electronics

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

Looking ahead into 1933

✦

Beauty—to sell more radios

✦

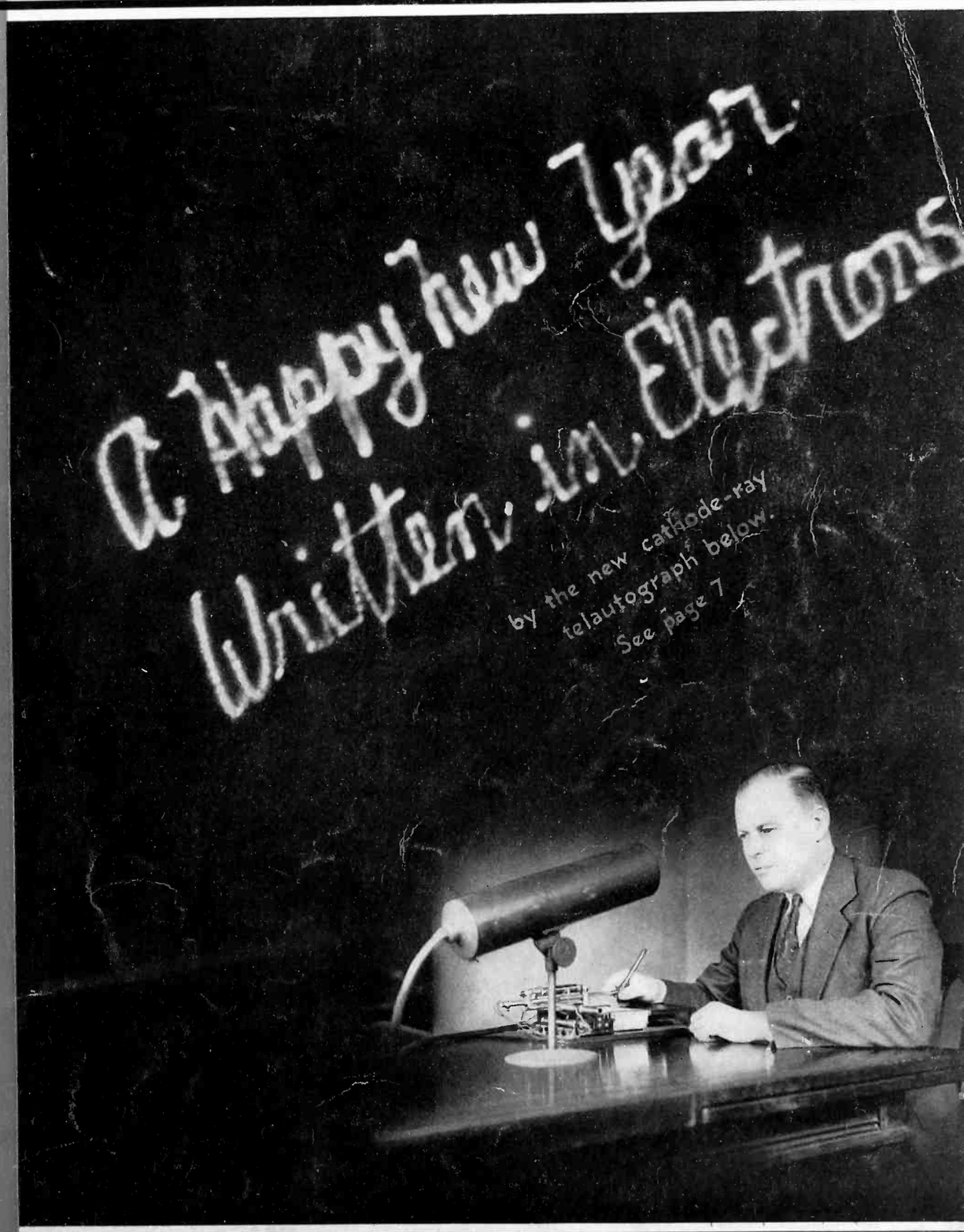
Control of sound-picture quality

✦

Auto-radio progress

✦

New circuits for automatic volume control



McGRAW-HILL PUBLISHING COMPANY, INC.

Price 35 Cents

JANUARY 1933

Electronics, January, 1933. Vol. 6, No. 1. Published monthly. McGraw-Hill Publishing Company, Inc., 330 West 42d Street, New York, N. Y. $3.00 per year, 35 cents a copy. Foreign Postage, $4 U. S. Currency or 20 shillings. Canada (including Canadian duty), $3.50. Entered as second-class matter April 4, 1930, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

electronics

McGRAW-HILL PUBLISHING COMPANY, INC.

New York, January, 1933

O. H. CALDWELL
Editor

KEITH HENNEY
Associate Editor

BEAUTY—

to sell more radio sets?

AS THE number of radio receivers in use approaches the "saturation" point, new factors of design must be introduced to restore greater appeal to the buying tastes of the public.

But so far, external beauty of color and form — controlling elements of sales in so many other lines of merchandise—have been almost overlooked in radio receivers. Consoles as a class have little charm or originality. And the infamous "tombstone" model, adopted for midgets, has been a precedent from which only a hardy few have dared break away.

▼

BEAUTY and style are two sales-creating elements which must be injected into radio sets in 1933.

Beauty creates fresh enthusiasm for any product,—provides a new basis for comparison, in place of price.

Beauty opens up new markets,—postpones the saturation point.

Beauty creates obsolescence. And it converts old customers into new ones.

Beauty is one of the least costly elements that can go into the design of a radio set. In fact, a beautiful design may be even less expensive to build than the old crude model.

But beauty is a powerful sales compellant. Its force was exemplified in the recent redesign of a table model "weather-guide." Artistically refashioned, actually twice as many weather-guides were sold during 1931, as were moved even in the golden year of 1929, when only the "engineer model" was available.

Beauty of external form, smart design, charm of appeal to women as well as men, are the intangibles which can help build back radio volume in 1933.

But such artistic design to be effective, must be the work of experts in good taste. The requisites needed are not likely to be found around the engineering drafting room, or in the painful Victorianisms of the average furniture plant.

▼

THIS year 1933 is a time for fresh ideas of design. This is the day when creative artistry must be given the same sway in shaping the external form of the radio set, as the engineer has enjoyed in perfecting its "innards."

As a stimulant to sales, beauty will prove the best 1933 investment for the hard-boiled business man intent on selling more radio receivers.

LOOKING AHEAD

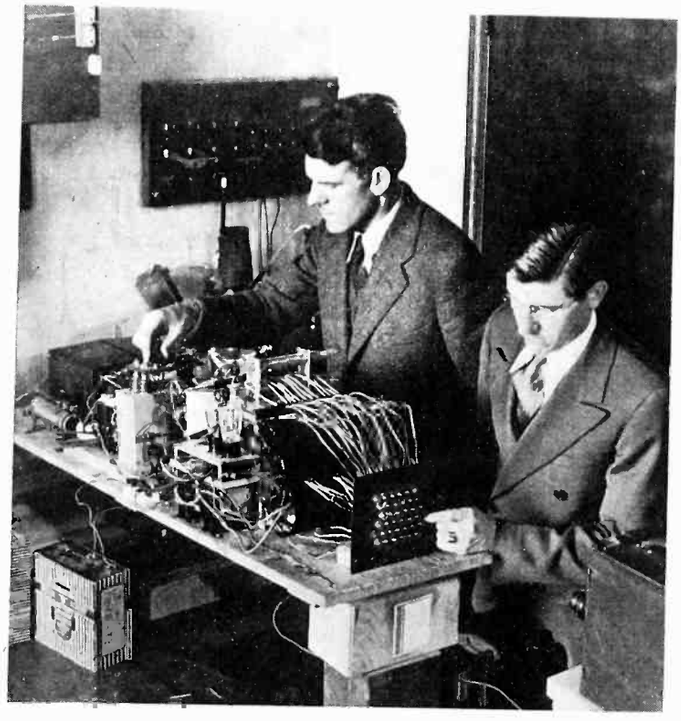
THE year 1933 is a year of new horizons in electronics. Steadily, persistently, the usefulness and variety of electronic-tube applications widen out. Meanwhile, the installations of a few years or months ago rapidly shake themselves down into regular, dependable operating routine.

It is in the ultra short waves and in television that romance still abounds; the impossible today may always be the possible tomorrow. The photocell and all its works have largely simmered down into mechanical ingenuities of use and application, while the roster of different uses endlessly expands. And the electronic tube in power and control applications, constantly finds new fields to conquer as great power currents and motor equipments rush to do the bidding of their tiny electronic commanders.

New aids to television

As 1933 opens, television is temporarily outside the center of public attention; yet perverse child that she is, television today gives more promise of performance than at any time since her theoretical discovery by Nipkow in 1888.

Development of the cathode-ray tube goes on, and several extremely satisfactory images are now regularly produced. The wizards at Camden continue to refine the equipment used with the Empire State Tower job, but have essayed no further public demonstration. At Philadelphia, Farnsworth is working on electronic scanning for Philco. At Purdue, in Indiana, George has developed excellent detail of cathode-ray-tube reception in co-operation with Grigsby-Grunow.



By means of neon lamps, this "hodoscope" invented by Dr. T. H. Johnson of Franklin Institute, traces direction of incoming cosmic rays. It was exhibited at Atlantic City A.A.A.S. convention

In the scanning-disk receiver field, Garner of Western Television is producing a receiver to sell at $75, and is offering this in Kansas City in connection with a studio service which KMBC, the Columbia outlet in Kansas City, is putting on locally. This picture is of a special character, with successive scanning of numbered alternate lines, which does not lend itself to being picked up by other standard receivers.

Meanwhile a brand-new element is injected into television in the use of Rochelle-salt crystals to modulate the light-beam, by their inherent rapid mechanical flexure, demonstrating that mechanical methods are not yet exhausted. Myers' new mercury-vapor light source, with its high luminous efficiency and ability to respond to high frequencies, has brought in still another factor for the use of future television designers.

During the year just closed considerable progress was made in exploring the ultra-high frequencies. Notable work was done by members of the Bell Telephone Laboratories, the RCA Victor Company and RCA Communications, Inc. and the Westinghouse engineers. After experiments on waves below ten meters transmitted from Camden and later from the RCA Building in New York City, two antennas were erected on top the Empire State Building. These antennas are the highest structures above ground level ever erected by man. The bases of the vertical half-wave 6.8 and 4.9 meter antennas were roughly 1,280 feet above ground. The 6.8 meter transmitter (44 Mc.) had a power of 2 kilowatts and was used for picture transmission, 120 lines. The sound transmitter of 1 kw. used the 4.9 meter (61 Mc.) antenna.

Observations made by airplane, automobile, auto-gyro and dirigible indicate that field strengths of the order of 5.5 and 3.0 millivolts per meter would be found at a distance of 4 miles from the 44 and 61Mc. transmitters respectively. At 8 miles the field strengths were 2.3 and 1.5 mv/m; at 20 miles they were 0.7 and 0.4 mv/m and at 40 miles 0.2 and 0.09 mv/m for the 44 and 61 Mc. transmitters.

Signals were heard as far away at Mt. Washington, in New Hampshire, 284 miles, and 37,600 feet below the line of sight from the top of the Empire State Building, at Montauk Point 130 miles and at Albany. At 100 miles the signals on the ground were about equal to the 284 mile signal obtained at an elevation of 6,290 feet. These signals were audible, but not much more.

Assuming a desired minimum signal of 1 millivolt for a 120-line picture, the range of the 2-kw. 44 Mc. transmitter was about 15 miles. On 8 meters a 10 kw. transmitter, 1,200 feet above the ground would deliver a one-half millivolt signal at a distance of 27 miles; on 3 meters the distance for a same signal would be reduced to 22 miles.

Interference on such waves was chiefly due to automobiles. Other sources of noise were telephone exchanges, airplanes in flight, and electric trains. It was found that a six-car elevated train would not cause as much trouble as a single automobile of a given make. Some automobiles could be heard for several blocks and all cars made some noise.

It was estimated that transmitters of 2 kw. as high as

AS 1933 OPENS

the Empire State Building should not be placed closer together than 100 miles provided high quality sound or picture transmission is desired.

According to L. F. Jones of RCA Victor who delivered one of three papers before the New York section of the I.R.E. on the subject in November, "no inexplicable phenomenon of immediate importance has yet been encountered. It is assured that for transmission of television broadcasting, sound broadcasting, facsimile broadcasting, aircraft communication, police communication, and other types of public and private communication, ultra-short waves will prove definitely useful."

Applications of photo-sensitive cells

In the industrial and commercial field, the expanding use of photocells has surprised even the enthusiasts. New applications are appearing from day to day, and a new degree of dependability is being felt for photo-sensitive devices. Important services in navigation, aviation, traffic control, elevator travel and safety protection, now employ photocells with full confidence. Meanwhile such installations as restaurant "magic doors" and elevator safety-rays, are demonstrating that they can be operated at actual money-saving compared with the expense of getting along without them. Thus a metropolitan restaurant saves enough dish-breakage to offset the carrying cost of the installation, while the speeding up of service, amounts to the equivalent of $2,500 worth of rental space otherwise needed to do the same volume of business. Elevator-door protection with photocells can be financed out of the saving in accident insurance premiums. Some 58 of these light-protected elevators are now being installed in Radio City.

Photocell applications may be expected to increase in variety and in ingenuity as new uses are found for this ubiquitous device. Expansion of the number of installations of each type of use will probably wait on the coming of better times, but progressive concerns and individuals are already showing leadership in adopting photo-electric control, counting, measuring, and color analysis.

Power uses of tubes

During 1932 there was installed a rectifier utilizing electron tubes taking alternating current from a 13,800-volt distribution system and supplying 250-volt direct current to an Edison three-wire system. This equipment is installed on the lines of the Edison Electric Illuminating Company of Boston. Previously the rectifier apparatus was given service tests carrying the load of the Schenectady trolley lines.

A new type of metal-envelope tube has been commercially developed. This hot-cathode mercury-vapor rectifier tube consists of an indirectly-heated cathode surrounded by a metallic shell which acts as the anode and as the enclosing envelope. Each of these new metal tubes is capable of rectifying 100 amp. average current at the usual commercial voltages and frequencies.

The year 1933 will see the introduction of many more types of tubes designed for radio receivers. The first of the new brood will appear early in January and undoubtedly the birth-rate will continue high throughout the year, as the result of continued research and development on the part of both set and tube engineers. Such tubes will bring to play a new order of complexity, of usefulness, or power output or amplification and serviceability. Most of them will bear numbers according to the new system of nomenclature.

Short-wave police systems increased rapidly in 1932. Now photocells detect speeders. And here's the latest, a microphone feeding loudspeakers a quarter mile away, so the policeman can instruct drivers as far as he can see them

One of the first to appear is the 25-Z-5 rectifier aimed directly at the a.c.-d.c. receivers now attracting so much sales attention. By the middle of January some fifteen other types will be announced.

Receiving sets

It is certain that renewed engineering effort will be made to bring the more expensive technical features into the cheaper sets, and to find new services for the high-class sets. A concerted effect is to be directed toward bettering the broadcast system not only from the receiver standpoint but from the transmitter as well. To that end new loud speakers, new low levels of distortion, new high levels of power output, new possibilities of control will find their way into radio sets. New microphones, new lines, new schemes of avoiding modulation distortion will be found in the better broadcast stations as the year goes on.

Already evident is a trend toward the inclusion of an heretofore alien note in broadcast furniture, the note of beauty. To date radio sets have worked well and have cost little—in the future they must look well too. This development will come during the present year.

The place of NICKEL in radio tube manufacture

By A. J. MARINO
Gilby Wire Company

Machinery in use in a nickel rolling mill

THE importance of nickel to the radio tube industry is well known. Hundreds of tons of the metal are used annually for making the plates, grids and supports that go into the fifty-odd millions of tubes used for radio receivers and for the thousands of larger tubes. There are good practical reasons why this element has become so widely used; they will be outlined below. Before listing the technical characteristics of nickel it may be worth while to state why it is the standard metal for radio tubes. They are:

1. It can be obtained in high purity at a reasonable cost.
2. Being a pure metal, it has uniform quality, and physical properties that can be controlled and duplicated without trouble.
3. Nickel does not tarnish in air, and is not corroded by handling, nor from changing atmospheric conditions.
4. It is soft and easily workable. In sheet, it can be formed into almost any shape. In wire it is easily cut, bent, and wound. Sheet can be carbonized and still remain soft enough to be shaped in automatic machines. The wire in fine sizes is readily woven into mesh which can be cut into shape for all purposes. The metal is easily spot welded and makes easy the fabrication of the tubes.
5. The melting point is high. It can be fired at high temperatures, and is readily cleaned in hydrogen gas.
6. A very important feature in the use of nickel is that the scrap commands a high price. There is always a good market for its sale.
7. Nickel forms alloys with various metals which are very important in special applications in the tube industry.

The commercial grade of pure nickel, which in the trade is called "grade A," is used in sheet form for punching and forming plates, in wire for supports, and in finer sizes for grid winding and for the manufacture of mesh for screens.

The specific gravity of nickel averages 8.84, according to the amount of mechanical working to which the metal has been subjected in the manufacturing processes. Its melting point, as given by the Bureau of Standards, is 1452° C. (2636° F.). On page 5 are its chemical and physical characteristics which make it and its alloys so useful in the manufacture of high quality tubes at minimum expense by reducing final inspection rejection losses.

Nickel in grid manufacture

Nickel has always played a part in the manufacture of grid wire, but is now taking a more prominent position by the use of its alloys in replacing more expensive materials. This has been accomplished after a considerable amount of research and development. It was necessary to duplicate in the nickel alloy certain physical properties previously obtainable only in the more expensive metals. Other studies were made to meet variable conditions found in grid-winding machines.

The manufacture of the alloys to meet conditions found in the various shapes for grids, such as round and flat types, meant, besides the composition of the metal, the control of tensile strength and elongation of the wire. Alloys which successfully have met requirements of grid manufacture are as follows:

1. Manganese nickel
   (2 per cent and 5 per cent manganese)
2. Nickel 60 per cent chromium 15 per cent
3. Nickel 80 per cent chromium 20 per cent

To obtain the full value of these alloys, care is taken in the manufacture of the wire to keep the sizes accurate within limits of 0.0001 in., truly round in shape, and uniform in physical characteristics.

Pure nickel in sheet form is used for the manufacture of plates, cups, discs, and smaller parts. The thicknesses in use range from 0.0015 in. to 0.010 in.; the widths range from 0.025 in. to 2 in. In the manufacture of the radio sheet from metal billets extreme care is taken throughout the operation to insure the attainment of proper metal structure and quality to meet the high standards necessary for the radio trade. The manufacture of this sheet requires scientific control with the best knowledge of metal practice. Machinery of high precision together with special methods of handling nickel have been developed so that at no time in the manufacture are the natural properties of the metal affected. The finished sheet is annealed in special furnaces using an atmosphere of hydrogen gas, and with temperature control and constant speeds, tempers are kept uniform.

Nickel sheet, to meet the requirements of tubes in which the plate current is high, is carbonized to increase heat radiation. The manufacture of carbonized nickel consists in chemically applying to the surface a coating of pure carbon in apparatus especially constructed to keep it uniform in quality and in thickness, it is possible to produce carbonized nickel soft enough to retain its shape after being formed in automatic machines.

Nickel for support wires

Nickel wire is used in the radio tube for supporting the various parts. It is most important that the material for this purpose be kept uniform in size and of even temper so that it can be easily formed in automatic machines. All nickel wire is annealed and cleaned in electric furnaces with hydrogen gas to eliminate foreign matter.

When a more rigid wire is necessary, an alloy of manganese nickel is used for support wire. A special soft wire is manufactured for grid supports to allow the cutting and swaging operations to be easily performed without extreme wear on the tools. This is specified in the trade as "double annealed."

In the weaving of mesh for radio screens, fine sizes of nickel wire are used, the most popular being 0.007 inch. This mesh is principally woven 60 by 60 and 60 by 40. It is possible to obtain this mesh with special edges to prevent loosening of side wires in the subsequent manufacturing processes. Carbonized mesh can be manufactured, and is used for special purposes.

Pure nickel is used as a base for coated filaments because its chemical properties make possible, by a surface reaction with the barium salts of the coating, the formation of an activated film which emits a large supply of electrons. For high filament efficiency, it is necessary to use a nickel of extremely high purity in which are eliminated certain small impurities that, because of their effect on this film, result in "low emission" and short life of the tubes.

ANALYSIS "GRADE A" NICKEL

Nickel	99.00 per cent (plus)
Iron	.50
Manganese	.30
Copper (maximum)	.18
Silicon	.20
Carbon	.10

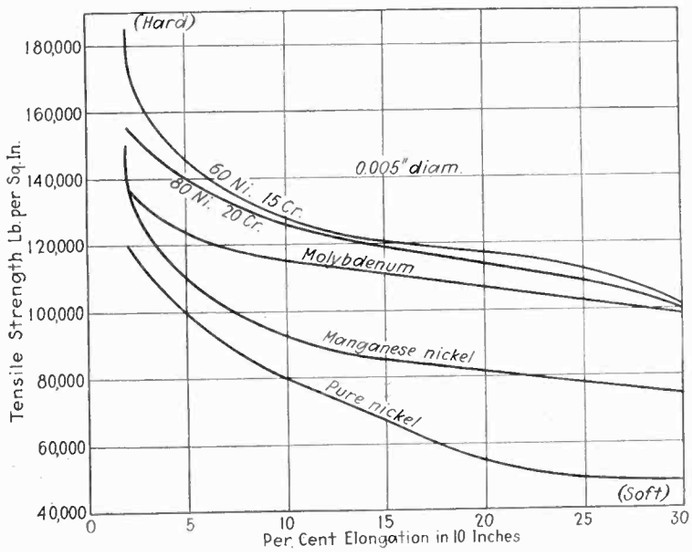
TENSILE PROPERTIES—LBS. PER SQ.IN.

Sheet	Hard rolled	90,000	110,000
	Soft annealed	60,000	75,000
Wire	Hard drawn	90,000	110,000
	Soft annealed	65,000	75,000

It is highly important to control the purity of filament nickel. To that end small melts are made so that extreme uniformity throughout the metal billet is attained. Each melt is carefully analyzed so that there is absolutely no trace of harmful elements present. Each batch of material is given a melt number and this number is supplied to the user with the nickel. This is very important as it allows a constant check by the tube manufacturer on his own processes and provides a record for checking filament performance. All of this procedure is expensive, but worthwhile since it results in higher quality radio tubes.

Nickel filament is principally used in ribbon shape. Extreme care is taken in the rolling of the material so that there is no variation in size. For certain types of tubes it is necessary to keep the tolerances on physical dimensions as close as 0.00005 inch. The rolling of filament is an operation of extreme importance, and requires the use of high precision equipment. Sizes are checked by microscopic projection using magnifications of 1,000 diameters.

The highly important feature of uniform size, together with weight per standard length, cannot be stressed too emphatically. Besides chemical purity and physical dimensions with weights adjusted, important points in filament control are the electrical resistance and temperature coefficient, which must be kept within close limits. This is important because nickel has a very high temperature coefficient, and if not kept uniform will give



Physical data on various metals used for grid windings

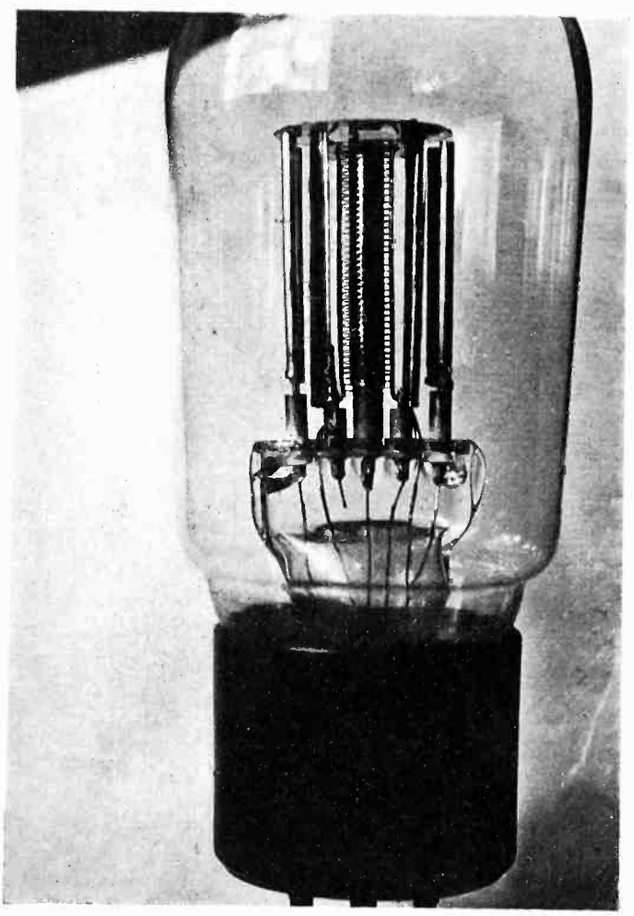
large variation in the filament when heated. The exact control of slight amounts of certain impurities is very important as it has a great effect on the electrical properties. The largest factor in the cost of radio tube filament manufacture consists of labor and scientific control. The resulting high quality has always proved to be cheaper in the final tube cost.

An important feature of filament manufacture is the control of hardness. For this, the percentage of elongation has been made a standard for the specification of the material. It is necessary that the finished filament be cleaned very thoroughly to remove from its surface any impurities which would be injurious to the coating, and in the functioning of the tube. For special applications, filaments are made of nickel alloys, such as silicon nickel, nickel cobalt, etc.

Tubes with cold cathodes

Dr. August Hund describes work before the I.R.E.

IN A paper presented before the Institute of Radio Engineers January 4, Dr. August Hund of the research staff of Wired Radio, Inc., described the results of his work on glow-discharge amplifiers, oscillators, and modulators. Although privately demonstrated at various times during the past year and first publicly announced in *Electronics* (September and November, 1931) this was the first public explanation of the principles involved and the first public demonstration of apparatus built around the filamentless tube.



The above tube is a sample of gas-discharge tubes made by Dr. George Seibt of Germany, a pioneer in the development of tubes without filaments. According to Dr. Henry J. Miller, through whose courtesy this photograph is presented, this tube has discharge cathode and anodes of iron, control grid of molybdenum, uses either neon or helium at various pressures from 3 to 6 mm of mercury. The discharge potential is 80 to 250 volts; the plate potential 20 to 30 volts; power consumption in the glow discharge is from 4 to 7 watts

Two types of tube have been developed, one depending upon the conduction of negative ions and the other operating on the negative resistance principle similar to the Poulsen arc. In both cases the source of electrons is a glow discharge which takes the place of the familiar thermionic cathode. In general such tubes, depending upon the ionization of a gas, have a characteristic with three distinct regions. Plotting anode current against voltage, at first the increase in current is very slow and quite uniform. The total current obtainable in this region is very small. Dr. Hund calls this region the "Seibt region" for the reason that Dr. Seibt in Germany seems to have concentrated his efforts on making a useful amplifier out of this portion of the characteristic.

At the end of this region is a very abrupt increase in current with any small increase in plate or anode voltage and at the end of this up-shooting curve is a much less steep increase in current giving a characteristic resembling that of a thermionic tube. According to Dr. Hund, tubes have been made in which the first two regions have been eliminated, giving a plate characteristic very similar to that of more conventional tubes.

The construction of the tubes was illustrated; the effects of varying the nature and pressure of the gas were explained, and curves were given showing the characteristics of tubes having plate resistances of 7,000 ohms, mutual conductances of 3,000 micromhos and input impedances of the order of one-third megohm.

With respect to the life of the tubes, the speaker explained that he had noted no gas clean-up. With respect to the uniformity with which the tubes could be manufactured in quantity Dr. Hund said that they were not critical as to construction or pumping. Air at 8 mm. pressure seemed to have about the same characteristics as helium at 40 mm.; the heat to be dissipated does not differ appreciable from thermionic tubes; the efficiency is about equivalent. In a typical tube about 6 watts were required for the glow discharge.

The simple construction of the elements and the possibility of using cheap gases added to the absence of necessity for careful and long exhaust, gave evidence of the fact that the manufacture of this type of tube would not be expensive.

The use of both types of tubes as oscillators in connection with piezo-electric crystals was described. An interesting method of generating three phase oscillations by means of the negative resistance form of tube operating on the relaxation principle, in conjunction with a piezo-electric rod was described. In this system a standing wave was created on the rod and two voltages with the proper phase difference between them are taken off the rod by means of amplifiers.

The tubes have been operated in their various capacities over the audio and radio frequency ranges extending into the ultra high frequency field. The use of the tubes in multi-channel transmitting and receiving equipment was also described. Relaxation oscillators functioning as low as 50 meters or lower were possible according to Dr. Hund.

Several demonstrations of the tubes in actual circuits

[*Please turn to page 22*]

The cathautograph

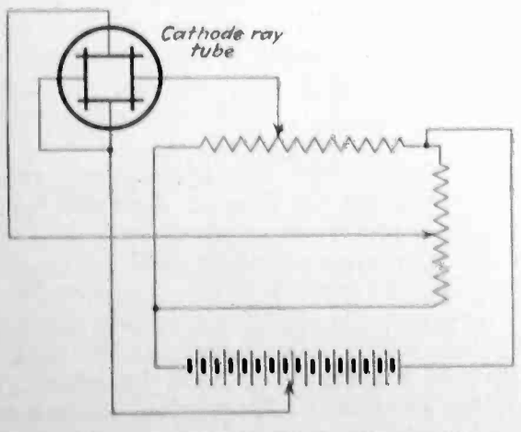
An electronic pencil

By ALLEN B. DUMONT

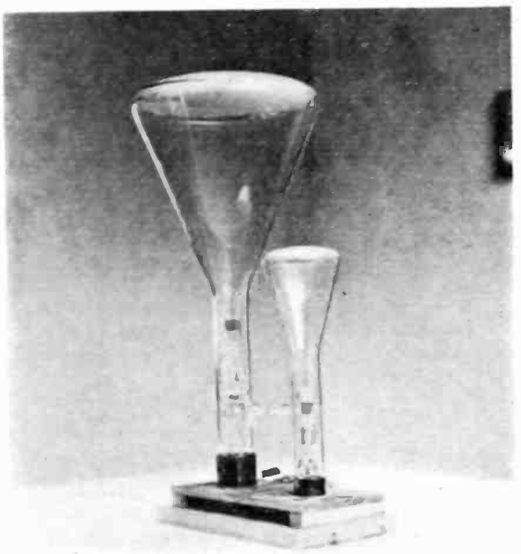
WITH the recent improvements in cathode-ray tubes which enable a high intensity spot of sharp focus to be obtained at relatively low anode potentials, many uses which have previously been impractical suggest themselves. In addition the stability, long life and moderate cost are rapidly placing the cathode-ray tube into industrial applications.

The Cathautograph is an interesting and useful application making use of a cathode-ray tube for the transmission of intelligence either in printed or written form. The electron beam is controlled by a suitable transmitting apparatus which causes the spot to move in any desired direction for any desired distance on the screen. If a standard cathode-ray tube is used for this purpose the operation of the transmitting apparatus would cause the spot to move around but it would be impossible to tell what was being printed or written. However special salts have been developed which instead of having a decay period of a fractional part of a second as is the case with the commonly used Willimite or calcium tungstate, have a decay period in the neighborhood of thirty seconds. This lag causes a line to be drawn as the spot moves. At present some ten words can be seen on the fluorescent screen of the cathode-ray tube at one time. As the eleventh word is being written the first word has faded out.

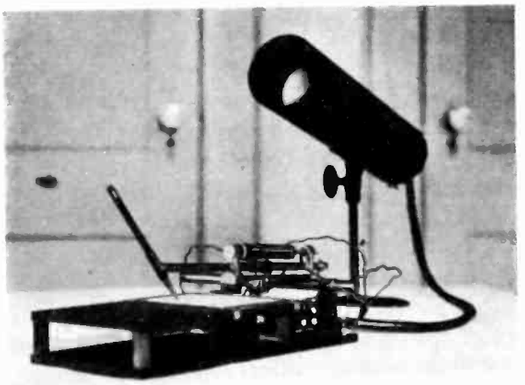
The transmitting system consists of a pencil or stylus which is connected with two resistances so that as the pencil is moved a voltage is picked off the resistances which is proportional to the movement of the pencil. The receiver consists of a standard cathode-ray tube with two pairs of deflection plates. In the photograph is shown the largest and smallest standard commercial size. The small three-inch screen tube was used to write the season's greetings on the cover of this issue of *Electronics*. The large tube has a nine-inch diameter screen and of course much larger writing can be obtained with it. A suitable shielded stand or holder supports the tube. The voltage picked off one resistance is applied across one pair of plates and the voltage picked off the other resistance is applied across the second pair of deflection plates.



Circuit used in the "electronic pencil".



Standard 3 and 9 inch cathode ray tubes



Cathautograph operating from a. c. The power supply apparatus is not shown

Provision has been made so that when the pencil of the transmitter is brought into writing position the receiver at the distant station is set into operation which requires less than two seconds. A buzzer signal is also operated at the distant station. Provision has been made so that when the pencil is lifted from the paper the spot is turned off eliminating traces between words.

The Cathautograph may also be operated over radio circuits by modulating two separate tones on a single carrier. At the receiver each tone is rectified and used to operate a set of deflection plates.

Some of the applications which suggest themselves are communication between airplanes and ground stations, communication between small vessels at sea not carrying a licensed operator and land stations, office intercommunication and communication between distant offices, communication between police department and radio equipped squad cars, noiseless instructions to broadcast artists, Chinese or Japanese communication circuits and also for advertising purposes.

Auto-radio an expanding market in 1933

Police radio increases

A QUARTER of a million automobile radios will be sold during 1933 according to estimates made by prominent radio and automotive manufacturers. This optimistic figure is based on the growth of sales figures during 1932 and is colored somewhat by the high degree of public interest shown late in the year. The average price of these sets will be in the neighborhood of $45 if sold without power supply or approximately ten dollars more for complete a.c. operation.

A survey of all automotive manufacturers to determine the extent of their interest in radio disclosed little change in sentiment from a year ago. Most of them will install radios if the customer demands it; to date none has decided to take the bull by the horns and put a radio into every car; about half of the cars have antennas in them when they leave the factory; many of the radio sets will no longer bear the trade mark of the radio manufacturer but will be much more closely identified with the automobile.

General Motors cars, and those of Dodge and Ford will have provision for radio so that installation will be simple. Furthermore, special radios are engineered for these cars bearing the name of the automobile, thereby removing from the customer's mind knowledge of the part the radio designer, the engineer or the manufacturer played in the construction of the unit. Radio therefore becomes to the automobile manufacturer and the ultimate owner merely an accessory, a gadget; the car is the important thing.

At present the automobile manufacturer and dealer is more than mildly interested in radio because of the necessity to boost the dollar volume of sales. In better times when many thousands of cars must be replaced with new ones, an auto dealer or maker's interest in radio will wane again, and again the car will become of primary importance.

At present there is no automotive manufacturer who has decided to equip every car with a radio as it now journeys from the factory, as it does with an extra wheel. This status may change over night; once started such a bulge might assume large proportions. Such a demand would be filled by the radio manufacturer selling his entire output to some auto maker, and might easily account for appreciable profit. The tie-ups between Ford and Majestic, between U. S. Radio and Television and Chevrolet are interesting and important trends, pointing to the loss of identity of the radio partner in the auto-radio combination.

It is generally felt that it will be impossible to sell sets to cars over two years old. The table below shows a very large market even under these restrictions.

New cars sold

1930	2,625,979
1931	1,908,141
1932	1,125,000
Total	5,659,120

There is also a feeling that the more expensive cars will be easier to sell; but on this point there is much argument. Some feel that the owner of an expensive car has problems on his mind too weighty to be relieved by radio tunes or talks.

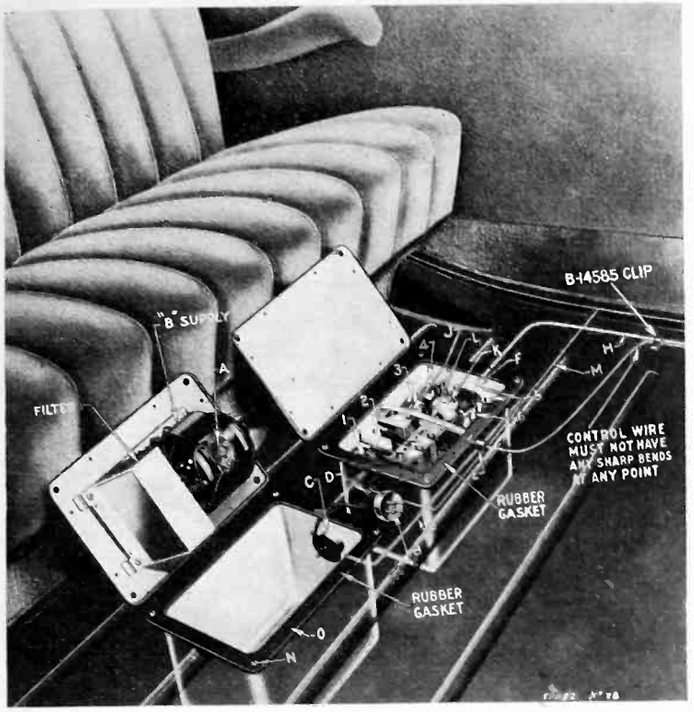
Who will sell and install?

There are three possible types of outlets for receivers to be installed in automobiles. The radio dealer, the auto dealer, and finally a newcomer, the auto-radio specialist. Of the latter there are perhaps 2,000 operating at the present time. They seem to have the best qualifications for capitalizing on this admittedly large market. The radio dealer knows most about radio but has an inferiority complex when it comes to tearing the top out of a car for the purpose of installing an antenna or of drilling holes in dash or floor boards. The automobile dealer has the necessary tools and experience to do practically anything to the automobile but lacks confidence to tackle ignition noises and other anticipated and feared radio troubles.

The problem of credit enters the picture too. The automobile dealer has the edge on the radio man here; in addition he has a place in which to work. But the radio dealer who seizes all opportunities may capitalize on the fact that auto radios can be installed in the car owner's garage. The specialist, doing nothing but installing radio receivers in automobiles, can combine the knowledge and experience of both the other types of dealer and because this is his primary job can work it harder, taking advantage of all kinds of sales efforts and

Rapid awakening of public interest; cooperative efforts among radio and automotive engineers, and reduction in prices will make the market for receivers to be installed in pleasure cars expand to a considerable extent in 1933.

The industry hopes for a car manufacturer to make auto-radio as an integral part of his entire output of cars. The automobile industry, still considers radio as a gadget to be installed if the car owner wants it.



The Ford-Majestic manual of instruction gives complete directions for installation of the radio in the car

the word-of-mouth advertising that is so valuable. One well known radio manufacturer estimated that less than 30 per cent of all auto radios would move through the regular radio channels.

In six New England states one jobber sold 3,000 radio sets for automobile installation during the four months preceding November. Two types of sets were sold, one cheap (about $60) and the other about $15 higher. The ratio of expensive to cheap sets was two to one; 90 per cent of the sets moved through automotive dealers.

The time and cost of installation will come down appreciably in 1933. The present charge of $10 seems to be due for some revision downward. The time of installation will probably level off at between one and two hours, what with the interest automobile engineers are taking in equipping their cars with antennas and in providing places for the radio added to the skill which radio engineers are showing in putting their tubes and components in compact metallic containers simple to install.

Road tests will be instituted to determine the ability of the radio and power supply unit to stand up under average driving conditions. One radio engineer making a quality product installed an experimental model in his car, drove it a thousand miles over winter roads and found to his gratification that the use of lock nuts properly placed had been worth while. A maker of B eliminators of the vibrator type uses as part of his promotion the fact that one of his units had gone through the Indianapolis races effectively surviving 10 million jolts.

A distinct trend toward built-in power supply units whether of the vibrator or rotating machine types was evident toward the end of the year. Opinion was still divided as to whether the older and better known type of machine, the dynamotor or equivalent would prove to be more satisfactory than more elegant methods of getting high voltage from the car battery. It is significant that Ford chose rotating devices for his cars. It is known that other automotive manufacturers look with critical eyes on the problem of getting plate voltage from the car battery. Dodge, for example, has very recently equipped 1,000 Plymouths with radios as demonstrator cars. Many of the bugs of the proposition will undoubtedly be ironed out as a result of such large scale trial installations.

RMA-SAE joint meetings

A very hopeful sign in the auto-radio heaven is the cooperation between members of the leading automotive engineering organization, the Society of Automotive Engineers and the members of the Radio Manufacturers Association. In September members of the two groups met in Detroit and discussed many of the joint problems. Such matters as sources of interference, battery drain, location of receiver in car, antenna installation were discussed and committees were appointed to handle more technical aspects of the items.

At a meeting of the RMA Committee on Automotive Radio in Detroit early in December representatives of all but two of the major radio manufacturers discussed such matters as radiation from the car, life testing of B power devices, interference from dome light wiring, the rating of sensitivity of automobile receivers and other technical problems. In a report of the committee on B power devices, it was recommended that a voltage of 6.3 be chosen as design and test center and that at least 1,000 hours' operation be taken as satisfactory for a B power device. If the unit operated satisfactorily for this period with some small service charge at the half-life period, it would be considered as satisfactory.

Radio receivers for police cars

During 1932 a number of prominent and large municipalities installed police radio systems, adding their names to a long list of the cities and states which have seized upon radio as a deterrant to crime and an aid in the apprehension of criminals. New York City was among these cities, installing two transmitters of Western Electric manufacture and many police cruisers with receivers made by United American Bosch.

Thus the design and manufacture of radio receivers for use in police cars has become an appreciable part of the automobile radio industry. Although the receivers are built to different specifications and different wavebands, the essential problems are the same—without the price chiseling! A police radio receiver must perform at all times and with minimum service; dependability is more important than high fidelity or great sensitivity.

The advent of police radio and the wide-spread sale of short-wave receivers to the lay listeners have brought strange problems. There is nothing difficult about procuring a receiver for receiving the police calls, in fact many manufacturers of sets working in these wave bands advertise the thrill of listening to such communications. Therefore criminals find it to advantage to equip their cars as effectively as the police in some states leading to absurd and unenforceable laws prohibiting the installation in cars of receivers which will tune below 200 meters! Such laws will not deter the production and installation of radio receivers in automobiles either to receive the broadcast-band stations or to go down into the other wave bands where other and withal more interesting and exciting programs are available. Doubtless the market for police radio receivers will continue to provide manufacturers with outlets for high class sets of this special nature.

Control of sound quality in picture production

By CARL DREHER
Director of Sound, RKO Studios, Inc.

THE fidelity of which a sound picture recording-reproducing system is capable depends on its design and is therefore, initially the responsibility of the design engineers. But the problem of *maintaining* the best possible quality is one for the operating engineer or studio technician. If he does not know his job, the equipment may function badly, resulting in sub-standard sound, or it may not function at all, resulting in costly delays in production.

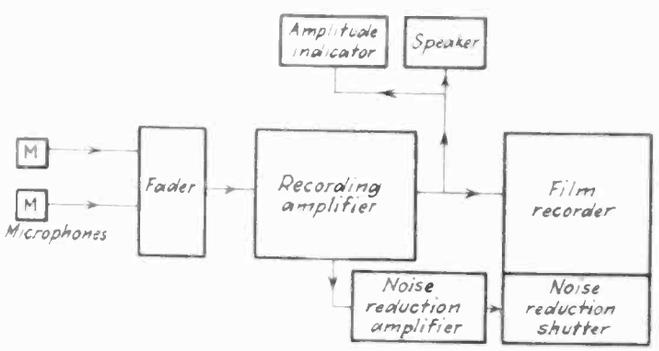


Fig. 1—Block diagram of recording system

Although in sound-picture production the problem of controlling unskilled personnel is not encountered, since the number of workers is low enough to permit employing only qualified men, it is the business of the supervising engineer to organize a maintenance and testing routine which will impress his own presumably greater skill and experience on the personnel all the way down the line. He does this by leaving nothing to chance and overlooking no opportunity to observe and measure the characteristics of the product—in his case, a sound track only 70 or 80 mils wide, but in the aggregate of a year's recording in a major studio, many millions of feet long.

The maintenance and test methods to be described in this article pertain particularly to RCA variable area recording as used at RKO Studios in Hollywood, but the basic principles are the same for any system of recording and any studio.

Fig. 2—Variable area track (print) with noise reduction

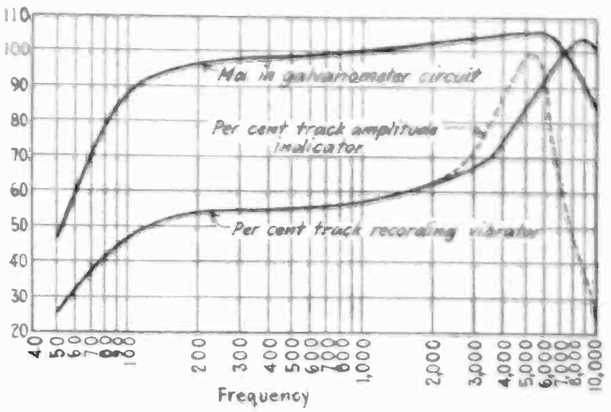


Fig. 3—Recorder frequency characteristics

Figure 1 is a block diagram of the principal elements in a film recording system. Beginning with the microphone, we will first outline the routine tests carried out on the various elements and the system as a whole.

Microphones

Microphones are of the electrostatic (condenser) or electromagnetic (ribbon) type. The high internal impedance of the condenser requires an associated amplifier close to the transmitter. The ribbon microphone amplifier may be similarly attached to the transmitter, or it may be some distance away, connection being made by means of a suitable cable.

In either case, frequency runs are regularly made on all microphone amplifiers after they are brought in from production and before they are again issued for recording purposes. For the transmitter is substituted a suitable oscillator input (range 60–6000 cycles) and the deflections of a thermocouple meter in the output of the amplifier are noted.

Microphones are also connected in circuit in the test room and allowed to "cook" with the current on for a period of about one hour. A skilled observer then listens in the output of each amplifier for noise. Through long experience, this man can generally tell the origin of disturbances by the way they sound and may localize noise in one of the coupling resistors of the amplifier, in the transmitter itself, or in some other element of the circuit. Quick diagnosis is necessary, since twenty or thirty units may have to be tested in a few hours.

Combined with the test for noise, there is a rough sensitivity check utilizing a watch placed at a fixed distance from the transmitter under test. With a normal amplifier, the output signal is comfortably audible in headphones. Inability to hear the ticking of the watch under these conditions indicates that the amplifier is not supplying the necessary gain. A loud signal, on the other hand, indicates a hypersensitive condition, which would probably result in tube bonging or other irregularities during movement on the stage. (It must be remembered that in motion picture recording, microphones are continually swung around to follow the move-

ments of the actors, and quietness during such operations is essential).

The storage A and dry B batteries, which supply energy for microphones, are tested every day, since the least irregularity in this power supply will cause severe noise interference in the output of the recording amplifier.

Microphones are controlled through fader units, which contain six individual positions; two sub-gains, governing three microphones each; and one overall gain for the six positions. These are of the well-known T- or H-network type, resistance controlled. When one of these units has been out of use for two days or more, before it is put back in service the variable resistors are cleaned with carbon tetrachloride, all connections tightened up, and the unit is tested in all six positions with a normal recording amplifier for quiet operation. A resistance bridge is used in testing for grounds, resistance irregularities, etc.

A-, B-, and C-voltages are measured each day with the battery supply under normal load, and all plate currents are checked. At intervals of about one week, connections are tightened up and the amplifier receives a general overhauling, tubes being changed wherever indicated, etc.

Noise reduction amplifiers

Noise reduction is accomplished in the RCA system by blocking light from the unused portion of the track.[1] Measurements similar to those on the recording amplifier are made on the noise reduction amplifiers and the sensitivity is carefully checked, since the ability of the shutter to get out of the way of the modulation peaks depends jointly on its dead clearance and on the amplification of the amplifier which feeds it.

The edge of the electromagnetic shutter which blocks the undesired light is checked for vertical position by means of a scale. The minimum clearance is set on an optical target to correspond to 5 mils on the film. That is, the shadow of the shutter is 5 mils from the zero modulation beam, as shown in Fig. 2 (left). The gain of the noise reduction amplifier is then adjusted by means of a grid bias control so that the shutter clears the track 100 per cent when the modulation rises to 40 per cent of the full track. This is shown in the right-hand half of Fig. 2. The shutter must be sensitive enough to move appreciably for a modulation of 2 per cent, the input switch to the system being turned on and off so that this movement, or its absence, may be noted by the operator. All these observations require a hand-magnifying glass of five- to eight-power size.

A variable area film recorder consists of a constant source of light which, through a suitable condensing lens, illuminates the mirror of an oscillographic galvanometer fed by the recording amplifier. The vibrations of this mirror cause proportional variations in the

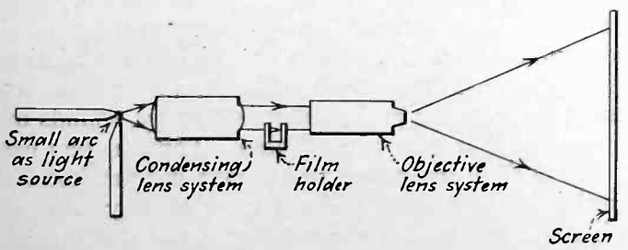


Fig. 4—Micro-projector for examining sound track

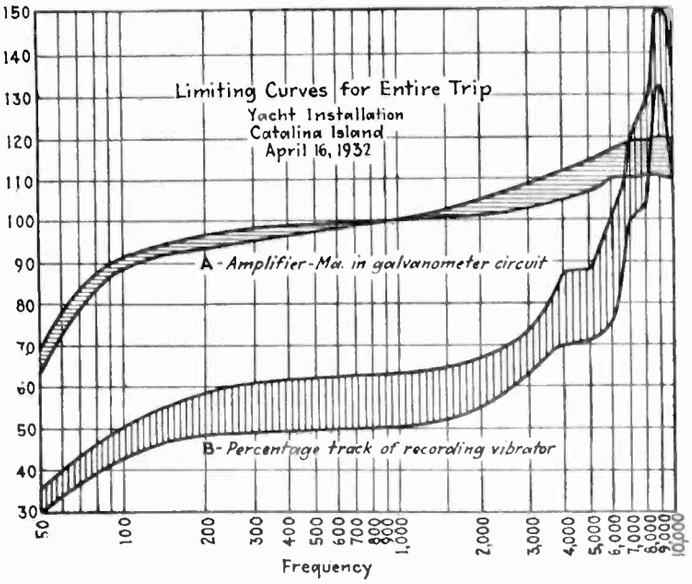


Fig. 5—Limiting curves for recording amplifier and vibrator

position of the reflected beam directed on the moving film through a microscope objective, which includes an optical slit; a variable area track is the ultimate result.

A daily mechanical check is made on each film recorder before it is used commercially. The *sine qua non* of a good film recorder is constancy of motion of the film past the recording light. This is checked by a specialist who runs a length of film through the machine, notes the adjustment of the take-up, the functioning of the various shrinkage compensating mechanisms, the action of rollers and sprockets, etc.

Optical checks include a photometer reading and observation of the position of the recording light on the film. The latter can be gauged to within 2 mils by an experienced observer who notes the distance between the edge of the light and the sprocket perforations. The photometer is a means of comparing the illumination of the excitation lamp of the recorder, with that of a standard light source. The former provides an illuminated field which varies in luminosity as the current through the excitation lamp is changed. The current is set at a point where the field and the central standard spot merge in the photometer.

The recordist monitors by ear through a loudspeaker in the recording booth. The loudspeaker level should be standard for all booths, so that as the company moves from one stage to another the operator will not be deceived by random changes in level. It would be difficult to measure the acoustic output of a speaker for a standard signal, but this is not found essential as long as loudspeakers of one type are used and maintained in normal condition. Setting of the current in the voice coil of the loudspeaker for a standard input satisfies the requirements.

In some types of recording equipment, the operator, while manipulating his microphone controls and listening to the monitoring speaker, is in a position to see the width of the modulation on the recorder. In other cases, the recorder is in a remote location, whence, in order to provide a visual check of the modulation and avoid insufficient amplitude or over-shooting, it is necessary to provide an auxiliary indicator. This consists of an oscillographic galvanometer similar to the recording

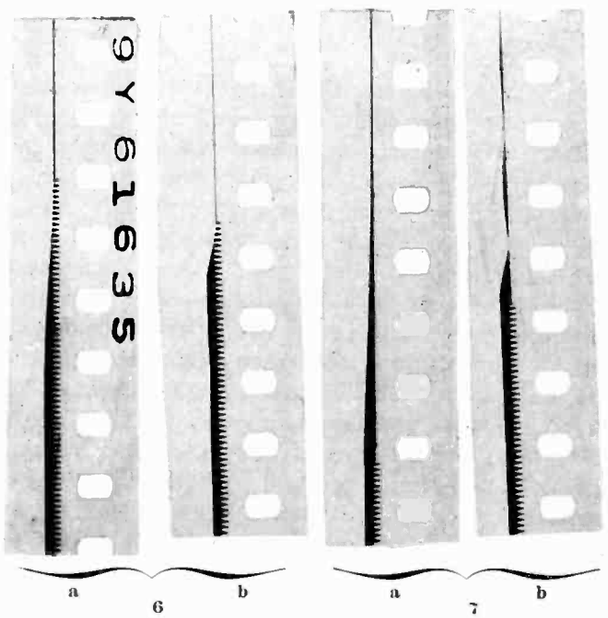
[1] "Progress in Sound Picture Recording," Carl Dreher, *Electronics*, March, 1931, page 542.

unit, the reflected beam, however, appearing on a calibrated glass instead of reaching a film.

This optical indicator is calibrated against the recording vibrator by means of a variable shunt resistance. With a constant input from an oscillator at a standard frequency (1000 cycles) the amplitude indicator is set to read the same degree of modulation as that on the film. The correspondence is checked at 100 per cent track, 75 per cent, 50 per cent, and 25 per cent.

Overall frequency characteristics

An oscillator is arranged to give constant voltage to the fader at frequencies between 50 and 10,000 cycles. With signal on, the resistors on the individual faders are first "scrubbed in" to remove minor particles in the mechanism capable of causing noise later. The output current is then read on a thermocouple meter of the same impedance as the galvanometer circuit, connected across the output of the recording amplifier. This gives



Figs. 6 and 7—Sound film negatives showing shutter action

the upper curve in Fig. 3. Next, the resonant peak of the optical amplitude indicator (middle curve) and that of the recording vibrator are measured. It will be noted in Fig. 3 that the amplitude indicator resonance is about 5300 cycles, while that of the recording vibrator is about 8800 cycles. The object of the latter is to permit recording up to about 10,000 cycles on the film, whereas the optical indicator resonance is not particularly important as long as the two curves coincide at 1,000 cycles.

Whenever the recorder is loaded with a new roll of film, the first ten feet are exposed without modulation and sent to the film laboratory for development in advance of the rest of the roll. The laboratory reads the density before proceeding with processing of the sound track. Thus, if the film is by any chance underexposed, the advance strip will indicate the fact to the laboratory operatives, who then run the roll through the developing "soup" at a lower speed, enabling it to come up to the standard density of 1.5 generally set for variable area negative. Should the film be over-exposed, its passage through the developing solution will, of course, be accelerated correspondingly to avoid excessive density, with a high fog factor, etc.

A sort of stereopticon arrangement, shown diagrammatically in Fig. 4, is used for inspecting film sound track. This merely involves a source of light, such as a small arc lamp, which throws an image of the track magnified about one hundred times on a calibrated screen. A 70-mil sound track, under these conditions, has an amplitude of 7 inches on a screen a few feet from the lantern, permitting close checking of track placement, printer irregularities, filling in of high-frequency valleys by over-exposure, etc.

The finished negative is carefully inspected at the laboratory, beginning at about 6:00 a.m. on the day following exposure. Density, track placement, clearance-ance of noise reduction shutter, etc., are noted. Thus, if there is anything wrong it will be known to the sound supervisors before another day's shooting starts, and necessary adjustments can be made. Prints are inspected as soon as available later in the day for track placement, density, etc.

Figure 5 shows the limits within which proper maintenance routine will keep the characteristics shown individually in Fig. 3. The amplifier, as shown in *A*, changes its state very little. There is more variation in the curves of *B*, which involve vibrator peaks, since these are affected by temperature, the height of the peak, referred to the 1000-cycle amplitude, increasing with the temperature.

The above list of tests, while not intended to be comprehensive, includes most of the routine maintenance operations of a major studio. Some of the test results are confined to the specialist who makes them. These are of such a nature that, once a reliable routine has been established, its proper carrying out may be left to the man delegated to it. The supervising engineers, however, receive copies of characteristic curves, as shown in Fig. 3, of all stage or mobile equipments to be used on a given day. They also receive reports of the results of the laboratory measurements on the sensitometric strips, and any irregularities disclosed by the negative and print inspection are likewise immediately brought to their attention. Thus many hours of work on the part of perhaps a dozen specialists are compressed into graphs and quantitative data which may be read in a few minutes by the technicians in charge. These curves and figures show that the maintenance routine is being properly followed, and if there are any irregularities their magnitude may immediately be noted.

It was stated at the beginning of this article that nothing must be left to chance and no opportunity should be overlooked to measure the physical characteristics of the sound track. Experience shows this to be a basic fact. If neglected, it is only a matter of time before trouble will be encountered. For example, in the case of one studio, the routine of visually checking the negative and prints each day was overlooked. The sound supervisors merely listened to the film as it was run off in the daily "rushes." One day it happened that a sluggish noise reduction shutter was causing cutting of low modulation peaks. By chance all the low modulation in this day's work was traffic noise. Of course traffic noise, even with the peaks cut considerably, sounds much the same as if it were unmutilated. Thus, merely listening to the film, the sound technicians did not know that anything was wrong. The following day, the same equipment was used for recording some low amplitude dialogue, and the shutter, continuing to cut peaks, caused

[*Please turn to page 22*]

Inter-carrier noise suppression

A new system

By NORMAN E. WUNDERLICH

THE method of inter-carrier noise suppression to be described below is a simplified system which requires no additional tubes and hence is much less expensive than more complicated systems, although performing the same functions. These results are attained by taking advantage of circuit arrangements made possible by the strategic electrode construction of the Wunderlich B tube which has a longer cathode and a small additional anode placed at the top of the structure and shielded from the other elements. By this extra anode, the AVC potentials are amplified before being applied.

Performance curves show the "threshold" level of the receiver may be set to any desired value while retaining the AVC action. The sustaining action of the AVC may be caused to release at any desired, lower signal level. The point of release may be adjusted by means of the sensitivity control. This action is very sharply defined because of the fact that the potentials applied to the automatic control system are amplified to just the correct degree. In addition to the advantage of sharply defined releasing action for noise suppression, the circuit makes it possible to handle high signal input levels without overloading the 2nd detector or preceding tubes.

In carrying out the amplified AVC control, the cathode of the detector is approximately 100 volts negative with respect to ground. This may be done by placing the speaker field winding in the negative return of the power system, as shown in the circuit diagram. If the drop of potential across the speaker winding is more, or less, than 100 volts, R_1 and R_2 are changed so that the drop across them due to the plate current will just equal the drop across the field winding, when no signal is being received.

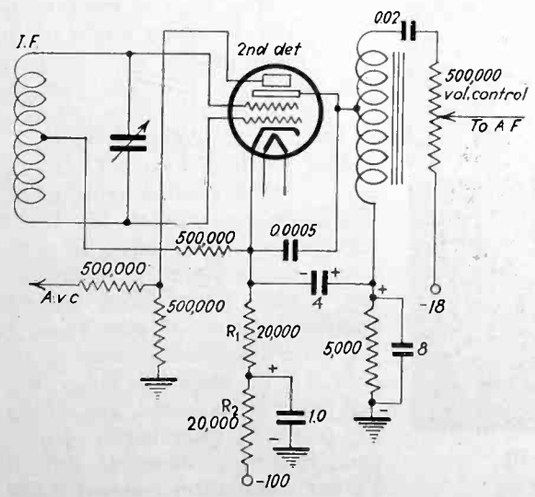


Fig. 1—Circuit of the new amplifier AVC system

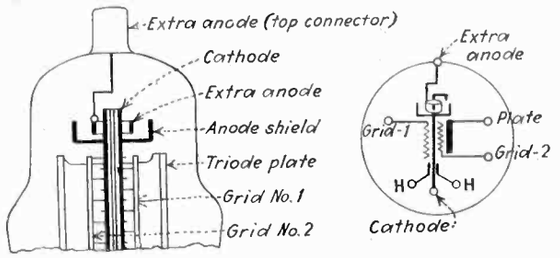


Fig. 2—Construction of Wunderlich B tube

The plate of the detector is preferably connected through the primary of a 1:2 step-up, center-tapped audio choke having a d.c. resistance of about 5800 ohms total winding, to a point in the power supply which is approximately 100 volts positive with respect to ground.

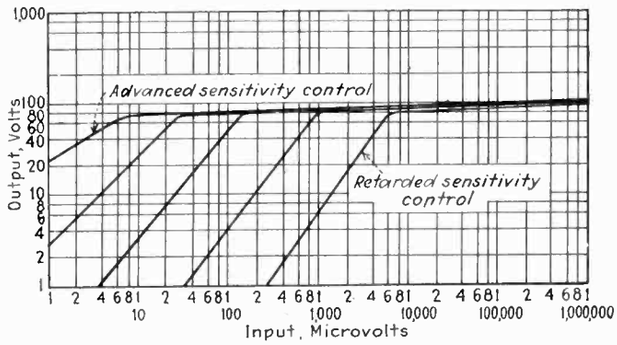


Fig. 3—Performance curves of 7-tube super-heterodyne

The use of an iron core step-up auto-transformer serves two purposes; (1) it increases the a.f. potentials applied to the output tube and (2) it increases the potential variations across resistors R_1 and R_2, thereby sharpening and increasing the action of the AVC system.

With no signal the potential drop in the tube plus the potential drop in the primary of the auto-transformer approximately offset the drop of potential across resistors R_1 and R_2. As the drop in these cathode resistors is approximately equal to and opposite in polarity to the drop across the speaker field winding to which it is connected, there is no difference of potential between the cathode of the tube and the chassis ground. In other words, the cathode of the 2nd detector will be "floating" at about ground potential. The extra anode will be at the same potential except that it will act as a one-way valve to permit passage of negative potentials for the AVC bias on the grids under control.

When a signal is tuned in, the grids of the second detector act as a full-wave grid rectifier and become negatively charged with respect to the cathode. This lowers the plate current through the resistors R_1, R_2, causing the cathode to become negative with respect to ground, and placing a negative AVC voltage upon the grids of the tubes under control. The AVC potentials thus obtained are greater than the rectified signal voltage. This makes it possible to have amplified AVC potentials which are high enough to control the strongest local signals without overloading either the detector tube or any of the tubes preceding it.

HIGH LIGHTS ON ELECTRONIC

Daylight control of factory lighting saves electricity

AT THE CHISHOLM RYDER PLANT, Niagara Falls, photoelectric control of lighting saves 4,000 kw.-hours monthly, reduces lamp replacements one-fourth, improves production and reduces accidents.

By having a photo tube gage the intensity of daylight, the lights in the plant are automatically turned on during dark cloudy hours and later extinguished when daylight returns to normal intensity. At the Chisholm Ryder Works approximately 15 foot-candles of light intensity is maintained on the benches of tool-makers and on machine tools, the lighting of the entire plant being governed by changes in this level of illumination. When the natural illumination drops to 14 foot-candles, owing to morning or evening darkness or a passing cloud, the lights come on automatically and stay on until the daylight has raised the foot candles to 20.

As happens in practically all industrial plants with manually controlled lighting, workmen invariably left the lights on after the natural light had raised the intensity far above that required for artificial lights. For example, on dark days, workmen reporting at 7:00 in the morning turned on the lights and did not turn them off until after 8:30, thus causing the lights to burn needlessly for nearly an hour. With photoelectric control, the lights burn only when needed, greatly increasing their life. Previous to the installation of "day-light" control the Chisholm Ryder plant used 1,200 lamps a year whereas now 900 to 1,000 are sufficient. Energy consumption is 4,000 to 5,000 kw. hours less a month.

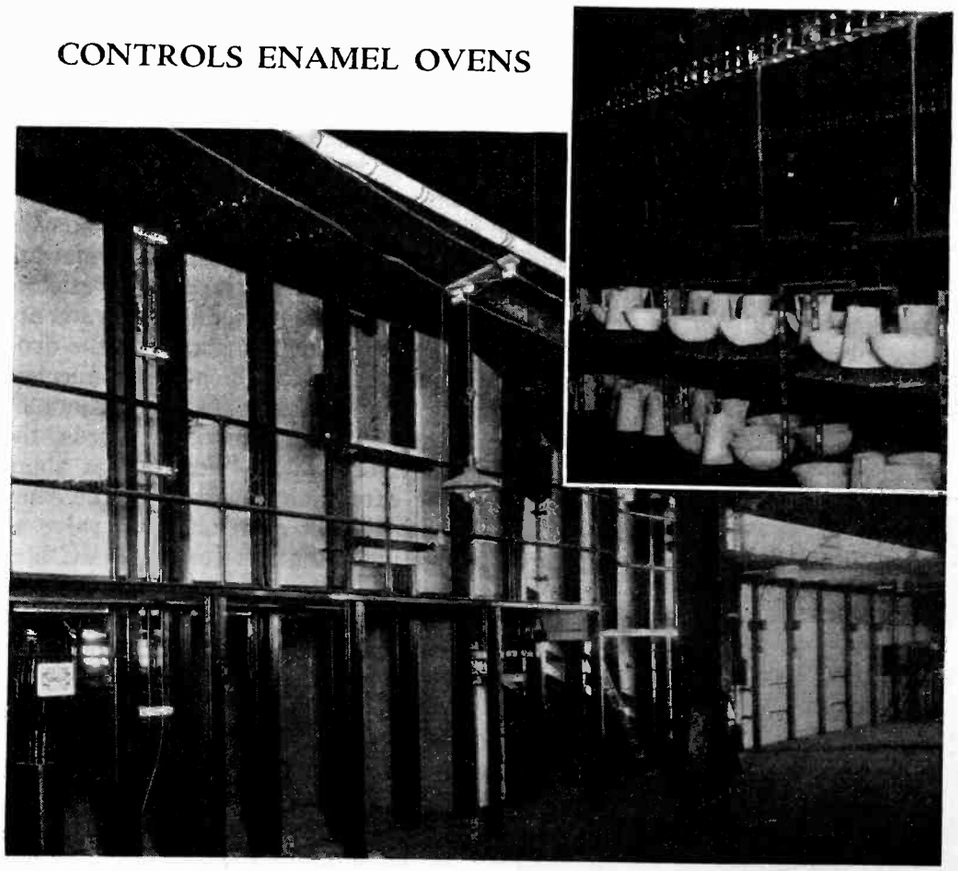
✦

Newspaper measures opacity of paper stock

THE OFFICIALS OF THE New York Daily News had the problem of detecting, before their papers were printed, whether the ink would show through enough to disturb the reader. Then Captain MacFarlane and Mr. Baumrucker developed an opacity meter using a Weston photronic cell, a microammeter and an ordinary 100-watt lamp. With this equipment, they have already classified over 500 samples of newsprint.

✦ ✦ ✦

CONTROLS ENAMEL OVENS



The National Enameling and Stamping Company, Granite City, Ill., employs photocells to control metal-ware entering its automatic enameling ovens, which insures uniform heat treatment

Stroboscope inspects high-speed printing

THE EDGERTON STROBOSCOPE, recently described in Electronics (page 220, July, 1932), has been applied by the General Radio Company, Cambridge, Mass., in determining the register of color printing as it is speeding through the presses. Its usefulness is in "stopping" the motion of color printing as each color is applied. The application, of course, is only to rotary presses, such as are used for printing comic sections and long-run magazines.

In operation, a suitable make-and-break contact is fastened to one roller of the rotary press, which will flash the stroboscope as each sheet goes by. This will, of course, give the effect to the eye of the sheets standing still and the register of the color can be determined and adjusted when necessary. Similarly, the device can be used in determining the register of ordinary black-and-white printing.

Another application which the printing industry will find for the stroboscope is in stopping the motion of any of the high-speed machinery used to determine if the various parts in operation are working properly. Effects such as vibration and the action of rollers and cams can be studied with the machinery operating.

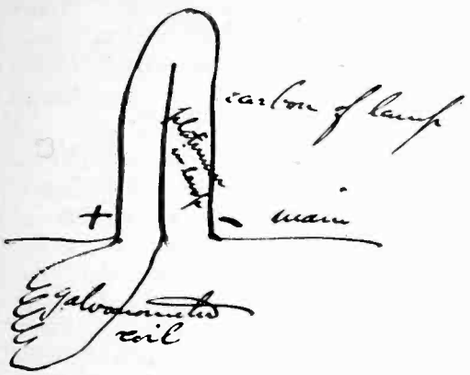
✦

Counting crates on conveyors

THE CANADA DRY BOTTLING WORKS at Boston makes use of a photo-cell installation to count the crates of filled bottles as they go out to the shipping room. Ordinarily crates or boxes on conveyors are placed end to end, so that the line is too solid,—too continuous for counting. This conveyor, however, has a transfer from one belt to another, and as the boxes make the change, they are tipped first one way, then in the reverse direction. The resulting angle of light between boxes passing over the peak at the transfer point, provides just the place for installing the photo-cell beam, and so an accurate count is made.

The Sheffield Farms Dairy Company has solved a similar problem on a flat continuous conveyor, by inserting a high roller in the conveyor at the point where the photocell is to do the counting. This high roller interjects an angular interval of open space between the closely following boxes as they pass over it. Through this space, the photocell beam is projected, and so the counting proceeds, unfailingly. During a recent Saturday morning this Sheffield Farms installation counted 3,600 crates each containing twenty bottles of cream.

DEVICES IN INDUSTRY + +



The first industrial application of electronics?

DR. FRANK J. SPRAGUE'S 75th anniversary, recently widely celebrated, has recalled many early developments in electricity, not the least interesting of which is his own experiment with an electronic voltmeter in 1883.

Dr. Sprague had been in Brockton, Mass., in charge of the first underground three-wire Edison station (and it was in Brockton that he was also busying himself at this time with his first industrial motors), when the Pearl Street Station in New York failed, due to an overloaded feeder in the Stock Exchange quarter of the city resulting in a successive failure of "safety catches."

He had already begun his investigation of the laws of electrical distribution for two- and three-wire d.c. systems, and had developed a mathematical method for determining their proper values. This work incidentally was the foundation of his later complete fundamental design of overhead and underground distribution systems in use today.

On hearing of the failure at Pearl Street, he telegraphed his opinion of the trouble, and Edison promptly called him to New York to solve the overload difficulties, which he did successfully. About this time he apparently took up the development and test of the first real electronic potential indicator, as shown in the reproduction of Dr. Sprague's original sketch, which was made on December 27, 1883.

His own description of the indicator in a letter of that date written to this friend and associate William J. Hammer, at that time chief engineer of the Deutsche Edison Gesellschaft, Berlin, is as follows:

"Then I went on to a new pressure indicator—a daisy founded on an old discovery of E's (Ed. Note—Edison's well known 'Edison effect'), thus. "With above connections (see sketch) of this special lamp, no appreciable current will flow through the galvanometer coil across the platinum to the carbon until a fair incandescence is reached, and then the current increases very rapidly. Hence the indicator shows no deflection until you wish it to, and then it begins to move rapidly. It has fine adjustment and is so sensitive that if 1/100th of the lamps be thrown off it will show the change in pressure. Its sensitiveness can be made more or less."

The accompanying sketch shows a typical diode comprising a platinum anode with the galvanometer coil in series, the anode voltage being supplied by the positive side of the d.c. lighting system. The negative leg of the carbon lamp filament acts as a cathode when incandescent.

Dr. Sprague does not recall other than an experimental use of this device —but it is nevertheless of interest as one of the forerunners of the present day vacuum tube.

✦

Stroboscopic testing of meters

TO MAKE THE TESTING of clocks and meters as simple as setting a timepiece, a portable stroboscopic-meter method has been developed, which brings laboratory accuracy into field testing.

In meter testing, for example, the problem is to obtain an accurate comparison of two-meter disc speeds, one that of a standard meter and the other the speed of the meter under test.

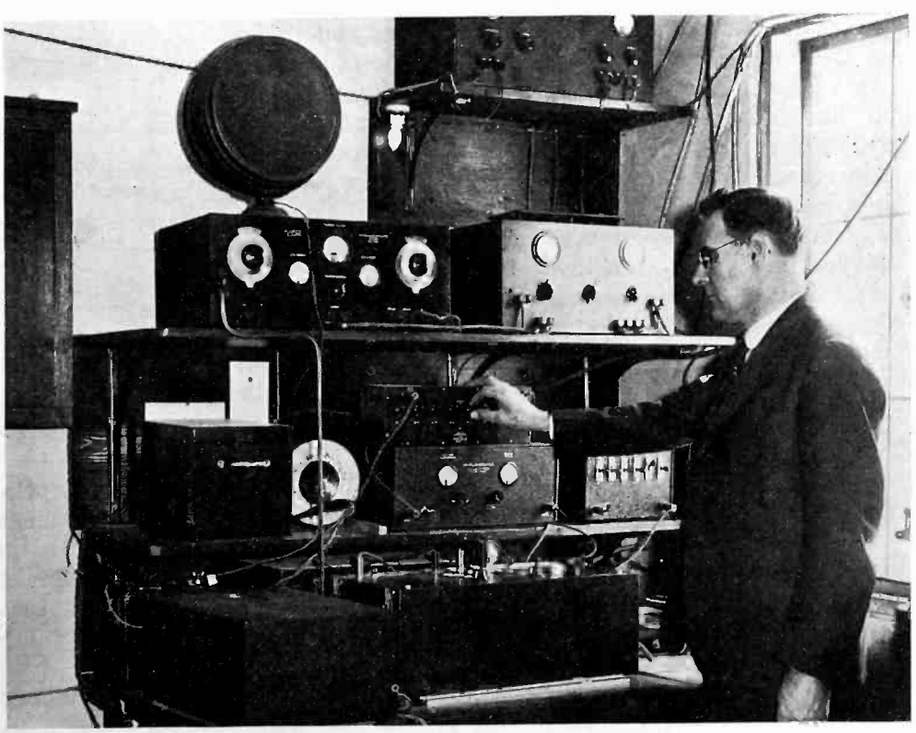
The stroboscopic principle depends upon the phenomenon of a uniformly-rotating device, illuminated by a series of instantaneous flashes, appearing stationary if the rate of flashing is equal to the rate of rotation; "moving forward" if the rate of rotation exceeds that of the flashes and appearing to move backward if the rotation is slower than the flashing.

To use the new Westinghouse standard, the meter element is connected in series with the meter under test, both being connected to the same load. The incandescent lamp in the tester is lighted and the neon lamp is placed near the disc of the meter being tested, so that its light strikes the disc.

Light from the incandescent lamp is broken into pulsations by passing through notches in the revolving disc of the standard meter. These pulsations strike the phototube and are transmitted to the neon tube through the amplifier. Therefore, the neon tube flashes in synchronism with the disc of the standard meter and the disc of the meter under test, being seen in this flashing neon light, appears stationary if it is in perfect synchronism with the standard meter. Thus to calibrate the meter it is necessary merely to adjust its speed until the meter disc appears to stand still.

✦ ✦ ✦

MEASURING SOUND ABSORPTION



V. L. Chrisler of the Bureau of Standards, Washington, with his apparatus for measuring the sound absorption of various building materials, at any required frequency

Circuits for amplified automatic volume control

An interesting circuit development making use of the possibilities of the 55 tube has been worked out by L. E. Barton of the RCA Victor Company, and independently by C. Travis of the RCA License Laboratories. In this circuit the steady d.c. voltage generated by the diode detector is amplified in the triode unit of the tube along with the detected audio frequency signal, and used as an AVC bias after this amplification. There results a very sensitive and level AVC system.

The advantages to be gained by thus amplifying the AVC bias appear from the following considerations. It is found that when the bias taken directly from the diode is undelayed the resulting control is not sufficiently flat, due to the fact that bias begins to build up as soon as any signal whatever appears at the detector, and thereafter can only increase by virtue of a proportionate increase of the detector input. If for example, a certain input at the antenna develops 5 volts bias and another stronger one raises this to 20 volts, there is necessarily a 4:1 increase in the output of the receiver if the modulation is assumed to be the same in each case.

To remedy this condition delayed AVC systems are employed, in which no control bias appears on the r.f. grid returns until the amount of the delay voltage is overpassed. Thus, referring again to the above example, if a delay of 40 volts is introduced, the receiver output changes in the ratio of 40+20 to 40+5, or there is a 4:3 change instead of the original 4:1 change without delay. It is apparent that the greater the delay voltage used the flatter will be the AVC characteristic.

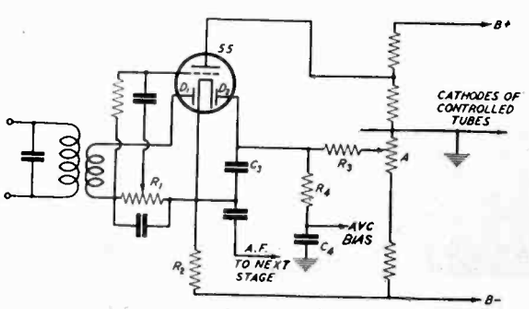


Fig. 1—Circuit for amplified automatic volume control

The antenna input necessary to overcome the delay voltage and bring about threshold conditions is in direct proportion to the magnitude of the delay voltage. Hence increasing the latter to obtain a flat AVC characteristic is done at the expense of the threshold sensitivity of the receiver unless the gain of the r.f. amplifier is increased at the same time.

As far as AVC action is concerned, the d.c. amplification of the controlling bias is equivalent to a corresponding increase in the r.f. gain of the receiver and this increase may be used as desired to make the AVC characteristic flatter or to increase threshold sensitivity, or both. The increase in gain possible is very nearly 8 for the 55 tube, so that the threshold may be moved down to an antenna input of one-eighth of what it was without the use of d.c. amplification, the delay voltage remaining the same, or, on the other hand, the delay may be multiplied by 8 for the same threshold.

The circuit is illustrated in schematic form in Fig. 1. The diode D_1 acts in the ordinary manner as a detector, the detected d.c. and a.f. voltages appearing between the cathode and the triode grid. The amount of the a.f. thus taken off is variable if so desired by the use of a potentiometer for the leak resistor R_1 as a manual level control.

As the triode has a resistance load the d.c. is amplified equally with the a.f. or by nearly the μ of the tube. By placing the load resistor R_2 in the cathode leg instead of in the more usual position in the plate leg, the d.c. output has the proper polarity to operate as a control bias for the r.f. amplifier.

The voltage delay action is produced by the second diode plate D_2. This is connected through the large resistance R_3 to the point A of the voltage divider, the potential of A being that of the minimum bias for the controlled tubes. The AVC bias is then taken off not from the cathode but from this plate D_2, through the filter R_4C_4. With no signal the cathode is considerably more positive than A, the difference in potential representing the delay voltage. With incoming signal the cathode becomes more negative, finally reaching the same potential as A, at which time D_2 begins to draw space current. Thereafter as the cathode goes still more negative D_2 follows it in potential, for the internal resistance of the diode is very small compared to R_3. As D_2 goes negative with the cathode the controlled grids are given increasing bias and the desired AVC action takes place.

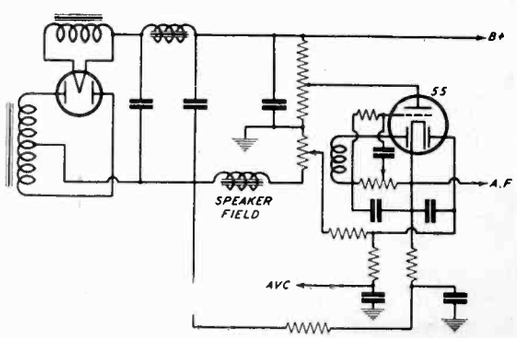


Fig. 2—Method of getting negative potential by using loud speaker field winding

D_2 is bypassed to the cathode for a.f. by the condenser C_3, so that the plate D_2 follows at all times the a.f. variations of the cathode. Hence when space current is

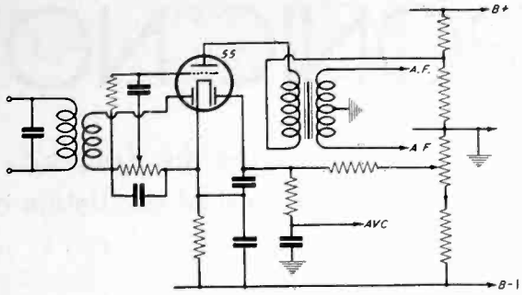


Fig. 3—Coupling the AVC-detector tube to push-pull tubes via transformer

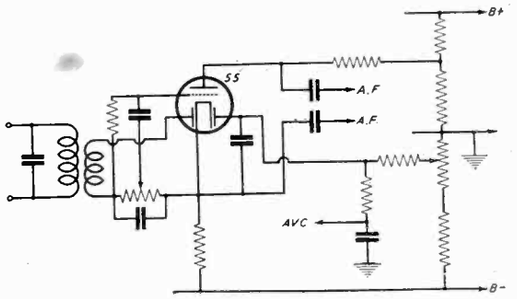


Fig. 4—The input push-pull transformer may be dispensed with in this circuit

drawn by this plate it is drawn uniformly over the audio cycle. This renders the generated AVC bias independent of the modulation, and eliminates the possibility of distortion that might occur if the space current were drawn only on the peaks of the audio cycle.

It may be desirable to make the potential of *A* variable with respect to the cathodes of the controlled tubes, as shown in the figure. This provides a means of controlling the sensitivity of the receiver.

The delay voltage, or the potential of the cathode above *A* for no signal input, depends only to a small extent upon the value of the cathode resistor, but is determined largely by the location of the plate connection to the *B* voltage divider and the resulting plate voltage. Changing tubes produces a variation in cathode voltage of the order of several volts, so that with an average delay of 50 volts or over the extreme variation to be expected from this cause is about ±10 per cent, which is quite unimportant.

A practical circuit arrangement

The most usual form that the circuit would assume in an actual receiver is probably that shown in Fig. 2. Here the necessary negative potential to ground is provided by the drop across the speaker field, which is placed in the negative leg of the power supply, still acting as a choke in this postion. Owing to the hum voltage that appears across the speaker field, additional filtering of the plate circuit of the 55 tube will probably be found necessary, inserted at the negative end of the cathode resistor as indicated in the figure.

In Fig. 1 the a.f. signal is taken from the cathode of the 55 through a blocking condenser, the grid of the next tube being biased through a leak in the conventional manner. Other methods of coupling may equally well be employed. Fig. 3 shows the use of transformer coupling. In this circuit the cathode resistor is by-passed for a.f. and acts as a d.c. impedance only.

If push-pull output without transformer coupling is desired the modification of Fig. 4 may be used. A pair of '47s can be driven to full grid swing in this manner with somewhat more than 20 volts peak carrier, 20 per cent modulated, at the detector diode, an input which is considerably less than that employed in many existing receivers to provide sufficient AVC directly from the diode. In this circuit half of the d.c. amplification is necessarily thrown away, but this is less important in view of the larger signal input. Thus in the example given 80 volts of AVC bias is available, all or most of which is used as a delay.

The indirect advantages accruing from the use of d.c. amplification are probably quite as important as the more apparent one that has just been discussed. It is regarded as conservative to say that the delay voltage should be at least as great as the bias necessary to control the strongest signal to be encountered. This gives a 2:1 rise in output from threshold to maximum input, and in the average receiver necessitates a delay of 30 to 40 volts. The diode driver (last i-f tube) is therefore called upon for an output of 60 volts peak carrier or more at the diode plate for the strongest signals, and at this output must drive two diodes, one for detection and one for AVC. At the threshold, the AVC diode places no additional load upon the driver, but as the signal strength increases the load from this source increases correspondingly.

A possible effect of the above is shown in Fig. 5. Here the performance of a certain receiver with direct AVC is compared with that resulting after the receiver had been changed over to employ the circuit described. The original AVC characteristic is shown by curve (1); it is seen that overload occurs at about 20,000 μv, in the antenna. The delay employed in this case was 30 volts. With the new detector circuit, the delay used being 50 volts, curve (2) resulted. The threshold is now much sharper and has been lowered to 90 μv, and for higher inputs the characteristic is a straight line, as nearly as it may be plotted, up to the highest input available, which was 700,000 μv.

With the usual delayed diode AVC it is hardly possible to control the last i.f. tube owing to the high outputs required from it under the load conditions that obtain. With the new circuit the required output is reduced to one-quarter or one-eighth of its former value, the load is reduced to that of a single unbiased diode and more efficient coupling into this diode may be used, still further lowering the level at which the driver stage operates. It thus would seem that partial or possibly full control may be applied to this last i-f stage. Any increase in the efficiency of coupling between driver plate and diode is accompanied by a corresponding increase in the sensitivity of the receiver, as well as in the sensitivity of the AVC threshold.

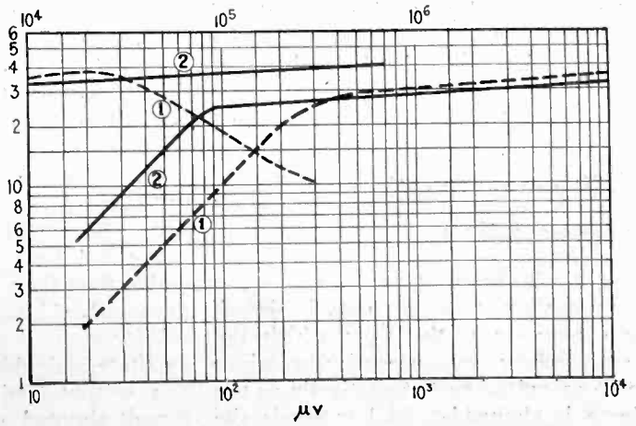


Fig. 5—Results of substituting amplified AVC for conventional circuit

✦ ✦ ✦ ELECTRONIC NOTES

Cuprous-oxide rectifier life tests

IN TESTS MADE by H. Boehm of the Westinghouse Cooper Hewitt a full-wave rectifier to which 15 volts a.c. was applied was used for charging a twelve-volt battery. After 2,000 hours the charging current fell from 0.7 amp. toward 0.5 amp. (a drop of 27 per cent). After 6,200 hours the a.c. voltage was increased to 16.2, the charging current rose to 0.74 amp. and remained at this value for over a year. The current in the reverse direction increased from 0.3 to 3.3 per cent. A very remarkable advantage of this type of rectifier is that when with continued charging the potential of the storage cell increases, due to the drop in charging current the voltage drop increases at the same time. The internal resistance may be so chosen that the charging stops quite automatically. The rectifying circuit used was the Graetz circuit with four rectifying units. The work is described in *Elektrotechnische Zeitschrift, November, 1932.*

✦

New low noise vacuum tube

WHEN COMMERCIAL VACUUM TUBES are used to amplify small low-frequency voltages, disturbances of the order of 100 to 1,000 microvolts limit the minimum voltage which can be measured in the range below 100 cycles per sec. The causes outlined by G. F. Metcalf and G. M. Dickinson of the General Electric Company, are insulating material in or near the path of the electrons, irregularity in the emission of electrons, the presence of gas, deposits on grid wires, emission of positive ions. In the PJ-11 tube described in *Physics,* July, 1932, these effects have been reduced to a point where they are of the order of the shot effect, so that low frequency voltages of less than 1 microvolt can be amplified over the entire frequency band below 100 cycles (noise output of PJ-11 is 5 to 10 microvolts, 222 tube 52 microvolts, 240 tube 65 and 112-A 85 μv.).

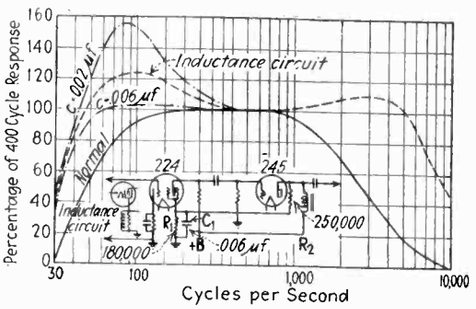
✦

Fidelity compensation by regeneration

BY A. C. MATTHEWS

CONSIDERABLE INTEREST IS displayed, this season, in methods by which the low frequency response of a receiver can be raised, often automatically as the volume is changed. At low levels the peculiarity of the audibility curve makes decreased low frequency response unusually apparent. Other reasons for boosting the bass are the losses in degeneration in bias resistors, insufficient baffle area and general circuit losses.

The schematic shown below has been used with much success in compensating the low frequency response in an amplifier. The compensation is introduced in the screen circuit of a tetrode so as to not affect the otherwise normal frequency characteristic. A portion of the signal in the output circuit is fed back



in phase to the screen-grid circuit. The resistors R_1 and R_2 are of such a value that the tube is operating with its normal d.c. screen-grid potential. Obviously an a.c. potential also appears (assuming a signal is present) across these resistors, part of which is applied between screen-grid and ground. The resistors should be of the order of 100,000 to 500,000 ohms so as not to draw too heavy a current or be an appreciable shunt on the output circuit. The condenser C_1 is of such a value so that it bypasses the higher frequencies. Increasing C_1 beyond a certain value will result in a low frequency oscillation. The value is not extremely critical however and an approximate frequency characteristic may be calculated at a given output level if the original fidelity is known. The impedance of the screen-grid circuit decreases with frequency thus the voltage fed back through the tube is greater for the lower frequencies. (Measurements indicate that the amplification factor between the screen-grid and plate under normal operating conditions is about twenty.)

This method of fidelity compensation actually adds to the fidelity curve and does not depend on the suppression of the other frequencies. Should it become necessary to compensate for the high frequency end of the audio characteristic C_1 is replaced by an inductance. This will result in more voltage being fed back at the high frequency end rather than at the low end and an appreciable hump will appear in the fidelity curve. Some requirements necessitate a double humped curve. This can be obtained by a series resonant circuit shunted across resistor R_1. The point of resonance of course may be shifted to suit the individual case.

Measuring the damping coefficient of oscillating circuits

THE CIRCUIT examined by V. Petrzilka and W. Fehr of the Heinrich Hertz Institute in which the frequency f_2 could be varied, was coupled inductively to a quartz-controlled tube which oscillated at a constant frequency f_1, and the current I_1 and I_2 was measured for different values of f_2. The half-width of the curve at $I_2^2/I_1^2 = \frac{1}{2}$ the resonance value when I_2^2/I_1^2 is plotted as a function of $1 - f_2^2/f_1^2$ is equal to the damping $R_2/6.28\,f_2L_2$, whatever the amplitude and the coupling used. The October, 1932, issue of *Zeitschrift für Technische Physik,* contains the paper by the German experimenters.

✦

The thyratron as an oscillator

IF IN CERTAIN types of thyratrons, such as the FG-67, the anode is connected to the positive side of a d.c. source through sufficient resistance, and a condenser in series with a small inductance is connected between cathode and anode, oscillations are set up in the anode circuit when current is allowed to pass. The oscillations according to H. J. Reich, University of Illinois, resemble those obtained in neon-tube circuits. The current can be permanently stopped if the grid is made negative while the circuit is oscillating. If load resistance is replaced by the primary of a transformer, a.c. may be taken from the transformer secondary (100 watts from 120 volts d.c. at 50 per cent efficiency). All these effects are based on the breakdown voltage being much higher than the operating voltage. The *Review of Scient. Instruments* for October, 1932, contains the data on Professor Reich's work.

✦

Practical vacuum-tube potentiometer

THE COMPTON ELECTROMETER having been found unsatisfactory, F. Rosebury, College of Physicians and Surgeons, New York, applied the low-grid, low plate voltage FP54 for pH measurements with glass electrodes. Galvanometer drift was reduced to a minimum by automatic compensation for filament voltage changes and floating of filament battery on a charging source. It is advisable, when first setting up the instrument, to test a batch of glass cells for potential drift; after some days the readings will be found nearly constant. The use of the FP54 is described in *Industrial and Engineering Chemistry,* October, 1932.

FROM THE LABORATORY + + +

Amplification at 7 meters

BY ENCLOSING THE ELEMENTS of two tubes in the same bulb, the Loewe vacuum-tube factory (Germany) has found it possible to get appreciable amplification at wavelengths of the order of 7 meters. The inherent capacity between tube elements has been reduced by this measure, and by sealing in the bulb the inductance and capacity used to couple the two tube elements together. Manfred von Ardenne writing in the *Hochfrequenz Technik und Electro Akustic,* August, 1932, describes these tubes which have a mutual conductance of 2000 micromhos. Two of them with 200 volts on the plate deliver an amplification of 100 over a band width of 500,000 cycles at 7 meters. This is sufficient for television reception.

✦

Long versus short broadcast waves

STUDIES ON THE COMPARATIVE EFFICACY of frequencies in the present broadcast band made by Professor J. F. Byrne of Ohio State University show why broadcast stations are so desirous of getting assignments on the lower frequencies. Professor Byrne measured the field strength in Ohio of nine stations operating on various frequencies in the present band. These field strengths were then reduced to a common basis, that of one kilowatt of radiated power and therefore a picture was had of the comparative value of the longer versus the shorter broadcast waves.

The experiments did not take into account the conditions peculiar to the transmitter, i.e., ground conditions, steel buildings or other variables; it consisted merely in measuring the fields laid down in Ohio by these stations.

Professor Byrne's measured data showing that a one-kw. station on 1450 kc. will have a field strength of 0.2 millivolts per meter at 45 miles, on 1070 kc. the distance will be 75 miles, on 700 kc. the same field strength will be found at 110 miles, and on 550 kc. the distance will be 135 miles. Thus the distance is roughly inversely proportional to the frequency.

Other comparisons, as reported by Professor J. F. Byrne, show that to deliver 0.5 mv/m costs $2.06 per square mile of service area on 550 kc., $5.88 on 1070 kc. and $15.50 on 1450 kc. These costs are figured on an annual charge of $50,000 for a one-kw. station.

✦

Control by "non-linear" circuits

FOR SOME TIME work has been under way in the laboratories of the General Electric Company on the uses of non-linear circuits for purposes of control. Present circuits will cause a lamp to flash, dim, or brighten in any desired sequence or rate.

Other experiments have brought to light circuits which are oscillators or generators of alternating currents, more or less functioning like vacuum tubes. One circuit produces slow oscillations which will turn on and off an incandescent lamp several times per second or as slowly as once in thirty seconds, according to the arrangement of the circuit. Another oscillator has blinked a light on and off silently, without radio interference, and without wearing parts, approximately 100,000,000 times in the past two years while on life test in the laboratory.

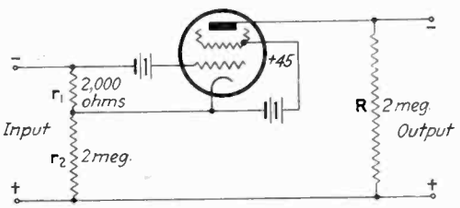
Another oscillator produces relatively high-frequency alternating current. It was known for some time that high frequencies could be produced in transformers under certain conditions, but these frequencies are always multiplied or integral fractions of the frequency of the power supply. The new oscillator will produce any frequency in its range of usefulness; vibrations of 5,000 cycles per second already have been observed audibly in the laboratory.

Still another application of non-linear circuits has been in resonance relays. Such relay circuits, which function because of "voltage resonance" and "current resonance" principles, are so sensitive that a voltage change of as little as 1/100th of one per cent will cause a current change of 100 per cent. Relays of this type are adjusted by changing electric constants rather than mechanical constants, and are therefore practically free from the effects of wear, friction, dirt, and extremes of temperature; the burden of accuracy is placed on a circuit, where accuracy may be obtained economically with perfect reproducibility.

✦

Thermionic tetrode voltage control

FOR SMALL CURRENTS (0.01 microampere) but very constant voltage, the rectified a.c. from a transformer operating from the lighting circuit and controlled by a 24-A type tube is far more steady than a battery of storage cells of one ampere-hour capacity according to J. C. Street and T. H. Johnson of the Bartol Research Foundation. The voltage supply from the rectifiers is connected across two resistances r_1 and r_2 in series, the drop across r_2 being the supply voltage for the plate and that across r_1 for the grid. The description in the *Journal of the Franklin Institute,* August, 1932, states that for a variation of 60 volts in the input voltage (from 1580 to 1640 volts) the output voltage varied less than one volt.

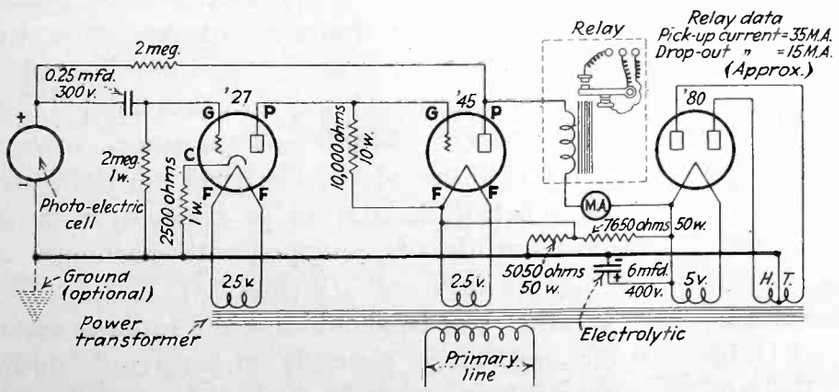


✦

Photocell-amplifier circuit

AN AMPLIFIER TO BE USED with a photocell which will operate directly a Square D magnetic contactor capable of handling 20 amperes at 440 to 550 volts has been designed by Harry L. Kagamaster of Akron, Ohio. The circuit is given here and will be seen to consist of a very simple arrangement of apparatus which will control considerable amounts of power without any intermediate relay.

✦ ✦ ✦



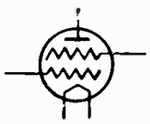
Circuit for operating a Square D contactor from a photocell through a two-stage amplifier

electronics

McGraw-Hill Publishing Company, Inc.
330 West 42d Street
New York City

O. H. CALDWELL, *Editor*

Volume VI — JANUARY, 1933 — Number 1



Technocracy's strength and weakness

READERS of *Electronics* have long watched with interest and concern the social and economic results of the mechanization of industry, which the Columbia University group known as Technocracy now seek to reduce to a statistical basis. Such statistics are needed, and Technocracy deserves credit for its double-stroke in putting unemployed engineers to work to get the facts on unemployment.

But Technocracy's interpretations, and the solutions proposed by individual Technocrats, will be examined critically, by engineers as well as by economists. They have their weaknesses. Even an "energy dollar" or an "electricity dollar" would be speedily demonetized, with the inevitable increasing efficiency of the photo-cell to utilize the 200 watts of free energy which pours down in every square foot of sunshine. Even the units set up by Technocracy itself are not impregnable against the ceaseless attack of scientific research and invention, which falls upon technocrat and plutocrat alike.

550 versus 1,500 kilocycles

AS A RESULT of a field-strength survey in Ohio of broadcast stations on several frequencies made by Professor J. F. Byrne of Ohio State University, and reported in its Bulletin 71, there is no longer any need or excuse for an ostrich-like attitude on the relative merits of frequency assignments at the two extremes of the present band. Although the research did not take into account unfavorable location of the transmitter, the results are most important.

Professor Byrne's studies conclusively prove "that the different frequencies in the broadcast band cannot be treated as equivalent, and that frequencies of 1,000 kilocycles or above are uneconomical for large coverage and high power. They also indicate that low power stations are at present wasting good low frequency assignments that are suitable for high power and large coverage. It is realized that the political problems involved in any contemplated changes are indeed difficult, but the engineering and economic solutions are clear and straight-forward; and if these solutions are kept in mind, time may solve the apparently insuperable difficulties of a political nature now existent."

Musical instruments— a new electronic industry

THE rôle played by the radio "fan" of a decade ago is well known; statistics show that hundreds of thousands of listeners were introduced to "music in the air" by home-made apparatus that furnished the thrill of hearing sweet music as well as the joy of making something with one's own hands.

Is it impossible that a new industry—that of electrical musical instruments — might not be built up in just this same manner? Might not the vast population, for generations more or less skilled in making its own music, grow tired of canned tunes, especially those selected by others? Might not people desire to express their own emotions on their own instruments instead of having their music diluted with talk handed them by advertisers? Might not the desire to build things create out of the electrical musical instrument a new fad, later to be taken over by the radio plant already equipped with machinery for its manufacture and distribution?

In other words, should not the radio manufacturer look more seriously at electrical musical instruments that can be built out of radio components by methods already in wide use?

News of the electronic field

Radio Forum discusses noise elimination—At the first Radio Forum conducted by the Radio Club of America at Columbia University, New York City, December 17, engineers discussed various methods of reducing extraneous noises picked up by radio receivers. Preceding the Forum, C. E. Brigham, chief engineer of Kolster Radio outlined the engineering attack made by his company on this problem. Contributions to the discussion were made by C. W. Horn, general engineer National Broadcasting Company; F. X. Rettenmeyer of the Western Electric Company; J. G. Aceves, for many years right-hand man in Professor Pupin's laboratory; C. J. Franks of the Radio Frequency Laboratory; and Keith Henney, associate editor of *Electronics* and editor-in-chief of the new McGraw-Hill Radio Engineering Handbook.

Photocell exhibit at Columbia University—Many examples of light-sensitive cells of both the past and present art have been placed on exhibit at the Physics Building at Columbia University. The collection has been made by Mr. Samuel Wein and is in charge of Professor Stone for the University.

Automotive and radio engineers cooperate—Thirty engineers of radio manufacturers held an important meeting Dec. 2, at Detroit on the development of automotive radio. The conference was directed by Chairman Virgil M. Graham of the RMA standards committee. Special work was accomplished on B power supplies of various types and work begun on standardized instruction for ignition suppression. A sub-committee was appointed to prepare specifications on the measurement of sensitivity in automobile receivers. Other sub-committees will cooperate with the automotive engineers' wire commitee on the subject of connecting cables for radio receivers and work on standard instructions for ignition suppression methods including a standard "suppressor kit" and instructions for car antenna installation.

Society for electronic music—The Berlin Radio Show brought to light such a deep interest in electronic musical instruments that a society has been formed in order to further the technical as well as the artistic side of the new movement. Among the founder members are: Prof. George Schuenemann, director of the State Conservatory; Prof. Dr. G. Leithaeuser of the H. Hertz Institute; Dr. Fr. Trantwein, inventor of the Trautonium; Carl Bechstein, builder of the Neo-Bechstein Grand Piano, etc. The secretary is W. Zerlett, Berlin W 57.

A. S. Wells, chief engineer of RMA—As A. S. Wells, president of the Gulbransen Company of Chicago was unanimously elected by the board of directors of the Radio Manufacturers Association to be chairman of the engineering committee, succeeding Franklin Hutchinson of New York who resigned. Mr. Wells will have charge of all engineering matters of the association. No changes in personnel of the engineering division, of which Dr. C. E. Brigham of Newark, N. J., is director, or its sections and sub-commttees, is planned. Mr. Wells also will have charge of the new RMA Engineering Institute and the new official RMA seal plan.

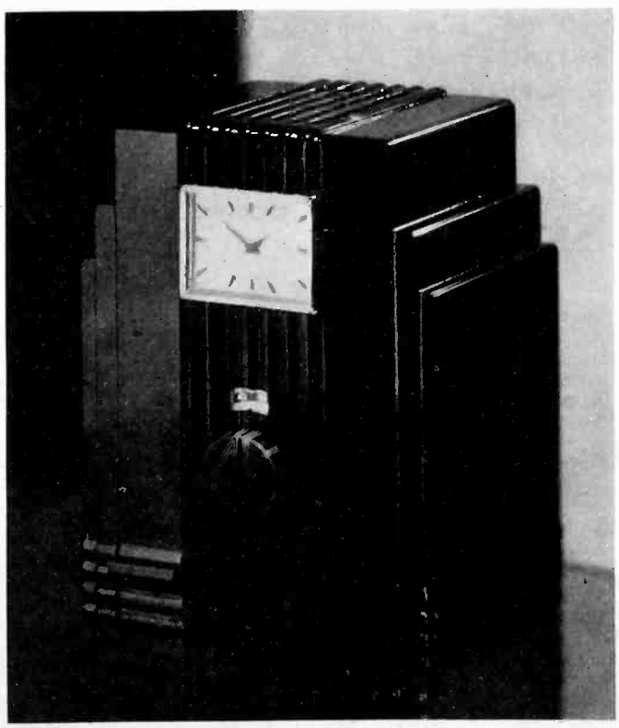
Joseph Henry's radio flash of 1840—During a tribute to Joseph Henry, early American scientist, who produced the first telegraph (1830) and the first motor (1831), and discovered electromagnetic induction and self-induction (1832), Henry's experiments with space radio across the Princeton campus in 1840, were demonstrated over the NBC Blue Network, Dec. 17. Henry's own description of his experiment follows: "When the discharge of a battery of several Leyden jars was sent through the wire stretched across the campus in front of Nassau Hall, an inductive effect was produced in a parallel wire the ends of which terminated in plates of metal in the ground in the back campus, at a distance of several hundred feet from the primary circuit, the building of Nassau Hall intervening. The effect produced consisted in the magnetization of steel needles."

Radio City's first broadcast—A four-hour program over the National Broadcasting System, Dec. 27, marked the first broadcast from the new $250,000,000 radio center, and signalized the opening of the two great music halls to be conducted under Roxy's direction. The Radio City Music Hall seats 6,200, and has elaborate lighting effects controlled by 4,100 switches. Thyratron dimmers are operated through selsyn motors from a centralized switchboard. Not until next September will the NBC studios be installed in Radio City, delay in beginning the manufacture of the apparatus having resulted from the Government suit. Production is now underway and installation will proceed during the summer.

Electronics, Volume Six—With this issue *Electronics* begins its sixth volume. This is the thirty-fourth consecutive number since the magazine first appeared in April, 1930. Following the usual McGraw-Hill practice of bringing the publication's history down to date in each January number, the members of the editorial staff who have been continuously with the paper from the first issue, are as follows. Orestes H. Caldwell, editor; Keith Henney, associate editor; Helen Sheridan, make-up editor.

✦

MIDGET, 1933 MODEL



Artistic, compelling design will be a force to sell more radio sets in 1933. Gone, the old "tombstone" lines, this attractive set was modelled by Vandoren and Rideout, Toledo

Tubes with cold cathodes

[*Continued from page 6*]

were made. In one case a single-tube demodulator made audible throughout the auditorium local broadcast programs. The signals were not loud but in another set employing a detector, a single audio amplifier followed by a stage of push-pull amplification, all using the glow-discharge tubes, the signals were comparable to present-day receivers. The volume corresponded to an output level of the order of several hundred milliwatts. The tubes had a distinct purple glow in them.

Following the demonstration, Mr. R. D. Duncan, chief engineer of Wired Radio, Inc., explained that the tubes were the result of the desire on the part of his company for radio receivers on which the service costs would be reduced to a minimum. Wired Radio, a subsidiary of the North American Company, has complete plans and apparatus for introducing a program service to the home by means of power wires on a rental basis. In such a system the company would bear the cost of servicing receivers, and tubes which could be integral parts of the receiver and not require replacement would be a distinct advantage.

Mr. Duncan intimated that tubes would be ready for the market within a reasonable period. Characteristics of the tubes will be available to engineers within a short while, he said.

▼ ▼ ▼

Control of sound quality in picture production

[*Continued from page 12*]

distortion which necessitated costly retakes. Had the tracks been visually inspected after the first day's work, the shutter difficulty would have been corrected before the equipment was again permitted to be used in commercial recording.

While judgment of quality, amplitude control, etc., are not materially different in picture recording than, for example, in broadcasting, the picture field has its peculiar difficulties. As in other forms of trouble shooting, experience constantly teaches one new peculiarities, some of an unforeseeable nature. For example, on some stages there is a certain amount of 50-cycle field which, when picked up by microphone cables or other conductors, affects the track as a wavy line or "snake," on which the rest of the modulation rides. Now, a 50-cycle note is not audible in a monitoring speaker, so that it is difficult to check its presence at ordinary amplitudes. As long as open tracks were used in recording by the variable area system, a few mils of 50-cycle modulation on the track were of no particular consequence. But when noiseless recording was introduced, with its microscopic spacing between the modulation peaks and the light blocking shutter, difficulties were encountered from this source. Thus it became necessary to introduce an additional check, which merely consisted in opening and closing the vibrator circuit, any movement indicating the presence of 50-cycle or other inaudible pickup. This indication corresponds to the key clicks heard in a radio receiving set which is picking up an unmodulated and unheterodyned carrier.

In coping with the unique problems of motion picture sound recording, the engineer takes advantage of the fact that his film recorder is in effect an oscillograph which can always be used to photograph its own action. Figures 6 and 7, which are reproduced from film negative, show the technique involved. Figure 6-*A* shows a noise reduction shutter moving out to accommodate modulation, but it takes 0.014 second to clear, and in this interval there is considerable cutting of peaks. In (*B*) of Fig. 7, the corresponding decrement is shown as the modulation ceases. In Fig. 7, a modification of the noise reduction amplifier has resulted in a more agile shutter action, so that only about 0.004 second is required for clearance, but it will be noted in (*B*) of this figure that in going back to dead clearance the shutter manifests a transient bouncing action which prevents it from dropping immediately to the minimum clearance. The illustration is typical of the methods used in checking the action of sound recording apparatus in a well-operated studio.

▼ ▼ ▼

A NEW BOOK ON AN ELECTRONIC SUBJECT

Electronics

By Ralph Gorton Hudson, Professor of Electrical Engineering, Massachusetts Institute of Technology. 135 pages, 45 illustrations, several tables. Price $2. Published by John Wiley & Sons, Inc.

IN HIS PREFACE TO *Electronics*, a book dealing almost exclusively with the properties of electrons rather than the uses of electronics apparatus, Professor Hudson states, "it is quite probable that the advancement of science during the next quarter century will relate more definitely to electronics than to any other subject. Each step in the progress may be expected to suggest practical applications of electronics theory which will give man increasing control of the forces of nature."

The book is to bring the engineer, or other user of electron tubes up to date, in the matter of what electrons are, how their properties were discovered, what these properties are, what the atomic theory of gases is, the facts with respect to conduction in metals, in liquids and in gases, and theories of radiation and electron and photoelectric emission. The final chapters of this small book deal more with the practical uses of electrons in motion, and more nearly correspond with what many people understand as "electronics."

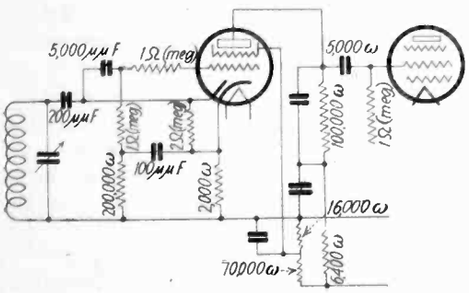
The book is without mathematics which is desriable, is sound, and in very small space undoubtedly covers a good bit of the ground leading up to the application of electron circuits. A better title would have been desirable; surely the single word "Electronics" is ambiguous.

REVIEW OF ELECTRONIC LITERATURE

HERE AND ABROAD

Philips binode tube

A NEW TUBE SPECIALLY for detection, essentially a combination of a diode as detector (small auxiliary anode close to one end of the cathode) with a



screen-grid tube as amplifier. Amplifications of 70 to 80 times are claimed, in such a circuit as shown.—*L'Onde Electrique* (advertisement), Paris, September (published December 5) 1932.

✦

Vacuum-tube voltmeter with logarithmic calibration

[F. E. ROMMEL] Development Laboratory, Neufeldt and Kuhnke, Kiel. For many purposes, for instance the recording of sound intensities in decibels, the testing of loudspeakers and receivers, a vacuum-tube voltmeter with a logarithmic scale saves much time. In some of the variable-mu tubes the relation between grid bias and anode current is given by an exponential curve between —6 and —26 volt bias, while the plate current varies from 2 to 0.2 ma. By applying the potentials over a voltage divider the sensitivity of which can be varied ten or hundredfold, a good logarithmic scale of sufficient range can be obtained when using the best portion of the characteristic (bias varies in the ratio 1:2, current in the ratio 1:10). —*Hochr. u. El Ak. 40:124-126 (October, 1932).*

✦

Differential selenium obverse photocell

[L. BERGMANN] University of Breslau. A cut is made through the selenium layer and the metal film with which it is covered and each part is shunted by a resistance in order to give the same sensitivity to the two halves. The electrodes are so connected that no photocurrent flows when the two halves are evenly illuminated. In many measurements it is possible to throw light from one part of the measuring system upon one side of the double cell and light from another part upon the second half. Any change is indicated by flow of current. Changes in length can be measured if the object be made to vary the width of a slit which lets a strong light fall upon the line of separation. Small angles of rotation can also be measured by means of this very compact device.—*Zeits. f. techn. Phys. 13:568-573. November, 1932.*

✦

Television progress in Germany

[E. H. TRAUB] A review comprising a dozen pages and 19 figures dealing with the television receivers exhibited at the Berlin radio show with a handy list of transmitters and receivers. The Telefunken cathode ray receiver gave the best images. No details of the electrode arrangement could be obtained. The Telefunkn-Karolus Kerr cell receiver gave an image equal in size, brilliance and almost in definition to the 9.5 mm. home cinema, but the high voltages needed make the instrument unsuitable for home use. In the Loewe cathode ray receiver, about as good as that of Telefunken, the path of the ray is governed by a sweep circuit which is controlled by special synchronization signals, the tube gave a picture 9x12 centimeters. Mirror screws now being developed give clear images 13x15 cm. of films showing motor boat and bicycle racing.

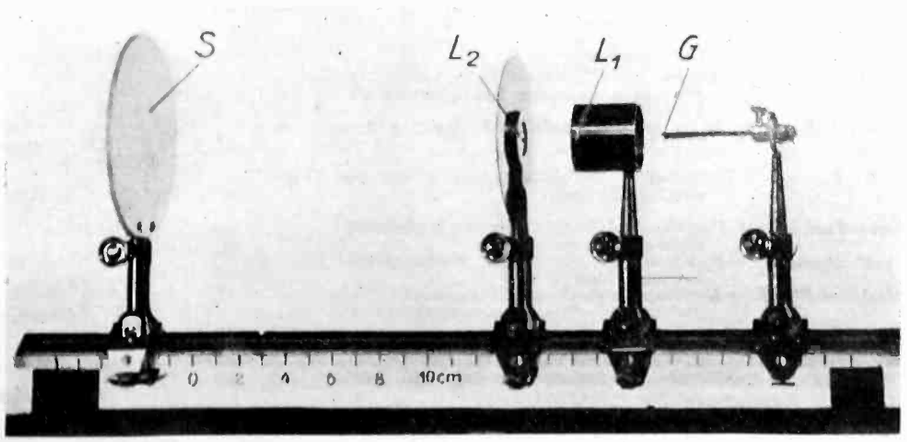
The 43,000 kc. 15-kw. transmitter was sending out a film daily during one hour in the morning and one hour in the early afternoon. The transmitter is described in *Fernsehen, Oct./Dec., 1932 —Journal of the Television Society, 1:155-166, September, 1932 (published November, 1932).*

✦

Transmitting tubes

[W. E. KUEHLE] Telefunken Laboratory. One progress made during the past four years in the construction of new transmitting tubes by Telefunken consists in the reduction in size of the tubes giving the same power. This was rendered possible by the introduction of hard glass which allowed the use of heavy lead-in wires so that the electrodes could be directly mounted on these wires and by a method of blackening the plate with a substance acting also as a getter in radiation-cooled tubes. Indirectly-heated cathodes can be used for powers up to 100 watts. A remarkable water-cooled tube is the 300,000 watt tube which has been in operation for some time (plate voltage 10,000) and which unlike the English giant tube (see *Electronics,* 1931) is completely sealed off. The full emission of 200 amp. is obtained with 800 volts on the plate (250 milliamp. per volt). The RS 282 is a 100 watt tube for 12 m. waves, the RS 291 for the same service is indirectly heated, the RS 296 gives 4 watts at 55 cm. in the Barkhausen-Kurz circuit (400 volts on the plate). A list of 34 tubes is given.—*Telef. Zeit. 13:5-19 (July) 1932 (published November, 1932).*

THE ELECTRONIC MICROSCOPE



The filament *G* sends out electrons, and when placed close to the diaphragm L_2, the opening in L_1 and L_2 act like lenses. An enlarged picture of the filament is produced on the screen *S* by the electrons themselves. The entire set-up is placed under a glass jar and evacuated. (See *Electronics,* December, 1932, page 377)

Hot cathode X-ray tube design

[W. R. HARPER] University of Bristol. The body of the tube is a block of copper bored out at one side to take the filament, and from the other to take the water-cooling, the partition between the two chambers being 1½ mm. thick and serving as anti-cathode. The X-rays leave the tube through a window of nickel foil 0.015 mm. thick. Every part is as rigid as possible and an X-ray beam can be maintained constant to within 1 per cent over a period of several hours and reproduced.—*Cambridge Phil. Society Proceedings, October-December 1932.*

✦

Micro-waves

A MICRO-RAY EQUIPMENT has been ordered from Standard Telephones and Cables, Herndon, by the English air ministry for use in cross-Channel flying service. The equipment ordered will work on a wavelength in the neighborhood of 15 cm. (in place of 18 cm. —see *Electronics*, July, 1931). It will be located at Lympne airport, near Hythe, and will correspond to the outfit ordered by the French Air Ministry for St. Inglevert aerodrome seven miles southwest of Calais. Teleprinters will be used for both receiving and transmitting messages.—*The Electrician, p. 655, November 18, 1932.*

✦

Oscillating crystals

[LOEST] Chiefly based on Haban's recent experiments. Various combinations are discussed, among which one of the most suitable was found to be a mixture of five parts of Mn_2O_3 to three to two parts of V_2O_5, both finely powdered so as to give a multiplicity of points of contact between the two substances, and the mixture pressed strongly between two steel electrodes about one millimeter apart. Such an arrangement is found to give a good and constant falling characteristic (negative resistance).—*Funk, Berlin, November 25, 1932.*

✦

Theory of gramaphone registration

[GUNDLACH] Mathematical treatment of the mechanics of disc-recording, especially from the point of view of the amateur.—*Funk, Berlin, November 25, 1932.*

✦

Transient conditions and time-factors

[ROCARD] Mathematical study of such conditions for the principal circuits used in radio, especially as applied to the setting up of a current in a series of tuned circuits (whether from a single impulse or a sinusoidal voltage); the same for a double circuit capacity- or inductance-coupled (band-filter type); time-constants in general and for certain important cases (tuned circuit, regenerative detector, transformer-coupled amplifier with tuned secondary, or with both primary and secondary tuned); action of a relay from an atmospheric arriving at the receiver. This last application is of special importance, giving striking results: for example, two circuits of the same number of elements and having sensibly the same selectivity may offer entirely different results as regards response to such disturbances.—*L'Onde Electrique, Paris, September (published December 5) 1932; and to be continued.*

✦

Amplitudes of sound from musical instruments

[K. W. WAGNER] H. Hertz Institute. A small calibrated condenser microphone, corrected to give the same sensitivity between 60 and 10,000 cycles and followed by an amplifier, is used for measuring sound pressures from about 0.03 μ bar (about 1/300,000 grams per sq.cm.), the noise level of the Berlin broadcast studio, to over 150 μ bar (concert given by big choir) near the spot usually occupied by the microphone. During an organ recital the sound pressure amplitudes varied between 1 and 21 μ bar, during a piano concert from 0.06 to 14 μ bar, during a soprano solo from 0.08 to 25 μ bar, and similar results were obtained for string quartets and small choirs. For a large choir (250) and orchestra (110), however, there was a variation from 0.5 to 150 μ bars at 18 m. from the conductor. The maximum power developed by musical instruments is given as 0.006 watt for the violin, 0.06 for the flute, 0.27 for the piano, 0.3 for the trumpet, 3.5 watts on an average for the organ, 6.4 watts for the trombone, 12 watts for the drum and the deep registers of the organ, these values being in good agreement with American measurements.—*Sitzungsberichte preuss. akademie, No. XXV. November, 1932.*

✦

Industrial automatism

[KLONINGER] General article: some uses of the photo-cell are given (the A.E.G. counting apparatus, a device based on a reflected ray for automatic train-stopping).—*Science et la Vie, Paris, December, 1932.*

✦ ✦ ✦

Electronics abstracts

IN 1931 THE YEAR BOOK of the Institute of Radio Engineers presented a list of some 60 periodicals of interest to radio engineers. Of these more than a dozen are written in foreign languages, and another dozen are scientific publications unlikely to fall into the hands of an engineer. Abstracts of the most important articles appearing in these periodicals are presented in *Electronics.*

Besides the periodicals given in the list a large number of trade journals and periodicals for the amateur are also published similar to *Wireless World, Radio-Helios, Funkmagazin, l'Antenne, Radio-Magazine, Radio per tutti,* etc.

Moreover, with the growth of electronic applications, descriptions of many devices using vacuum tubes appear in technical magazines, such as *Iron Age, Journal of the Textile Institute, Electrical World, Industrial and Engineering Chemistry.* Every attempt will be made to bring these articles to the attention of the readers of *Electronics.*

The periodicals can be consulted at any large library, and obtained through booksellers or subscription agents.

Abbreviation	Complete Name	Volumes in 1933	Editor and Price
Alta Fr.	—*Alta Frequenza*, Rivista di Radio tecnica, Telefonia e Acustica Associazione Electrotecnica, 10 via San Paola, Milano	2	Lire 30
Arch. f.Elek'rot	—*Archie für Elektrotechnik*, J. Springer, Linkstrasse 23-24 Berlin	27	Prof. Dr. W. Rogowski (Price variable)
E. N. T.	—*Elektrische Nachrichtentecknik*, J. Springer, Linkstrasse 23-24 Berlin	10	Prof. Dr. K.W. Wagner R. M. 48
Ferns, Tonf.	—*Fernsehen und Tonfilm*, Hermann Reckendorf Hedemannstrasse 24 Berlin	4	Dr. F. Banneitz R. M. 12
Funkt. Monatsh	—*Funktechnische Monatshafte*, Weidmann'sche Buchhandlung, Berlin S W 68	2	
Hochfr. u. El. Ak.	—*Hochfrequenztchnik und Elektroakustik.* Akademische Verlagsgesellschaft Markgrafenstrasse 6 Leipzig	41	Prof. Dr. J. Zenneck and Dr. E. Mauz R. M. 40
Onde Elec.	—*L'onde electrique*, Etienne Chiron, 40 rue de Seine, Paris (VI)	12	M. Mesny 80 francs
Phys. Zeits	—*Physikalische Zeitschrift vereinigt mit.*, Jahrbuch der Radioaktivitat und Elektronik S. Hirzel, Leipzig	34	Prof. Dr. P. Debye Prof. Dr. R. Seeliger $16.80 T. Brillouin, etc. 150 francs
Revue ac.	—*Revue d'acoustique*, Les Presses Universalitaires 49 Boulevard Saint Michel, Paris (V)	13	Dr. G. von Arco, Prof. Dr. F. Schroeter R.M. 6
Telef. Zeit.	—*Telefunken Zeitung*, Telefunken Gesellschaft, 12 Hallesches Ufer Berlin SW 11	6	
Tijds. Nederland	—*Tijdschrift van het*, Nederlandsch Radiogenootschap 11 Elzentlaan, Eindhoven, Holland	2	Prof. Dr. E. W. Scripture
Zeitz. Exp. Ph.	—*Zeutschrift für Experimental*, Phonetik Joh. Ambr. Barth, 18 B Salomonstrasse, Leipzig	14	Dr. W. Hort, R.M.51
Zeits.f.techn.Physik	—*Zeitschrift für technishe Physik* Joh. Ambr. Barth. 18 B Salomonstrasse, Leipzig		

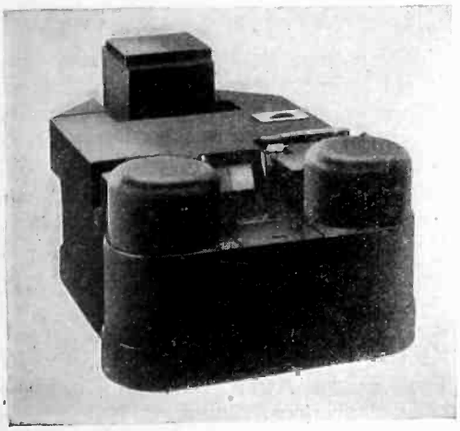
+ NEW PRODUCTS

THE MANUFACTURERS OFFER

Photoelectric scopometer

A NEW PHOTOELECTRIC SCOPOMETER is announced by the Bausch & Lomb Optical Company, Rochester, N. Y., for making turbidimetric and colorimetric measurements with greater speed and greater accuracy. It dispenses with the human eye for making the delicate color matches and notation of disappearance points, thereby giving it a combination of speed and accuracy otherwise impossible. Furthermore it is extremely simple in its operation.

The human eye is affected from hour to hour by physiological and psychological conditions. At best it is never as exact at matching colors and otherwise measuring light strength as could



be desired. Fatigue and other causes will still further decrease the eye's efficiency. A matched pair of photo-electric cells registers the light intensities accurately and without variation. The photo-electric cell is extremely sensitive to change in light intensity and it is not affected by long usage.—*Electronics, January, 1933.*

✦

Volume indicator

A NEW LINE OF volume indicators for the broadcast field is announced by The Daven Company, Newark, N. J. The instruments are of the copper oxide rectifier type and are furnished mounted in a box for laboratory use or on standard rack panel. The multiplying network is of the L type and is made with a constant impedance of 5,000 ohms. Standard units are furnished with 2 db. per step.

Daven volume indicators are obtainable in two sensitivities. The standard unit, most suitable for ordinary purposes, has a range from —10 db. to +46 db. Besides this there is also a special meter having a range from —20 db. to +36 db. The first one has a sturdy movement which will stand much abuse, while the second type is extremely sensitive and should only be used where such sensitivity is expressly required.—*Electronics, January, 1933.*

✦

Solder in improved package

THE FEDERATED METALS CORPORATION, 75 Folsom St., San Francisco, Calif., is now manufacturing rosin-core and acid-core solders in its exclusive "neatpak" can.

The Neatpak can has a hole in the top. This hole is covered with cellophane, preventing dust or dirt getting to the solder while in storage.

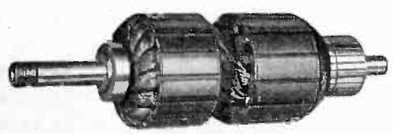
When the solder is to be used, the cellophane is broken and as much solder as required pulled out. This prevents tangling, and also waste, inasmuch as only as much solder as required is pulled through the hole.

Neatpak acid-core and rosin-core solders are packed in one and five-pound cans.—*Electronics, January, 1933.*

✦

AC-DC generator

ABILITY to produce constant voltage at variable speeds is one of the outstanding features of the Upp combination D.C.-A.C. generator, for automobile radio and sound equipment operation, now being manufactured by the Whitaker-Upp Company, Kansas City,



Mo. This generator is mounted under the hood, is driven by the car engine, and produces both 6 volts D.C. and 110 volts A.C.

A 60-watt model for auto radio and a 200-watt model for portable sound equipment are now in production, after two years of development and testing. —*Electronics, January, 1933.*

Self-generating photocell

THOMAS RHAMSTINE, MANUFACTURER OF precision electrical apparatus, 508 East Woodbridge St., Detroit, Mich., has developed a new self-generating type of photoelectric cell or "electronic" cell, as it is named, of the dry-disk type which transforms light energy directly into electrical energy, without the aid of batteries or any other source of emf. Tested on a direct-current milliameter, the cell generated from 5 to 7 milliamperes in direct sunlight.

This self-generated current is always directly proportional to the light intensity.

Exposure to strong light or any climatic condition has no effect on the cell's efficiency, and it generates electrical energy at no expense to the materials used in its construction. It is of apparently unlimited life. Durably constructed of metal, except for the plain lens over the face of the cell, with reasonable care it should last indefinitely.

In combination with a sensitive relay and an auxiliary relay power circuits can be turned on or off. In addition to all the known commercial and industrial applications, which become more numerous every day, the Rhamstine Electronic cell is an ideal unit for the experimenter and the student.

The cell measures $2\frac{3}{8}$ in. diameter and 1 in. thick. It is equipped with two connection prongs which fit the standard UX radio tube socket. — *Electronics, January, 1933.*

✦

Relay

A NEW LINE OF RELAYS developed by the Westinghouse Electric & Manufacturing Company, 95 Orange St., Newark, N. J., is especially applicable to circuits. The slow movement of a telephone-type relay armature when carrying an appreciable current often results in severely burned contacts. But on the new relay a "hold-in" contact is provided which keeps the auxiliary relay coil circuit closed, even though the controlling relay may chatter or make intermittent contact.

The non-inductive contact rating is 15 amperes, 120 volts, a.c. or d.c. The coil circuit is regularly supplied for 115 volts, 60 cycles. The coil current is approximately 150 milliamperes when the relay armature is open, and half that value when closed. List price, $7.50.—*Electronics, January, 1933.*

✦

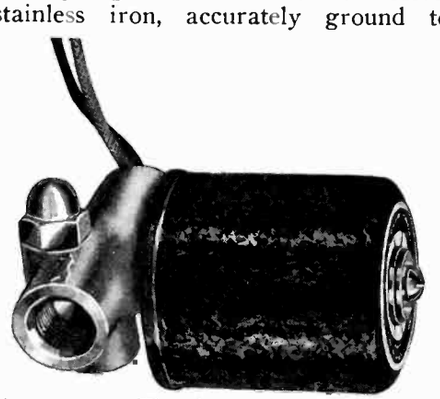
Amplifiers and laboratory equipment

KENDALL CLOUGH AND RALPH BRENGLE, formerly chief engineer and general superintendent respectively of Silver-Marshall, Inc., announce the formation of The Clough-Brengle Company with headquarters at 1134 West Austin Ave., Chicago. Associated with them are Ralph P. Glover, who was sound engineer at the former company, and Leon Worner, recently inspection engineer for the same concern. The newly formed company will manufacture laboratory and production test equipment, amplifiers and accessories for sound, broadcast and recording applications, radio specialties and a complete line of audio amplifier and speech-input transformers. In addition to manufacturing, the firm will also engage in consulting engineering on radio receiver and special equipment designs, and on plant layout, cost and production problems.—*Electronics, January, 1933.*

✦

Electrically-operated valves

THE DETROIT LUBRICATOR COMPANY, Trumbull, Lincoln, Marquette and Viaduct, Detroit, Mich., manufactures a complete line of electric solenoid-operated valves for water and other fluids, which are adapted for control through photo-cells and other electronic devices. The coils of the solenoids are impregnated to resist moisture, tested to 1,500 volts, and will carry rated current indefinitely. Coils may be changed without removing valve from the pipe-line. The plungers are of non-corrosive, stainless iron, accurately ground to



diameter. Floating design reduces alternating-current noise. The valve needle and valve seat are made of a special alloy, resistant to corrosion, and burnished to a high polish at the seating edge. Detroit electric valves are supplied to control water, oil, gas, low-pressure steam, refrigerants, etc.—*Electronics, January, 1933.*

Moving-coil meters

THE BEEDE ELECTRICAL INSTRUMENT COMPANY, 48 West Broadway, N. Y. C., is marketing a new line of D'Arsonval moving-coil meters in which improved design of the moving coil assembly permits a greater simplicity of construction than has heretofore been possible in the art. This results in unusual ruggedness, high accuracy and freedom from interference of dust and foreign matter. The meter is balanced in all positions, and the moving system is exceptionally well damped. Accuracy is guaranteed within 2 per cent.

Cost is the other vital factor; and Beede moving coil meters are available at astonishingly low prices. The list prices are very low for this type of instrument and the low cost is further reflected in the liberal dealer discounts. Contrary to the present day trend, where quality is sacrificed to lower costs, Beede meters represent improved quality and

design which, in turn, result in lower production costs.

The Beede Electrical Instrument Company, whose factory is at Penacook, N. H., has been continuously in the business of manufacturing meters for 15 years.—*Electronics, January, 1933.*

✦

Selenium cell employing new principle

THE SÜDDEUTSCHE APPARATEFABRIK, Nürnburg, Germany, claims for its new selenium cell higher sensitivity than that of alkali-metal cells and relatively low cost. The new cell consists of a layer of selenium fused on an iron disc. Over the selenium there is deposited, by means of a cathode spray, an extremely thin layer of one of the precious metals—so thin as to be transparent. Near its edge this layer is in contact with a somewhat thicker ring-shaped layer of the metal. Terminals are connected to this ring and to the iron base. Incident light causes air emission of electrons at the contact surface of the selenium, and therefore a flow of current through the external circuit.

With a cell of 10 sq.cm. (1.55 sq.in.) surface the current due to a 25-watt lamp at 1 meter (3.3 ft.) distance is 5.1 micro-amperes. It rises to 17.1 micro-amperes with a 75-watt lamp, 76.8 with a 200-watt and 445.5 with a 500-watt projector lamp. This appreciable current output permits direct use of the cell for actuating relays, or reduces the number of stages of amplification. The cell is stated to be rapid enough for voice-films, though it has the drawback that the relation between current and incident light is not quite linear. — *Electronics, January, 1933.*

✦

Electrostatic voltmeters

FERRANTI, INC., 130 W. 42d St., New York City, has introduced a complete line of electrostatic voltmeters, designed to provide a ready measurement of high d.c. and a.c. voltages, particularly in circuits of high resistance where any appreciable current taken by a voltmeter introduces considerable error.

The instruments are entirely free from wave-form, frequency, and temperature errors and are available in the single range projecting, flush or portable types, fitted in moulded bakelite cases.

Meters can be supplied in nine different ranges having full scales from 450 volts to 3,500 volts, the capacity ranging from 30 micro-microfarads with full scale deflection for the 450-volt meter, to 5 micro-microfarads for the 3,500-volt instrument.—*Electronics, January, 1933.*

✦

Motion-picture projectors

THE VICTOR ANIMATOGRAPH CORPORATION, Davenport, Iowa, is featuring a new line of projectors consisting of three improved models. Taking the place of the previous Models 3 and 7 is the new Model 10 Regular, which is priced at $143.50 against the old price of $175. The Model 10 Regular is supplied with the 400-watt lamp, but may also be used with 200 and 300-watt lamps if desired. All of the exclusive Victor features, such as four-point film protection with automatic film trip, the adjustable shuttle, and the built-in automatic three-way rewind, have been retained in the new models. The instrument is more quiet and smooth running than its predecessor.

The Premier "Hi-Power" 10FH is the feature model of the new Victor line. The powerful 400-watt biplane filament lamp is supplied as standard on this equipment, but 200, 300, and 400-watt lamps of line voltage ratings may also be used.

Other interesting new features of the Premier model are a new rack-and-pinion tilting device, and an automatic pilot which turns on when the projection lamp is extinguished by a turn of the resistance control knob.—*Electronics, January, 1933.*

High-voltage electrostatic generator

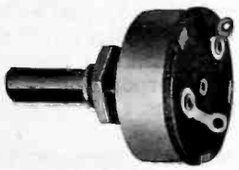
SOMETHING REALLY "new under the sun" in laboratory apparatus is the Cenco-Browne high-voltage electrostatic generator built by the Central Scientific Company, 460 E. Ohio St., Chicago. By means of two belts of special material travelling in opposite directions voltages of from 750,000 to 1,000,000 are developed, resulting in sparks of 30 inches length. This new, high voltage, electrostatic generator was developed from the designs of Ralph C. Browne, Fellow A.I.E.E. It generates under practically all conditions of temperature and humidity. Voltages estimated to be in the range of 500,000 to 750,000 are obtained unfailingly.

The machine consists of two highly insulated collecting spheres, about 15 in. in diameter and about 5½ ft. between centers, into which the charges are carried by two flexible insulating belts.—*Electronics, January, 1933.*

✦

Rotary snap switch

THE WIRT COMPANY, 5221 Greene street, Germantown, Philadelphia, Pa., has put on the market its new 711 single-pole single-throw rotary snap switch. Severe tests have shown this



switch to operate with smooth positive action and excellent contact with lowest contact resistance. Simplicity of working parts and ease of mounting make this switch especially applicable for radio-receiver assembly. The switch is rated to carry three amperes at 125 volts.—*Electronics, January, 1933.*

✦

Glass for sodium-vapor lamps

AS A NEW LIGHT SOURCE, sodium vapor has an efficiency of 70 per cent, which is three to four times neon and about six times as much as tungsten filament lighting. The light of the element sodium falls very nearly in that part of the visible spectrum which is most sensitive to the eye, therefore, 70 per cent of the electrical energy passed through the vaporized sodium is converted into light.

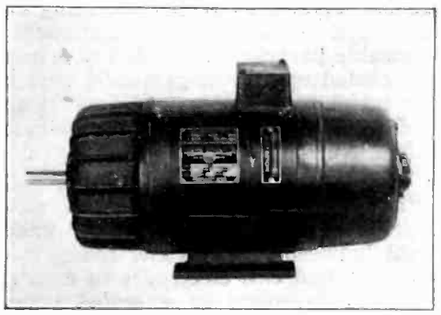
The difficulty in commercializing and adapting such a lamp has been the inability of ordinary glass to resist the attack of sodium. The Jena Glass Works of Schott and Gen., in answer to a universal demand, has now perfected a glass which resists the attack of sodium in their type T-3872. In addition to resisting the attack of sodium it was also important that the glass safely withstands temperatures up to 300°C, at which point sodium vaporizes. It was also necessary that the glasses be made to seal directly with a standard metal for the making of electrodes.

This glass is now being imported into the United States by the Fish-Schurman Corporation, 230 East 45th St., New York City.—*Electronics, January, 1933.*

✦

Constant-speed generator

THE ELECTRIC SPECIALTY COMPANY, Stamford, Conn., has developed this constant output voltage and a.c. frequency when driven from a varying speed source. This machine will operate at constant speed, and when furnished as a self-excited a.c. generator, will deliver constant output voltage and frequency,



when driven from a source of power, the sped of which is varying. It is particularly applicable to a.c. generators supplying power to sound amplifiers or talking moving picture equipment mounted on motor trucks. The generator may be driven from the automobile or truck engine, and will then provide a constant and reliable source of power.

The generator consists in a self-excited alternator, with d.c. windings for field excitation, which may also be used for charging the storage battery, if desired, and with a.c. windings delivering 60 cycles, a.c. A special centrifugal clutch has been developed for driving these generators. The working faces of the clutch are covered with a lining which has a constant coefficient of friction throughout a very wide range of activity.—*Electronics, January, 1933.*

✦

"Radio knife" employing induced currents

PAUL C. RAWLS, president of the Technical Equipment Company, Des Moines, Iowa, announces a new form of surgeon's high-frequency knife equipment, in which the cutting current can be carried to the cutting instrument by induction, without wire connection. This "free knife" possibility enables surgeons to operate with no electric-cord connection to the knife, but nevertheless separates tissue by electrical cutting action with a minimum destruction of cellular tissue, while at the same time effecting perfect coagulation of blood vessels. The circuit can also be "tuned" to the conditions of the patient's body and surroundings, giving greater facility of control of the cutting current.—*Electronics, January, 1933.*

✦

Coil-type rheostat

THE WARD LEONARD ELECTRIC COMPANY, Mount Vernon, N. Y., has produced a new coil-type rheostat for applications requiring a rheostat with a fine continuous adjustment. Its extremely shallow depth is a distinct advantage where space is limited.

The coiled wire resistance element of low-temperature coefficient of resistivity is set in concentric grooves cast in the refractory base. The plate and wire are coated with a powdered glassy enamel, and fired at red heat. This prevents shifting of the resistance wire with the adjustment of the contact shoes.

The dead shaft, completely insulated from the two contact levers, makes the rheostat adaptable for steel panel mounting without the use of insulating bushings or washers.

The rheostat is obtainable in values from 1 to 350 ohms. It will dissipate 70 watts continuously with a temperature rise not exceeding 250° C. which is within the limits specified by Underwriters' Laboratories. — *Electronics, January, 1933.*

✦

Dry electrolytic condensers

A. M. FLECHTHEIM & CO., INC., 136 Liberty St., New York City, manufacturers of fixed condensers, announces the addition of a complete line of dry electrolytic condensers rated at 500

volts direct-current peak, in the inverted, upright and cardboard types of containers. The new catalog, No. 25A, lists a wide range of capacities of these condenser units. — *Electronics, January, 1933.*

U. S. PATENTS

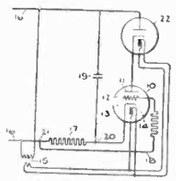
IN THE FIELD OF ELECTRONICS

Electronic Applications

Interference eliminator for electrocardiograph. Method of equalizing or eliminating interfering potential disturbances on the input to an amplifier feeding an electrocardiograph. H. E. Nichols, assigned to Clinical Development Laboratories, Inc. Filed July 16, 1928. No. 1,888,139.

Electron tube control. Method of controlling a three-element gaseous tube. J. D. Le Van assigned to Cutler-Hammer, Inc. Filed October 12, 1929. No. 1,887,766.

Stroboscopic apparatus. Producing instantaneous current impulses synchronous with the frequency of the source to be examined. H. W. Lord assigned to G. E. Co. No. 1,889,608. Filed June 19, 1931.



Electrical cutting apparatus. Method of using a quenched spark gap to drive an oscillating circuit, the voltage of which is utilized for therapeutic purposes. Arthur Mutscheller assigned to Wappler Electric Co. Filed July 21, 1928. No. 1,889,609.

Oscillator for therapeutic purposes. A combination of a vacuum tube circuit and other apparatus for inductively coupling the patient circuit to the oscillatory circuit, and means for varying the constants of the patient circuit whereby it may be brought into resonance with the oscillatory circuit. P. C. Rawles assigned to Technical Equipment Co., Des Moines. Filed Nov. 3, 1930. No. 1,888,408.

Amplification, Generation, Etc.

Magnetron. A slotted anode and cathode with several legs arranged in line with the slots of the anode and means for producing a magnetic field. K. C. De Walt assigned to G. E. Co. Filed Oct. 8, 1929. No. 1,889,595.

Synchronizing system. Several sources of alternating potentials, means for impressing these potentials on a resonant wave coil, and being coupled to the wave coil for indicating the lack of synchronism between frequencies. T. R. Coldsborough assigned to Westinghouse E. & M. Co. Filed April 11, 1929. No. 1,888,721.

Rectifier system. The method of using two arc discharge tubes for rectifying alternating voltages. G. Holst and E. Oosterhuis, Eindhoven, Holland. Assigned to R. C. A. Filed May 18, 1927. No. 1,888,628.

Television, Sound Recording, Photocells, Etc.

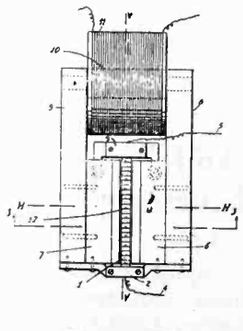
Electric energy converter. Apparatus for converting acoustic energy into electric energy or vice versa comprising a composite magnetostrictive core constituted of mechanically connected members of different magnetostrictive material and a diaphragm connected with the core. G. W. Pierce, Cambridge, Mass. Original filed Aug. 17, 1928. No. 1,889,153.

Recording system. Method of varying the intensity of the field of an electro magnet by impressing audio frequencies upon the circuit controlling the field and transposing magnetically permeable particles suspended in a mixture coated upon a magnetically permeable metal base within said field in accordance with said oscillation. Samuel Ruben, New Rochelle, New York. Filed July 14, 1931. No. 1,889,380.

Photovoltaic cell. Two metal electrodes equally spaced, a wire grid interposed between the two electrodes, said wire grid and two electrodes in contact with an electrolyte in a sealed transparent glass envelope. Samuel Wein assigned to Radiovision Corp. No. 1,887,531. Filed July 31, 1928.

Television system. Rotating mirror type of scanning system. F. Von Okolicsanyi and Gustav Wikkenhauser assigned to Telehor, Berlin, Germany. Filed Sept. 17, 1930. No. 1,887,472.

Velocity microphone. Apparatus for converting sound vibration and electrical vibration comprising a body subjected at opposite sides to pressure variations and a baffle to provide a sound wave path between the opposite sides of the vibrating body equal to half the wavelength of the highest frequency sound waves to be converted into electrical variations. H. F. Olson, assigned to R. C. A. Filed March 31, 1931. No. 1,885,001.



Signal recording. Method of recording electrical energy comprising projecting a stream of marking fluid toward a recording surface and influencing the stream directly by electro-magnetic force to control the amount of fluid reaching the surface. Fritz Schröter assigned to Telefunken. Filed Sept. 12, 1929. No. 1,882,043.

Magnetic sound recording system. Method of magnetically recording sound on a paramagnetic element that comprises first magnetizing the element to a saturated state and then passing the saturated element through a high frequency magnetic shield produced by a sound-modulated high-frequency carrier wave. J. G. Alverson, assigned to Addison-Investment Co., Los Angeles. Filed March 30, 1931. No. 1,886,616.

Sound reproducer. A permanent magnet electrodynamic reproducer and a transformer, the latter mounted upon the permanent magnet at a point of zero potential. P. L. Jensen assigned to the Jensen Radio Mfg. Co. Filed July 25, 1931. No. 1,886,816.

Film sound recording. A photo-phonographic sound recording apparatus. R. E. Grant assigned to R. C. A. Filed Oct. 11, 1930. No. 1,886,540.

Patent Suits

1,448,279, 1,579,392, Pridham & Jensen, Electrodynamic receiver, 1,745,118, same, Sound reproducing device, filed Aug. 15, 1932, D. C., N. D. Calif. (San Francisco). Doc. E 3331-K, The Magnavox Co. v. The Rudolph Wurlitzer Co.

1,258,423, F. Lowenstein, Variable electrical apparatus, C. C. A., 3d Cir., Doc. 4644, M. Balistockey et al. v. Scovill Mfg. Co. Decree reversed Sept. 22, 1932.

Adjudicated Patents

(C. C. A. Del.) Lowell and Dunmore patent, No. 1,455,141, for radio receiving apparatus, claims 3 and 14 Held invalid. Radio Corporation of America v. Dubilier Condenser Corporation. 59 F. (2d) 305.

(C. C. A. Del.) Dunmore patent, No. 1,635,117, for signal-receiving system, claim 9 Held invalid. Radio Corporation of America v. Dubilier Condenser Corporation. 59 F.(2d) 309.

(C. C. A. N. Y.) Colpitts patent, No. 1,128,292, for electric-wave amplifier, claims 1 and 5 Held invalid. Western Electric Co. v. Wallerstein, 60 F.(2d) 723.

(C. C. A. N. Y.) Lowenstein patent, No. 1,231,764, for telephone-relay, claims 1, 2, 4, 5, 6, and 7 Held invalid and, if valid, infringed. Western Electric Co. v. Wallerstein, 60 F.(2d) 723.

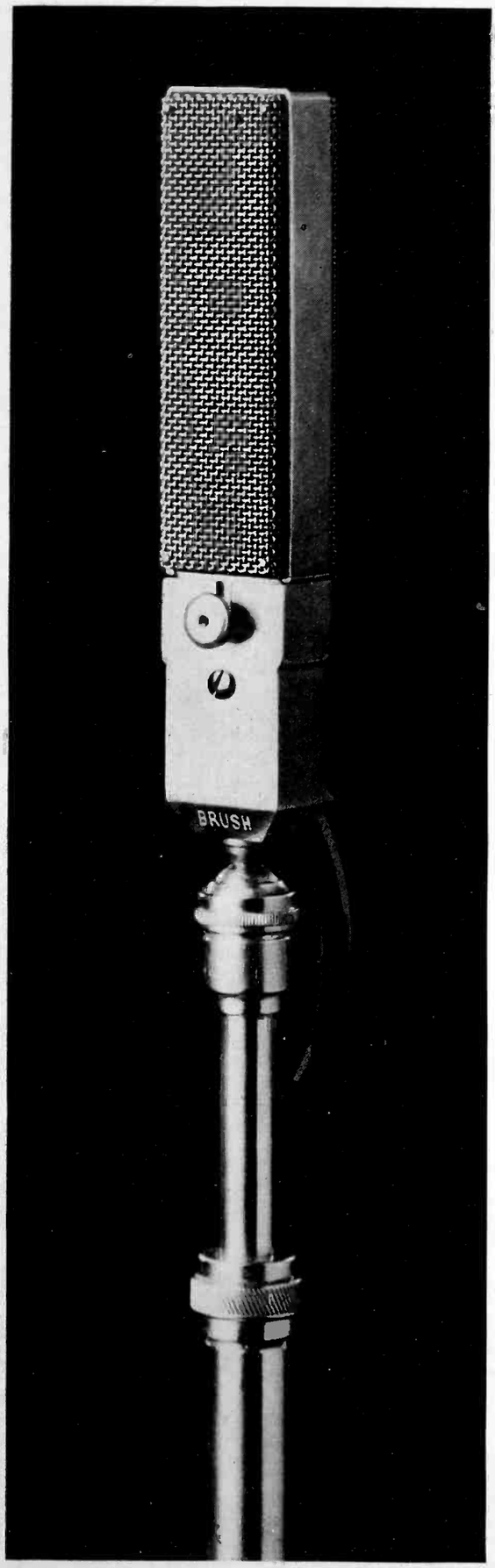
(C. C. A. N. Y.) Mathes patent, No. 1,426,754, for circuits for electron-discharge devices, claim 25 Held invalid. Western Electric Co. v. Wallerstein, 60 F.(2d) 723.

(C. C. A. N. Y.) Blattner patent, No. 1,483,273, for circuit for heating the filaments of audions, claims 6 and 8 Held invalid. Id.

(C. C. A. N. Y.) Arnold patent, No. 1,504,537, for power-limiting amplifying devices, claims 17, 18, 20, 33, 34, 35, and 36 Held invalid. Id.

(D. C. N. Y.) De Forest patent, No. 1,507,016, for radio-signaling system, claims 24, 25, 26, 27 and 28 Held infringed. Radio Corporation of America v. Radio Engineering Laboratories, 1 F. Supp. 65.

(D. C. N. Y.) De Forest patent, No. 1,507,017, for wireless telegraph and telephone system, claims 15, 17, 18, 19, 20, and 21 Held infringed. Id.



BRUSH

ANNOUNCES

a new principle in recording, reproduction and measurement of sound; available in a* COMPLETE LINE *of* MICROPHONES *having the following general characteristics:*

1. EXTREME RUGGEDNESS. Having no delicate mechanical parts, the Brush Grille type microphone is almost unbreakable, is unaffected by vibration or shock and cannot be overloaded.

2. TRANSPARENT TO SOUND. Being constructed of a number of "sound cells"* arranged edgewise to form a grille, there is a minimum distortion of the wave front, no reflection or pressure doubling and no cavity resonance.

3. IMPROVED FIDELITY. No low cut-off. Absolutely flat response over the whole broadcast range. To obviate the necessity of using a compensated amplifier the microphone is designed to have a rising characteristic from 6,000 cycles to 10,000 cycles.

4. NON-DIRECTIONAL. Therefore ideal for studio work.

5. ELECTRICAL AND PHYSICAL CONVENIENCE. Light and strong. It may be used in any position. High capacity — low impedance. High output level. Only two conductors, no field current or polarizing voltage, therefore free from background noise.

Following types now available:

TYPE G-20 (Illustrated two-thirds full size) is the general purpose studio microphone. It consists of twenty "sound cells"* connected to give the required output — mounted in monel-metal cage and plug. May be unplugged from stand and plugged into overhead suspension in a few seconds.

TYPE G-1 — single 'sound cell' in case 1½" x 1" x ¼" must be within about 30 feet of preamplifier. Ideal where microphone must be concealed in film recording; for announcing, for use in parabola and as "lapel" microphone.

CONDENSER HEAD SUBSTITUTES — May be used to replace present condenser head in amplifier, converting condenser into crystal microphone, doing away with frequent adjustments and greatly improving the response.

**Sound Cells:* Brush Piezo-electric "Sound Cells" are crystal energy-converters whose active surfaces are less than one-half square inch each. This extraordinarily small size results, as already noted above, in absolutely natural response never possible with diaphragm-type microphones. It has the additional advantage that any number may be combined in a single microphone according to the output required.

THE BRUSH DEVELOPMENT COMPANY

3715 EUCLID AVENUE . . . . CLEVELAND, OHIO

BALDWIN INTERNATIONAL, LTD.
Toronto, Ontario, Canada

NEUFELDT & KUHNKE, GMBH
Kiel, Germany

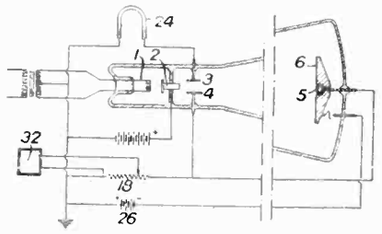
BRITISH PATENTS

IN THE FIELD OF ELECTRONICS

Electron Tubes

Thermionic cathode. A mixture containing alkaline earth carbonate is sintered so as to increase greatly the size of the carbonate particle, for example, from one micron to 120 microns and is then applied to the cathode core. In one example, equal weight of precipitated carbonate and strontium carbonate are mixed, placed in a nickel boat, heated for ten minutes to a temperature of 1,100 deg. C. in a stream of carbon dioxide and cooled while still in the gas. The mass is mixed in a ball mill, heated for 70 minutes, and cooled as before. The mass is then ball milled for five minutes and particles over 120 microns in diameter sifted out and crushed. The mixture may then be suspended in a binding medium, coated on the cathode core and reduced to the oxide in the usual way. W. H. Aldous and J. F. Jackson, G. E. Co. No. 378,651.

Cathode ray tube. An oscillation generator having a double target electrode consisting of the central electrode surrounded by an annular electrode. C. B. Terry Marconi Co. No. 379,812.



Cathode ray tube. The anode of the cathode ray tube is coated with carbon in a finely divided state to form minute points which glow when struck by electrons. The anode is coated by smoking it in a suitable flame, or it may consist of a nickel base which is preferably slightly oxidized and heated to 800 deg. C. in a furnace through which flows a stream of coal gas or of hydrogen saturated with benzine vapor. R. C. Clincker and L. J. Davies, British Thomson-Houston Co. No. 378,397.

Television lamp. A lamp in which light varies rapidly with the discharge current, and applicable to facsimile television, etc. The bulb is filled at 30 mm. pressure with neon containing ⅛ per cent of argon. With a neon filling a nickel or tungsten cathode gives a red light; a magnesium or cold rolled steel cathode a less red light; a cathode of steel containing 17 per cent of tungsten a yellowish light; and a cathode of cerium iron alloy a purple light. With helium, a magnesium cathode gives a white light.

In forming the cathode tungsten powder may be sintered at 1,700 deg. C. to form a porous body or at 3,000 deg. C. to form a dense body. D. M. Moore, British Thomson-Houston Co. No. 377,726.

Variable-mu amplifier. Construction of a tube in which the grid exercises different rates of control at different portions of the electron stream. In such a tube the cut-off occurs at a much higher value of negative grid bias than in other types of tubes, permitting more gradual control of volume without the introduction of a high proportion of distortion. Boonton Research Corp. No. 376,737.

Gaseous tube. A discharge device containing a gas or vapor or a mixture of these in which electrons for the discharge are produced by an auxiliary cathode; the main electrodes consist of a perforated cathode of extended area through which electrons pass, an anode of extended area and a grid, the anode and cathode being closely spaced apart and the discharge being confined by insulation so that no substantial ionization occurs to heat the electrodes when a voltage higher than the ionization voltage is supplied. J. D. Le Van, Raytheon, Inc. No. 376,517.

Cold cathode tube. In a tube filled with gas at low pressure giving glow discharges, insulating granules are placed between the electrodes which absorb heat and extend and subdivide the discharge pass without obstructing current, so that the striking voltage is increased and arc discharges are avoided or can exist for a short time and are then quickly extinguished. The tube may be used as a protective device when excess voltages are led away by the tube or current through the tube operates overload devices. The granules of material may be quartz, glass, stone, clay, etc. S. Ruppel, Frankfort, Germany. No. 377,238.

Electron Tube Circuits

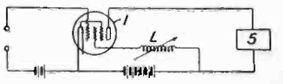
Automatic volume control. In a high frequency receiver having a.v.c., a relay is provided for operating an indicator, when the volume-controlled signal strength reaches a certain level. Marconi Co. No. 374,695.

Temperature control apparatus. Method of using a glow discharge tube as a sensitive element for indicating and controlling the temperature. The tube may contain neon at a pressure of 7 mm. of mercury, helium at a pressure of 14 mm. and mercury vapor from liquid mercury. C. A. Sabbah, assigned to British Thomson-Houston Co. No. 374,754.

Automatic volume control. In a superheterodyne receiver for use as a ship-to-shore telephone receiver, variations in signal strength due to fading and other causes, are eliminated by providing in parallel with the signal detector an additional detector, the output from which is utilized to control the amplification of the receiver in accordance with received intensity. C. G. Kemp and L. G. Kemp, Marconi Co. No. 379,758.

Volume control. In an amplifier the gain is arranged to vary in accordance with signal strength so that loud passages are reproduced at more realistic levels and the change in relative amplitude effected in recording or in wireless transmission is wholly or partially corrected. F. R. Farrow, Marconi Co. No. 379,916.

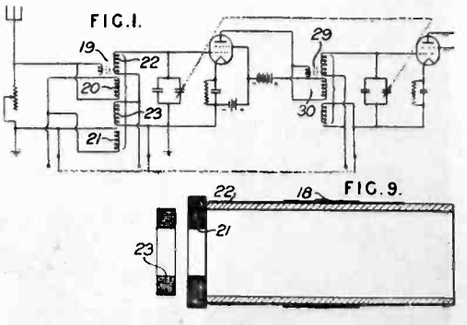
Frequency correction. To correct the frequency response characteristic of a moving coil loud speaker, associated with a pentode output tube, a reactive impedance coil is connected in the screen-grid circuit of the amplifier. By this means the tendency of the pentode to emphasize the higher frequencies due to its practically constant current output, combined with the increase of loud speaker coil impedance with frequency is obviated. The inductance coil *L* may be variable, constituting a tone control. R. A. Braden, Marconi Co. No. 379,974.



Television system. A two-wave telephone and television system providing a predetermined position for the user, preferably in the form of a chair at a fixed distance from the scanning apparatus. This patent describes rather fully the apparatus in service between the Bell Telephone Laboratories at 463 West Street and the A. T. & T. Co. at 195 Broadway for the past several years. H. E. Ives, assigned to E.R.P.I. No. 375,422.

Automatic volume control. In an audio frequency amplifier means are provided to control automatically the amplification and the ratio between the high and low frequencies in accordance with the input. Walter V. B. Roberts, Marconi Co. No. 378,539.

Inter-stage system. A coupling system operating over a two-wave band with equal efficiency over the whole of each band. H. A. Wheeler, assigned to Hazeltine. No. 378,662.



High frequency oscillator. Electrons passing from a cathode to an anode are deflected so that they follow alternate paths longer than the shortest distance between two electrodes, the electrons impinging on the anode without overshooting it and generating oscillation in it at its natural frequency. G. L. Usselman, Marconi Co. No. 379,395.

Noise suppression system. In a receiver the detector is arranged to be normally inoperative and to be rendered operative by means actuated by the strength of the incoming signals so that the detector does not function when the signals are below a predetermined value. G. L. Beers, Marconi Co. No. 379,608.