electronics

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

Television—where it stands today

✦

Superheterodyne tuning condenser design

✦

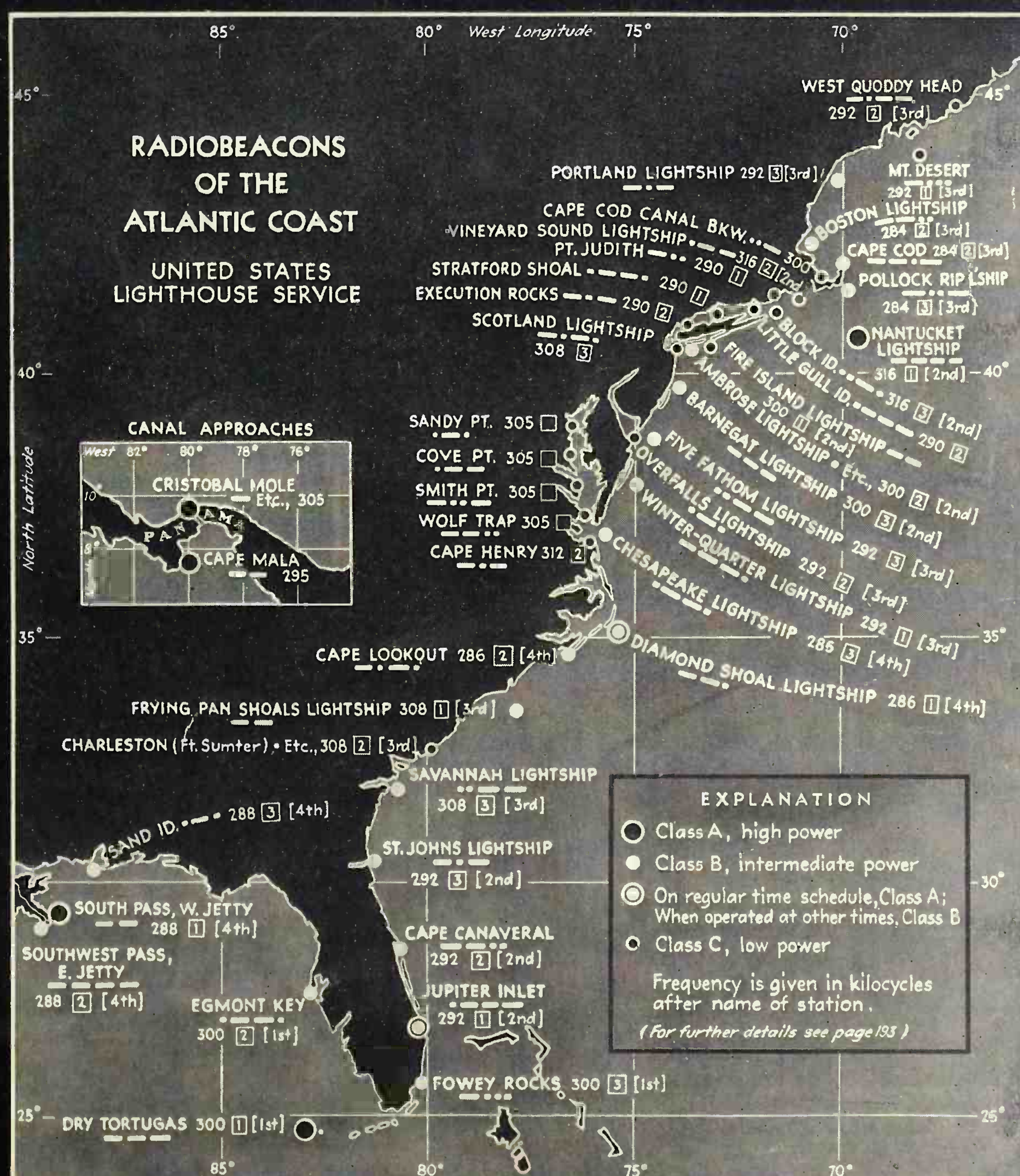
Home recording on 16-mm film

✦

Short wave coil design

✦

Temperature control by electron tubes



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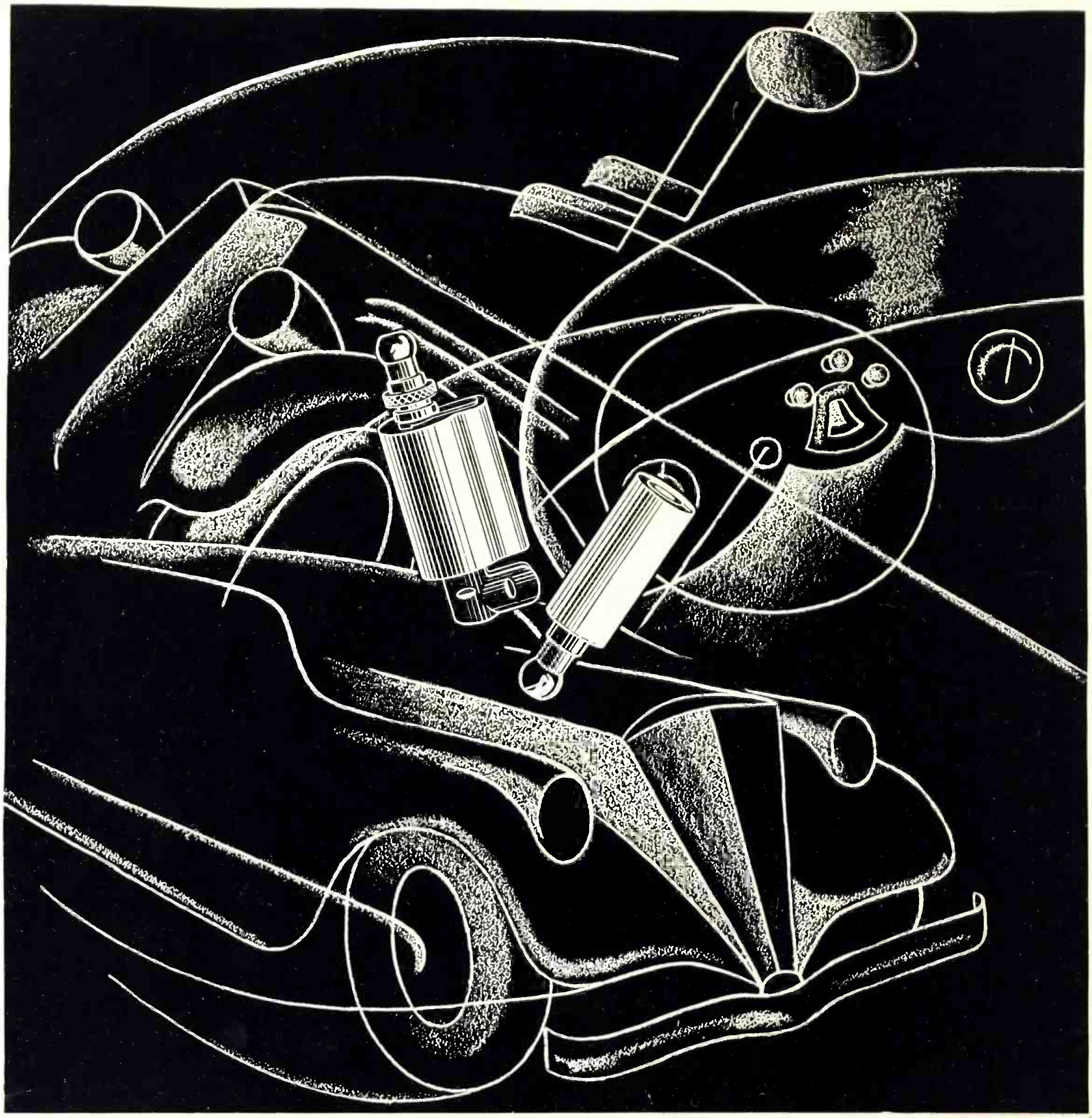

TUNED *to* TODAY

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Centralab MOTOR RADIO *Noise* SUPPRESSORS

Central Radio Laboratories—Milwaukee, Wisconsin

ELECTRONICS, June, 1934. Vol. 7, No. 6. Published monthly, price 35c. a copy. Subscription rates—United States, $3.00 a year. Canada, including duty, $3.50 a year. All other countries, $4.00 a year or 16 shillings. Entered as second class matter April 4, 1930, at Post Office at New York, N. Y., under the Act of March 3rd, 1879. Printed in U. S. A. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.C. Copyright 1934 by McGraw-Hill Publishing Co., Inc., 330 West 42d Street, New York, N. Y.

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electronics

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New York, June, 1934

NRA CODE 1934

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

Electronics in THE DAY'S NEWS

THE VITALITY of the electronic arts—the spread of the uses of electronic tubes in their myriad of applications—the penetration of electronic tools of one kind or another into almost every walk of modern life—are all well illustrated by the frequency with which news events based on some electronic feature, are reported in the daily press.

Usually the electronic aspect is hidden behind some commonplace reference, but the vacuum tube is playing its part, nevertheless. Here for example, are news items of electronic significance picked up at random during the past few weeks:

The Gettle kidnapping mystery is solved and the kidnappers apprehended through use of a police microphone, amplifier and recorder

The Nantucket lightship is run down by a steamer whose navigator followed the radio beam, without picking up the underwater oscillator

Chicago's second Century of Progress Exposition is opened by radio by Admiral Byrd from his solitary shack nearest the South Pole

Newspapers of the Associated Press group contract for picture-transmission service by means of facsimile over the telephone lines

Dr. Morehead of the Reconstruction Hospital, New York, applies photocells and amplifiers to permit totally paralyzed persons to "handle" radio, books, etc.

President Roosevelt's Warm Springs Foundation applies photocell self-opening door, for convenience of infantile-paralysis patients

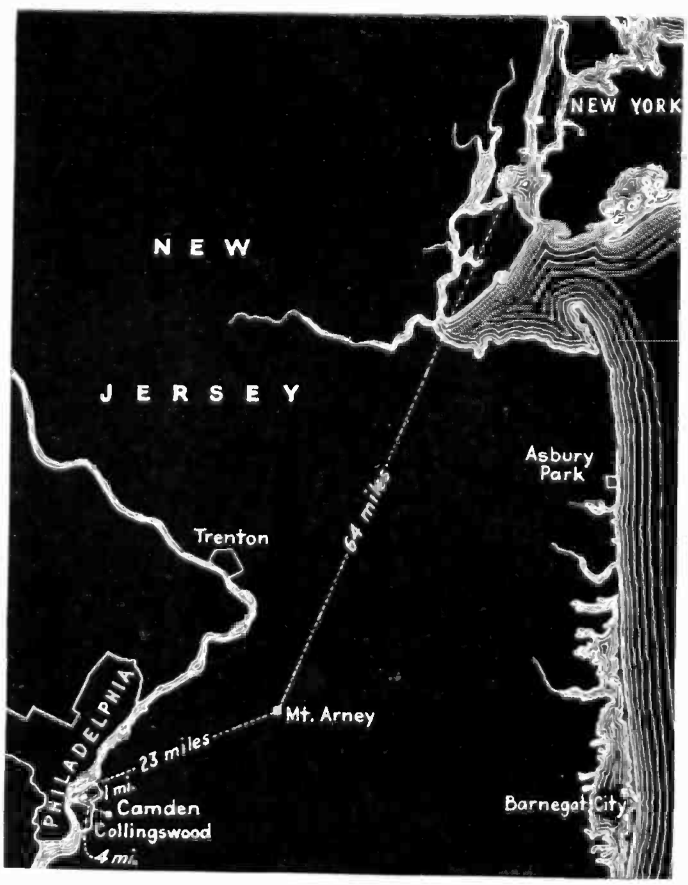
New York City's BMT subway installs new air-conditioned electric trains with photocells to control lights when trains enter tunnels

THE ELECTRON is now a front-page headliner. Electronic tubes are making history daily,—not only in the laboratory and in the experimental plant, but also outside in the affairs of men.

TELEVISION NEARS

Engineers of RCA Victor reveal progress in all aspects of television art at the annual I.R.E. Convention held in Philadelphia, May 28, 29 and 30

Describing television as being no longer around any corner, but as at the end of a long street, much of which remains to be traversed, engineers of the RCA Victor company disclosed their efforts toward developing a new system of communication to the members of the Institute of Radio Engineers at their 9th annual convention just closed. Major advances in the art were stated to be the ability to pick up and transmit outdoor scenes through the medium of a cathode ray television camera, the accomplishment of much greater detail than has been possible heretofore, and the solution of near perfect synchronization between the transmitter and receiver for both the video and the audio sidebands of the million-cycle wide carrier.



Path of 49-50 megacycle waves from New York to Camden which underwent one radio relay enroute to be rebroadcast and "seen" at Collingswood

Each of the engineers who had a major share in the development of some particular phase of the research described the status of his work to date. These engineers were E. W. Engstrom, R. D. Kell, A. V. Bedford, M. A. Trainer, C. J. Young, R. S. Holmes, W. L. Carlson, and W. A. Tolson.

Prior to the reading of the technical papers describing the year's work leading to the experimental television system in operation at Camden, New Jersey, W. R. G. Baker, vice president and general manager of the RCA Victor company, spoke of the tremendous cost of establishing a national television system. One gathered that the major problem at the present time was cost, and after hearing the technical papers engineers in attendance at the convention felt that if the cost problem could be solved a saleable television system was ready.

Thus was laid to rest the old bogey of the necessity for some fundamental invention that would enable television to take place without the necessity of taking the picture apart with piece-meal transmission; perhaps this fundamental invention in the iconoscope of Dr. Zworykin has already been made. This device accomplishes picture transmission in the old way but much more efficiently. The picture must still be taken apart and put back together at the receiver. For his work in developing the new television devices using a rapid beam of cathode rays, or electrons, Dr. Zworykin was awarded the Morris Liebmann Memorial prize for the year 1933.

Mr. Baker's summary of the costs of establishing and maintaining a television system was based on the supposition that the receiver would cost $300 (in itself this is encouraging). He stated that if 700,000 persons purchased such receivers the cost would be $210,000,000. To serve this audience would require 80 transmitters costing another $40,000,000 with another equivalent sum expended to build up an interconnecting network. To keep these stations on the air and to provide for depreciation would require an annual bill of $58,000,000.

In considering these staggering figures it must be realized that the present investment in the broadcast industry is approximately $25,000,000, that this sum of money was not expended over a short period but over a span of more than 10 years. Like Rome, the television system cannot be built in a day.

Who is to pay for television?

The problem of furnishing programs was discussed by Dr. Baker. "A radio broadcast station," he said, "is likely to have 5,000 program hours a year. For a television station, to show once each of the 300 feature motion pictures produced a year in the United States would take up only 300 or 350 program hours. To broadcast once each of the new plays of a year shown on New York stages would take up only another 300 hours. Shorts and newsreels would bring the total only to 2,000 hours. and not all news events would be in reach."

He said that high salaries of entertainers and expensive stage properties and scenery would be required. The manufacturer could not be expected to bear the cost, he asserted, and "you could not expect advertisers to pay much until coverage was assured them."

The cost of establishing and maintaining a television system for the nation has led to some talk of the advisability of a government subsidy—thus doing away with

TECHNICAL SOLUTION

Programs transmitted from Empire State building to Camden. Greater detail, pick-up of outdoor scenes, near perfect synchronization now possible

the payment for the system by the advertisers. At any rate the question which assailed the early broadcasters "who is to pay for it" now is being repeated in connection with a new entertainment and educational communication problem.

Technical advances related

The technical aspects of television seem distinctly more hopeful than the economic side. During the past years the art has advanced to the point where video programs originating in New York were sent from the Empire State building to Camden, a distance of about 90 miles, undergoing one stage of relay transmission en route to be looked at in the receiving laboratory at the latter place. Outdoor scenes originating a mile from the transmitter in Camden were sent through a cable 1500 feet long, sent by radio to the station, transmitted to the receiving point 4 miles away and finally viewed on the cathode ray screen.

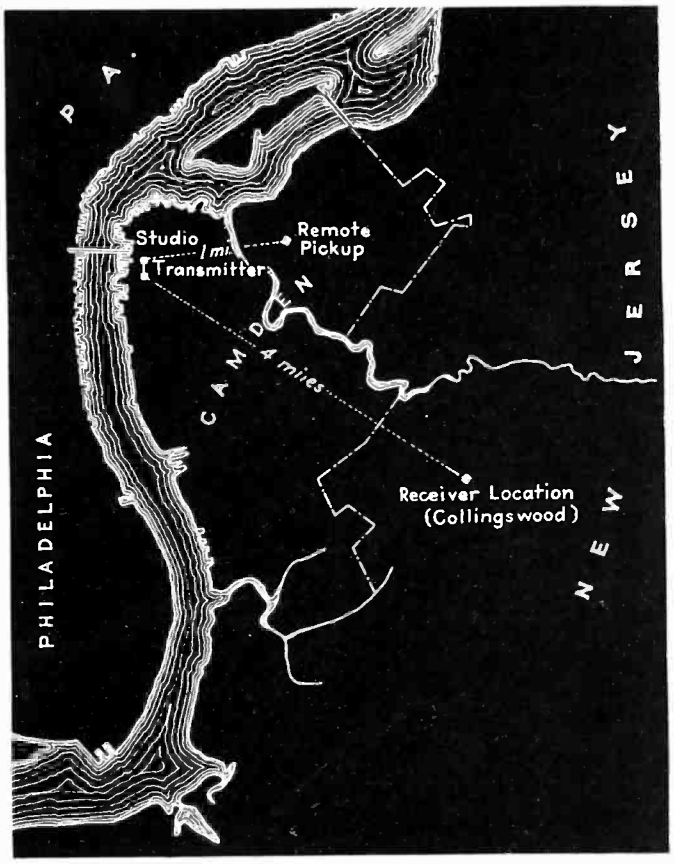
Mr. Engstrom stated that the video and audio programs were properly synchronized together, and kept 1 megacycle apart in the ether. Need for higher power at the transmitter was emphasized. It is understood that the transmitter in the Empire State building has a power rating which would hardly get recognition in the broadcast field today—although at the beginning it would have been condemned by the conservatives as excessive!

The great gain in the technical art has been the increased detail due to the development of the iconoscope, the cathode ray scanner. This device is capable of much greater detail than the remainder of the system and because of the characteristics of the cathode ray tube it is possible not only to change the focus easily so that close ups may be made, but "zooms" and fade-outs are easily possible. By proper change of deflecting voltages the center of interest can be shifted from the physical center of the picture to one side, much as a camera photographer may use a rising and falling lens board or a movable back to his camera. In these changes of view the camera need not be moved at all.

At present the detail is about equal to that obtainable in an 8-mm home movie. This, of course, is only one quarter that of the 16-mm camera when the pictures are projected to the same size. At the convention, however, a very large screen used for lantern slides was filled with pictures made from photographs of the cathode ray receiving tube when covered with typical scenes or portraits. In these large magnifications the horizontal scanning lines were distinctly visible, but of course the enlargement was very great.

These pictures required a half hour exposure of the photographic plate to get sufficient light; yet the scanning lines were beautifully horizontal and even, indicating the extreme stability of the system.

The iconoscope has made it possible to go immediately from a 180-line picture to a picture made up of 240 lines with consequent improvement in detail. The iconoscope in fact and the corresponding cathode ray tube receiver are the heart of the present highly developed system; and this need not belittle the work of other engineers in their task of working out wide-band amplifiers, the intricate synchronizing circuits, the many field strength tests to determine the best effective wave lengths, or in the labors that led to the high frequency, wide-band cable using steel wire plated with higher conductive material



Transmission set-up of outdoor scenes to studio, through special 1500-ft. cable, thence by radio 4 miles to receiver

for carrying the 1-megacycle wide video signal bands.

Thus engineers were encouraged by the advances described; they felt that many of the obstacles had been overcome. Undoubtedly the successful transmission of a highly detailed outdoor picture to a remote station; of relaying by radio a picture originating some 90 miles from the receiver; of successful synchronization of sight and sound channels, and of developing apparatus with flat characteristics over a million-cycle band—all of these advances point to the end of the road down which television engineers of RCA Victor have been plodding.

The next problem—and perhaps the largest—is to find some way to finance the transmitters and programs.

Coil design for short-wave receivers

A study of 15 Mc inductances

Notable differences of opinion exist regarding the size of wire, coil diameter and length of winding for single layer solenoids for use at very high frequencies, say 15 Mc. Answers to many short-wave coil questions will be found in this report of a study of the problem made by W. S. Barden and David Grimes of the RCA License Laboratory.

ENTHUSIASM for short-wave reception has made necessary proper evaluation of various coils for r.f. circuits preceding frequency changing in supers and for t-r-f sets where the frequency is not changed. To settle many of the debated points about coils for short waves a set of inductances was made to include wire size variation from No. 28 to No. 10, a diameter variation of from 0.5 inch to 1.5 inch, and a length of winding of from 0.25 inch to 2 inches. These coils were tested at 15 Mc, a frequency at or near the center of the highest frequency band in typical "all-wave" receivers.

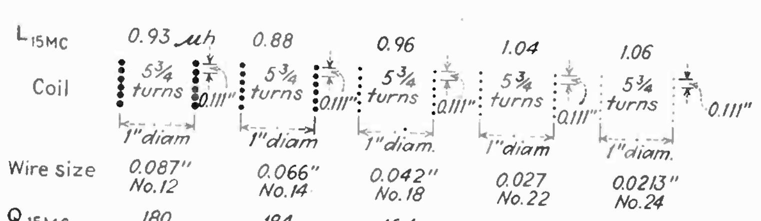


Fig. 1—Coils tested differing only in wire size

The measurement was made of the Q $(L\omega/R)$ of these windings since that is a suitable figure of merit for single coils at the chosen frequency.

Figure 1 is a detailed example of the test data on which figures are based. It shows a set of five coils which are physically identical excepting wire size. Each of the five coils has 5.75 turns, 0.111 winding pitch, and the same diameter of winding. Ten sets of coils, each set differing from Fig. 1 as regards coil diameter, number of turns, winding pitch, or all of these properties, were required to obtain the data shown in the following figures.

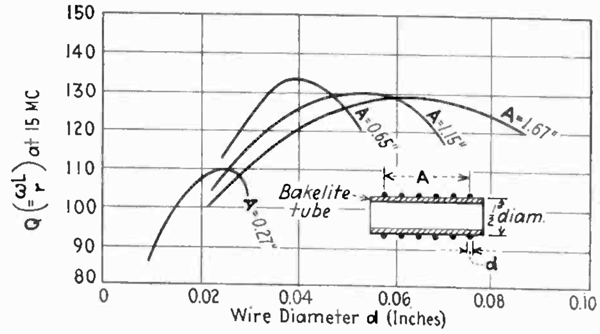


Fig. 2—Effect of changing wire diameter

The coils of Fig. 1 are wound on bakelite. The black circles represent a cross-section of the coil, as though it were self-supporting. They are drawn to scale, according to the wire size. For the right-hand coil, the space between turns is several times as great as the wire diameter. For the left-hand coil, the wire diameter is greater than the space between turns. For the second coil from the left, the space between turns is nearly equal to the wire diameter. Thus, for a given and quite typical configuration, Fig. 1 shows how L and Q are affected by wire size. Although the inductance is materially influenced by wire size, it is not improper to regard all of the coils in Fig. 1 as having $L = 1$ μh. The values of Q would not change materially due to a correction for the small differences in inductance.

It is noted that the inductance does not continually decrease as the wire diameter is increased, but starts to increase when the wire diameter is roughly equal to the space between turns. The extent of variation of L with wire size, though unimportant as far as subsequent figures are concerned, is great enough to bear in mind during receiver design.

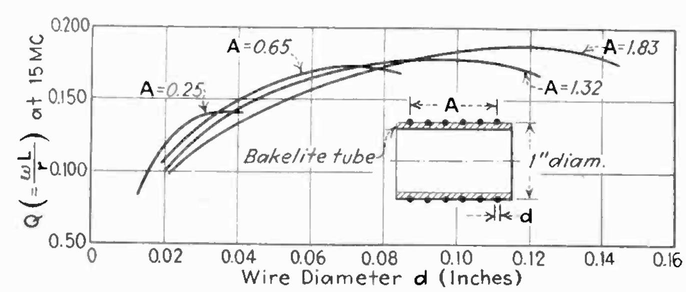


Fig. 3—Relation between Q and wire diameter in 1-inch diameter coil

For the smallest wire size used in this series Q is 122 (without a shielding can around the coil). Q increases as the wire diameter increases, until the wire diameter is approximately equal to the space between turns. As the wire diameter is further increased, Q fails to increase, and drops. This decrease in Q is not an abrupt occurrence. Comparing the two coils with the highest Q it is noted that there is no particular importance to the idea of having the wire diameter quite nearly equal to the space between turns. The rule is a good one, but the relations are not critical. After testing 50 coils, it has been found that for truly best results the wire diameter should be perhaps 30 per cent greater than the space between turns, but the advantage is too small to warrant a serious choice between that relation and equality of wire diameter to spacing.

For the set of coils in Fig. 1, the variation of Q with wire diameter can be readily appreciated without plotting. The center coil, having No. 18 wire, probably represents what many engineers would use when called upon to make a good guess. They might regard No. 18 wire as being the largest wire to be tolerated in efficient production.

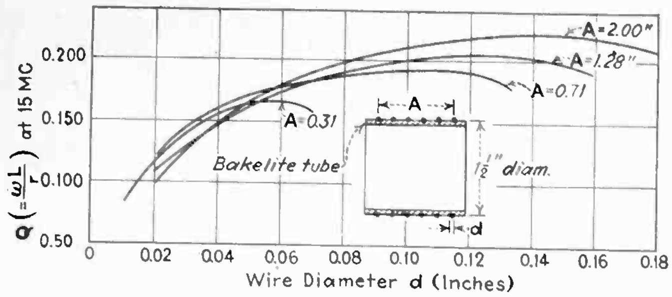


Fig. 4—Effect of wire diameter on large coil

In other cases, larger wire would be regarded as tolerable from a production standpoint although No. 15 wire, a less impractical wire diameter, would be only slightly less meritable than No. 14.

Rather than duplicate the scheme of Fig. 1 for many other sets of coils (ranging from very small coils to coils of 0.16 in. diameter wire), the results are thought to be more usefully depicted by means of Figs. 2, 3 and 4. Each of these figures is based on a particular coil diameter as shown. The inductance is assumed to be constant. Q is plotted against the wire diameter. Each of the several curves is based on a certain winding length, as labeled. Each curve is carried to and a little beyond the wire diameter yielding maximum Q.

For any curve on Figs. 2, 3, and 4, the maximum value of Q is secured with a wire diameter which is from 10 to 30 per cent greater than the space between turns. But the very conspicuous broadness of the curves at their peaks does not warrant a departure from the rule of making the wire diameter equal to the spacing between turns. When that rule is followed, the slight loss of coil merit is indeed likely to be definitely outweighed by the consequent use of a more practical wire size. And from the broadness of the peaks of the curves in these figures, it may be safely assumed that in general the next size smaller wire may be used without an important loss of coil merit.

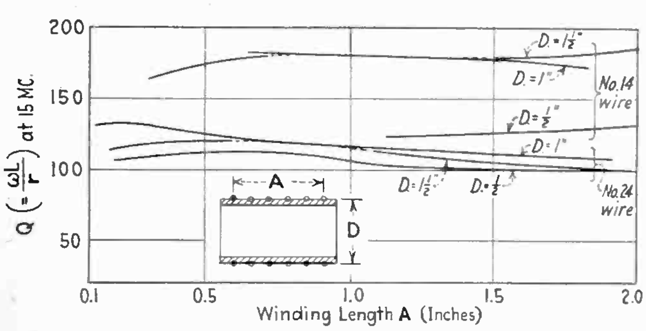


Fig. 5—Relation between winding length and Q

Another conclusion to be drawn from Figs. 2, 3, and 4, is that very large wire (and therefore long coils) is not markedly better than medium wire: e.g. No. 20, or No. 22.

Effect of winding length

Figure 5 shows two families of curves for Q vs. winding length. As regards No. 24 wire, it is noted that Q is substantially independent of winding length (note the lower family on Fig. 5), for coil diameters ranging from 0.5 in. to 1.5 in.

The upper family on Fig. 5 shows that when using large wire, such as No. 14, Q is substantially independent of winding length when the coil diameter is 1 in. or 1.5 in., and that for a given winding length 1 in. diameter is noticeably better than 0.5 in. diameter.

Effect of proximity to steel chassis

There are cases when space considerations lead to a desire to mount a t-r-f coil near the chassis. Fig. 6 shows a typical coil (for high r.f.) placed a distance d from a cadmium plated steel chassis. Q is plotted against d. The coil diameter is 1 in. Without the steel chassis, the coil has $Q = 154$. When the coil is placed 1 in. from the chassis, Q is hardly affected. When the distance d is 0.5 in., Q has decreased approximately 10 per cent. When the distance d is only 0.06 in., Q is halved.

When the coil is placed at least half its diameter away from the chassis, Q is not seriously affected.

Effect of bakelite forms and shielding can

A 1μh coil of No. 10 (0.104 in.) wire was wound on a 2 in. length of 1.5 in. diameter bakelite having 0.125 in. wall. This coil had 0.333 in. winding pitch. At 15 Mc, $Q = 212$. Upon removing the bakelite from this coil it remained self-supporting, and Q increased to 229. The bakelite form introduced a 7.5 per cent decrease in Q at 15 Mc. For physically smaller coils having the same inductance, less bakelite is used, and Q, due to the bakelite form, decreases less than the 7.5 per cent in the example noted above. The bakelite forms do not have a serious effect on coil merit.

The extent to which various cans decrease Q and L is suitably indicated by Fig. 7. An exact evaluation of these effects is not attempted. In reasonable practice, a shielding can need not decrease Q by more than 10 per cent, nor L by more than 15 per cent.

Efficacy of two-strand coils

Two identical coils, connected in parallel and coupled 100 per cent magnetically, would result in a two-strand coil having the same inductance as either coil alone, and one-half the resistance of either coil alone, provided that the proximity effect of each coil on the other does not have an effect. Of course proximity must be influential, and this is the principal reason why a two-strand coil does not result in twice the Q of a single-strand coil. The two-strand coil may have a lower Q than the single-strand coil, due to the proximity effect of one winding on the other.

A 1μh coil was made by winding 6 turns of No. 10 wire on a 1.5 in. diameter bakelite form, with a winding pitch = 0.333 in.: the space between turns was more than twice the wire diameter. Q was equal to 212 at 15 Mc. Then another identical coil was wound with its turns midway between the turns of the first coil, and these two closely coupled coils were connected in parallel.

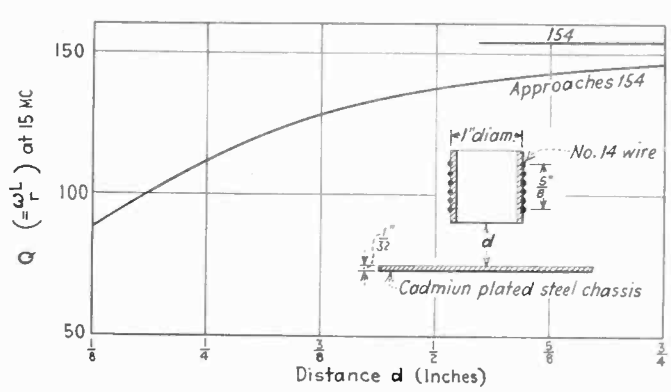


Fig. 6—Effect on Q of placing coil near steel chassis

[*Please turn to page 196*]

Home-recording on 16-mm. film

New portable camera with microphone attachments

MUCH activity in the field of "home talkies" was reported during the recent Atlantic City convention of the Society of Motion Picture Engineers. Not only are new 16-millimeter sound-on-film projectors being developed for the market in both America and Europe, but a new home-recording camera was demonstrated and new possibilities in 16-millimeter films in color were also shown.

G. L. Dimmick, C. N. Batsel, and L. T. Sachtleben of the RCA Victor Company, Camden, N. J. reported on the new 16-millimeter sound camera which is expected to be ready for the Fall market, although laboratory samples have been in experimental use for the past ten months. The new camera is so light and compact that it can be carried slung over the shoulder, and held in the hand when being operated.

The new sound-recording camera utilizes 16 millimeter film with a narrow track replacing the sprocket holes on one side, for recording sound. In its self-contained form it can be described as a "newsreel" type, incorporating the sound-recording system in the single light-weight camera case. With this "autographic" form, as the subject is photographed, the operator talks into a mouthpiece leading to a vibrating metal diaphragm, recording a running description of the picture. The diaphragm, which is set in motion by the speaking voice, is coupled mechanically to a tiny mirror which vibrates in unison with it. A light beam directed on the mirror is reflected with its fluctuations on the sensitized edge of the film as it passes through the camera.

In another form of this home recording unit, designed for recording the voice of the person or group being photographed, as well as for atmospherical sound effects, a separate microphone attachment together with electrical amplifying and recording equipment are provided for convenient mounting on a specially designed "unimount" tripod upon which the sound camera itself may also be set.

In the microphone-type camera, a two-stage amplifier with cable, a microphone with cable, a battery box, a belt assembly, a connecting cable from camera to amplifier and one monitoring phone are supplied. The amplifier is a high-gain battery-operated type using one RCA 232 and one RCA 233 tube. Special features are its manual volume control and visual recording level indicator, the latter consisting of three neon tubes, each lighting at a different sound level.

A new British 16 mm. sound-on-film camera has also been announced. Variable-density recording is used, the recording lamp being quickly removable for shipment or replacement. A four-lens turret is fitted and direct focussing is employed. Film retorts of 400 feet capacity are supplied. Single-perforation S.M.P.E. standard film is utilized.

New sound-on-film projectors for 16 mm.

From several different quarters come new 16 mm. sound-on-film home projectors, according to J. G. Frayne, chairman of the SMPE Committee on Progress, who reported that the Bell & Howell Company has announced the B. & H. Filmosound. Features of this apparatus are an "optical slit" which is obtained through a system of cylindrical lenses so arranged as to produce an image of the exciter filament reduced in size approximately 10 to 1 in the vertical plane, and an oscillatory circuit supplying a high frequency alternating current for the exciter lamp and incorporating a single 145 triode to eliminate any hum due to A.C. supply. The volume is controlled by simultaneously varying the photocell and exciter lamp voltages with a single control.

From England we are advised that the Western Electric Company, Ltd. are manufacturing 16 mm. with sound-on-disc apparatus. Some of the features of this equipment are: a double projector system for change-over purposes, thus allowing a continuous program to be given; a gear changing device to enable the projector to run at either 16 or 24 frames per second; and a gear changing device to allow the turntable to run at either $33\frac{1}{3}$ r.p.m. for sound pictures, or 78 r.p.m. for incidental music.

A sound-on-film projector for 17.5 mm. film and using one square perforation per picture was introduced abroad last winter by the Pathe Company. A gate mask is used to prevent the perforation holes showing on the screen. One of the most interesting features is that the same lamp is used both for projection and illumination of the sound track. After the light passes through the sound track, it is reflected by a mirror into the photocell in the sound head. Volume control is secured by a rotatable shutter in the light path before the photocell.

Early in 1934, the German firm of E. Bauer, introduced a portable 16 mm. sound-on-film projector. The sound head permits a reproduction to 6000 cycles. The projector is operated with an "Asynchron" motor. The apparatus weighs about 60 pounds.

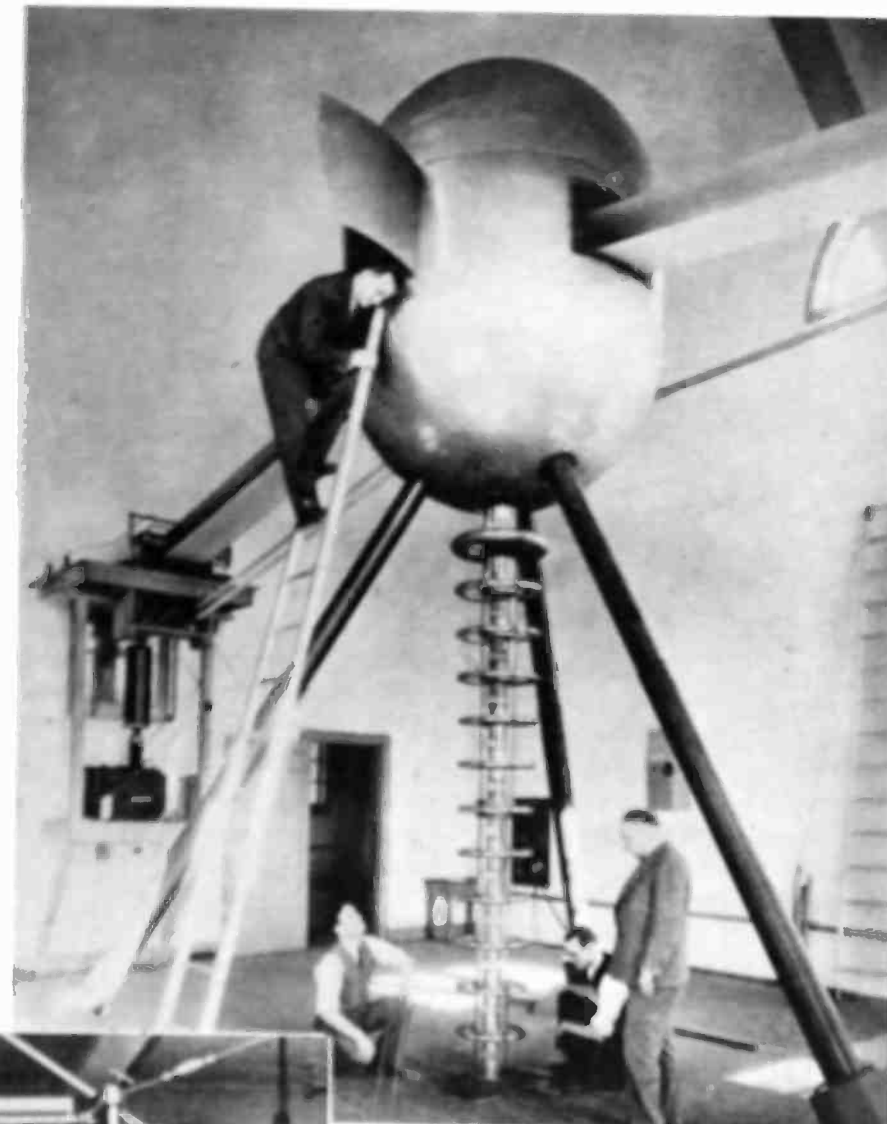
Laboratory experiments for the first time demonstrating the practicability of making and printing 16-mm. sound-on-film motion pictures in natural colors, were described before the Society by Mr. Batsel and Mr. Sachtleben.

Some 1934 advances in 16-mm. sound-on-film

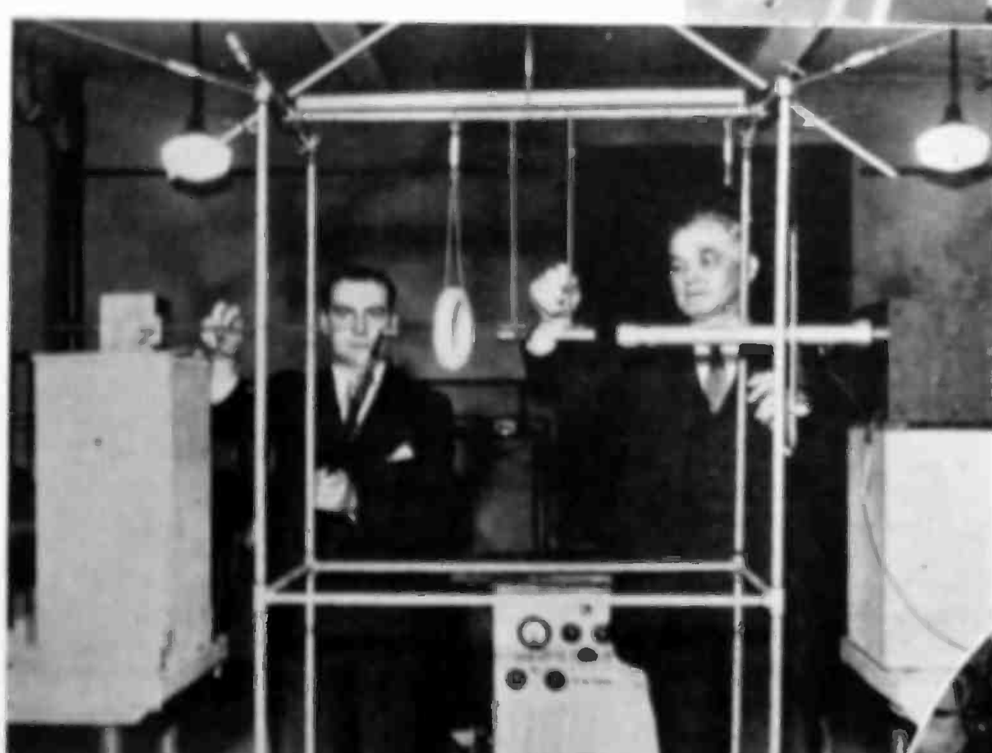
"Autographic" camera with self-contained microphone
Home-recording camera with extension-cord microphone and amplifier
Sound successfully recorded on 16-mm. lenticulated color film
Standard color-talkies re-recorded on 16-mm. color-film
New "optical slit" obtained by cylindrical lenses
Sound-on-film projector lamp used as exciter lamp

ELECTRONS—NEUTRONS

yield more secrets



Right—A new form of the Van de Graff electrostatic generator being developed by the Carnegie Institution, Washington, D. C., and capable of producing 1,300,000 volts. From the charged sphere, extending through the floor, is the cascade vacuum tube through which electrons and neutrons will be accelerated and focussed on a quarter-inch target at a distance of 15 ft. Drs. M. A. Tuve, L. R. Hafstead, and O. Dahl developed the new experimental apparatus, which will be used in attempts to split atoms of the target material.



Below—Artificially-radioactive nitrogen has been produced at the California Institute of Technology, under the direction of Dr. Robert A. Millikan. The new radioactive material ejects both beta and gamma rays, like the radioactive heavier elements found in nature, indicating that electrons are being thrown off from the synthetic radioactive atoms.

With the apparatus shown above, Drs. George R. Popam and John R. Dunning of Columbia University have measured the neutron, as well as the diameters of nuclei of various atoms. Dr. Dunning is holding the platinum capsule containing the radon beryllium bulb which is the source of the neutrons. The neutron's diameter measured one ten-trillionth (10^{-13}) inch. Nuclei of the lighter atoms (hydrogen, lithium, carbon) measured 1×10^{-12} inch, with the nucleus of lead only three times as large.

Improving the broadcast of recorded programs

By GEORGE H. MILLER

TO A LARGE number of broadcast stations the transmission of recorded programs has proved to be a convenient source of entertainment, especially in those districts where good talent is scarce. While the technique of disc recording has advanced rapidly in the past few years, there are certain physical limitations which so far have received but little attention, and which are becoming more prominent as the standards of the broadcasting art are raised.

The output of most phonograph reproducers or "pick ups" used today is directly proportional to the velocity of the vibrating armature and to the needle which drives it. The velocity with which the reproducer armature cuts its magnetic field depends on two factors, (*a*) the frequency being reproduced and (*b*) the amplitude of the recorded signal on the record. Therefore, to obtain a constant output over a range of frequencies, we must present a constant velocity to the reproducer armature, and this in turn requires that the amplitude of the recorded signal change with frequency, being inversely dependent upon it.

If the distance between grooves is 1/90, or 0.011 inch, the minimum allowable sidewall thickness is 0.001 inch, the width of the grooves is 0.006 inches and assuming a maximum allowable amplitude of about 0.002 inches, then at 40 cycles the velocity of the record must be 0.502 inches per second. This velocity is far too low for actual recording.

A value of 3 inches per second is nearer the minimum speed and using the above data the lowest frequency would be about 240 cycles per second. The loss at 40 cycles would be about 15.5 db.

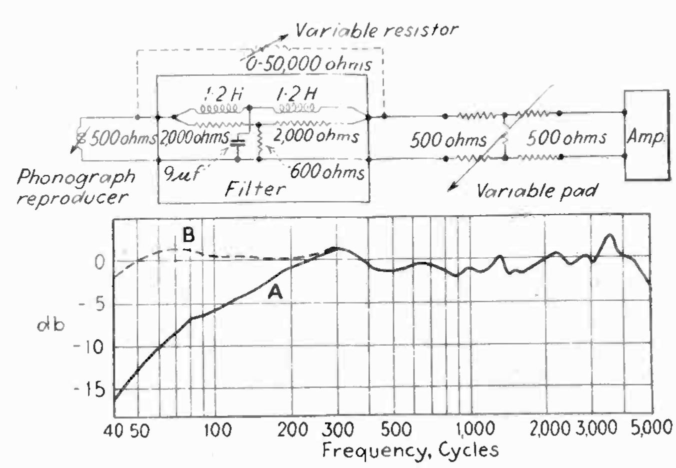
This loss at the lower frequencies is reduced in some cases by the use of the larger 16-inch records turning at $33\frac{1}{3}$ r.p.m., allowing a larger groove spacing and consequently a larger maximum allowable amplitude. However, due to other limitations, such as needle tracking difficulties, it is doubtful whether an attenuation of less than 10 db. at 40 cycles is ever attained in commercial work. On the other hand, it is common to run across records having losses in excess of 20 db.

This lack of low frequency response is about the only way that one can identify a good electrical transcription program broadcast from a radio station. Attempts have been made to make up for these losses by mechanically resonating the reproducers at some point in this attenuated range of frequencies, but the results have been poor and in many cases the condition was made worse.

To correct this deficiency in recording the author had a network constructed which supplied a characteristic just opposite to that of the recording. This network incorporated a wave filter in conjunction with a resistance pad, and introduced a constant attenuation of 20 db. over the range of 250 to 10,000 cycles. Below 250 cycles the attenuation decreased in linear fashion to nearly zero at 40 cycles. It was found possible, through the use of suitable shunting resistors around the network, to obtain some variation in the attenuation of the fixed portion between 250 and 10,000 cycles. This, in effect, moved the cut-off point to the left somewhat, and to a fair degree, varied the amount of correction.

Using a set of calibrated frequency records and the set up shown, a series of runs was made to test the results of the filter network. A reproducer of the high grade type used in sound picture work was used in these tests, and the result of two runs is shown. Curve A shows the over-all response without filter and variable attenuator set at —20 db. Curve B shows the results with filter in circuit and attenuator set at zero. The adjustable shunt, in this case, was adjusted to give best over-all results. The amplifier used was of the direct-coupled type having a flat response well below 40 cycles.

An immediate improvement was noted in practically all types of records during subsequent listening tests. The lower frequencies were reproduced without any suggestion of resonance peaks, and the consequent absence of the "boomy" effect usually encountered when using certain methods of low frequency correction was noteworthy. Although the fundamental low frequency components were more or less absent when reproducing in the regular manner without filter, the sense of *pitch* was present due to the presence of harmonic components of the musical tone in question. The absence of these fundamental components is not generally noticed by the average listener as long as the sense of pitch is sufficient. Upon supplying these fundamental frequencies, however, the reproduction became more realistic and many of the musical instruments stood out in their true form. It was found that the amount of filter correction, obtained by varying the shunting network, was not critical as regards listening tests. The larger type of transcription record required somewhat less correction than the smaller 12-inch type more generally encountered. Very striking improvements were obtained in the reproduction of the ordinary phonograph record. Records of this class required the maximum correction obtainable with the filter, and the variable shunt was not necessary.



Electron tube motor control

By F. H. GULLIKSEN

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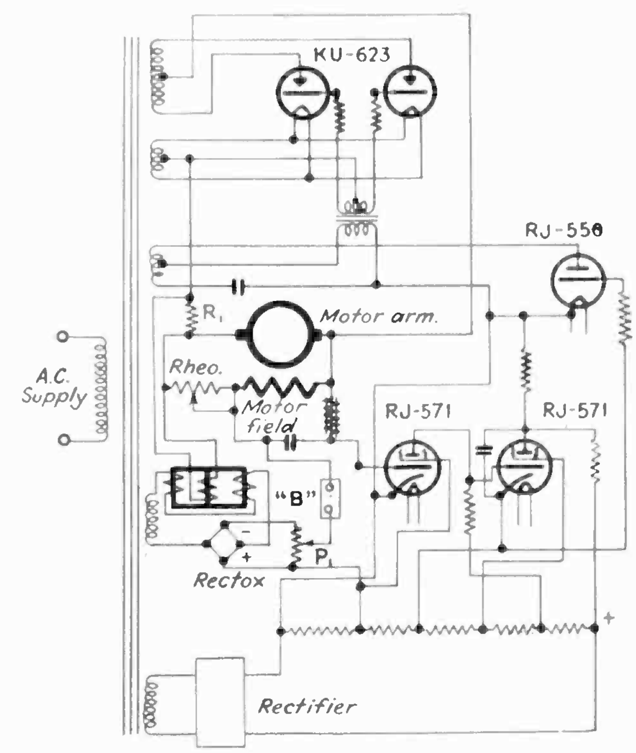
IN APPLICATIONS where variable speed control of d-c motors over a wide speed range is needed, the conventional method of control is to supply a motor generator set, and to vary the generator voltage. Unless the motor design and the generator design are carefully coordinated, it is difficult to obtain a constant motor speed at varying motor loads, for any selected motor speed within a wide operating range. This is particularly the case with motors of small horsepower rating. To obtain constant speed characteristics with such motors over a wide range, it becomes necessary to apply a speed regulator to control the generator voltage and thus indirectly control the motor speed.

To provide simple, easily adjustable, accurate, and quick response characteristic speed regulating equipment for direct current motors rated at 3 hp. or less and to make it unnecessary to provide direct current for operation of motors of these ratings, an electronic type a-c operated voltage controlled rectifier has been developed. This device is designed to supply constant direct current voltage at any value between 100 volts and 550 volts, from a single phase a-c source. The equipment is so arranged that the direct current voltage remains constant within a range of $\pm\frac{1}{2}$ of one per cent if the direct current load is changing from zero to maximum, and if the a-c supply voltage varies within standard commercial limits. The maximum direct current load is 10 amperes at any direct current voltage. Compensating means are supplied to give the controller a rising voltage characteristic with increasing load and this load compensation can be adjusted so that the motor speed will be maintained within a range of 1 per cent from no load to full load for any speed within a 5 to 1 speed range.

As shown in the schematic diagram—the direct current voltage is supplied to the motor armature and the motor field by means of two KU-623 grid-glow tubes. The direct current voltage is, therefore, rectified a-c voltage and has an a-c ripple considerably smoothed out by the armature and field reactance, with a frequency twice the a-c supply frequency. By means of a phase shift circuit employing an RJ-550 tube and a condenser the phase angle between the grid voltage and the anode voltage of the KU-623 tubes can be varied so that the point on the anode voltage wave at which the KU-623 tubes become conductive can be shifted. In this manner the rectified current output of the KU-623 tubes can be varied from zero to maximum. The current through the RJ-550 tube, and consequently the phase angle between the KU-623 grid voltage and anode voltage, is controlled by means of a 2-stage resistance coupled amplifier employing two RJ-571 tubes. This amplifier has a very high amplification factor so that less than 0.1 volt change in grid bias voltage of the first RJ-571 tube produces sufficient phase shift to vary the KU-623 tube current from zero to maximum.

The motor field is connected in series with a rheostat across the motor armature. The voltage across the motor field is smoothed out by means of a filter circuit consisting of a reactor and a condenser and this voltage is bucked by means of a dry cell battery and the difference between the motor field voltage and the battery voltage is applied to the grid of the first RJ-571 tube. Under all operating conditions this difference will be maintained at a constant value of approximately 2.5 volts. Not considering the effect of the compensating circuit, the motor field voltage will, therefore, always be maintained at a constant value, and the armature voltage will consequently also be maintained at a constant value equal to the combined voltage drops across the motor field and the rheostat.



Circuit details of the apparatus for operating d-c motors from a-c sources by electronic control

The compensating circuit consists of a three-legged reactor connected in series with a full wave rectox rectifier. The d-c winding of the three-legged reactor is shunted across a resistor R_1 connected in series with the motor armature. The impedance of the three-legged reactor decreases as the current through the d-c winding increases and for this reason the d-c output voltage of the rectox rectifier connected in series with the a-c windings of the reactor will increase with increasing motor load. By means of a potentiometer P_1, a variable amount of the rectox output voltage can be applied to the grid circuit of the first RJ-571 tube so as to add to the battery voltage. In order to maintain the constant balancing grid bias of the first RJ-571 tube, as previously mentioned, the field voltage and consequently the armature voltage will be increased, so as to maintain constant motor speed under the changed load conditions.

Superheterodyne tuning condenser design—for use in multi-range receivers

By H. SCHWARTZMANN, E. E., and L. G. BURNELL, E. E.

THE fundamental mathematical principles of the super-heterodyne circuit are nowhere so completely illustrated as in the design of the variable portion of the circuit, the variable condensers. An incomplete knowledge of mathematics has led to the design of these variable condensers by a combination of laborious graphical solutions and the trial and error process, with its consequent inaccuracies.

The following article presents the mathematical solution for determining the physical dimensions of the curve of condenser plates, without resorting to graphical solutions. It is divided into two parts. In Part I, is presented the exact solution for determining the physical dimensions of the curve of the oscillator section necessary for single dial control when the physical and electrical constants of the radio frequency tuning section are known. Part II is concerned with the use of the super-heterodyne condenser for dual wave ranges, showing two methods of using condensers, designed for the broadcast range on the long wave range. One method requires a very simple padding for only the long wave band; the second method requires no padding at all.

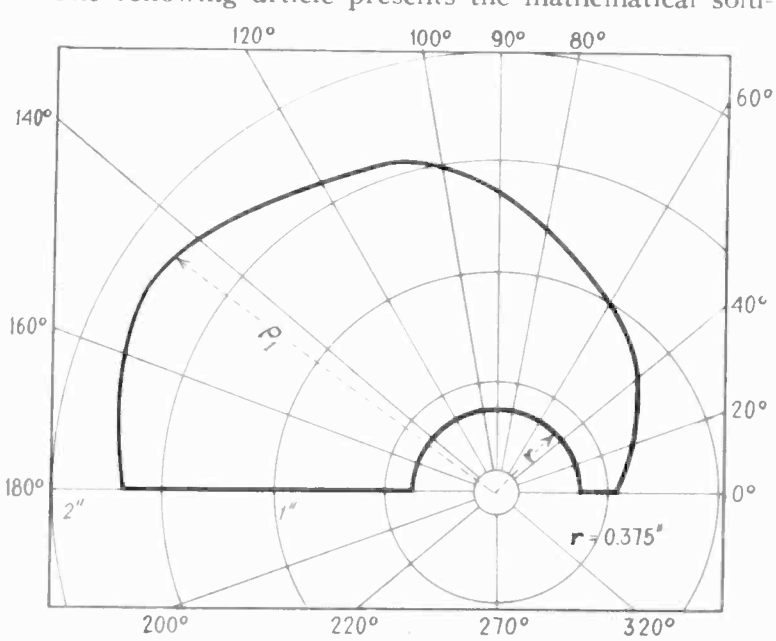


Fig. 1—Curve of r-f plate

The design of the oscillator portion of the variable condenser does not depend upon the manner in which the r-f rotor curve was designed. It is only necessary to know the capacity and radius of the r-f plate at every point to obtain an exact solution of the oscillator rotor plate for perfect tracking. For the design here presented, a typical r-f section of 19 plates was chosen, the curve of the rotor plate being given in Figure 1. The capacity of the condenser, including circuit capacity, is given as C_K in Table I, while in column 4 is given the square of the radius of the r-f rotor plate.

Consider the r.f. rotor plate (fig. 2). Its area in polar coordinates is:

$$A = \tfrac{1}{2}\int \rho_1^2 d\theta - \tfrac{1}{2}\int r^2 d\theta$$

therefore:

$$(1) \qquad C_1 = K_1 \left[\tfrac{1}{2}\int \rho_1^2 d\theta - \tfrac{1}{2}\int r^2 d\theta\right]$$

where C_1 represents the capacity of the condenser referred to zero, and K_1 a constant.

Differentiating (1) gives

$$\frac{dC_1}{d\theta} = \frac{K_1}{2}(\rho_1^2 - r^2)$$

Similarly, the capacity of the oscillator plate is:

$$(2) \qquad C_2 = K_2 \left[\tfrac{1}{2}\int \rho_2^2 d\theta - \tfrac{1}{2}\int r^2 d\theta\right]$$

Dividing one by the other gives.

$$\frac{C_1}{C_2} = B\,\frac{\int \rho_1^2 d\theta - \int r^2 d\theta}{\int \rho_2^2 d\theta - \int r^2 d\theta} \qquad \text{where } B = \frac{K_1}{K_2}$$

or

$$\int \rho_2^2 d\theta - \int r^2 d\theta = \frac{BC_2}{C_1}\left[\int \rho_1^2 d\theta - r^2 d\theta\right]$$

Differentiating and noting that $\frac{C_2}{C_1}$ is a variable.

$$\rho_2^2 - r^2 = B\left[\frac{C_2}{C_1}(\rho_1^2 - r^2) + 2\frac{d}{d\theta}\left(\frac{C_2}{C_1}\right)\left(\tfrac{1}{2}\int \rho_1^2 d\theta - \tfrac{1}{2}\int r^2 d\theta\right)\right]$$

But it has been shown in equation (1) that

$$\tfrac{1}{2}\int \rho_1^2 d\theta - \tfrac{1}{2}\int r^2 d\theta = \frac{C_1}{K}$$

therefore

$$(3) \qquad \rho_2^2 - r^2 = B\left[\frac{C_2}{C_1}(\rho_1^2 - r^2) + \frac{2C_1}{K} \times \frac{d}{d\theta}\left(\frac{C_2}{C_1}\right)\right]$$

This equation involves the term

$\frac{d}{d\theta}\left(\frac{C_2}{C_1}\right)$ which can be eliminated as follows:

Let f_2 = oscillator frequency in Kc.
f_1 = incoming frequency in Kc.
L_2 = oscillator inductance in microhenries
L_1 = rf inductance in microhenries
C_2 = oscillator capacity in $\mu\mu f$ referred to 0
C_1 = rf capacity in $\mu\mu f$ referred to 0
I = intermediate frequency in Kc
M = oscillator minimum capacity
N = r-f minimum capacity
$C_0 = C_2 + M$ = total oscillator capacity in circuit
$C_K = C_1 + N$ = total r-f capacity in circuit

Then

$$f_2 - f_1 = I$$

or

$$\frac{159150}{\sqrt{L_2(C_2 + M)}} - \frac{159150}{\sqrt{L_1(C_1 + N)}} = I$$

Or simplifying,

$$(4) \qquad \frac{C_2 + M}{C_1 + N} = \frac{1}{(D\sqrt{C_1 + N} + P)^2} = \frac{C_0}{C_K} \quad \text{where } D = \frac{I\sqrt{L_2}}{159150};\quad P = \sqrt{\frac{L_2}{L_1}}$$

Differentiating,

$$(5) \qquad d\left(\frac{C_0}{C_K}\right) = \frac{-DC_0^{3/2}}{C_K^2}dC_1$$

Equation (4) can be transformed into

$$\frac{C_2}{C_1} = \frac{C_0}{C_R} + \left(\frac{N}{C_1} \times \frac{C_0}{C_R}\right) - \frac{M}{C_1}$$

Differentiating and substituting equation (5).

$$C_1^2 \frac{d}{d\theta}\left(\frac{C_2}{C_1}\right) = \left[M - \frac{NC_0 + DC_1C_0^{3/2}}{C_R}\right]\frac{dC_1}{d\theta}$$

But from equation (1).

$$\frac{dC_1}{d\theta} = \frac{K_1}{2}(\rho_1^2 - r^2)$$

therefore

$$C_1^2 \frac{d}{d\theta}\left(\frac{C_2}{C_1}\right) = \left[M - N\frac{C_0}{C_R} - \frac{DC_1C_0^{3/2}}{C_R}\right]\frac{K_1}{2}(\rho_1^2 - r^2)$$

Substituting this value for $\frac{d}{d\theta}\left(\frac{C_2}{C_1}\right)$ in equation (3).

$$\rho_2^2 - r^2 = B(\rho_1^2 - r^2)\left[\frac{C_2}{C_1} + \frac{M}{C_1} - \frac{N\frac{C_0}{C_R}}{C_1} - \frac{DC_0^{3/2}}{C_R}\right]$$

then
$$\rho_2^2 - r^2 = B\sqrt{\frac{L_2}{L_1}\frac{C_0^3}{C_R^3}}\,(\rho_1^2 - r^2)$$

where
$$B = \frac{K_1}{K_2} = \frac{N_R - 1}{N_0 - 1}$$
where N_R = number of plates in the r-f and N_o is the number of plates in the oscillator condenser.

So that,

$$(6)\quad \frac{\rho_2^2 - r^2}{\rho_1^2 - r^2} = \frac{N_R - 1}{N_0 - 1}\sqrt{\frac{L_2}{L_1} \times \frac{C_0^3}{C_R^3}} = \frac{N_R - 1}{N_0 - 1} \times \frac{L_1}{L_2} \times \left(\frac{f_1}{f_2}\right)^3$$

This, then, is the formula for the curve of the oscillator rotor plate. In recapitulation, it will be noticed that this formula was derived with the understanding that four facts about the r-f condenser must be known. namely, ρ, the radius of the r-f rotor plate, no matter

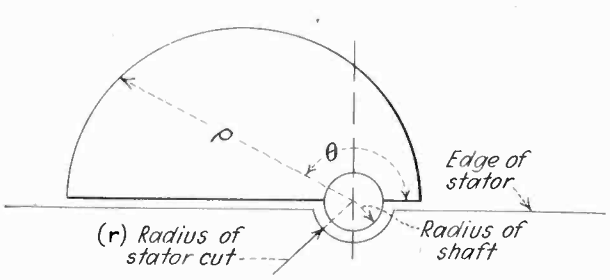


Fig. 2—Typical plate with symbols used in text

how it was computed, r, the radius of the cut in the stator plate, the frequency to which the r-f circuit tunes f_1, and the number of plates N_R. The number of oscillator plates N_O is usually so chosen that the oscillator plate is not larger than the r-f plate. The oscillator frequency f_2 is equal to $f_1 + I$.

Practical operation of the design data

The use of this formula will be illustrated in the following example. The constants to be chosen are:

$N_R = N_0$ = 19 plates total
L_2 = 150 microhenries
L_1 = 250 microhenries
r = 0.375 inches
I = 175 kc.

Table I gives all the necessary steps. F_1, the incoming frequency, is computed from

$$F_1 = \frac{159150}{\sqrt{250}\ \sqrt{C_R}}$$

F_2, the oscillator frequency, equals $F_1 + 175$. The formula then used in obtaining ρ_2 is from equation (6)

$$\frac{\rho_2^2 - .14}{\rho_1^2 - .14} = \frac{L_1}{L_2}\left(\frac{f_1}{f_2}\right)^3.$$

The values of ρ_2 are plotted in Fig. 3.

Part II—Application to two-band receivers

Due to the use of dual wave ranges by manufacturers, for foreign export, an example will be presented, using the condenser designed in Part I, for both 1,500 to 500 Kc. and 150-300 Kc. by padding only the long wave portion. A receiving set using a 175 Kc. intermediate frequency is not feasible for use in dual range sets, since this frequency falls within the range to be covered. Usually 115 Kc. is employed. However, for purposes of illustration of the method to be used in padding, the condenser designed above will be used. The method is exactly the same if a 115 Kc. tracking section were to be used.

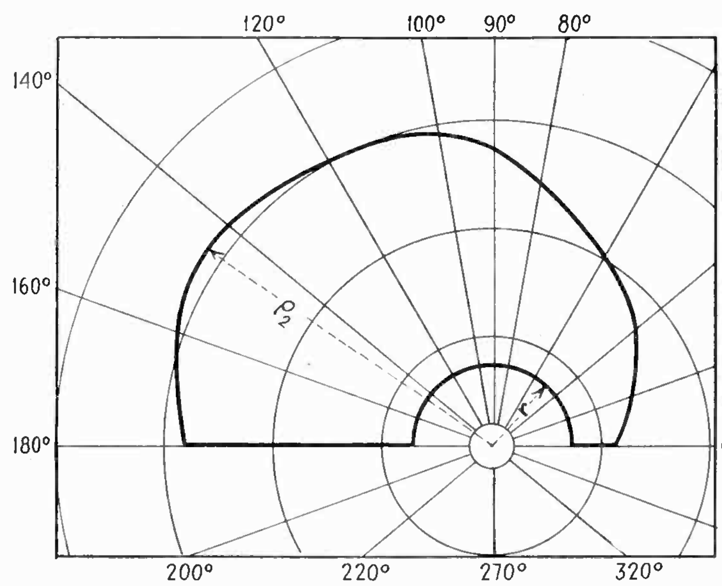


Fig. 3—Curve of oscillator plate

In Table I the actual capacities of the broadcast circuit are given for the condenser under consideration. An r-f inductance L_1 of 3500 μh. will require

$$C_R^{150} = \left(\frac{159150}{\sqrt{3500} \times 150}\right)^2 = 321.6\ \mu\mu f \text{ for 150 Kc.}$$

At this point on the condenser, the oscillator section capacity is 311.0 μμf.

$$C_R^{300} = \left(\frac{159150}{\sqrt{3500} \times 300}\right)^2 = 80.4\ \mu\mu f \text{ for 300 Kc.}$$

At this point on the condenser, the oscillator section capacity is 100.2 μμf.

The circuit for the long wave range requires a padding condenser C_P in series with the oscillator section whence,

$$C_0^{150} = \frac{C_P \times 311}{C_P + 311} = \text{oscillator circuit capacity at 150 Kc.}$$

$$C_0^{300} = \frac{C_P \times 100.2}{C_P + 100.2} = \text{oscillator circuit capacity at 300 Kc.}$$

Now, since $f^2 = \dfrac{159150^2}{LC}$

then:

$$(7) \qquad 150^2 = \frac{159150^2}{L_1 C_R^{150}}$$

$$(8) \text{ and } \qquad (150 + I)^2 = \frac{159150^2}{L_2 C_0^{150}}$$

$$(9) \text{ then } \qquad \left(\frac{150}{150 + 175}\right)^2 = \frac{L_2 C_0^{150}}{L_1 C_R^{150}}$$

$$(10) \text{ Similarly, } \qquad \left(\frac{300}{300 + 175}\right)^2 = \frac{L_2 C_0^{300}}{L_1 C_R^{300}}$$

✦

TABLE I

1 θ	1 C_r	2 F_1	3 F_2	4 P_1^2	5 $P_1^2 - .14$	6 Col. 5 × $\frac{L_1}{L_2}\left(\frac{F_1}{F_2}\right)^3$	7 Col. 6 + .14	8 ρ_2
0	41.2	1568.2	1743.2	.274	.134	.162	.302	.550
π/18	43.2	1531.4	1706.4	.352	.212	.254	.394	.628
π/9	46.2	1480.9	1655.9	.433	.293	.352	.492	.701
π/6	50.2	1420.7	1595.7	.541	.401	.474	.614	.784
2π/9	55.7	1348.7	1525.7	.670	.530	.615	.755	.869
5π/18	62.7	1271.2	1446.2	.818	.678	.766	.906	.952
π/3	71.7	1188.7	1365.7	.990	.850	.935	1.08	1.04
7π/18	82.7	1106.9	1281.9	1.17	1.03	1.10	1.24	1.11
4π/9	96.2	1026.3	1201.3	1.46	1.32	1.37	1.51	1.23
π/2	114.2	941.9	1116.9	1.90	1.76	1.76	1.90	1.38
5π/9	137.2	859.4	1034.4	2.25	2.11	2.01	2.15	1.47
11π/18	163.2	787.9	962.9	2.46	2.32	2.11	2.25	1.50
2π/3	191.2	728.0	903.0	2.55	2.41	2.10	2.24	1.50
13π/18	220.2	678.3	853.3	2.76	2.62	2.18	2.32	1.52
7π/9	253.2	632.6	807.6	3.11	2.97	2.37	2.51	1.58
5π/6	289.2	591.9	766.9	3.26	3.12	2.39	2.53	1.59
8π/9	325.2	558.2	733.2	3.09	2.95	2.16	2.30	1.52
17π/18	358.2	531.8	706.8	2.93	2.79	1.97	2.11	1.45
π	391.2	508.9	683.9	2.78	2.64	1.82	1.96	1.40

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Equations (9) and (10) are two simultaneous equations with two unknowns, L_2 and C_P.

To solve for C_P, divide equation (9) by equation (10),

$$\left(\frac{150}{325} \times \frac{475}{300}\right)^2 = \frac{C_0^{150} \times C_R^{300}}{C_R^{150} \times C_0^{300}} = \frac{361}{676}$$

or

$$\frac{C_0^{150}}{C_0^{300}} = \frac{361}{676} \times \frac{321.6}{80.4} = 2.136$$

Substituting the values for C_0^{150} and C_0^{300},

$$\frac{C_P \times 311}{C_P + 311} = \frac{C_P \times 100.2}{C_P + 100.2} \times 2.136$$

whence $\qquad C_P = 364.6 \mu\mu f$

and $\qquad C_0^{150} = \dfrac{364.6 \times 311}{364.6 + 311} = 167.9$

substituting in equation (8) gives.

$$L_2 = \frac{159150^2}{167.9 \times 325^2} = 1428.7 \mu h$$

These two values of 1428.7 and 364.6 give perfect tracking at 150 Kc. and 300 Kc. In between these two points, the r-f circuit will be off resonance by the amounts indicated in Table II. This table also gives the results of padding a condenser composed of two straight t-r-f sections of the type used in Part I. The values of L_2 and C_P for perfect tracking at 150 and 300 Kc. was computed to be $L_2 = 1969.5$ and $C_P = 196.0$. The results obtained show it is better to pad the special condenser than the t-r-f section.

Design for perfect tracking

There is another method to cover the long wave and broadcast range that is not dependent upon padding, and is capable of perfect tracking throughout both ranges. To use this solution, a condenser whose oscillator section is cut for a 456 Kc. intermediate is required.

Consider the general super-heterodyne equation that

$$f_2 - f_1 = I$$

or

$$\frac{159150}{\sqrt{L_2 C_2}} - \frac{159150}{\sqrt{L_1 C_1}} = I$$

$$(11) \text{ or } \qquad \frac{1}{\sqrt{C_2}} - \sqrt{\frac{L_2}{L_1}} \times \frac{1}{\sqrt{C_1}} = \frac{\sqrt{L_2}\, I}{159150}$$

Inspection of this formula shows that the left hand side of the equation, which is a property of the condenser and the *ratio* of the two coils used, is equal to a constant, no matter what the rotation of the condenser may be. For example, assume that the condenser had been cut for 456 Kc., with coils $L_2 = 150$ μh., $L_1 = 250$ μh. then

$$\text{then} \qquad \frac{1}{\sqrt{C_2}} - \sqrt{\frac{150}{250}} \times \frac{1}{\sqrt{C_1}} = \frac{\sqrt{150} \times 456}{159150}$$

But now suppose that it is desired to use this condenser for the long wave range where $L_1 = 3930$ μh. The left hand side of the equation must still have the same value. This can be obtained only by the use of an oscillator inductance

$$L_2 = \frac{150}{250} \times 3930 = 2358 \mu h$$

The right hand side of the equation must also keep the same value of $\dfrac{\sqrt{150} \times 456}{159150}$, which can be done only by changing the intermediate frequency to

$$I = \sqrt{\frac{150}{2358}} \times 456 = 115 \text{ Kc.}$$

✦

TABLE II

θ	Padding 175Kc. Condenser: Incoming Frequency f_1	Required Oscillator Frequency f_2	Actual Resonant Frequency f_2-175	Kc. off Tracking f_1-(f_2-175)	Padding t-r-f Cond.: Required Oscillator Frequency f_2	Actual Resonant Frequency f_2-175	Kc off Tracking f_1-(f_2-175)
7π/18	295.8	470.4	295.4	+ .4	470.2	295.2	+ .6
4π/9	274.3	447.4	272.4	+1.9	446.4	271.4	+2.9
π/2	251.7	423.9	248.9	+2.8	422.2	247.2	+4.5
5π/9	229.7	401.3	226.3	+3.4	399.2	224.2	+5.5
11π/18	210.6	392.2	207.2	+3.4	380.0	205.0	+5.6
2π/3	194.5	366.6	191.6	+2.9	364.5	189.5	+5.0
13π/18	181.3	353.8	178.8	+2.5	352.2	177.2	+4.1
7π/9	169.1	342.4	167.4	+1.7	341.2	166.2	+2.9
5π/6	158.2	332.4	157.4	+ .8	331.8	156.8	+1.4
8π/9	149.2	324.3	149.3	− .1	324.3	149.3	− .1

✦

The intermediate frequency, then, changes to 115 Kc. when using $L_2 = 2358$ μh., $L_1 = 3930$ μh. The change from 456 Kc. to 115 Kc. could be accomplished by designing the intermediate transformers to tune to both 456 Kc. and 115 Kc. and cutting in the desired intermediate by means of the switch that accomplishes the change from broadcast to long wave.

Temperature control by electron tubes

By KEITH HENNEY
Associate Editor, Electronics

ALTHOUGH the time has not arrived when the average citizen can heat his house, or cool his head, by electron tubes, all manner of tubes—amplifiers, rectifiers, phototubes—are being used in all manner of ways for controlling temperature for all manner of purposes.

Representative methods are given in this excerpt from Mr. Henney's book, *"Electron Tubes in Industry"* to be published by the McGraw-Hill Book Company.

AMONG the simplest circuits using tubes for temperature control are those in which the tube merely relieves the thermostat contacts of passing much current, or where greater currents are to be passed to heating coils, grid-controlled rectifiers are employed. In the latter case[1] the varying plate current passing through a transformer in series with the heating coil varies the impedance and thus affects the series heating current.

A somewhat more complex circuit[2] is shown in Fig. 1 and used in a medium temperature furnace in a resistor plant where the requirements as to allowable temperature variation are quite severe.

A special resistance thermometer is placed in the furnace and made the fourth arm in an a.c. bridge. By variation of one of the fixed arms of the bridge the temperature may be adjusted. No voltage is present across the bridge at correct temperature. An increase or decrease in temperature unbalances the bridge, applies a voltage to the insulating transformer, to be amplified and applied to the controlled rectifier grid. An increase in temperature causes the grid bias on the tube to increase and stop the flow of current on the half cycle when the anode is normally conducting, *i.e.*, the positive half cycle. A decrease in temperature permits the tube to conduct and to close the power relay. One

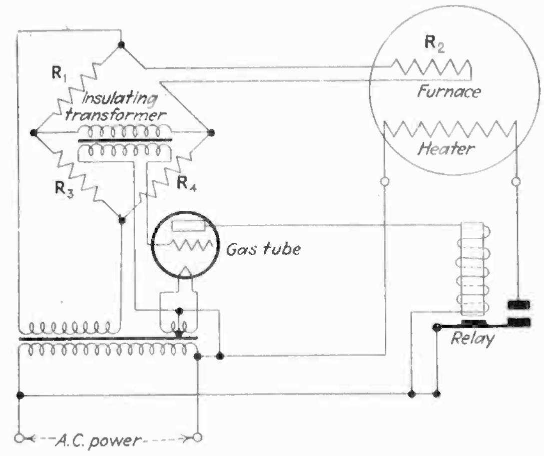


Fig. 1—Bridge circuit in which one arm is a resistance thermometer

furnace of this type permitted a temperature to be maintained without difficulty at 500°C. to within 5°.

Another temperature-control system[3] using gaseous triodes is shown in Fig. 2 used in the growth of single crystals of alkali halides. It was necessary to keep temperature constant at some times, and at others to vary it as slowly as 2°C. per day. The circuit has the advantage that it has no mechanical relays, and produces continuous modulation reducing the tendency of the furnace temperature to hunt or oscillate.

The thermocouple is constantan-chromel, one junction in the furnace and the other in an ice bath. The galvanometer has a sensitivity of 40 megohms, resistance 80 ohms. More or less light falling on the photocell through a V-shaped slot varies proportionately the flow of current through the tubes by the phase-variation method.

The tube has a capacity of 5 amp., and since 18 amp. were required, a large proportion of the heating current flowed through R_1, the tube passing about 3 amp.

At a furnace temperature of 880°C., the maximum variation from the normal temperature was 0.06°C.

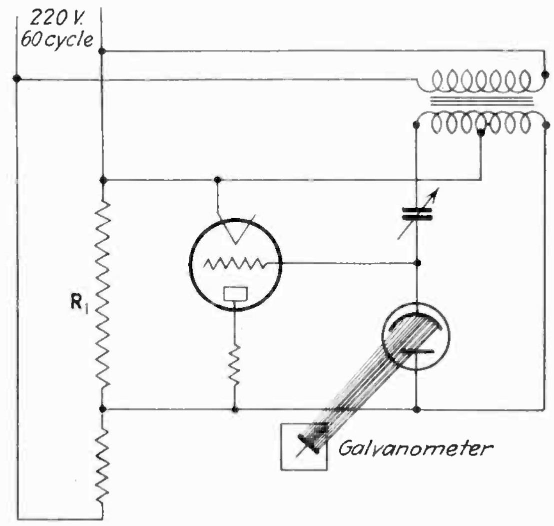


Fig. 2—Phototube-rectifier temperature control circuit

Another use of the photocell has been made by Anderson[4] in the preparation of single metal crystals in which it was necessary to hold a quantity of zinc at its melting point for periods of from 12 to 48 hours by surrounding it with a bath of zinc automatically maintained in two-phase equilibrium through the abrupt change in resistance attending isothermal fusion. Use is made of the fact that at the melting point the specific resistance of molten pure metal is about twice that of the solid metal at the same temperature. Thus, if contacts are immersed in the metal and a constant direct current is passed through it, the voltage drop across these potential contacts will be a function of the quantity of metal that has melted. This variation in potential may be used, for example, to control the heating current in a furnace.

In the diagram, F is the furnace thermostat, M the zinc bath. Tungsten potential contacts connected to a galvanometer (a Moll instrument with negligible zero shift and a voltage sensitivity of 5×10^{-6}) and tungsten current contacts leading to a 2-volt storage battery are immersed in the bath. Light from the lamp L is reflected from the mirror of the galvanometer to a photocell which controls the grid-controlled rectifier.

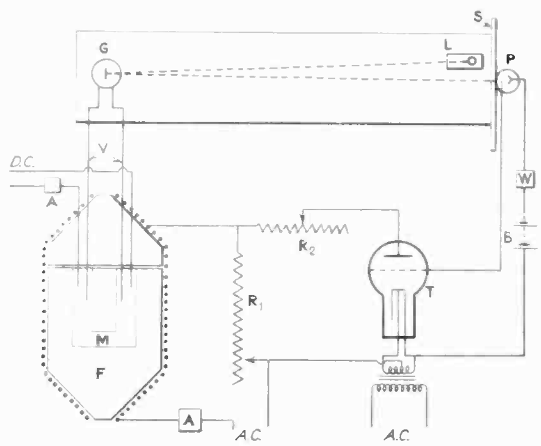


Fig. 3—System used in growing crystals

Heating current enters the furnace through a parallel circuit composed of R_1 and the plate circuit of the tube. In operation full current goes into the furnace until the resistance of the bath falls when the light spot shifts away from the photocell and the tube bias is increased to the point where the discharge is extinguished.

Anderson reports that the resistance of the zinc bath was of the order of 1×10^{-5} ohm in the solid state and twice this in the liquid state. With a control current of 20 amp. the potential drop during fusion was about 2×10^{-4} volt and the galvanometer deflection was 40 mm. A change of 2 mm. operates the photocell.

Another method (by J. V. Kovalsky) of controlling temperatures by a photocell is shown in Fig. 4. Here light is focused upon the phototube when the temperature is low. The amplifier is so arranged that when light is on the phototube, the heater contacts are closed. Thus when the lamp, or the phototube, or control voltage fails, the power is disconnected from the heater.

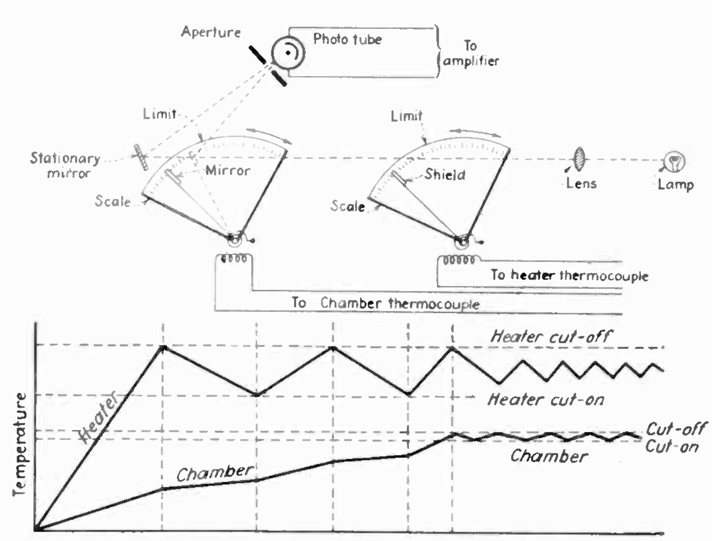


Fig. 4—Circuit and characteristic of a phototube method of maintaining temperature

When the temperature is low, the beam of light is focused upon the stationary mirror and thence to the phototube. Power is applied to the heater in the furnace. As the temperature of the furnace chamber rises, the heater temperature reaches a maximum and may burn out if left on for appreciable time. Therefore the circuit is so arranged that the shield on the pointer of the heater thermocouple meter intercepts the light and opens the power contacts. The chamber continues to heat, however, due to the stored heat in the walls and the heater.

The heater temperature falls and the shield is removed from the path of the beam permitting the light to fall on the mirror again. As the chamber temperature rises and the thermocouple meter measuring the chamber temperature indicates this increase, a mirror on the indicating device picks up the light and continues to reflect it into the phototube until the temperature reaches some upper limit desired when the light beam is reflected at such an angle that it no longer falls upon the phototube. Then the amplifier opens the power contacts and the temperature begins to fall. Soon, however, the light is again reflected into the phototube and the cycle continues.

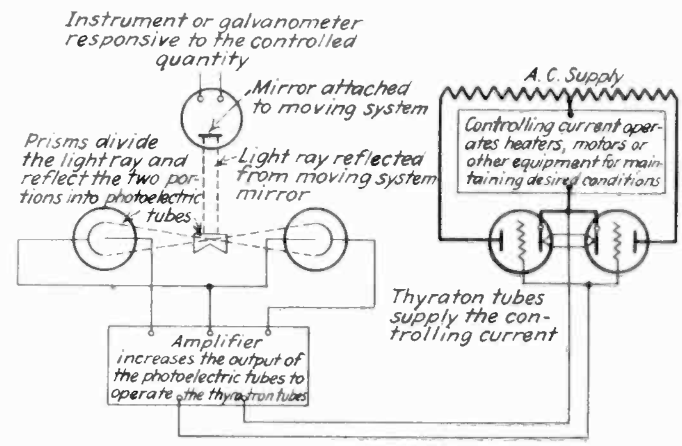


Fig. 5—Precision control circuit that maintains temperature to within 0.005 deg. C.

The limits of temperatures on both the furnace chamber and the heater can be changed by turning the meter unit on the axis of the pointer. Tests show that the temperature at constant load in furnaces is kept so close to the limit that with the present day recording instruments it is impossible to see any variations. The variation estimated to be approximately $\frac{1}{2}°$ in 1500° F., as compared with 10° on standard instruments.

A precision method[5] on maintaining temperature of an oil bath is shown in Fig. 5. A galvanometer is used whose deflections are caused by variations in the voltage generated in a copper-manganin thermojunction immersed in the oil. A beam of light reflected from the mirror of the galvanometer into one of two photocells increases or decreases the temperature accordingly, through an amplifier and grid-controlled rectifiers, by changing the heating-coil current.

In a three-week test the temperature was kept constant at all times within 0.003 to 0.005° C.

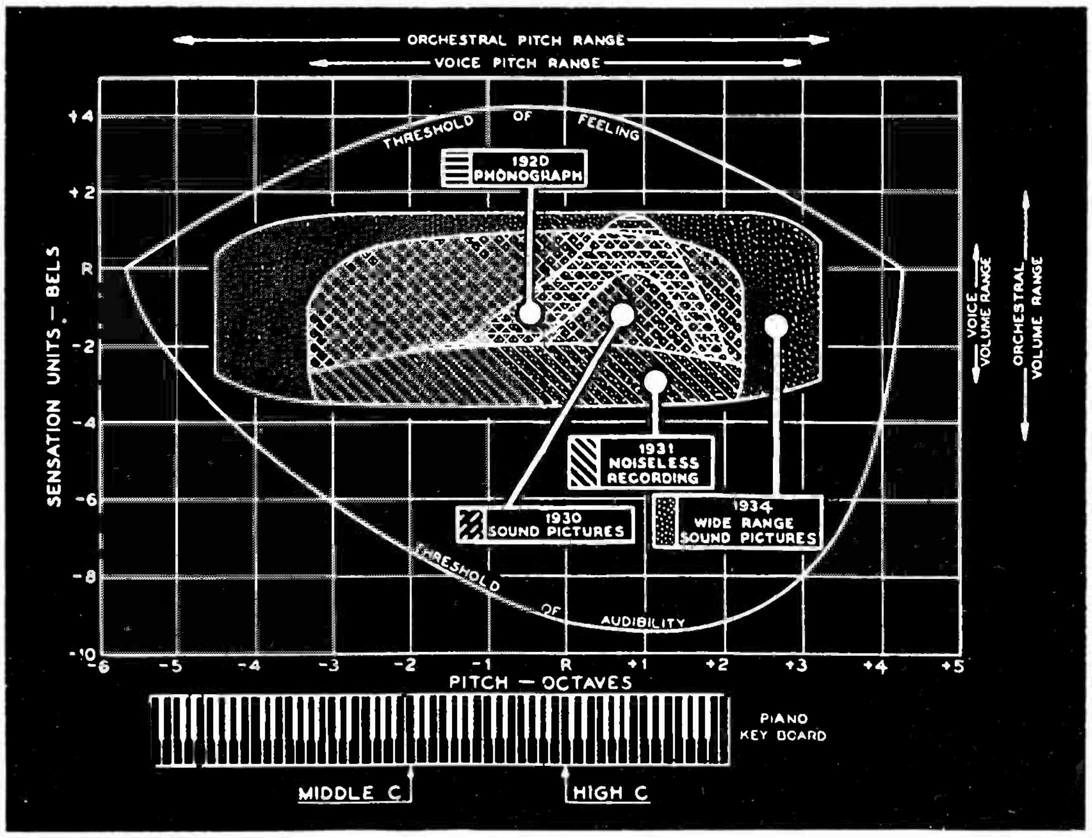
Apparatus[6] used in the Low Temperature Laboratory of the Bureau of Standards to maintain temperatures between —180° and 0° C., constant to 0.001° C. is shown in Fig. 6.

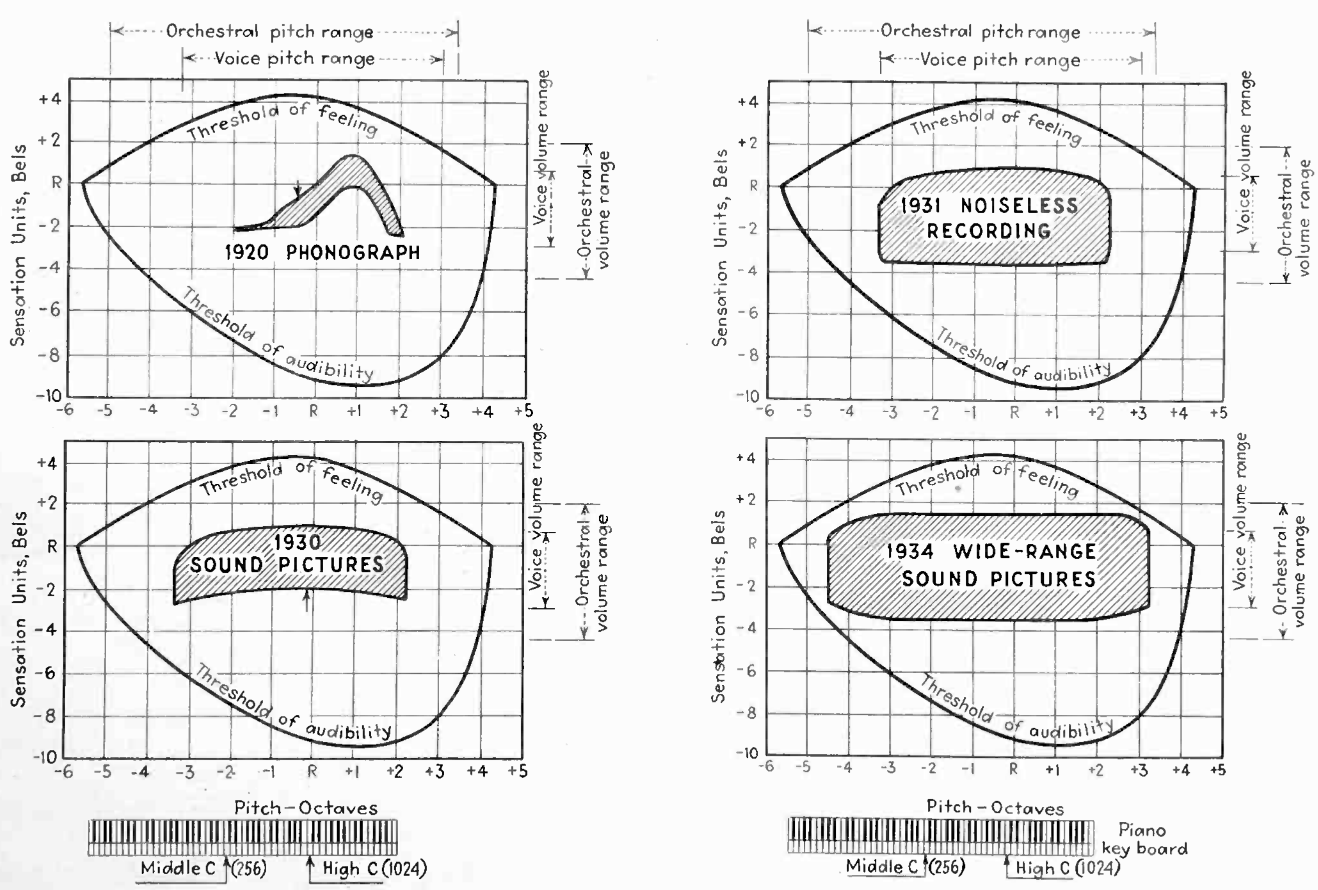
Here, X is to be maintained at the same temperature

[*Please turn to page 196*]

The march toward

HIGH FIDELITY IN SOUND





Recognizing the greater artistic and emotional appeal of wide-range reproduction, the sound-picture industry has carried its fidelity of tone further and further in both "highs" and "lows," with the result shown in these charts which have been compiled and copyrighted by Electrical Research Products, Inc.

HIGH LIGHTS ON ELECTRONIC

Daylight intensity controlled by photo-cells

IN THE NEW POST-OFFICE building at High Point, North Carolina, by equipping the mail sorting room with photoelectric cells which maintain correct illumination, the eyesight of postal employees is protected. The photo-cells cause louvers or shutters on the skylights to open or close, thereby letting in the proper amount of light. (See also *Electronics,* Dec. 1933, p. 334.)

"Glare is the chief offender in buildings designed to admit an abundance of natural light," says E. H. Vedder, engineer of the Westinghouse company who arranged this new use. "Bright sunshine produces glare which causes eye strain, headaches and general physical discomfort to the workers. Combatting this, the photo-sensitive relays are adjusted to maintain the correct level of illumination in the sorting room regardless of outside weather conditions."

The roof above the sorting room has a raised rectangular section, 80 feet long, 60 feet wide and 12 feet high, whose slanting sides are of glass. One side faces the north, one the east, one south and one west, giving good exposure in all directions. Nine louvers or shutters about a foot wide run horizontally the length of each skylight. They are located one above another and, when closed, completely cover the skylight. Each louver is hinged at the top and the nine are raised or lowered in unison by a mechanical arm which is powered by an electric motor.

A master photoelectric control unit is located on the roof. It has two settings or limits. On cloudy days it permits the louvers to open all the way, but on bright sunshiny days, allows them to open only part way.

Four photo-cells are suspended from the sorting room ceiling, one facing each skylight. As the amount of daylight falling upon one of these cells varies, it starts the motor which opens or closes its skylight louvers as much as needed.

Such control of natural lighting will not only improve the general health of workers through relieving eye strain, but it will also increase their efficiency, says Mr. Vedder. He predicts that in the future natural-light control will come into general use for many types of buildings and offices.

✦

Electronic aids to voice-culture

THE POSSIBILITIES available when science co-operates with art are well demonstrated at the Berlin (Germany) Conservatoire, especially as regards the teaching of singing. For example, pupils are shown when they are singing a vowel unevenly by means of the curve on a cathode-ray screen or traced on a smoked drum, and such curves can be recorded and preserved to prove the student's subsequent progress. Or again wax, film and steel-tape records are freely used to let the singer hear his own performance. Or the contact-microphone is used, with a six- or seven-stage amplifier, to separate the sound due to the vocal chords alone, from that added by the resonance-cavities of the mouth, etc.

Several American teachers of voice have also used line indicators to show the singer the volume created at each moment as he sings.

Lights go on when train enters tunnel

AMERICAN PHOTO-CELLS are now being used experimentally on a crack Belgian train, to control the train lights. As soon as the train enters a tunnel, the lights come on, and are extinguished when the train emerges. The photo-cell control also serves when the train enters dark trainsheds at city railroad stations along its travel, or when natural darkness falls.

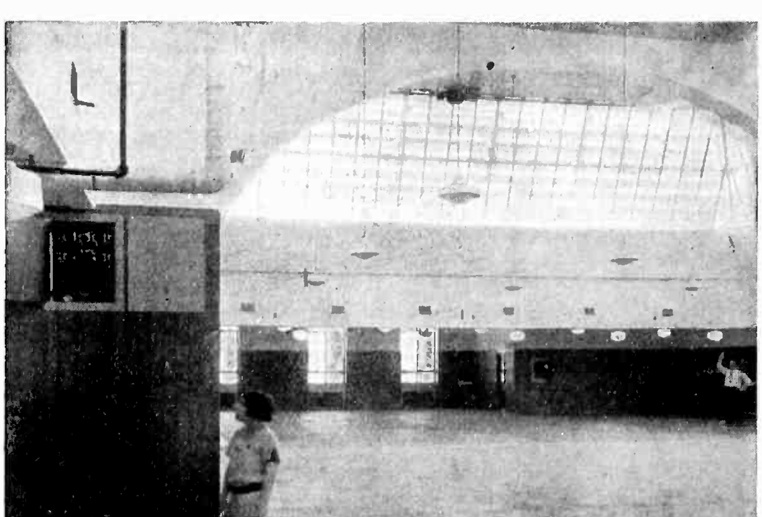
"This is a simple installation and one which railroads generally, particularly those that go in and out of tunnels frequently, could use to good advantage," explains R. E. Smiley, general sales manager of the Continental Electric Company, St. Charles, Ill., the American manufacturer who supplied the photo-cells for the Belgian experiment.

✦

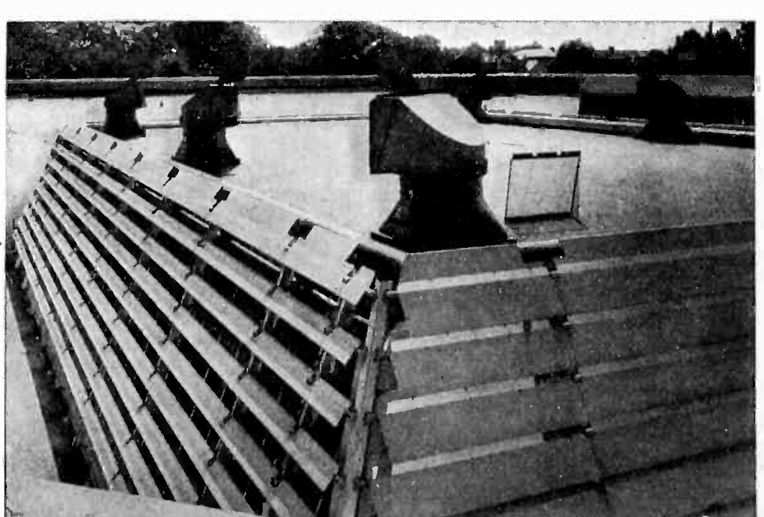
Lighthouses and beacons photocell operated

TWO GOVERNMENT LIGHTHOUSES on Long Island and two on Staten Island are now controlled by Photronic cells, which switch the lights on and off at predetermined levels of illumination.

In addition nearly four hundred of these cells have been used by the Lighthouse Service for operating river markers and range lights. The lights in the Gulf of Mexico, Mississippi Delta region, and New Orleans approach are so controlled, as well as a number of markers in the Connecticut and Hudson rivers. The circuits of the associated relay apparatus are so arranged that breakage of any wire or apparatus, causes the light to be turned on.



The sorting room, showing skylights and louvers, of new post-office, High Point, N. C.



Adjustable louvers on skylights, which are automatically opened or closed to provide sufficient illumination but no glare in the sorting room below

DEVICES IN INDUSTRY + +

Measuring luster of textiles

H. L. Barthelemy of the Tubize Chatillon Corporation, producers of acetate, nitro-cellulose and viscose yarns, 2 Park Avenue, New York City, has developed a photo-electric "luster meter" for comparing the sheen or luster of products handled in his routine work.

A diaphragmed beam of parallel light from a 250-watt Mazda C bulb is reflected on the rotative pulley of a small pivoting electric motor as shown. The pulley is covered with three layers of the fabric for which one is interested to determine the luster. This fabric is maintained in position by a rubber band placed around the grooved part of the pulley.

The reflected light is received by a type A Westinghouse photoelectric-cell amplifier unit having a response per foot candle directly proportional to the electric current within a range of 0 to 10 milli-amperes of the plate current of the amplifier tube.

It is interesting to point out that by pivoting the motor in such a way that the pulley-mirror turns around a vertical axis (see 0 on the diagram), the intensity of the light received was found maximum for a position corresponding to an angle of about 154 deg. to 156 deg. between the direction of the beam of light and the surface of the pulley-mirror. But this is not absolutely true as this angle can vary considerably at times with the nature of the surface and the interlocking of weaving, etc.

The luster is expressed in relative value in comparison with the luster of a piece of known woven fabric taken as the standard. After having mounted three layers of the standard fabric on the pulley, the diaphragm of the lamp is adjusted to read 10.0 milli-amperes.

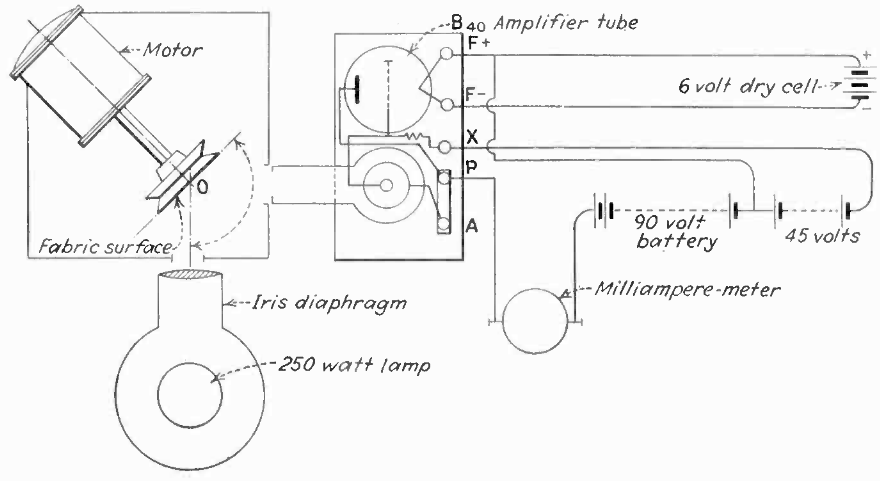
Scoured, Knitted 150 Denier 40 Filaments Viscose Yarn

Pigment % from Cellulose	Milli-amperes	% Gloss from Standard
.22	8.5	85
.18	9.3	93
.22	9.4	94
.14	9.9	99

Scoured, Knitted 150 Denier 40 Filaments Cellulose Acetate Yarn

Pigment %	Milli-amperes	% Gloss from Standard
1.9	3.7	37
1.5	4.1	41
1.19	4.2	42
.88	4.25	42.5

No one was able to detect with the naked eye any discrepancies between the different samples of each series related above, but the luster meter did, and, in the meantime, showed that doubling the amount of pigment in the yarn above 0.8 per cent did not proportionally improve the quality of the luster.



Arrangement of apparatus for measuring luster or sheen of fabrics on face of pulley. Photocell indicates reflection from textile

Why electronic-made sandpaper cuts better

By making use of electronic rectifiers and a new electrostatic process of coating paper with abrasives, a group of sandpaper manufacturers has produced a new abrasive product which is found to increase cutting efficiencies from 20 to 60 per cent, resulting in economies of 30 to 40 per cent for the average job.

A unique electrostatic process is responsible for this new product. The abrasive particles, sifted to size as in the past, are fed from a hopper onto an endless belt. This belt carries them over the negative side of a pair of closely-opposed electrodes between which a high-tension electrostatic field is set up, through the action of a unidirectional potential of around 50,000 volts, supplied by vacuum-tube rectifiers. Under the positive or upper electrode, with its glue-covered surface facing the granules on the belt, the backing passes on its way to the drier.

As the abrasive particles pass into the electro-static field they are all immediately oriented so that they stand "on end," and at approximately equal distances from each other. The force of the field then translates them along the lines of force toward the other electrode. Here they are firmly imbedded in the adhesive.

The product resulting from this process has a coating in which the abrasive grains stand on end, with their sharp points facing outward toward the work. These grains are also securely set at approximately uniform distances from one another. It is these qualities of the coating that enable the new electrocoated sandpaper to turn out more high quality cutting work in less time, with less labor, and at less cost.

Electrocoated sandpaper is being marketed with coatings of garnet, silicon carbide, and aluminum oxide, in standard grit numbers from "fine" to "coarse" and with backings of cloth, paper, or combinations.

✦

Electronic robot "greeter" at new Franklin Institute

At the main entrance of the magnificent new building of the Franklin Institute, Philadelphia, stands an electronic robot "greeter" garbed in the uniform of one of the museum attendants, who calls out a cheery message of welcome to each visitor who enters the building.

"This robot greeter is known around here as Egbert (for no reason at all)," explains James Stokley, associate director of the Franklin Institute, "and is operated by two photo-electric relays.

"A visitor coming in through the entrance door to the Museum, interrupts a beam of deep red light which shines through gratings over the radiators in the vestibule. This sets off the mechanism in Egbert so that he raises his arm and salutes, and then an electrical phonograph connected with a loud speaker in his stomach says: 'How do you do. I'm very glad to see you. I hope you enjoy your visit' in a baritone voice.

"In order that Egbert will not greet people who are leaving, the second light beam is arranged so that visitors on the way out interrupt the second beam first. This operates another relay which disconnects the first one and so the welcoming mechanism does not function."

The sun's effects on radio

Variations in transmission characteristics related to solar changes

By J. L. Richey

Chief Operator, Trans-Atlantic Control, American Telephone & Telegraph Co. New York

Investigations reveal that in the rarified upper atmosphere of the earth, above a height of approximately fifty miles, there exists a region containing a large number of ionized or electrified particles. This region is now called the "ionosphere," and its electrification is produced for the most part by solar radiations.

Directly overhead the ionosphere is densest around noon time, and rarest just before dawn. Measurements have shown it to exist in two major layers, one above the other. The lower reflecting layer is in the region about 60 miles high, and the upper layer about 120 to 240 miles high. Incidentally, the upper layer usually contains more electrified particles than the lower.

Radio waves in their travel into the ionosphere are reflected or bent back toward the earth. The longer the length of these waves, the greater is the amount of bending, and the easier it is for them to return to the earth. Long radio waves are thus virtually reflected back by the lower regions of the ionosphere, and they travel around the earth's curvature by a series of bounces,—from the earth to the ionosphere and back to the earth again, and so on. On the other hand, the shorter the length of the radio waves the less will be the degree of bending, and the deeper will be the penetration into the ionosphere. The shorter waves keep going into the ionosphere until they encounter electrified particles in increasingly sufficient numbers to bend them back toward the earth. They are, therefore, reflected from higher regions of the ionosphere, and in consequence make a longer hop along the earth's surface in going from the earth to the ionosphere and back to the earth again. The much shorter waves are bent so little that they penetrate through the ionosphere into interstellar space. It is on very short waves that a behavior similar to that observed on light waves is obtained, and the shorter the waves become the more like light waves they behave.

All radio waves that go up to the ionosphere and back to the earth undergo variations in strength that are intimately related with changes taking place in the ionosphere, and these in turn depend upon the earth's position with respect to the sun; that is, it depends upon both the time of day and the time of year. On all waves longer than say, about 30 meters, it is generally observed that greater distances and louder signals obtain at night than in the daytime. Over long distances, the short waves between approximately 10 and 25 meters, perform best in daylight. Waves shorter than 10 meters have not been found useful for long distances, because ordinarily they are not bent sufficiently to return to the earth. The most pronounced of the seasonal variations in radio transmission is caused by the change in the length of day or night, or the extent to which the upper atmosphere is exposed to the direct rays of the sun.

The changes in radio conditions that are related with solar phenomena are most noticeable on transmission paths which lie close to the auroral zones surrounding the earth's magnetic poles, as indicated by the marked effect with which such disturbances are felt on North Atlantic radio circuits, while showing only a slight effect between North and South American points.

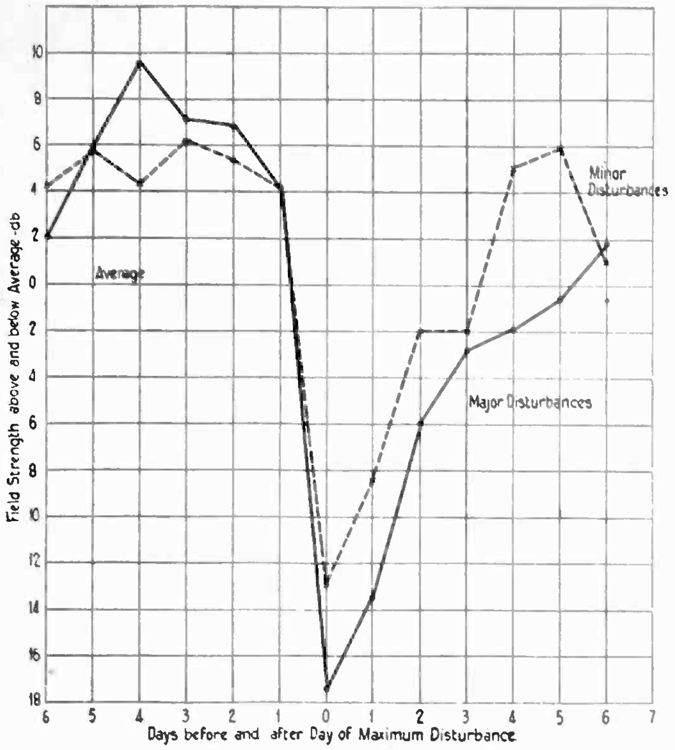
The most conspicuous of the solar phenomena usually seen co-incident with changes in radio conditions, are sunspots. These sunspots are visible to us as swirling eddies in the intensely hot gaseous surface of the sun. Although extremely hot, they are cool compared to the normal surface, so they appear dark only by contrast. Actually the darkest part of a sunspot is really brighter than an electric arc. To be seen by the naked eye, one of these spots must measure nearly 30,000 miles across.

The activity of a sunspot is generally accompanied by a vast disturbance of the sun's surface, producing near it what is known as an eruptive prominence. Vast sheets of gaseous material are shot into space at velocities up to hundreds of miles a second. Clouds of hydrogen and calcium gas called flocculi also hover about these active areas. The violent motions that have been observed suggest gigantic storms that in their fury pale into utter insignificance the most violent of earthly tornadoes. The general disturbance is evidenced in other solar phenomena also, such as bright patches on the sun's surface, increases in the solar corona, and changes in the sun's temperature.

Corona electrons travel 1000 miles per second

A very interesting theory called upon to explain how solar activity affects the earth, considers that the gaseous eruptions accompanying the sunspots, and the light of the sun, combine their forces to drive streams of electrified gas particles into space. From studies made so far, it appears as though these streams attain speeds of approximately 1,000 miles a second. At this rate, they would, if properly directed, travel the 93,000,000-mile journey from the sun to the earth in something like 26 hours.

Sunspots are found in two zones, one in the northern and the other in the southern hemisphere of the sun, extending from a region near the equator to a latitude of about 30 degrees on either side. Observations have shown that sunspots actually move, the motion being of a two-fold nature. The sun rotates on its axis, and the spots collectively participate in this motion of rotation. But in addition to this, it was observed that the active region from which the sunspots develop, starts in a latitude near 25 to 30 degrees on both sides of the equator, and gradually moves in toward the equator, completing this phenomenon in about 13 to 14 years. Two or three years before the active regions arrive near the equator, new regions start up nearer the poles. By observing the motions of sunspots, it was found that the sun does



Characteristic effect on radio of a magnetic storm of solar origin

not rotate as a solid body like the earth. Instead, its fluid-like mass makes a complete rotation faster at its equator than it does in higher latitude.

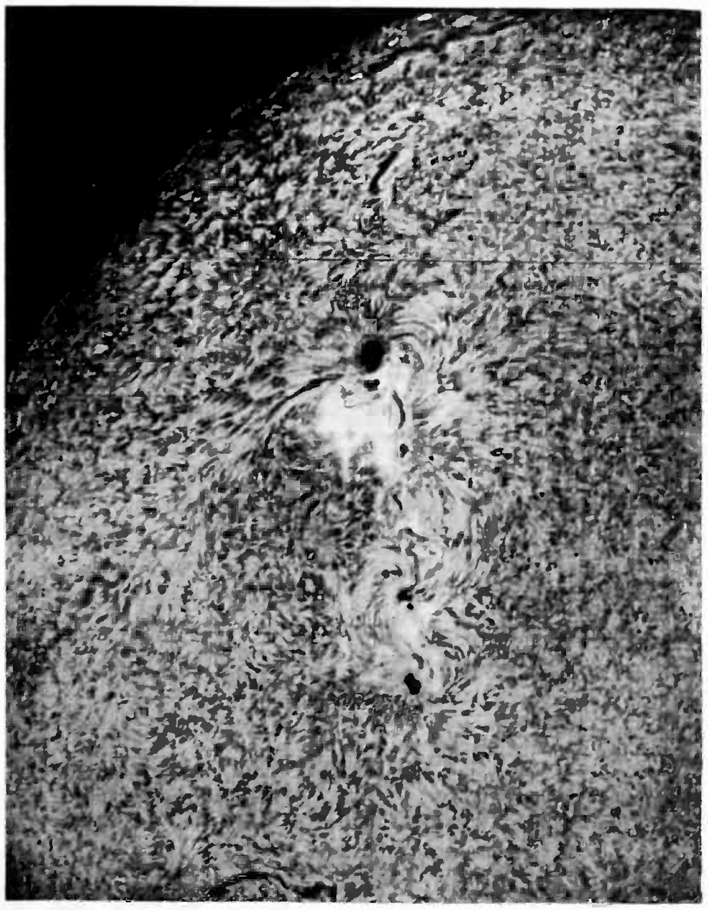
As the sun rotates, the active region from which the sunspots develop appears to send out electrified streams which spray the vast surrounding space in somewhat the same way that water jets from a revolving lawn-sprayer sprinkle a lawn. When one of these invisible electric jets strikes the earth its effect is observed in a number of ways. Auroral lights flash in the polar regions, compass needles oscillate erratically, and enormous electrical current sheets flow back and forth in the earth's outer crust. But an even more important effect in connection with this discussion is the disturbance which this passing stream sets up in that region of electrified particles in the upper atmosphere, and thus bringing about a change in radio conditions. If the magnetic storm (as these effects are generally called) is severe, signals from broadcasting stations which are ordinarily heard at a long distance, are weakened, the transoceanic short-wave signals following paths near the auroral latitudes may under these conditions fade out completely. On the other hand the very long wave signals are slightly improved in the daytime, although they are somewhat lessened in strength at night.

In a number of instances individual magnetic storms and changed radio conditions have been clearly associated with individual groups of sunspots. However, as the active region on the sun may not always be directed earthward, many sunspots may be visible without any effect being produced on the earth. On the other hand, disturbances have occurred when no sunspots were visible. Invisible sunspots, however, have been detected by their inherent magnetic fields underneath the solar surface and clouds of hydrogen and calcium gases.

A large number of sunspots last for only a day or two. Occasionally one will persist for a number of months and may be recognizable for as many as four to six revolutions of the sun. The most persistent on record reappeared through eighteen months. As seen from the earth the rotation period of the sun where sunspots are mostly found is about 27 days. The changed radio conditions have in a number of instances been found to recur on an average of 27 days, and to a large measure confirm the "lawn-sprinkler" analogy of the spraying disturbance on the sun, associated with a persistent spot, and rotating with it.

A certain rhythm in their increase and decrease in numbers is a very important characteristic of sunspots. Sometimes there are whole years during which the sun is never without them, and sometimes there are periods as long as several months when no spots are in evidence. From one maximum period to the next is approximately eleven years. When sunspots are fewest there are four well marked belts, two near the equator, with the active region dying out, and two new regions in higher latitudes just coming into existence. Sunspots are greatest in number when the active region is located in a latitude of about 16 degrees. The solar surface has been found to radiate more energy during the sunspot maximum as compared with the sunspot minimum. So in effect the sun can be considered a slightly variable star.

The changed radio conditions follow a two-fold cycle, one associated with the rotation period of the sun, and the other with the increase and decrease in the number of sunspots. The efficacy of the solar sprinkler system increases as the number of sunspots or holes in our sprinkler increases, so that during the years of numerous sunspots, magnetic storms and changed radio conditions are most frequent. The increased radiation from the sun at the time of the sunspot maximum, results in creating more ionization in the upper atmosphere. The ionosphere, therefore, undergoes an increase in density from sunspot minimum to sunspot maximum. When sunspots are fewest it is possible to get louder signals, and to hear over longer distances on the wavelengths where most of our broadcasting stations are found, as compared with the sunspot maximum. The very long waves, on the other hand, are stronger during the sunspot maximum period as compared with the sunspot minimum.


The turbulent surface of the sun. Flocculi and several "spots"

+ + NOTES ON ELECTRON

A regenerative null indicator

By Daniel E. Noble

The circuit shown in Figure 1 was invented and patented by John L. Reinartz. It has been used by Mr. Reinartz in a recording potentiometer circuit which registered changes of the order of one millivolt or less.

One tube acts in the usual manner of the vacuum tube voltmeter, while the other tube balances out the off-zero current in the galvanometer circuit. Since the entire current change through the voltmeter tube must flow through the galvanometer (no division as in the bridge circuit) the galvanometer is very sensitive to changes in input voltage.

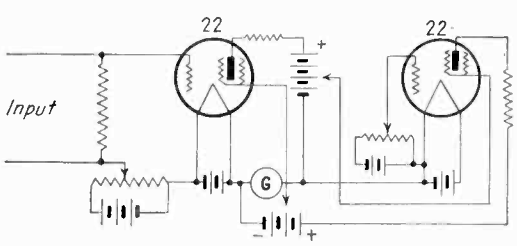


Fig. 1—Original circuit invented by Mr. Reinartz

By adding regeneration to the circuit the writer succeeded in raising the sensitivity of the circuit to very high values. Figure 2 shows the regenerative hook-up. The bias in the first tube is supplied by a voltage drop through a resistor in the plate circuit of the second

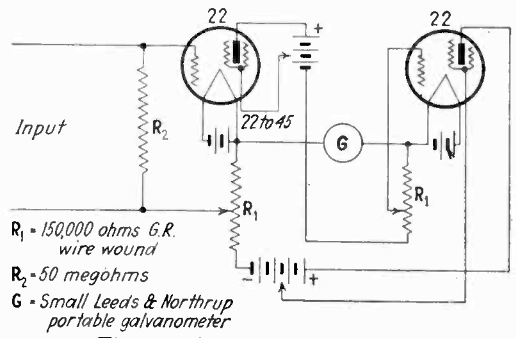
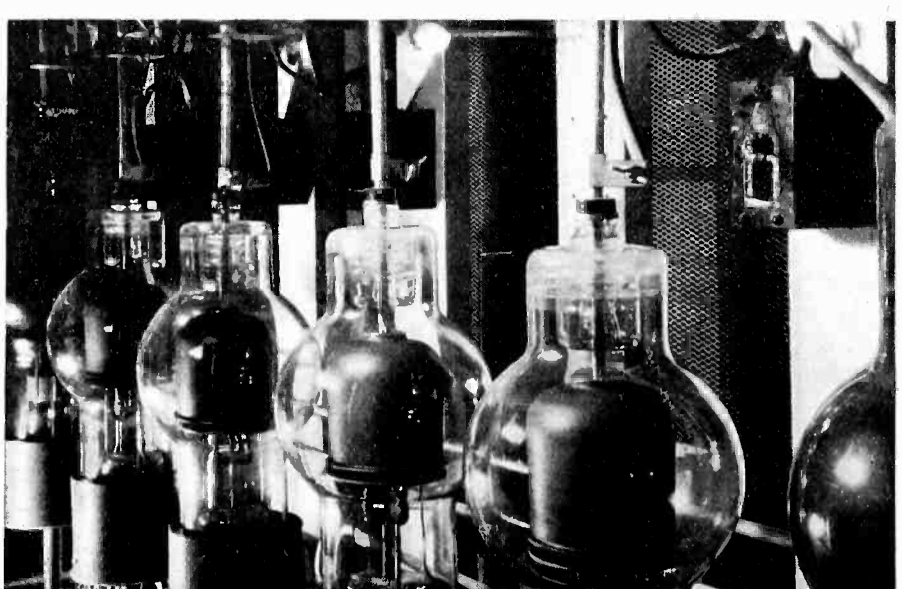


Fig. 2—Regenerative circuit

tube. The second tube bias is determined by the plate current in the first tube. Therefore a reduction of negative voltage in the first tube grid will increase plate current and correspondingly increase the negative bias on the second tube grid. This reduces the plate current in the second tube which produces a corresponding decrease in the negative bias of the first grid. The additional drop added to the original signal originates a second cycle of bias changes which further adds to the input voltage to produce the unbalance current indicated by the galvanometer. The sensitivity of the indicator may be increased to a point of instability by changing the adjustments on R_1. Instability is a factor dependent largely on the input voltage: An extremely high degree of regeneration may be used for very small input voltages but if the input voltage exceeds a critical value for a given adjustment the plate current will surge out of control.

Since the sensitivity is controlled so satisfactorily by varying potentiometers R_1, it has been suggested that the instrument might be used by the psychologist in lie-detection experiments in which the skin voltage and resistance changes are observed. Of course the unit may be used in many applications where a very sensitive null indicator is needed.

500 KW. POWER SUPPLY



For the Crosley transmitter 100 amperes at 12,000 volts are needed. Six of these mercury vapor tubes, rated at 450 amperes each, in a three phase full-wave rectifier furnish that power

Precise light measurement—a new photocell application

By Donald G. Fink

The precise measurement of light has always been a difficult task because the human eye, for long the only instrument available for this purpose, is notoriously inexact and temperamental. This difficulty has been overcome recently by the adaptation of the photocell to still another rôle in its varied career, the rôle of precise measurer of light. A circuit developed at the Massachusetts Institute of Technology makes it possible to compare light intensities, of two electric lamps for example, to an accuracy of 1/10 of one per cent, and to do so without the use of special tubes or other apparatus. The best record of the human eye in photometric measurements is about one percent accuracy.

Engineers who have used photocells are familiar with the fact that they, like the eye, are temperamental, inclined to change their response without warning, and, unless used properly, untrustworthy for precise work. That photocell sensitivity will change with time and other factors such as temperature has long been recognized, and as a result it is desirable to use them in such a way that such changes in sensitivity do not seriously affect the precision of the measurement. An effective method of accomplishing this makes use of two photocells connected in series in such a way that they strike a balance between two sources of light. This balance position is reached regardless of the light level, and is in effect a "null-point"; the use of this null-method has the same advantage for precise work that the potentiometer has over the voltmeter.

The circuit used is shown in the figure. Two vacuum-type cells, type PJ 22, are used, one of which receives light from a standard source while the other receives light from the source whose intensity is to be compared with the standard. The cells are connected in series, anode to cathode as shown, with a constant voltage supply. This supply is obtained from the voltage regulator stage shown to the left of the line "a-a." This stage uses a standard 53 tube, with the two sets of elements connected in parallel as shown.

The cells are operated at saturation voltage, about 100 volts per cell, and as a result the upper part of the characteristic of each cell is used. This insures high sensitivity, since large changes in the dynamic resistance of the cell can be obtained in this region with very small changes in the incident light. The theory of the measurement is this: if the light falling on photocell 1 is equal to that falling on cell 2 equal currents will flow in each, and the voltage applied across the two sells will divide equally between them. That is, the voltage between points *b* and *c* will have a definite value, very near 100 volts. Now if the light falling on cell 1 becomes greater than that falling on cell 2 an additional current will tend to flow in cell 1. But this greater current will also have to flow in cell 2 because of the series connection; but cell 2 is not receiving sufficient light to cause this greater current to flow. The only way in which the additional current can flow in cell 2 is this: the voltage across cell 2 must increase. As it does so, the voltage across cell 1 must decrease and the current decreases also. The net result when more light falls upon cell 1 is only a small increase in current accompanied by a large change in the voltage distribution between the two cells. The change in voltage distribution, which can be measured by measuring the voltage across points *b* and *c*, is thus a direct indication of the division of light between the two cells.

To measure the ratio of the lights falling on the two cells, therefore, it is necessary simply to measure the voltage between points *b* and *c*. But there is a catch: the voltmeter used must draw a negligibly small current or else the delicate adjustment of voltage distribution will be disturbed and the sensitivity decreased. What ever device is used to measure the voltage must have a very high input impedance; a vacuum-tube voltmeter is the indicated answer.

Vacuum-tube voltmeter

The vacuum-tube voltmeter used for this purpose is of unusual design. It uses a standard 38 tube, with the heater voltage reduced to one-half its normal value. The plate voltage is only 12 volts; that of the screen is 10 volts. When the input grid voltage is minus one volt, this tube, operating under these conditions, will offer an impedance of 10^{12} ohms, or a million megohms. In this way the condition of high input impedance is met; actually a value of 100 megohms is sufficiently high to permit very sensitive determinations of the voltage. The plate current is, of course, very small, not more than 50 microamperes. But this current can be read easily on an ordinary panel-mounted meter. The current is a direct measure of the voltage between points *b* and *c*, and hence of the division of light between the two cells.

One of the interesting facts observed in the development of the circuit was the discovery that even a small amount of light falling on the 38 tube was sufficient to set up photoelectric effects within it of sufficient magnitude to completely unbalance the circuit. These photoelectric currents are undoubtedly very small, but they are large enough compared with the grid currents to cause trouble. Hence, in addition to the usual electric shielding, "optical" shielding was necessary. When these precautions are taken the circuit is remarkably stable. It will operate for hours without deviating from the balance position by a tenth of a microampere in the plate circuit.

Balanced photocell circuit

The circuit is usually used in a modified photometer set-up. Each light source is arranged so that it can be moved relative to its photocell. Balance is obtained by moving the unknown source away from or nearer to its photocell while the distance between the standard and its cell is kept fixed. The ratio of the two distances, at balance, squared, is then a measure of the relative intensities of the two light sources, by the well known law of optics which states that the illumination decreases as the square of the distance separating the source and the receiver. For absolute determinations it is necessary to determine the ratio of the sensitivities of the two cells, which can be done by allowing light from the standard to fall into both cells simultaneously. This process is repeated occasionally so that the changes which usually occur with age can be detected and taken into account.

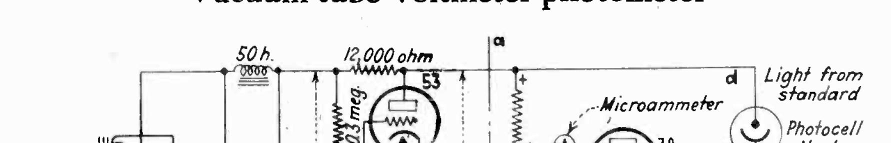
This set-up has been used for several months in the calibration of the brightness of straight-line filament lamps, and for comparing the brightness of different parts of the same filament, with very gratifying results. Changes in brightness of the order of 1/100 of one percent may be readily detected, while variations of 1/10 of a percent may be accurately measured. Many other uses for the circuit, both in the laboratory and in any industrial application where light intensities must be compared, can be developed with little difficulty. The photocell will serve in these applications with greater accuracy, consistency, and reliability than the eye could possibly attain.

✦

Measuring technique at very high frequencies

According to K. Küpfmiller, Danzig Institute of Technology, the development of measuring methods lags far behind the practical applications at high frequencies. At 1000 kc. a wire 20 cm. long and 0.1 cm. in diameter may be required to give an inductive reactance of one ohm, at 100 Mc. this length is reduced to one cm. Even short pieces of wire, such as are used for grounding represent appreciable reactances. Again a rod, 10 cm. long and 1 cm. in diameter, freely suspended in air, has a capacitive reactance to ground which measures 90,000 ohms at 1000 kc., 900 ohms at 100 Mc., and 90 ohms at 1000 Mc., hence the necessity of using short wires. Screening however, is relatively easy and makes it possible to preserve much of the energy which otherwise is wasted. in the construction of bridge circuits, for instance. Cylindrical screens guide the very high frequencies to the instruments. Carbon resistances are useful owing to the absence of skin effect. This work is recorded in *Zeitschrift für techn. Physik. 14:* 447-456, 1933.

Vacuum-tube voltmeter-photometer



Circuit described by Mr. Fink consisting of a source of constant voltage, balanced photocell input to vacuum-tube voltmeter

electronics

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O. H. CALDWELL, *Editor*

Volume VII —JUNE, 1934— Number 6

Business statistics vs. business psychology

THE opportunity for the legitimate sale of high-fidelity receivers fulfilling the require-temporary state of popular psychology regarding the business situation, with the actual statistics of the business picture.

The statistical level is definitely far above that of a year ago; but our business psychology at times falls lower. Yet when the business figures are examined, it is evident that the statistical valleys of 1934 are actually higher than some of the peaks of 1933.

As the summer proceeds, the statistical picture may fall off somewhat. But the psychology of business men is bound to improve. Based on achievements to date, the general spirit is sure to brighten as Fall approaches, and, all in all, a good 1934-35 season is in prospect. We have registered real gains from our position of twelve months back.

The Supreme Court ruling on the "feed-back" case

ON May 21, the United States Supreme Court declared that Lee de Forest, and not Major Armstrong, was the inventor of the regenerative or feed-back principle. It is believed that this decision will be final and that the economic waste that has been going on for many years in carrying on a contest that has given the decision first to one and then the other of the two claimants, will at last come to an end.

The amount of money that has gone into this fight must run to several millions of dollars; so far as the art was concerned, wasted, gone to attorneys and patent lawyers instead of being reinvested in further research to the benefit of the art.

The final scene seems to prove only that the inventor without endless sums of money to prove his priority had better spend his inventive spirit in other ways, if he is looking for profit. So far as recognition goes, both de Forest and Armstrong are appreciated as inventors of the first rank—the only regret is that their energies could not have been spent exclusively in invention and not futilely dissipated in litigation.

Hail, high fidelity!

ANNOUNCEMENT by Philco of its high-fidelity receiver, the first on the American market, marks the beginning of a new phase in broadcast reception. The very fact that the bulletin describing this 50-7500 cycle receiver calls attention to the difficulties in the way of wide band reception should whet the curiosity of the listener, and point out to him that at last he has a receiver that is better than the broadcast system—and that he can hear all that is broadcast by the finest stations.

It is the hope of the industry that such receivers as this can be sold in large numbers so that millions of homes may have full-range music—and not shabby imitations of the real thing.

From 25 to 40 per cent are prospects

THE opportunity for the legitimate sale of high-fidelity receivers fulfilling the requirements laid down by RMA engineering committee, expands into a thoroughly respectable proportion of the listening audience. As pointed out by Dr. Jolliffe, chief engineer of the Federal Radio Commission, local electrical interference is the controlling limit to high-quality reception, rather than "monkey chatter" from the adjoining channels. In any locality, with separations of 50 kilocycles between stations prevailing, the actual usable range is not merely 5000 cycles but 25,000 cycles, so far as local side-channel interference is concerned. Field-strengths of 10 millivolts or above are necessary for quality reception, to override noise. In the vicinity of population centers, such intensities exist over areas comprising at least 25 per cent of the nation's total listening audience. With directive antennas for listeners, even the 5-millivolt area could be gathered into the high-fidelity fold. Altogether, then, 40 per cent of the listening audience is in position to receive 7500-cycle broadcasting, when such wide-range broadcasting is generally available.

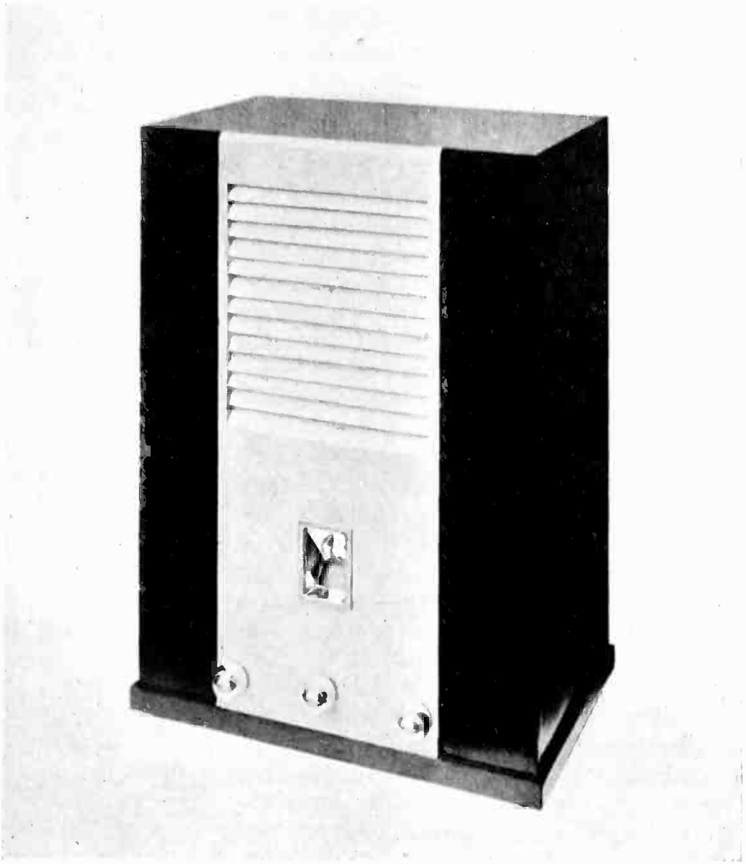
Engineering must not become a monopoly

ONE of the by-products of the depression, and of bad business practices in the radio industry, has caused much of the set engineering to be done in few laboratories. Aside from the research carried out by one or two of the larger set companies and in licensing laboratories, little fundamental work is being done. And much of the design leading directly to sets in production comes from engineers not employed by set makers but by tube manufacturers.

Thus a manufacturer wanting a five-tube set to sell at $39.50 calls upon the tube maker for a diagram on a direct trade basis—you do our engineering, we buy your tubes. Under such a system a circuit engineer, employed by a tube company, gives just enough of his inventiveness to land the contract, holding out the remainder of his knowledge as bait for the first manufacturer's competitor.

Such concentration of industry engineering in few places must result in technical stagnation and in circuit standardization. In the long run the industry will prosper as technicians advance the art. Intellectual competition must not be permitted to die out; every set manufacturer must be under continuous necessity to make his daily production better technically.

RADIO MIDGET—1934 ITALIAN STYLE



Italian manufacturers have been among the first to incorporate modern design principles into the lines of their receiving sets. Here is one of the recent table models produced in Rome. Similar simplification of treatment has also been applied to the console models

▼ ▼ ▼

Radio beacons of the Atlantic Coast

In view of the wide general interest in the system of radio beacons operated by the United States Lighthouse Service, resulting from the disaster in which the Nantucket lightship was sunk by the liner Olympic, we reproduce on the front cover a chart of the Atlantic Coast radio beacons, with positions, signals, and power.

The first number after the name gives the frequency in kilocycles on which the beacon operates (thus 292, 300, 308 kc.).

The heavy dot-dash "characteristic" is given for each beacon. These characteristic dot-dash signals repeated for 60 seconds, with 120 seconds silence.

Most U. S. radio beacons are assigned group frequencies and definite operating minutes. The sequence within a group is indicated by the numeral in square, after the name.

All radio beacons operate during fog or low visibility. Also in clear weather U. S. radio beacons with certain exceptions operate for 15 minutes out of each hour, the respective quarter-hour being given in brackets after the name thus [4].

REVIEW OF ELECTRONIC LITERATURE
HERE AND ABROAD

Selenium barrier plane cells

W. Grundman and L. Kassner, of the Meteorological office, Breslau, make the following report concerning selenium cells. When freshly formed commercial cells (of 10 sq. cm. surface, giving 0.3 ma. per lumen when the external resistance is 2 ohms) are first exposed to light, the current observed decreases with time and it may take a few days before the final value is reached. Left a few days in the dark, the cells recover their original sensitivity, but the decrease toward the final reading in a second exposure to the light is very rapid, a question of perhaps ten minutes. If a cell is exposed to a stronger illumination before the recovery in the dark has run its course, the initial value of the current corresponds to what would be the initial value minus the drop suffered during the first exposure to the light. At each change in the illumination the cell runs through such a stage of aging, and as whenever the illumination decreases a process of recovery sets in, the cell is not suited to the recording of changing intensities of light. Further data are given in *Physik Zeits*, 35:16-20, January, 1934.

Types of vacuum tube oscillation

[J. Mercier, University of Bordeaux] Depending upon the conditions under which an oscillating tube functions, it may produce oscillations of very different characters and periods. Compared to a simple tuned parallel circuit C, L, R, the tuned plate circuit behaves as if its resistance R_a exceeded R by the amount $(L + \mu M)\ Cr$, where μ is the amplification factor and r the (variable) internal resistance of the tube. The pulsation is the square root of the difference $1/LC - R_a^2/4L^2$ instead of $1/LC$. Now, when for a given load and a given grid bias, the plate current is plotted as a function of the voltage which remains applied to the plate (dynamic characteristics), the current is seen to be zero above a certain voltage, rises, as the voltage becomes lower, along a nearly straight line—with the operating point in the middle—toward the saturation value which it may or may not reach, and stays at this value until it plunges toward zero as the grid becomes more and more positive with respect to the plate.

Depending upon whether in the oscillating state the excursion of the current remains restricted to the straight portion, or extends into the zone of saturation or even farther, the tube gives elementary oscillations, saturated oscillations (and if the grid bias is sufficiently negative blocking oscillations) retarded oscillations and finally with very strong grid currents, relaxation oscillations.—*J. de Physique 5: 126-131, March, 1934.*

✦

Fine structure of vacuum tube characteristics

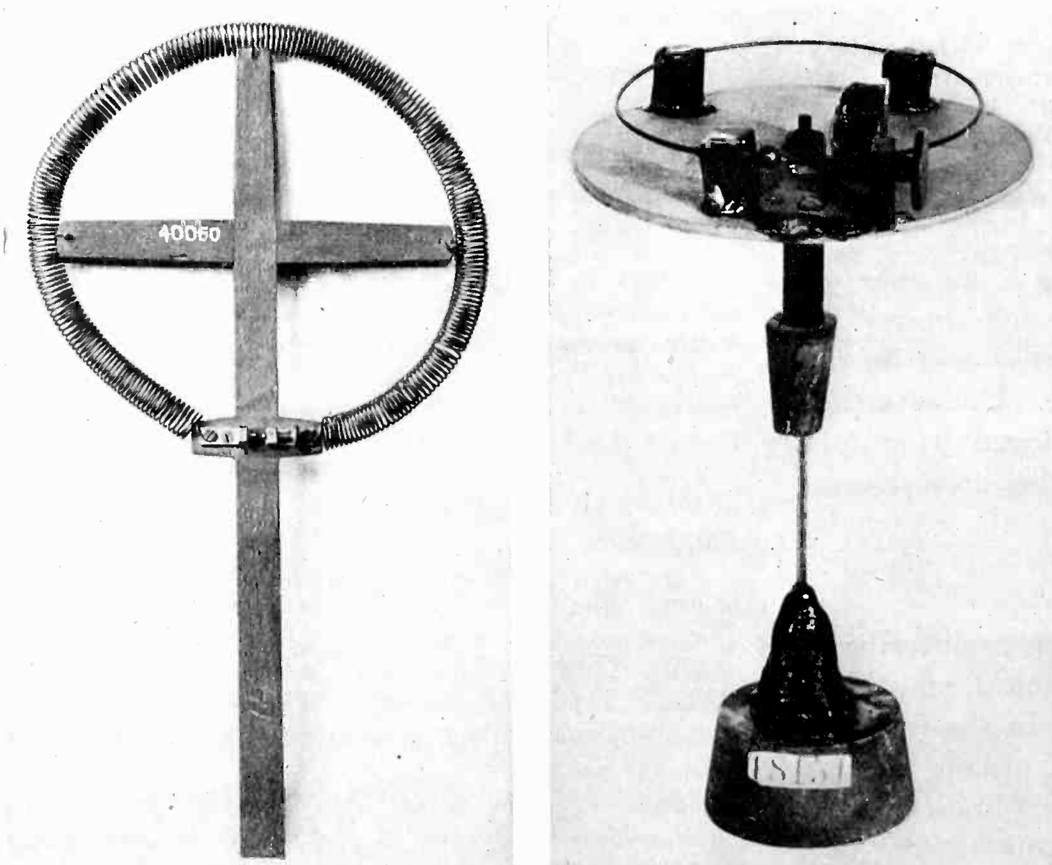
[Balth. Van der Pol and Th. J. Meyers, Philips' Research Laboratory, Eindhoven] A constant sinusoidal e.m.f. is applied to the grid of an indirectly-heated tube (filament 4 volt, 1 amp., plate 200 volt, screen 100 volt, grid 1 volt r.m.s.), and the amplitude of the strength of the different harmonics present in the 50-ohm plate load, is measured at various values of the grid bias. The curves show a great number of maxima and minima. At a given grid bias the amplitude of any harmonic is on the whole equal to the slope of the next lower one, showing that the Fourier analysis of the current is being obtained. There are small regions where this rule fails owing to the appearance of secondary electrons at certain critical potentials. A new series development based on Tchebycheff polynominals is shown to have advantages over the more normal representation as a series of Taylor.—*Physica 1: 481-496, April, 1934.*

✦

Cathode ray deflection by r-f voltages

W. Heimann, of the Research Laboratory, German G. E. Company, writing in *El. Nachr. Tech.* 10:476-485, 1933, states that in the low voltage cathode ray tube with 200 to 3,000 volts on the plate and a negatively charged Wehnelt cylinder the electronic jet comes to a sharp focus upon the screen for frequencies below 10 kc., but between 10 kc. and 1,000 kc. the cylinder must be made progressively less negative and finally positive to produce a sharp trace. The voltage sensitivity to changes in voltage is constant up to 10 kc., increases as the frequency is raised toward 50 kc., and decreases toward a second constant value which is reached at 1,000 kc. Two electron lenses are responsible for bringing the electron jet to a sharp focus, one lens being formed by the Wehnelt cylinder, the other by the space

FIRST SHORT-WAVE RECEIVERS



Photographs of two resonators used by Heinrich Hertz in his demonstration of the existence of electric waves

charge due to the positive ions. At higher frequencies the positive ions succeed in concentrating the jet into a sharp spot, as shown by direct photographs of the entire length of the beam so that the refractive power of the Wehnelt cylinder may be decreased by rendering the cylinder less negative. The maximum sensitivity observed at about 50 kc. (for a deflecting potential of 10 volts) is due to the ionized gas oscillating at its natural frequency; the drop in the sensitivity beyond this point is caused by the inertia of the positive ions which makes itself felt at lower frequencies the heavier the gas (xenon, for instance) and the higher the deflecting voltage.

✦

Australian patent suits settled

After twelve months of negotiations, wrangling and threatening litigation, arrangements have been completed whereby Australian radio manufacturers can obtain a license giving them the right, upon the payment of certain royalties, to use practically every radio patent of importance in existence. It is stated that in no other country is such a comprehensive license available.

For five years the Commonwealth Government used to pay 3/- a year to Amalgamated Wireless (A'sia) Ltd. out of every listener's license fee of 24/-. In return A.W.A. permitted the use of its patents which include those of the Radio Corporation and the General Electric Company of America, the Marconi Company of England, the Telefunken Company of Germany and the Societe Francaise Radio Electrique of France. Other companies, however, had to make private arrangements with manufacturers and this lead to the Australian government not renewing the arrangement with Amalgamated Wireless. All patent holders were thus left equally free to make their own arrangements with manufacturers. A.W.A., Standard Telephone and Cables and Philips Radio thereupon formed the Australian Radio Technical Services and Patents Company Ltd. pooling their patent interests, while the Hazeltine patents were in the hands of Neutrodyne Proprietory Ltd. Some Australian manufacturers took a license from one group and some from the other and each group of patent holders was threatening litigation against manufacturers in the other group for alleged infringement.

Now all the patents have been pooled by the Hazeltine-Neutrodyne group coming into the A.R.T.S. and P. pool. The manufacturers will now pay, for one license covering all these patents, 3/6 per socket per set with a reduction varying according to the output of each manufacturer. Thus a manufacturer using 2000 valves a year (making, say 400 receivers) will pay 3/5 per tube, one using 60,000 tubes 2/7d.

All writs and pending litigation have been called off and manufacturers are joining with listeners to demand that the Government reduce the listener's license fee by 3/- a year as the Government no longer pays that amount to Amalgamated Wireless. The Government has been holding on to this 3/- which now represents about £7,000 a month.

Chairman addresses shareholders by television

Baird Television Ltd., of England, made history recently when the chairman of the company, Sir Harry Greer, gave his annual report of progress to the shareholders by means of television. The chairman was at the Crystal Palace, 10 miles from Film House, Wardour St. where the shareholders were seated in a small theater.

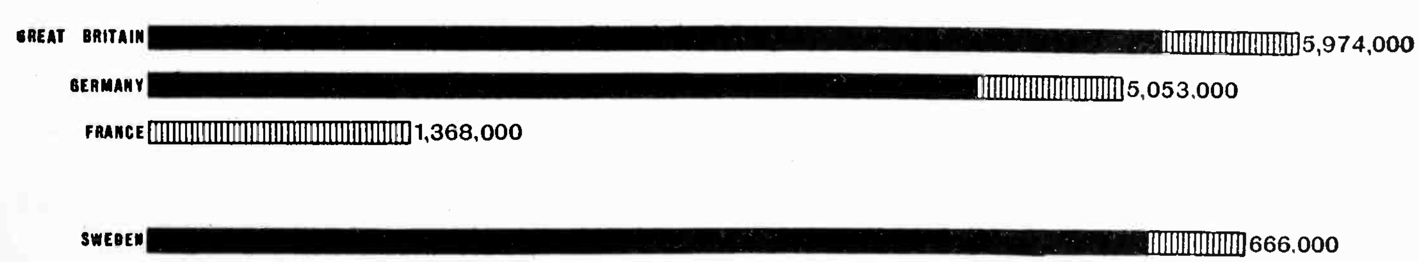
The received image of the chairman was formed upon the 8 in. by 10 in. screen of a cathode ray tube. Normally this picture can be seen comfortably by 10 persons but for the larger audience it was enlarged by means of a lens 2 ft. 6 in. in diameter.

The 180-line picture was scanned 25 times a second. A scanning disc was employed at the transmitter. The picture and synchronizing signals were conveyed by a 6-metre channel and the accompanying words were broadcast on a wavelength of 6.25 metres.

Electronics London representative was present at a special demonstration the next day. A program of vaudeville artistes and the Gaumont-British films "I Was a Spy" and "Aunt Sally" was received. The picture was bright with strong contrasts and there was only a very slight yellow tinge. Loss of synchronism was entirely absent. Flicker was very slight.

There was a little distortion due to displacement of scanning lines while there was a tendency for straight lines to waver. Towards the edges of the picture straight lines became slightly curved.

EUROPE HAS 71,500,000 LICENSED BROADCAST LISTENERS



This chart of the licensed listening audience in the countries of Europe, compiled by the London *Wireless World*, shows Great Britain, Germany and France leading. Other countries are given on a different scale for mutual comparison. Light-shaded areas show increases in licenses during 1933. In France the licensing plan began only last year, and further large gains in licenses are expected during 1934.

Temperature control by tubes

[*Continued from page 184*]

as Y, *e.g.*, the shield of an adiabatic colorimeter to be kept at the same temperature as the container or to keep the guard ring of a thermal conductivity apparatus at the same temperature as the plate.

In X and Y are the heat-sensitive ends of a thermo-electric cell circuit to which is attached a sensitive galvanometer, G. The mirror of the galvanometer forms an image of the lamp L on a screen K placed in front of a photocell C.

The positions of the lamp, screen and photocell are so adjusted with respect to the galvanometer that when X is at the same temperature as Y and no current flows through the galvanometer, the image of the lamp filament is focused on the edge of the screen K. When the temperature of X changes from that of Y, the image moves across the edge onto the screen or photocell depending upon the direction of the temperature change. The change in the illumination on the photocell varies the potential of the amplifier grid. The relay R opens and closes a shunt circuit across a resistance W_2 connected in series with the heater W_x in X. The steady heating current is varied by W_1 and the thermostating current by W_2.

The regulator described is operated on 240 volts d.c.

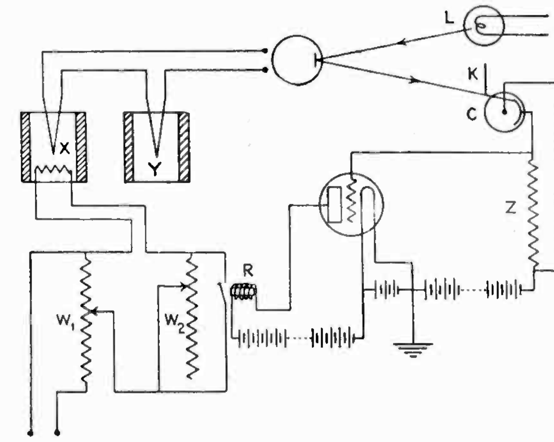


Fig. 6—Circuit used in maintaining low temperatures at the Bureau of Standards

power without batteries using only one slide-wire rheostat with four sliding contacts to furnish all the sources of potential for the phototube and its amplifier.

[1] SHARP, C. H. *Electronics*, September, 1932.
[2] PODOLSKY, LEON, *Electronics*, July 133. See also HIBBEN, JAMES H., *Rev. Sci. Instruments*, May, 1930, p. 285; and NOYES, BRADFORD, *J. Optical Soc. Am.*, vol. 17, p. 128, 1928.
[3] ZABEL, R. M., and R. R. HANCOX, Use of Thyratron for Temperature Control, *Rev. Sci. Instruments*, January, 1934.
[4] ANDERSON, P. A. *Rev. Sci. Instruments*, December, 1930.
[5] LAPIERRE, C. W., *Gen. Elec. Rev.*, July, 1932.
[6] BRICKWEDDE, F. G., and R. B. SCOTT, *Electronics*, April, 1930, p. 45.

Short-wave coil design

[*Continued from page 175*]

For this two-strand coil, $Q = 205$, at 15 Mc. Q dropped 3.3 per cent due to the proximity effect involved. The proximity effect was a little more than enough to offset the advantage which would otherwise accrue.

It is not unlikely that for quite small coils, a definite but not marked improvement in Q can be made by a

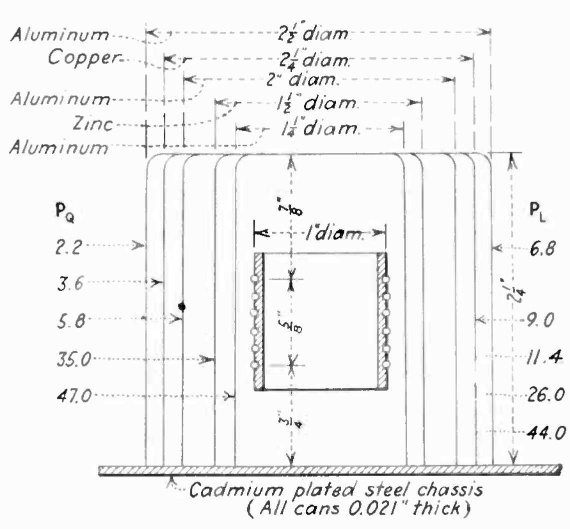


Fig. 7—Influence of shielding can, where P_Q = percentage decrease in Q and P_L = percentage decrease in L

two-strand winding, provided that the coil length be sufficiently increased, etc. It seems likely that a coil of this type (for high r.f.) would not justify its cost.

What is best coil?

For a t-r-f coil intended for use at 15 Mc. in all-wave receivers, Q is not critically related to wire size and physical dimensions, although the extremes render a marked difference in Q.

The No. 14 wire coil on Fig. 1 seems to be a reasonable compromise of merit and cost, although it is probable that No. 16 wire would result in a similarly good compromise. And while a 1 in. diameter coil is evidently a reasonable compromise of performance and space considerations, 0.785 in. diameter or 1.25 in. diameter would not be bad compromises either.

With No. 14 or No. 16 wire, spaced approximately equal to the wire diameter on a 1 in. diameter form, and in a can whose diameter is approximately twice the coil diameter, the end of the coil being at least half the coil diameter away from the end of the can, a Q of 140 may be assumed for band switching arrangements shown in Fig. 8.

Truly small coils, i.e., having a diameter of 0.5 in. or less, and wound with small wire: No. 24, etc., have a value of Q which is usually less than 100 and greater than 70 when a similarly small can is used. Evidently, a Q of 200 with coil in can requires impractically large wire on at least 1.5 in. diameter form. The can would be in the neighborhood of 4 in. diameter.

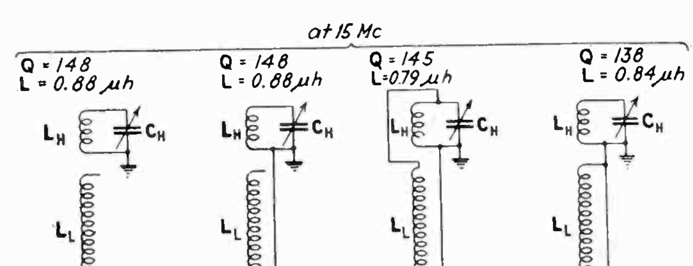


Fig. 8—Various wave-changing methods tested at 15 Mc

Popular methods of band switching affect Q of the highest frequency coil to practically the same extent. A choice between methods should be based on other considerations, one being the performance of the lowest frequency coil.

+ NEW PRODUCTS

THE MANUFACTURERS OFFER

Wave analyzer

The General Radio Company, Cambridge, Mass., announces its Type 636-A wave-analyzer which is a precision instrument to facilitate measurements of harmonic distortion in audio-frequency circuits. The selectivity is very high. There is a discriminaton of 6 db to frequencies only 2 cycles off resonance. At 100 cycles off resonance, the discrimination is over 60 db. This means that 60 cycles and the harmonics thereof can be measured with ease, and the tenth and eleventh harmonic, for example, can be separated by more than 50 db.—*Electronics.*

✦

Inverted rotary converters

Inverted rotary converters are specified particularly for applications in direct-current districts requiring a continuous and uninterrupted supply of alternating current. They are used extensively as a source of A.C. power for operating luminous tube (Neon) electric signs, radio devices and X-ray equipment. New uses are being discovered continually.

Converters built by the Louis Allis Company, Milwaukee, Wis., are two-bearing, single-unit, self-contained machines which are electrically and mechanically very rugged and dependable. The frames are exceptionally liberal, insuring excellent commutation, low operating temperatures, and maximum life of insulation.—*Electronics.*

✦

Noise meter

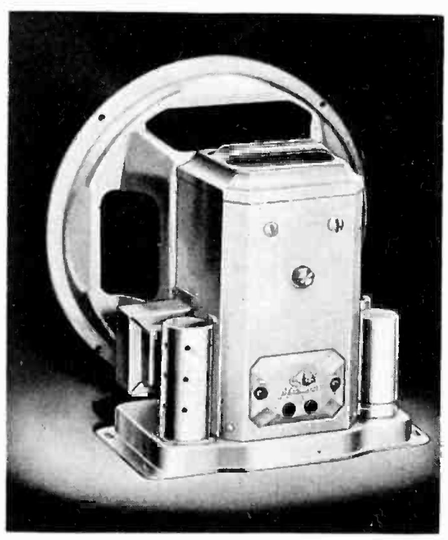
The fundamental idea in the design of the new "Erpi" RA-138 noise meter was to produce an instrument positive in the value of its readings, rugged to withstand field use, portable and simple to operate, with a range of loudness readings sufficient for most field uses.

True readings are obtained unaffected by severe jolts, jars and vibration, and high acoustic fields. A built-in calibrating unit insures accuracy of reading at all times. A dynamic type of microphone is used to insure proper and enduring characteristics, relatively free from vibration disturbance and wind noise. One case 17 in. x 12 in. x 9 in. contains the complete unit. Weight 45 pounds equipped with all batteries, microphone, cords, etc. The small microphone, 2¼ in. in diameter and weighing 2 pounds, may be used with a cord up to 200 ft. long. The new noise meter is marketed by Electrical Research Products, Inc., 250 W. 57th Street, New York City.—*Electronics.*

✦

Loud speaker

The Magnavox Company, of Fort Wayne, Ind., has developed its new "high-fidelity" No. 522 12-inch speaker illustrated herewith. As pointed out by Stanley S. Sondles, sales manager, this speaker represents a major development in acoustical design and efficiency. It is a large speaker, ruggedly built, and its tone is lifelike over the complete audible frequency range. With this speaker, the manufacturers feel that results are accomplished possible hitherto



only with wide range dual combinations. Among its suggested uses are connection from a midget as an auxiliary speaker, giving small-set performance comparable to a console. For amplifying equipment for hotels, clubs, schools, etc., performance at high volume is obtained with a naturalness that demands attention.—*Electronics.*

✦

Graphite films for cathode-ray tubes

It is common in cathode-ray tube manufacture,—especially in tubes intended for television—to apply to the interior walls of the glass envelopes, a conducting coating which extends from the edges of the fluorescent screen into the neck of the tube near the point where the electrons are projected. This conducting layer acts as a second anode and plays an important role in focusing the electron beam.

When the second anode is composed of silver or similar metal, its lustrous surface acts as a mirror and impairs the brilliancy of the image by reflecting any light.

The substance best suited for ray-focusing anodes, therefore, is one which possesses not only opacity but a dark matte surface as well. Graphite films are especially advantageous in this connection. When formed through the agency of colloidal-graphited water of proper concentration, they show poor reflecting properties, are electrically conductive and, unlike silver, can be applied to all types of glass with equal ease.

Furthermore, graphite films are highly resistant to oxidation, acquire "getter" properties when baked and have a low coefficient of expansion. Films formed with colloidal-graphited water adhere equally well to metallic parts, thus making possible the formation of a good contact with lead-in wires.

The use of colloidal graphite in cathode-ray tubes is fully described in technical bulletin No. 191.1 of the Acheson Oildag Company, Port Huron, Mich.—*Electronics.*

✦

Condenser analyzer

Using the new condenser analyzer developed by the Tobe Deutschman Corporation, Canton, Mass., paper, mica and oil dielectric condensers can be tested by the method of measuring the D.C. resistance under an applied voltage. The resultant leakage current is indicated by means of a special neon glow-tube indicator. Good condensers having a satisfactorily high resistance, as well as open, shorted, intermittently open and closed, and poor leaky condensers are readily indicated by this instrument.

Complete analysis is also afforded for electrolytic condensers. The glow-tube indicator gives a measurement of the D.C. leakage current at the rated voltage passed by the condenser under test. Satisfactory and defective electrolytic condensers are quickly identified.

The instrument contains a built-in power supply operating on a 110 volt A.C. 60 cycles. Voltages up to 700 volts D.C. are available for testing at the output terminals. The instrument is encased in a metal container finished in attractive black Damaskene wrinkle. Price $11.40.—*Electronics.*

High-potential test tips

Isolantite, Inc., of Belleville, N. J., manufacturer of high-grade ceramic insulators, with New York offices at 233 Broadway, has introduced a new set of high potential ("hipot") test electrodes having Isolantite insulating grips, nichrome electrodes and detachable high voltage cables 5 feet long with suitable terminal lugs. These electrodes are furnished in pairs one with red and one with black cable. Cables of special lengths will be furnished to customer's specifications. Such electrodes should prove valuable in laboratories, testing departments and service and repair organizations.—*Electronics.*

✦

Hour counter

For recording the hours of operation of radio transmitting tubes, and for totalizing the performance of other electrical devices and pieces of apparatus, the Weston Electrical Instrument Corporation, Newark, N. J., has brought out its Model 691 hour-counter. This comprises a special ball-bearing self-starting synchronous motor, drawing less than 2 watts, connected through cut gears to an indicating train.

The hour-counter weighs 1 lb., 2 oz. and is 4½ in. deep overall. It is regularly furnished for 110-volt, 60-cycle circuits, but 11-volt units are also standard for connection in parallel with power tube filaments.—*Electronics.*

✦

Transformers for portable use

The United Transformer Corporation, with factory and offices at 264 Canal St., New York City, announces a new addition to its line of quality transformers, the new group being compact and light in weight and specifically designed for portable use. The fidelity of these units measures up to high quality broadcast standards, being uniform in response from 40 to 12,000 cycles.

These high fidelity transformers have been made possible through the development of "Hiperm," a nickel-iron alloy having extremely high initial permeability. This alloy is used not only for the core material, but also for the shielding case, affording a maximum of shielding with a minimum of size and weight. Another unique feature developed to make possible the small size of these units is the elimination of all extended mounting flanges or feet. These are replaced by simple threaded metal inserts in the case allowing mounting with terminals either up or down, so that the units can be mounted either on rack panel or metal chassis with no waste space.—*Electronics.*

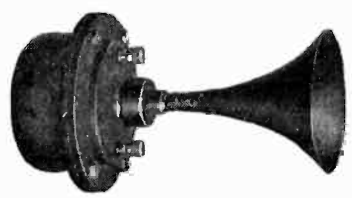
Dry electrolytic condensers

The Condenser Corporation, Jersey City, N. J., is announcing a new line of dry electrolytic condensers which are greatly reduced in size. Due to an impervious aluminum oxide developed during the past year, various improvements have been made which include improving the initial leakage characteristic after the condensers have not been used for extended periods, as well as improved filtering quality during initial period of operation.

The new condensers have a greatly increased factor of safety from a surge voltage standpoint since it is now possible to produce units having a power factor loss as low as 1½ per cent and a leakage current of less than 8 to 20 micro amperes per microfarad at rated voltages of from 25 to 500 volts d.c.—*Electronics.*

✦

Electro-dynamic high-frequency receiver



A new electro-dynamic high-frequency loudspeaker has been announced by the Racon Electric Company, Inc., 52 East Nineteenth Street, New York City. This new unit is designed to cover the frequency band from 300 to 10,000 cycles. Special units are available, however, for reproduction up to 18,000 cycles.

As supplied in standard models, a cast horn is provided as an integral part of the loudspeaker, and the complete assembly can be quickly and conveniently mounted by means of a bracket.

The loudspeaker may be coupled to the output circuit in several different ways. Where a separate winding is provided, to match the voice coil impedance of 15 ohms, only a blocking condenser to obtain high-pass is required. Where special acoustic conditions are to be met, a dual path filter network is available, and such a system is found extremely useful in large auditoriums and similar locations that may be subject to excessive acoustic feedback and reverberation if indiscriminate projection within the wide-range band is carried out. It has been found desirable to utilize a volume control across the high-frequency unit as the simplest method of balancing the high efficiency of the high-frequency loudspeaker against the comparatively low efficiency of most low-frequency reproducers. Price $27.50—*Electronics.*

"Talking" scale

A Scale which "talks," has been developed by Robophone, Inc., 188 W. Randolph Street, Chicago, Ill., as an advertising novelty. The advertising message to be repeated is recorded on the scale mechanism, and then each time a customer weighs himself on the scale, the mechanism is put into operation, giving a brief ten to fifteen-word advertising message just as the customer has finished weighing himself. Such a talking scale is recommended as a novelty to increase store traffic or to attract customers.—*Electronics.*

✦

Powdered-iron-core inductances

The Aladdin Radio Industries, Inc., 609 West Lake Street, Chicago, Ill., announces the sale of tuning devices incorporating the new "Polyiron" or powdered-iron-core inductances.

Included among the products are I. F. transformers employing electromagnetic coupling and necessary tuning condensers in proper shield. Polyiron inductances can now be furnished in completely fabricated I. F. transformers, radio frequency and intermediate choke coils, antenna and R. F. inter-stage tuning units will be available shortly. The I. F. transformers are furnished for the following frequencies: 465, 370, 260, 175 and 110 kcs.—*Electronics.*

✦

Piezo-crystal phonograph reproducer

Difficulties inherent in other phonograph pick-ups have been overcome in the new Proctor Piezo phonograph reproducer, developed and manufactured by B. A. Proctor Company, Inc., 315 West 68th St., New York City. Contrasted with the magnetic type, the Proctor reproducer employs a small crystal element coupled to an extremely light stylus chuck. Owing to the flexibility of the crystal and the small mass of the stylus chuck, very little damping is required, resulting in a reproducer having uniform response over practically the whole audio range and one that will handle maximum amplitudes with as little as one and one half ounces of weight on the stylus.

The entire unit, including the tone arm, is solidly built of cast aluminum finished in instrument black and chromium. By the use of double self-aligning ground cone ball bearings, which take both the radial and thrust strain, freedom of movement of the pick-up arm is obtained in both vertical and horizontal directions.—*Electronics.*

Capacity wire

THE GENERAL MANUFACTURING COMPANY, 8066 South Chicago Avenue, Chicago, Ill., in addition to its well-known Gen-ral coils, has put on the market a new development in the form of Gen-ral "capacity wire." This material is adaptable for use as small electro-static capacities in radio-frequency work, and comprises an insulated helix wound about a central insulated core-wire. Various capacities, formed in this way, can be provided,—cut to length, treated and measured for capacity, or the capacity wire can be supplied in spools as required. The General Manufacturing Company also supplies circuits and diagrams for receiver construction employing its coils.—*Electronics.*

✦

Carbon-button microphones

THE ELECTRO-VOICE microphones made by the Electro-voice Manufacturing Company, 324 East Colfax Avenue, South Bend, Ind., have the following features:

Pure 24-kt. gold spot contacts. Extra heavy and can be cleaned without injury. All metal plating is polished chromium. Buttons are one-piece turned from brass rod. Carbon retaining felt is soft and resilient, yet holds the carbon firmly in place. Carbon granules are acid-treated to remove ash content. Quieter operation and longer life result. Hiss level is —94 DB, which sets new standards for low background noise. An individual curve is run on every microphone and close tolerances are adhered to. All microphones are made, complete, in the Electro-voice plant from raw material.—*Electronics.*

✦

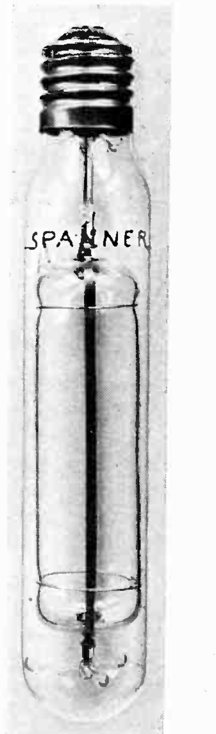
Cathode-ray tubes

THE ALLEN B. DU MONT LABORATORIES of Upper Montclair, N. J., announce three new cathode-ray tubes, types 34-8, 54-8 and 94-8. These tubes are similar to the types previously supplied except that separate leads are taken from each deflection plate. In certain applications this is of considerable advantage as it eliminates the asymmetric effects caused by having one deflection plate of each pair connected to the anode. Since in normal tubes the voltage required to give full scale deflection is about 5% to 15% of the normal accelerating voltage, when one deflection plate of each pair is tied together the effective accelerating voltage is made to fluctuate by plus or minus 5% to plus or minus 15% when full scale deflections are produced, the positive peaks applied to the isolated deflector plate being added to and the negative being subtracted from the effective accelerating voltage. With separate leads from each deflection plate this effect may be eliminated by a symmetrical push-pull arrangement in which both pairs of plates of a pair are connected to the anode through input circuits of equal impedance and oscillate in potential symmetrically about the ground potential of the anode.

The price of the type 34-8 tube, which has a three-inch screen, is $20. The type 54-8, with a five-inch screen, is $35, and the type 94-8, with, nine-inch screen, is $80.—*Electronics.*

✦

Mercury 110-volt lamps



High-pressure mercury vapor lamps to operate on standard 110-volt circuits are announced by the Spanner Vapor Lamp Company, Inc., 308 West 231st Street, New York, in four sizes: 100, 200, 300, and 400 watts. They will operate in any position. The 400-watt size illustrated has an over-all length of approximately 11 in. and has a 6-in. light-giving tube within a T-16 tipless bulb, 2 in. in diameter. The smallest lamp has an over-all length of 5½ in. and outer diameter of 1¼ in. The over-all efficiency, including series reactor, of the 400-watt lamp is 40 lumens per watt by test and for other sizes this will drop off to approximately 25 lumens for the smallest size. These lamps are suitable for street, flood or other commercial and industrial lighting. Lamps for 220-volt service, similar to those used in Europe, are also available in the above wattages.—*Electronics.*

✦

Fuse-blocks with neon indicators

L. S. BRACH MANUFACTURING CORP., 80 Duryea Street, Newark, N. J., has announced a new line of porcelain plug and cartridge cutouts which have neon lamp indicators built in permanently. When a fuse blows, a small neon lamp glows, indicating where the blown fuse is; inserting a new fuse puts out the neon light. The line is called Fuse-O-Lite indicating cutouts and completely parallels the present lines of plug and cartridge, 30-amp., 60-amp. and 100-amp. porcelain cutouts, as well as 600-v. They are made the same size as the present lines, with identical mounting holes so as to be completely interchangeable.—*Electronics.*

Tubes with graphite plates

THE ANODYNE ENGINEERING COMPANY, 5 Oliver street, Newark, N. J., of which Thomas T. James is president, is offering a complete line of Anodyne transmitting and power tubes for amateurs, broadcasters, public-address systems, sound motion pictures, industrial uses, and photo-electric applications.

All air-cooled anodynes have graphite plates, which are declared to secure longer life due to freedom from gas, and higher obtainable vacuum; high plate dissipation without overheating; lower anode operating temperature and consequent reduction in primary and secondary grid emission; uniformity of characteristics due to careful and accurate machining of the graphite parts; and one-piece construction eliminating high contact resistance.

Graphite is also used in the grids of the water-cooled Anodyne tube types. —*Electronics.*

✦

Replacement transformers

IN ITS NEW catalog, No. 341-R, the Jefferson Electric Company, Bellwood, Ill., announces the addition of a great many replacement and manufacturers' style transformers, including types for every radio requirement. Audio, input, output, filament, microphone, line and power transformers, as well as a complete line of chokes, radio fuses and fuse blocks, make up the complete line. —*Electronics.*

✦

Dry electrolytic condensers

IN A DECISION rendered May 28, 1934, in the case of Ruben Condenser Company and P. R. Mallory & Co., Inc. vs. Aerovox Corporation, Judge Marcus B. Campbell of the United States District Court for the Eastern District of New York upheld the validity of the Ruben patent No. 1,891,207 issued December 13, 1932, as covering a dry electrolytic condenser with an ethylene glycol-ammonium borate-boric acid electrolyte. The decision held that this patent carried forward and improved upon the work of Samuel Ruben represented in his patents Nos. 1,710,073 and 1,714,-191, which disclosed dry electrolytic condensers composed of aluminum foils, spacers and viscous electrolyte compositions containing glycerin.

The Ruben patent No. 1,891,207 is owned by the Ruben Condenser Company. P. R. Mallory & Co., Inc., of Indianapolis is the exclusive licensee under this as well as other Ruben patents relating to dry electrolytic condensers, and has granted sub-licenses to other condenser manufacturers.

U. S. PATENTS

IN THE FIELD OF ELECTRONICS

Electron tube applications

Automobile dimming device. The use of a light sensitive cell as a light controlling device for vehicles having a bright and dim light circuit. E. F. Mekelburg, Wauwatosa, Wis. 1,955,555.

Time alarm. Method of sending and reproducing through a loud speaker a time alarm transmitted over power wires. H. J. Nelson and B. S. Franklin, New York, N. Y., R.C.A. 1,955,558.

Testing magnetizable objects. Testing magnetic material by use of an amplifier for simultaneously comparing two magnetizable bodies. W. L. Hehn, New York, N. Y., Magnetic Aanalysis Corp. 1,954,996.

Flaw location. Use of an amplifier in locating flaws in electrically conducting bodies by passing currents through the body to be tested and also through a compensating coil. T. Zuschlag, Magnetic Analysis Corp. 1,954,975.

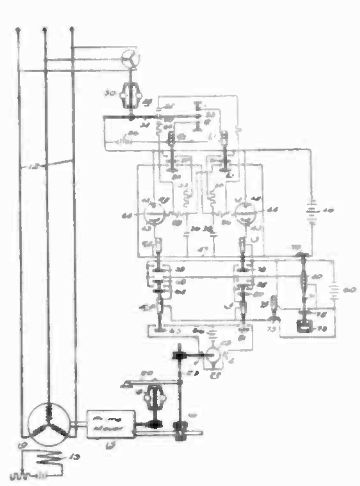
Meter reading circuit. Use of an electron tube for a telemetering system involving telephone and power company wires. P. Yates and J. M. Guthrie, Pittsburgh, Pa. 1,955,043.

Cathode ray circuit. A scanning system involving producing a variable potential having a straight line wave front and means for periodically modifying this characteristic to produce a step-like formation. H. Iams, Westinghouse Elec. & Mfg. Co. 1,955,332.

Modulating system. Use of a beam of cathode rays and a tube with an anode having several spaced elements as a modulation system. R. M. Heintz, Heintz & Kaufman, Ltd. 1,955,126.

Speed control. A motor drives a governor member, the position of which varies in a positive or negative direction; the bias of a tube whose plate circuit carries a current controlling the speed of a motor. A. H. Mears, Leeds & Northrup Co. 1,954,884.

Regulator system. Use of electronic tube between a regulator and quantity-adjusting means on a rotating machine. C. C. Levy and R. De Camp, W. E. & M. Co. No. 1,959,298.



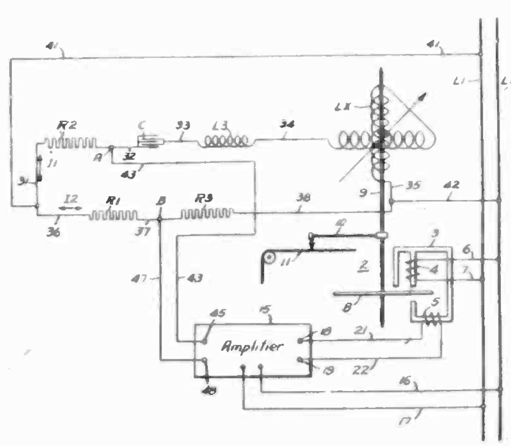
Photocell relay. Phototube operating in combination with a source of direct current, and a gaseous discharge device in which the potential of the anode is reduced below the ionization potential of the anode in the event of some function not being completely carried out. W. D. Cockrell. No. 1,957,247. G. E. Co.

Sorting device. In color sorting apparatus, the combination of a light source and cooperating light-sensitive member, including a receptacle containing several irregular objects sorted according to color. W. R. Horsfield. G. E. Co. No. 1,959,238.

Vehicle control. Grid-glow tube system in a circuit responsive to speed variations. J. W. Logan, Jr., Union Switch & Signal Co. No. 1,958,631.

Motor control. Use of thermionic tube for controlling direction and rotation of a motor. C. R. Gilchrest, Wilkinsburg, Pa. No. 1,959,052.

Frequency responsive system. Resonant circuit comprising a variable reactance element, means for automatically tuning the circuit to resonance and for making a record in accordance with the frequency variation of a source, using an amplifier. H. L. Bernarde, W. E. & M. Co. No. 1,958,883.



Rotating machine control. A dynamo and a circuit including a battery and a substantially constant load, such as saturated tubes, and a means for controlling the field strength of the machine. G. J. Hausamann, Eclipse Aviation Corp. No. 1,958,665.

Illumination control. A system for controlling several lights by means of light sensitive control devices. C. E. Stewart, G. E. Co. No. 1,957,236.

Control device. A system comprising a light source such as a searchlight, photoelectric control devices, etc. G. E. Young, G. E. Co. No. 1,957,240.

Control circuit. Grid-glow tube circuit including relay, a galvanometer, etc., for control purposes. G. D. Bower, Minneapolis. Honeywell Regulator Co. No. 1,956,753.

Flaw detector. Method of establishing an electromagnetic field around the conductor, several coils moved over the conductor whereby each coil generates impulses on passing through a region of flaw. H. C. Drake, Sperry Products, Inc. No. 1,955,953.

Automatic steering system. Patent No. 1,958,258, E. F. W. Alexanderson, and 1,958,259, H. I. Becker, both assigned to G. E. Co. Means for automatic steering for moving craft.

Control equipment. A follow-up system comprising a pilot device rotatable in a closed path, a driven object, driving means to drive the object into positional agreement with the other device. A. H. Mittag and M. A. Edwards, G. E. Co. No. 1,958,245.

Flaw detector. A device for electromagnetically testing metallic objects for defects using an amplifier voltmeter. A. E. F. Billstein, Pennsylvania Railroad Co. No. 1,958,079.

Control circuit. Electro-magnets controlled by vacuum tubes in a motor control system. J. F. Timmons, Coshocton, Ohio. No. 1,957,479.

Radio Circuits

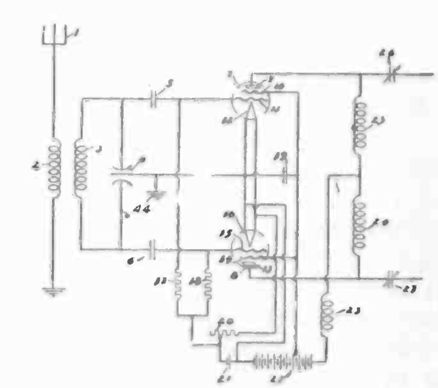
Remote control system. A system of the motor type for tuning a radio receiver. C. R. Garrett, G. E. Co. No. 1,956,419.

Transmission line. Method of connecting a push-pull oscillator or amplifier to an antenna by means of a transmission line whose characteristics are such that oscillations with a frequency of an undesired harmonic are impressed. J. W. Labus G. E. Co. 1,955,553.

Tuning system. Combination of an untuned amplifier and a non-amplifying signal selecting net work. D. D. Israel, Cincinnati, O. 1,955,130.

Directional system. Direction finding device which receives a modulated radio wave and has means for simultaneously varying the strength of the receiving signal in some proportion to the angle of deviation of the receiver from a straight line to the transmitter. G. G. Kruesi and G. Fisher, Bendix Aviation Corporation. 1,955,505.

Push-pull detector. Circuit adapted to short wave reception whereby the tuned circuit and the screen grid electrodes of the two tubes are maintained symmetrical with respect to the cathode. T. A. Marshall, U.S.N. No. 1,956,582.

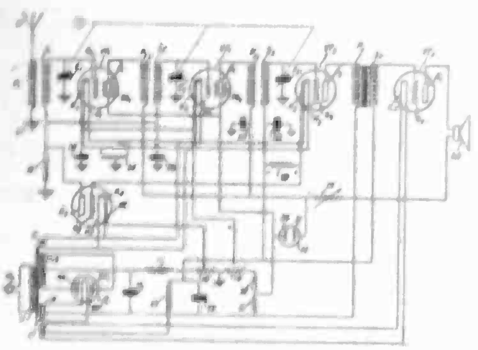


Volume control systems. No. 1,958,998 and 1,958,999. E. R. Hentschel, Wired Radio, Inc.

Program selector. An automatic system using protuberances arranged on concentrically located circles, a time mechanism controlled turntable, a selector disk, etc., for automatically selecting radio programs. V. F. Detwiler, V. A. Detwiler, and J. J. Doran, San Francisco. No. 1,958,943.

Transmission system. A single side-band transmitter method. Jozef Plebanski, Warsaw, Poland. No. 1,958,954.

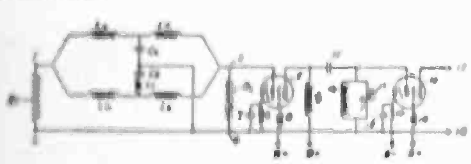
Tuning Indicator. A circuit using a gaseous conductor lamp connected between points on the power supply circuit between which there exists a potential difference which increases when signals are being received. Alexander Senauke, New York. Reissue, No. 19,170.



High frequency feeder. Transmission line comprising zigzag conductors consecutive parallel portions of which are less than half a wavelength apart whereby consecutive points throughout the conductor of maximum opposite potential in the current flowing through said feeder system will be displaced substantially 180 deg. in phase relation. C. S. Franklin, R.C.A. No. 1,958,991.

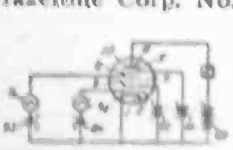
Volume Control. Patents No. 1,959,062 and 1,959,063 to W. P. Place, Union Switch & Signal Co., using copper oxide rectifiers for volume control.

Static suppressor system. Two transmission paths connecting a collector to a detector beam path having filter networks having substantially complementary indicial admittances. P. H. Craig, assigned to Invex Corp. No. 1,956,121.



Electron Tubes

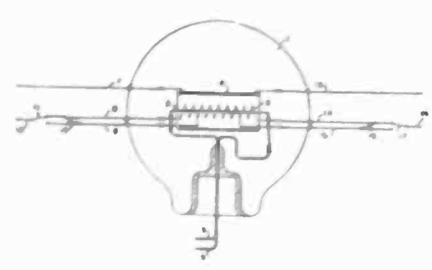
Modulator tube. An emission valve modulator tube comprising an actual cathode, a means for producing a virtual cathode, and a means for making the electron density of the virtual cathode fluctuate periodically, etc. H. A. Wheeler, Hazeltine Corp. No. 1,958,027.



Light sensitive cell. A voltaic cell of the copper oxide type. A. L. Williams, Union Switch & Signal Co. No. 1,959,073.

Shielded tube. A construction in which the envelope and base are roughened and sprayed with a shielding metal. H. W. Parker, Rogers Radio Tubes, Ltd. No. 1,958,953.

Microray tube. A vacuum tube with a cathode, an oscillating electrode and a reflecting electrode, the oscillating electrode having a length equal to the longest wave to be produced, and equal to 1.25 times the shortest wave to be produced. Andre G. Clavier, International Communications Laboratories. No. 1,959,019.



Patent suits reported by U. S. Patent Office

T. M. 288,962, Silver-Marshall, Inc., Radio receiving set and electric pick-up for phonographs and accessories and parts, D. C., N. D. Ill., E. Div., Doc. 13,395, Silver-Marshall, Inc., v. Silver Marshall Mfg. Co. et al. Bill dismissed for want of equity; plaintiff enjoined from using name "Silver-Marshall, Inc." or any name containing "Silver" or "Marshall." Decree without prejudice as to any rights of J. J. Stream to trademark or property rights Oct. 30, 1933.

1,573,374, P. A. Chamberlain, Radio condenser; 1,702,833, W. S. Lemmon, Electrical condenser; 1,811,095, H. J. Round, Thermionic amplifier and detector; Re. 18,916, J. G. Aceves, Supply circuit for radio-sets; Re. 18,579, Ballantine & Hull, Demodulator and method; 1,403,475, H. D. Arnold, Vacuum tube circuit; 1,465,332, same, Vacuum tube amplifier; 1,403,932, R. H. Wilson, Electron discharge device; 1,231,764, F. Lowenstein, Telephone relay; 1,618,017, same Wireless telegraph apparatus; 1,507,016, L. de Forest, Radio signaling system; 1,507,017, same, Wireless telegraph and telephone system, filed Mar. 9, 1934, D. C., E. D. Mich. (Detroit), Doc. 6271, R.C.A. et al v. Plymouth Radio.

1,879,863, H. A. Wheeler, Volume control, filed Mar. 9, 1934, D. C., E. D. N. Y., Doc. E 7199, Hazeltine Corp. v. Yellow Taxi Corp.

1,881,324, H. E. Metcalf, Signal reproducer, D. C., S. D. Calif. (Los Angeles), Doc. E Y-98-J, The Magnavox Co. v. Jackson-Bell Co., Ltd., et al. Dismissed for want of prosecution Feb. 26, 1934. Same, D. C., N. D. Ill., E. Div., Doc. 12711, The Magnavox Co. v. Baldwin Radio Products, Inc. Decree as above Sept. 22, 1933. Doc. 12712, The Magnavox Co. v. Century Radio Products, Inc. Decree as above.

1,231,764, F. Lowenstein, Telephone relay; 1,618,017, same, Wireless telegraph apparatus; 1,403,475, H. D. Arnold, Vacuum tube circuit; 1,465,332, same, Vacuum tube amplifier; 1,573,374, P. A. Chamberlain, Radio condenser; 1,403,932, R. H. Wilson, Electron discharge device; 1,702,833, W. S. Lemmon, Electrical condenser; 1,811,095, H. J. Round, Thermionic amplifier and detector; Re. 18,579, Ballantine & Hull, Demodulator and method of demodulation, filed Mar. 9, 1934, D. C., N. D. Ill., E. Div., Doc. 13757, Radio Corp. of America et al. v. International Parts Corp.

1,251,377, A. W. Hull, Method of and means for obtaining constant direct current potentials; 1,297,188, I. Langmuir, System for amplifying variable currents; 1,477,898, C. W. Rice, Amplifying systems, filed Mar. 9, 1934, D. C., N. D. Ill., E. Div., Doc. 13758, General Electric Co. v. International Radio Parts Corp.

1,141,402, R. D. Mershon, Electrolytic apparatus employing filmed electrodes, D. C., S. D. N. Y., Doc. E 66/298, R. D. Mershon et al. v. Condenser Corp. of America. Consent decree (notice Mar. 13, 1934).

1,231,764, F. Lowenstein, Telephone relay; 1,618,017, same, Wireless telegraph apparatus; 1,403,475, H. D. Arnold, Vacuum tube circuit; 1,465,332, same, Vacuum tube amplifier; 1,403,932, R. H. Wilson, Electron discharge device; 1,531,805, R. C. Mathos, Oscillation generator; 1,658,346, same, Amplifier circuit; 1,596,198, S. Loewe, System for generating oscillations; 1,896,780, F. B. Llewellyn, Modulating device; 1,239,852, F. K. Vreeland, Receiver of electrical impulses; 1,544,081, same, Transmitting intelligence by radiant energy; 1,573,374, P. A. Chamberlain, Radio condenser; 1,702,833, W. S. Lemmon, Electrical condenser; 1,811,095, H. J. Round, Thermionic amplifier and detector; Re. 18,579, Ballantine & Hull Demodulator and method of demodulation, filed Mar. 16, 1934, D. C., S. D. N. Y., Doc. E 77/272, Radio Corp. of America et al. v. H. Kirschbaum (Luxor Radio Mfg. Co.).

1,251,377, A. W. Hull, Method of and means for obtaining constant direct current potentials; 1,297,188, I. Langmuir, System for amplifying variable currents; 1,707,617, 1,795,214, E. W. Kellogg, Sound reproducing apparatus, filed Mar. 16, 1934, D. C., S. D. N. Y., Doc. E 77/273, General Electric Co. v. H. Kirschbaum (Luxor Radio Mfg. Co.)

1,648,808, L. A. Hazeltine, Wave Signaling system, D. C., S. D. N. Y., Doc. E 73/337, Hazeltine Corp. v. Pilot Radio & Tube Corp. et al. Consent decree granting injunction as to Wholesale Radio Equipment Co. and Gimbel Bros. Nov. 23, 1933, discontinued as to Pilot Radio & Tube Co. Mar. 13, 1934.

1,755,114, L. A. Hazeltine, Unicontrol signaling system; 1,755,115, same, Variable condenser, D. C., S. D. N. Y., Doc. E 73/339, Hazeltine Corp. v. Pilot Radio & Tube Corp. et al. Consent decree granting injunction as to Wholesale Radio Equipment Co. and Gimbel Bros. Nov. 23, 1933; discontinued as to Pilot Radio & Tube Corp. Mar. 13, 1934.

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1,920,162, Amy & King, Radio aerial attachment; 1,938,092, Amy & Aceves, Radio receiving system, filed Mar. 12, 1934, D. C., S. D. N. Y., Doc. E 77/259, Amy, Aceves & King, Inc., v. Wholesale Radio Service Co., Inc.

1,617,240, R. A. Fessenden, Method for wireless directive signaling; 1,617,242, same, Wireless transmission and reception, filed Feb. 12, 1934, D. C. Del., Doc. E 1054, H. M. Fessenden v. R.C.A.

1,920,162, Amy & King, Radio aerial attachment, D. C., E. D. Pa., Doc. 7887, Amy, Aceves & King, Inc., v. Snyder, Inc. Injunction granted Mar. 1, 1934.

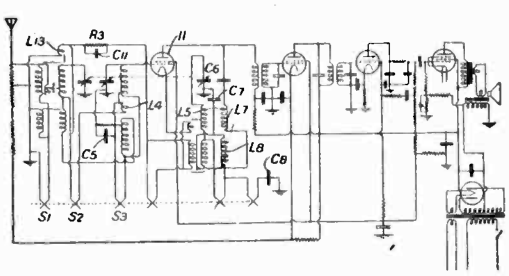
BRITISH PATENTS
IN THE FIELD OF ELECTRONICS

Radio Circuits

Landing beam. In a system for landing aircraft a radio transmitter is adapted to produce a radiation diagram, the lower surface of which is in the form of an obtuse-angled cone adapted to be used as a landing curve. The radiation is emitted from a single vertical dipole aerial having an electrical length of one-quarter wavelength, fed by a coupling coil near its lower end which is grounded. Lorenz, Berlin. No. 404,167.

Band-pass circuit. A fixed tuned or variable tuned type, each branch comprising inductance in series with capacity and associated with negative resistance to reduce the effective damping. In one circuit shown in the patent a dynatron is used to provide the negative resistance. Marconi Co. No. 404,349.

Image frequency suppression. In a two-band receiver, series capacity, shunted by resistance, and inductance coupled to the input suppresses the image frequency by opposing the energy of this frequency passing through the band-pass filter on either of the two bands. Hazeltine Corp., H. A. Wheeler and J. K. Johnson. No. 404,401.



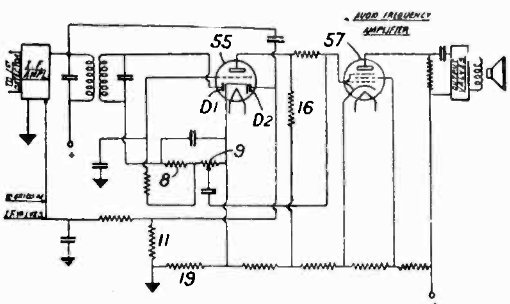
Reflex receiver. Automatic gain control is employed so that distortion due to overloading is prevented. The circuit is particularly applicable to receivers in which the reflexing is of the inverse type. David Grimes, Marconi Co. No. 403,329.

Antenna system. To reduce the space-wave component and to radiate energy that is predominantly earthbound, thereby reducing fading effects in broadcast transmission, one or more dipoles are arranged so that the center of oscillation of the highest dipole is within one-half wavelength of the ground. C. Lorenz, Berlin. No. 403,376.

Synchronizing system. The frequency of a synchronizing signal is a whole-number fraction of the line frequency and an integral multiple of the picture frequency. The synchronizing frequency is in a part of the frequency spectrum little used by the picture signals, and is equal to $\sqrt{f_2 f_b}$ where f_2 is the line frequency and f_b the picture frequency. The synchronizing-signal has an amplitude greater than the maximum picture signal, and is separated from the picture signals at the receiver by a tuned filter. D. S. Loewe and K. Schlesinger, Berlin. No. 402,291.

Secret signalling. A frequency scrambling system, the sidebands, representing the intelligence, are separated from each other and from the carrier wave and are passed to separate detectors or to a single push-pull detector in such a way that inter-modulation between the side bands is prevented. Voice frequencies are divided into two ranges which are transposed and inverted and modulated on a carrier wave. Soc. Francaise Radio-Electrique. No. 404,574.

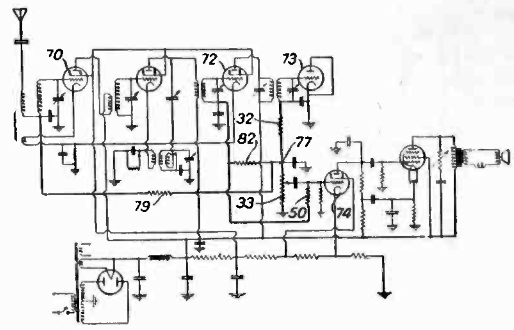
Intercarrier noise suppressor. In a receiver the audio frequency amplifier



is made inoperative under the control of a diode detector when the input energy is below a predetermined level. W. A. Harris, Marconi Co. No. 404,583.

Scanning system. A device for television, etc., comprising a number of reflecting strips helically disposed about an axis of rotation and illuminated by a laterally located and controlled linear light-source so that the image may be directly observed by the eye. H. E. Ives, E.R.P.I. No. 402,401.

Automatic volume control. Direct current voltage proportional to the signal voltage is applied to the grid of a post-detector valve of the variable-mu type, in which the product of the increment in grid bias and the mutual conductance is nearly constant. H. A. Wheeler, Hazeltine Corp. No. 402,981.



Scanning system. A saw-tooth or special wave form for controlling a cathode ray beam is generated in a feed-back thermionic tube. W. A. Tolson and J. R. Duncan, No. 402,629.

Scanning system. Production of a saw-tooth current for deflecting a ray and a cathode ray tube with a method for compensating distortion of the wave form. A. V. Bedford, No. 401,990.

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BROADCAST SIGNAL DIRECTION FINDER

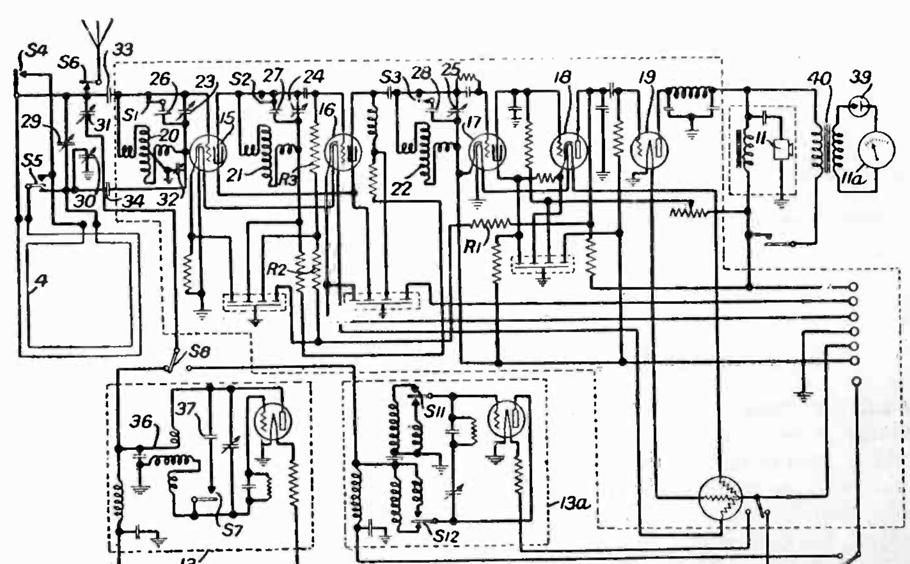


FIG. 3.

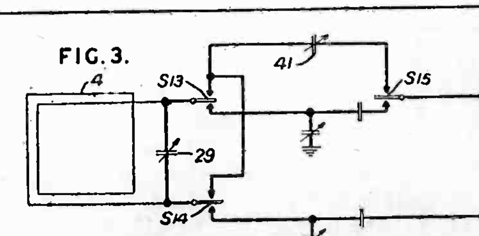
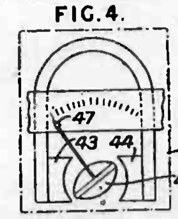


FIG. 4.



Patent granted to Bendix Aviation Corporation for an installation to be used (a) for direction finding on ordinary broadcast transmission, when the effect of modulation on a visual type of indicator is eliminated by a local heterodyne, or (b) as a non-directional receiver for reproducing programs. British patent No. 404,659.