENTAL ELECTRONICS AND VACUUM TUBES, by A. L. Albert, published by The Macmillan Company, 60 Fifth Avenue, New York City, 1938, 422 *pages, price* $4.50.

The title of this book is somewhat misleading inasmuch as less than 18% of the book is devoted to what might be called fundamental electronics. The remainder of the book is devoted to the elucidation of vacuum tubes and their affiliated circuits. As is proper for any text presenting a survey of vacuum tubes the preponderance of space is devoted to thermionic vacuum tubes.

The treatment is mainly descriptive, the emphasis being placed upon why vacuum tubes behave as they do rather than on mathematical analysis. Accordingly, this book offers an excellent introduction to vacuum-tube theory. A knowledge of elementary algebra should prove sufficient to understand the relatively few equations that appear.

The author adopts the highly desirable custom of employing both italic and bold face type to emphasize important words and phrases. It is to be hoped that other authors follow this example.

Well worthy of comment is the author's brief but much needed discussion on precautions to be observed in using the term "decibel."

Several minor criticisms might be made of this work. For example, the explanation of triode plate-circuit square-law detection is for a signal in which the carrier and one side band are suppressed, a treatment which would hardly clarify the operation of such detectors for the reader unfamiliar with such action. Occasionally, as on pages 348-350, the author uses small letters in the text to refer to capital letters in the diagram referred to.

Several minor errors were also noticeable. On page 145, line 1 should read "close to" and not "to close." On page 349, the paragraph starting on line 20 should read "As was shown on page 123." On page 346, Fig. 12-7, the phrase, "on the curved portion of the plate voltage—plate current curve" should read "on the curved portion of the grid voltage—plate current curve."

Professor Albert has done an excellent job. It is the reviewer's opinion that *Fundamental Electronics and Vacuum Tubes* is one of the best surveys of vacuum-tube theory that has thus far appeared.

R. L.

THE ENGINEERS' MANUAL, Second edition, by R. G. Hudson, published by John Wiley and Sons, Inc., 440 *Fourth Avenue, New York City,* 1939, 340 *pages, price* $2.75.

The revised edition of this popular manual is, like its predecessor, divided into five parts: Mathematics, Mechanics, Hydraulics, Heat, and Electricity. The flexible binding, as well as the convenient size of this book make it suitable for carrying in one's pocket, if desired. Although it is highly unlikely that advantage will be taken of its pocketability, it is nevertheless true that this small format is a very useful attribute for a manual to possess.

The formulas selected for inclusion in this volume are well chosen and the mathematical tables are those most frequently used by the practicing engineer. So true is this, together with its ease in handling, the reviewer must admit that when he is in need of a manual his hand automatically reaches for Hudson.

D. B.

TELEVISION: A STRUGGLE FOR POWER, by C. Waldrop and Borkin, published by William Morrow and Company, 386 *Fourth Avenue, New York City,* 1938, 299 *pages, price* $2.75.

The present volume is an attempt to furnish a basis for independent conclusions as to who will benefit when television develops on a widespread household basis.

The authors have succeeded in the translation of much solid research into a readable, non-technical book. Beginning with a popularized outline of the technological aspects of television, they continue by pointing out the various private and public interests involved in any decision concerning commercial television. A deftly, highlighted account of the activities of *A. T. & T., R. C. A.* and the moving picture industry in the fields of wireless and sound motion pictures is supplied as a background, and constitutes one of the most interesting features of the book, as well as one of the those most stimulating to thought. A discussion of public policy with regard to television, liberally besprinkled with question marks, and sketches of those arbiters of destiny, the seven members of the Federal Communications Commission, conclude the book.

In the limited space of approximately 300 pages it was, of course, impossible for the authors to include any great portion of the important material bearing upon "the public interest, convenience, and necessity" in the field of television. The authors have, however, outlined the most important aspects of the matter.

E. A. M.

SCIENCE AND MUSIC, by Sir James Jeans, published by The Macmillan Company, 60 Fifth Avenue, New York City, 1938, 258 *pages, price* $2.75.

The ability to write on technical subjects, particularly those pertaining to the physical sciences, without resorting to mathematical formulae is possessed by relatively few men. When, coupled with this ability, the style of writing is characterized by its clarity and literary merit the number of men so fitted becomes vanishingly small. That Sir James Jeans belongs to this select group is once again proven by the appearance of his latest book, *Science and Music.*

The title of the book is somewhat deceptive, giving as it does the impression that its contents are devoted to an exposition of the sociological and cultural implications of science as it applies to music. This, however, is not the case, for this volume deals with the science of sound and covers substantially the same material that would be embraced by any book on this subject.

For many years the science of sound has been neglected and has not received the attention it deserved. In relatively recent years this subject has been receiving more and more attention, largely due to its importance in communication engineering. The engineer, who has hitherto neglected this important subject, will find *Science And Music* an interesting and valuable introduction to this field. It should be kept in mind that the reasons why communication equipment *should* meet certain requirements is equally as important as the reasons why his equipment *is able* to meet these requirements.

R. L.

COMPLETE PROCEEDINGS OF THE WORLD RADIO CONVENTION, held in Sydney, Australia, April 4-14, 1938, *under the auspices of the Institution of Radio Engineers (Australia), published by the Institution of Radio Engineers (Australia), Box* 3120, *G.P.O., Sydney, N.S.W.,* 1938, *price* 21/- *in Australia, price* 23/- *elsewhere. Individual papers purchasable at* 6d *each, including postage.*

This volume presents under one cover the fifty-one separate papers delivered at the World Radio Convention held in Sydney, Australia. Practically all of these papers pertain to the subject of communications and will, accordingly, be of interest to workers in this field. The diversity of topics discussed is so great that space cannot here be given to a description of the subjects covered. An examination of the contents of this volume indicates that some of the material presented is not available from other sources even by the same authors on similar subjects in other publications. Accordingly, the communication engineer would do well to examine this volume for possible new developments in his own specialized field.

D. B.

A. C. MOTORS OF FRACTIONAL HORSE-POWER, by H. H. Jones, published by the Chemical Publishing Company of N. Y. Inc., 148 *Lafayette Street, New York City,* 1938, 189 *pages, price* $3.00.

A modern book on low-power alternating-current motors has been badly needed. The author is to be commended for filling the gap in this branch of engineering literature.

Since the emphasis in this book is placed mainly upon the practical aspects of motor construction, the treatment is non-mathematical in character. The few formulas which appear require but the slightest knowledge of elementary algebra.

The author prefaces the exposition of each type of motor with an excellent but over-simplified description of the underlying theory. He then jumps to a design formula but does not explain the theoretical significance of this formula. In addition, the author uses terms pertaining to motors which he does not explain. It is regrettable that these defects should mar an otherwise excellent book. This book can be recommended to the engineer already familiar with motor principles, or to the individual who is willing to supplement his reading in this book by some other text in the field.

D. B.

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WESTINGHOUSE BULLETIN

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., have recently issued a bulletin covering their Type MT air-cooled control and warp-stop transformers. Copies may be secured by writing to the above organization for Catalog Section 75-030.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President | RCA Building, 30 Rockefeller Plaza, New York, N. Y. | H. H. PARKER, Secretary

DE FOREST

ALL aboard for the New York World's Fair, 1939—Be there on Friday, September 22nd, 1939—de Forest Day—To pay tribute to one of humanity's greatest benefactors.

Dr. de Forest is making a special trip from the West Coast to be there on this occasion.

We quote from our 1939 Year Book—the story of de Forest:

"Lee de Forest did not receive the plaudits of Kings and Emperors; he did not find backers with millions of dollars at their disposal; but he did find friends, in unlimited number, and his reputation as the most colorful inventor that radio has ever had remains undimmed today. We cordially invite all of Dr. de Forest's friends to participate in the de Forest Day festivities at the World's Fair in New York."

Continuing to quote from our Year Book: "The audion; the amplifier; the vacuum tube as generator; this electronic trinity will ever live, long after de Forest is forgotten. Forgotten, too, will be his early struggles—attempting to live and buy apparatus on twelve dollars a week; selling his inventions at a price far below their real value, but forced by necessity to do so. But perhaps even after all this has disappeared, there will still live in the pages of wireless some of the witty, yet pungent, remarks which he unleashed at times. Had de Forest not sat in the first row of a lecture class at Sheffield Scientific School to hear a description of Hertz' work, and had he chosen literature instead, he might have succeeded better financially; but the world would have been the loser."

Further along in the story of de Forest we read:

"For pure rhymeless poetry, it would be hard to excel one of Dr. de Forest's contributions to the press in answer to a critic who had questioned the value of a wireless telephone set, at the time—1907—when Doc's phone sets were being installed in Naval vessels. Under the title 'What's the Use' Doc fulminated as follows:

"Now comes the eternal question of the utilitarian: 'What's the Use?' the most pertinent question, by the way, ever asked. What is the use of erecting a wire and speaking a spirit whisper—lassoing a ghostly voice with a metal noose, of attuning a new aeolian harp and having it vibrate, not to the lawless songs of the wind, but to the will of a master musician playing in a great auditorium?

"What is the use, when some distant mariner, fog-bound and lost, unacquainted with his bearing as well as with the Morse code, can call to a listener on the nearest shore and hear, in a still, small voice, his name repeated and his whereabouts disclosed—or perhaps hear an answering 'Ahoy' and avoid certain collision by learning that another craft, steering a certain course, is close upon him!

"What's the use, when a tug's captain can be in easy telephonic communication with the steersman of his tows or with his barge office, miles away? . . .

In these later years, his pen has grown more mellow. His message four years ago flowed as follows:

"As the dots of days and dashes of months pound out on the rapidly lengthening tape of the years, I realize more and more the immeasurable span of time since wireless was hatched and first put on the air.

"Only a single handful of us who were really pioneers seem alive today to tell of the actual genesis of our noble guild. Only Bob Marriott, and Isbel, Pannill, George Clark, Dave Sarnoff, Ford Greaves, Frank Butler, and a few similar barnacles still live to tell the youngsters what was the acrid stink of nitrous oxide from an open spark gap, or the cathartic odor of castor oil when a glass-plate condenser let go in the night watches.

"Proud am I, proud are we all, to peer back through the years since the first aerial went aloft on American shores, and to realize that—notwithstanding the magnificent progress scored by radio invention and engineering, the morale of the operator, and the spirit of courage and devotion to duty which characterizes him is even more worthy of man's praise and esteem. And so I give to you all a deep and heartfelt toast—Wireless Forever!"

The program for de Forest Day at the New York World's Fair will consist of the reception of Dr. de Forest by the dignitaries of the Fair shortly after noon; luncheon; a tour of the most interesting exhibits with the exhibit managers playing host to Dr. de Forest; an afternoon public reception either in the Court of Peace or the Hall of Special Events; and the Jubilee Dinner at the exclusive Sulgrave Club in the Merrie England Village in the evening which will be attended by all of Dr. de Forest's friends who can attend included among whom will be many of the leading figures in radio today.

Tickets are $5.00 per person and entitle you to admission to the Fair any time Friday—de Forest Day—admission to the Merrie England Village and a full course dinner in the swank Sulgrave Club, which, with all its facilities, has been reserved for that evening. A full hour's entertainment will be given in the open air garden just below the Sulgrave Club and may conveniently be viewed from there and there will be dancing on the terrace after the entertainment to a popular broadcasting orchestra. The Sulgrave Club borders on Fountain Lake and the fireworks which are a nightly highlight of the activities there are easily viewed from the Club. A large reception room with private cocktail bar and lounge assure maximum privacy and comfort for all.

We earnestly request all who wish to participate in this well deserved tribute to one of Radio's Founders to make their reservations early. Tables of ten may be reserved in advance and the choice locations will be given in the order in which reservations are made. It is important that we know well in advance what the attendance will be. Your cooperation will be appreciated.

SCHOLARSHIP

On Saturday afternoon, August 12th, 1939, the first Marconi Memorial Scholarship in Radio Engineering was awarded to Robert Barkey, graduate student of Stuyvesant High School of New York City, by our Association. The Scholarship consists of a complete and comprehensive course in fundamental and advanced electrical and radio theory and practice and requires either eighteen months days, or four years evenings, for completion, in the residence school of RCA Institute. Our Association sponsors the Scholarship with the cooperation of Mr. C. J. Pannill, President of RCA Institutes.

The Scholarship recipient, Mr. Barkey, was selected from among competitors in an examination covering the fields of physics, mathematics, engineering aptitude and an intelligence test participated in by High School seniors in schools as far west as Concordia, Kansas. The examination was conducted by the American Institute of Science. The presentation of the Scholarship Scroll was made in the Westinghouse auditorium in the Westinghouse Building at the New York World's Fair and the proceedings were broadcast over WOR and a nationwide Mutual Broadcasting System network. Present to do honor to Mr. Barkey were Mr. Pollock, President of the American Institute of Science; Mr. J. K. Whitteker, Chief Instructor of RCA Institutes; J. R. Poppele, Chief Engineer of WOR and Chairman of our Scholarship committee, and our President, William J. McGonigle.

After the presentation a visit was made to the RCA Building at the Fair, where Mr. D'Agostino, Exhibit Manager, was host, and later to the plaque of Marconi which adorns the forepart of the Italian Building.

Our sincere good wishes to Mr. Barkey and cordial thanks to Mr. Pollock and the American Institute of Science for their cooperation.

PERSONALS

Radio Operators Become Skippers: Included among our members who now skipper their own yachts are: O. B. Hanson, NBC v-p, on the "Phantom"; Arthur F. Van Dyck, Engineer in Charge RCA License Laboratory, on the "Delka"; W. A. Winterbottom, RCA Communications v-p, on the "Randa"; E. K. Cohan, CBS Technical Director, on the "Electron," and

(*Continued on page* 16)

THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATIONS FIELD

POLYSTYRENE FILM

Bakelite Corporation announces the development of Bakelite polystyrene film for electrical insulation purposes. All of the advantageous properties that are found in Bakelite polystyrene molding material are said to be incorporated in this new film which has been developed especially for such uses as wound capacitors in radio sets and other types of electrical equipment. The film is water white in appearance, but may also be had in a tinted shade of purplish black. It is supplied in ribbons 1½" and 2½" wide and wound on spools to a diameter of 4". The standard thickness is 1 mil; certain other thicknesses might be supplied. Full details as to the physical and electrical properties of this new material may be had from *Bakelite Corporation,* 247 Park Avenue, New York City.—COMMUNICATIONS.

I-F COIL

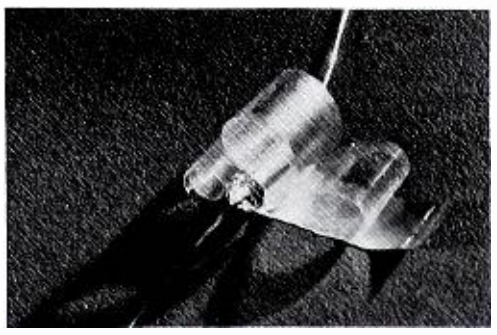
The Burlington Laboratories have just announced a new permeability tuned i-f coil. These special coils are wound on bakelite tubing with a top and bottom adjustment and are suitable for amateur and television use. They are compact and come in a shielded can 1⅜" x 3½". *Burlington Laboratories, Inc.,* 1617 N. Damen Ave., Chicago, Illinois.—COMMUNICATIONS.

AUTOMATIC VOLTAGE STABILIZER

A Raytheon voltage regulator is shown in the accompanying illustration. It is designed to correct varying voltage conditions and provide constant a-c voltage. Since the regulator will stabilize at any load within rating, it may be used as an accessory to devices already installed. Some of the types of equipment which may be benefited by a stabilized voltage are X-ray machines, color comparators, photo-printing devices, photometers, and amplifiers used in talking motion pictures, radio transmitters, and telephone apparatus. It is also widely used by laboratories making electrical experiments and for general use. A typical regulator stabilizes an a-c voltage that may be varying from 95 to 130 volts and holds it constant at 115 volts plus or minus 1% automatically and instantaneously. It is a magnetic device without moving parts or adjustments. It can be made to operate from any commercial a-c power source and deliver one or more required voltages with power outputs up to several thousand voltamperes. *Raytheon Manufacturing Company,* 102 Willow Street, Waltham, Massachusetts.—COMMUNICATIONS.

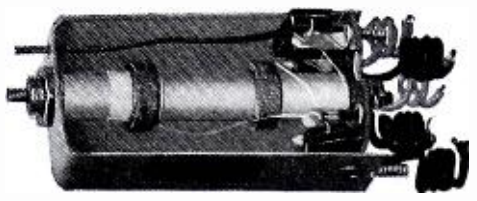
TELEVISION COMPONENTS

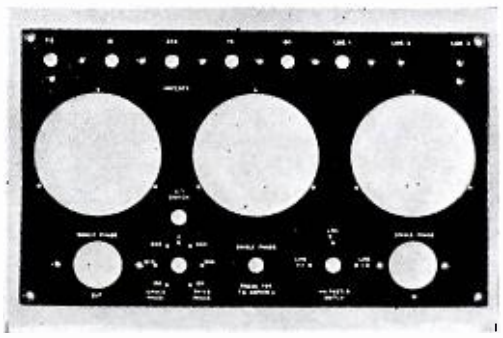
A number of television components have been made available by the Alden Products Co. Included among these units are high-voltage television wire, coaxial cables and connectors, insulated tube caps, rectifier and low-capacitance type sockets for television use, as well as a line of miniature plugs and sockets. Bulletins describing these various products are available. Write to the *Alden Products Company,* 715 Center St., Brockton, Mass.—COMMUNICATIONS.



Above: Bakelite polystyrene film.

Below: Burlington i-f coil.





Above: Richardson Insurok panel.

Below: Raytheon voltage stabilizer.

Below: Lapp gas-filled condenser.

RICHARDSON PRODUCTS

The Richardson plastic, Insurok, is made in many grades, sizes and thicknesses. It is available in sheets, rods, tubes, punchings and other forms for fabrication in the plant or in completely finished parts ready for assembly.

In the radio field, Insurok is used extensively for instrument panels, receiver cabinets, switch parts, tube socket bases, coil forms, spools, cores, punched insulating parts, bushings, washers, condenser brackets, dials, knobs, and the like. This material is hard and light as well as resistant to moisture and the destructive action of most chemicals.

Richardson has recently announced a new product known as Rub-Erok, a hard rubber material with a fine finish. The features of Rub-Erok are low moisture absorption, high insulation resistance, low power factor and low corrosion. It is used for trimmers, leaf spacers for push-button switches on radios, terminal strips, sockets, etc. Literature and catalogs are available on request. Write to *The Richardson Co.,* Melrose Park, Ill.—COMMUNICATIONS.

GAS FILLED CONDENSERS

Well known to the radio field for its line of tower insulators, porcelain water coils and tubing and other radio units, Lapp has recently announced a new series of gas-filled condensers. These units were designed with a view to overcoming some of the troublesome features previously encountered with this type of unit. Great care has been given to mechanical construction. All metal parts are non-magnetic, being of aluminum or bronze. Gaskets are self-sealing under pressure. The units are practically zero loss, the only loss-producing element being a single porcelain bowl which is full diameter of tank and supports and insulates the rotor. There is no change of capacitance with change of temperature. Condensers are provided with external spark gaps which are adjusted to flash externally under excess voltage. Condensers are carefully proof tested for pressure and checked for capacitance before shipment. Fixed, adjustable and variable type are available offering a range of capacitance from 100-2000 mmfd and sizes to operate at 3 voltage ratings, 75 kv, 40 amp.; 10 kv, 60 amp.; and 15 kv, 100 amp.; (voltage rating carrier rms based on continuous operation at 1000 kc, 100% modulation). *Lapp Insulator Co., Inc.,* Leroy, N. Y.—COMMUNICATIONS.

IMPREGNATING WAXES

Zophar Mills have developed impregnating waxes of melting points above 212° F., with true sag points above 200° F. This in addition to waxes of relatively high melting points and high Q's.

To serve their customers in the condenser, transformer, coil, battery and other electrical fields, over 180 different types of materials have been developed by *Zophar Mills, Inc.,* 112-130 26th St., Brooklyn, N. Y.—COMMUNICATIONS.

(*Continued on page* 23)

OVER THE TAPE . . .

NEWS OF THE COMMUNICATIONS FIELD

ERPI APPOINTMENT

At a special meeting of the Board of Directors of Electrical Research Products, Inc., T. E. Shea was elected Vice-President, succeeding H. G. Knox, who resigned on the advice of his physician. Mr. Shea, formerly of Bell Telephone Laboratories, becomes Director of Engineering and will have charge of all technical activities for the Company in both New York and Hollywood.

HYTRONIC CATALOG

A six-page folder giving the characteristics of the Hytronic products has been announced by the Hytronic Laboratories Division of the Hytron Corporation, 76 Lafayette Street, Salem, Massachusetts. This bulletin lists transmitting tubes, diathermy types, high-frequency "Bantams" with ceramic base and also high-frequency types. It will be sent free upon request.

DR. POWER SAILS FOR NEW ZEALAND

Dr. Ralph L. Power, Advertising Manager for the Universal Microphone Co., Ltd., Inglewood, Calif., and American representative for the Macquarie network of Sydney sails for New Zealand and Australia early in August on a four months' business trip. While visiting Treasure Island he recently broadcast on the weekly program for Australia sent out by W6XBE each week to the Antipodes. 2GB, Sydney, key station of the Macquarie network has received permission to rebroadcast programs from the General Electric International Station W6XBE.

TRIPLETT BULLETIN

The Triplett Electrical Instrument Co., Bluffton, Ohio, have published a bulletin describing in considerable detail their line of tube testers, conductance testers, signal generators, volt-ohm-milliammeters, vacuum-tube voltmeters, output meters, oscilloscopes, modulation monitors, vibrators testers, etc. Copies of the bulletin may be secured from the above organization.

MAGNAVOX APPOINTMENT

The Magnavox Co., Ft. Wayne, Indiana, have announced the appointment of Mr. Joseph Sprung, 254 W. 31 St., New York City, as their representative for the Metropolitan New York territory. Mr. Sprung has been known to the radio trade for a number of years.

DU PONT PLASTICS BULLETIN

The first issue of an illustrated periodical "Plastics Bulletin," giving news of developments of plastics and their applications, has been published by the Plastics Department of E. I. du Pont de Nemours & Company at Arlington, New Jersey. The bulletin is 8½ by 11-inch sheet size, in four page leaflet form with margin perforations for filing in a loose-leaf notebook, and is printed in two colors. Distribution of present and future issues will be made on request, without charge, to interested trade and business fields.

HENYAN RECEIVES APPOINTMENT

George W. Henyan, for the last nine years Sales Manager of the radio department of the General Electric Co. at Schenectady, has been made manager of the transmitter and tube sales divisions of the company's recently organized radio and television department. Mr. Henyan will continue to make his headquarters in Schenectady.

THORDARSON CATALOG

The Fall-Winter edition of the Thordarson Transformer Catalog No. 400 just released introduces several new transformers. Also included are the new automatic voltage regulators which feature control limits said to be capable of holding the supply or output voltage within ±1% of the desired value. Copies of this Catalog are available from Thordarson Electric Mfg. Co., 500 West Huron St., Chicago, Illinois.

"TREMENDOUS TRIFLES"

"Tremendous Trifles" is the title of a new booklet issued by The International Nickel Company which emphasizes the importance of small items of equipment, such as springs, bolts, electrical contact points and the like in making the wheels of industry run smoothly. Sixteen pages in size, with illustrations and charts, it presents technical and mechanical data on nickel, Monel, Inconel, "Z" Nickel, "K" Monel, and other high nickel alloys. The booklet is being distributed without charge by The International Nickel Company, 67 Wall Street, New York City.

NEW OFFICES FOR "RADIO"

Radio Ltd., technical publishers, and the Editors of "Radio", announce their removal to 1300 Kenwood Road, Santa Barbara, Calif. The change of address was effective August 1, 1939.

RCA CATALOG

The Commercial Sound Section, RCA Manufacturing Co., Inc., Camden, N. J., has recently issued Catalog No. 212 covering their line of sound equipment. This 54-page catalog may be obtained by writing directly to the above organization.

FINCH APPOINTMENT

Roscoe Kent has been appointed Sales-Manager of all Finch facsimile apparatus, according to an announcement by W. G. H. Finch, President of the Finch Telecommunications Laboratories, Inc., New York City. Mr. Kent, who previously was associated with the Deforest Radio Company, Wired Radio and for the past few years with the Musak Corporation brings to the Finch organization more than twenty years of sales experience in both fields of wire and radio communications.

JEFFERSON CATALOG

Television components, power transformers, filter chokes, tube deflecting yokes, oscillation and output transformers are described and illustrated along with nine new radio parts items in the 16-page Catalog 391-R recently published by Jefferson Electric Company, Bellwood, Illinois.

GARRARD CATALOG

Garrard Sales Corporation, American sales representative for Garrard Engineering and Manufacturing Co., Ltd., Swindon, England, has announced a new 16-page catalog describing and illustrating the new, complete Garrard line of automatic record changers, motors, pick-ups and turntables. Copies of the new catalog may be secured without charge by writing to Garrard Sales Corporation, 296 Broadway, New York City.

CORNELL-DUBILIER CATALOGS

Cornell-Dubilier announces a new 36-page radio transmitter capacitor catalog. Catalog No. 160-T lists and describes the latest C-D types of capacitors designed for use in the broadcast and industrial fields. The capacitor units are clearly illustrated by large halftones with dimensional drawings immediately beneath the illustrations. The last four pages of the catalog are devoted to technical information.

Also available to the trade is Catalog No. 166-A describing and listing in detail the entire C-D line of Quietone radio interference filters.

Copies of both catalogs are available free on request at the main offices of the Cornell-Dubilier Electric Corporation at South Plainfield, New Jersey.

GENERAL INDUSTRIES BULLETIN

The General Industries Company, Elyria, Ohio, have released a bulletin announcing their new models RX and KX electric motors, new Master Junior and Majestic spring wound motors, and ACX and AKX assemblies. Prices and technical information are given in the bulletin. Write to the above organization.

WRIGHT-DeCOSTER APPOINTMENTS

Wright-DeCoster, Inc., St. Paul, Minn., have announced the election of D. W. DeCoster as President-Treasurer, R. R. DuPuy as Vice-President and L. L. Erickson as Secretary. D. H. Wright recently resigned as President of the organization.

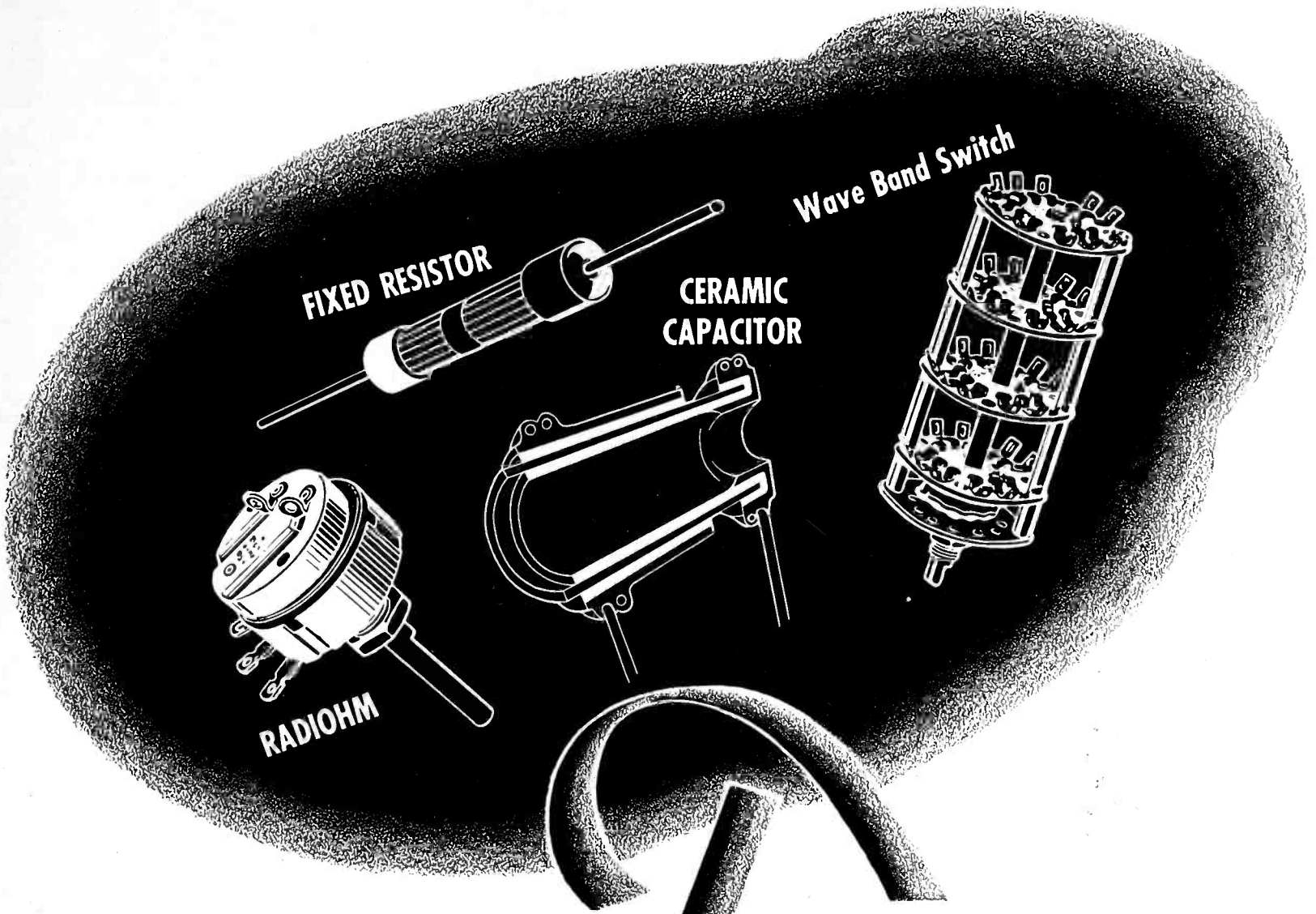
ADVANCE ELECTRIC CATALOG

A new 12-page catalog, containing data on general circuit controls, sensitive a-c and d-c relays, is now ready for distribution. Copies may be secured from the Advance Electric Company, 1260 W. 2nd St., Los Angeles, Calif.

ANACONDA CATALOG

The complete success of the first edition of the Magnet Wire Catalog has prompted Anaconda to reprint with considerable revision a new edition, giving greater information on magnet wire, electrical and physical properties, also, more space given to the use of magnet wire coils. Also, available is a small-size pocket handbook containing technical tables of information to the shopman and engineer. Copies may be obtained by writing Anaconda Wire and Cable Company, 25 Broadway, New York City.

(*Continued on page* 16)



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Where permanence or temperature compensation is important.

WAVE BAND SWITCHES

In Isolantite or Bakelite . . . available in various combinations.

Centralab

Division of GLOBE-UNION, Inc., Milwaukee, Wis.

OVER THE TAPE

(*Continued from page* 14)

LATHE BULLETIN

A new bulletin, No. 43, has just been issued by the South Bend Lathe Works illustrating and describing the three new models of the workshop precision lathe, and the new improvements which have been added. Copies of the new bulletin No. 43 may be had by writing the Technical Service Dept., South Bend Lathe Works, South Bend, Ind.

SHURE CATALOG

A new catalog has just been issued by Shure Brothers, Chicago, designers and manufacturers of microphones and acoustic devices. This new Catalog 152 covers the complete Shure line of crystal, dynamic and carbon microphones, in uni-directional, semi-directional, general-purpose, and special new "Communications" models; crystal pickups; friction-lock floor stands with "Stabilized" cushion base, etc. For free copy of Catalog 152, write to Shure Brothers, 225 W. Huron Street, Chicago.

TUBE DIAGRAM BOOK

A novel and useful booklet for use by radio service men and engineers while testing or wiring sets has been developed by Tung-Sol Lamp Works, Inc., of Newark, N. J. One feature of this booklet is its compact size, being only 2¼" x 3¼". In it is a base diagram of every tube manufactured up to the present time. This booklet can be obtained for 10c from Tung-Sol jobbers or direct from the manufacturer.

TEMCO BULLETIN

A bulletin covering the Temco line of marine radio telephones for two-way communication on commercial and private vessels has recently been made available. To secure a copy of this bulletin write to the Transmitter Equipment Manufacturing Co., Inc., 130 Cedar Street, New York City.

CREI CATALOG

With the inclusion of more than twice as many photographs and a complete outline of both the Practical Radio and Television Engineering courses, the new C.R.E.I. catalog should be of interest. This booklet will be gladly sent to any interested person. Simply mail your request to The Capitol Radio Engineering Institute, 3224 Sixteenth Street, N. W., Washington, D. C.

NEW COMPANY

A new company, to be known as Radio Wire Television Corporation of America with studios at 160 East 56th Street, New York City, embraces the former holdings of Wire Broadcasting Inc., Wholesale Radio Service Co., Inc., and the various subsidiaries of these enterprises.

John E. Otterson, formerly President of Winchester Repeating Arms Corporation, Electrical Research Products, Inc., and Paramount Pictures, will head the new company as President. J. R. West, President of Wire Broadcasting and A. W. Pletman, President of Wholesale Radio, have been elected Vice-Presidents of the newly formed parent company.

Under the new corporate structure, the various retail outlets of Wholesale Radio, which engage in the merchandising of radio equipment, phonographs, and photographic supplies, will take the name of the parent company and will be further identified by the state in which they are situated. Thus Wholesale Radio Inc., of New York becomes Radio Wire Television Inc. of New York, etc.

Wire Broadcasting together with its principal subsidiaries including Teleprograms Inc. of N. Y.; Telemusic Inc., of N. Y.; Wire Programs Inc. of Delaware; Muse-Art Inc., of Pennsylvania; Wire Broadcasting Inc., also of Pennsylvania; and Tele-Vision-Music Inc., of Washington, D. C., will continue under their present titles.

In addition to these operating subsidiaries, the new company acquires full interest in the Transformer Corporation of America, a manufacturing unit devoting itself to an extensive line of radio and electrical products; TeleCapital Corporation, a financing unit, and the Syndak Corporation. This latter organization is understood to own a large group of patents relating to motion picture projection, sound, and lighting. These units will also continue to operate under their present corporate titles.

In addition to the patents acquired by the new company the organization is licensed by Electrical Research Products, Inc., under the patents of Western Electric Company, Bell Telephone and Telegraph Company.

CORRECTION

We regret the typographical error which occurred in the caption accompanying the illustration at the bottom of page 34, July, 1939, COMMUNICATIONS. The gentlemen are, left to right: I. A. Mitchell, UTC, and Sam Norris, Amperex. Mr. Norris' name was incorrectly given as Harris.—*Editor.*

THORDARSON HONORED

Mr. C. H. Thordarson, founder and president of Thordarson Electric Mfg. Co., has recently been awarded the highest honor given by the Danish and Icelandic governments. On behalf of King Christian of Denmark, Mr. Thor Thors, a member of the Danish Parliament, presented Mr. Thordarson with the Cross of the Icelandic Falcon Order. It is given to those of Icelandic or Danish decent who have contributed some outstanding achievement to the world. Mr. Thordarson received this honor for his work on the transformer, and his contribution to science and culture through his collection of priceless 16th and 17th century books and manuscripts on scientific subjects. Mr. Thordarson was born in Iceland, and at the age of six came to America, sixty-six years ago. In 1895, forty-four years ago, he founded the company that now bears his name.

IDEAL CATALOG & HANDBOOK

An 84-page catalog and handbook is now available from the Ideal Commutator Dresser Co., Sycamore, Illinois. This catalog covers the Ideal line of motor and other maintenance equipment, as well as electrical specialties. Write to the above organization.

SOLAR CATALOG

Installed entirely in its Bayonne, N. J., plant, Solar Mfg. Corp., presents new Catalog No. 10 which elaborately illustrates and describes the complete line, including testing instruments. This catalog is now being distributed. Copies may be had by writing the manufacturer direct.

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VWOA NEWS

(*Continued from page* 12)

Commodore C. S. Anderson, our Year Book Editor, a veteran yachting enthusiast and navigator par excellence. And yes, they are radio equipped—radio telephone that is.

TELEVISION ENGINEERING

Registered U. S. Patent Office

SOUND MOTION PICTURE FILMS IN TELEVISION

Part IV

By JOHN A. MAURER
THE BERNDT-MAURER CORP.

THE general adoption of a particular type of film-scanning equipment by the television broadcasting industry will probably have more effect than any other single factor in either limiting or extending the use of films in television. The selection of film-scanning equipment very nearly amounts to the same thing as standardizing the films to be used, since it will be possible to broadcast only those films which operate correctly with the type of scanner that is adopted.

The importance of the problem of providing suitable mechanisms for projecting film images on the screen of the transmitting tubes was early recognized by all television research groups, and as a result much development work has been done on film scanners. Two of the types that have been employed successfully in practice are described in a recent issue of the *Journal of the Society of Motion Picture Engineers* (July, 1939) and a third type was described in COMMUNICATIONS for May, 1939, on page 22.

These three machines are built around three fundamentally different principles of operation. The first is similar to the conventional theatre type of motion-picture projector. The film is advanced

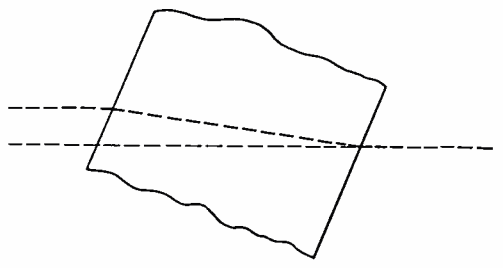
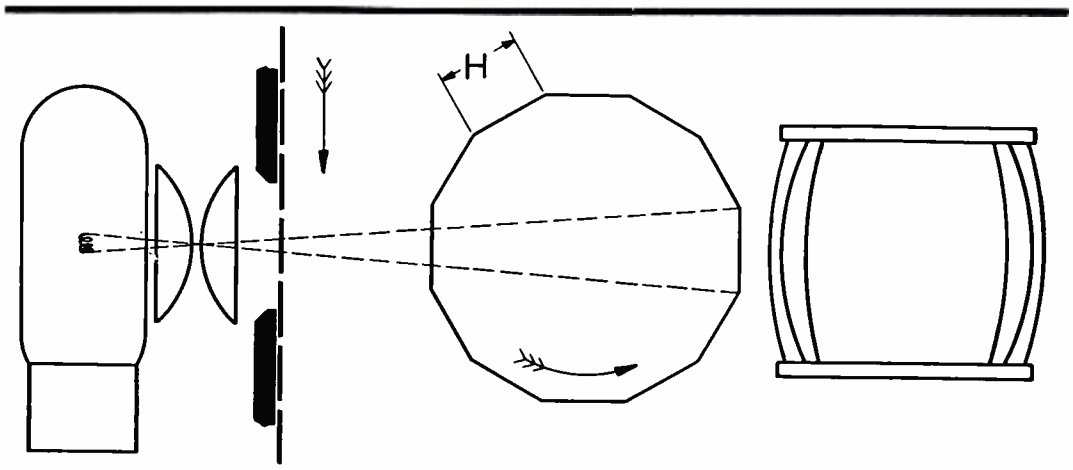


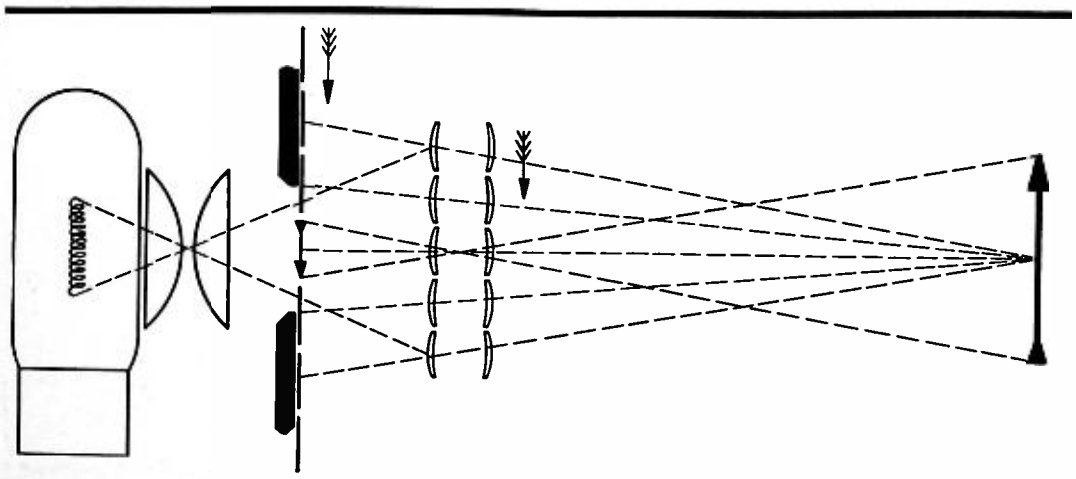
Fig. 2.

intermittently, and a rotating shutter cuts off the light except for certain intervals when the film is standing still. Significant differences from the standard motion-picture projector are the use of a special type of cam in the intermittent movement mechanism, giving two pull-down movements during each revolution, with unequal periods of dwell, in order to permit the scanning of alternate frames two and three times respectively, and the limiting of the light flash to a very brief time, less than 1/600 second, so that it can occur entirely within the vertical return time of the picture transmitting tube. This machine provides 60 images per second from film photographed at 24 frames per second. Obviously it cannot be used without modification for film photographed at any other frame frequency. Since its operation depends on storage of the image between light flashes in the form of an electron image on the insulated light-sensitive mosaic of the tube, it is suitable for use with the iconoscope type of transmitting tube, but not with the image-dissector type.



Above: Fig. 3.

Below: Fig. 1.



The second type of machine advances the film continuously, and obtains vertical scanning by combining the vertical movement of the projected image with an additional vertical component from the usual electron beam control in the transmitting tube. This method is suitable for operation with the image-dissector type of tube, but not with the

(*Continued on page 25*)

TELEVISION ECONOMICS

Part VII

By

Dr. ALFRED N. GOLDSMITH

Consulting Industrial Engineer

THE fluorescent phenomena occurring when a crystalline medium or "phosphor," containing a suitable activator in an appropriate concentration, is excited by cathode rays (electron impact) are too complex to be here discussed in detail. In the main they comprise a primary light-emitting effect of relatively brief duration termed "phosphorescence" and a usually secondary effect of considerably longer duration, following different laws of growth and decay, termed "luminescence." Only the former should be of practical importance in the commercial kinescopes.

A wide variety of fluorescent materials are available, among the more important of which are the following: zinc orthosilicate (activated by the presence of extremely small amounts of manganese), zinc-beryllium orthosilicate (manganese activated), calcium tungstate, zinc sulfide (silver activated), and cadmium tungstate. For performance studies or test purposes, experimental screens may be made by suspending the phosphor (fluorescent material) in finely divided form in acetone, and thereafter gently agitating the supporting surface during the evaporation of the acetone. A wide variety of binding materials have been tried including materials containing sulphur or borax, as well as alkali-metal compounds. Sintering of the fluorescent material on its support is also possible.

The performance characteristics of the various phosphors are not readily expressed in simple form. As the current density of the electron spot on the screen increases, the light emission increases and then tends to saturate. Zinc orthosilicate (synthetic willemite), calcium tungstate, and zinc sulfide may be operated at higher current densities before this saturation effect occurs than may the other phosphors previously mentioned.

The potential used to accelerate the electron stream also reaches a useful maximum, as limited by secondary emission from the fluorescent screen. For zinc orthosilicate and calcium tungstate, the respective maximum useful potentials were stated by one investigator to be approximately 6,500 volts and 5,000 volts respectively. These particular phosphors give a luminous output per unit electron current which varies approximately as the square of the voltage. However, for zinc sulfide, the variation is as the 2.8th power of the voltage. Zinc-cadmium sulfide has been found to give a maximum light output at 8,000 volts, with no simple relation connecting the light output per unit electron current and the voltage. In general the sulfides have excellent secondary emission, the maximum limiting potential for their operation accordingly being well above 10,000 volts. It is understood that particles of sulfide materials scaling off the screen and then contaminating the cathode surface may reduce emission.

When operating at constant voltage and at low current densities, the light emitted by the phosphors per unit current is constant. However, as the current density is increased, a saturation effect shows itself by a diminution in the light output per unit current, a 20% loss in such light output per unit current occurring for zinc-cadmium sulfide and zinc orthosilicate at 10 micro-amperes per square centimeter, and for zinc sulfide at 200 micro-amperes per square centimeter. Recent developments appear to widen considerably the capabilities of fluorescent screens of appropriately prepared phosphors supported on a suitable mount (e.g., a metal plate.).

It has been stated that practical examples of kinescope screens produce an output of 8-16 lumens per watt, or about 1-2.5 candle power per watt. In one European tube having a screen slightly under 12" wide, the image brightness was 80 lux (7.4 ft.-lamberts) when operated at 6,000 volts. The image decay after excitation appears to be exponential, and in one practical case corresponded to a drop of image brightness in 1/60th of a second to 30% of the initial value.

The color of fluorescence depends upon the phosphor, its mode of preparation, and its activation. Zinc orthosilicate (manganese activated) fluoresces green; zinc-beryllium orthosilicate orange to green; zinc-cadmium sulfide (silver activated) red to blue; zinc sulfide (silver-activated) blue; zinc sulfide pale blue; and cadmium tungstate light or white blue.

Measured efficiencies of certain phosphors expressed in candle power per watt at 1,000-6,000 volts and 1 microampere per square centimeter have been stated to be 1-3 for zinc orthosilicate (manganese activated) and zinc sulfide (pure or silver activated). The range for zinc-beryllium orthosilicate is 0.5-3, for zinc cadmium sulfide (silver activated) 1-5, and for cadmium tungstate below 1.

The afterglow or luminous-persistence time, expressed in elapsed seconds for the brightness to fall to 1% approximately of its initial value, varies widely. The mentioned sulfides have a persistence time of about 0.001 second; the orthosilicates of 0.05, and cadmium tungstate has the very brief afterglow time of 0.00001.

The mixture of phosphors to produce particular fluorescence colors must be carried out with great care. Unless the mixture is uniform and even, diverse color patches will become visible. If the persistence times or afterglows of the mixed phosphors and their colors are widely different, there is danger of "tailing" with a resulting change of image color as the picture fades—an effect which is particularly noticeable in the images of rapidly moving objects.

In general, convenient kinescopes for television purposes with direct viewing have approximate bulb diameters between 5 and 14 inches and lengths between 18 and 27 inches. The final anode voltage ranges between about 3,000 and 7,000 volts, the second or focusing anode voltage between approximately 800 and 2,500 volts, and the first anode voltage between 200 and 800 volts. In one form of these tubes a so-called accelerator anode is provided near the screen, at a still higher voltage than the third anode, this arrangement being stated to give equally bright pictures with an increased deflection sensitivity.

In shipment of kinescopes it is necessary to protect the tube carefully not only because it is costly but also because of the annoyance or danger incidental to possible breakage. It is good practice permanently to enclose the kinescope at the factory in a protective sheath which enables its installation and electrical connection in the receiver without removal of the sheath, after which a cap covering the screen end of

the kinescope may be removed and replaced by a cover of shatterproof glass forming a part of the receiver. It may be added that modern practice tends toward black-and-white pictures, the term "white" being interpretable broadly as very pale yellow or ivory (with sepia shadows) or very pale blue (with blue gray shadows), or other similar light tints. It is of interest to note that any pale color, viewed for a considerable time, tends increasingly to give the impression of white.

Pictures

Inasmuch as the fluorescent screen is generally circular, the most economical utilization of its area would lead to a square picture which, however, is unattractive to many people. Probably the most generally useful picture aspect ratio (ratio of width to height) is that used for motion pictures, namely, 1.33. This is the television-picture standard adopted in America. The actual picture outline is a rectangle with rounded corners. For a certain 12-inch diameter kinescope, the picture size is 7⅜ by 9¾ inches with rounded corners of a radius of 1-15/16th inch. For a 9⅛ inch diameter tube, the picture size is 5½ by 7⅜ inches, with a corner radius of 1¾ inch. For a 5-1/16th inch diameter tube, the picture size is 3 x 4 inches and the corner radius 15/16th of an inch. In practice, the straight sides of the picture have sometimes been masked so that they are curved or bowed slightly outward, but this is believed to detract somewhat from the appearance of certain types of pictures (particularly architectural subjects and interiors).

The images obtained in these tubes show certain limitations resulting from their method of production. The electron beam may be defocused in the highlights, thus causing the defect known as "blooming". This is particularly noticeable in high-contrast pictures, and development work toward its reduction has been in progress.

If a small black spot is imaged on the bright field of the usual kinescope having a screen sprayed with fluorescent material, there are certain definite limits to the contrast ratio obtainable between the spot and the field. Some of the factors reducing contrast have been rated as follows. The spreading of light in the screen by internal reflection, that is, halation, may be rated at unity. Normal reflection within the glass wall of the tube will be a limiting factor 1/10th as great. Internal cross lighting in the glass end of the tube, resulting from its curvature, will have an effect nearly 1/12th as great. The inside walls of the kinescope will reflect the general light of the image, reducing contrast to an extent more than 1/30th as much as the first factor mentioned. Partial remedies for the preceding are obvious, including matte blackening of the interior of the tube and the introduction of a gray material or layer into the kinescope screen or its glass support. Such a layer which absorbs only 10 to 20% of the light will nevertheless reduce halation 3- to 6-fold. A separate flat image screen, while more costly, avoids halation caused by curvature of the screen as well as picture distortion due to nonplaneity of the image. Any halation resulting from stray electrons within the tube can be reduced only by careful design and construction of the gun.

Kinescopes may be mounted vertically or slightly inclined in the receiver, with the screen end at top, viewing being then accomplished through the reflection in a mirror in the hinged top of the receiver. Alternatively the kinescope may be mounted horizontally or slightly tilted up or down within the receiver and with its screen end to the front, thus permitting direct viewing.

Even at increased cost, the trend is toward pictures of an increased brightness range, that, is covering a larger number of distinguishable shading steps. Such pictures are more dramatic and give the impression of higher definition. The brightness range depends on the inherent contrast range of the tube as previously described. It depends further on the image color, as well as the relation between the image color and the color (as well as the brightness) of any stray light. It further depends upon the possible use of volume expansion, this being a form of video-amplification expansion in the deeper shadows and the brighter highlights whereby the loss of delineation in the corresponding picture portions is partly avoided. From observation of looker reactions, it has become clear that the novice looker tends to select a picture of high contrast regardless of loss of shadow detail, "chalk-and-coal" effects, and even some defocusing resulting from "blooming," much as the new listener generally chooses excessive sound volume and resulting distortion. After a time, the looker sets the controls of his receiver to a more desirable and somewhat lower picture gamma.

It is difficult to describe television picture quality in specific terms. Certain other picture factors will be further considered later in this analysis. Broadly speaking, the present television picture is not so good a picture, particularly for complicated views, as a 35-mm motion picture, and is definitely a better picture, even for close-ups, than an 8-mm motion picture. A high-quality television picture will on the

(*Continued on page 21*)

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OF TOMORROW

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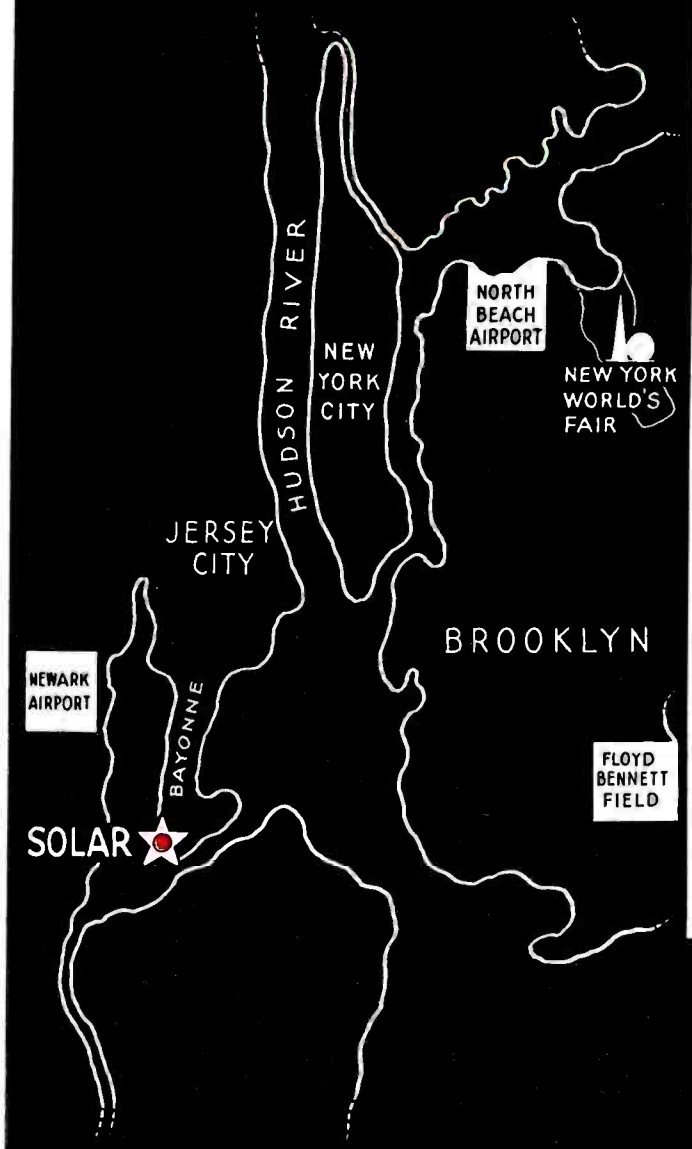


SOLAR MFG. CORP.

BAYONNE, NEW JERSEY

BUY FROM YOUR RELIABLE JOBBER

TELEVISION ECONOMICS

(*Continued from page* 19)

average give somewhat the general impression of a 16-mm motion picture projected in the home; that is, it will have adequate entertainment value.

1-4 Circuits and Controls

Of the 6-mc-wide television channels assigned to television by the Federal Communications Commission, the lowest is 44-50 mc. and the highest is 102-108 mc. A "universal" television receiver might accordingly be required to cover this entire band, with a 2.3-to-1 frequency range, and with adequate selectivity to enable differentiation between signals in adjacent channels with a suitable signal-strength ratio. In the absence at present anywhere in the world of a pair of transmitters of like power serving the same area on two such adjacent channels, and in the further absence of interference tests from such adjacent channels on commercially available receivers in the hands of the public, it is not practicable to specify the signal ratio in adjacent channels permitting interference-free differentiation. In part this ratio will also depend on the effectiveness of cut-off of the video-channel transmitter side bands. It has been stated, however, that if the carrier in the *same* channel is less than 10-to-1, noticeable interference will be caused.

In the following there will be selected illustrative circuit arrangements to indicate in each case at least one form of operative receiver circuit, though it must be understood that there are numerous alternative detailed arrangements concerning the commercial choice of which practice has as yet not crystallized even in localities where television service has been in progress for some time. The receivers will necessarily be adapted to the arrangement of the video and audio carriers within the channel which has been adopted in America including the selective, "vestigial," or mono-clipped double-side-band transmission. Essentially the complete receiver includes two superheterodyne receivers (one for picture and one for sound), selecting circuits for the synchronizing signals, thereby-controlled deflection circuits, a brightness-control circuit, a contrast-control circuit, a d-c-component insertion means, a kinescope, loudspeaker (and automatic volume controls for picture and sound in most cases). At the transmitter, as previously stated, the video signal is produced at the camera, after which blanking signals at the end of each line and frame define the reference level for black; and synchronizing signals are then added. Considering a typical television receiver, this will start with a pre-selector system and r-f amplifier, followed by heterodyning in a first detector to produce an intermediate frequency for the picture signal (and on a second intermediate frequency to produce the sound signal), and then i-f amplification followed by a second detector to produce the usable and complete television signal. This television signal is then split into two portions. The video-frequency modulation is amplified and applied to the grid of the kinescope in such fashion as to include the background or average-brightness control (that is, with the d-c component inserted). An amplitude filter or filters, also fed from the second detector, produces two outputs, namely, the horizontal deflection impulses and the vertical deflection impulses. Each of these actuate the corresponding deflection circuits, which in turn are applied to the scanning or deflection controls in or associated with the kinescope. It is to be noted that in general it is necessary that there be identity, or at any rate a close resemblance, between the scanning and synchronizing means at the transmitter and those at the receiver. This indicates a pressing need for standardization, and justifies the steps which have been taken in that direction.

Considering the individual portions of the preceding system in illustrative instances, the pre-selector circuit should admit the complete television channel of video- and audio-modulated carriers, when connected to an antenna having a sufficiently high gain to permit reducing tube noise to an acceptable minimum.

The intermediate frequencies used for video and audio reception in the television channels are of the order of 10 mc (e. g., 8.25 and 12.75 mc, or somewhat higher). Accordingly the ratio of the video or modulation band to the video intermediate frequency may be as high as 30-40% of the center frequency of the latter. Problems of design arise at this point. Such wide-band amplification tends to produce low amplication gain per stage. The number of video i-f stages and associated adjustable circuit components must be economically limited, and this in turn limits the sharpness of cutoff of the band pass. Fortunately it is possible to secure an acceptably uniform overall response characteristic, with useful gain and sufficient selectivity, by including a succession of diverse and mutually compensating amplification stages. One example of this procedure involves the use of one stage having a frequency characteristic with a single central hump followed by a stage having a characteristic showing two separated humps.

As previously indicated, phase delay (that is, the phase angle at any frequency, divided by 360 degrees multiplied by the frequency) must be held closely constant when the system is considered as a unit, phase distortion in television being at least as significant as frequency distortion. In the i-f amplifiers as well, the phase characteristic must not be disregarded. It has been stated that the maximum permissible differential time delay throughout the system is 0.1 microsecond. In a 441-line 10-inch-wide picture, the scanning spot moves approximately 15,000 inches per second. A change of 1 microsecond in the time delay causes a shift of the high-frequency components of the picture of 0.14 inch relative to the low-frequency components. The element width horizontally in this case is 0.017 inch, or approximately ⅛ the previously mentioned shift. Accordingly, a change in time delay of less than 0.1 microsecond seems just tolerable for the higher-frequency range. At the lower frequencies, a greater change in time delay may be acceptable; e. g., a change up to 75 microseconds might be tolerable at 60 cycles. In view of the preceding, the v-f amplifiers should have a flat frequency characteristic from 60 cycles to at least 2.5 mc and preferably to 4 mc, and time delays independent of frequency to the extent previously mentioned. To maintain the desired performance of the entire amplifier, the time delay *per stage* must be only a fraction of the permissible amount for the entire system.

The number of stages to be included in the v-f amplifier depends upon the type of detection. In one recommended circuit, where the cathode terminal of the load resistor (that is, not the applied-voltage terminal) becomes positive for modulation peaks of the v-f signal, a correct picture is obtainable if the amplifier has an even number of tubes or stages. Such an arrangement corresponds to a grounded cathode in the detector. It is obvious that a reactance effectively exists as a shunt to the plate-circuit load because of the finite input and output capacitances of the v-f tubes. Unless corrected, this will cause undesirable changes in the time delay for different frequencies and also reduce the gain at the higher frequencies. Further, if the v-f amplifiers contain circuits which resonate near or in the video band, transients may cause impulse excitation. A disagreeable effect in the picture will then result, with white bands appearing on the trailing edge of black objects on a white field, or vice versa. This effect may also cause distortion of blanking or synchronizing impulses with consequent white lines or edges in the picture, that is an intrusion into the sig-

nal-amplitude range corresponding to picture values. If this type of distortion becomes sufficiently marked, it may have other undesirable effects such as an ill-defined upper edge of the picture, partial rather than complete return blanking, and inclination or skewing of vertical lines.

In practice, the low-frequency corrections of the v-f amplifier are separately handled from the high-frequency corrections and by different means. Careful control of low-frequency gain is necessary to avoid "motor-boating" of the system. By the use of as small a coupling condenser as may seem practicable, and by keeping the impedance of the power supply low in the range from 10-30 cycles, this effect may be minimized. Other pertinent expedients include the use of a high inductance (e. g., 500 henrys) to separate the screen supplies for the various amplifier tubes as well as the use of large capacitances (e. g., 8-microfarad electrolytic condensers) for fully adequate by-passing of the screen leads.

Automatic volume control is generally provided both on the sound and on the picture. Picture a-v-c prevents changes in signal level or depth of modulation from disturbing synchronization. It maintains signal level when tuning from one station to another and minimizes fading of signals resulting from movement of the antenna or its transmission line or changes in position of objects in the vicinity of the antenna. The separation of synchronizing pulses in the receiver and accurate gain control are both simplified by the maintenance through a-v-c of a constant signal level at the second detector. It should be remembered in this connection that the gain control (picture contrast control) is necessarily operative at a point in the v-f amplifier further from the antenna than the point where the input to the synchronizing-separator circuit is withdrawn. For effective controls, a minimal frequency drift is desirable in the local oscillators.

Unlike audio a-v-c, the video a-v-c does not operate on or respond to the average carrier amplitude, which is in fact influenced by the "key" of the picture. Instead, although only for negative transmission as used in America, the a-v-c is based on the height of the peaks of the synchronizing impulses which are constantly transmitted.

If picture a-v-c is used as described, with negative-modulation signals according to the present American standard, the video and synchronizing-signals applied to the first v-f amplifier stage contain the d-c component of the picture signal. That is, the picture signal level corresponding to black is specified and practically constant at this point, and accordingly pictures covering the same brightness ranges but having different average brightness would be properly represented at this stage. However, an odd number of stages of v-f amplification (and greater than one stage) are usually required to produce an adequate video-modulation voltage on the kinescope beam-control grid. The transfer of the d-c signal component as well as lower-frequency picture-signal components through say a three-stage v-f amplifier is technically not a convenient arrangement. Accordingly, one solution has been to amplify only the higher-frequency components of the signals in all but the last stage of the v-f amplifier by using a suitable capacity-resistance coupling between such stages. As a result of this, the output circuit of the next-to-the-last v-f stage contains synchronizing signals of an apparent amplitude proportional to the average brightness (amount of white) in the picture. Taking advantage of this fact, the d-c and lower-frequency video components are then re-injected into the grid circuit of the last stage of v-f amplification by a simple expedient, namely, connecting the grid of this tube to the cathode through a resistor and determining its effective bias by the drop through the resistor in question caused by the small grid current which flows during the synchronizing impulses. The time constant of the combination of grid resistor and grid-coupling capacitance for this tube is not shorter than is required to follow the relatively slow changes.

The line or horizontal synchronizing signals are brief impulses superimposed on the blanking pedestals. The frame or vertical synchronizing signals are longer impulses (although some engineers have preferred and advocated a type of narrow vertical-synchronizing signal distinguished from the horizontal synchronizing signals not by duration of the impulse but by a slightly greater amplitude, e. g., an increase of say 25% in amplitude). If the line-synchronizing signals do not continue effectively and concurrently through the vertical synchronizing signals, exact interlacing is not reliably obtainable. Examination of the American standard signals will indicate that this requirement has been considered.

The so-called "supersynch" (the entire video signal less the actual picture modulation) is utilized separately from the picture-modulation signals, as indicated above. The supersynch is separated first by clipping it off, and then is utilized by deriving therefrom the horizontal and vertical deflection impulses. The clipping of the supersynch is accomplished by means of a suitably biased tube, the careful choice of constants being generally experimentally checked. The derivation of the line impulses is accomplished by what may be termed "differentiation"; that is, by selecting the voltage generated across a resistor which has been placed in series with a capacity (the combination being fed with the supersynch group) or by taking the voltage across a mutual-inductance secondary. The frame impulses are obtained by "integrating"; that is, by applying the supersynch across a capacity in series with a resistor and deriving the frame impulses from the capacity terminals.

The actual deflection voltages or current utilized to control the kinescope scanning beam may be derived from the corresponding impulses in a number of different ways. A method widely used and approved depends on some form of relaxation oscillator. These oscillators in practice include impulse generators of the dynatron type, multi-vibrators, and the blocking oscillator. Such oscillators may be arranged to feed discharge tubes which are provided with peaking circuits. When such a system is actuated by impulses, it produces as output a wide range of useful combinations of a sawtooth wave and an impulse wave. Relaxation oscillators constitute a relatively recent and highly important type of generator. They can produce not only special wave forms but have the additional valuable characteristic that they can oscillate freely but will yet submit to synchronization from incoming impulses of somewhat different frequency, and even if such impulses have a controlling frequency which is a multiple of the fundamental free frequency of the relaxation oscillator. This last system therefore permits frequency demultiplication.

As a practical though purely illustrative case, the generation of the deflection currents may be accomplished as follows. A blocking oscillator which is essentially a triode (and which may be termed the first triode) is set into relaxation oscillations. It is provided with a "holding control" or frequency-determining means through a variable grid-leak resistance. It is generally adjusted to a slightly lower frequency than the incoming and controlling synchronizing impulses. This first triode feeds a second triode, which is usually in the same envelope, thus producing sawtooth plate-voltage changes because of the sudden changes which take place in the plate current of the first triode whenever an oscillation starts. The output of the second triode is then amplified in a third triode to produce the final deflection currents. A size control (e. g., the picture-height or picture-width control) of the picture, which controls the am-

(*Continued on page* 24)

VIBRAPACKS

Three new Vibrapack units have just been added to the Mallory line of vibrator power supplies, designed to supply B voltage to operate portable and mobile radio transmitters and receivers, public-address systems, and scientific apparatus. The new units are: VP-555—a dual Vibrapack with a rating of 300 volts at 200 ma load, 6.3 volts input; VP-557—6.3 volt dual Vibrapack having an output of 400 volts, 150 ma; VP-F558—a 32-volt Vibrapack of the tube rectifier type similar to the VP-554, with a 300-volt 100-ma nominal output. Booklet containing complete descriptions of all Mallory Vibrapacks with technical data and instructions, is available upon request. Address inquires to *P. R. Mallory & Co., Inc.,* Indianapolis, Indiana—COMMUNICATIONS.

COMPRESSED GAS CONDENSER

The Type 176 compressed nitrogen condenser is designed for applications where low cost, small space requirements are fundamental considerations. It is particularly suited for use in tank and antenna circuits in medium and high-power transmitters. It is easily installed and provides short and direct connecting leads to the remainder of the circuit. The case shielding eliminates stray fields.—*Heintz and Kaufman, Ltd.,* South San Francisco, Calif.—COMMUNICATIONS.

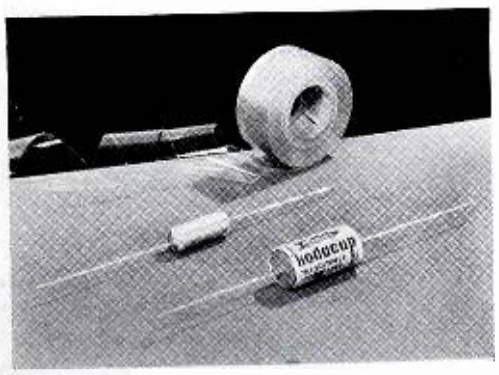
TRANSMITTING TUBE

A modernized version of the old standard type 849 transmitting tube is announced by United Electronics. The new tube is designated as United type 949A. Embodying an anode of specially processed graphite, the manufacturer claims freedom from occluded gases. The 949A in dimensional measurements and mounting facilities is identical with the standard type 849, yet comparison of ratings show higher output capabilities and r-f efficiency for the type 949A. *United Electronic Co.,* 42 Spring St., Newark, N. J.—COMMUNICATIONS.

TUBULAR CONDENSER

A recent development of the Micamold Radio Corporation is the Kodacap, a small-size long-life tubular condenser which utilizes a special processed cellulose derivative as the dielectric material. These condensers, which are said to be somewhat smaller than ordinary 600-volt tubular condensers, are rated at 1000 volts d-c working voltage and 3000 volts d-c test voltage. These units are also said to show an average life of over 1000 hours at 3000 volts d-c. The dielectric material employed in Kodacaps is claimed to be uniform and homogeneous and to be practically non-hygroscopic. *Micamold Radio Corporation,* 1087 Flushing Ave., Brooklyn, N. Y.—COMMUNICATIONS.

Micamold Kodacap condensers.



THE MARKET PLACE

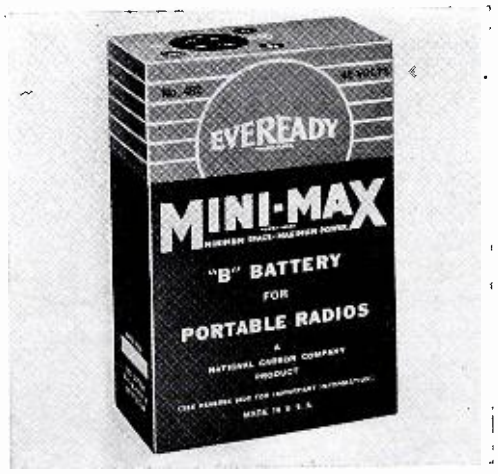
(*Continued from page* 13)

Above: Ohmite resistance units.

Below: Heintz & Kaufman condenser.

Above: United Electronics tube.

Below: National Carbon battery.



RESISTANCE UNITS

Some recent developments of Ohmite shown in the accompanying illustration are described below. These units include:

The dummy antenna—a small, compact, high-wattage, non-inductive, non-capacitive resistor of unique design in a glass bulb—said to provide a simple, accurate, direct means of measuring r-f power in all transmitter stages for the purpose of tuning. Four-prong base for convenient mounting in standard tube socket. Model D-100—100-watt unit in 73-ohm, 600-ohm and other resistance values; Model D-250—250-watt unit in 73-ohm and 600-ohm resistances.

Power tap switches. These units are all-enclosed, multi-point, load-break, non-shorting, single-pole, rotary selectors, particularly designed for alternating current. Available in single or tandem units, in four sizes from 10 to 75 amperes.

The P-300 parasitic suppressor is a non-inductive vitreous-enameled resistor combined with a choke into one small integral unit designed to prevent ultra-high-frequency parasitic oscillations.

Hermetically-glass-sealed precision resistors and attenuators to provide protection against heat, humidity, salt air, sulphur fumes, and other severe atmospheric conditions. Also available are Ohmite all-porcelain, vitreous-enameled rheostats—fixed and adjustable wire wound resistors—center-tapped resistors—standard-type precision resistors—r-f plate chokes—power-line chokes—transmitting band switches—line cord resistors.

Ohmite Manufacturing Company, 4835 West Flournoy Street, Chicago, Illinois.—COMMUNICATIONS.

COMPACT BATTERY

Eveready No. 482 Mini-Max B battery for battery portables and similar applications will give double the life of conventional batteries of equal size or about the same service life of a conventional battery, it is said.

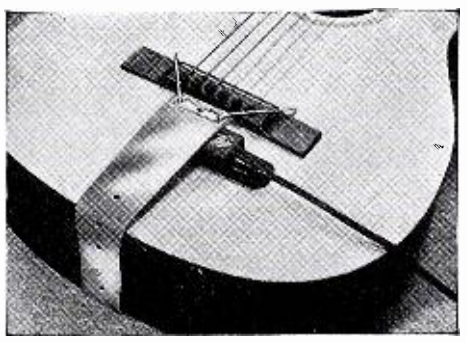
Additional information may be obtained directly from *National Carbon Co., Inc.,* 30 East 42d Street, New York City.—COMMUNICATIONS.

KONTAK STRAP

The new Amperite Kontak strap makes it easy to attach and detach the Amperite Kontak unit to any flat top guitar such as used by some popular players and many concert artists. Since most flat top guitars have very low volume, the Amperite Kontak unit increases both the range and the use of the instrument. *Amperite Co.,* 561 Broadway, New York City.—COMMUNICATIONS.

(*Continued on page* 32)

Showing Amperite Kontak strap.



TELEVISION ECONOMICS

(*Continued from page 22*)

plitude of the deflection current and therefore the corresponding deflection and picture size, is accomplished by variation of a plate resistance in the second triode circuit. A "peaking control" is provided by means of grid leaks in series with a condenser in the grid circuit of the second triode. A "disturbance control" can be accomplished by a grid-bias resistor in the third triode circuit. The important centering control, which is termed a line- or frame-shift control and permits moving the picture bodily, is accomplished by means of a potentiometer type of plate-voltage control in the third triode circuit, thus controlling the direct current passing through the output transformer.

The preceding circuit applies effectively for vertical (frame) deflection circuits. For the horizontal or line-deflection circuits a similar arrangement may be used, but in view of the higher generated frequency it is necessary to add a "damping tube" across the primary of the output transformer in order to damp out oscillations which are shock-excited in the plate circuit of the third triode each time an oscillation is initiated. In general, the trend appears to be toward magnetic deflection. Thus, at a major television receiver exhibit in Europe in 1938, about 80% of the receivers used magnetic deflection.

It is necessary further carefully to avoid the production of transients in the inductance of the deflection coils. In this connection, it is interesting to note that the line deflection amplifier requires a band pass of the order of 130 kc if at least the tenth harmonic of the fundamental line frequency is required, and that a pass band as high as 200 kc may be desirable. The control of the frequency and phase characteristics in this part of the system presents an economic problem, as do the construction and accurate centering of the deflection yokes, the shielding of the deflection circuits, and the avoidance of cross talk between the horizontal and vertical deflection circuits. There is, however, no practical advantage in designing a deflection system which is inherently superior either to the transmitter or the remainder of the receiver. Indeed, the study of the matching of the goodness (similarity of general performance in relation to the final picture) of the various portions of the television system, with due regard to the relatively small number of transmitters and the great number of receivers, is an essential element of any well-planned television system. Unnecessarily elaborate components in a receiver individually meeting higher performance specifications than are required or justified by the performance of the remainder of the system constitute an economic "neck of the bottle."

One element of the television system which must be carefully considered from the economic viewpoint is the accuracy of synchronizing and interlacing. The quality of television reception depends to a large extent on this factor. This is obvious since, for a satisfactory 7½ by 10-inch picture, the lines must be placed accurately to within 0.002 inch for satisfactory interlacing, that is, with an accuracy of 0.03%. The amplitude of successive vertical deflections must therefore be equal to a high degree of accuracy. Interlaced scanning is in fact a useful but sensitive method of reducing picture flicker. Sequential scanning is also less affected by object motion in the picture than is interlaced scanning inasmuch as the latter more readily leads to multiply-interpretable (that is, multiply-definable) pictures through the interaction between the fine and coarse structures of the picture. It has also been pointed out previously that interlaced scanning is more sensitive to the effects of vertical picture bounce resulting from weave in film scanning.

The present two-to-one interlacing method is standard in America, but other transmission and reception methods have been proposed with an interlace of four-to-one or even higher. Designers of such systems have also suggested the transmission of the actual deflection wave forms on sub-carriers not related directly to the picture carrier, as well as the use of double sawtooth-wave scanning from left-to-right and right-to-left, and also from up-to-down and down-to-up alternately, so that all parts of the deflection wave will be visibly active in picture scanning. When such double deflection means are used, no line blanking signals, either vertically or horizontally, are necessary. The circuits for the preceding proposed method are claimed to be less critical than those generally used and are also stated to respond more nearly "universally." Their utility depends on the possibility of accurate transmission and reception of deflection wave forms, as determined in the field.

The selection of kinescope anode voltage involves certain economic considerations. While the use of higher voltages enable a small bright spot to be produced, lower voltages lead to a reduced cost of circuit elements, particularly as regards the insulation of the filter condenser in the power-unit rectifier, and also as regards currents required in the deflection circuits. The deflection sensitivity varies inversely as the square root of the second anode voltage, and it has been stated that the power-supply-unit cost varies roughly as the cube of the

voltage. A balance between these factors must be sought.

When a television receiver is turned on, it is desirable to avoid operation of the kinescope with a positive bias on its grid during the warming-up period instead of being under the normal brightness control. A stationary or excessively bright spot on the kinescope should always be avoided.

The controls of a certain typical television receiver are here listed as illustrative. The frequently used controls included a station tuning or selector control, a contrast control or gain regulator which varied the bias on the first v-f tubes following the second detector, a detail control to pass or suppress the higher video frequencies (to reduce the effects of electrical noises or disturbances), a brightness control which biassed the kinescope grid to control the beam current and thus the general brightness or key of the picture, and conventional controls for the sound portion of the program. The occasionally used or pre-set controls included a focusing control which varied the second anode and grid voltage, horizontal-hold and vertical-hold controls which changed the resistance in the grid circuits of the blocking oscillators to alter their normal or free frequency, horizontal-centering and vertical-centering controls which enabled centering the picture by varying the direct current through the deflection coils, and picture-height and picture-width controls which varied the deflection currents passing through the deflection coils and thus the corresponding dimensions of the picture. In another receiver the usual controls were for tuning, brightness, contrast, focusing, power switch, and a volume control for sound. The pre-set or factory adjusted controls included a horizontal sweep frequency or hold, vertical sweep frequency or hold, horizontal amplitude or picture width, vertical amplitude or picture height, horizontal positioning or centering, vertical positioning or centering, and an additional horizontal positioning control known as the "astigmatism" control for minimum astigmatic aberration of the electron-lens system. To avoid confusion, it should be noted that the term "brightness control" has a different meaning in receivers than in transmitters. In transmitters, it fixes the modulation level for black; in receivers it determines the average or general brightness of the picture. It has also been suggested that it would be desirable to provide a switch to turn off only the video portion of the receiver for economical reception of exclusively audio programs.

(*To be continued*)

FILMS IN TELEVISION

(*Continued from page* 17)

iconoscope. The design of the machine and the associated electrical control are again directed to the production of 60 images from film made at 24 frames per second, and the changes that would have to be made to handle film photographed at any other speed are too extensive to be made during routine studio operation.

The third of the scanning machines referred to above also advances the film continuously, but produces a steady image on the screen of the transmitting tube by employing one form of what has been called "optical rectification." Two lens wheels, each carrying 24 well corrected lenses accurately centered and spaced, rotate at a speed proportional to the speed of advancement of the film. The wheels overlap, so that the images are formed through pairs of lenses, one lens of the pair being located in each wheel. Since these pairs of lenses move in step with the motion of the film, a stationary image is produced. This image, depending on what method of illumination is employed, might consist of images of either two or three frames of film superimposed. A shutter is not needed with such a projecting mechanism, but in this case it was found desirable to use the image from only one pair of lenses at a time. To secure this type of operation the machine is equipped with a shutter having spirally shaped slots only wide enough to expose one lens at a time. As in the two preceding machines, alternate frames of film are projected two and three times respectively, giving 60 images from 24 frames of film. The principal advantages of this machine are that it eliminates strain on the film and that it provides illumination on the screen of the transmitting tube during the period of scanning instead of between scannings.

The diverse character of the principles represented in these three machines has been pointed out in order to justify the statement that no universally satisfactory type of film scanner has yet been constructed. Perhaps no such machine can be produced at the present stage of the art. But this possibility should not deter us from examining the requirements to be satisfied, and inquiring what principles of operation might be found capable of meeting them.

Now, aside from the usual requirements of quality of performance, reliability, convenience, and economy, the writer believes that the most important need in television equipment is flexibility; that is, the ability to keep pace with future changes in requirements and methods. This need is not met by any of the machines referred to above, all

(*Continued on page* 28)

The group of RCA sales and engineering executives at the NAB Convention. (Back row, l. to r.) R. P. May, W. P. Dutton, Thomas Hall, B. Robins, T. H. Smith, E. M. Washburn and E. S. Winlund. (Second row, l. to r.) W. M. Witty, Ben Adler, G. Warren Kimball, C. Slaybaugh, Jack Calvin, A. N. Curtis, W. L. Garnett and C. M. Lewis. (First row, l. to r.) D. A. Ressor, Paul V. Intz, A. R. Hopkins, J. P. Taylor, S. W. Goulden and H. C. Vance

NOISE SUPPRESSOR CONDENSERS

THE Joint Coordinating Committee on Radio Reception of the Radio Manufacturers Association, the Edison Electric Institute, and the National Electrical Manufacturers Association has studied the problems presented by the use of small capacitors for suppressing radio interference which may be generated at the brushes of commutator type motors, at the contacts of thermostats, and at the contacts of other types of electrical appliances.

In metal frame devices these capacitors frequently are connected between the energized conductors of the device and the frame, thus giving rise to the possibility of objectionable shock. The choice of the suitable value of noise suppression capacitors is, therefore, a compromise between a desirably high value for purposes of noise suppression and a low value required for the avoidance of an appreciable possibility of sense of shock for the large majority of individuals under usual conditions.

As a result of the study of this problem, the Joint Committee has recommended, as tentative limits, that the maximum value of the capacitance to be connected between the windings and the case shall be such that the current to ground through this capacitance shall not exceed 0.3 milliampere with the switch or switches of the device in any position. (Devices rated at 110 to 120 volts shall be assumed to operate at 120 volts and at rated frequency.)

This study has not included consideration of devices where the frame is permanently grounded, as in oil burners, pump motors, etc., or where there is little likelihood of contact by an individual with the metal frame, as in the case of most radio sets. For such devices the limitation on size of capacitors for the avoidance of the possibility of shock does not, in general, apply. Nor has consideration been given to the make and break of switches which, as a rule, are operated infrequently.

It is recognized that the limiting value of current as here given may be subject to revision after further field experience.

TUBE BOOKLET

Copies of the RCA Receiving Tube Characteristics Chart 1275-B are just off the press. This booklet gives characteristics data on 191 RCA tubes including glass, glass-octal, GT, and metal types. Socket connections with RMA designations are shown at the end of the booklet. Copies are available from the Commercial Engineering Section, RCA Manufacturing Co., Inc., Harrison, N. J.

DUMONT BULLETIN

The DuMont television transmitting equipment is described in a new bulletin recently issued by the Allen B. DuMont Laboratories, Inc., 2 Main Ave., Passaic, N. J. A description is given of a complete 1-kw television transmitting equipment. Data is also given on test equipment and receivers. Copies may be obtained from the above organization.

VOLUME CONTROL MANUAL

After months of checking, listing and rechecking, the Clarostat engineers headed by Eddie Trefz have finally compiled an up-to-the-minute compilation of volume-control replacements for all standard radio sets in use. The new Clarostat manual, which was first distributed at the Parts Show in Chicago, is of the popular 8½ x 11 inch page size, with two columns of listings on each page. A copy of the new manual, as well as supplements to be issued from time to time, may be had from the local Clarostat jobber, or by writing to Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y.

RCA BULLETIN

RCA have recently issued a booklet giving instructions and describing their aircraft radio beacon receivers, Model AVR-15 and AVR-15A. To secure a copy, write to the RCA Manufacturing Co., Inc., Camden, N. J.

H. R. S. BULLETIN

The H. R. S. line of condensers is described in a bulletin just made available. Write to H. R. S. Products, 703 N. Cicero Ave., Chicago, Ill.

REMCO BULLETIN

An interesting bulletin has just been made available by the Radio Engineering & Mfg. Co., 58 W. 25th St., New York City. This bulletin describes the Remco 26-B transcription and record reproducer. Write to the above organization.

OPERADIO CATALOG

Catalog No. 16 is now available from the Operadio Manufacturing Co., St. Charles, Illinois. This 22-page publication covers the Operadio line of sound equipment. Considerable information is given on each of the various sound units covered.

REL BULLETINS

A number of bulletins have been made available by the Radio Engineering Laboratories, Inc., 35-54 36th St., Long Island City, N. Y. These bulletins deal with two-way mobile radio equipment, a 100-watt u-h-f radio telephone station, a 50-watt radio telephone station . . . all for police and fire service. Also covered is a frequency meter monitor and signal generator. Write for bulletins 250, 251, 253, 252, 255.

FILMS IN TELEVISION

(*Continued from page 25*)

of which require exact synchronization with the scanning impulses in the transmitting tube, and all of which are limited to films made at the standard sound speed of 24 frames per second.

In view of the major difficulty of finding adequate supplies of material for television broadcasts, a film scanner ought to be capable of handling all good existing film subjects as well as subjects made especially for television. But silent motion-picture films, of which there are many that could and should be used by television, have generally been photographed at 16 frames per second. Sound films have been standardized at 24 frames. Thirty frames is generally considered to be the desirable figure for films produced directly for television, corresponding to the rate of repetition of completely scanned pictures in direct broadcasting, while, as the writer pointed out last month, 40 frames gives the minimum film speed with which we can permanently be certain of our ability to meet all requirements for sound quality in the otherwise desirable 16-mm film size.

Obviously there is a need for film-projection equipment that does not have to be operated in synchronism with the electrical scanning system of the transmitter. This means film projectors capable of continuous, uniformly illuminated picture on the screen of the transmitting tube. If such an image is provided, the operation of the iconoscope or image-dissector tube becomes exactly the same as if the scene were being transmitted directly, and there is nothing to prevent running the film at any speed that may be convenient. It is true that much of the time the image transmitted over the television system in this manner will be a composite of the images from two or even three frames of film; but this is not objectionable, since the same blending of images occurs in the eye of anyone looking at an ordinary motion picture, as a result of the persistence of vision.

Scanning equipment to meet the above requirements will necessarily be of the optical rectifier, or non-intermittent type, since an intermittent movement projector must have a shutter to cut off the light during the time of pull-down. Even among non-intermittent projector mechanisms the choice is limited, since even small variations in the brightness of the image projected on the screen of the transmitting tube are likely to cause streaks in the transmitted picture. The principle of operation must be one that is capable of providing an illuminated field of unchanging brightness, even when the mechanism is operated so slowly that the eye can easily follow the gradual dissolving of the image of one frame of film into that of the next.

Two such principles of operation will be described in the remainder of this article. One of these is theoretically capable of ideal performance, that is, the optical system can be arranged to give an absolutely constant field brightness, while the sharpness and steadiness of the image are limited only by mechanical inaccuracies. The accuracy required for good performance is exceptional, but not unattainable with modern machine tools.

The second principle of operation leads to a machine that is simple to manufacture, but has certain inherent errors which must be kept within allowable limits by suitable design. The restrictions which it is necessary to impose in order to obtain a sharp enough and steady enough picture have mainly the effect of limiting the light transmitting efficiency of the system.

Those who are familiar with the history of the many unsuccessful attempts that have been made to produce non-intermittent motion-picture projectors capable of competing with the conventional intermittent type may well question the wisdom of recommending this direction of progress for the television industry. It should be remembered, however, that neither the performance

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standards nor the economic limitations are the same in the two fields. Theatrical motion-picture projection requires the transmission of a great deal of light to the screen. Television transmission, on the other hand, requires the production of only a small image of brightness comparable to that obtained when a rapid photographic lens is directed at a well illuminated scene. The theatrical light transmission requirement is perhaps 500 times the television requirement.

On the economic side it must be remembered that the television film scanner is an essential component of a system to which it contributes only a tiny fraction of the cost; therefore a grade of workmanship superior to that of theatre equipment is justified if it is required in order to make available a machine of superior adaptability.

This superior grade of workmanship will in fact be required if the first of the two operating principles referred to above proves to be the desirable one. This principle is illustrated in Fig. 1. A series of matched lenses travels in a path parallel to the path of the film. The spacing of the lenses and the speed at which they travel are proportional to the distance between successive frames of the film and its speed of travel. The relationship is simple, and is almost immediately obvious from the figure. Suppose the magnification at which the picture is projected is M. Then both the ratio of the spacings and the ratio of the speeds of travel of lenses and frames of film are $\frac{M}{M+1}$.

Naturally an endless series of matched lenses cannot be provided. In some manner the lenses must be brought back to the starting point and used over again, so that a limited number will do the work. This has been accomplished in the past in four different ways. First, the lens mounts have been linked together into a chain, which is looped around a driving sprocket and an idler. Second, an "O" shaped channel has been provided in which the lens mounts are made to slide around by a driving sprocket, either functional resistance or gravity serving to keep the mounts in contact with each other over the straight part of their path where the lenses are in operative relationship with the film. Third, the lens mounts have been attached by hinged links to a rotating drive shaft, the whole arrangement being operated inside a casing which serves as a stationary cam to cause the lenses to travel in the desired path. Fourth, the lenses have been divided into front and rear components placed on two overlapping lens wheels, as in the third of the scanning devices re-

ferred to in the earlier part of this article.

Obviously the diameter of the lenses in this arrangement cannot exceed $\frac{M}{M+1}$ times the height of the picture frames on the film. In practice the diameter of the lenses must be reduced still further in order to provide space for mountings. If, therefore, a high light transmitting efficiency is required, as in theatre projection, it is necessary to give the lenses a very short focal length in order to arrive at a large relative aperture. With a lens of short focal length and large relative aperture it is difficult to secure good definition in the corners of the picture. This is one of the principal reasons why this system of non-intermittent projection has not been successful in the theatrical field. For television scanning, however, the lenses may be given a focal length adequate to secure good covering power, since even at a reduced relative aperture they will transmit all the light that is needed.

In all non-intermittent projectors it is necessary to provide adjustments to compensate for varying degrees of shrinkage of the film. This compensation must take two forms: an adjustment to provide the proper effective pitch of the teeth of the sprocket driving the film, and an adjustment to compensate for the variation in frame to frame spacing. The first adjustment requires some form of variable pitch sprocket, of which numerous designs have appeared since the advent of sound made it necessary for the motion picture industry to take closer account of shrinkage. The second adjustment can be made, in the mechanism under discussion, by simultaneous movement of the lens train and the screen, so as to change the value of the magnification enough to make the lens to lens spacing again equal to $\frac{M}{M+1}$ times the altered frame height. An alternative method is to introduce supplementary lenses which can be moved axially to change the magnification.

The mechanical requirements of accuracy in the matching, focusing, spacing, and centering of the lenses, and in the maintenance of constant speeds of travel of film and lenses are obvious, and need not be discussed further except to state that the writer during the past ten years has seen three machines of widely different designs in which these difficult requirements had been met successfully enough to indicate that such mechanism can be manufactured for television purposes if desirable.

Deserving of special mention are two

requirements to be met for perfect constancy of brightness in the picture. Stated as simply as possible, the first is this: from the time when a given lens reaches the point where it first begins to take part in the projection of the image to the time when it passes completely out of action, it must receive a *full cone* of light from every point of the frame corresponding to it that is exposed in the gate of the projector. This requires that the image of the light source, formed by the condenser lens in the plane of the moving lenses, be at least enough to cover three lenses of the train if only the height of one frame of film is exposed in the gate, and high enough to cover four lenses if the height of two frames of film is exposed. The second requirement is that the opening in the gate must be exactly an integral number of frames high. In practice either a one-frame height or a two-frame height should be used.

These conditions for constancy of screen illumination can be met more easily with an incandescent filament light source than with an arc. The newly developed high-pressure mercury-arc lamps are also well adapted to the optical requirements of this type of non-intermittent projector.

The practical complexity of the moving lens train type of non-intermittent projector mechanism is not as great as might be supposed. The number of matched lenses required is nine for the linked arm and cam type of movement; twelve for the "O" shaped channel type, and fourteen for the chain type. If lens wheels are employed each wheel must carry about twenty-four lenses. Matching of focal lengths is accomplished by adjusting the distance between the front and back components of the individual lenses, since it is generally impractical to produce by gravity this number of lenses having identical focal lengths within the necessary limits.

The second principle on which a constant illumination projector can be built is shown diagrammatically in Fig. 2, while the construction to be employed in practice is shown by Fig. 3. When a block of glass having parallel faces is rotated as indicated in Fig. 2, it produces an apparent displacement of objects viewed through it. To make the operation continuous the glass must take the form of a prism having as its base any regular polygon of an even number of sides. This must be rotated at a rate such that the time required for it to pass each of its faces across the optical axis is the same as the time in which one frame of film is pulled down.

Since the displacement produced by rotating the prism is a result of refraction, which follows a law of sines, there

(*Continued on page* 34)

CRYSTAL-CONTROLLED MICROVOLTER

This new Hickok instrument has a self-contained vacuum-tube voltmeter, power-level meter and crystal. It has over 250 crystal-controlled, modulated or unmodulated, outputs—from 100 kc to 15,000 kc every 100 kc and from 1000 kc to 100 megacycles every 1000 kc. Accuracy is said to be better than .01%. Gain per stage and selectivity are standardized by the self-contained vacuum-tube voltmeter. Direct calibration of continuously variable r-f output is from ½ to 100,000 microvolts on all ranges. A-f output calibrated from 0 to 1.0 volt. Self-contained power-level meter has three decibel ranges: —10 to +6; +6 to +22; +22 to +38. Seven radio-frequency ranges are calibrated directly 100 kc to 60 megacycles. For more complete data write the manufacturer, *The Hickok Electrical Instrument Co.,* 10514 Dupont Ave., Cleveland, Ohio.—COMMUNICATIONS.

COIL TURRETS

Four new B & W Baby Coil Turrets are finding use as 5-band switching units for use in low-power transmitters and exciter stages. Each turret utilizes five of the familiar B & W Baby coils, covering the amateur bands from 10 to 160 meters and may be tuned in all types of service with any of the midget condensers having an effective capacity of 100 mmfds. Switches employed have ceramic sections for the coil ends where high voltage is encountered. The link terminals and center tap sections are switched by bakelite sections. Complete details and prices will be sent upon request to *Barker & Williamson, Ardmore, Pa.*—COMMUNICATIONS.

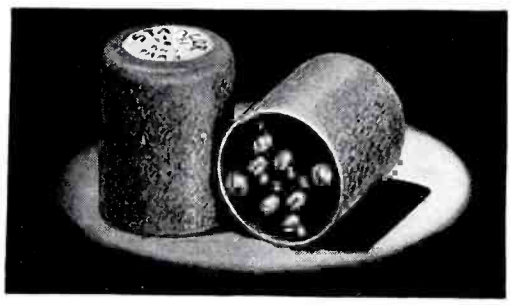
WIRE-WOUND CONTROLS

Low-power wire-wound controls and rheostats are being introduced to both the jobbing and manufacturing trade by IRC. These new controls are made in all needed ranges up to 10,000 ohms. They are equipped with the "silent spiral connector" which is said to provide positive, continuous contact between the rotor arm and end terminal. Power dissipation is 2 watts. Descriptive catalog will gladly be sent upon request. Write to *International Resistance Co.,* 401 N. Broad St., Philadelphia, Pa.—COMMUNICATIONS.

TINYTRANS

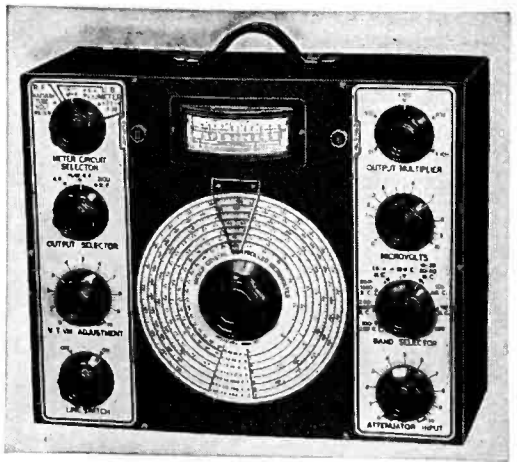
The miniature transformers shown in the accompanying illustration are known as Tinytrans. These units measure 15/16" in diameter by 1¼" in height. According to the manufacturer, the transformers carrying d-c in the primary are for voice frequencies from 150 to 5500 cps, while those not carrying d-c in the primary are high-fidelity units. Hum pickup is said to be low. *Standard Transformer Corp.,* 1500 N. Halstead St., Chicago, Ill.—COMMUNICATIONS.

Stancor Tinytrans.

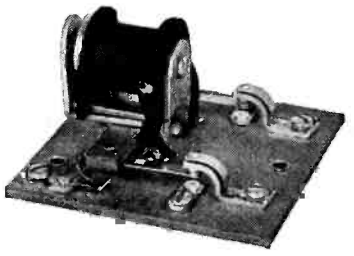


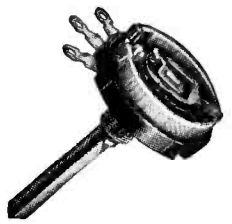
THE MARKET PLACE

(*Continued from page* 23)

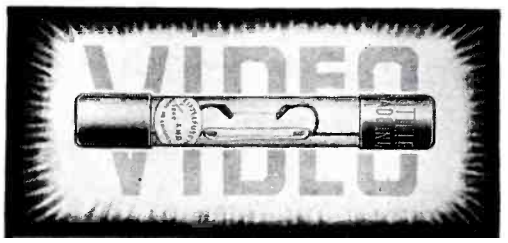


Above: Hickok microvolter. Below: Staco relay.

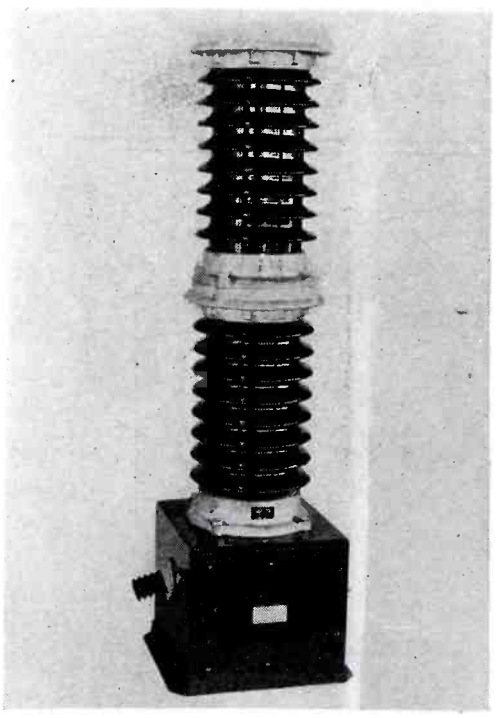




Above: IRC control. Below: Video Littelfuse.



Below: Cornell-Dubilier carrier-current capacitor.



R-F RELAYS

The Staco antenna change-over relays (illustrated) are radio-frequency relays especially designed for automatic switching of the antenna from receiving to transmitting or vice versa. These relays find special application in the doublet or transmission line and beam types of antenna, these types being ideal for reception near the same frequency. Both XPLW insulation for operation on 15 mc and Mycalex insulation for operation to 60 mc are available. Coil voltages for standard relays are 6 volts d-c or 110 volts a-c. These relays feature 3/16" d-p-d-t pure silver contacts, "floating armature" construction, no a-c chatter, shorter r-f path, and ball-bearing pivot. *Standard Electrical Products Co.,* 317 Sibley St., St. Paul, Minn.—COMMUNICATIONS.

"VIDEO" LITTELFUSES

Vacuum-enclosed "Video" Littelfuses are now going into production. There are six sizes available between 1/1000 and 1/16 ampere. "Video" Littelfuses perform a two-fold function in television: (1) to protect the equipment itself against damage due to loss of bias, insulation breakdown, shorts, etc., (2) protection against lethal shock to persons working on the equipment. Because of the vacuum-enclosed feature, "Video" Littelfuses break unusually high voltages—20,000 volts peak being the maximum. Physical size, 1¾"x9/32" diameter. *Littelfuse, Inc.,* 4238 Lincoln Ave., Chicago, Ill.—COMMUNICATIONS.

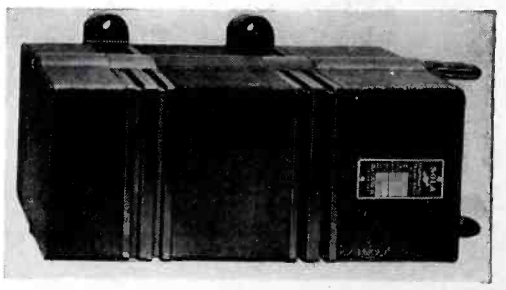
CARRIER-CURRENT CAPACITOR

Cornell-Dubilier engineers announce the new larger type CA carrier-current coupling capacitor. The fog type petticoats give a large creepage distance between terminals. The capacitors are constructed with galvanized malleable iron mounting flanges so that they may be stacked for series, high-voltage connection. New internal mechanical construction affords high tensile strength. The base and top are sealed so as to afford leakproof service. These individual units are now made up to 46 kv, but may be stacked to operate at any desired voltage.—*Cornell-Dubilier Electric Corp.,* South Plainfield, N. J.—COMMUNICATIONS.

CONSTANT-VOLTAGE TRANSFORMER

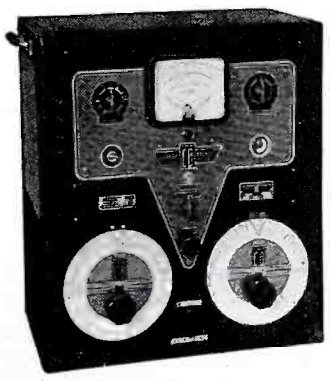
A new constant-voltage transformer has been announced by Sola Electric. The price of the unit is said to be low enough to permit its use in production equipment applications. This transformer maintains constant output voltage within ± 1%, it is stated. There are no moving parts and nothing to adjust. Both the transformer and its associated circuits are protected against damage from accidental short circuits. *Sola Electric Co.,* 2525 Clybourn Ave., Chicago, Ill.—COMMUNICATIONS.

Sola constant-voltage transformer.



BEAT-FREQUENCY OSCILLATOR

Rated output of six watts, low harmonic content, high thermal stability, and hand-calibrated twin dials are features of the No. 133 beat-frequency oscillator of the Clough-Brengle Co. By means of the added dial, low frequencies are said to be spread to 420 cycles. Between the dials is a three-position range switch which enables check of zero-beat without disturbing either dial setting, and further allows check on either dial at 400-cycle reference level, while operating the other. Once zero-beat adjustment has been made, a still more precise frequency calibration is readily obtained by heterodyning the output of the oscillator against the line frequency at 60 cycles or multiples thereof. Maximum power output available is 10.5 watts into a load of



1150 ohms, while normally the instrument works into a load of 500 ohms. *Clough-Brengle Co.*, 5501 Broadway, Chicago, Ill. —COMMUNICATIONS.

COMMUNICATIONS MIKE

A new communications-type crystal microphone is offered by Shure Brothers for amateur and commercial 'phone communications. This new Model 70ST has a built-in r-f filter which protects against burnouts. The output level is 26 db below 1 volt for 10-bar speech signal. The microphone is finished in satin chrome—the desk mount in iridescent gray. Comes equipped with built-in cable connector and 7 ft. shielded cable. For complete details,

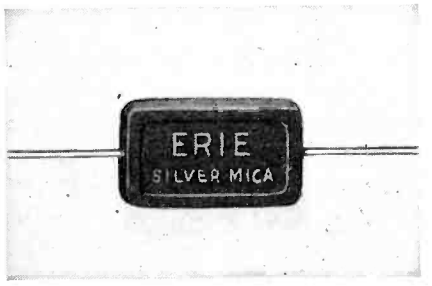
write for Catalog 152, *Shure Brothers*, 225 W. Huron St., Chicago, Illinois.—COMMUNICATIONS.

VIDEOTRON

One of the latest Videotrons to be added to the National Union line is a short 7" white screen tube. The overall length of the tube is only 13¾". The focus is electrostatic, while the deflection is magnetic. The second anode voltage recommended is 3500 volts. This tube makes possible the design of a television receiver cabinet scarcely deeper than a typical radio cabinet, yet having a direct viewing 7" screen. *National Union Radio Corporation*, 57 State St., Newark, N. J.—COMMUNICATIONS.

SILVER-MICA CONDENSER

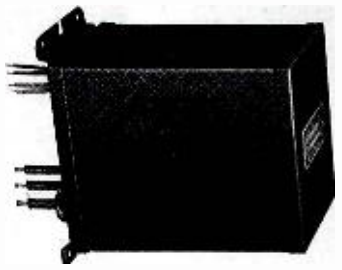
A new silver-mica condenser, known as Type K, has been announced by Erie. It has a temperature coefficient of approximately +.000025 mmfd/mmfd/°C. and is unaffected by changes in humidity and heat. These units are compact, being only 7/16 x 25/32". They are insulated by a low-loss thermo-setting plastic covering that is molded around the silver-coated mica



sheets. Leads are riveted to the mica sheets. For samples and performance data on these units write *Erie Resistor Corp.*, Erie, Pa.—COMMUNICATIONS.

TELEVISION COMPONENTS

Added to their line of transformers, chokes, and other components for radio, Jefferson has announced new units designed for use in television receivers. These include high-voltage power transformers for use with the electrically deflected 5" tube and the magnetically deflected 9" and 12" tubes, respectively; filter choke of 8600 ohms resistance, 1800 henries at 1.5 ma d-c; oscillation (horizontal and vertical) transformers for blocking oscillator circuits; output transformers for use in conjunction with scanning yokes, one to work out of pentodes and one out of triodes; and a scanning or deflecting yoke for use with magnetically deflected picture tubes, supplying horizontal and vertical deflection in conjunction with output transformers.—*Jefferson Electric Co.*, Bellwood, Ill.—COMMUNICATIONS.



SOUND MOTION PICTURE FILMS IN TELEVISION

(*Continued from page* 31)

is an error in the "rectification" of the film movement at large angles of rotation. This error becomes smaller as the number of faces on the prism increases. On the other hand, as the number of prism faces increases the effective relative aperture of the lens which can be employed decreases, which means that the greater the number of prism faces the lower is the light transmitting efficiency of the system. Here again it is entirely reasonable to assume that we can use for television an arrangement that would not provide enough light for theatre projection.

The displacement produced by the rotation of the prism is a function of the angle of rotation, of the index of refraction of the glass, and of the distance between opposite faces of the prism. Since the rate of rotation is fixed by the number of prism faces, the size of the prism is determined by the refractive index of the glass, and must be correct within fairly narrow limits if the projected image of the film is to be stationary. For a prism having a large number of faces used in combination with a projection lens focused at infinity, it can readily be demonstrated from elementary considerations that the height of each face ("H" in Fig. 3) must be

$$\frac{N}{2\,(N-1)}$$

times the height of a frame of the film, where N is the refractive index of the glass.

This relation shows that for all ordinary optical glasses, which have indices between 1.5 and 1.8, the prism face must be larger than the frame of film. This, in turn, means that gears must be interposed between the sprocket driving the film and the shaft carrying the prism. The gear train required is simple, as may be seen by examining any one of several inexpensive film editing devices using this principle that have recently been placed on the market. Nevertheless gears are undesirable, since they must be of unusual accuracy if the projected picture is to be perfectly steady and sharp.

It is interesting to note from the above relationship that if the index of refraction exceeds 2, the prism face required becomes smaller than the frame of film, and thus it becomes possible to mount the prism on the same shaft as the sprocket which drives the film. This almost ideally simple arrangement may soon be practical, since new types of optical glass having refractive indices greater than 2 have recently been patented (U. S. Patent 2,150,694).

Aside from the error in "rectification" due to the sine law of refraction, this type of non-intermittent projector is subject to several minor sources of bad definition which makes the design problem as complicated as the mechanism is simple. The glass prism itself, even if perfectly made, introduces small amounts of spherical and chromatic aberration which, however, can be corrected in the projection lens. In all inclined positions of the prism faces an astigmatic error is introduced, that is, the focus becomes different for horizontal and vertical lines. This error diminishes rapidly as the number of prism faces is increased. Probably the most serious of these prism aberrations is the variation of the displacement produced with light of different colors. For a given angular movement of the prism, the image formed by red light moves less than the green image, which in turn moves less than the blue image. Thus, strictly speaking, the compensation of the film movement can be perfect for only one wave length. In practice it may be necessary to limit the range of wave lengths by means of filters in order to obtain sensibly perfect definition. Here again we have a loss of light that could not be tolerated in theatre projection, but which need not be serious in television.

The conditions for constant illumination in this system of projection are three: First, the gate of the projector must expose exactly two frames of film, this area being evenly illuminated. Second, the image of the light source, formed by whatever condensing lenses are used, must be large enough to fill with light one face of the prism on the side away from the film. The image should be focused on this side of the prism. Third, the projection lens must be of large enough aperture to cover three faces of the prism. All of these conditions can be met with ease in a system using a prism having ten or more faces.

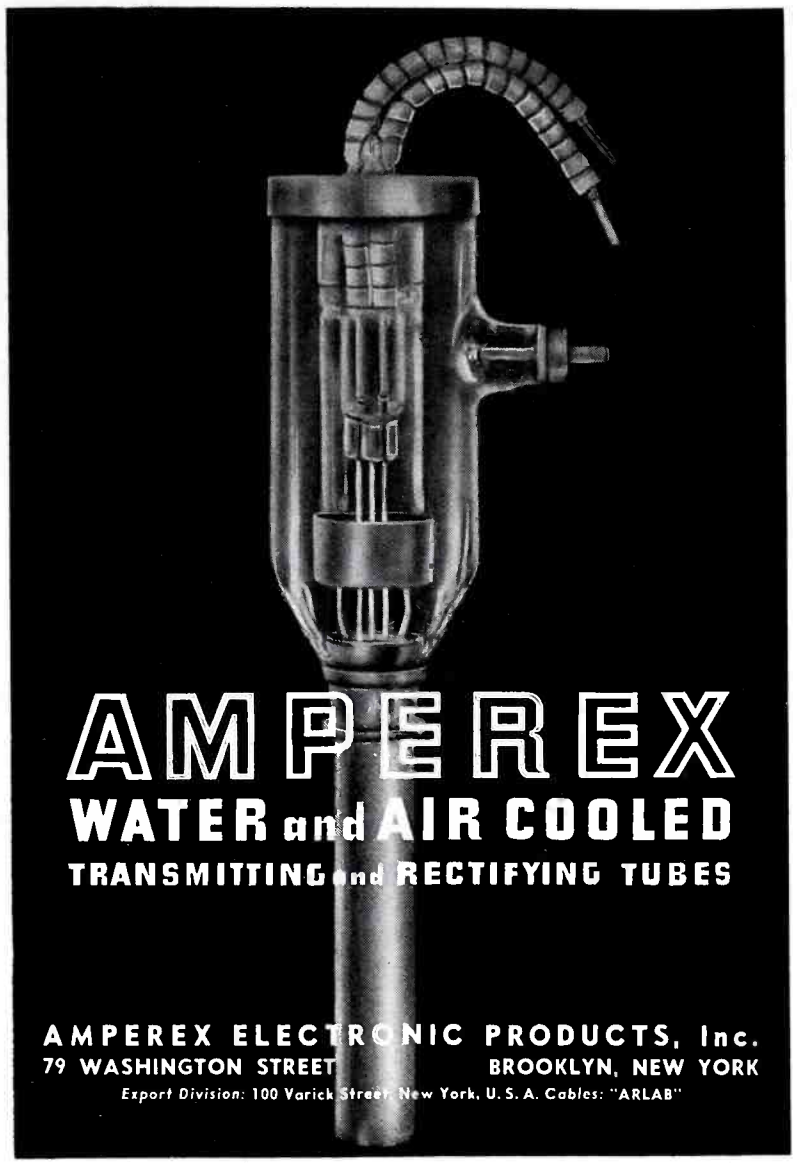
Compensation of shrinkage in this rotating prism system of projection requires the same provisions as in the moving lens train system. The sprocket must be of adjustable pitch, and the magnification must be variable. In both cases these adjustments can be made simultaneously by proper combinations of cams.

Discussion of these two systems of constant illumination motion picture projection for television transmitting tubes has necessarily been incomplete. A full development of the theory of either system would require more space than is available in an entire issue of COMMUNICATIONS.

All that the writer has sought is to establish the fact that construction of constant illumination non-intermittent projectors suitable for television broadcast purposes is by no means a hopeless task. If such equipment is provided, broadcasting from film can take place with the utmost flexibility; every class of available film subject can be employed, and high rates of picture frame repetition can be introduced at any time in the future, should they become necessary in order to provide higher linear speed for the improvement of sound quality. In the writer's opinion these advantages are great enough to justify a considerable amount of effort to make this type of projection equipment standard in the art.

The next paper in this series will deal with the film laboratory aspects of the use of films for television.

(*To be continued*)



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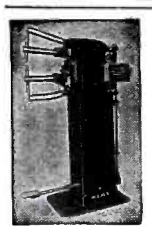

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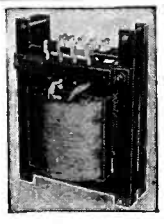

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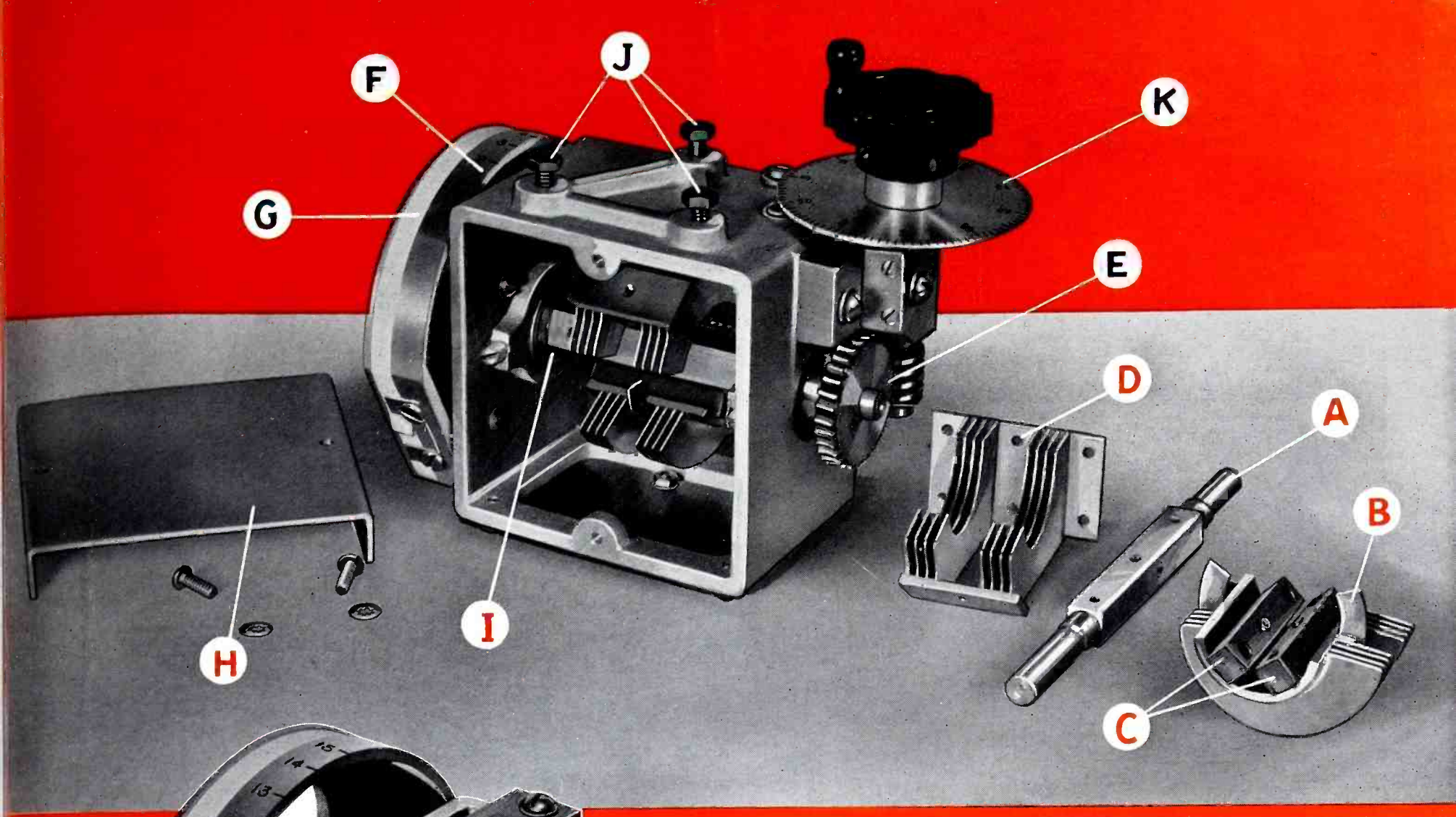

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FEATURES

- **A** Stainless steel rotor shaft
- **B** Rotor contact ring of nickel silver with pure silver overlay; 4-finger silver contact brush
- **C** Polystyrene rotor insulation; Mycalex stator insulation
- **D** Heavy, copper-plated, soldered brass rotor and stators
- **E** 30:1 precision worm drive with spring in indicator drum to prevent backlash
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GENERAL RADIO COMPANY CAMBRIDGE MASSACHUSETTS

FUNCTIONAL DESIGN OF RCA 2-STUDIO SPEECH INPUT ASSEMBLY

Steps up Efficiency!

The RCA 78-B-1 Rack Assembly, a sturdily constructed unit, contains an RCA 41-C pre-amplifier, a 40-D program amplifier, a 94-D 17-watt monitoring and audition amplifier, and two 33-A double jack strips. Meter indicates plate currents of all tubes in program channel. Trim is satin finished chromium.

This fine unit also provides you with amazing flexibility in location and new operating convenience—at moderate cost.

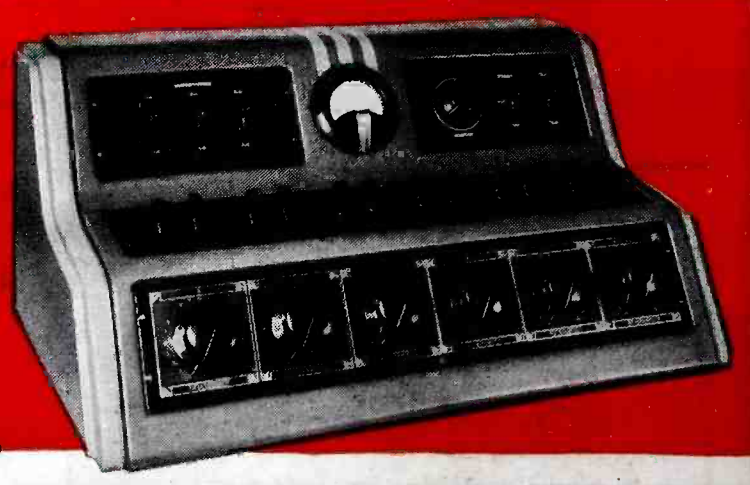
RCA Type 78-B-1 Speech Input equipment is excellent for use in the usual control room for two studios. A factory assembled grouping of RCA de luxe panels, it consists of three units — a cabinet rack containing amplifiers and jacks . . . control console with sloping front containing all mixing and switching controls . . . and a small relay power supply for wall mounting.

With this equipment you not only get the finest in mechanical construction and transmission fidelity — but because of its functional design, it provides unusual efficiency in application, flexibility in location and convenience in operation. Full details will be supplied on request.

The RCA 78-B-1 Console

Has switches for connecting pre-amplifier inputs to microphones in either of two studios and for connecting the outputs of the mixers to the broadcast or audition channels. Also has mixers for turntables and remote lines. A master mixer is included. The V. I. meter is illuminated and may be set for "peak" or r.m.s. readings.

Use RCA Radio Tubes in your station—for finer performance



RCA Broadcast Equipment

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