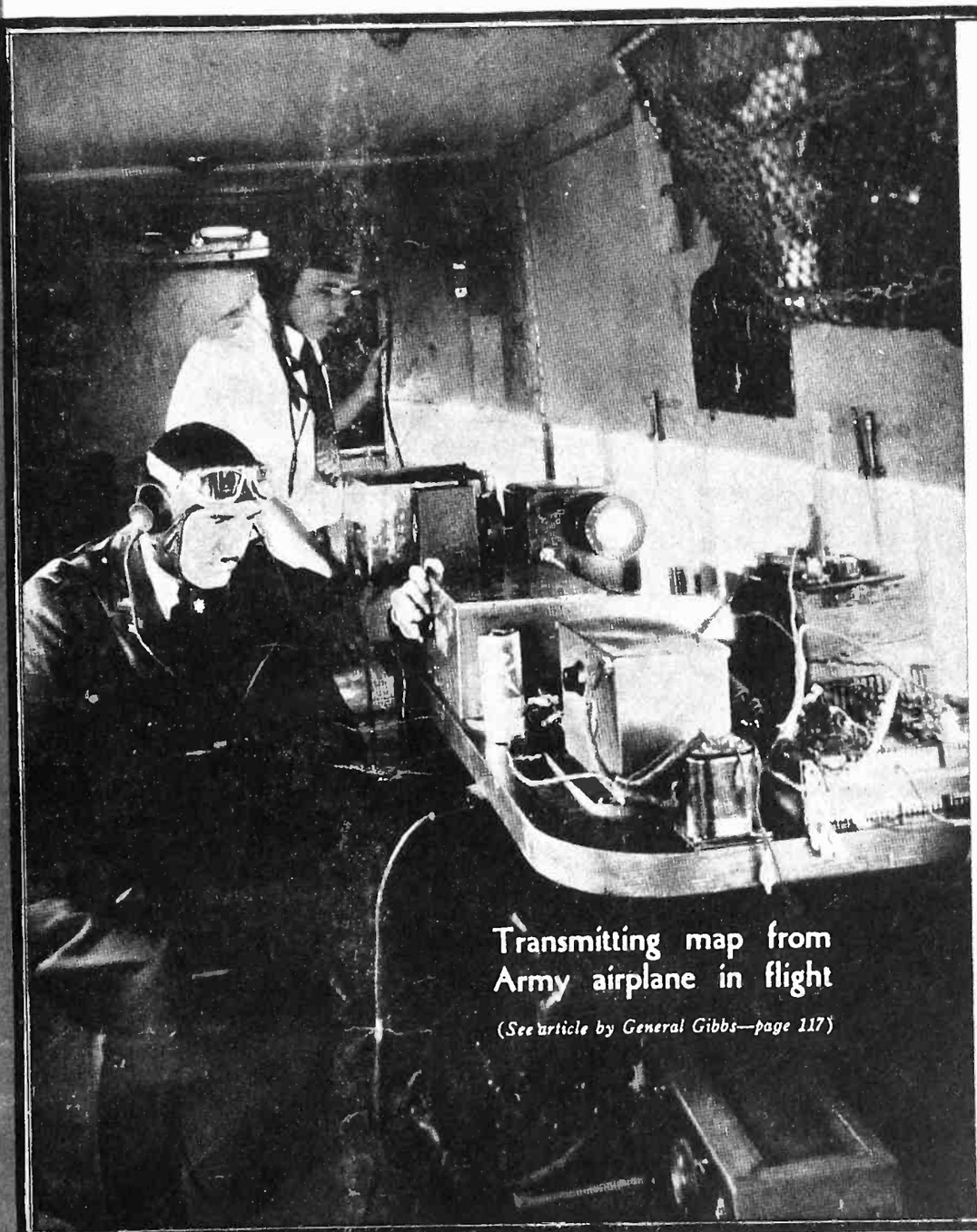
electronics

electron tubes—their radio, audio, visio and industrial applications

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



Transmitting map from Army airplane in flight

(See article by General Gibbs—page 117)

A McGRAW-HILL PUBLICATION

JUNE 1930

electronics

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Contents for June, 1930

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electronics

A McGRAW-HILL PUBLICATION

New York, June, 1930

The march of the electronic arts

world accord
und-film patents

meetings at Berlin between Zukor, president of the Para-Famous Lasky Corporation, and tatives of the world patent controlling sound recording and projecting apparatus indicate an cord between all parties. It is d that the German market soon available for exploitation of an talking and sound produc-

final conversations will be held itzerland the middle of June n representatives of the German merican patent groups, the West-ectric interests being represented.

m very happy that my mission lin has met with success," Mr. said, "I have met the directors mens & Halske, who also repre-A. E. G. and Klangfilm in this , as well as an accredited repre-ve of the Tobis concern.

explained to these gentlemen that otion picture industry was very handicapped through the fact that ectrical instruments are controlled h patents held by various organi-s and that if a unification of these tive rights could be brought about uld very materially enhance the erity of picture producers and e owners."

✦

by protests prices
ound-picture equipment

ges that the American Tele-e and Telegraph Company had ged motion-picture theatre owners 00,000 more than they would have to pay independent manufacturers the installation of sound equipment had forced them to agree to pay an tional $50,000,000 for "service" dur-the next ten years, were made to the Senate Committee on Patents May 21 during a hearing on Senator Dill's bill to make patents unenforceable if used to violate the anti-trust laws. The charge was made by C. C. Colby of Canton, Mass., chairman of the board of directors of the Audio Research Foundation representing the independent amplifier industry.

Ernest R. Reichmann of Chicago, general counsel for the foundation and of the Radio Protective Association, said Congress must act to curb the illegal use of patents in building up monopolies.

Leroi J. Williams, director of patents of the Grigsby-Grunow company of Chicago, declared that "the remedies provided by the Dill bill are necessary for the protection of the independents against illegal patent combinations."

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HERBERT HOOVER, JR.

who has just been elected president of Aeronautical Radio, Inc., formed to operate the radio divisions of the principal aviation companies

Government files suit against RCA group

The Department of Justice on May 13, filed suit in the Federal Court at Wilmington, Del., claiming "unlawful combination and conspiracy" on the part of the Radio Corporation of America, General Electric Company, American Telephone and Telegraph Company, Western Electric Company, Westinghouse Electric and Manufacturing Company, RCA Photophone, Inc.; RCA Radiotron Company, Inc.; RCA Victor Company, Inc.; General Motors Radio Corporation and General Motors Corporation.

The Government's petition claims:

"The defendants . . . have been and are engaged in a combination and conspiracy in restraint of trade and commerce among the several states, and with foreign nations in radio communication and apparatus, and the defendants are parties to contracts, agreements and understandings in restraint of said commerce, in violation of Section 1 of the act of Congress of July 2, 1890, known as the Sherman anti-trust act, and the defendants have in like manner monopolized and are attempting to monopolize, and are combining and conspiring with one another to monopolize said commerce among the several states and with foreign nations . . . and this suit is instituted to prevent and restrain the defendants from further violation of the act.

"As a part of said unlawful combination, conspiracy and monopoly, the defendants by contracts, agreements and understandings, made between themselves at various times, beginning in the year 1919, have granted to each other rights to make, use and sell radio apparatus under all existing and future patents and patent rights on radio apparatus held or acquired by them; and the defendants thereby have had and enjoyed a community of interest in each and all of said patents and patent rights and in the control thereof; and the defendants have continuously used and dealt with said patents and patent rights as being jointly owned for their common, mutual and exclusive benefit; and have assigned and allocated among themselves the exclusive

use, enjoyment and benefits of said patents and patent rights, including the right to make, use and sell all radio apparatus covered by said patents and patent rights; and the defendants have thereby divided among themselves the business of interstate commerce in radio communication and apparatus to the end that they should not compete with each other in said commerce and to the end that each defendant should unlawfully restrain and monopolize said commerce in the fields allocated to it, and the remaining defendants should refrain from competing in said fields."

Patent dictatorship

The defendants have continuously refused, except on terms prescribed by them, to grant licenses under said patents and the patent rights to any individuals, firms or corporations for the purpose of enabling the latter to engage in radio communication, radio broadcasting or interstate commerce in radio apparatus, independently or in competition with the defendants."

The petition asserted that the control of interstate commerce in radio apparatus acquired by the defendants through the licensing, cross-licensing or pooling of the radio patents has been used by them for the purpose of obtaining additional patents which increase the effectiveness and power of the patent pool, and the defendants have acquired and control more than 1,000 patents or alleged patents on radio apparatus.

The patent pool, according to the government, has enabled the defendants to dictate by agreement among themselves the terms upon which any competitor or potential competitor may use the patents owned or controlled by any of the defendants; to exact by agreement burdensome royalty payments from any competitor granted a license to use patents owned by the defendants; to compel any such licensee to accept a license on all the patents of all the defendants applicable to the patent apparatus which the licensee desired to manufacture and sell, thereby preventing such licensee from contesting the validity of any of the patents and thereby tending to prevent adjudication as to the validity of the patents.

The Government suit is welcomed, says O. D. Young

Following the announcement of the Government's suit against the Radio Corporation, Owen D. Young, chairman of the executive committee of the Radio Corporation of America, made the following statement:

"The Radio Corporation of America welcomes the suit of the government of the United States to test the validity of its organization, which has now existed for more than ten years, and in every step of which the government has been advised.

"In 1919, when the company was organized, no one concern in the country had the necessary patents to enable it to develop the radio art and create a business. Each had some, and each could block the other. The purpose of the organization of the Radio Corporation was to release the art by grouping patents enough in one place so as to enable sending stations to be created and receiving sets to be built. That this was accomplished is shown by the rapid development of the radio business.

"In order to promote competition in the art and in the business, and to avoid patent litigation which would have prevented development, licenses have been issued to thirty-four concerns to make radio receiving sets and to fourteen concerns to make radio tubes. Between them, as the public knows, competition is severe.

Sees benefits in licenses

"These licenses provide a royalty payment, which was intended to represent the fair contribution of the licensees to the expenses of the research and the cost of the original patents. It was intended to be less than the royalty payment would have been had the patents remained in scattered hands. All these licensees are licensed under all new inventions, and have the benefits of all existing research of the Radio Corporation and its associated companies in the field the licenses cover.

"This arrangement seemed wise. As a result an industry was born, thousands of people were employed, and millions were enabled to listen, without charge for programs. There can be no question of benefit to the public. There is apparently now, looking backward, and because of a recent court decision in another industry, some question in the mind of the Department of Justice of a technical violation of the law.

"Certainly, if there be anything illegal in the set-up of the Radio Corporation, its officers, directors and stockholders are more deeply interested in that question than either the government or any other group can possibly be. It is very glad, therefore, that a test case has been brought. It prefers very much to have such a question out of politics."

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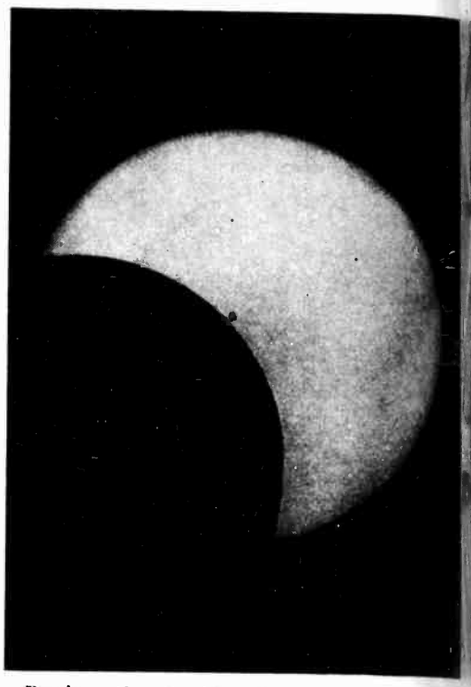
ELECTRONICS AT THE CROSSROADS OF THE WORLD

With regular radio telephone service opened last month to South America; now through this short section of switchboard at New York, conversations are handled directly, to London, Paris, Buenos Aires, Havana and Mexico

DID SUNSPOT BLANKET RADIO?



During the sun's eclipse of April 28, some observers reported 100 per cent increase in radio signals just as large sunspot above was covered by moon. Others denied any marked instantaneous effect

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Warner Brothers acquire National Radio Advertising

Warner Bros. Pictures, Inc., has acquired National Radio Advertising, Inc., thereby obtaining a dominant position in the field of electrical transcriptions for broadcasting purposes. The announcement is made by Herman Starr, vice-president of Warner Bros., in charge of technical expansion of that firm.

Taken in conjunction with the recent control of the Brunswick-Balke-Collender musical division, and the numerous music publishing companies previously acquired, the new acquisition places the entire preparation, sale and broadcasting of recorded programs in the hands of a single company, Warner Bros. Pictures.

dio signals increased ring eclipse

rbert Hoover, Jr., son of the President the United States and in charge of mmunications for the Western Air press, supervised a radio study dur- the eclipse of April 28, working with air line's twenty-two stations.

is observations were as follows:

was found that although the eclipse rred at daylight, radio conditions which narily are associated with darkness me noticeable during the entire period he eclipse.

l Paso, Salt Lake, Denver and other ts which are usually out of range of Angeles during daylight, could be municated with with great signal ngth. Points which were entirely out the area of the eclipse reported no age in conditions from which it would nally be prevalent in daylight.

t many of the points in the area of eclipse, it was noticed that the signal ngth was greater than had ever been rienced before in daylight.

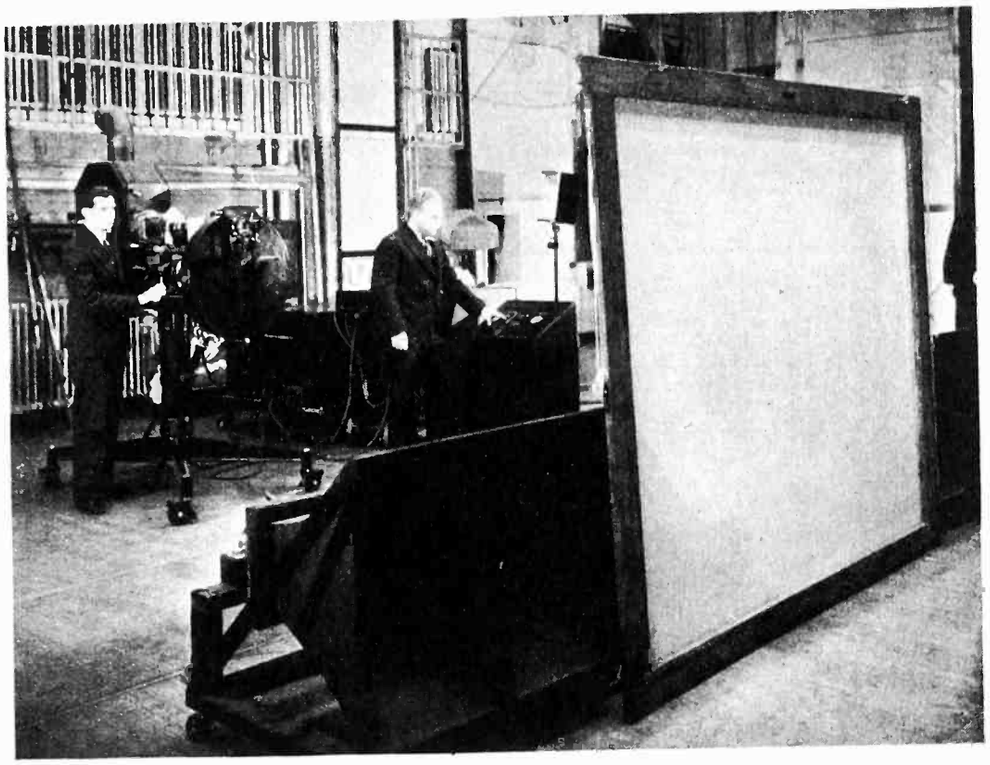
he results of these tests will tend to irm the theory that the "heavyside" r was raised during the period of the bse in very much the same manner that ally takes place at night.

s darkness started in Los Angeles, t 9:30 a.m., the radio signals became er, and kept increasing in volume until were loudest ever heard under any ight conditions. They reached their imum efficiency at 11:18 a.m., and from on the signals became weaker.

PHOTO CELLS MAKE NEW MUSIC

Here are A. C. Hardy and S. F. Brown of Massachusetts "Tech," with their light-beam electronic organ, which creates many new musical sounds, besides reproducing timbre of all familiar instruments

TELEVISION NOW ASSUMES MOVIE-SCREEN PROPORTIONS



Dr. E. E. F. Alexanderson demonstrated "talking television" on a 6 x 7 ft. screen in a Schenectady, N. Y., theater, May 22. Full details and diagram of the novel projector system are given on page 147 of this issue

RKO investing $20,000,000 in 34 "talkies"

Radio Pictures Corporation plans to produce thirty-four talking films next season at a cost of about $20,000,000. These films are to include a picture featuring Amos and Andy, the radio stars; three productions supervised by Basil Dean; "Escape," by John Galsworthy, and "The Perfect Alibi" films with Richard Dix, Betty Compson and Bebe Daniels; Edna Ferber's novel, "Cimarron," and Victor Herbert's "Babes in Toyland."

Radio chairman heads trade-show program, Atlantic City, June 4

General Charles McK. Saltzman, chairman of the Federal Radio Commission, will be the principal speaker at the Sixth Annual Convention and Trade Show of the Radio Manufacturers Association at Atlantic City, New Jersey, the week of June 2nd. Thousands of radio dealers, jobbers and manufacturers throughout the United States are expected to attend the convention and trade show. The only other speaker on the program will be Dr. Hugh P. Baker, of the Chamber of Commerce of the U. S. at Washington, D. C.

General Saltzman's address will be made on Wednesday morning June 4th, at a meeting in the new $15,000,000 Civic Auditorium, where the radio trade show will be staged.

Radio Engineers at Atlantic City, June 3

Both the Institute of Radio Engineers and the Radio Club of America will hold meetings at Atlantic City during the R.M.A. convention and trade show.

The I.R.E. meetings will be held Tuesday morning and afternoon, with Dr. Lee DeForest presiding. Following are the papers to be presented:

10 a.m.

"Commercial Methods of Testing Loud Speakers," C. H. G. Gray and P. B. Flanders.

"Overall Response Testing of Radio Receivers," A. V. Loughrer

12:30 p.m.

Luncheon, I.R.E. officers and directors, Chelsea Hotel.

2:00 p.m.

"Problems Involved in the Design and Use of Apparatus for Testing Radio Receivers," P. O. Farnham and A. W. Barber.

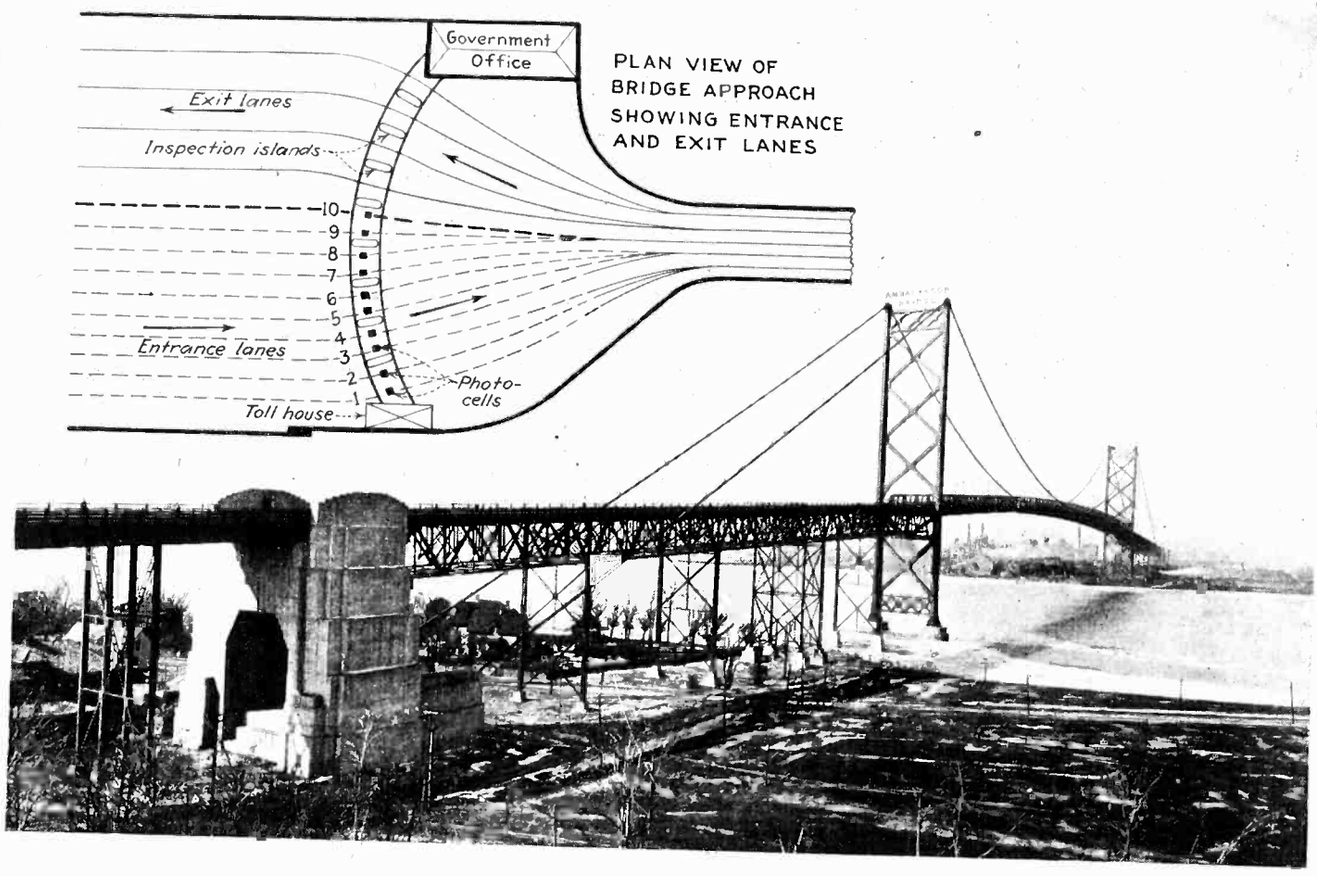
"Engineering Control of Radio Receiver Production," V. M. Graham and Benjamin Olney.

"Essential Tests for Component Parts of Electric Radio Receivers," H. E. Kranz.

The Radio Club of America, L. C. Pacent, president, will meet Tuesday evening at 8 p.m. Julius G. Aceves, chief engineer Amy, Aceves & King, Inc., will discuss "Adjustable-Tone Compensating Circuits for Improvement of Audio Amplifiers." Allen B. Dumont, vice-president De Forest Radio Company will demonstrate a new tube employing a rotating control element.

PHOTO CELLS CONTRO

Register automobile movement over 20 approach lanes, reducing toll attendants by one-half



THE checking and controlling of traffic over the twenty lanes of the longest suspension span in the world, the Ambassador Bridge, across the Detroit river, from Detroit to Windsor, is now accomplished by means of photo-electric cells. The traffic board, located in the control room, indicates the number of traffic lanes that are in operation, the density of traffic, and the efficiency with which the tolls are collected and the traffic is cleared through each traffic lane. The number of cars that have gone through each traffic lane are also automatically registered.

▼

The most important traffic and toll-collection use of photo-electric cells to date is that on the new international bridge at Detroit. At twenty different points on the bridge approaches, photo cells indicate and register the movement of cars. Compared with former ticket-collection methods, this photo-cell plan has eliminated twenty men from the operating payroll.

▲

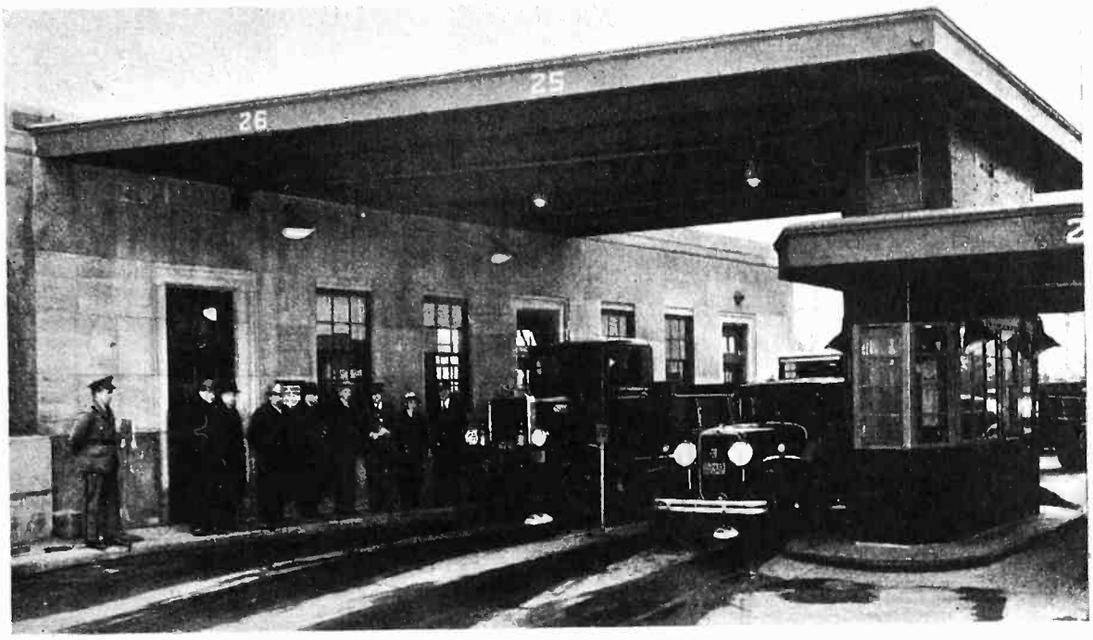
Photo-electric cells are imbedded in the roadbed opposite each toll collector of each of the ten incoming traffic lanes on each side of the bridge. A concentrated beam of light, located overhead, is directed upon the photo-electric cell in the roadbed and causes a current to flow through the cell. The vehicle, approaching the bridge, stops in front of the toll-keeper's booth to pay the necessary toll charges. During this time, the vehicle stands directly over the photo-electric cell and intercepts the beam of light, thereby causing the relay to be actuated and register an additional count. The indicator lamp remains out during this period. The chief toll-keeper, by looking at the indicator lamp on the control panel, can thus readily see that a vehicle is in that particular lane.

The indicator lamp or the meter incidentally indicates whether the system is operating properly. Any tampering with the photo-electric cells can be noted either in the toll office or the general manager's office, where a miniature control board is located. The frequency with which the indicator lights go on and off denotes the speed with which traffic is cleared by the toll-keepers. The traffic count on the magnetic registers that are actuated by the photo-electric cells, is recorded every hour and a permanent record of the density of traffic is thereby kept. At the end of each working shift the number of transactions indicated on the cash registers is compared with the traffic count shown on the photo cell registers.

The photo-electric cells being placed in the center of the roadbed must be properly shielded against mechanical and electrical disturbances as well as misdirected light

TROIT BRIDGE TRAFFIC

JAMIN
OPER
l Engineer



Two of the ten eastward approach lanes. The "mushrooms" containing the photo cells are the white objects seen beneath the automobiles. Overhead are the activating projector lamps

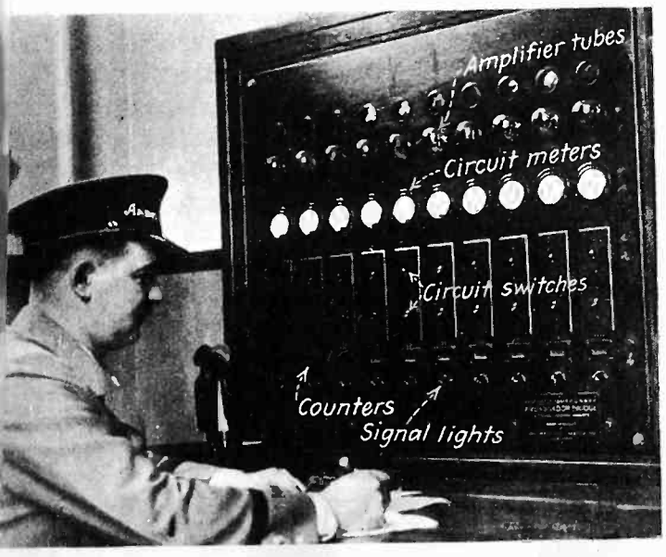
The photo-electric cell lso be properly sus- in order to minimize ct of the mechanical n from heavy trucks. ell is encased and led in a cast-steel om-like housing. A ser lens, which collects ncentrates the over- eam of light, is coun- k in the mushroom. ons are made to mini- he amount of water freign matter that can n the condenser lens us insure the maximum amount of light striking to-electric cell at all times.

ngement must be made to exclude as much light sible from striking the cell when a vehicle passes . A truck body which may be built high from und will allow an appreciable amount of light to nder the truck when the sun is strong and is td at an angle. This light might be of sufficient sy to interfere with the proper operation of the n order to exclude as much of this light as pos- ach side of the condenser lens is flanged in the on in which the vehicle moves. These flanges also a a means to protect the condenser lens from nical injury by traffic.

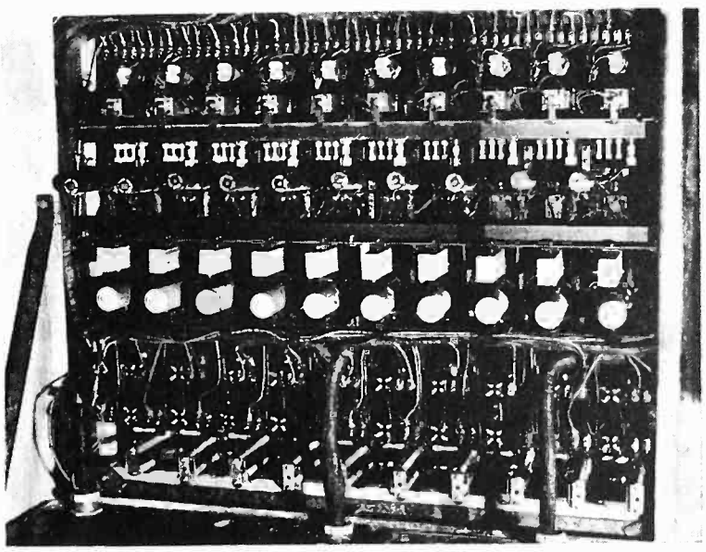
wires from the photo-electric cells are carried round to the amplifiers which are located on the l board in the control room. These wires, which currents ranging only in millionths of an ampere and extend over several hundred feet, must be properly shielded against external electrical disturbances. Telephone lines or power lines in the vicinity help to make the problem of shielding more complex.

The underground wires are brought into the back of the operating panel and connected to the proper terminals. The 60-cycle alternating current on the American side and the 25-cycle alternating current on the Canadian side of the bridge are transformed and rectified by means of copper-oxide disk rectifiers and filtered before being used as the power supply for the operating panels. Unless this current is properly filtered the sensitive primary relays may chatter and become unstable in operation. Compensating resistances are used to prevent the rectifiers from varying their voltages with a change in load.

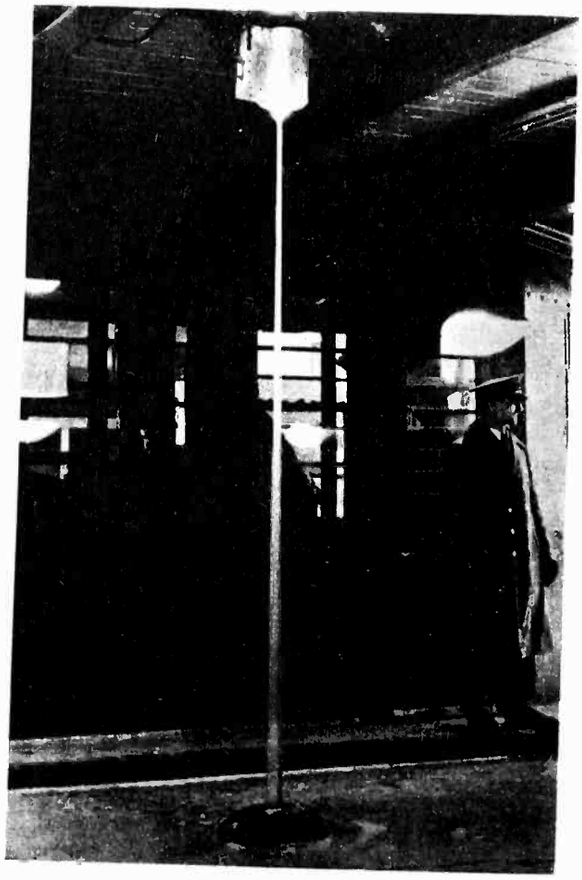
Increased efficiency in operation is brought about by changing the sensitivity of the photo-cell circuit with



One of the control boards. Here are mounted the amplifying tubes, relays, and circuit switches



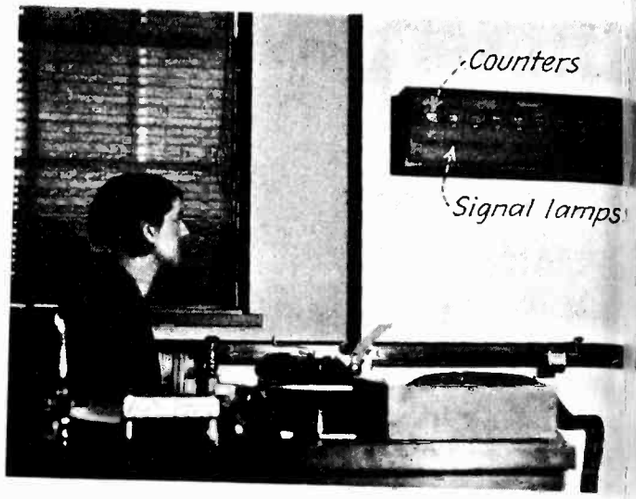
Rear view of the control board seen at the left, showing method of mounting equipment



A toll-collector's station. The photo-cell is mounted in the heavy metal mushroom, directly beneath the light source

the change in the light intensity that strikes the cell. Thus, when an automobile stands directly over the photo cell and intercepts the beam of light, the voltage on the photo cell is automatically increased and the cell becomes more sensitive to a given intensity of light although it is not sensitive enough to actuate the relay until the car has passed. As soon as the vehicle passes the cell, the same source of light causes more current to pass through the cell and the relay is actuated back to normal more effectively. After this operation is affected the voltage on the photo cell is again automatically reduced and the cell becomes less sensitive. The arrangement makes the photo-cell circuit more sensitive and allows more current to flow through the photo cell only when it is most needed. The life of the photo cell is thereby extended considerably.

The photo cells being placed in the roadbed make it



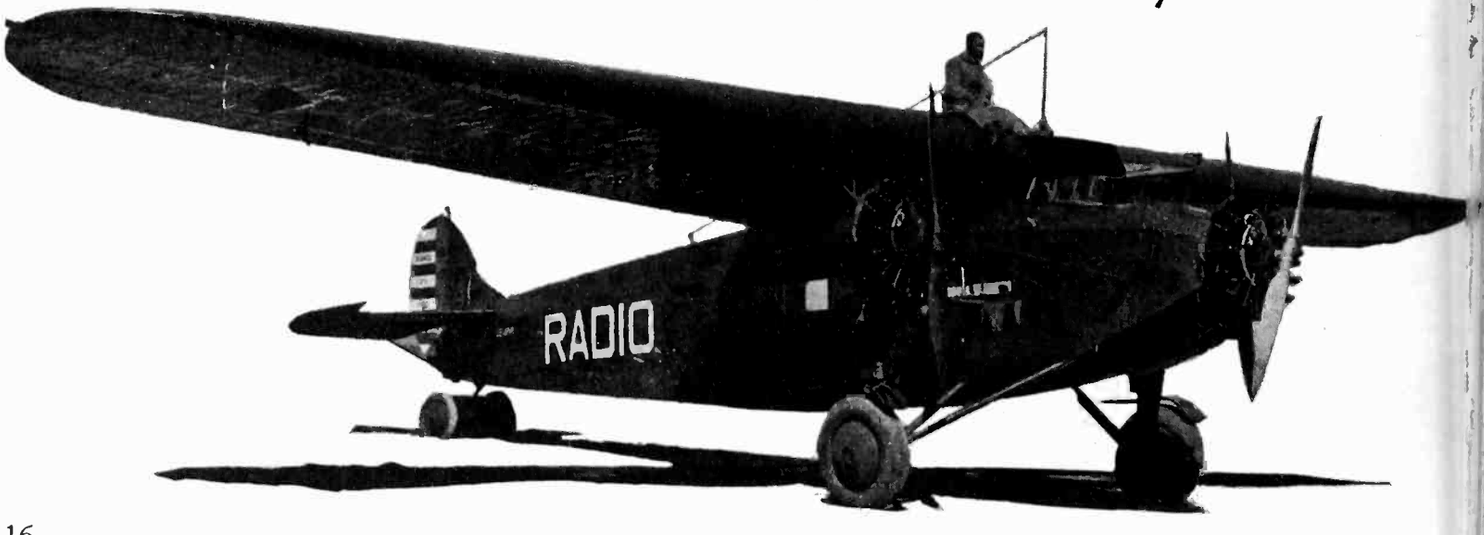
An auxiliary traffic register in the superintendent's office, carrying signal lamps and counters

possible for people to walk over them and intercep overhead beam of light. But the system is so desi that a man walking over the cells will not cause register. This is brought about by so constructing relays that they will operate only when the light is i cepted long enough to represent the time it takes a ve to pass over the cell. This time will be longer than it will take a man to walk over the cell. This lag in relays also eliminates the possibility of bumpers, s tires or luggage carriers to register. To further in against the possibility of tires and luggage carriers re tering the overhead beam of light is directed at the pl cell at an angle.

If the lag in the relay is made too great, cars con after one another in rapid succession will not al enough time for the relays to operate. The relays n therefore be designed to close the register circuit wit considerable lag and release just as soon as the car passed in order to catch the next car that may come rapid succession.

This photo-cell application for counting and controll traffic over toll bridges and highways offers numer advantages over systems that have been used hitherto accomplish the same purpose. The system of sell tickets and having them collected, requires twise as ma men as the photo-cell system. Tickets that may h been sold once may find their way back to be res and thereby cause a loss of revenue to the operat company.

The flying radio laboratory of the U. S. Army



acsimile ransmission om plane o ground

GENERAL GEORGE S. GIBBS

Signal Officer of the Army

A sketch map and message, as transmitted from the plane in flight over San Francisco Bay

NE of the functions of the Signal Corps is to devise and adapt new and better means of communication for the use of our armies in the field. he operating and supply divisions of the Corps are ding communication with present equipment, the rch and development division not only keeps this nt equipment under continual study with a view improvement, but surveys the entire communicafield for the purpose of making advances in the r of adapting such advances to the military need. Army employs all means of electric communication lding cable, wire and radio, but the rapid develop- of aircraft for military use has recently empha-, somewhat, communication by radio, the best avail- means for transmitting messages between plane and e and between ground and plane.

I the development of radio for the use of aircraft, the gal Corps employs a flying laboratory in addition to nd establishments at Fort Monmouth and at Wright d. The laboratory is a three-motored Fokker of cient capacity to accommodate table layouts of new pment in addition to the necessary standards, test measuring equipment. Personnel sufficient to make desired changes in layouts and to make necessary rvations are amply accommodated while the plane n flight. Efficient radio, telephone, telegraph and gational equipment, the latter including the Signal ps' equi-signal radio range, have been in use by the ny for the past six or seven years. While these have n under continued study and improvement, the fields ned by the advent of facsimile transmission and tele- on have not been overlooked.

acsimile apparatus, at first heavy and bulky, has been ught down to such weight and proportions that it can installed and operated in a plane of the two-place e. Difficulties have been met in the process. In the ler of their importance these are: Synchronization, electric noise, variation in signal strength and interference.

Facsimile equipment, the result of experiment in the Signal Corps' Flying Laboratory at Wright Field, was tried out during the recent Air Corps maneuvers on the West Coast. The sketch shown was transmitted from a C-7 Fokker. It is neither the worst nor the best transmission accomplished during the maneuvers. A number of sketches were transmitted. It is however a typical sketch containing such intelligence as may be sent by an observer from a "fox hole" on a commanding hill, an airplane or other point of vantage. The lack of clearness in the middle third of the transmitted sketch was caused by electric noise on the plane. It detracts but little from the value of the sketch and was soon remedied once the cause was known. Much will yet be done to improve the equipment and the transmitted sketch. The fundamental principle employed, i.e., the variation in flow of electrons under the influence of varying illumination, is the least of our troubles.

Interior of the "flying radio laboratory" maintained by the U. S. Army Signal Corps. The table at left provides space for various apparatus set-ups. See also front-cover photograph

Harmonic analysis applied to the power pentode

By HOWARD E. RHODES

THE amount of harmonic distortion produced by a tube or amplifier can be experimentally determined by a number of different methods—some quite complicated and others reasonably simple. Generally, the more accurate methods require considerable apparatus and in many laboratories where harmonic determinations are made but infrequently it may not be considered economical to tie up the necessary apparatus in a complete harmonic analyzer. In such laboratories a simple but effective method of harmonic analysis has obvious advantages. In connection with some measurements on power pentode tubes the writer has had occasion to use a method of harmonic analysis described by C. G. Suits in the Proceedings of the Institute of R Engineers.[1] This method has proved to be quite sir and reasonably accurate in results.

A simple and fairly accurate method of measuring harmonics in the output of an amplifier or other circuit has been sought for some time. Such a method was recently described in the Proceedings of the I.R.E. Mr. Rhodes applied the method to the power pentode and in this article gives the results of his measurements made in the Electron Research Laboratory.

The method can best be described with the aid of fundamental circuit given in Fig. 1. Here we have audio oscillators, the device under test as, for exan a tube, and connected to the output, a vacuum t voltmeter. The oscillator *A* generates the fundame frequency at which the measurements are to be m This oscillator is connected to the device under test output of which appears across the load resistance

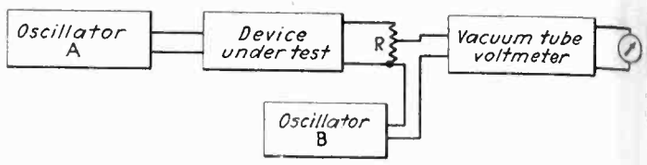


Fig. 1—Fundamental circuit of the harmonic measurement method

Flowing through this output load resistance are curre of the fundamental frequency and also harmonic c rents generated in the device being tested—and it is amplitude of these harmonic currents that we desire measure. Part of the voltage appearing across the lc resistance is impressed on the input to the vacuum tu voltmeter. In series with the input to the vacuum tu voltmeter is connected the output of another au oscillator *B* whose frequency is adjusted so that it diff by about one-quarter of a cycle from the frequency the harmonic to be measured. For example, if input frequency for oscillator *A* is 100 cycles then frequency of oscillator *B* is adjusted to about o quarter of a cycle above or below the frequency of harmonic to be measured. Since the output from device and oscillator *B* are both connected in series w the input to the vacuum tube voltmeter (working or square law) a beat frequency will be produced in plate circuit of the vacuum tube voltmeter. If the d ference between the frequency of the harmonic bei measured and the frequency of oscillator *B* is sufficien small, the plate meter of the voltmeter will slowly osc late back and forth at a rate corresponding to the d ference frequency. Under such conditions it is possi to accurately read the currents corresponding to maximum and minimum deflections of the plate met Determining the amplitude of the beat by noting meter swing and knowing the voltage applied to the vc meter input by oscillator *B* it is possible to calculate voltage of the harmonic from the formula

$$H = \frac{I_b}{L} K$$

Where

H is the voltage of the harmonic
I_b is the difference in milliamperes between the maximum minimum deflections of the plate meter
L is the voltage supplied by oscillator *B*
K is a constant

The electrical requirements of the two oscillators briefly as follows: Both oscillators must be reasona free from harmonics. This is especially true of os lator *A*, although it is possible to correct for harmonics present in this oscillator. The harmonic c

[1] A Thermionic Voltmeter Method for the Analysis of Electr Waves, by Chauncey Guy Suits. *Proceedings of the Institut Radio Engineers, January, 1930. Vol. 18, No. 1.*

f oscillator B may be as much as 5 per cent with-eriously affecting the accuracy of the results. ltor A must be capable of generating the funda- frequencies at which it is desired to make the rements. Since oscillator B must be adjusted to a ncy approximately equal to that of the harmonic measured, the range of adjustment required will sly depend upon what fundamental frequency is nd upon what harmonics are to be measured.

essential that the frequencies of both oscillators sonably constant to permit an accurate determina- the minimum and maximum readings of the meter plate circuit of the vacuum tube voltmeter. An f the stability required can be obtained from a al example. Suppose that measurements are to be of all harmonics up to the fifth, the fundamental ncy being 100 cycles. Assuming that oscillator all cases to be adjusted and held at a frequency ng from the harmonic frequency by not more ne-quarter of a cycle, then the frequency stabil-quired is readily determined and will be most when measuring the highest harmonic. In this he frequency of the fifth harmonic is 500 and to maintain the frequency within one-quarter ycle is equivalent to a frequency stability of one 2,000. With a fundamental of 400 cycles the armonic is 2,000 cycles and maintaining the fre-nc within one-quarter of a cycle is equivalent to a ncy stability of one part in 8,000.

Voltmeter characteristics

tive to the characteristics of the vacuum tube volt-it is essential that it accurately follow a square ($\sqrt{I_p}$ proportional to E_g) over the range in input ge it is to be operated. Whether the necessary law relationship exists can be determined simply otting the grid bias against the square root of he resultant curve should be a straight line. der to make the curve follow the same relation a.c. input it is essential that the external plate e made very small. This is readily done by con-g a capacity of several microfarads directly be-the plate and the filament.

Fig. 2 is a curve showing the relation between E_c ne square root of I_p for a 171-A type tube with a otential of about 70 volts. It is essentially straight zero bias down to 21 volts. In operation the tube l be supplied with a steady bias corresponding to idpoint of the straight portion of the curve—with

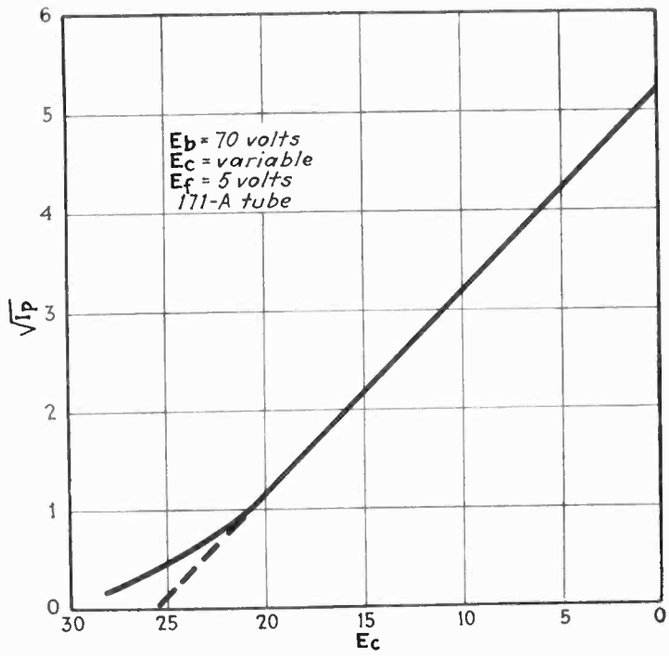


Fig. 2—Calibration of vacuum tube voltmeter

this particular tube and plate voltage the best bias was about 10 volts. Care must be taken during any tests to make certain that the peak voltage applied to the grid of the tube, due to oscillator B and the output of the device under test, does not exceed the quadratic part of the characteristic.

The constant K in the formula can be calculated from the characteristic curves or it can be determined experimentally by applying known voltages from oscillator A and B directly to the input of the voltmeter. Knowing both voltages and determining I by noting the swing of the plate meter, K can be readily calculated from:

$$K = \frac{HL}{I_p}$$

The constancy of K with various voltages applied from the oscillators is then an indication of the performance of the circuit. Of course, if the method is to give accurate results, K must be reasonably independent of the applied voltage over a sufficient working range.

If the constant K is to be determined graphically the following relation may be used:

$$K = \frac{1}{4a}$$

where the factor a is the milliamperes per volt input squared determined from the voltmeter calibration. In

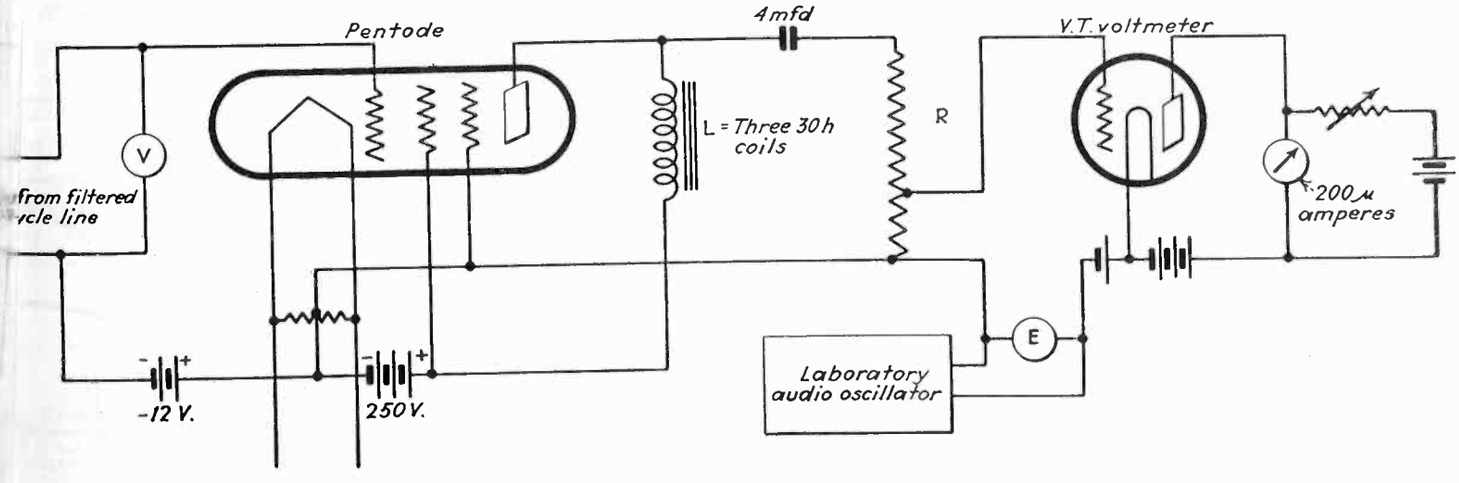


Fig. 3—Circuit used for measuring harmonics from power pentode tube

a typical case[1] a, determined from the voltmeter calibration, was equal to 0.0322 ma/volts[2]. Therefore

$$H = \frac{I_b}{0.129L}$$

The constant 0.129 above varies with different tubes but usually falls between about 0.1 and 0.15.

The data given in Figs. 4 and 5 will give a definite quantitative idea of the voltages and currents involved in harmonic measurements by this method. The data given in these figures were obtained in connection with some measurements on an experimental power pentode tube made by the Arcturus Radio Tube Company. Fig. 3 gives the details of the circuit. Using a 200 microampere meter in the vacuum tube voltmeter circuit it is not difficult to measure harmonic voltages as low as 0.01 volts.

Because of the interest among engineers in the power pentode tube, a brief discussion of the results of these harmonic measurements on the pentode is given in the following paragraphs. These measurements were made to determine the amount of second and third harmonic distortion as a function of the load resistance and also as a function of the a.c. voltage applied to the grid.

Method of measurement

The measurements of distortion as a function of the load resistance were made by applying to the grid an a.c. voltage whose peak value was equal to the d.c. bias (—12 volts) on the grid. With the a.c. input held constant the load resistance was then varied from practically zero up to a value equal to the R_p of the tube, in this case approximately 40,000 ohms. The results of this test are given in Fig. 4. From these curves the best value of load resistance, from the standpoint of minimum distortion, was found to be approximately 5,000 ohms and a second group of measurements was then made with this value of load resistance, varying the a.c. voltage applied to the grid from zero up to 8.4 volts, corresponding to a peak input of 12 volts.

The curves of Fig. 4 are the most interesting since they show the distortion with maximum grid excitation —the distortion will of course be less with any smaller value of a.c. input. These curves show that the pentode power output tube produces a minimum amount of distortion at a definite value of load resistance. This condition is quite different from that found with triodes where the distortion progressively decreases as the load resistance is increased. Under the particular conditions of the tests the second harmonic was more than 26 db below the fundamental over a range of six to load resistance.

It is not possible however to operate the tube six to one range in load resistance, 1,500 ohms to ohms in this particular case, without a consid change in sensitivity. The power output (Fig. 4) to fall off at load resistances below 7,000 ohm therefore, in practice the range in load resistance which the tube can be operated will be determin two factors i.e. (1) loss in sensitivity with low val load resistance and (2) distortion with large valu load resistances.

Use of power pentodes in push-pull

The fact that the curves of distortion vs. load r ance show comparatively large amounts of s harmonic distortion suggests the possibility that to practical use of the tube it will be necessary to them in push-pull. The even-order harmonics will be cancelled leaving only the odd-order components considered. The curves of Fig. 4 show the third less than 5 per cent (26 db or more below the fu mental) at all values of load resistance up to 2(ohms. If we consider the normal power output o tube to be 2 watts, that a 1 db (25 per cent) dec or increase in power output is permissible and fur more that the distortion is not to exceed 5 per cent, the useful range with two tubes in push-pull, will ex from 4,000 ohms up to 20,000 ohms. The 4,000 point is determined by the loss in power output and 20,000 ohm point by distortion. The maximum per sible range in load resistance is therefore 5 to 1. matter of comparison triode tubes give a power outpu not less than 1 db below the maximum undistc output over a range in load resistance of about 4 t If we consider a 3 db decrease in power output t permissible then the power pentode has a useful rang load resistance of 8 to 1 and the triode has a range to 1. It seems therefore that consideration of practicability of the power pentode boils down to a de mination of whether its superior sensitivity and sc what lower plate power dissipation in comparison the triode is sufficient to warrant its use in receivers power amplifiers.

In conclusion it should be pointed out that since t measurements were made on a single power pen operated under certain definite conditions, it is not sible to reach any conclusions applicable to the po pentode in general. The same tube under different ditions or tubes of somewhat different design might s quite different results. It does appear, however, although the curves might change in magnitude, t general form will remain the same.

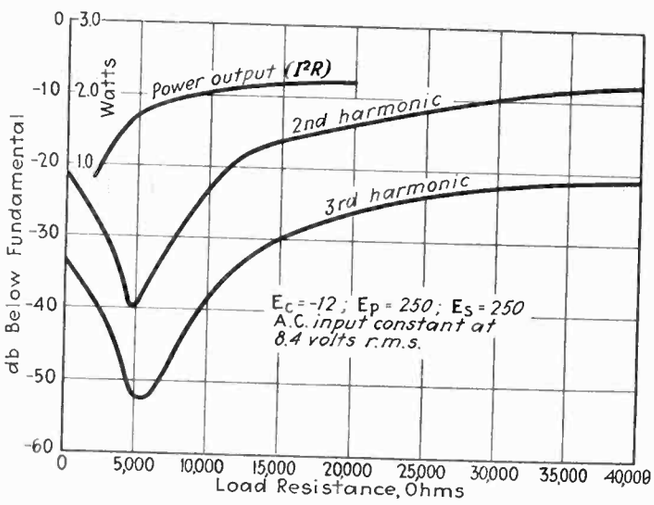


Fig. 4—Distortion vs. load resistance; power pentode

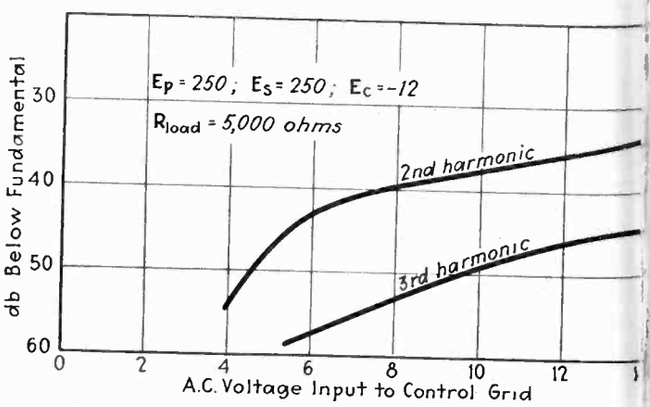


Fig. 5—Distortion vs. a.c. input; power pentode

Heads of great electrical and radio Conventions this month

nvision future of electronics

the President of the American stitute of Electrical Engineers

onvening at onto, Canada, ne 23 to 27

HAROLD B. SMITH

THE vacuum tube is rapidly coming out of ategory of sig- lig devices, and veloping onto a where it is ale of handling atities of power ia make it a real tool for the electrical engineer. t tubes now being built with ratings of from 100 to kilowatts, one can see that the electronic era of r equipment is indeed opening up.

ssessing extraordinary versatility in rectifying, erting, changing frequencies, regulating, con- ng, and performing other complex functions, the um tube presents a new and valuable tool for the rical engineer in the practice of his profession. s developed most rapidly within the past ten years, ra of radio broadcasting, as the direct outgrowth te tremendous volume production of vacuum tubes radio purposes. Because of this sudden advent, electrical engineers of the present generation overlooked its possibilities in purely electrical cations. But the younger group of engineers, cularly those who have had experience in radio, pressing forward with this vacuum-tube develop- t and the new branch of electronics must soon take lace alongside of and co-ordinate with the older ol of electromagnetic machinery.

ot only will the tube supplement and replace tons oving machinery for converting and transforming er, but it will find uses in switching high-tension currents and as a lightning arrester for protection of lines.

In fact, as the result of the tube's advent, we are likely to witness a complete re-design of our electrical systems in many respects.

The electrical engineer of 1930 is, therefore, giving increasing attention to the whole field of electronic action in vacua, for through the developments here being made he foresees the even wider expansion of the instrumentalities with which he works.

By the President of the Radio Manufacturers Association

Convening at Atlantic City, N. J., June 2 to 6

H. B. RICHMOND

AN attempt to define the uses of the electron tube would be an attempt to define the limits of the imagination of man. We must not think of the electron tube as a device complete in itself. It is rather just one of the tools in that new and extensive art now being popularly referred to as electronics.

The most familiar use of the electron tube is in the radio receiving set. How few people realize that the telephone industry uses as many vacuum tubes as does the radio industry. Some of our traffic beacons are dependent on this device. The uses of an inertia-less relay are so limitless and the future so promising that we can all profit best by applying our time to the development of the art rather than to speculating as to its limits.

▼ ▼ ▼

CONVENTIONS AND MEETINGS AHEAD, OF INTEREST TO ELECTRONICS READERS

Manufacturers Association—Convention Trade Show, Atlantic City, N. J., June Bond Geddes, 11 W. 42nd St., New City.

ciation of Iron and Steel Electrical En-gineers—Buffalo, N. Y., June 16-20. John F. Kelly, Empire Bldg., Pittsburgh, Pa.

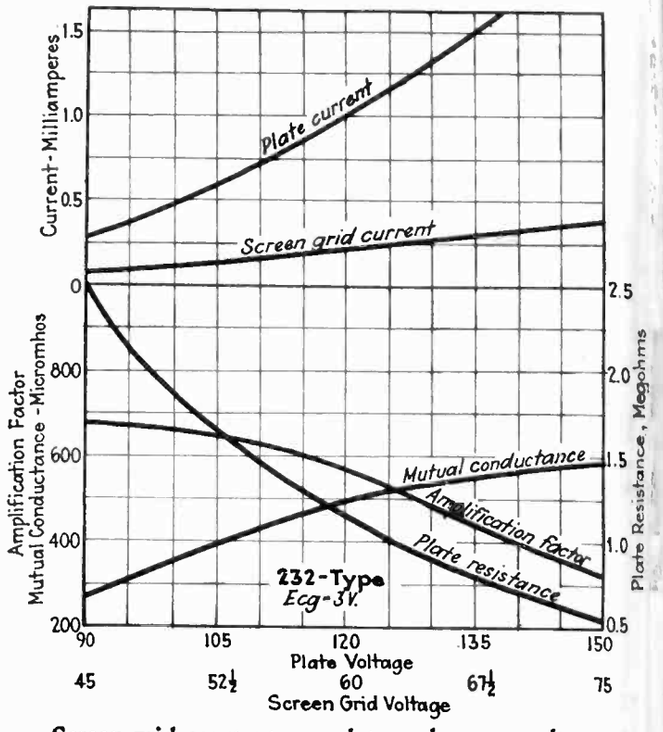
American Institute of Electrical Engineers—Toronto, Canada, June 23-27. F. L. Hutchinson, 29 W. 39th St., New York City.

American Society for Testing Materials — Atlantic City, N. J., June 23-27. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Institute of Radio Engineers—Toronto, Canada, August 18-21. Harold P. Westman, 33 W. 39th St., New York City.

Characteristics of

New low-drain tubes for battery receivers



Screen-grid constants vs. plate and screen voltages

CONSIDERABLE research has been expended, during the past two years on the development of receivers requiring but little current for heating the filaments, for the thousands of homes where a.c. power is not available. Realizing that the proper circuit was not the entire solution to the problem of providing the rural dweller and others desiring to use batteries with an economical receiver, tube manufacturers busied themselves with the design of a new series of tubes particularly adapted to this use.

The curves given here are characteristic of this new series of tubes; they were made on typical Eveready-Raytheon tubes. All three of the tubes operate from a 2.0-volt source of filament current, and comprise a complete line of general purpose tube for detection and audio amplification (the 230-type) screen-grid tube for radio amplification and detection (232-type) and a power tube for loud speaker operation (the 231-type).

All three tubes are of the high-vacuum type, employing an oxide-coated filament designed to require the minimum amount of battery power possible consistent with satisfactory performance and life.

Manufacturers who are building this new series of tubes emphasize the fact that for satisfactory life a performance it is necessary to operate the tubes at th rated filament voltage, and since the filament power w be taken from dry cells or from a storage cell wh voltage characteristics vary with the life of the c it is important that a rheostat be used to adjust the vo age to the proper value, and that either a voltmeter an ammeter be the means by which the operator kno when the proper condition is attained.

Operation with fixed filament resistors will not gi sufficient regulation to permit of satisfactory perfor ance throughout the discharge cycle of present types batteries. This variable resistor can be used as t "on-and-off" switch of course and should be arrang that when the filaments are turned off the maximu resistance will be cut in.

The characteristic curves of the three tubes compr ing the new dry-cell series to tubes provide sufficie information for any design engineer to use them amplifier or detector circuits. The general-purpose tu as grid-leak detector operates best with normal valu of grid condenser and leak; viz., 0.00025 mfd. and 2 5 megohms. The plate voltage should be of the or of 45 volts.

ELECTRICAL CHARACTERISTICS AND DIMENSIONS

	230-Type	231-Type	232-Type
Filament voltage	2.0 volts	2.0 volts	2.0 volts
Filament current	0.06 ampere	0.15 ampere	0.06 ampere
Plate voltage—recommended	90 volts	135 volts	135 volts
Grid voltage nominal	—4.5 volts	—22.5 volts	— 3.0 volts
Plate current	2.0 mil-amp	8.0 mil-amp	1.5 mil-amp
Plate resistance	12,500 ohms	4,000 ohms	0.8 megohm
Amplification factor	8.8	3.5	440
Mutual conductance	700 micromhos	875 micromhos	550 micromhos
Undistorted output	.....	170 milliwatts	.....
Approx. direct inter-electrode capacitances			
Approx. grid to plate	6 mmf.	6 mmf.	0.02 mmf. max.
Approx. grid to filament	3.5 mmf.	3.5 mmf.	.....
Approx. plate to filament	2 mmf.	2.0 mmf.	.....
Screen-grid voltage	.....	.....	67.5 volts
Screen-grid current	.....	.....	0.5 mil-amp
Dimensions			
Maximum overall length	$4\frac{15}{16}$ in.	$4\frac{1}{4}$ in.	$5\frac{1}{4}$ in.
Maximum diameter	$1\frac{1}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{13}{16}$ in.
Control grid cap diameter	.....	.....	0.346–0.369 in.

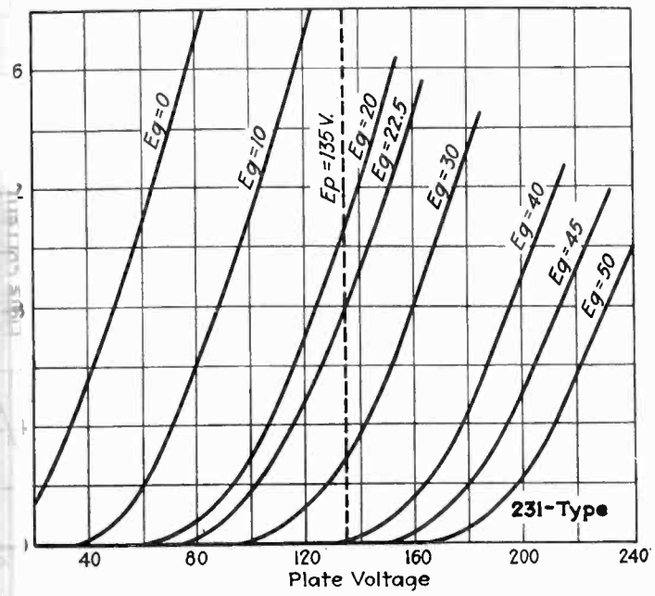
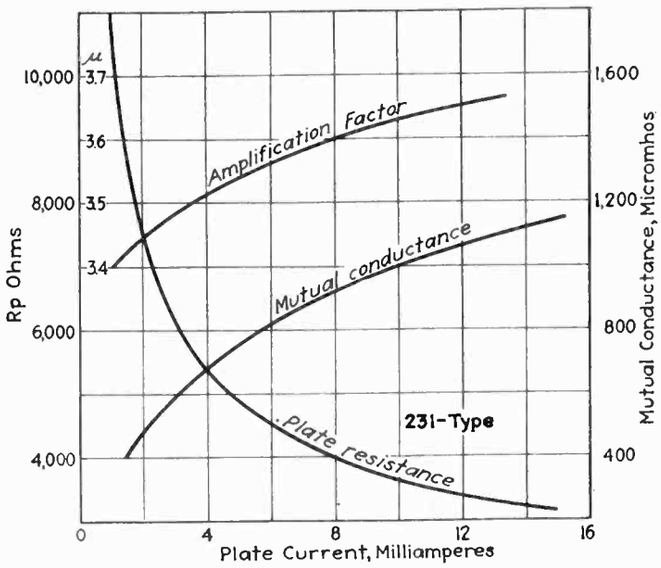
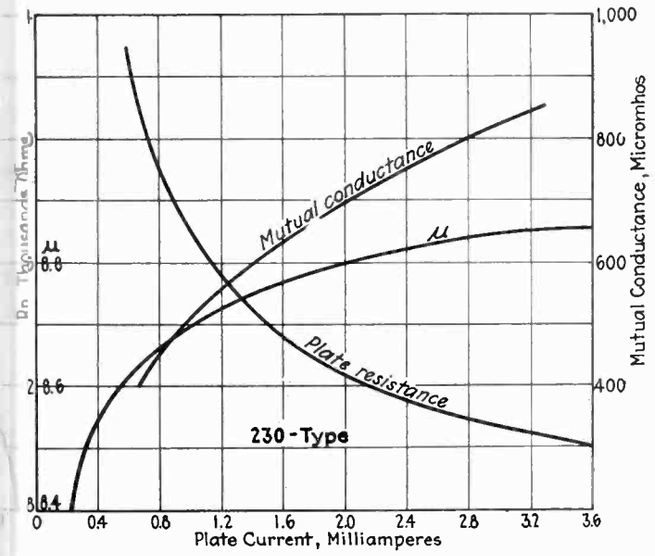


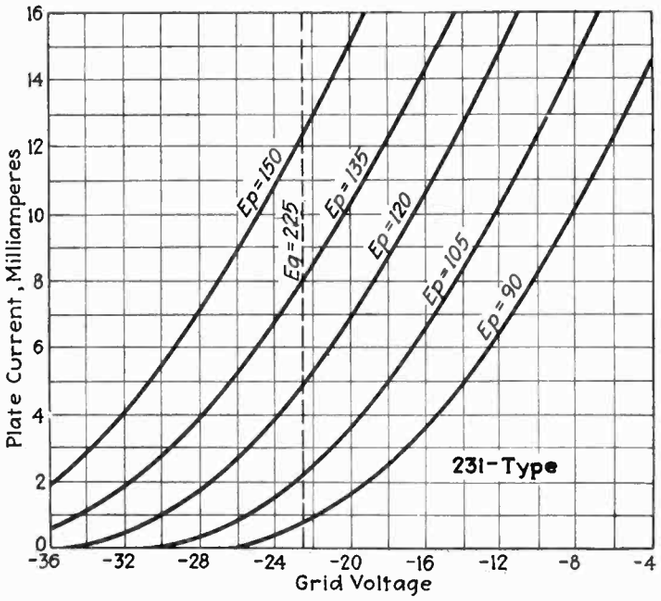
Plate voltage-plate current curves; power tube



Power tube; constants vs. plate current



General-purpose tube; constants vs. plate current



Grid voltage-plate current curves of power tube

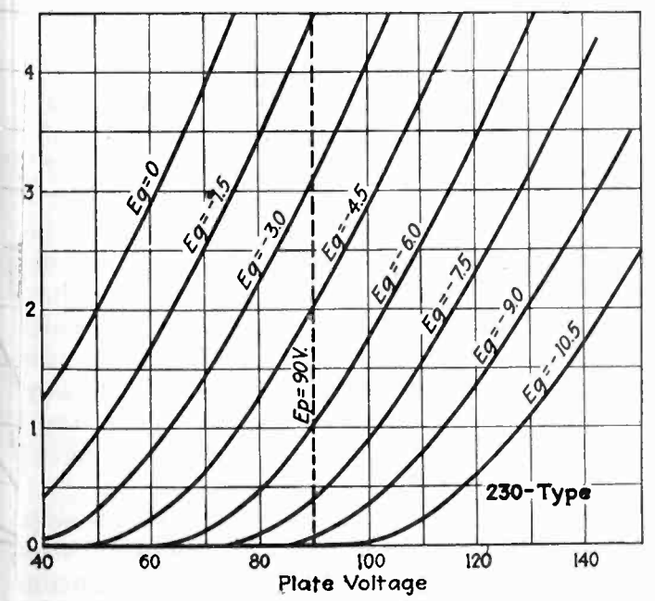


Plate voltage-plate current curves of general-purpose tube

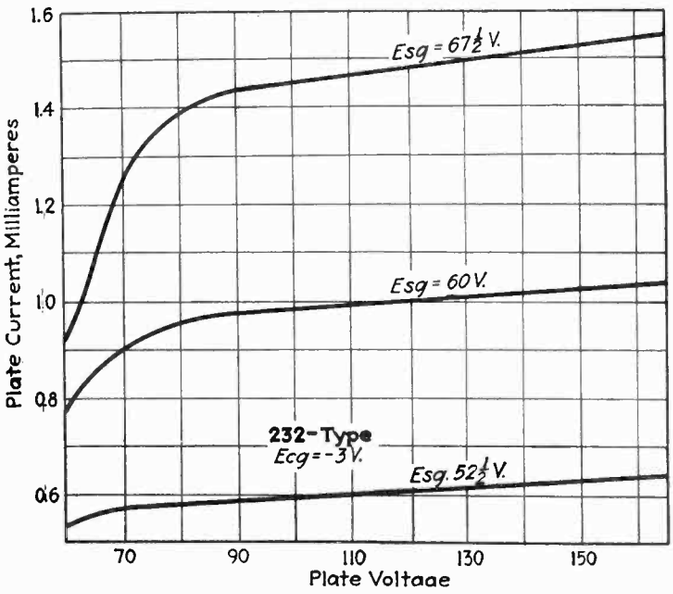


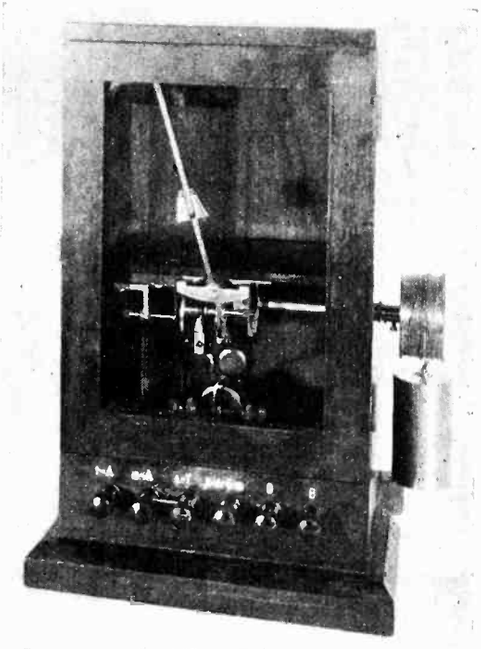
Plate voltage-plate current curves; screen grid tube

In hydrographic chart making,

The tube—as a surveying tool

By DOUGLAS L. PARKHURST

Chief, Instrument Division,
U. S. Coast and Geodetic Survey



Metronome for timing radio signals

A NEW use for radio and the vacuum tube is found in assisting the hydrographic surveyor in charting positions at which he has measured, or sounded, the depth of the ocean. Near shore, this is a simple operation. But where the sounding is to be made at a point out of sight of land, or when fog or haze intervenes, the work, prior to the advent of radio communication, could not be carried on with any great degree of accuracy.

The mariner is furnished with charts which show the contours of the shore which he is approaching, and the depths of water to be expected are indicated at frequent points. He is thereby able to determine whether he will have sufficient water in which to operate his vessel in safety, and at night or in fog to approximately locate his position. Each one of the marked depths on the chart represents an actual measurement at that particular point, and the radio apparatus which is to be described in this article, and which has been developed by the U. S. Coast and Geodetic Survey, is materially aiding in accurately carrying on this work far out at sea or under conditions of poor visibility.

Sound impulses recorded on tape

The system, in brief, consists of firing a small quantity of high explosive beneath the surface of the water at the spot where the sounding has been made. The sound of this explosion travels at a velocity of 4,920 feet per second through the water to submerged hydrophones at the shore, where it is transformed into radio waves, broadcast, picked up by a receiver aboard ship, and recorded as a dot upon the tape of a chronograph. The initial impulse has also been recorded on this tape by means of a hydrophone at the ship, and the elapsed time is measured by a chronometer. The velocity of sound through sea water being known, distances from ship to shore hydrophones are easily computed and the ship's location plotted.

The bomb, a tin-can or cast-iron container, is filled with loose TNT and, just before firing, a No. 8 blasting cap with a length of Bickford powder-train blasti fuse crimped to it, is inserted, the joint being proper sealed to keep out water.

At the proper moment, after a sounding has be completed, the fuse is lighted and the bomb thrown ove board. Its impulse is received by a carbon-grain hydr phone located in the ship's outer skin. A three-sta amplifier is used to step this impulse up so that it w actuate the pen-operating magnets of the chronograp This latter instrument is of a commercial, two-pen typ and is driven by a six-volt storage-battery shunt mot which runs at practically constant speed. It is on essential, in fact, that its speed be constant during th first and last seconds of the record so that the time ma be interpolated to a one-hundredth part of a second.

The timing mechanism

The timing device consists of a high-grade marin chronometer fitted with a circuit-breaking mechanis which operates each second, causing the second chron graph pen, whose normal trace is coincident with that the first, to make a mark on the record strip in th opposite direction from that caused by the bomb impuls

After the record of the explosion has been made, th tape continues to pass through the chronograph, eac second being marked upon it by the chronometer. Th sound from the bomb travels through the water to th hydrophones at the shore stations. These are sometim anchored as much as two miles or more offshore, depen ing upon the character of the sea bottom, as it has bee found that the system does not operate so well unless th hydrophones are at least fifty feet below the surfac On the Atlantic Coast, where the bottom falls away ver gradually, it has in cases been found advantageous to g to even greater depths, considerably greater ranges beir obtained thereby.

The shore hydrophones, like that aboard ship, a usually of the carbon-grain type. Recent experimen however, with such instruments of the magnetopho type, have given very promising results, and this form

bject, of course, to the objectionable packing which uently found in the carbon-grain hydrophone and destroys to a large extent its sensitivity. Sub- cable, armored where wave action may cause , connects the hydrophones to the shore station tus.

Shore station sends radio flash

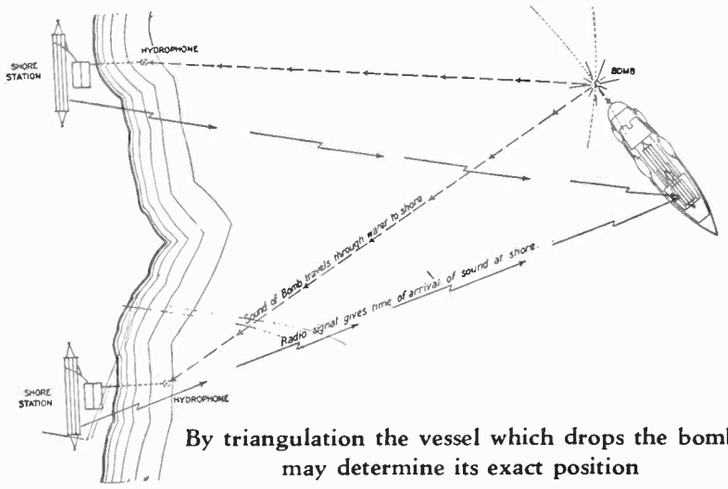
energy from the hydrophone is amplified in a tage amplifier, which is very similar to that used ship, and the current, actuating an 800-ohm relay completes a circuit through a 140-meter trans- sends out a radio flash. At the same time this ets an automatic telegraph key in operation which ut three additional equally-timed flashes from the itter. No two keys have the same timing, so that tion may be identified by its characteristic mark- the chronograph tape. The automatic keys are p using an ordinary musician's metronome as a ement, having the spring removed and a weight substituted for it. A standard pony relay is d directly beneath it with a finger so attached to ature that it engages with a similar finger on the m of the metronome when it is in the off posi-

impulse from the bomb pulls the armature over, ig the metronome mechanism, and a suitable sys- contacts acting on a notched wheel attached to e shaft opens and closes circuits in such a manner e armature is held over during one complete on of the time shaft and at the same time sends ee flashes through the radio transmitter. When olution has been made the armature is released metronome stops.

ransmitter is a single tube instrument designed to t at 140 meters. It is sufficiently powerful to t through approximately two hundred miles.

Receiving signal on board ship

initial and the three identifying flashes from the ransmitter are picked up at the ship by a standard f short-wave radio receiver. This receiver con- detector tube and two stages of audio amplifica- d additional amplification is secured by connecting eiver to the three-stage amplifier previously men- The panel of this amplifier is fitted with a throw switch, by means of which either the hone or the radio receiver may be connected to soon as the explosion has occurred and has been d, this switch is thrown over, disconnecting the hone and connecting the radio receiver ready for pulse from the short station to be recorded. The ied radio signal actuates the chronograph pen pre- referred to, making a mark upon the tape.



By triangulation the vessel which drops the bomb may determine its exact position

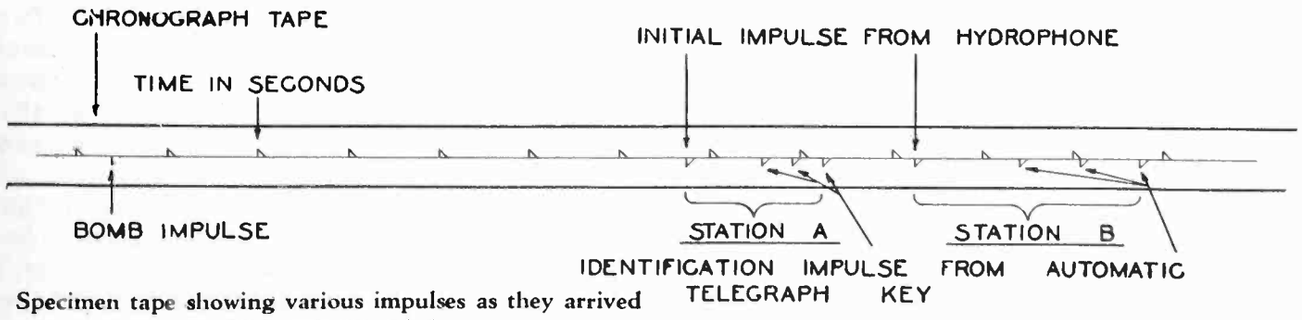
The tape now contains a line punctuated at one side with the one-second marks recorded by the chronometer. The other side of this line is punctuated with the impulse from the hydrophone and also those from the several shore stations with their characteristic identification marks. The time elapsed between the bomb explosion and the radio reception may be readily determined by counting the number of second marks and by measuring the fractions at each end.

Speed of sound through salt water

Accurate measurements have determined that the velocity of sound through sea water is approximately 4,920 feet per second, the velocity varying somewhat with the temperature. If the record shows a period of 10 seconds between the explosion of the bomb and the return of its sound from the shore by radio, the distance from ship to shore (or hydrophone) is 49,200 feet, or more than nine miles. As the geographic positions of these stations are already known, arcs of the proper radii are struck from each and their intersections indicate the ship's position. Remarkably accurate results have been obtained by this means.

The system experiences certain difficulties in some locations, the cause of which is not always apparent, and shoals are particularly troublesome.

On the Atlantic Coast, where the bottom falls away slowly and at a very even gradient from the shore, considerable difficulty has been experienced in getting the apparatus to work at any great distance. In recent experiments, however, in which the magnetophone was used, and anchored quite far off-shore in order to get a greater depth of water, much better results and satisfactory distances have been obtained. On the West coast, where conditions seem more favorable, excellent results have been achieved over a distance of about two hundred miles.



Specimen tape showing various impulses as they arrived and were recorded

Stimulating the engineer

To make more rapid individual progress

By W. R. G. BAKER

Vice-president in Charge of Engineering,
RCA-Victor Company, Camden, N. J.

THE radio and electronic industries are young, but still there is a tendency for some individuals to grow old in spirit,—to stagnate on the job. Unless precautions are taken, a man may find himself in a rut, with little ahead for the future. If he is satisfied to stay in the rut, something was wrong with his early training.

Often a jolt, such as a change to radically different work, if administered early, will arouse ambition; if delayed, it only serves to strengthen the man's pessimistic belief that "someone has it in for him." As an investment he is then almost a total loss, and salvage operations are indicated. In this field too, prevention is better than a possible cure. The precaution merely includes among each man's studies that of his prime asset—*himself*.

At frequent intervals during his student course in one organization, and at least twice a year thereafter, each man is graded or "rated" without his knowledge, by or more of his associates, and the combined rat discussed with him. Most men naturally resent an but a perfect score on all counts, and when they are to realize that a low score on one characteristic opportunity for self-improvement and advancemen sentment turns to coöperation, and subsequent r measure progress.

Several methods of comparing the over-all abiliti individuals have been tried. The "rating sheet" proved most effective, as it provides a means of he men overcome their deficiencies. A typical summa three ratings, prepared for discussion with the indivi together with the record card, are shown.

Similar forms are provided for rating clerical stenographers, etc., and such records are of conside assistance in explaining why requests for increase salary sometimes cannot be granted. A few of the leges have adopted plans of frequent ratings that ca discussed with the individuals, and many others are ginning to realize that qualities such as character, sonality, aggressiveness, initiative, and so forth, considered by employers, as well as scholastic stand

In case of wide differences in two ratings of the s man, additional opinions may be obtained for comp son, and the raters differing too greatly from the ave may be called upon to explain why. In this way case favoritism or antagonism are sometimes uncove either of which hinders efficient coöperation and lo morale.

Morale has been defined as "personal effectiven in an organization. It is the feeling of the indivi toward the group, and it depends upon several fact

First, the individual must *feel* leadership, and loy to the individuals who are guiding his future; he n have adequate encouragement and reward, financial otherwise; he must be physically fit, and must work der good physical conditions in pleasant surroundi he must receive a definite allotment of responsibility authority; and most of all, he must feel the importa of his work, and pride in his contribution to the comm cause. With these requirements satisfied, a man beco a partner in the enterprise, not a hireling. Of cou the individual must have confidence in the managem as well as in his immediate superiors, otherwise he hesitate to link his future with the company's. He m feel that he can take his difficulties personally to highest executive, if necessary, and obtain a hearin

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Last month Mr. Baker discussed the methods of organizing a competent but flexible engineering and design staff.

In the present article he continues his analysis of the individual types of technical men, showing how by proper executive leadership, engineers can be stimulated to further degrees of usefulness—to their companies and to themselves.

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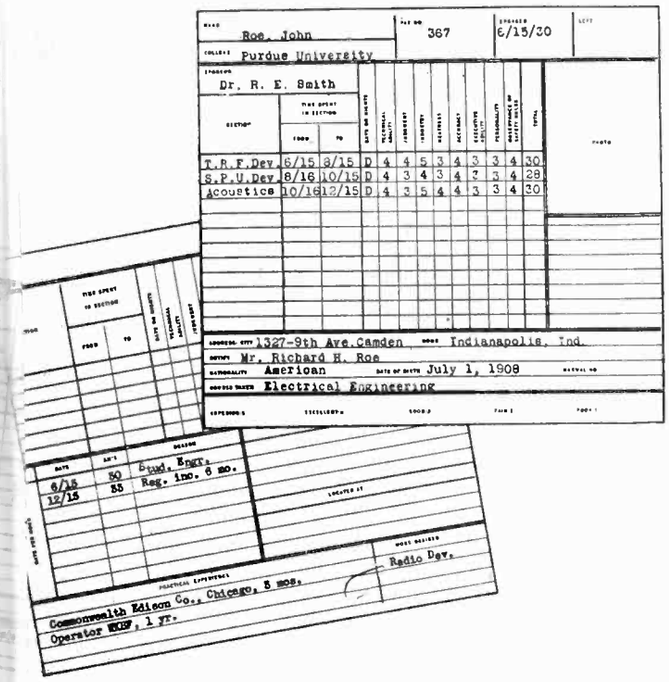
The problem of coördination

In a large company having several other departme there must be definite lines of coördination with the e neering group. Whenever responsibility is sub-divi special efforts must be made to coördinate activi maintaining overall efficiency and morale. When t are many subdivisions of responsibility, management coördination become increasingly difficult. All divisi of the organization must conform in general to comm routines and policies. The standardized method is always the easiest, but it is the safest and surest in long run. Classified instructions covering all rou situations are made available in each section, and sh be one of the first reading assignments for a new m It is not expected that he will *remember* all the det but at least he will *know where to find them* when nee

Routine keeps the ship afloat in calm weather, but *creative thought* that provides the motive power givin headway, and that charts the course for all kinds



Every employee in the organization is rated at least twice each year by three of his fellow workers using this "Special Rating Sheet"

ter. Routine is repetition; creative thought is origi-

here is, of course, some tendency to overdo the mat- routine, and perhaps make the paper work more bled than the action desired. The use of office ma-, tabulating cards, etc., has helped to simplify and ardize routines, and to reduce the number of docu- t required. No engineer should waste valuable time necessary routine if he can find a better method.

Necessary reports can be simplified also, so that too clof a man's time is not occupied in writing or read- tem. Three general classes of routine reports have found of value in engineering work:

a) *The Status Report,* recording very briefly lh results accomplished during one period and out- mg plans for the next. This report can consti- the minutes of a weekly meeting of division ds.

b) *The Engineering Memorandum* records in e detail results of any minor investigation that y be of general interest. It is distributed to all ion heads, and serves to keep them in touch h progress in other parts of the organization.

c) *The Technical Report* records in consider- e detail processes and results related to a major estigation or problem. Owing to its bulk, dis- ution is usually rather limited, but file copies accessible to those particularly interested.

addition, special reports of other types may be re- d from time to time, but in general the three classes oned cover the ordinary conditions.

Reading and study for the engineer

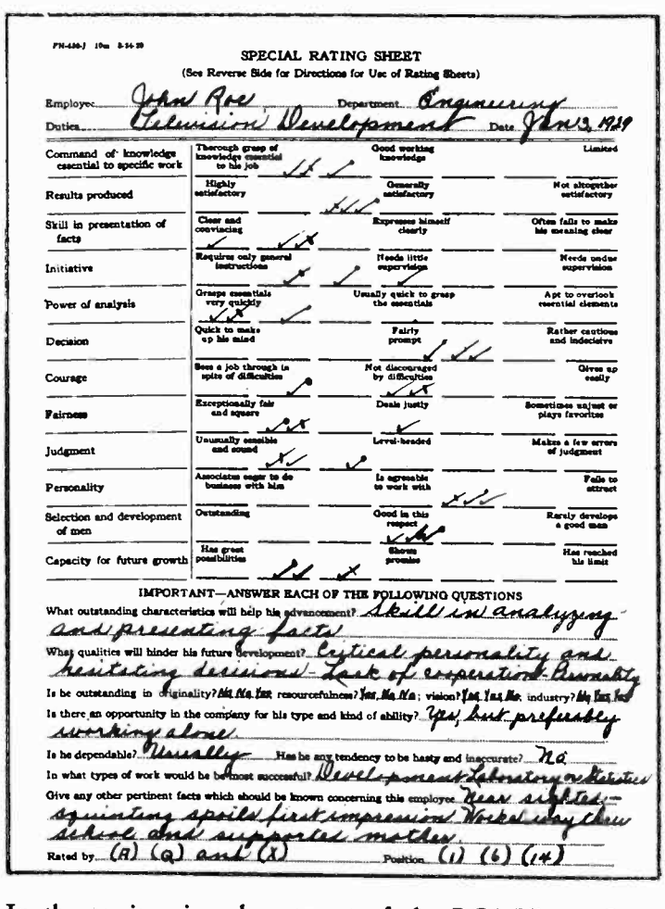
keep abreast with progress and methods used in branches of the technical industries, each man must nsiderable reading and studying. In fact, it has been that an engineer never ceases to be a student. How- the time required for such contemporary literature value for other purposes, and it is often conserved se of brief digests, prepared and indexed by a com- nt librarian, for general use. This "library service" also include summaries of technical reports, patents,

The contribution of the engineering department is largely ideas, in various forms. Provision must, therefore, be made to develop the *will to think,* to give proper *recognition* and *credit for ideas,* and then apply these ideas profitably. In the interests of the company and the individual, patent protection must be obtained on all new ideas. For this reason research and development engineers maintain daily "log" books of their work and ideas. These "idea-records" are reviewed from time to time by a patent committee. In the past many opportunities have been overlooked by paying most attention to ideas originating outside an organization, neglecting internal ideas until used elsewhere.

There are so many steps between the original idea and the finished product, that several months may elapse in the process. Research, development, working models, design, drafting, preliminary samples, testing, revisions, final samples, tools and fixtures, machines, materials, and methods all take time, and each contributes a necessary bit to the finished product.

Each necessary bit, however, must justify its *cost,* or means will be found to eliminate it. All of the early efforts are expense items, justified only if they make possible a *profit.* The overall efficiency of an organization is measured directly by its ability to make a net profit. Therefore, each item of expense must be controlled, keeping the total within the estimate on which selling prices were based. Even quantities must be carefully estimated in advance, and all optimistic tendencies discounted, for *cost is a function of quantity,* and many of the items of expense, such as machines and tools, depend almost entirely upon quantity and continuity of production.

(Continued on page 162)



In the engineering department of the RCA-Victor Company, on a card of the type illustrated, a record is kept of the positions held by each employee. It will be noted that the employee's ability is rated under seven different classifications

The race for lower unit manufacturing costs. Is it bringing excessive factory schedules and

Radio overproduction again in 1930?

ARE we heading once more into overproduction of radio sets? Will 1930 see a repetition of the serious surplus of radio receivers which made a nightmare of 1929, and spilled over into the spring dumping of 1930?

Each year since 1924, radio has undergone an annual overproduction. Each year manufacturers, racing for supremacy and low production costs, have swelled their totals—and ended by unloading their excessive output at bargain prices. Will the economic blunders of 1929, 1928, 1927, etc., be committed over again in 1930?

Frankly, it looks as if we were headed that way.

In the race for lower production costs on unit sets, huge production orders are right now being set up. Schedules measured in hundreds of thousands and in millions, are already under consideration. Manufacturers justify their huge figures on the basis of customer service, declaring that only by mass production on such scales can they pare down set prices to the point when they can compete with others hurtling toward the same goal.

What is the net result of this rush to cut down costs and prices? It simply means that manufacturers are being forced into schedules of such magnitude that these figures, when added together, make totals far beyond any possible absorbing power of the 1930 market.

Let's get out our pencils and paper.

In 1929, 4,700,000 radio sets were manufactured, of which 4,200,000 sets were sold. In 1930 every indication in the radio field and in general business, points to restricted demand—a repetition, not of 1929 but of 1928, when sales were 3,000,000 sets. Undoubtedly, 3,5(is the figure to put down as representing top for 1930.

But already it can be surmised that three or manufacturers are set to go on a million-set pro Other large interests have schedules of 300,000, 20 and so on. Adding up all these, it is apparent 1930 production of 5,000,000 to 5,500,000 sets is planned, ready to supply—or rather to glut—a max market of 3,500,000.

With what inevitable result?

Dumping and liquidation by December!

* * *

This thing must be stopped. Lower production and lower prices to the public are admirable an greatly to be desired. Prices of sets have been f for the past two years, despite the larger value deli to the purchaser. The radio engineer, the radio desi and the radio manufacturer have thus distinctly good on their obligation to the individual customer

But obligation to the customer does not involve c production prices to such a point and making pr tion commitments of such size as to swamp the commercial structure of radio. Service to the does not consist in taking part in huge volumes must invariably crack up and bring disaster.

It is time for radio manufacturers to sit down c as business men, analyze their possible market for and revise their production schedules accordingly thereby manufacturing costs are held the same o vated slightly, the public will be better served, even somewhat higher price,—than it would be by h unassimilated quantities of radio sets again thrust it, with the distress of former years re-enacted.

The cue for 1930 is to cut production schedul sane quantities. Some of the big quotas might we reduced by 50 per cent, with greater profit to the m facturer and the public.

Now is the time to study figures of sales possibi and to act. Now is the time to hold down schedul obtainable quantities, and to put manufacturing proc and material commitments on a basis of monthly co subject to demand.

It is time radio outgrew the excesses of its you past. We must not have another year of overproduc

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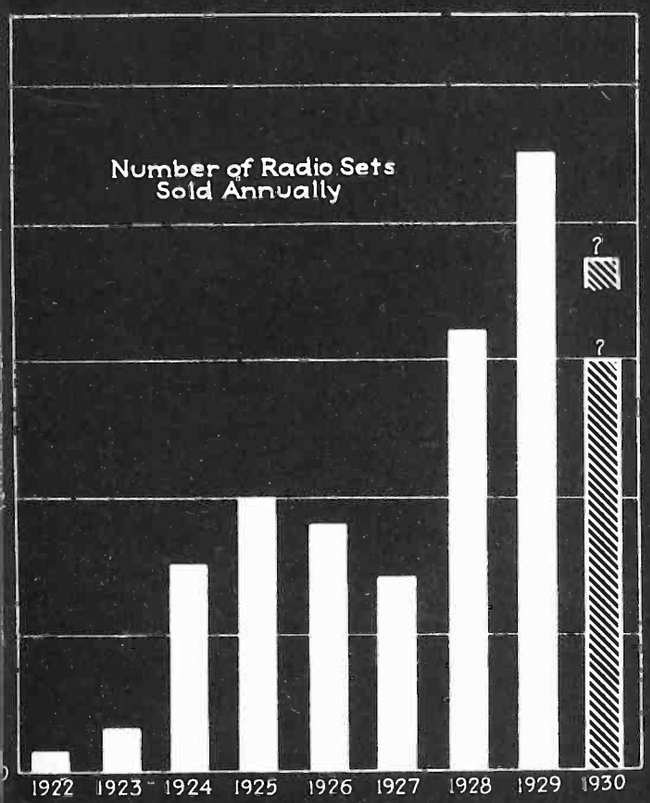
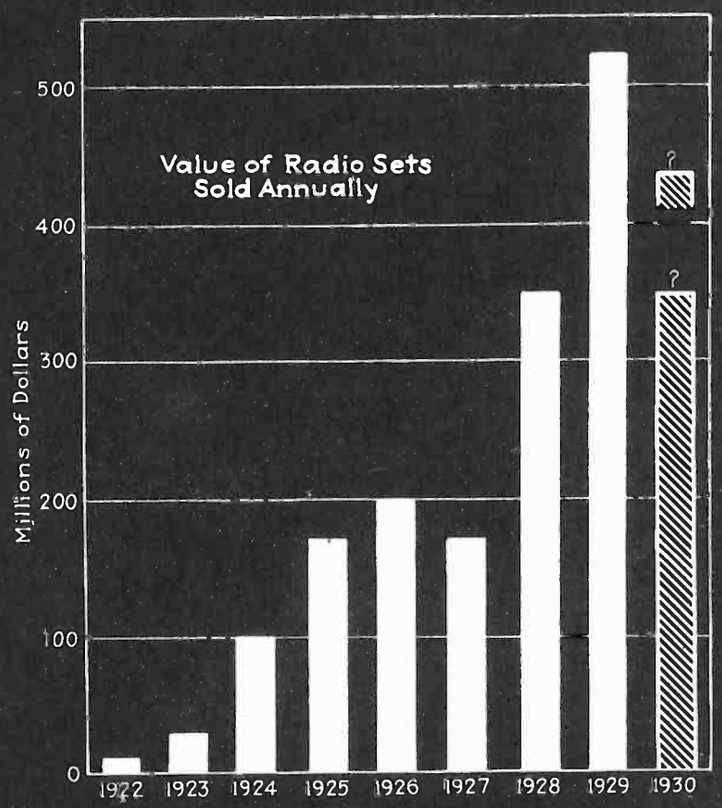
THE VICIOUS CIRCLE OF RADIO ECONOMICS

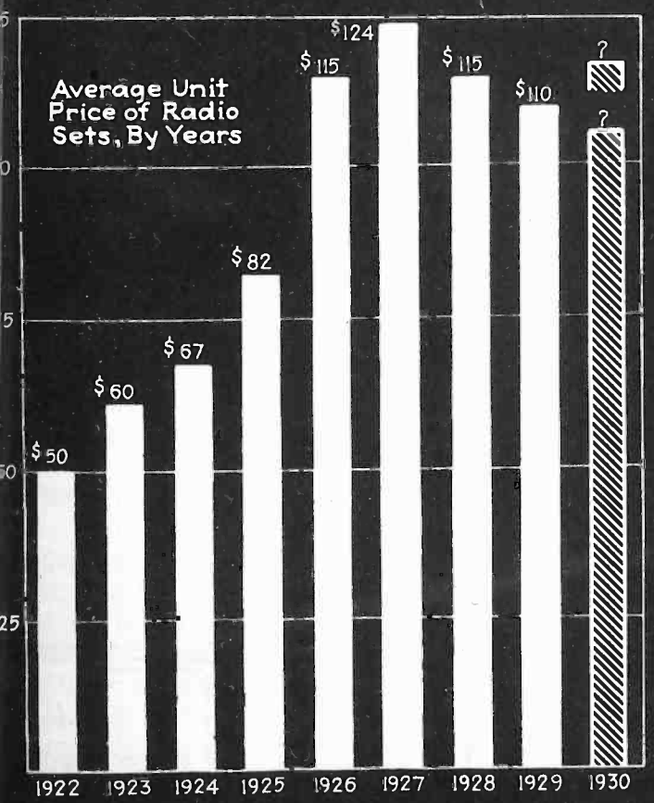
To meet competitive low prices, manufacturing commitments are boosted to huge figures on all sides. This results in widespread overproduction, in turn causing price slashing, and dumping. Price confidence is thus further impaired, prices are demoralized, and disaster follows. The only way out of this economic morass is to know the market's limits, and to establish sane manufacturing quotas and sound unit-cost limits.

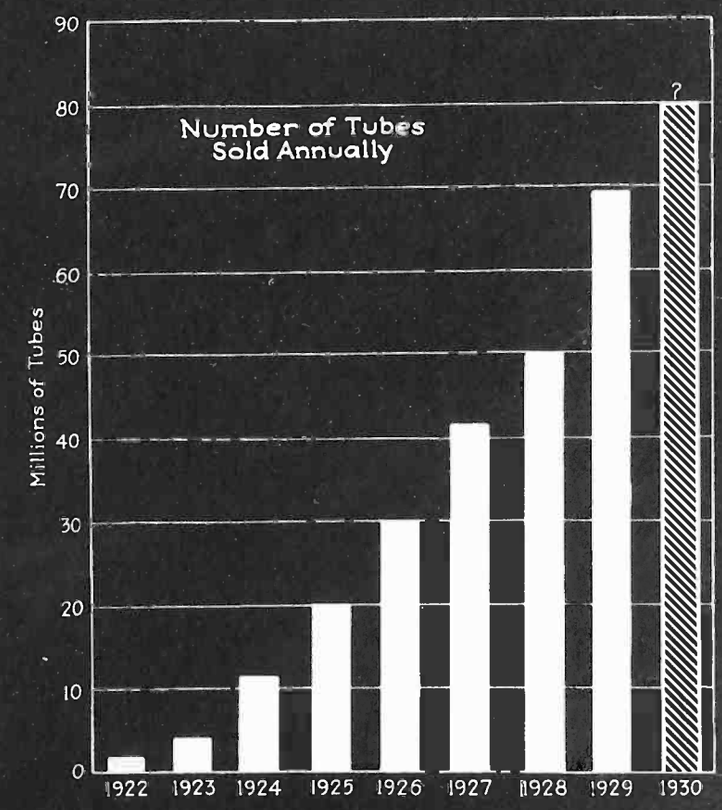
Radio Sets and Tubes

What will 1930 show in unit prices and production volume?



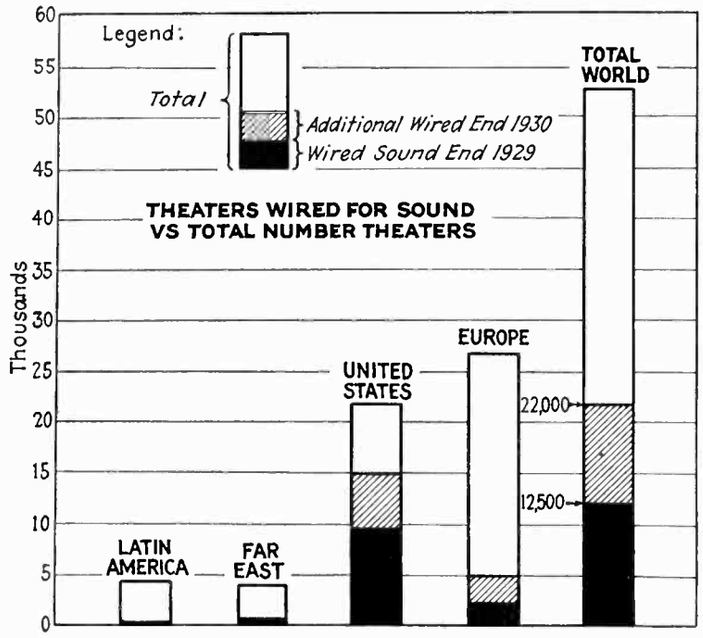


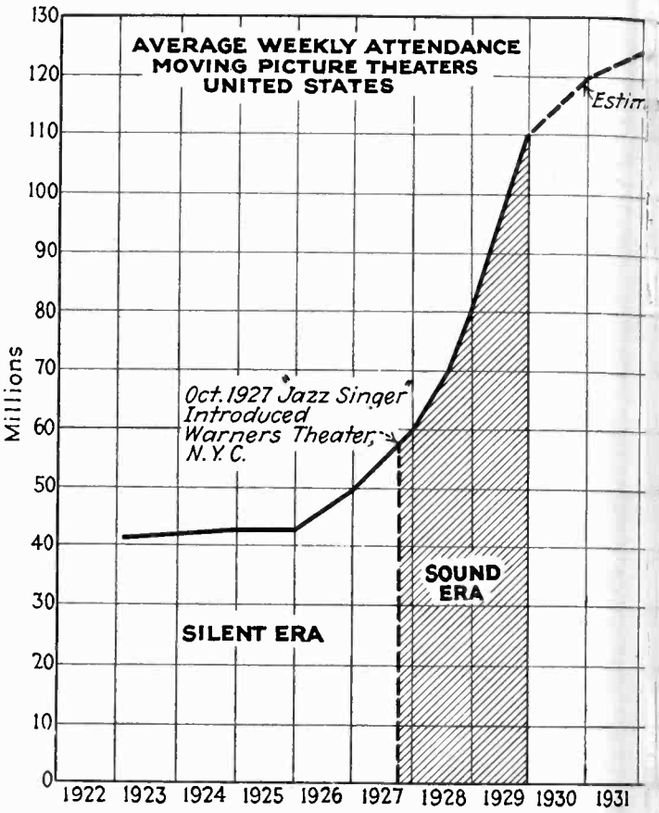


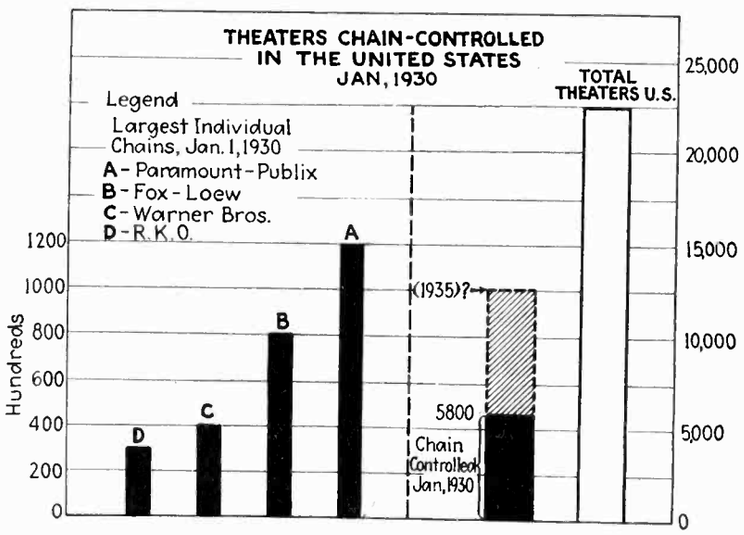


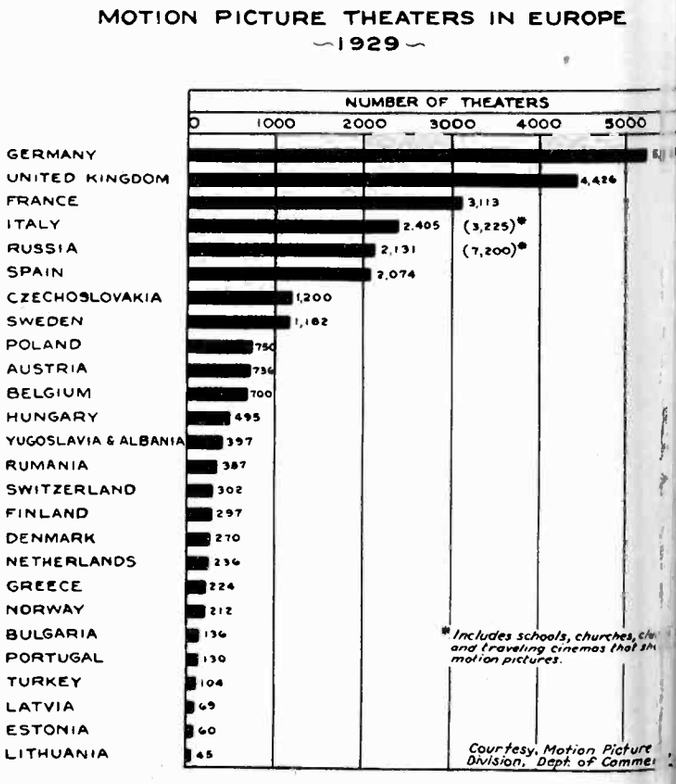
Statistics of the sound-picture field

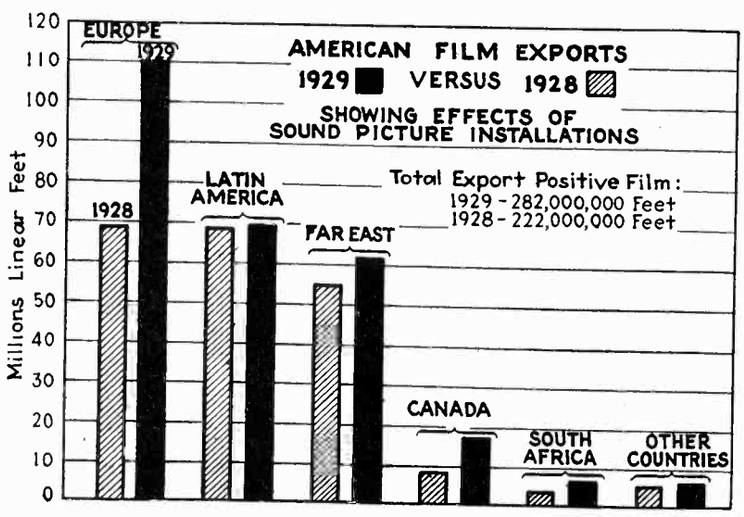
Sweeping economic changes follow the advent of the electronic tube











From the paper by Dr. F. S. Irby, associate editor of Electronics, before the Society of Motion Picture Engineers' Spring Convention, Washington, D. C., May 5 to 8, 1930

Motion picture engineers survey latest advances in sound-pictures

NE of the most successful meetings ever held by the Society of Motion Picture Engineers took place at its spring convention held in Washington, C, May 5-8. Some 400 engineers representing all us in this industry were present. Fifty-two papers read covering the latest developments in all phases tion picture engineering. J. I. Crabtree, president th society presided.

his opening address, the president pointed out the es of the society as follows: Advancement in the or and practice of motion picture engineering and lied arts and sciences; the standardization of the chnisms and practices employed in motion pictures d ie dissemination of knowledge by publication.

o new local sections of the society have recently organized, one in New York City and the other in ego, these are in addition to those now existing in on and Hollywood. Three new committees have appointed; the Color Committee, under the chairnip of W. V. D. Kelley; the Historical Committee, de the chairmanship of F. J. Wilstack and a Solici- Committee, under E. P. Curtis.

Wl H. Hays, president of the Motion Picture Pro- es and Distributors of America, speaking before the ty at the banquet May 7, stated that President Hoover and the motion picture industry will appoint committees to assure permanent preservation of the picture records of historical events now available and which will hereafter be made by the American motion picture industry. The announcement that under government auspices the motion picture records of today and tomorrow would be preserved for future generations was prefaced by the prophecy on Mr. Hays' part that "motion pictures in sound and color will be the textbook of the future. The motion picture engineers have thus made a contribution to the spread of greater knowledge unequalled since the Gutenberg Bible became Exhibit A in the history of movable type."

C. Francis Jenkins, the first president and founder of the society, made a very inspiring speech on "The Engineer and His Tools." He stated that "the line of our particular activities is picture entertainment, but all such conventions of engineers have a like purpose, namely, to improve the facilities of their particular employment. The tools available to us and our engineers are the things which enable us, we moderns, to live at all, although we usually think of them as a means to decrease our labor and increase leisure. Tools have been the most civilizing influence in all man's history. It has changed him from a food robber to a sympathetic neighbor.

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ort of committee on progress

G. E. MATTHEWS
astman Kodak Company

VO large sound stages have been completed in Hollywood recently by two producers. One, a re auditorium capable of seating 1,500 persons, has tion designed as a theatre stage which is, 75 ft. 80 ft. wide, and 120 ft. high. This stage has been ined particularly for the production of spectacles. equipped with a steel curtain weighing 65 tons, ach of its 12 floor sections is fitted with a hydrauft. A vertical steel track, 65 ft. high, permits ra shots in synchronism with the rising stage and in.

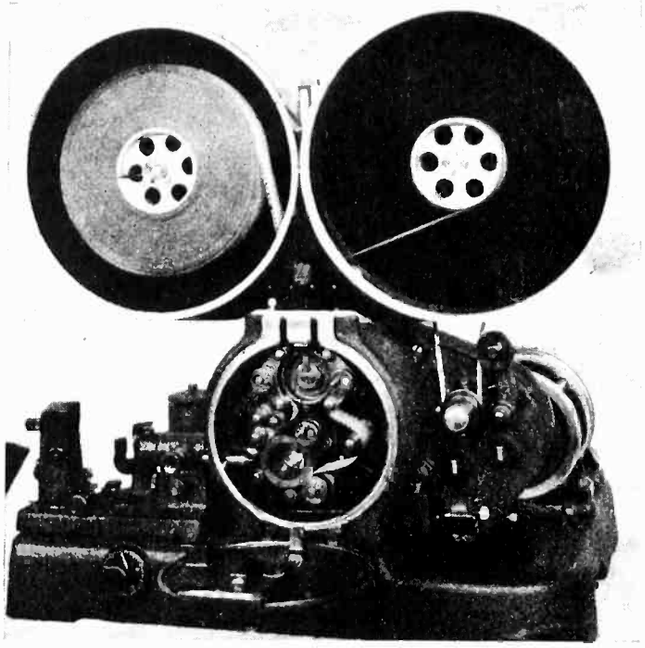
he cinematographic section of the French Photograpociety has reported on some interesting experiments gaseous illuminants. Mercury and neon cannot be effectively in the same tube to give a white light, when their combined light is supplemented with that n vaporized antimony and arsenic, a good white light oduced for the photography of colored objects. A o has been produced which contains neon gas and a um-bismuth alloy at the cathode. After heating, cadium is vaporized and its arc gives a light of dele spectral distribution.

everal French studios have commenced sound proions on a large scale, a number of them by the variable area process. Societé Gaumont which until quite recently recorded on the full width of a separate film by the Danish Peterson-Poulson method has adopted fixed density recording in the margin of a separate film. This record is printed subsequently on the border of the film bearing the positive image.

A novel feature of the sound studio at Wembly, England, is a tank fitted with a camera booth permitting under-water photography. The four new German studios at Newbabelsberg are built as the arms of a cross; all recording and monitoring being done at the center.

A novel lens device for securing wider pictures without the use of wide film is of interest. It consists of two lenses held in a mount which screws onto the front of the camera. A lateral compression of the image is produced so that nearly three times as much image is included in the normal frame. The picture is then expanded to three times normal width on projection.

One of several problems connected with the reproduction of sound has been the proper control of sound level in the theatre. Much use and some abuse of fader control have resulted from efforts to correct for volume variations resulting from recording sound at different levels and which were not entirely smoothed out by rerecording. One studio has devised a "squeeze track" for the purpose of adjusting these differences in level. This consists in blocking out part of the sound track by exposing it before development to a negative con-



New photophone film recorder with magnetic driven free running drum.

sisting of a black line whose width varies from zero to the full track width. The positive sound track becomes a record of varying width contained between two black lines filling up the remaining space of the track on each side of the track itself, which is in the center of the space.

Sound picture projection apparatus is now in active use on transatlantic liners, in a Chicago hotel dining room, and even in railway cars. A Delaware corporation has been formed to promote a fleet of specially designed railway coaches as the first unit of a projected nation-wide system of mobile sound theaters to present pictures in small villages.

A unique generator is being marketed by an Austrian firm located in Vienna. It is known as the Rosenberg cross-field generator. An arc, such as that in a projector, may be connected directly to the generator and the voltage and current are self regulating. Two of the four commutator brushes are short circuited. When the outer circuit is closed, a magnetic field and an armature field results in the same direction but opposed; the former increasing slowly, the latter rapidly.

Included in a group of motion pictures shown at the 1929 fall convention of the American College of Surgeons were four sound pictures, three of which were recorded addresses accompanying diagrammatic pictures while the fourth represented an obstetrical operation accompanied by dialogue. The operation was performed by Dr. DeLee, well known Chicago obstetrician, and the dialogue was synchronized with the film by a crew of Fox cameramen. Dr. DeLee has an elaborate laboratory for motion picture photography in the Lying-in Hospital in Chicago. It is also equipped with an animation department.

A camera capable of taking 40,000 pictures per sound by means of a drum having 180 mirrors, revolving 225 times per second was exhibited at a Scientific Congress in Tokyo. The camera was designed by the Institute for Physical Research of the University of Tokyo. Lawrence and Dunning, of the University of California, have been studying the characteristics of the high voltage spark by means of a camera which has a shutter speed equivalent to taking of 250,000 pictures per second.

Recent and future economic change in the motion-picture field

FRANKLIN S. IRBY
Associate Editor, Electronics

STIMULATED by the increasing drawing power o talking picture, the motion-picture industry ex enced in 1929 the best year of its history. The wi of houses for sound pictures progressed rapidly here abroad, and at the close of 1929, there were appr mately 9,000 theaters equipped for such pictures, ou a total of 22,600 in the United States. There were al 2,000 sound installations in Europe, out of a tota 27,000 theaters.

It is estimated that at least 5,500 additional thea in the United States will be equipped for sound du 1930. This will mean that 75 per cent of all pic houses in this country will have sound apparatus by end of this year. The total installations in Europe probably reach 5,000 by the end of 1930, bringing total installations throughout the world to 22,000 or ab 40 per cent of the theaters built. This record-break growth will be considerably slackened at the end of period, though it is expected that installations will c tinue until all suitable theaters have been equipped. what will be the final percentage of sound installati will depend on language barriers and limiting size theaters in which sound equipment will pay. Satisfact solutions will ultimately hurdle both these present b riers, and at no distant date we may expect a sou equipped theater or no theater at all.

In 1907, there were 5,000 theaters in the Uni States; at the beginning of 1930 there were 22,6 representing an average growth of about 740 theaters year. This average has now decreased to about 500 n theaters annually. It should be noted, however, that type and size of the new theaters are far superior to earlier theaters. The total investment in the motion p ture industry has increased year by year until today is about $2,500,000,000 in the United States. In Euro the total investment in this industry is estimated $1,000,000,000. Motion-pictures, while not classified a manufacturing industry, may be considered as s from the point of purchase by the public of enterta ment as a commodity. Considering this industry in latter classification it now ranks eighth of all manuf turing industries in this country.

Rise in theater attendance

It may be of interest to note the rise in attendance motion picture theaters during the past eight years. T is shown in an accompanying view. The first sound equ ments were installed in the latter part of 1926; howev no great public interest was aroused until the introd tion of the talking picture, "The Jazz Singer" in Octob 1927. The immediate success of this sound picture v the turning point from silent to audible pictures. T phenomenal rise in the attendance curve is most mark from this time up to the present and many indicati point to even higher levels. It is conservatively estima that the total average weekly attendance will reach 1 000,000 by the end of 1931. This is based on the creased number of theaters that will be equipped, the better quality and wider scope of sound pictu The introduction of wide-film pictures and the grea use of color will make new converts.

the present attendance of 115,000,000 paid admis-
per week, it means that practically the entire popu-
of the United States attends the picture theater
very seven days. It is an accepted fact that mo-
ictures can no longer be considered a luxury, but
ecessary form of recreation for the masses.
average admission price in the key cities is given
cents, while the average for all theaters is approx-
35 cents. Using an average admission price of
0 cents and 100,000,000 as the average weekly
ance, it is estimated that the total annual paid
ions to American theaters has reached the sum of
,000,000. Of this amount $500,000,000 can be
ted to the introduction of sound pictures.

Theater chains in the United States

earlier theaters in this country were individually-
units. It was not long, however, before owner-
control of more than single units appeared. This
natural step, in view of chain organizations formed
ay other fields. From 1925 to 1930, this growth
en particularly rapid. The introduction of sound
rs has played an important rôle in advancing these
dations. In the diagram it will be seen that
total theaters in this country, 5,805 were operated
rchain ownership or control as of January, 1930.
were actually 329 theater chains in existence at
ne. These chain-controlled units may be classified
he following groups:

2 chains control 50 or more theaters, each,
5 chains control 25 to 50 theaters,
15 chains control 6 to 25 theaters,
17 chains control 6 or less theaters.

he larger chains there are several which are out-
ig. They are shown in another view; the num-
theaters controlled indicated in hundreds. It
be noted that of all theaters now built, only about
e cent are chain controlled, but they represent the
eaters throughout the country, and their revenue
nts approximately 75 per cent of the total. It is
ed that chain growth will continue at a rapid pace,
1935 chains large and small will control over 50
nt of the total theaters in the country.

Sound pictures and foreign markets

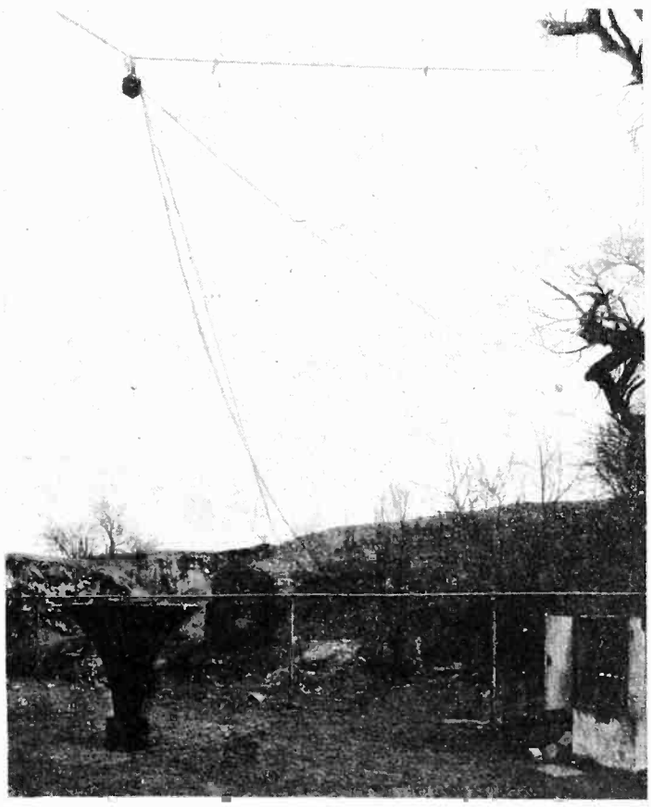
enormous increase in the average weekly attend-
American theaters following the introduction of
has already been shown. The same is true, al-
to a lesser degree, for the theaters in Europe
have been equipped with sound apparatus. With
rs throughout the world wired for sound, there are
tant problems of language to be considered to pro-
he proper pictures for our foreign markets. Amer-
ictures are now shown in 70 countries with sub-
translated into 37 foreign languages.
spite this apparent handicap of language, it is inter-
to note that United States film exports increased
0,000 linear feet in 1929 over 1928. The total
ican film exported in 1929 was 282,000,000 feet of
about 8,000,000 feet was negative film. This com-
with approximately 1,000,000,000 feet of positive
produced in the United States in 1929. It can be
that our foreign markets in the past have been im-
nt, and every effort will undoubtedly be made to
nue them in the future.

A new recorder for sound-on-film

EDWARD W. KELLOGG
RCA Victor Company, Inc.

A NEW model of studio recorder has recently been adopted by RCA Photophone Inc. The most important difference between the new machine and its predecessors is in the means employed to give uniform motion to the film. A sprocket, no matter how perfectly made, nor how constant its rate of rotation, does not impart uniform movement to the film, a slight slip or jerk occurring as each tooth engages or disengages. The effect may be of the nature of a "flutter or gurgle," but frequently has only the effect of making the high tones "wheezy" or of adding ground noise.

The new machine employs not a sprocket, but a smooth drum to move the film past the exposure light. In this respect it is like its predecessors. The drum is free running, its speed being fixed by the film and varying with film shrinkage. The drum shaft carries a flywheel, and attached to the flywheel is a copper flange in which eddy currents are induced by an electro-magnet which is driven at a speed about 15 per cent above that of the drum. This serves the double purpose of damping out oscillations in drum speed or "hunting," and of supplying a forward torque sufficient to overcome friction. The result is that the film has so little to do in helping or retarding the drum, that it runs with decided smoothness, and no jerks are transmitted from the sprockets. Considerable latitude in magnet current is possible without impairment of results, and the most sensitive tests fail to indicate appreciable variations in speed. The fact that speed constancy is not dependent on precision construction nor exact adjustment insures consistently satisfactory performance.



Set-up to determine frequency response characteristic of loud speaker for higher frequencies.

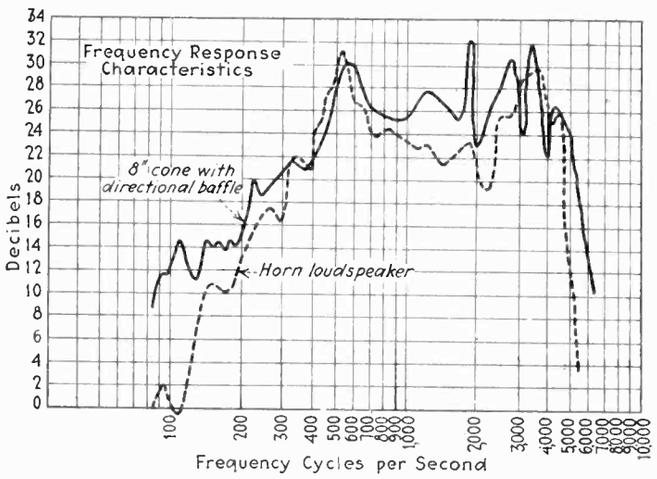
Loudspeaker and theater sound reproduction

LOUIS MALTER
RCA Photophone, Inc.

A COMPARISON of the two chief types of loudspeakers used in theaters is given, viz., directional baffle type speaker, and horn type speaker. On the basis of actual experimental measurements a comparison is made on the basis of:

1. Frequency range
2. Uniformity of response
3. Radiation distribution characteristics
4. Efficiency
5. Input power capacity

The measurements indicate that the directional baffle type speaker is superior in frequency range and uniformity of response. With respect to radiation distribution characteristics and input power capacity, the two speakers are approximately the same. With regard to efficiency the horn type speaker is slightly superior.



Relative frequency response characteristic of horn type loud speaker and directional baffle type loud speaker.

Experimental measurements are used to explain the greater naturalness of reproduction of both speech and music in theaters with the directional baffle type speaker.

Results in a theater indicated that in the reproduction of frequencies below 300 cycles the baffle speakers gave more naturalness to speech than horn type speakers. A single horn when compared to a single baffle speaker is not representative, as the latter has added advantages when combined in a group of baffle speakers.

New galvanometers for variable-area recording

G. L. DIMMICK
RCA Victor Company, Inc.

A NEW dry galvanometer has been developed for recording sound film by the variable area method. The reflecting mirror in the new galvanometer is approximately 15 times greater in area than the present mirrors. It does not require oil damping to give it the necessary stability. This new galvanometer can gather more light than the previous one and is thus more adaptable for handling the wider sound track and higher speed.

Photo-electric device for timing negati

M. W. PALMER
Paramount-Famous-Lasky Studios

VARIOUS methods of timing negatives are use different laboratories. The most common me consists in printing a known exposure through a ne density wedge so that each one of several frames scene receives a slightly different exposure. The pos is then examined after a controlled development and exposure time for the scene chosen.

Photo-electric cells have been suggested for us measuring the light transmission of negatives by met involving means for integrating the light transmis from an entire frame.

A method is described for printing on the nega a uniform density in the area reserved for the sc track, the density of the record being proportional to illumination of some standard area in the set, such as highlight density of a face. Subsequently the develc density is used to control automatically the printing of the scene. An arrangement is provided in the pri for the light transmitted by this density to act o photo-electric cell, the electrical energy, fluctuation which varying the printing light.

Analysis of photographic sound reco

O. SANDVIK
Eastman Kodak Research Laboratories

NEW apparatus has been developed for analy variable area and variable density sound tracks. device provides a means of accurately moving the past a slit in steps of two-thousandth of a millime This will allow the plotting of a curve of approxima 40 points for a 5000 cycle wave. An accurate met is thus provided for an analysis of what happens to photographic image during film processing.

Volume control by the squeeze track method

W. C. MILLER
Metro-Goldwyn-Mayer Studios

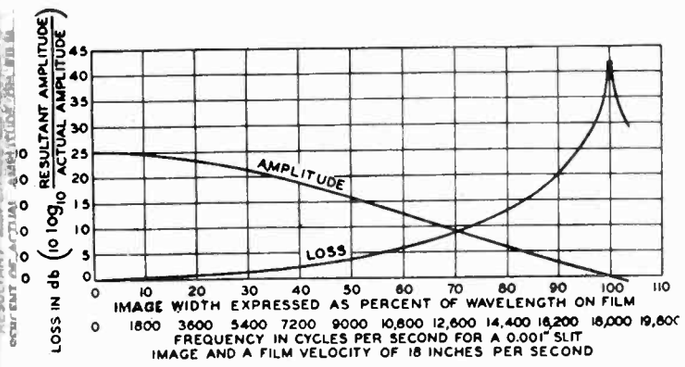
THIS method provides for varying the width of present 80 mil sound track during the reviewin the picture and prior to release of the print to in the proper volume level at all times during reproduc in the theater. Average sound track width is take 40 mils, this width varies from 20 mils to 80 mils gi an increase or decrease of 6 db in volume level. fader in the theater should be set 6 db. higher than u using this method because of less average volum start with. This method of automatic volume co has been used several months and comments rece are very favorable. The device for making the squ track volume control is located in the reviewing r This method is applicable to the variable density s track but it is thought a similar scheme might be ap to the variable area sound track. A sound track of mils as contemplated for the new wide films would itself most effectively to this method.

nning losses in reproduction

N. R. STRYKER
Bell Telephone Laboratories

THE photographic reproduction of sound there are ffects related to the film speed which must be care- lly considered for high quality reproduction and these cts must be reduced to within tolerable limits. The of these effects may be called the *image width effect* the second the *azimuth effect*.

his paper presents both theoretical and experimental res showing the magnitude of these two effects and asses the influence of combined image width and uth effects under what corresponds to normal operat- conditions.



l general it is considered that experimental measure- ts of scanning losses under various conditions of test ve indicated excellent agreement with those which old be anticipated from the theoretical study. Methods ve been given for computing the magnitude of the ses due to the image width effect and the azimuth ffect. Charts for such losses have also been given. It been shown that for the width of image used in ctice, the loss due to image width effect is relatively ll. It has been shown that if azimuth deviations are t within reasonable bounds the loss due to the azimuth ct is small. Correspondence of theoretical and experi- tal data shows that the losses obtained in practice as small as those which would be predicted by theory the conclusion is drawn from this that with proper ign, optical systems need not be responsible for ap- ciable degradation of quality within the frequency ge at present used for reproduction.

und reproduction—disk vs. film

P. H. EVANS
Warner Bros. Vitaphone Corporation

HE advantages and disadvantages of disk and film methods are considered from a standpoint of sound ality, operation and cost, and each factor is considered ctically, as well as theoretically, and the points at ich the theoretical advantages are not realized in prac- e are pointed out. The factors are also discussed from producers', distributors', and exhibitors' standpoint. It is maintained that sound quality in the theater is e differentiating factor between present successes and evious failures. Due to the inherent lack of inertia the film, causing speed variation or flutter, and the cessity of using more complicated and delicate appara- tus in film reproduction, it is stated that better results are obtained at the present time by using disk.

It is pointed out that obvious advantages from an operating standpoint of sound-on-film have enhanced, and are stimulating the development of this method, that marked improvements have been made so far, that the weak spots are gradually being discovered and eliminated and that at some future date we may expect the film to produce equal or superior results to disk.

Projection by the revolving lens wheel mechanism

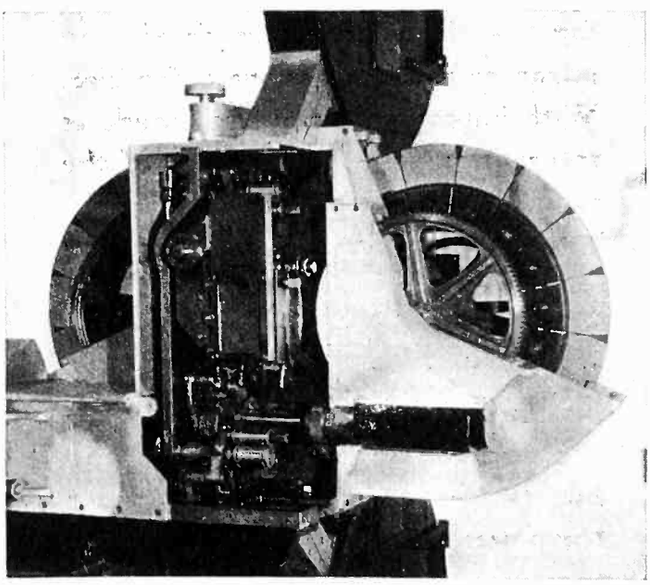
ARTHUR J. HOLMAN
Brookline, Mass.

THE advantages of the revolving lens wheel system of projection reside in the elimination of the intermittent movement and the shutter. The uninterrupted flow of uniform and relatively low intensity light to the screen produces a clear, bright and extremely pleasing quality of picture, entirely free from scintillating effect in the highlights. Due to the continual dissolving action, which occurs between successive film frames, the appearance of graininess is greatly reduced and the action is smoothed out. These factors materially reduce eye-strain and fatigue, thus enabling the observer to enjoy to the fullest extent the improved tone qualities.

Elimination of the intermittent movement and the introduction of a scientifically designed take-up control, reduce film wear and damage to a minimum, making it possible to get several thousand exhibitions from a single print.

The optical system is easily and instantly adjustable for variation in shrinkage of film. It contains no mirrors or prisms and does not require cams or other variable velocity devices for its operation. The system may be designed for any desired film frame size and is equally effective for 16 mm. or double width film.

The objective system is composed of a stationary front element and pairs of rear elements which constitute the peripheries of the two revolving lens wheels. The objective interposes the same amount of glass between the aperture plate and the screen as does the ordinary projection objective.



Revolving lens wheel projector that eliminates the "intermittent movement" in present projectors.

Recent developments in high-power broadcast transmitters

By A. W. KISPAUGH

Bell Telephone Laboratories, Inc.

AS LONG ago as January, 1924, the art of transmitting broadcast speech and music had advanced to the point where radical improvement in quality of transmission could not be expected. Years of telephone research indicated the requirements for high quality reproduction of sound; the Federal allocation scheme so restricted the width of broadcasting bands that little opportunity existed for actually realizing these requirements.

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Radio receivers have improved steadily since the early days of broadcasting. With the major trends of these advances nearly everyone is familiar. With improvements to the broadcast transmitter—the "back-stage" of the radio theater—there is no such widespread acquaintance, even among engineers. In this article Mr. Kispaugh tells of the latest advances in transmitting equipment. He has been active in increasing the percentage of modulation, in improving the fidelity of transmission, in increasing the power output.

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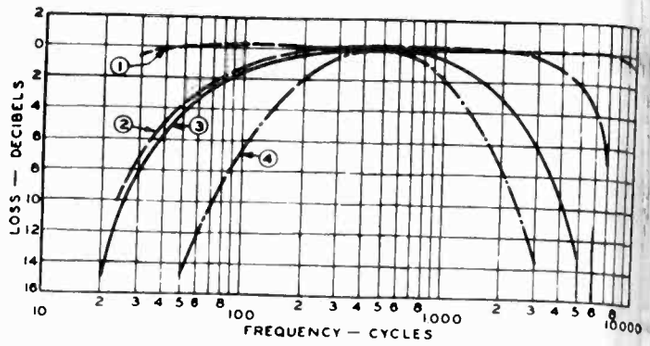

Fig. 1—Comparison of transmitters and receivers of a few years ago with those of recent date.

Briefly, the requirements for high quality reproducti are that the essential audible frequencies in the origi sound be transmitted and reproduced without distorti and in their correct relative magnitudes. The hum ear is so constructed that it hears as sound all f quencies from about 30 to nearly 20,000 cycles p second providing they are of proper intensity. T satisfactory reproduction of most ordinary sounds do not require the transmission of this entire range of fr quencies, though too much curtailment of it cannot tolerated.

Broadcast equipment performance

The performance of recent broadcasting equipment transmitting the range of audible frequencies is indicat in Fig. 1. In this figure, (1) is the characteristic of th present Western Electric 50 kw. transmitter, (2) is th of the Western Electric 500 watt transmitter of 192 and (3) and (4) are characteristics of typical radio r ceivers of the present and 1926, respectively. It is ev dent that the faithfulness of reproduction still depen largely upon the performance of the receiver.

Transmitter development has reached a stage whe the apparatus may be designed to transmit almost an required range of frequencies. Limitation in this re spect is determined by the available space in the eth and the economics of the situation. In the case of re ceivers, there is an additional factor—that of selectivit —and a difficulty of design is imposed by the clos spacing of the broadcast channels. It makes the repr duction of a wide range of frequencies difficult, for the is but a 10,000 cycle band between adjacent assignment and it is often necessary for the receiver to select be tween these. This requirement of selectivity make necessary a compromise in design, for it becomes mor difficult to prevent interference between programs o adjacent channels as the receiver is made to pass greater range of the higher audio frequencies. More over, as both sidebands are broadcast, frequencies abov 5,000 cycles begin to overlap those of the next assign ment, and it would appear that 5,000 cycles is the ex treme limit of reproduction to be hoped for without wider separation of channels.

A considerable part of the evident improvement i reception during the past five years must be credite to developments in the transmitting art.

The use of greater power at the transmitter for ex ample reduces the effect of noise, first because it in creases the ratio of signal strength to stray noise leve and second because it requires less amplification at th receiver. If stray noises are sufficiently great in com parison with the signal strength of the broadcast pro gram, they will be very disturbing, while, if they ar sufficiently below the signal strength they will be un

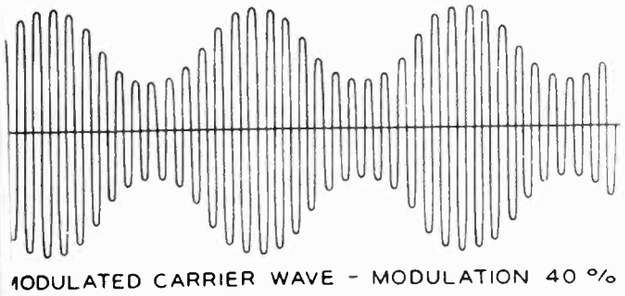

Fig. 2—Appearance of modulated carrier of transmitter of a year or so ago.

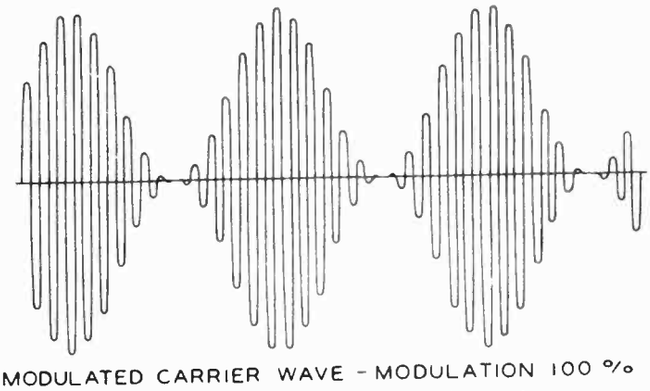

Fig. 3—Completely modulated carrier wave representative of up-to-date transmitter.

d. By radiating a suitable amount of power, ore, a situation may be attained where it will not cessary to employ sufficient amplification in the ier to raise the noise to an objectionable level. The l reduction of noise when the power of a station gmented is quite evident, and s increased power desirable en- regardless of the greater econ- lue to the larger number of list- served.

nefit of greater modulation

possibly greater effectiveness in uing noise than augmented power ity is increased modulation. The tance of this factor is appreciated it is remembered that the gth or volume of a received pro- is directly proportional to it.

the earlier sets, modulation was d to about 40 per cent and a car- wave so modulated is shown in 2. The new 1.0, 5.0 and 50 kw. ern Electric sets permit modula- o 100 per cent—producing a mod- l wave similar to that shown in 3. As a result, the peak output red is four times the power of nmodulated carrier or 200 kw. for arge transmitter, which accounts he large tube capacity in the final . For 40 per cent modulation the output required would be only w. This completely modulated er is then amplified to the desired r and delivered to the antenna.

hat this amplification of a com- ly modulated wave may be accom- ed without serious distortion is always clear to one considering the familiar static characteristic e showing the relation between plate current and grid voltage and obvious that when an amplifier is operated so that the range of rnating grid input voltage exceeds required to reduce the plate cur- t to zero or even extends beyond straight part of the curve distor- will be introduced. In the high quency power amplifier under con- eration, such distortion of the individual cycles is not important as it is *high frequency* distortion, which is suppressed in the tuned circuits and finally eliminated together with the carrier in the process of detecting to obtain the audible signal or program. It is important only that the envelope of the wave, which represents the modulation, be undistorted and this is assured if the effective high frequency inputs and outputs are proportional over the range of modulation. A substantially straight line relation between zero and the peak output required may be obtained and such a characteristic is shown in Fig. 4. This is the dynamic characteristic of a vacuum tube operating as a radio frequency amplifier and connected to a proper output circuit.

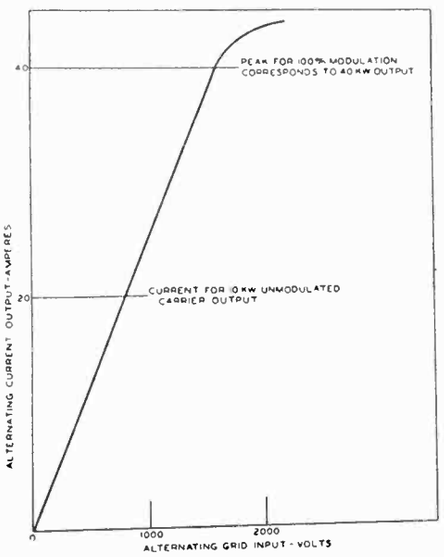

Fig. 4—Linear relation between input and output of correctly designed and operated transmitter.

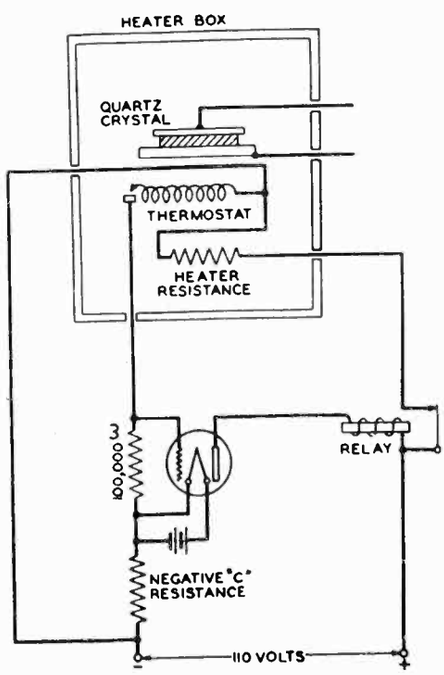

Fig. 5—Method of maintaining constant temperature in crystal housing

A high degree of modulation is made possible by providing sufficient audio frequency power to vary by the required amount the output of the tube in which modulation takes place and by providing in any following amplifiers sufficient capacity to handle the resulting power variations. This is accomplished in the 50 kw. (see Fig. 6) transmitter by using a relatively large tube as an audio power amplifier and employing on the plate of this tube a voltage twice as great as that used on the plate of the modulating amplifier tube, the two plates being fed through choke coils and coupled by a condenser which blocks the direct current but allows the output of the voice frequency amplifier to increase and decrease the output of carrier frequency from the modulating amplifier tube. By this arrangement it is possible to very the output of carrier frequency current in accordance with the demands of the program up to 100 per cent as a maximum.

Modulation is accomplished at low power in the 50 kw. transmitter; that is, most of the amplification takes place after modulation. The effectiveness of increased modulation in reducing interference by noise is particularly great as a certain amount of the noise brought in by the receiver is "beat in" by the carrier. This is because any electrical

disturbance whose frequency differs from the carrier by an audible amount will beat with it in the receiver to produce, upon detection, an audible signal or noise. This noise is proportional to the carrier power so that a minimum carrier to produce the desired useful signal entails minimum noise. For a given carrier power with 40 per cent modulation the sideband power is less than one-fifth of what it is with 100 per cent modulation. This means that the ratio of speech-to-noise level at the receiver is more than twice as great for 100 per cent modulation as for 40 per cent, and indicates clearly the importance of this feature of the modern transmitters which permits maximum utilization of the carrier power.

Problem of frequency control

Freedom from interference between broadcasting stations is as essential for good reception as freedom from noise and improvement in this respect has not been lacking. With broadcasting channels only 10,000 cycles apart it is essential that the carrier frequency be held very closely to its assigned value. If this is not done, there may be interference between adjacent .channels, and noise and annoyance to those listening in. Such interference is of two types: Either a beat note of a frequency equal to the difference between the two adjacent carriers, or cross-talk between the two programs. With a 1,000,000 and a 1,010,000 cycle carrier, for example, 0.2 per cent increase in the lower frequency and a similar decrease in the upper will produce a beat note of about 6,000 cycles. Cross-talk may also occur with relatively small deviations in frequency. Federal requirements are that the assigned carrier frequency be maintained to within 500 cycles. This is a variation of only 0.05 with a 1,000,000 cycle carrier, and not only is it difficult to maintain such constancy by manual adjustment but it is difficult to measure and detect such small deviations.

The problem has been very satisfactorily met by the use of piezo-electric crystals to control the carrier quency. The difference in thickness of a crystal c sponding to an appreciable change in frequency is small, e.g., only eight-millionths of an inch differen thickness will shift the normal frequency of vibra by 100 cycles. As small temperature changes pro frequency changes of comparable magnitude, some f of temperature control is generally required. To tain the required sensitivity it is desirable to re the current through the contacts of the thermosta a very small value and for this purpose a vacuum relay, shown in Fig. 5, has been devised. It is poss with this apparatus to hold the frequency of the o lator to within a very few cycles—far below the cycle requirement.

In the 50 kw. Western Electric transmitter all circ are completely shielded by copper enclosures to pre the radiation of harmonics directly from tuning coils leads and where the transmission line, which feeds antenna, emerges from the transmitter enclosure spe circuits are employed to keep harmonic voltages fron So successful are these precautions that the effec radiation of second harmonics is less than .00001 cent of the carrier power or 5/1000 of a watt with kilowatts of carrier.

The best broadcasting transmitters of today, in ac tion to transmitting the range of frequencies requi for satisfactory programs, thus show decidedly increa capabilities over the transmitters of a few years a Freedom from noise and interference has been affor to a great extent in radio broadcast reception by employment of greater power at the transmitters, m complete modulation, and accurate frequency cont By the reduction of noise, originating both within without the receiver, and by the prevention of interf ence with adjacent broadcasting bands, a much be grade of reception is secured and the illusion of actual presence of the entertainment being broadcas more nearly attained.

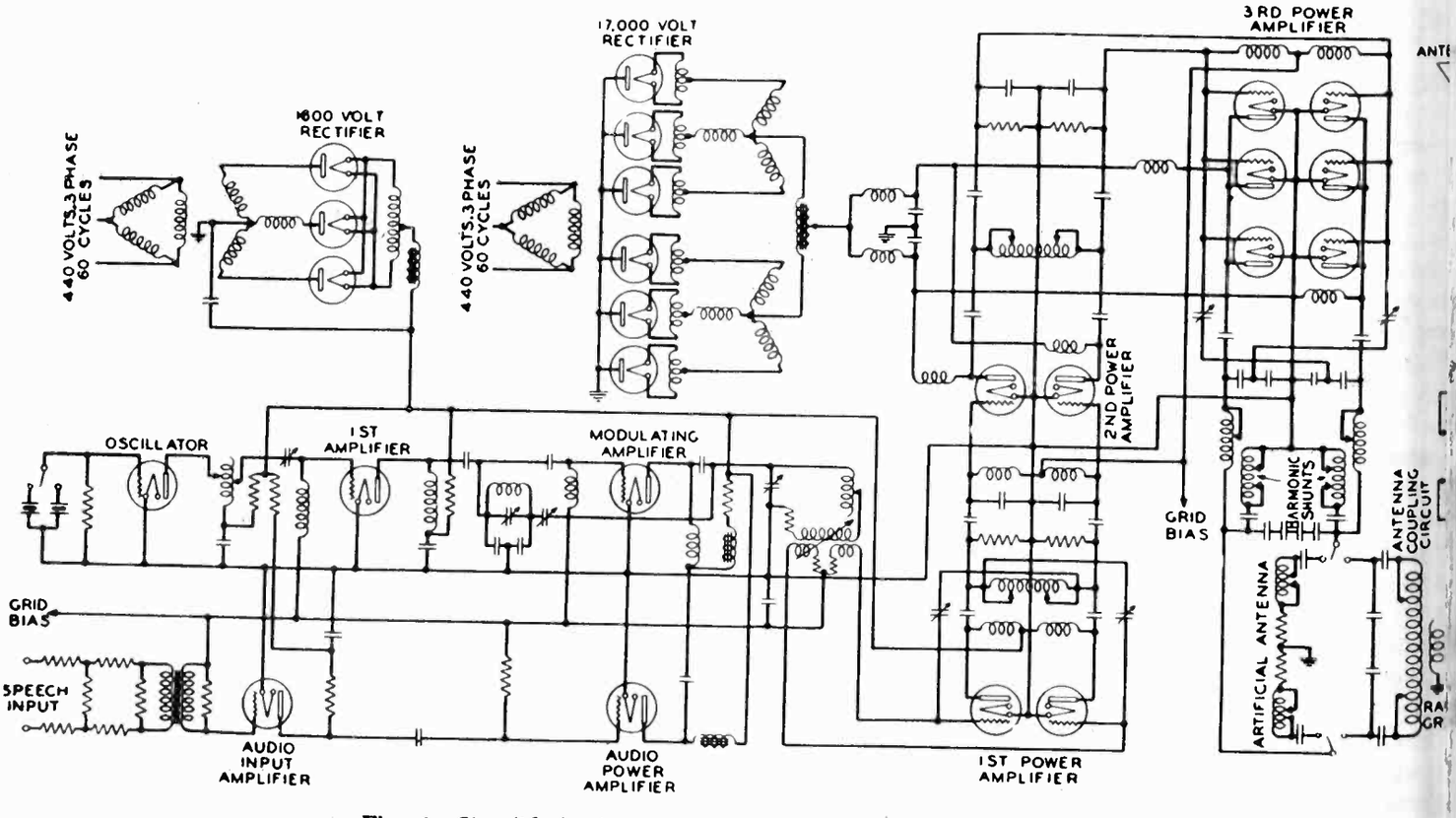

Fig. 6—Simplified schematic of high power broadcasting transmitter.

A new power amplifier with a positive grid-bias

LINCOLN THOMPSON

Wm. H. Bristol Talking Picture Corp.

THE ability of the grid of a vacuum tube to control the flow of electrons from the filament to the plate without taking any material current itself, has made the vacuum tube adaptable to the amplification of signals extremely low in energy. When the grid of a three-element tube is at a potential somewhat negative than that of the filament, no electrons flow to the grid, and the input impedance of most well-evacuated tubes is of the order of many millions of ohms at the audio-frequencies to be considered.

Since the input impedance often drops to the order of several thousand ohms when its grid becomes positive, amplifier tubes have usually been operated with negative biases on their grids in order to take advantage of the extremely high input impedance in this negative grid region. Conventional tube design has, therefore, been directed towards obtaining the optimum characteristics for distortionless amplification in this region.

One of the main considerations involved has been the maintenance of a linear relation between the magnitude of the input signal and the amplified output signal. This requires a straight-line relation between the grid voltage and plate current and the familiar grid voltage-plate current characteristic of practically any good amplifier tube exhibits some portion which very closely approaches a straight line.

The class of tubes of lower amplification constant has this straight-line portion in the negative grid region, while with tubes of higher amplification constant, this portion is usually displaced toward the positive grid region. Consequently, power tubes designed for use in conventional amplifiers are of the low amplification constant type, because they are expected to furnish maximum possible undistorted output, this being only attained when full usage is made of this straight-line portion of the grid voltage-plate current characteristic.

Use of high-mu output tubes

In the system to be described, tubes of relatively very high amplification constant are used as power tubes, and they are operated at zero or positive biases.

These tubes of high amplification constant have two advantages: First, that of greater gain, and, second, that of a higher output impedance. In order to illustrate these facts, the conventional 250 tube will be compared with a tube of the same mechanical size used in this new system and designated as the 530. The main difference between these tubes is that the 530 has a finer grid structure and, consequently, a higher amplification constant.

At zero grid and 450 volts on the plate, the plate current of the 530 is about 55 milliamperes, the same as the 250 at 84 volts negative. The amplification constant of the 530 is 19, while that of the 250 is 3.8 and the plate impedance of the 530 is 6,000 ohms at zero grid and 450 volts on the plate against 1,800 ohms for the 250 at normal bias and a plate voltage of 450. The mutual conductance of the 530 is 3,200, while that of the 250 is only 2,100, due to the fact that the plate impedance of the 530 at zero grid is lower than if it were biased. Due to its higher mutual conductance, the 530 has a steeper characteristic than the 250, but otherwise the curves are exactly similar, excepting that the 530 is displaced toward the positive grid region.

The available plate current swing of the 250 in either direction is the same as the 530, namely, 55 milliamperes. Therefore, it is evident that, with the same plate-current swing available from each tube, the available power output from the plate circuit will be in the ratio of their output impedances, or about 3⅓ times greater with the 530, other factors being equal.

Special circuit requirements

However, if any tube is operated at zero grid, it is obvious that, unless some special system of operation is devised, distortion will occur. When the signal swings positive, grid current will flow, tending to reduce the signal voltage, while when the grid swings negative, no grid current will flow and the signal voltage will be unaffected. This distortion practically amounts to rectification and is extremely unpleasant to the ear.

However, by interconnecting two matched tubes properly when an applied signal swings positive, current flows

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Circuit engineers have made occasional attacks upon the positive region of a tube's grid characteristic. On May 8, 1930, before the Society of Motion Picture Engineers at Washington, D. C., Mr. Thompson described the operation of an amplifier which uses tubes with a zero or positive bias. Such a development is of fundamental importance to the electronics field. Special tubes are required for this amplifier which delivers more power output than the conventional systems. In these tubes use is made of secondary emission. They were designed and built by Mr. Joseph B. Zetka.

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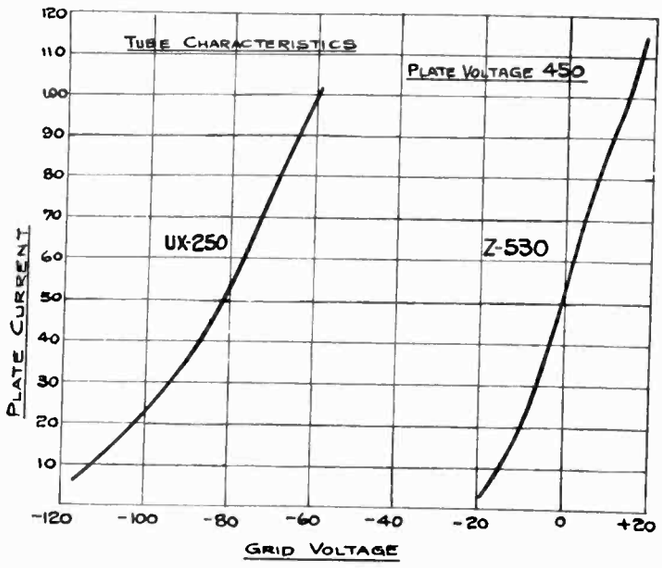
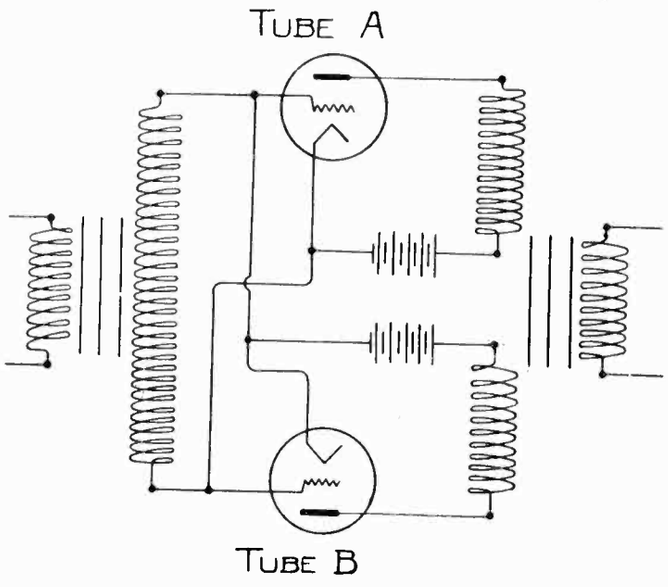
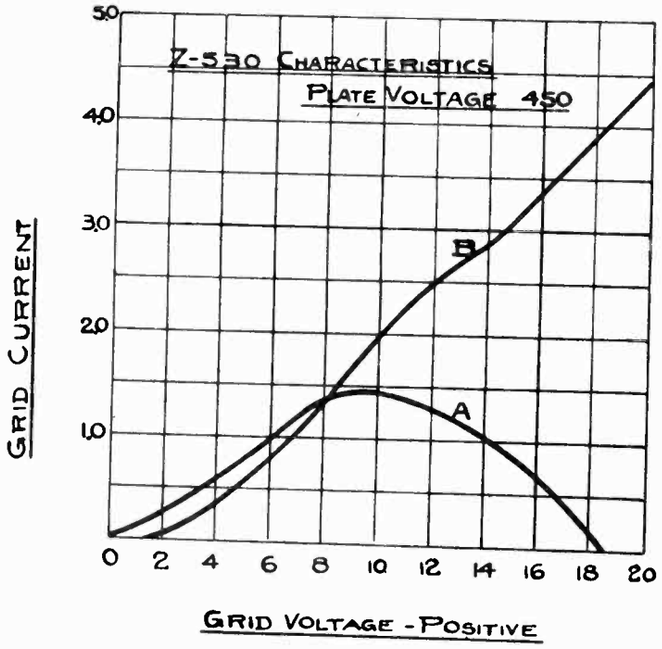


Characteristic of standard low-mu output tube compared with that of high-mu output tube of new type



Circuit diagram of the new power amplifier.



Grid currents in tubes of two types, one with considerable secondary emission, and the other in which the secondary emission is controlled.

in the grid circuit of Tube *A*, since the grid is pos with respect to the filament, but not in the grid ci of Tube *B*, since the grid is negative with respect t filament; but when the signal swings negative, cu flows in the grid circuit of Tube *B* and not in tha Tube *A*. If the *Eg–Ig* characteristics of the two t are matched, equal positive and negative swings of signal will produce equal flows of current in each circuit, and the reflected load on the signal source the positive pulsation will be equal to that for the n tive pulsation. Consequently, the positive and nega half cycles of the signal are subjected to equal conditi

If the *Eg–Ig* characteristic for each tube wer straight line starting from zero, it is evident that combined grid circuits would function like a p resistance. In other words, equal positive and nega pulsations would not only cause equal flows of grid c rent, but a linear relation would exist between amplitude of the signal voltage and the grid current p duced by it.

In the design of the tubes for this system, it therefore necessary to produce as nearly a straight-l grid voltage-grid current characteristic as possible.

Effect of secondary emission

The structural constants of the tube such as plate-grid spacing, grid-to-filament spacing, grid surface a grid material affect the shape of this curve due to th effect on secondary emission from the grid. Wh secondary emission occurs, secondary electrons are bei ejected from the grid by the primary electrons from t filament. If this velocity of ejection is sufficiently gr to project them into the region where the electro-sta field of the plate is stronger than that of the grid, th add to the stream of electrons entering the plate. T net grid current under these conditions is represented the difference between the primary electrons entering t grid and the secondary electrons which join the stre to the plate. Consequently, secondary emission infl ences the net grid current considerably and is a power factor in determining the shape of the grid voltage-g curve. Excessive secondary emission may produce current curve like that of Curve *A* in the illustrati which shows a point where the increase in secondary el trons cause the grid current to decrease as the potential increased, and finally, the secondary electron curre equals and exceeds the primary electron curre reversing the direction of the net current. Curve shows a standard 530 and it will be noted that the cur is quite straight except for a slight bump. Tubes wi no secondary emission from the grid tend to give curv characteristics following something between the clas 3/2 power law and a square law, but carefully co trolled secondary emission from the grid serves straighten the characteristic.

Another important factor in the lower part of the cur toward zero grid is the filament voltage, a lowered fi ment voltage causing a straighter curve. Since zero g is referred to the negative end of the filament, the g will not be positive with respect to every part of t filament until its potential exceeds the voltage dr across the filament terminals. This produces a lo curved portion in the grid voltage-grid current characte istic which is shortened by decreased filament voltage.

As a result the standard 530 has a 3.5-volt 2.5-ampe filament, instead of a 7.5-volt, 1.25-ampere filame

[Continued on page 162]

NEW BOOKS ON ELECTRONIC SUBJECTS

...io and its future

...ted by Martin Codel. New York: ...per & Brothers, 327 pages. ...e $4.

...COMPILER HAS rendered a real ... to the radio art by getting a ... of authorities to contribute into ...olume summaries of their best ... on the radio topics in which they ...specialized. Beginning with the ...history of broadcasting by H. P. ..., the chapters are sponsored by ...h personalities as David Sarnoff, ...al J. G. Harbord, Hiram P. ...n, John V. L. Hogan, Dr. A. H. ...lr, Dr. J. H. Dellinger, Dr. H. E. ... Senator C. C. Dill, Senator James ...ns, Captain S. C. Hooper, U.S.N.; ...al G. S. Gibbs, U.S.A.; Roy Dur... M. H. Aylesworth, O. H. Cald... etc., with a closing chapter of ...pecy by Dr. Lee DeForest.

...s closing contribution, one of the ...interesting in the book, discusses ...of "the things around the corner." ...I cannot conceive of television ...mating the motion picture," writes ...DeForest. "The two serve totally ...ent ends. Television . . . will ...e spontaneous presentation—flashed ...ce the audience for immediate en...ent or enlightenment—born and ...in a fraction of a second. The ...on picture . . . is recorded per...ently and made available to any audi...at any time and any place. . . . ...s as the phonograph industry has ...rd hands with the radio . . . ...ust television and the motion pic... join hands in the future."

...r. DeForest goes on to speak of ...soceanic radio, its competition with ...e communication and its future use ...facsimile transmission of pictures. His chapter ends, as does the book, with the observation:

"And with all that I have here mentioned, I still believe the story of radio's future is far from complete. There are so many fields to which radio technique can be applied—in geology for the locating of mineral deposits; in agriculture for accelerating plant growth and for exterminating insect pests; in diagnosis and medicine because of the peculiar curative properties of certain high frequences; in surgery because of the proved value of the radio knife, which sears its way through flesh, cauterizing as it goes; in fine measurement work in the laboratory.

"Indeed, no man can prophesy the future of radio with any degree of success. Prophecy is at best a wild guess—and that is precisely what I have attempted to do, . . . perhaps much too mildly, despite my avowed intention of being rash in my predictions."

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Collected researches

The National Physical Laboratory, London, Vol. 21, 1929. His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2. Price, about $5.50.

A COLLECTION OF twenty-one papers giving the work of a number of research physicists at the well known English Laboratory. The subjects all relate to radio, the vacuum tube, crystal-apparatus, inductance standards, etc. Some of the more important and useful subjects are: Construction of a mutual inductance standard; precision method of comparing unequal mutual inductances at telephonic frequencies; shielded non-inductive resistances; method of measuring very small capacities; cathode-ray method of harmonic comparison of frequencies. The great volume is a most excellent example of bookmaking as well as a valuable treatise.

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Radio receiving tubes

By James A. Moyer and John F. Wostrel, New York; McGraw-Hill Book Company. 292 pages. Illustrated. Price $2.75.

THE MAN who wants to study the operation and construction of vacuum tubes will find this a useful book. The theory of electronic action is clearly explained, methods of testing tubes are described, and the operation of tubes as detectors, amplifiers, and sources of oscillation are fully discussed. A valuable chapter covers detail specifications for tubes, and is illustrated with characteristics of representative types, and with circuits for commercial tubes.

An interesting part of the book discusses special industrial applications. Among the uses of vacuum tubes described, outside of radio transmission and reception, are: Methods of weighing and measuring with radio currents; moisture and temperature control; telephone repeaters and amplifiers; airplane control and communication; electrical prospecting; and machine and elevator control.

The widening uses of the tube are clearly appreciated by the authors, who close one of their chapters as follows: "Addition of the grid as a part of the radio vacuum tube produced a device of enormous possibilities, giving the vacuum tube the same importance as the steam turbine, the Diesel engine, the dynamo, and the telephone."

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THE COMING OF THE ELECTRONIC AGE

The vacuum tubes give us direct control of fundamental energy, the electron. The significance of this fact can hardly be grasped today. Developments are crowding so rapidly it is difficult to get a detached perspective and predict beyond the immediate future. Certain it is that through "electronics" will come changes vitally affecting our everyday life. It is conceivable that these changes may be so far-reaching that this will be called the Electronic Age.

WALTER E. HOLLAND

Chairman Engineering Committee, Radio Manufacturers Association

Acoustical engineers hold symposium on loud speakers

THE third meeting of the Acoustical Society of America was held in New York May 9 and 10, with Dr. Harvey Fletcher, president, in the chair. Many interesting subjects were presented covering noise surveys and effects of acoustic phenomena. A summary of the papers presented on loud speakers is given as being of most interest to the readers of *Electronics*.

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Loud-speaker sound-pressure measurements

EDWARD W. KELLOGG
RCA Victor Company, Inc.

METHODS of taking frequency-response curves of loud speakers have tended to become prematurely standardized within commercial organizations, and inadequately standardized in the industry as a whole. Characteristics taken by different experimenters are not comparable. Each may have a good defense to make of his system, and such discussion should be "A free for all, and not a private affair." More general discussion would promote education if not standardization. A critical attitude on the part of all is desirable, and a demand that published curves be accompanied by information as to the method of test.

Two valuable contributions on the subject have so far been published (Bostwick *Bell Syst. Tech. Jour., Jan., 1929*, and Wolff & Ringel *Proc. I.R.E., May, 1927*, in which the results obtained by several methods of test are compared. This paper makes additional contribution to the experimental evidence, suggests some other methods of measurement, and criticises the several methods from a theoretical standpoint. One of the difficulties arises from the fact that it is desired to show a single curve whose flatness is an indication of the general merit or fidelity of the loud speaker, whereas the differences in directive properties as well as in total sound output make it impossible to describe the properties of a speaker in a single curve. Only in so far as it is possible to s the exact conditions under which the loud speake be used, can such a single curve have significance.

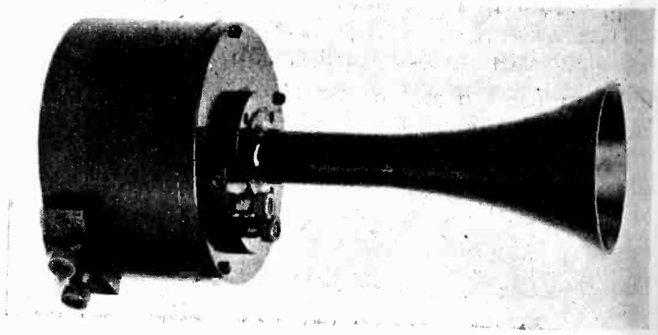
▼ ▼ ▼

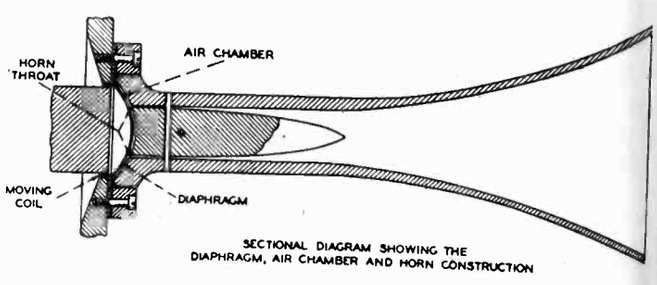
An efficient loud speaker at the higher frequencies—

L. G. BOSTWICK
Bell Telephone Laboratories

THIS paper describes a loud speaker designed use as an adjunct to existing types for the pur of extending the range of efficient performance to 1 or 12,000 cycles. A moving coil piston diaphr structure is used in conjunction with a 2,000 cycle off exponential horn having a mouth diameter of a 2 inches. Motional impedance measurements on loud speaker indicate an average absolute efficienc about 20 per cent within the frequency range from 3 to 11,000 cycles. The variation in response within band does not exceed 5 db. By using a high freque loud speaker of this type, the efficiency and power pacity of the associated low frequency loud speaker be improved and a uniform response-frequency cu from 50 to 12,000 cycles can be obtained.

The angle subtended by this new speaker is 90 deg so that one speaker would usually take care of an au torium. This speaker is intended to be used in conj tion with a speaker covering the lower audible frequ cies. The two speakers are connected to the cir through a special electrical filter designed to allow a cut-over from the low range audible speaker to high audible frequency speaker at 3,000 cycles. Th is no noticeable shift over to the ear from the low to high frequency speaker at this point and the measu response curve shows a smooth curve over the ent range.





SECTIONAL DIAGRAM SHOWING THE DIAPHRAGM, AIR CHAMBER AND HORN CONSTRUCTION

Loud speaker designed by the Bell Telephone Laboratories, which operates over a frequency range from 3,000 to 12,000 cycles. Top view shows complete unit; lower view, cross-section

cted radiation of sound
n loud speakers

IVING WOLFF
CA Victor Company, Inc.
OUIS MALTER
CA Photophone

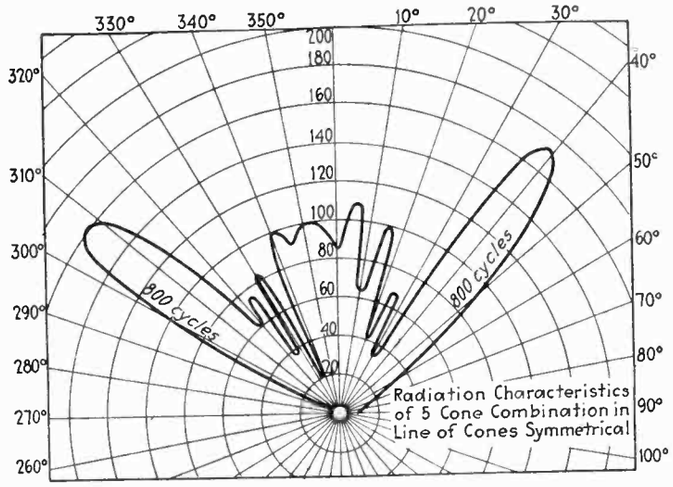
E OF the important factors which is a measure f loud speaker performance is its directional char- tics.

h directional characteristics desired depend upon nditions under which it is to be used. Thus loud rs to be used in the home should radiate uni- r throughout a hemisphere, whereas, loud speakers used in a theater or out-of-doors should possess a teristic, uniform for all frequencies, whose limits sarply defined by the edges of the audience.

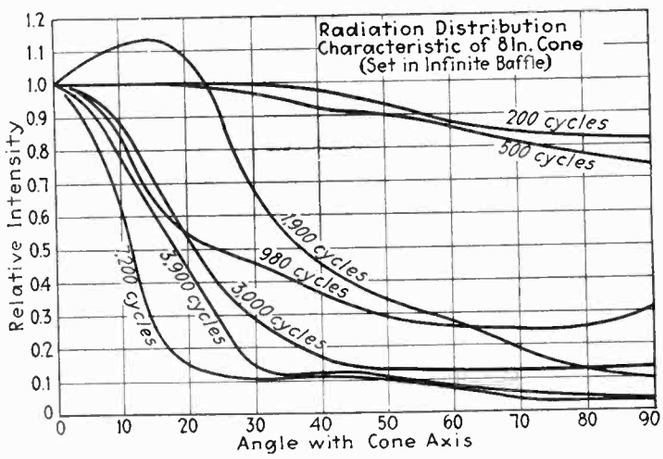
heoretical study is presented of the distribution teristics of combinations of point sources, of line rces and combinations thereof, and of surface rces. General and specific types of sources are con- rd. Uniform and non-uniform intensity and phase utions are treated. From these theoretical con- rtions it is possible to determine the type of sound re which is most suitable for use under specific lions.

ual distribution characteristics of experimental and mercial types of sound reproducers for use in the me or in theaters are presented in graphical form. es experimental results are compared with the pre- y obtained theoretical results. The degree to c the initially outlined conditions are satisfied by mmercial devices is discussed.

me 30 diagrams are used to illustrate the theoretical measured values obtained for a wide set of condi- ns. The resulting curves show the importance of di- tinal characteristics of loud speakers in considering use under varying conditions. The curves shown e accompanying view are typical for the conditions ned.



Radiation characteristics measured with 5 cones in line equally spaced, distance apart equal to diameter of cones



Measurements made with 8-in. cone mounted in a box which is buried in ground with edge of cone flush with the surface

ory of the electrostatic loud speaker

C. R. HANNA
Vestinghouse Electric and Manufacturing Company

THIS paper a mathematical analysis is given which ows the ultimate theoretical efficiency that may be ned with an electrostatic speaker having a pure stance radiator and covering a given frequency range. substitution of reasonable values in the final equa- indicates that efficiency between 5 and 10 per cent some day be obtained with good fidelity of re- duction.

the electromagnetic driver the force per unit cur- has been shown to be a function of the inductance the negative stiffness resulting from the presence he steady magnetic field. In this paper it is proved the force per unit voltage in the electrostatic device similar function of the capacity and the negative ness due to the steady electrostatic field.

new concept called motional admittance is intro- ed for the electrostatic loud speaker and this is shown e similar in its mathematical form to the motional edance of the electromagnetic driver.

A concatenated cone speaker

A. V. BEDFORD
Research Laboratory, General Electric Co.

IT IS evident that if a speaker is to show great fidelity of reproduction of sound in all directions from the speaker, it must generate the *same* shaped waves for all frequencies. The generation of plane waves would require for the lower frequencies, a uniformly driven surface very much larger than is considered practicable for general use. (Dr. Hewlett's speaker is a good one of this type.)

The simplest means of generating a spherical wave apparently would be to use a piston whose diameter is smaller than the wave length of the highest frequency sound wave to be generated. However, a piston which is small enough to fill this requirement on 5,000 cycles per second would have to move an absurdly great distance (several inches) at the lower audio frequencies to produce sufficient sound.

This paper discusses and gives the results of tests on a new multiple cone structure speaker which changes its effective size so that it is practically a point source for all frequencies. The transition from one effective size to another is made smoothly and in such a way that no major variations in response occur due to either interference or resonance.

electronics

McGraw-Hill Publishing Company, Inc.
Tenth Avenue at 36th Street
New York City

O. H. CALDWELL, *Editor*

Volume 1 — JUNE, 1930 — Number 2

Safety on the scouting line

IN modern fleet movements, aircrafts are sent aloft at dusk to scout ahead for a hundred miles to insure the absence of enemy craft during the night's run of the main fleet. At daybreak, the search is repeated to prevent the element of surprise which is always to be avoided in good strategy.

What we need in certain fields of business today are a few more far-sighted scouts, to be sent aloft at dusk and daybreak to chart a safe course of action.

Perhaps when such a solution is realized we can avoid such common ills as overproduction, confusion, and litigation.

Controlling electrical machinery with electrons

THE next few years are bound to see the many and diverse modifications of vacuum tubes and their associated circuits play a larger and larger part in electrical engineering and in electrical applications generally. For in the electronic tube, the electrical designer has a versatile new tool which he can utilize in countless ways to solve the problems which still confront the art.

Electrical manufacturers are watching electronic developments closely and with keen interest. Research in their own laboratories has already pioneered the way and has produced some remarkable developments which are being made i for commercial use.

These vacuum-tube applications to indu and power purposes are not new, for they been developing slowly but substantially ov number of years. Indeed, a decade ago, the uum tube had already cast its shadow on the trical-control situation, and far-seeing engi and executives were even then shaping plans directing research to take into account this force for the control of electrical machinery. technical development has been steadily prog ing since. For contacts, relays and switches tube has many demonstrated uses. And for po transmission, it now appears likely that the uum tube may result in the design of compl new types of apparatus, all along the line.

The future of the whole electrical industry undoubtedly be written in terms of the advanc the electronic art during the next decade.

That little "e"; its big significance

EVER since *Electronics* first appeared with modern typography and advanced use of lower-case "e" in its title headings, conjecture been rife among our friends and critics as whether we were merely trying to be smart "voguish" or whether there was an underly purpose and profound significance to this la from the strict consistency of the style sheet.

The best explanation of our vagary which have seen to date, is that courteously presented our admirable contemporary, *Science News Le* of Washington, which numbers on its staff s distinguished personalities as Dr. Vernon Kello Watson Davis, Frank Thone, James Stok and others.

Says *Science News Letter* regarding us: "T title of the new magazine begins with a small " not because of modernistic typography but beca "e" is the symbol in physics for the charge of electron, fundamental to both matter and e tricity." This is a better explanation than a thing we had thought of, so hereafter, this wil our story, and we will stick to it.

Automatic volume control for sound-movies

JND engineers recognize that one of the reatest needs in sound-movie theaters today ne means of providing automatic volume ol for the reproducing equipment. A studio, spending thousands of dollars and infinite to record an excellent picture, should have definite method of insuring proper presenta- f its sound-recording art to the public.

recent development of a "squeeze track" od of recording the sound on film may be a ul solution. This method provides, in the of variable-density recording, a variable- sound track of 20 mils to 80 mils, with 40 s an "average" width. This allows a volume of plus or minus six decibels over a normal ue setting. A thoroughly practical solution ls problem for "variable-area" recording as as "disk recording," would be welcome to ublic.

College courses on electronics

NE of the most significant developments in the tube field during the past year has been ncrease in the number of special courses on ronic subjects in leading technical schools and lges.

t Swarthmore, for example, a course covering operation of electron tubes in power circuits ell as in communication fields is being given enior students in electrical engineering. In tion to multi-element vacuum tubes and cir- , a study is made of various other tubes such he "thyratron," the cathode-ray oscillograph, and cold-cathode neon tubes, gas and vacuum gnetrons, photo-electric cells, etc. In the bratory, tests cover the operation of relays, ulators, low and high-range voltmeters, circuit akers, direct-reading photometers, low-fre- ncy high-current oscillator rectifier net- rks, etc.

The work as outlined, according to Professor K. Alpern, in charge, is intended to give the student an appreciation of the physics and electro-mechanical foundations underlying the engineering operation of the tubes. In this way, it is hoped that the student will further develop his critical attitude and ability to analyze down to operation fundamentals, the requirements of existing electro-mechanical systems and the sphere of economic utilization of tube networks.

The use of vacuum and gaseous conduction tubes in power circuits is expanding so rapidly, that a basic knowledge of the principles of operation of such devices, together with their applications is indeed becoming of vital importance to the general engineer.

Wanted, a more efficient speaker

INTRODUCTION of a new series of vacuum tubes is made elsewhere in this issue of *Electronics,* together with the first presentation of their electrical characteristics.

The tubes are to consume less filament power than other tubes now available. This is their only purpose; they were designed for the vast market for radio receivers which must operate from batteries.

One tube is a general-purpose tube, the second is a screen-grid tube, and the third is a power output. It is unfortunate that a triode of given plate and filament power consumption cannot deliver more undistorted power output than the new tube (the 231-type). An output of only 170 milliwatts is far below what the average listener demands; purchasers of radio sets equipped with this tube may be sadly disappointed at the volume they secure without overloading distortion—at least with present loud-speakers.

Two new units would make the battery set deservedly popular. One is a new loud speaker, so efficient that 170 milliwatts into it will sound like 1.7 watts into present speakers. The other is a new type of power tube; one which will deliver considerably more power output than a triode and with no greater power consumption.

Is the pentode this new tube? Why does not some enterprising tube manufacturer find out?

REVIEW OF ELECTRONIC LITERATUR

HERE AND ABROAD

Multiple-grid tubes

[B. DECAUX] It is well known that the increase in the number of electrodes in a vacuum tube can effect an increase in the characteristic constants of the tube and therefore permit their better utilization; but this modification carries in its wake certain inconveniences which make it necessary to specify accurately the condition under which the advantages may be realized and the manner in which the tubes function. As examples there may be cited the tetrode, which may operate on the screen-grid or space-charge grid principle, and the pentode which may operate as a radio-frequency amplifier or as a power amplifier. The author considers in a comprehensive manner the various methods of operating multiple-grid tubes; he first points out the characteristic properties of the tube in question and then shows how the properties may be utilized, especially for radio transmission and reception.

The Tetrode: (A) Space Charge Grid. The two outstanding characteristics of this tube are (1) the reduction of space-charge effect and (2) the negative slope of the space-charge-grid current versus control grid potential. The first results in the use of lower plate potentials, diminution of resistances and increase in plate current. The second enables us to build push-pull circuits utilizing a single tube. Various applications of these ideas are shown.

(B) Screen-Grid. The two outstanding characteristics of this tube are (1) the high amplification factor and (2) the low internal capacitance between plate and control grid. The first characteristic finds application in the amplification of small voltages and the second in the amplification or generation of voltages of very high frequency.

(C) Either one of the above tubes may be used when the two grids perform different functions. The chief advantage of the tetrode over the triode in this respect is the better separation of the two frequencies or components involved.

(D) Other miscellaneous uses include negative resistance connections (Dynatron, Negatron) and combinations of the latter with the above applications (Pliodynatron).

Pentodes: (A) The radio frequency pentode may be considered as a screen-grid tetrode to which a space charge grid has been added or vice versa. This corresponds to the Ceco tube on American markets. Its chief advantages are high amplification factor with relatively low internal resistance.

(B) The power pentode in which a "stopper" grid is inserted between the screen-grid and plate of the ordinary tetrode. This corresponds to the Arcturus type tube PE 7. Its chief advantages are a relatively large power output for small input voltages.

(C) As in the case of the tetrode, there are many miscellaneous applications which are not of pressing interest. —*Revue General d'Electricité, April 5, 1930.*

✦

The behavior of electrons in magnetic fields

The best method for the determination of the drift velocity W of electrons in gases in uniform electric fields depends on the principle that a uniform magnetic field of intensity H and perpendicular to the electric field of intensity Z deflects the stream of electrons through an angle θ where $\tan \theta = HW/Z$. In gases in which the electron stream is very divergent or where a large number of negative ions are produced this relation is no longer valid. However, a magnetic field acting in the same direction as the electric field will reduce the divergence of the electron stream and this change in divergence gives a measure of W. In all, five methods of applying this new principle are described.—*Philosophical Magazine, London, April, 1930.*

✦

Cables for ship-guiding

[LABADIÉ]. The old principle was to run a submarine cable down the center of the navigable channel, currents of a musical frequency being sent along the cable and returning from the grounded outer end through the water to a submerged metal plate near the shore end of the cable. These return currents gave false indications. Modified procedure is to substitute two large metal plates submerged along the coast one on each side of the channel entrance and some considerable distance from it, connected by land-lines to the source of current, so that the return currents do not follow the channel-route. Further, the exciting source is switched alternately between these two plates so that, while the current in the cable is substantially unbroken, the return curr are broken up; and by varying the d tion of the switching, these broken rents are heard as a succession of da or of dots respectively. In its simp form the ship equipment consists frame-aerial rotatable about a vert axis (minimum signals indicating allelism with the cable) and tilt about a horizontal axis (for obtain the distance from the cable), associa with tube amplifiers and head-telephon should dots or dashes be heard inst of the steady musical note, the naviga knows on which side of the cable he and proceeds accordingly.—*Science la Vie, April, 1930.*

✦

Application of photo-electr cell to measurement of small displacements

[J. A. C. TEEGAN and R. G. KRISHNA The displacement to be measured made to open or close a slit throu which a light is focussed on a phot electric cell. The change in the qua tity of light entering the cell chang the photo-electric current which amplified and measured. The curre is then calibrated against displacem Displacements of less than 0.1 m.m. c be measured with accuracy—*Philosoph cal Society, London, April, 1930.*

✦

Best values for the output circuit of audio-frequency amplifiers

[ALBRECHT FORSTMAN] A full discu sion, largely mathematical, with t basic idea that the effective resistan in the plate circuit of the last tu should be either very much greater very much less than the internal sistance of this tube, the former con tion being suitable with triodes, t latter with pentodes.—*Funk, Berlin, April 4, 1930.*

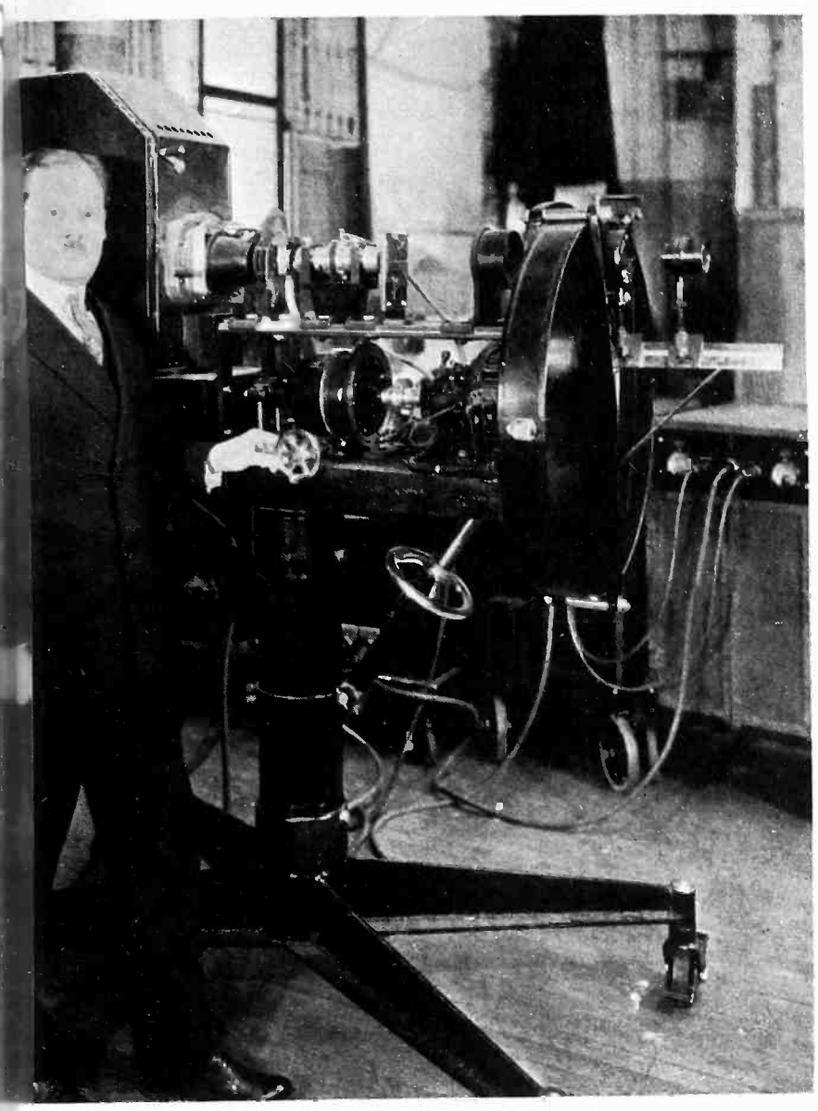
✦

New observations on short waves

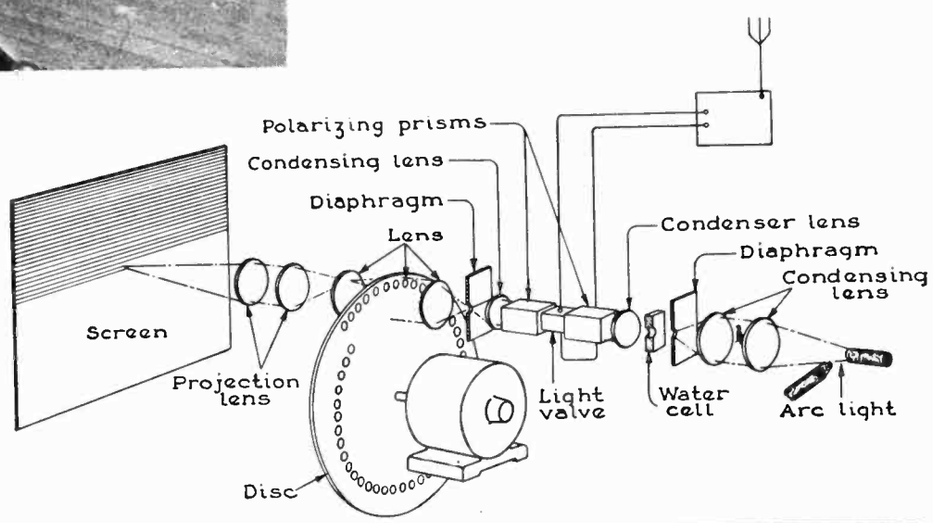
[K. STOYE]. Some suggestive expe ments on the shielding effects of hil buildings, etc., with 3 and 5-me waves.—*Funk, Berlin, 17, April 25, 19.*

Television in the Theater

An audience at a regular performance of a theater saw television images on a screen as large as six by seven feet for the first time at Proctor's Theater (RKO) Schenectady, N. Y., on May 22. Such a large reproduction was made possible by means of a high intensity arc, a new light valve, and general improvements to existing apparatus.

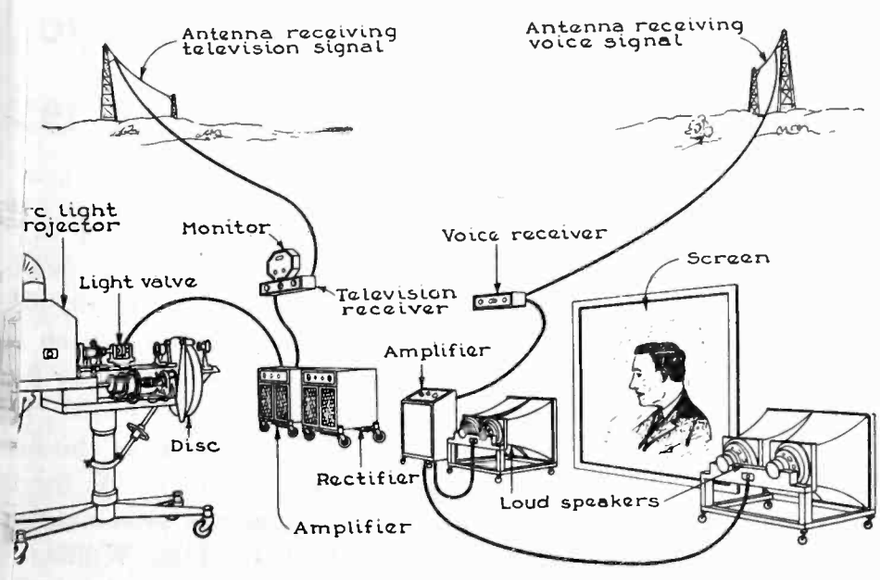


At the left is shown Dr. E. F. W. Alexanderson of the Research Laboratory of the General Electric Company, standing beside his newly developed television projector.



Right. The light valve—a Karolus cell is the heart of the system. It changes the plane of polarization of the light beam going through it by means of an electrostatic field.

Below. Complete receiving and projection equipment. The television signals are transmitted on a different channel from the audio voice or musical signals synchronized with the television image; a view of the scanning booth.



With President Hoover
at the White House, May 7

Electronics,
June, 1930

Motion-pictu
engineers a
Washingto
May 5 to 8, 193

The first meeting of the Society of
Picture Engineers was held in Wa
D. C., back in 1916, and the twenty-ni
vention was held in the same city on
of this year. The large attendance p
shown in the accompanying views.
Hoover greeted the members of the S
the White House on May 7. At the
on the same evening the prominent
included Will H. Hays, Hon. William
nery, Jr., C. Francis Jenkins, and J. I.
the president of the Society.

NEWS
THE ELECTRON INDUSTRIES

ee New R.M.A. Directors. Radio ry personnel changes have resulted anges among the R.M.A. di- ate. Upon receipt by the R.M.A. of Directors of the resignations J. Grigsby of the Grigsby-Grunow any; A. G. Messick of the U. S. and Television Corp.; and H. C. f the Columbia Phonograph Com- the three vacancies on the R.M.A. were filled by the unanimous elec- f Herbert E. Young, vice-president Grigsby-Grunow Co.; J. Clark president of the U. S. Radio and sion Corporation; and Roger J. rt, president of the General Mo- adio Corporation.

h Hygrade Lamp Company, Salem, announces that Dr. Chaffee, pro- of advanced courses in physics at rd University and recognized as thority on electronic theory as ap- to vacuum tubes, has become as- æd with the Hygrade Lamp Com- as consultant on radio-tube engi- g problems. Dr. Chaffee's name l known in the radio engineering is a contributor to the I.R.E., in monthly publication several of ighly interesting articles on the ject of vacuum-tube phenomena have ered.

old O. Braun has been made vice- ent in charge of sales of P. R. ry & Co., Inc., Indianapolis, Ind., facturers of Elkon radio products. raun is well known throughout the field and is particularly well fitted ect sales to that trade, having had years of radio sales experience in tive capacities.

e Clarostat Manufacturing Com- 285 N. Sixth St., Brooklyn, N. Y., ssued a folder entitled "Volume ol Insurance." This deals with the problems of satisfactory volume ol and how these have been solved gh specialized engineering develop- It also covers various types of ne controls in single and duo forms very conceivable single and multiple it controls.

e Dubilier Condenser Corporation, Madison Avenue, New York City, ssued Bulletin 166 for those inter- in the simplest and most economi- orm of multi-tube radio receiver, oying untuned r.f. in place of the tuned r.f. amplification. This tin deals with the untuned radio- ency transformer or Dubilier n-grid duratran recently developed, how it may be applied to modern reception in combination with n-grid tubes.

e Arcturus Radio Tube Company, ark, N. J., announces the appoint- t of C. E. Stahl as general manager. Stahl has been elected to the Board Directors. He comes to the Arcturus pany with a wide experience of the o business gained since the early s of the industry.

Supreme Instruments Corporation, Greenwood, Mississippi, has appointed district representatives in various trade localities of the country, as follows: James P. Hermans Co., 585 Mission St., San Francisco, Calif. (Los Angeles Branch, 224 E. 16th St.); James J. Backer Co., 106 Denny Way, Seattle, Wash.; Southern Sellers, 918 Union St., New Orleans, La.; Electrical Apparatus Sales Co., 10 High St., Boston, Mass.; Bruce O. Burlingame, 130 W. 42nd St., New York City; J. E. Sheldon, c/o Radio Experimenters Service Bureau, Claremont, Va.; Frank A. Baumgarten, 422 Penn Ave., Pittsburgh, Pa.; W. A. Burke, Charleston, W. Va.

The Electron Research Laboratory, Kellum Place, Garden City, N. Y., is the name of a new commercial engineering organization headed by Howard E. Rhodes, formerly technical editor of *Radio Broadcast.* Mr. Rhodes bought what was known as the Radio Broadcast Laboratory and has set this up for research on electronic problems at the address given. He is equipped to make all kinds of radio and audio frequency measurements as well as devices using the photoelectric cell.

R. P. Van Zilc announces his resignation as western sales manager of F. A. D. Andrea, Inc., to join the radio sales organization of the General Electric Company at Bridgeport, Conn.

The Pacent Reproducer Corporation, New York City, manufacturers of talking-picture equipment, through its president, Louis Gerard Pacent, has announced the appointment of Robert H. Spahn as special sales manager. Mr. Spahn, who has had many years' experience in the piano field, will direct sales for the corporation in the non-theatrical field. Coincident with Mr. Spahn's appointment to direct sales in the new field embracing clubs, schools, educational institutions, lodges, camps and similar places where sound equipment is rapidly finding favor, the Pacent Corporation started an intensive sales drive in the non-theatrical field. Mr. Spahn will have his headquarters in the home office of the corporation in the Film Center Building, 630 Ninth Avenue, New York City.

GEORGE LEWIS

George Lewis, vice-president and chief engineer of Arcturus Radio Tube Company, Newark, N. J., examines 25 Type-127 detector tubes which have been on life test over a year—16,000 hours, more than 16 years of average service

The Eisler Electric Corporation, Newark, N. J., has brought out a new 136-page catalog containing over 700 illustrations of various types of machines employed in the manufacture of radio tubes, television tubes, neon sign tubes, incandescent lamps and glass products. This catalog is described as one of the most complete of its kind and according to Michael Fox, advertising manager, has been received by the manufacturers in the industry with much interested comment.

The American Lava Corporation of Chattanooga, Tennessee, at a directors' meeting held April 7, elected Paul J. Kruesi, president, to succeed John Kruesi, deceased. Paul J. Kruesi is also president of the Southern Ferro Alloys Company of Chattanooga and a manufacturer of national reputation. Among other honors, he has served as president of the American Electro Chemical Society. He is the founder of the American Lava Corporation and his election insures the continuance of the progressive management which the company has enjoyed since it was established.

The Oxford Radio Corporation announces the removal of its factory and general office from 3200 Carroll Ave., to 2035 West Pershing Place, Chicago.

The Transformer Corporation of America, Chicago, is installing $200,000 worth of equipment for the manufacture of a complete line of fixed condensers, according to J. J. Kahn, director of sales. The line will include both bi-pass and filter condensers of various types and capacities, for both a.c. and d.c. circuits, and will meet practically all radio and general electrical requirements. Emphasis is to be placed on the electrical equipment phases of condenser manufacture. Albert O. Hauser, for five years chief engineer for Tung-Sol Condensers, Inc., formerly Brown & Caine, Inc., Chicago condenser manufacturers, has been retained to supervise the construction of the new condenser plant and processes of manufacture as well as the development and performance of the products.

The United Scientific Laboratories, Inc., 113 Fourth Avenue, New York City, has enlarged its plant and floor space and has installed much new machinery and equipment to provide for effective and rapid production of their new type S.G. shielded condensers. Pierce-Airo, Inc., a subsidiary of United Scientific Laboratories, is also increasing its facilities for the production of its new 1931 triple-screen-grid Pierce-Airo chassis.

✦ NEW PRODUCTS

THE MANUFACTURERS OFFE

This section is prepared by the editors of Electronics purely as a service to readers. Its aim is to present announcements of all new products, devices and materials of interest in the field of the paper. All items are published solely as news, and without any charge or any advertising consideration whatsoever

✦

Sensitive relay

A NEW sensitive relay for use in conjunction with photo-electric cells has been developed recently by the G-M Laboratories, Inc., Grace and Ravenswood Ave., of Chicago. This relay can be used in the conversion of photo-electric reactions into electrical impulses, thus permitting the operation of auxiliary apparatus. This relay is complete in itself, as it embodies a one-stage amplifier using standard UX 199 type tube, which makes possible sensitivity to as minute a change in light intensity as .005 of a lumen.

The manufacturers state this relay can be put to a multiplicity of uses, in conjunction with photo-electric cells, some of them being the counting of moving objects, the grading of materials according to color, inspection and testing of different products. The G-M Laboratories, Inc., also manufacture VISI-TRON photo-electric cells which are used in talking motion picture projectors when reproducing from sound on film.— *Electronics, June, 1930.*

✦

Aquadag uses in tube manufacture

THE Acheson Oildag Company, Port Huron, Mich., is the manufacturer of "Aquadag" which is a collodial solution of Acheson-Graphite in distilled water. This product has a wide variety of uses in the electrical industry. It is useful in the drawing of tungsten and molybdenum wire, where it is used as a die lubricant; serves as a "getter" in incandescent lamp manufacture; prevents grid emission in radio vacuum tubes; also as a resistance material for volume control and grid-leaks and useful as a conducting medium to make possible the electro-plating of non-conductors. — *Electronics, June, 1930.*

Screen-grid d.c. chassis

PIERCE-AIRO, INC., 117 Fourth Ave., New York City, has announced a screen-grid d.c. chassis designed to utilize a.c. tubes, to be known as Model D.C. 273. The construction of the d.c. model is the same as the Pierce-Airo A.C. 724, but designed so that with the same a.c. tubes it will operate on direct current. The chassis uses three screen-grid tubes and has specially designed selected control, tuning with highly efficient double push-pull amplification and humless filter circuit. The r.f. assembly is completely shielded with a special bridge circuit compensated antenna. Provision is also made for an automatic phonograph attachment. — *Electronics, June, 1930.*

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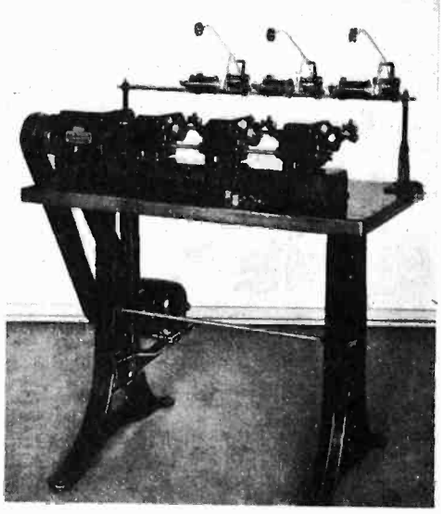
Universal winding machine

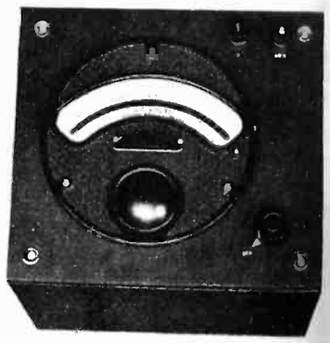
THE Universal Winding Company, Providence, R. I., has a winding machine which was originally designed for handling of headset and speaker



bobbins, but can also be utilized for the high speed spooling of molybdenum and other wires used in this industry.— *Electronics, June, 1930.*

Thermionic voltmeter

THE General Radio Company, C bridge A, Mass., has marketed thermionic voltmeter. The cab contains a UV-199 tube and both p and filament batteries. The inst ment operates on the bridge princi the internal plate resistance of the t being one arm of the bridge. Volt is applied to the voltmeter wh changes this resistance, unbalances bridge and causes a deflection on



micro-ammeter. The impedance this vacuum tube voltmeter is extrem high. Actually, it is the order of megohms which is infinity for m purposes. The meter is calibra directly in r.m.s. a.c. volts. It ha range of 0 to 3 volts. — *Electron June, 1930.*

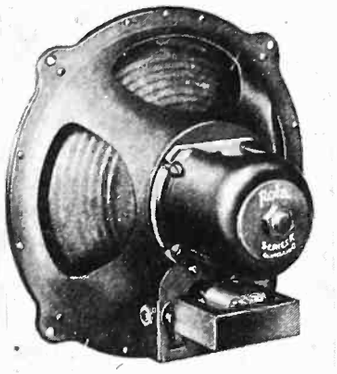
✦

Heavy duty rheostats and potentiometers

TO MEET the exacting requirem of the talking movies and other ph sound reproducing systems, and to p vide an added degree of perfection the power control of many other cuits and systems to which the w wound variable resistor is adapted, DeJur-Amsco Corporation, Broome Lafayette Sts., New York City, has troduced a new line of heavy rheostats and potentiometers. T have made several types to provide the various requirements in this field.—*Electronics, June, 1930.*

mic speaker

ACTNESS, simplicity and high factors have been attained in the "K" speaker of the Rola Com- 2570 Superior Avenue, Cleve- hio. Speaker will be furnished

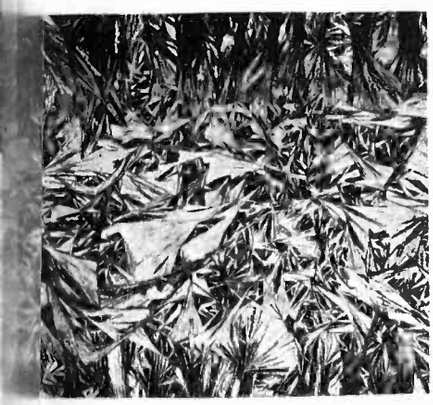


sizes, the large standard, measur- linches in diameter with a depth 5½ inches and the smaller size ing 9¾ inches by 5½ inches. It is e the speaker has a high fre- response as well as a reinforced sponse, giving it excellent tone it *Electronics, June, 1930.*

✦

corative lacquer

LICITY and rapidity of applica- cupled with an unusual decorative are features of the "Prismlac" ue developed by the Maas & Wald- Company, 438 Riverside Ave., k, N. J. Polished or smooth parts can be given a distinctive hin one coat that will air dry in bur. Moreover, in solid colors



nlac" will entirely obliterate such s as drawing marks, spot welds, marks on stamped steel parts, as xample, radio chassis and cans. material is available in clear lac- colors, and bronze finishes.— *ronics, June, 1930.*

✦

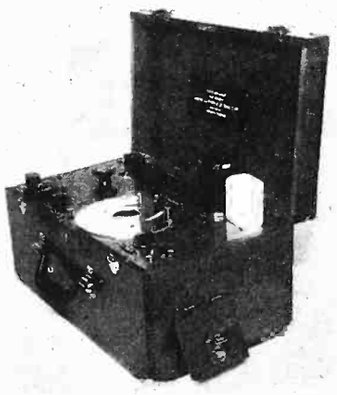
mm. sound equipment

Q.R.S.-DeVry Corporation, 333 h Michigan Ave., Chicago, Ill., marketed a 16 mm. talking picture oducing equipment. Sixteen mm. inflammable film is used and the essional size 16 in. 33⅓ r.p.m. disk turntable. It is operated off of nchronized motor which likewise drives the projector by direct drive. The entire outfit is carried in two cases. One contains the Cine-Tone itself (less the turn-table which is detached and put in the other case for convenience of carrying) and the other case carries the turntable, cords spare tube compartments, dynamic loudspeaker and amplifier. The list price of the Cine-tone, less tubes, is $500.—*Electronics, June, 1930.*

✦

Opacimeter

A NEW use for photo-electric cells and tubes has been found by the American Photoelectric Corporation in developing the A.P.C. Opacimeter, as shown in the accompanying view. This equipment is designed primarily for reading opacity of paper, glass, etc. Eimer and Amend Company, Third Ave. and 18th St., New



York City, are sole distributors for this apparatus. The operation of the device is quite simple. The percentage reading of opacity is in terms of the calibration of the sample itself. The determination of the opacity factor is independent of the color emitted by the illuminating lamps or the color sensitivity curve of the photo-electric cell. It is listed at $535, less accessories which cost $40. — *Electronics, June, 1930.*

✦

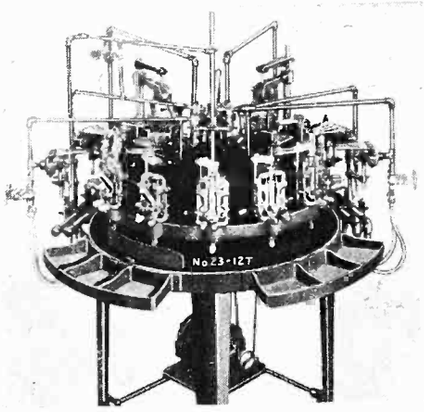
Remote control device

A DEVICE has been announced by the Utah Radio Products Company, 1737 South Michigan Ave., Chicago, Ill., which provides a complete control of a radio receiver from a point or number of points remote from the set. It consists of two units, one attached to the variable condensers of the receiver and a remote control switch box which may be connected by a cable of any desired length. The remote control switch box is 6 in. by 2½ in. by 1½ in. and may be held conveniently in the hand or placed on a table. This element contains the remote control switch for automatic tuning of nine pre-selected stations, two buttons for tuning in stations other than the nine pre-selected ones and a knob for remote volume control.—*Electronics, June, 1930.*

Twelve head automatic indexing tipless stem machine

THE Eisler Electric Corporation of 744 South 13th Street, Newark, New Jersey, offer to the market a new tipless type automatic stationary head stem machine, equipped with a new feature of tilting die block stem head.

Many novel features are embodied in this machine, such as automatic opening and closing of tipless arrange-

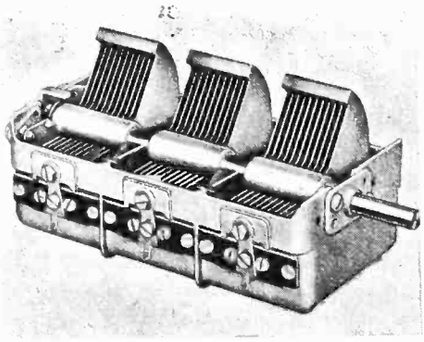


ments; automatic blowout; speed of indexing is increased so that head reaches next position very rapidly. The increased number of fires, greatly decreases shrinkage. It is equipped with flexible gas and air connections.— *Electronics, June, 1930.*

✦

Multiple condensers

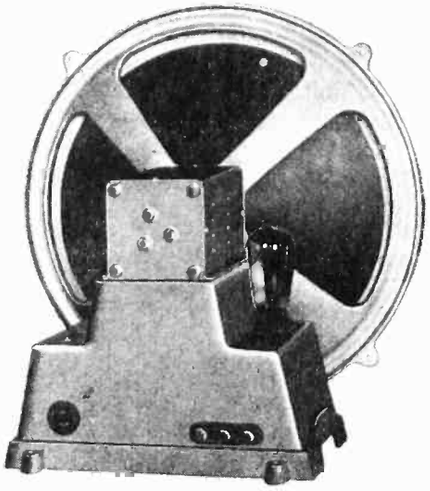
A LIGHT weight multiple condenser has recently been announced by the Hammarlund Manufacturing Company, Inc., 424 West 33rd St., New York City. The light weight and compact features are made possible by the use of a specially developed aluminum



frame, rotor and stator plates. Its compactness allows the construction of compact receivers to harmonize with the modern home setting. Surface type wiping contacts of phosphor bronze with their attendant low resistance, are connected to each rotor. The condenser is adaptable to shielding either in individual stages or as a complete unit. These condensers are made in two, three or four-gang style. They have a maximum capacity of 370 mmfd., and a minimum of 18 mmfd. This is less the capacity of the equalizers which have a minimum of two mmfd. and a maximum of 25 mmfd. — *Electronics, June, 1930.*

Dynamic speaker

THE Victory Speakers, Inc., 7131 East 14th St., Oakland, Calif., has announced two new types of electro-dynamic speakers. The manufacturers state that a single Victory A.C. 80 speaker will fill

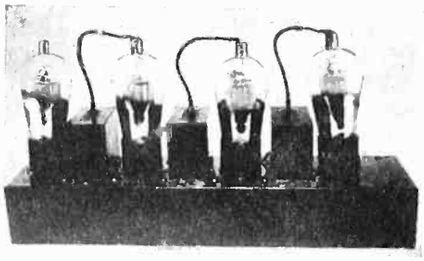


a 1,000 seat theatre with sufficient volume. This speaker uses no can around the field coil but instead, four pole pieces which go direct to four hot points on the heavy one-half inch top plate, thus creating extremely strong flux at those points, yet giving the coil a one-half inch movement. This speaker uses a 280 type tube for rectifying field current. — *Electronics, June, 1930.*

✦

Untuned r.f. amplification

A NEW fixed r.f. transformer, known as the "Dubilier Duratran" has been announced by the Dubilier Condenser Corporation, 342 Madison Ave., New York City. This transformer is designed exclusively for use with the latest screen-grid tube. In a circuit using the new screen-grid duratran, each stage represents approximately half the gain of the best tuned r.f. stage. The manufacturers claim that with the duratran stage it is possible to obtain an amplification factor in excess of 10, while the amplification curve is practically flat from 550 to 1,500 kilocycles. The circuit employing the



screen-grid duratran is relatively simple. The screen-grid duratran is thoroughly shielded, being placed in a metal container with the control grid lead shielded and grounded thereto. The untuned r.f. amplifier may be mounted on a small panel or inverted metal case.—*Electronics, June, 1930.*

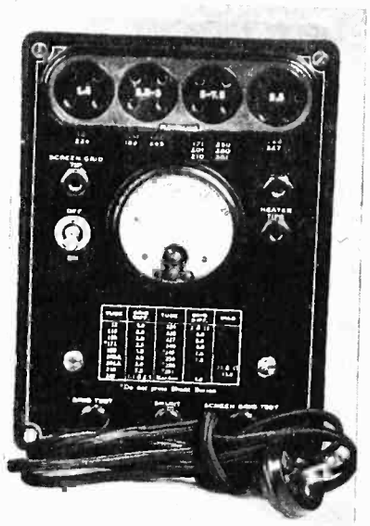
Visual monitor

THE Samson Electric Company, Canton, Mass., has recently added two devices especially designed for talking motion pictures and group address installations. The Samson visual monitor Type VM-1 has been developed to meet the needs for accurate indication of volume levels, wherever power amplification equipment is used. It is designed for rack mounting and consists of an a.c. operated vacuum tube voltmeter and gain control. This company also manufactures the Samson impedance adjusting transformer Model No. O-11 which is designed to adapt various loads to the output of a power amplifier. It consists of two identical primary windings and four identical secondary windings.—*Electronics, June, 1930.*

✦

Tube checker

THE Van Horne Tube Company of Franklin, Ohio, has announced the Van Horne-Flewelling tube checker for testing any type of tube without the use of adapters. This new device checks both plates of 280 tubes, the pentode, double screen-grid tube, and 866 mercury rectifier. The table of



normal tube ratings list all tubes in numerical order. Panels are of bakelite and are equipped with either Jewell or Weston meters. This set may be used on 60 cycle 110-115 volt a.c. circuit.—*Electronics, June, 1930.*

✦

Hook-up wire

THE Cornish Wire Company, 30 Church St., New York City, announces a new hook-up wire known as Corwico Super Braidite. In tests Super Braidite is reported to have shown average voltage breakdown of 1,340 volts against 1,000 volts for the ordinary hook-up wire. Super Braidite can be readily stripped back with any automatic stripper, and the neat appearing, glossy, flame-proof insulation does not bunch up nor fray when pushed back. Corwico Super Braidite is made in solid or stranded core in 15 color combinations. To manufacturers using Super Braidite, the Cornish Company supplies one of its A Stripping Machines.—*Electronics, June, 1930.*

✦

Electric pick-up

A NEW electric pick-up has been recently developed by the L. S. C. Company, 1800 Montrose Ave., Chicago, Ill. This device has been designed to meet the rapidly increasing demand for radio-phonograph combinations. One of the interesting features of the Gordon "D" pick-up is the construction of the pole pieces in the head of the pick-up head. These pole pieces are milled to exact dimension, and keyed to the back, thus providing a rigid assembly. The straight arm is provided with a spring which lightens the head to a weight of only a few ounces on the needle point, a feature which, it is claimed, improves greatly the type of reproduction. In manufacture the new Model "D" is carefully tested for frequency output and individually tested for tone accuracy.—*Electronics, June, 1930.*

✦

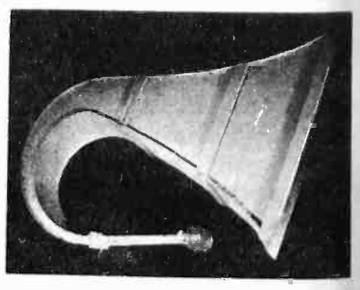
Felt

THE Western Felt Works, 4029 O Ave., Chicago, Ill., is the manufacturer of felt for radios to eliminate vibration in loud speakers and receiving sets, phonographs, turn-table discs, etc. It is also used as padding for shipping radio cabinets, instruments, vacuum tubes and other uses in this industry.—*Electronics, June, 1930.*

✦

Exponential horn

AN EXPONENTIAL horn speaker designed for outdoor use has been developed by the Amplion Corporation of America, 133 West 21st Street, New York City. In order to handle the necessary power for an outdoor speaker two tone arms have been built on a 12-foot horn in order to allow attachment of two Amplion A-102 units



These units work in tandem. The material of the horn is impervious to water, making it particularly desirable for outdoor use. — *Electronics, June, 1930.*

PATENTS

IN THE FIELD OF ELECTRONICS

A list of patents (up to May 19) granted by the United States Patent Office, chosen by the editors of *Electronics* for their interest to workers in the fields of the radio, visio, audio and industrial applications of the vacuum tube

Acoustics

rophone arrangement. Pick-up tus composed of four micro- ns arranged in a common frame. Marks. No. 1,755,484.

d speaker. Apparently, a moving stead of oscillating a diaphragm, p a column of air which is trans- to a horn by means of an inter- cting conduit of constant bore, aving a length at least one-quarter wave-length of the deepest tone reproduced. Frederick William ester, Birmingham, England. No. 460.

matic phonograph. A system of atically changing a series of records. Samuel Kohn, as- to Wonda Phonograph Company, York City. No. 1,754,897.

nograph-radio. A pick-up device ers audio variations from a record oscillator, which in turn has its ated output impressed upon the circuit of the radio system. Julius erger. Assigned to R.C.A. No. 493.

nd insulating construction. Bruno alduf, assigned to the United Gypsum Company, Chicago. No. 411.

nograph pick-up. The stylus is ed to an electrode which is in con- with a cuprous oxide electrode. el Ruben. No. 1,757,547.

amic loud speaker. Apparently a on the supporting form and used in dynamic speakers. Fred or and Don R. Seely, assigned to Radio Products Company. No. 386.

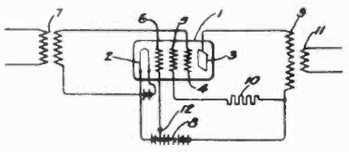
ctric phonograph motor. Three s granted to Harry P. Dorn, Cleve- Ohio, and assigned to Ray S. Gehr, r Heights, Ohio, on phonograph s. No. 1,758,189, to No. 1,758,191.

d speaker. A horn having sev- liaphragms of low elasticity spaced a portion of the length of the horn in contact with its inner surfaces. D. Harrison, assigned to W. E. pany. No. 1,757,459.

Vacuum Tubes

cuum tube. A tube containing a de and two other electrodes, one of electrodes having on it a coating hium compound, whereby the elec- is capable of serving as an efficient ter of impact electrons. Harry G. mpson, assigned to G. E. Company. 1,756,889.

cuum tube. Apparently a vacuum relay, composed of a filament h heats material which in turn closes a circuit normally electrically-dis- connected. Samuel Ruben, assigned to Ruben Tube Company, New York. No. 1,755,272. A similar patent is No. 1,755,796.



Multi-element vacuum tube. A five-electrode tube having three grids, the usual control grid located between the cathode and anode, a space charge grid located between the cathode and control grid, a third grid between the space charge grid and the control grid. According to the patent claim, the purpose of this third grid is to increase the efficiency of the tube by increasing the impedance of the electron path between the cathode and the space charge grid. John C. Warner, assigned to G. E. Company. No. 1,756,893.

Thermionic tube. A tube having filament, grid and several plates, with the input and output circuits connected with the grid and plates, respectively. The plates are energized from a multiphase source, the various phases connected to the separate plates. The source has a voltage of peaked wave form to maintain the excitation of the plate circuit at a substantially constant value. Vannevar Bush, assigned to Powell Crosley, Jr. No. 1,756,481.

Metallic vapor rectifier. A tube in which the cathode is a fluid metal on which float metallic chips. Arthur Gaudenzi and Ernst Kobel. Assigned to Aktiengesellschaft, Brown, Boveri and Cie, Baden, Switzerland. No. 1,756,682.

Electron discharge device. A cathode comprising a layer of metal having hydrogen absorbed therein, and a layer of alkali metal thereon. Lawrence K. Marshall, assigned to Old Colony Trust Company, Massachusetts. No. 1,758,710.

Screen-grid vacuum tube. Apparently a manufacturing patent involving making a tube with several stems and bringing the leads to the several elements through the various stems. Otis W. Pike, assigned to G. E. Company. No. 1,758,803.

Gas-filled tube. A discharge tube, a translucent envelope filled with a rare gas, a sodium mercury amalgam, two external electrodes one of which is connected to an internal electrode. W. F. Hendry, assigned to Manhattan Electrical Supply Company, Inc. No. 1,758,516.

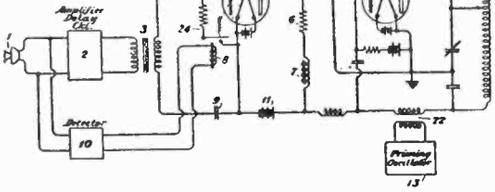
Filament-tensioning means. A means for supporting a filament under tension. The structure is so arranged that the spring tensioning device is removed from the region of the filament. Walter I. Relyea, assigned to G. E. Company. No. 1,756,882.

Tube flashing. An iron container within a vacuum tube containing a rare earth of the cerium group. At a sufficiently high temperature, the rare earth metal is vaporized, but does not react during such vaporization with its container. H. C. Rentschler, assigned to Westinghouse Lamp Company. No. 1,757,976.

Power and Oscillation Patents

Oscillation generator. A piezo-electric oscillator circuit in which the input and output circuits of the tube are coupled by the electrostatic capacity of the tube itself. The crystal frequency is the same as the frequency for which the output circuit has a high and predetermined impedance. A means is provided for starting and maintaining the continuance of oscillations. Russell F. Ohl, assigned to A. T. & T. Company. No. 1,756,130.

Harmonic producer. A grid leak and condenser detector providing rectification and therefore harmonics of a frequency of an alternating current input. In the plate circuit of the tube performing the rectification are reactant elements resonant to a pre-determined harmonic of the input frequency. Russell F. Ohl, assigned to A. T. & T. Company. No. 1,756,131.



High frequency system. An oscillator connected to a modulator and having a normal quiescent state under control of the modulator, and a means to continually apply to the grid of the oscillator a low amplitude priming wave. Ralph K. Potter, assigned to A. T. & T. Company. No. 1,758,058.

Oscillation generator. A system for deriving high frequency current from low frequency current. A crystal-controlled low frequency generator, several harmonic producers connected in tandem composed of three element tubes with a grid condenser and leak each, and a means of preventing excessive discharges in the plate circuits of these tubes, when the biasing voltage impressed upon the input circuit are below pre-determined values. Russell F. Ohl, assigned to A. T. & T. Company. No. 1,756,132.

Oscillator. A vacuum tube generating circuit, similar to what is known in this country as a Hartley circuit. R. E. Henri Chireix, Paris, France. No. 1,755,386.

Rectifier system. The system consists of a polyphase rectifier system connected to a resistance load, which is small in comparison with the total load to be applied. The external load has frequent and large variations in the amount of current desired. W. R. G.

Baker, assigned to General Electric Company. No. 1,755,859.

Oscillator modulator system. Vacuum tube oscillating circuit connected to a pair of push-pull tubes by a capacity coupling system. Henry R. Butler, assigned to General Electric Company. No. 1,755,865.

Radio receiver. High frequency receiver with conventional input and output circuits but with means of adjusting phase of anode circuit with respect to grid circuit. Hugh E. Allen, assigned to the General Electric Company. No. 1,755,091.

Static limiter. A circuit in which a vacuum tube is operated near the upper bend of its grid-voltage plate current characteristic. This tube has an aperiodic input, and an output circuit containing a rectifier and a radio frequency amplifier system. Hazen L. Hoyt and Bowden Washington. No. 1,754,557.

Systems of broadcast program distribution. An interesting series of patents granted to Edward F. Clement, assigned to Edward F. Colladay, Washington, D. C., on methods and circuits of distribution broadcast programs to a group of listeners who desire the service. Patents Nos. 1,754,875 to 1,754,882. Also Patent No. 1,755,980.

Radio volume control. Radio frequency amplifier is coupled to succeeding part of the circuit through a variable condenser whose capacity controls the volume without decreasing the stability of the amplifier. Sarkes Tarzian, assigned to Atwater Kent Manufacturing Company. No. 1,755,310.

Constant potential apparatus. Two rectifier tubes connected in a full-wave rectifying system, a filter circuit for smoothing out the pulsations and in series with the load is a relay which is responsive to rectified current and which converts the nominally inoperative load into an operative circuit. Vannevar Bush, assigned to Raytheon, Inc. No. 1,756,628.

Short wave generator. A generator where, in addition to the normal frequency, there is present a double frequency and an oscillating circuit connected in the anode circuit and tuned to the double frequency. Felix Gerth, assigned to P. Lorenz, Aktiengesellschaft, Berlin, Germany. No. 1,754,749.

Piezo electric generator. A crystal-controlled circuit comprised of a crystal in series with a variable inductance bridge across the input to a tube, and a tuned circuit in the output of the tube. John M. Miller, Philadelphia. No. 1,756,000.

Vacuum tube oscillator circuit. The circuit comprises an oscillator and a second oscillator operating at a substantially constant amplitude during a portion of the cycle of the first oscillator. Also a means for integrating the wave train which is produced by the second oscillator. Philo G. Farnsworth, assigned to Television Laboratories, Inc., San Francisco. No. 1,758,359.

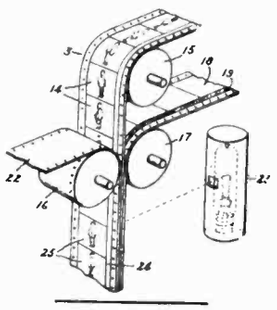
Filament supply circuit. Operating tubes in series. This interesting patent was filed in Germany in 1921, uses iron ballast resistors, a potentiometer across the filament for purposes of introducing the grid bias voltage at the proper point and a resistance across the filament to maintain the voltages on the other tubes at the proper value if one of the tubes burns out. August Leib, assigned to Gesellschaft für Drahtlose Telegraphie, Berlin, Germany. No. 1,757,318.

Polyphase Oscillator. A three-phase system consisting of three tubes, and three oscillating circuits having the same frequency. The grid circuit of each network is connected to the grid circuits of the other networks, the coupling of any two networks being between a point which is the grid potential of one network to a point in another network which is not at grid potential. Hugo Benioff, assigned to Carnegie Institution of Washington. No. 1,757,354.

Motion Pictures

Color screen. An apparatus for producing pictures in natural colors, using a rotatable disk having several color filters and shutter segments dividing the colors into two groups—one group composed of red and orange colors, and the other of red, green, blue and violet. Carl Alstrup and Viggo Jensen, Copenhagen, Denmark. No. 1,757,852.

Sound picture circuit. A light sensitive apparatus producing variations of current, a means for amplifying these current variations and a means for delaying the current through several circuits from this amplifier through several equalizing amplifiers. Clifton W. Hough, assigned to Federal Telegraph Company. No. 1,757,121.



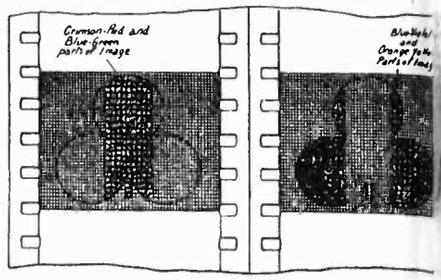
Motion picture film process. A method of impressing sound and pictures on films, consisting in making the picture record on one film, a sound record on another film and printing the two records on a third film. Charles A. Hoxie, assigned to G. E. Company. No. 1,753,863.

Color film. A method of producing a multi-color colloid film positive. John E. Thornton, assigned to John O. O'Brien, Manchester, England. No. 1,758,184.

Color film process. Apparatus for reproducing photographic films provided with nets of microscopic refractive elements for projection in colors. Rodolphe Berthon, assigned to Societe Francaise Cinechromatique, Paris, France. No. 1,758,137.

Motion picture camera. A patent filed in 1925 and composing 35 claims involving the construction and manufacture of motion picture cameras. Herman A. De Vry, assigned to Q. R. S. De Vry Corporation. No. 1,758,221.

Coated film. A manufacturing patent involving coating a strip of celluloid with a thin layer of insoluble bichromated gelatine and applying to it two strips of sensitized colloid, and a strip of porous paper. The two strips of colloid are joined together by the porous paper and formed into a single strip of film material. John E. Thornton, London, England, assigned to John O. O'Brien. No. 1,758,185.



Color film. Two patents granted John E. Thornton and assigned to J. O. O'Brien, Manchester, England, multi-colored films. Method consists dividing the original picture into component half pictures and into mosaic color-screen images and put them on each half of a double w film. No. 1,758,768, and No. 1,758,76

Vacuum Tube Circuits

Directional receiving system. A combination of a tuned directional and tuned non-directional antenna. A ra frequency amplifier is coupled to non-directional antenna and in its o put, which is common to the cir coupled to the directional antenna, reactance, and a resistance for regu ing the phase relation between the antennae. Alf Herzog, assigned Gesellschaft Für Drahtlose Telegrap Berlin, Germany. No. 1,755,180.

Level measuring set. A circuit measuring differences in volume le comprising two input circuits; a meth of introducing variable amounts of or gain in one of the circuits, rectifi in each of the input circuits and c nected across two arms of a Wheatst bridge, the other two arms of wh are two resistances. A galvanometer connected across the junction points the bridge. Eginhard Dietze, assig to A. T. & T. Company. No. 1,755,244

Tube tester. A circuit for testing vacuum tubes, which gives the inter resistance of the tube, direct readi Edward Lipson, Chelsea, Mass. 1,755,609.

Modulation system. Two electrosta condensers are arranged in series; o of the condensers varies in capacity accordance with the modulation, wh the total capacity of the circuit rema the same. James T. Coe, Stillwat Okla. No. 1,755,739.

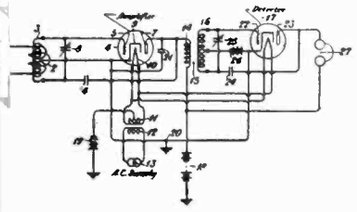
Amplifier system. Two vacuum tub connected so that the grids of the t tubes are respectively connected to t filaments of the other tubes and then the terminals of a transformer. T primary of this transformer is connect to a uni-lateral device, having a volta current characteristic adjusted to ma the grid voltage, grid current charact istics of the vacuum tube. Linc Thompson, assigned to Wm. H. Bris Talking Picture Corporation. 1,755,938.

Tuning system. A tuner for radio ceiving sets, comprising conventio inductive and capacity elements. M. Eells, assigned to Wm. Turner Lew Racine, Wis. No. 1,755,982.

Super-regenerative control. Seve amplifying stages connected in casca each amplifier coupled to the other a super-regenerative circuit. An oscil tor generates a frequency lower th the incoming signal and is coupled the amplifier stages. The ampli stages are each tuned to a higher h

PATENTS—

ithan a frequency of the preceding
R. A. Clausnitzer, Lubeck, Ger-
No. 1,754,264.



o frequency amplifier. The dia-
of this patent filed in 1924 dis-
two separate heater type tubes—
adio frequency amplifier, and the
detector. The tubes are operated
a.c. The first tube is a Rice
azed amplifier and coupled to a
tr with condenser feed-back. The
diagram and the date of this
tare very interesting. In almost
l form, it has been built by many
ads of radio enthusiasts, and has
d in one or more commercial re-
Russell F. Ohl, assigned to
& T. Company. No. 1,755,266.

ulstage audio amplifier. Trans-
coupled tubes with an arrange-
hereby the transformers can be
ed in series for reducing the ca-
coupling. Wilhelm Moser, as-
o Gesellshaft für Drahtlose Tele-
, Berlin, Germany. No. 1,757,466.

me control system. Some of the
input of the system is rectified.
gs in the rectified energy below a
frequency change the volume,
nore rapid changes in this recti-
ergy do not affect the volume.
C. Mathes, assigned to W. E.
ny. No. 1,757,729.

perature control system. Circuit
the vacuum tube to control
ature whereby a heat responsive
changes the potential on the grid
ube, thereby changing the heating
which is connected to the plate
Warren A. Marrison, assigned
l Telephone Labs., Inc. No.
7.

o transmitting system. A method
necting an oscillator to an antenna
at some frequencies the antenna
ent fed, and at other frequencies
oltage fed. Paul D. Andrews,
d to G. E. Company. No.
16.

en-grid amplifier circuit. A radio
r using screen-grid tubes in which
ble link circuit connects the tubes.
rcuits are arranged to have both
-static and electro-magnetic cou-
so that the voltage transfers will
form throughout the desired range
quencies. Burke Bradbury, as-
to G. E. Company. No. 1,758,779.

meter. Method whereby an avia-
n have indicated to him his ap-
n to an obstruction. It comprises
ding set carried by the aeroplane
ave pronounced directional char-
stics of a length corresponding to
sired height. These waves are re-
d back from the surface of the
d to the aeroplane, where a device
d to indicate when the propagated
reflected waves are in and out of phase. C. Francis Jenkins, Washington, D. C. No. 1,756,462.

Continuous wave receiver. A superheterodyne circuit. Fritz Michelssen, assigned to Gesellschaft für Drahtlose Telegraphie, Berlin, Germany. No. 1,757,325.

Push-pull amplifier. Input and output coils of this circuit are split and a condenser inserted therein. Resistances, chokes, etc., are inserted in the power lead to each half of the input and output circuit, so that each of the tubes operates under the same condition. Wilhelm Moser, assigned to Gesellschaft für Drahtlose Telegraphie, Berlin, Germany. No. 1,757,467.

Duplex high frequency telephone system. A system for the simultaneous transmission and reception of radio telephony, the transmitting system being of three phase, one phase of which is apparently connected to the receiver and used for balancing out interfering signals produced by the transmission. Robert G. Duncan, Jr., assigned to Federal Telegraph Company. No. 1,757,114.

Capacity coupling neutralizer. Method of eliminating unwanted capacity coupling in a radio vacuum tube circuit. Harold A. Wheeler, assigned to Hazeltine Corporation. No. 1,757,494.

Capacity neutralizing circuit. Introduction of a fourth element into a vacuum tube so connected in the circuit that potential variations between it and the plate are 180° out of phase with each other, by means of an inductance which is the output circuit. A tap on this inductance is connected to the positive terminal of the plate battery. Nicolaas Koomans, assigned to RCA. No. 1,757,910.

Wave trap. A coil tuned by a variable capacity and connected directly across the output circuit of a vacuum tube amplifier by means of a transformer, is used to trap out unwanted signals. R. H. Ranger, assigned to RCA. No. 1,757,333.

Fading eliminator. A system for the elimination of fading in radio picture transmission by continuing the exploring and re-assembling process until a good reproduction is obtained. Fritz Schroeter, assigned to Telefunken Gesellshaft für Drahtlose Telegraphie, Berlin, Germany. No. 1,757,480.

Capacity measuring circuit. A combination of a source of alternating current, visual measuring instruments and a rectifying device whereby the capacity of a condenser can be read directly upon the instrument. Ludwig Edenburg, assigned to Dubilier Condenser Corporation. No. 1.757,659.

Relay. A variable resistor having a negative temperature coefficient of resistance which controls the grid circuit of a valve and thereby opens and closes a relay. Abraham Press, assigned to Westinghouse E. & M. Company. No. 1,757,589.

Facsimile, Television, Etc., Apparatus

Television receiver. A television receiver in combination with variable intensity apparatus composed of a coil, having its inductance in several sections parallel to each other and enveloped by a glow discharge tube. Chester L. Davis, assigned to Wired Radio, Inc. No. 1,756,086.

Synchronous motor couplings. Motor structure, comprising a synchronous motor, a shaft, and a means of limiting the rotary movement of the rotor with respect to the shaft. C. Francis Jenkins, assigned to Jenkins Laboratory, Washington, D. C. No. 1,756,689.

Cell persistence transmitter. Several light current translating devices in series with an impulse storage element and a means for connecting the storage elements into a common circuit. C. Francis Jenkins, assigned to the Jenkins Laboratories. No. 1,756,291.

Television apparatus. Preparing an equalizing screen for a scanning ray which traverses a projection screen in such a fashion that it remains longer directed at some portions of the screen than at others, or traces lines more congested in some portions than in others. Joseph John Arnold, South Milwaukee, Wis. No. 1,756,232.

Picture transmission system. A system in which the synchronizing current impulses are superimposed upon the picture current and have a different intensity from the latter. At the receiving station, apparatus is responsive to currents of distinct intensity and therefore does not respond to the picture current if it is the synchronizing apparatus, or vice versa. Max Kagelman and Adolph Eulenhoefer, assigned to E. Lorenz Aktiengesellschaft, Berlin, Germany. No. 1,756,363.

Facsimile telegraphy. A method of transmitting pictures by dividing the picture into several parts, arranging the parts in continuous relation to form a strip, moving the strip in the direction of its length, and scanning the strip transverse to this direction. John L. Baird, assigned to Television, Ltd., London, England. No. 1,757,352.

Photo-telegraphy. Reproducing a picture by simultaneously causing a series of reader means to cooperate with several prints of the picture. Harry G. Bartholomew, London, England. No. 1,758,388.

Television system. A receiving element containing a number of intersecting anode and cathode elements enclosed in a vacuum tube and adapted to produce the desired image at intersecting points of varying brightness. Geo. Wald, Belleville, Ill. No. 1,754,491.

Miscellaneous

Telephone privacy. System whereby the important range of telephone frequencies is divided into sub-bands of such widths as to be substantially unintelligible when received alone. These sub-bands are transposed and brought together again in the proper relation at the receiving end. Lloyd Espenchied, assigned to A. T. & T. Company. No. 1,757,181.

Electromagnetic material. A magnetic material comprising a steel alloy consisting chiefly of iron and cobalt and having substantially constant permeability at low magnetizing forces, has impressed upon it small magnetizing force components corresponding to a composite signalling wave. William Fondiller, assigned to W. E. Company, Inc. No. 1,757,710.

Commutator noise preventer. Commutator of a direct-current machine is run so slowly that the frequency of commutator ripple is below the limit of audibility. Edward G. Gage, assigned to Radio Patent Corporation, New York. No. 1,754,622.