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1928
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Vol-13 No-19

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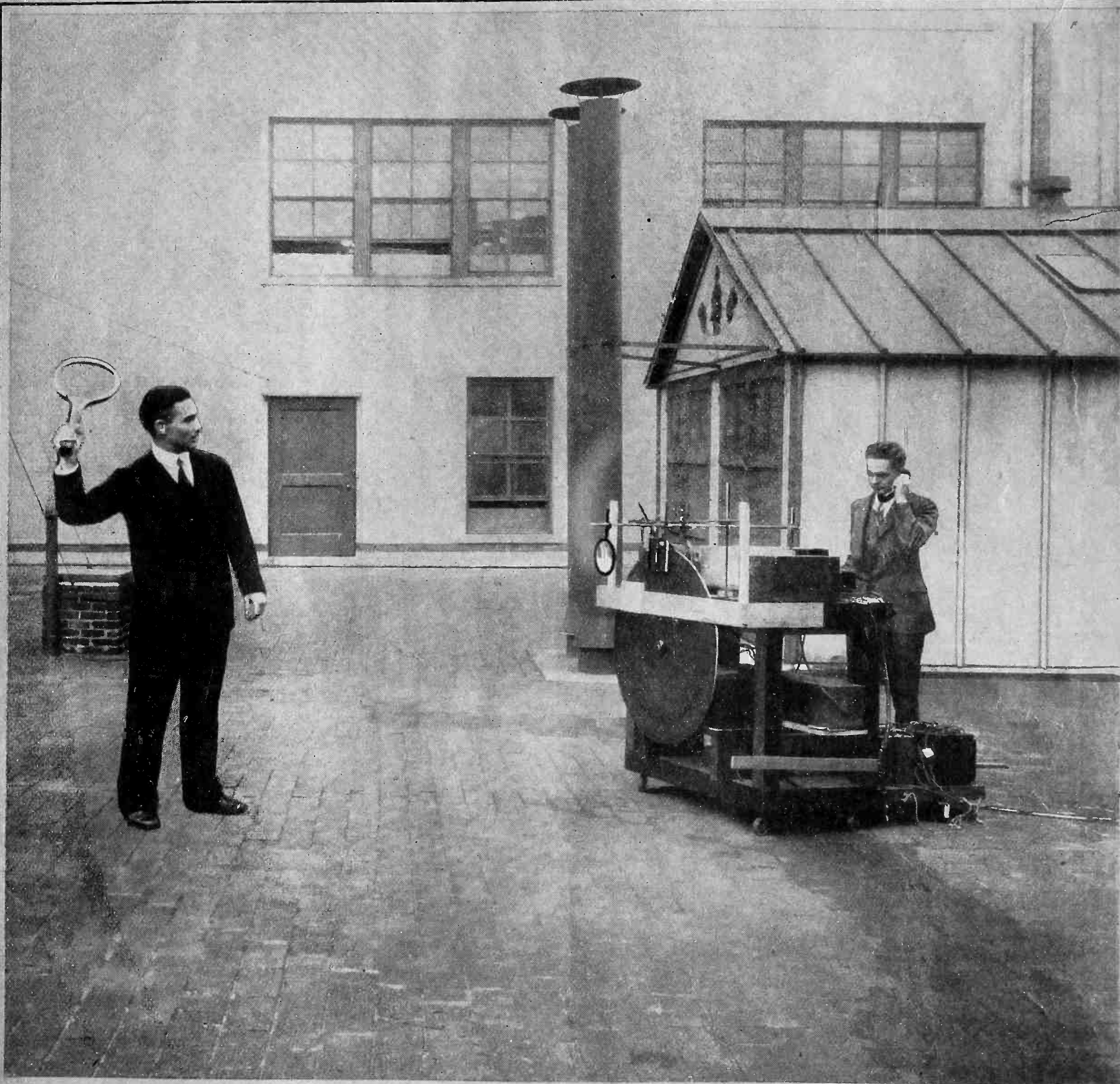
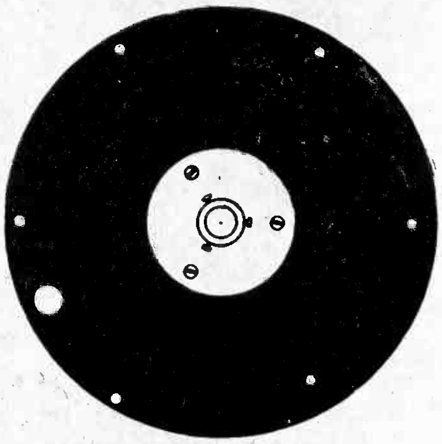


At right is one of Bell Telephone Laboratories' engineers operating the new television transmitter and sending a picture of the tennis player at the left to the receiver located in a room in the laboratories. See absorbing and intimate article on page 3

Learn About TELEVISION!



Expert articles in 16 issues give you a good understanding of this absorbing subject. Without such knowledge you may be up against it in trying to build a television receiver to tune in WGY, WLEX, WRNY, etc.

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to build a receiver to get television.
to connect kino-lamp (neon)
to regulate motor speed to synchronize.

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Titles of Articles on Television and Dates of Sixteen Issues of Radio World containing those articles.

1926

Eyes to Watch Scenes by Radio, by Conrad Nugent, Dec. 25. Illustrated by photograph of Dr. Alexanderson and his first television transmitter.

1927

The Advance Toward Television Told by Alexanderson in Absorbing Brief, by E. F. W. Alexanderson, Jan. 1.

Alexanderson in Address Explains Television Theory. Jan. 22, 1927. A Simple Explanation of Alexanderson Method of Television. Also, Television Set Being Planned by General Electric, by Herman Bernard. Both in Jan. 22 issue.

Baird Uses Infra-Red in His Television Tests, by Knollys Satterwhite, Jan. 29. A brief discussion on the use of infra-red light in television experiments and possible applications.

First Television Hookups Elucidate Alexanderson and Baird Plans, by Hector Wall, Feb. 26. Hookups illustrating the principles of transmission and reception of television.

New Television Advance Demonstrated, April 23. An account of the television demonstration between New York and Washington by wire and between New York and Whippany, N. J., by radio, conducted by the American Telephone & Telegraph Company.

1928

Television Quits Dream Road for Real Bumps. Also, The New Twist That Made Television Spurt, by Neal Fitzalan, an illustrated article comparing the Alexanderson seven-spot method of illuminating the picture to be sent, with the Gray innovation which overcame the chief difficulty in television transmission, that of adequate illumination without imposing dangerous light intensity on the subject. Also, Television Across the Ocean Claimed by Baird Company, Feb. 4. Also, Colored Television Due; Three Coils Suggested, Feb. 4. All four in Feb. 4 issue.

Movements of Woman in London Watched from New York by Television, by Neal Fitzalan, Feb. 25. An illustrated account of successful television experiments between New York and London by the Baird system.

Television in Five Years, Not Now, Says Trade, April 28.

Jenkins Demonstrates Silhouettes in Action. Also, Nakken to Broadcast Television from WRNY. Both in May 26.

How Television Is Tuned In, by Neal Fitzalan. June 9. A profusely illustrated article on the reception of television signals.

How to Connect Any Set's Output for Television Reception. An article with circuit diagrams showing how to connect the television receiving tube to the output of any radio receiver. Also, Automatic Television Synchronizing Apparatus, By Paul L. Clark. A richly illustrated article of a new system of automatically synchronizing a television receiver with the transmitter, invented by the author. Both in June 16.

The Effect of Wave and Frequency Distortion on Television Reception, by J. E. Anderson. June 23. The writer discusses the effect of wave form and frequency distortion in the transmission and reception apparatus on the received images. Illustrated with diagram showing the blurring effect of high frequency side band suppression.

Requirements for Television Reception, by J. E. Anderson, June 30. The author discusses the necessary conditions for retaining the high and the low frequencies in the side bands to prevent distortion of the received image and gives the design of a receiver which will not only give undistorted television images but which may be used as a high quality broadcast receiver.

Talking Television and How It Is Worked, by J. E. Anderson, July 7. A profusely illustrated article showing how talking television works.

Mechanical Problems in Television, by J. E. Anderson, July 14. Tells how to make disc for WGY reception, also how to avoid distortion due to mechanical conditions. Also schedule of WGY television broadcasts.

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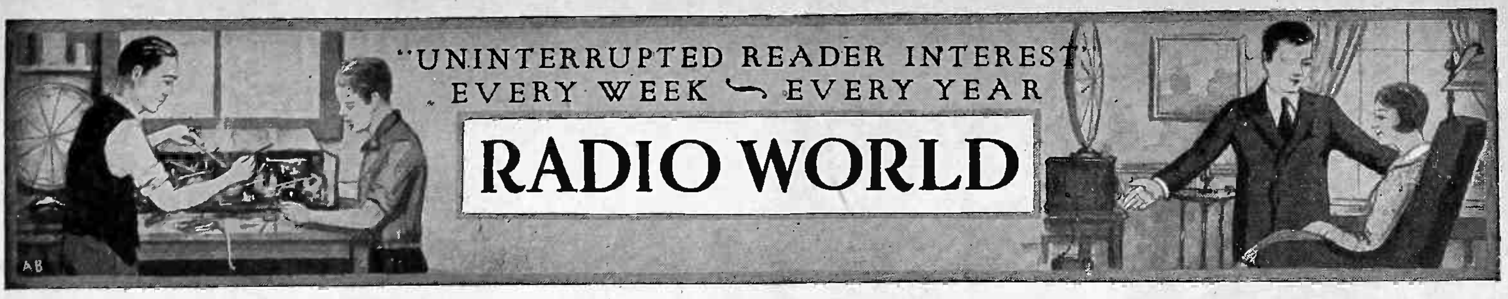

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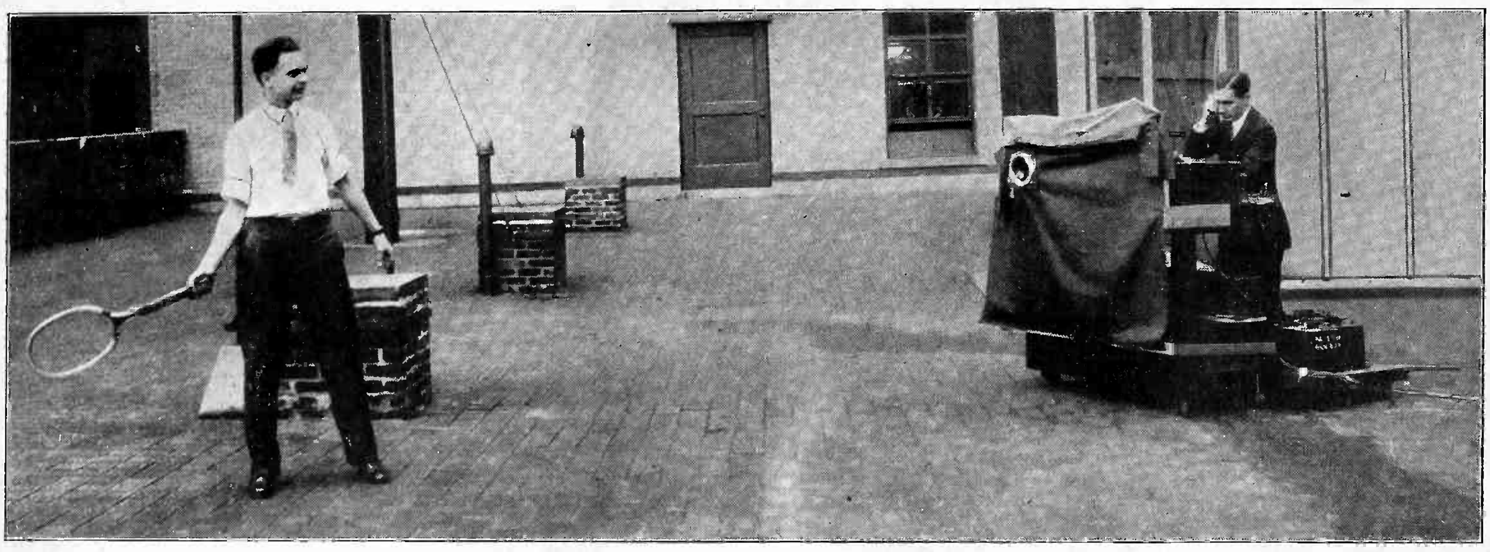
NEW SUPER-SENSITIVE PHOTO-ELECTRIC CELL PICKS UP

Television by Sunlight!

By J. E. Anderson
Technical Editor



THE NEW TELEVISION TRANSMITTER SET UP ON THE ROOF OF A FOUR-STORY SECTION OF BELL TELEPHONE LABORATORIES BUILDING AT 463 WEST STREET, NEW YORK CITY. THE HOOD PROTECTS THE TRANSMITTER FROM THE ELEMENTS.

ANOTHER advance in the development of television has been achieved in Bell Telephone Laboratories. This time the television transmitter has been taken out of the laboratory into the field. It is now possible to "televise" outdoor scenes and sporting events, with only the sunlight as illumination, and send them by wire or radio to distant receivers, there to be reproduced with gratifying distinctness and clarity.

Saying that it is possible to do so does not state the case fairly, for it would be more accurate to state that it is practical. The transmission of outdoor scenes and events has been achieved. Boxers and tennis players in action outdoors have been televised and a reproduction of the action has been received in a distant laboratory with a receiving apparatus which could well be placed in the living room of any home.

Secret of Advance

The secret of the advance is the development of a photo-electric cell which is vastly more sensitive than any cell heretofore constructed. Extensive research into photo-electric phenomena by the Bell engineers led to the development of this cell, and at the same time to the removal of one of the most serious obstacles to television progress.

Before the development of this cell lack of illumination of the scene to be televised was one limiting factor. The new

Bell Laboratories Demonstrate Tennis Strokes, Boxing and Batting in Fine Style—Ives and Gray Developed the System

cell has extended the boundary so far that it is safe to say that lack of illumination is no longer the weakest link in the system and that some other phase of the problem must not be attacked by research for further immediate progress in television.

And with the development of the new cell simplification of the transmitting and receiving apparatus has been effected. Super-complex electrical circuits are no longer required at either end, and synchronization is no longer the intricate problem that it was.

Camera Used

The scene or event to be transmitted is illuminated by the sun or some other intense source of light. An image of the scene is formed by an optical system which is essentially a high grade camera. That is, a lens is used which can be operated at a large aperture as compared with its focal length.

After the image has been formed in the desired plane it is scanned with a large scanning disc having 50 scanning holes and revolved at the rate of 18 revolutions per second.

The object of using a lens of wide aperture is to gather as much light from the subject as possible, for the more light gathered, the less amplification will be necessary of the photo-electric current output, and the less trouble in the amplifier. Also the more light gathered by the lens, the less the illumination on the subject will have to be to effect satisfactory transmission.

Details of Scanning Discs

The scanning disc used in the transmitter is made of aluminum about 1/16 inch thick and it has a diameter of about 36 inches. The diameter of each of the 50 scanning holes is 1/16 inch. These holes are arranged in a spiral so that the radial depth of the area scanned is about 3 inches. This allows a slight overlapping of adjacent scanning lines.

The receiver scanning disc is about 14 inches in diameter and it also is of aluminum. It has the same number of scanning holes as the transmitter disc and the holes are arranged in the same pattern. But the size of the scanning

(*Continued on next page*)

(*Continued from preceding page*)

holes in the receiver disc has been reduced in the same proportion as the diameter of the disc.

Great mechanical accuracy in the discs is required. The placement of the holes in the large disc offers no great difficulty, but that of the holes in the receiving disc is exacting.

To locate the holes in the receiving disc with high accuracy, large holes are first drilled approximately at the desired

Outdoor Scen

Early Limitation Due to Need of Special

Are Possible, Instead of Mere "Head and

50 Holes 1-16 inch Each in Dia

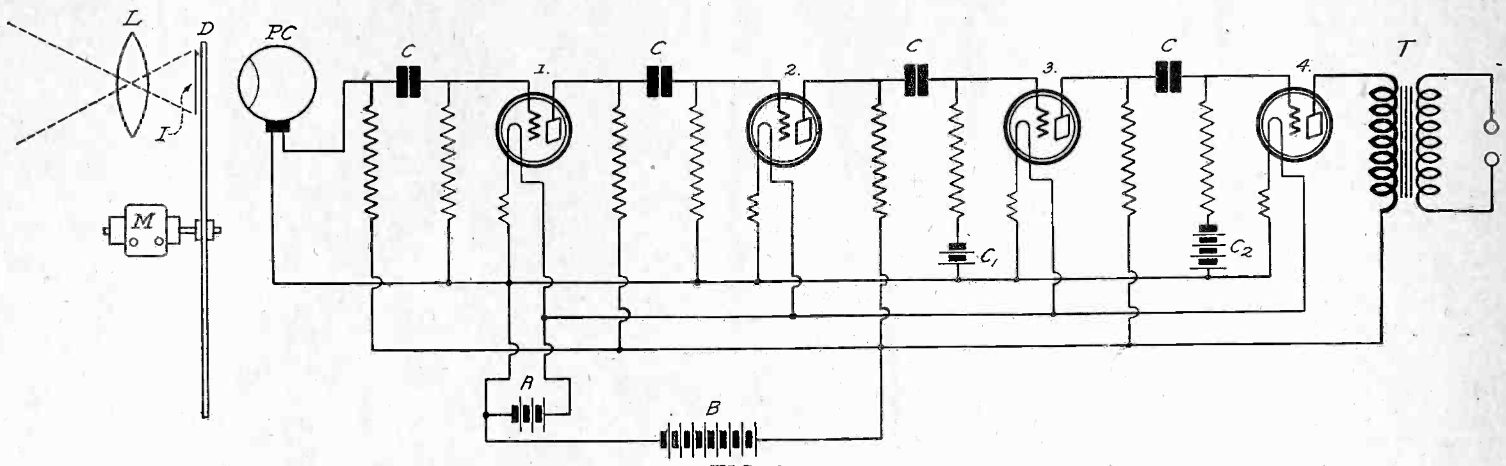


FIG. 1.

THE SCHEMATIC DIAGRAM OF THE NEW BELL TELEVISION TRANSMITTER. THE LENS L FORMS AN IMAGE I OF THE SUBJECT TO BE TRANSMITTED ON THE SCANNING DISC D, DRIVEN BY A MOTOR M. THE NEW SUPER-SENSITIVE PHOTO-ELECTRIC CELL PC CONVERTS THE LIGHT IMPULSES IN ELECTRIC CURRENT, WHICH IS AMPLIFIED BY A SPECIAL FOUR TUBE RESISTANCE COUPLED AMPLIFIER. T IS A LINE TRANSFORMER HAVING A UNIFORM TRANSMISSION BETWEEN 18 AND 20,000 CYCLES.

positions and then a metal piece with the proper size hole is mounted over each of the large holes. Each of these metal pieces is fastened to the disc by two small machine screws. Provision is made for moving the metal pieces both angularly and radially by small amounts so that the adjustment may be made with high accuracy.

When the adjustment of the holes is correct the entire luminous surface of the receiving lamp as seen through the scanning holes is of uniform intensity, provided that the surface is uniformly luminous when seen directly. Hence any deviation from uniformity when the light is seen through the holes is due to a modulation of the luminosity.

Details of Transmitter Amplifier

A very special resistance coupled amplifier is used to amplify the photo-electric signal. It is designed to amplify frequencies from 18 to 20,000 cycles per second with substantially the same amount. It is necessary to go down to 18 cycles so that current variations of the same frequency as the speed of rotation of the scanning disc may be amplified, and it is necessary to go as high as 20,000 cycles so that lines of sharp luminosity contrast may remain sharp.

For this reason the amplifier is resistance coupled, as shown in Fig. 1. Large stopping condensers C are used so that the low frequencies may have a chance to get through. Each of these condensers is 4 mfd. Also to insure that the low notes be amplified the grid leaks have high resistance values.

Between the last tube and the line is put a transformer which has a uniform transmission characteristic between 18 and 20,000 cycles. This transformer is of large size and has a core of permalloy. The line in this instance may be either the leads to the receiving apparatus or to the radio frequency transmitter.

Jars Prevented

The motor M driving the scanning disc D and the lens L (Fig. 1) are mounted on the same frame that holds the amplifier and the photo-electric cell. In view of this fact the vibrations from the motor are likely to be transmitted to the amplifier tubes and introduce disturbances in the photo-electric signal. To prevent jars from being communicated to the amplifier the first three tubes, which are in the same compartment as the photo-electric cell PC, are enclosed in lead tube shields, both suspended from elastic supports by threads. This construction eliminates all microphonic disturbances.

The last tube in the circuit is mounted outside the box containing the other tubes, without special precautions against jars. The last tube used is practically non-microphonic, and since any mechanical disturbance in this tube will not be amplified it is not necessary to mount this tube like the others.

New Photo-Electric Cell

The amplifier is battery operated. A is a storage battery for the filaments, B is a dry cell battery for the plates, and C1 and C2 are dry cell batteries to provide the grid bias for the last two tubes. The use of either a storage B battery or a fresh dry cell battery is desirable to prevent feedback through the impedance of the battery and hence oscillation disturbances in the amplifier.

There is nothing essentially new in the latest development except the increased sensitivity of the photo-electric cell, the secret of which is not yet available. The use of a lens for throwing an image on the Nipkow scanning disc was previously known, but the knowledge was of little value until the improved photo-electric cell was developed. With the new cell the camera can be used and almost any scene may be televised. And the whole transmitting apparatus may be made on a scale which permits easy transportation to any field where an interesting picture can be picked up.

It is obvious that if the reproduction is to be clear the receiver amplifier must be designed to cover as wide a frequency band as the amplifier at the transmitter shown above. In fact, it may be a duplicate of that circuit. But in place of the photo-electric cell a regular detector tube would be used, and this tube would be preceded by a tuner and RF amplifier.

The output transformer T would give way to a neon lamp, which would be scanned by a replica of the transmitter disc.

The tuner used in the radio receiver could not be very selective or the high frequencies in the signal, which give sharpness to the received picture, would be suppressed.

New Cell Smashes Tough Barrier

The following is the official publicity release on the subject of the demonstration:

Engineers of Bell Telephone Laboratories, who over a year ago gave the first demonstration of television, disclosed some of the further progress which they have made during their continued researches by demonstrating a new transmitting device which is capable of putting upon the television circuit outdoor scenes.

On the roof of the laboratories actors boxed and danced, swung baseball bats and tennis rackets, to appear in brightly illuminated pictures in one of the laboratories on the eighth floor.

The present apparatus differs radically from that of the first demonstration, when the scene to be transmitted was illuminated by a powerful artificial light and only the actor's head and shoulders appeared in transmission. With the improved apparatus the scene was illuminated by ordinary sunlight and covered the area occupied by two men engaged in a friendly boxing match.

Serious Limitation Overcome

In the first form of apparatus demonstrated in April of last year, the scene was illuminated by a rapidly oscillating beam from a powerful arc light and that

...s Televised!

...llumination Is Removed, and Panoramas ...Shoulders"—Three-Foot Disc Used with ...te, 18 Revolutions per Second

limited the scene to be transmitted to a very small area. The new development frees television from one of its most serious limitations.

The scene or event to be transmitted is reduced to the form of an image by a large lens, this image being scanned by a rapidly rotating disc similar to that previously employed but much larger.

The lens serves somewhat the same purpose in the television apparatus as the large lens of an astronomical telescope, and, like the latter, it should be large to gather as much light as possible.

Focus Unchanged

The experiments show that moving persons and objects can be successfully scanned, although at a considerable distance from the lens and therefore in such a position that the focus of the lens does not require changing from moment to moment. Light passing through the lens and scanning disc is caused to actuate a light responsive device of extreme sensitiveness and generate an electric current which after amplification may be transmitted either by wire or radio.

The developments in television which were demonstrated were perfected by Dr. Frank Gray of the laboratories working in collaboration with Dr. Herbert E. Ives. They illustrate the continued interest and progress of the telephone engineers in the problems of television, but the engineers themselves refused to prophesy as to future developments or applications.

They pointed out that the improvement was in the television transmitter and that its use required no fundamental change in the two types of receiving equipment for use by either single individuals or by larger audiences which were developed and demonstrated a year ago.

Two More Stations Send Still Pictures

The Radiovision Corporation, 62 West 39th Street, announces that stations KSTP, of the National Battery Broadcasting Company, St. Paul, Minn., and WJBI, of Scranton, Pa., have joined the list of stations broadcasting pictures through the Cooley Rayfoto process on their radio schedules.

Among the other stations in the chain are WMCA, New York City, which broadcasts a picture playlet every Wednesday night and pictures three mornings each week; WTMJ, Milwaukee; KMOX, St. Louis; WOKO, Mt. Beacon, N. Y.; WDEL, Wilmington, Del.; WWJ, Detroit; WFI, Philadelphia; CKNC, Toronto; and CJRN, Winnipeg.

WGY TELEVISION SCHEDULE

WGY of the General Electric Company is maintaining a regular schedule of television broadcasting. The transmission is from 1:30 to 2 p. m. on Tuesday, Thursday and Friday, and from 10:15 to 10:30 p. m. Sunday. At present 24 scanning lines are used at a speed of 20 repetions per second.

The transmission is on the regular wave of WGY of 379.5 meters, or 790 kc. The signals are also transmitted on the 31.4 meter wave 2XAF at the same time.

Workmen Far Back Seen on Screen

The new television apparatus developed at the Bell Telephone Laboratories, 463 West St., New York City, was perfected by Dr. Frank Gray in conjunction with Dr. Herbert E. Ives. Dr. Gray has been engaged in television research ever since this subject was taken up at the laboratories and has made notable contributions to the art.

The engineers immediately connected with this new development would not predict any startling applications of the system but merely stated what can be done at present. But others predicted that in a short time the television transmitter would be taken to tennis matches, baseball and football games, boxing matches and other events, and that the scenes there picked up would be broadcast so that all may look in who are equipped with a suitable radio set and television converter.

Paul B. Findley, managing editor of "Bell Laboratories Record," while not prophetic about the new development, said that the pictures received were remarkably clear. Explaining the transmitter, he pointed to some workmen in direct line with the camera and at a considerable distance back and said that during a previous demonstration he had distinctly seen the images of these men in the receiver. These workmen were much farther away from the camera than the microphone is placed when broadcasting a boxing contest and they were so far away that the camera could easily have covered an entire tennis court.

"While we should not become too enthusiastic about the possibilities of immediate television we should not forget that the engineers in Bell Telephone Laboratories and in other research laboratories have not stopped working on the problem," said one witness of the demonstration. "Additional announcements of further progress are likely to come any time."

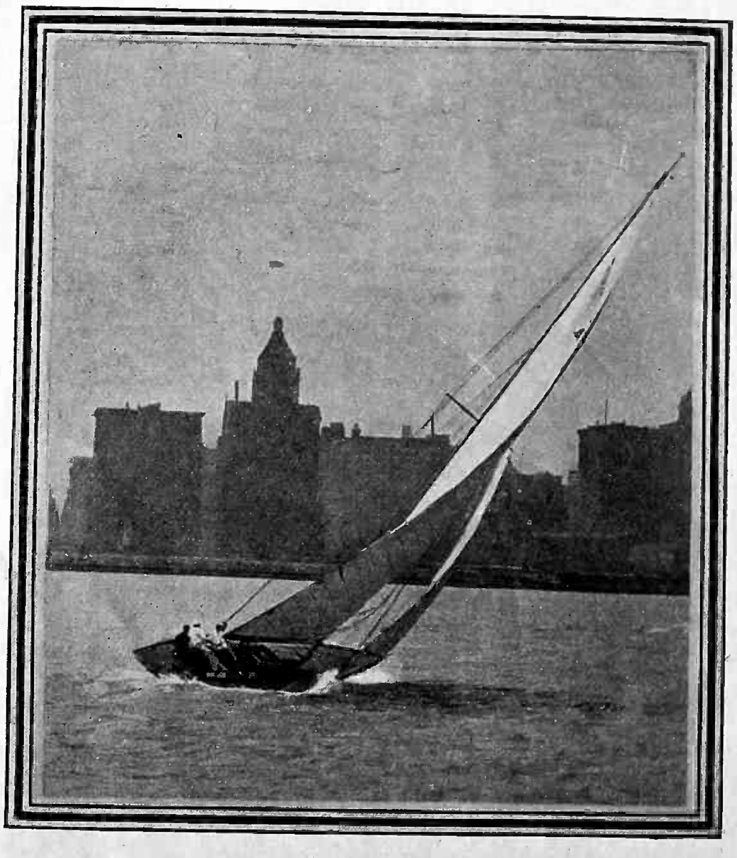
Two Karas Brothers Out for New Trophy With Yacht "Siren"

The sailing yacht "Siren" owned by L. L. Karas, vice-president and chief engineer, and A. E. Karas, vice-president and superintendent, both of the Karas Electric Company, prominent radio parts manufacturers, of 4040 N. Rockwell street, Chicago, is a consistent race winner under the guidance of the two brothers. In four starts this year the yacht won four firsts. These were the Columbia Yacht Club's annual Michigan City race and the races of three known as the Virginia Trophy Races.

"Siren" won first place in the Lake Michigan Yachting classic last year, the Mackinac race, a distance of about 340 miles, and is entered for the race again this year which will start on July 28. "Ole" (L. L.) is the "skipper" and "Al" (A. E.) is the "head man." "Siren" participates in all yachting events in the Chicago area and the Karas brothers have more than enough trophies to fill an auditorium.

So skillful are these two "born sailors" that their maneuvering of "Siren" often is watched from the shore by admiring crowds, while even yachtsmen stand by to see the two experts work.

The two Karas brothers, L. L., known as "Ole", and A. E., known as "Al", have distinguished themselves in yachting circles just as they have in radio circles with the Karas Electric Co., of Chicago. The picture shows their record - breaking, constant - prize - winning yacht "Siren" developing high speed before the wind on Lake Michigan.



The Distortio

By Capt. Pet

Contribut

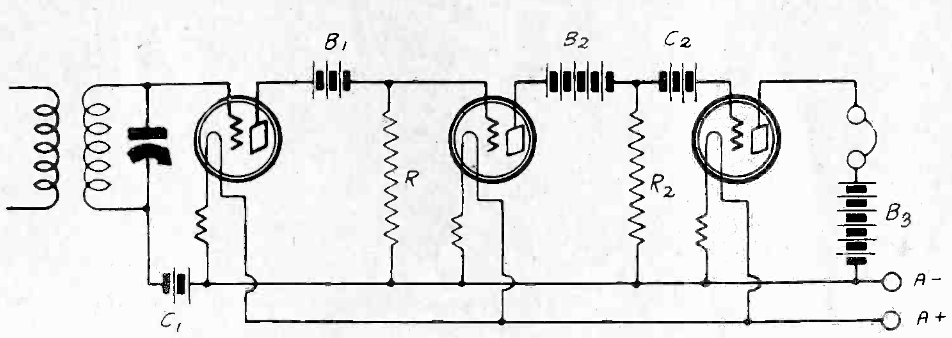


FIG. 2.

A COMPLETE CIRCUIT EMPLOYING THE DISTORTIONLESS SYSTEM OF AMPLIFICATION. IT COMPRISES A GRID BIAS DETECTOR AND TWO STAGES OF NON-REACTIVE AMPLIFICATION.

[*In an article in last week's issue, July 21st, a method of coupling audio tubes which is essentially distortionless was discussed. In the present article the discussion will be extended to complete amplifiers.*]

THE first tube in Fig. 2 is a detector operating on grid bias. The bias is obtained from the battery C1 and from the voltage drop in the filament ballast in that tube. The required value depends on the tube used for rectifier and on the value of the plate battery B1. For best results in a circuit like this the detector should be of the high mu variety, either a mu 30 tube or a screen grid tube. The correct value can be obtained very easily by varying the voltage until the volume is loudest.

Adjustment of Grid Bias

The adjustment of the grid bias is somewhat critical, especially for high mu tubes, and it may be that the proper voltage cannot be obtained by varying C1 a cell at a time. There are two methods by means of which a finer variation may be obtained. One is a potentiometer connected across a portion of C1, two cells for example, and connecting the grid return to the slider. Extremely fine adjustment can be obtained this way.

The other method is the adjustment of the voltage B1. Almost as fine adjustment can be obtained in this fashion. For example, if the mu of the tube is 30, varying the value of B1 by one cell, that is, by 1.5 volts, is equivalent to varying the grid bias by 1.5/30, or .05 volt. In the first stage, or detector, it is well to start with low values for C1 and B1. It may be best to start without C1 and depend for bias on the drop in the ballast resistor.

The resistor R may be one megohm. If a mu 30 tube is used as detector a .0005 mfd. condenser should be shunted across R to aid detection.

The direct current in the plate circuit of the detector sets up a steady voltage drop in R which is such that the grid of the second tube is negative. This bias is approximately one-half of the value of B1. Hence if B1 is of low voltage the bias on the second tube may be just right to bias the second grid. It may be too much, however, and it was for that reason that a positive grid battery was put in the grid lead. If B1 is small this battery should not be necessary.

Three Points Available

There are three points to which R may be returned for different bias values. The drawing shows it returned to the negative of the filament battery. If slightly less grid bias is wanted on the second tube the grid may be returned to the F minus post on the second socket. And if a still lower bias is required the grid return may be connected to A plus. Thus the bias may be varied in three steps without changing the values of the batteries, and one should be within operating range for a given value of B2.

The second tube should also be of high mu type. The plate voltage for this tube is derived from battery B2. Its value should be considerably higher than the value of B1, for at this point the signal voltage will be much higher. And the voltage should be adjusted so that for a given return of R the grid bias on the second tube is correct for amplification.

High Coupling Resistor Used

The coupling resistor R2 between the second and the third tubes should have a value about one megohm. As in the previous instance, there will be a large steady voltage drop in this resistor which will give a negative bias to the last tube. It may be too high for proper operation of the second tube, therefore battery C2 is inserted in the grid lead, with the positive terminal of C2 toward the grid. Also, as in the previous instance, there are three points to which the return of R2 may be connected for three different grid bias values. The adjustment of C2 and the return of R2 would depend on the type of the last tube and on the voltage applied to it, that is, the value of B3.

Working Backwards

Although a battery is indicated for B3 this may well be a B battery eliminator. A headset is also indicated in the plate circuit, but this is merely for convenience. A loudspeaker should be used.

After the circuit has been adjusted approximately it is best to work backwards for the final adjustmnt. Let us trace the process.

Let us assume that the last tube is a -12A tube. B3 then should have a value of 135 volts. The required grid bias on that tube is 9 volts. There will be a certain drop in R2 due to the plate current in the second tube. When R2 is one megohm and B2 is 90 volts this drop will be about 70 volts. This is 61 volts higher than necessary on the grid of the last tube. Now if R2 is returned to the positive side of the A battery 6 volts will be saved. Hence C2 should have a value of 55 volts.

But it is really not necessary to make B2 90 volts. Forty-five volts would handle the signal. When that is used the drop in R2 will be about 34 volts, which is 25 volts more than is necessary on the grid of the last tube. By connecting R2 to A plus, six volts will be gained and the value of C2 should be 19 volts. Eighteen volts will do, being obtained from a dry cell battery of 12 cells.

Second Tube Adjustment

Now the effective voltage on the second tube is really 51 volts, since the voltage of the A battery was added to that of B2. The grid bias on the high mu tube with 51 volts on the plate may have any value of about ½ volt to 2 volts. The value of B1 and the return of R should be adjusted so that the bias on the second tube falls in this range.

If B1 is 4½ volts the drop in R is about 3½ volts. If R is connected to the negative terminal of the socket the bias becomes 2½ volts. If it is connected to the positive side of the A battery the bias becomes 2½ volts positive. Neither of these adjustments is good, but the former is passable.

Suppose B1 is increased to 9 volts. The drop in R will be about 7 volts. Now, if R is returned to the positive terminal of the battery the bias becomes 1 volt. That is all right. Now it only remains to adjust the grid bias on the first tube until the tube detects best and the circuit is adjusted.

Thus B3 is 135 volts, B2 is 45 volts and B1 is 9 volts, C2 is 18 volts and the return of R2 is to A plus, and R is returned to the same place.

Circuit Made Regenerative

The circuit shown in Fig. 2 can be made regenerative by a very simple

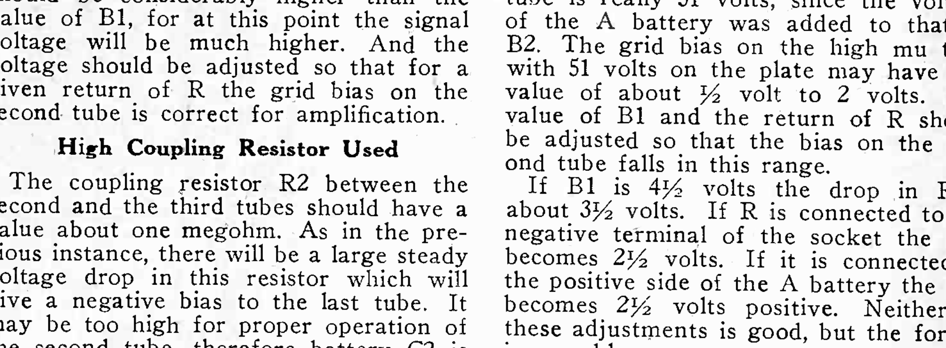


FIG. 3

A THREE-TUBE DISTORTIONLESS DIRECT COUPLED AMPLIFIER IN WHICH REGENERATION IS EMPLOYED TO INCREASE THE AMPLIFICATION TO ANY DESIRED EXTENT. THE FEED BACK IS THROUGH A NON-REACTIVE CIRCUIT INSTEAD OF THROUGH THE REACTIVE LOUDSPEAKER CIRCUIT

ess Amplifier

O'Rourke

or

change, a modification due to R. V. L. Hartley. This regenerative circuit is shown in Fig. 3. The return of R3 in the plate circuit of the second audio tube is made to a point on R1, which is in the plate circuit of the detector.

How this connection makes the circuit regenerative may be shown with the aid of the arrows. Suppose the direction of the signal current at some instant is toward the plate of the detector as indicated by the first arrow by R1. The tube following reverses the phase of the signal voltage so that the current in R2 is away from the plate of the first tube shown as indicated by the downward pointing arrow by R2.

The next tube also reverses the phase so that the signal current in R3 is toward the plate of the second tube, that is, the current in R3 is in the same phase as the current in R1. By returning R3 to a point on R1 the signal current in R3 flows through part of R1 and thus increases the voltage drop in R1. This increase is transmitted to the first tube so that the signal level is raised by the feedback in phase.

Oscillation Possible

If R3 is returned high enough on R1 the circuit will oscillate at some frequency. If R3 is returned far down on R1 the regeneration will be slight. Hence by sliding the point of contact from the filament upward toward the high potential end of R1 any desired degree of regeneration may be obtained. At first the increase in volume by this means is very slow, but as the point of oscillation is approached the increase is very rapid.

As the circuit will oscillate at some frequency, the amplification will not be independent of frequency and some distortion will result if too much regeneration is attempted. Also, the circuit will not be stable when the oscillation point is approached too closely. But the advantage of the arrangement is that the amplification may be increased enormously by the use of regeneration without any appreciable frequency distortion.

The regeneration may be obtained by connecting a 100,000 ohm potentiometer below R1 and connecting R3 to the slider.

Some circuits have been shown in which the loudspeaker or headset circuit was returned to a previous coupling resistor to obtain the regeneration. This is not done here because the output circuit is reactive and that fact would make the feedback depend on frequency. Hence the output would not be nearly so free from frequency distortion as when a non-reactive circuit is returned for regeneration.

For broadcast reception it would not be necessary to use regeneration, for the straight amplification would be sufficient. But there are many cases in which the signal level is originally so low that regeneration is required even in a three stage amplifier.

Similarity to Common Impedance

Those who have followed J. E. Anderson's articles on motorboating in RADIO WORLD and in "Proceedings" of the Institute of Radio Engineers, will recognize the similarity between the circuit in Fig. 3 and the circuits used for explaining the cause of motorboating. In Fig. 3 the portion of R1 below the tap constitutes a common impedance between the detector plate circuit and that of the second audio tube.

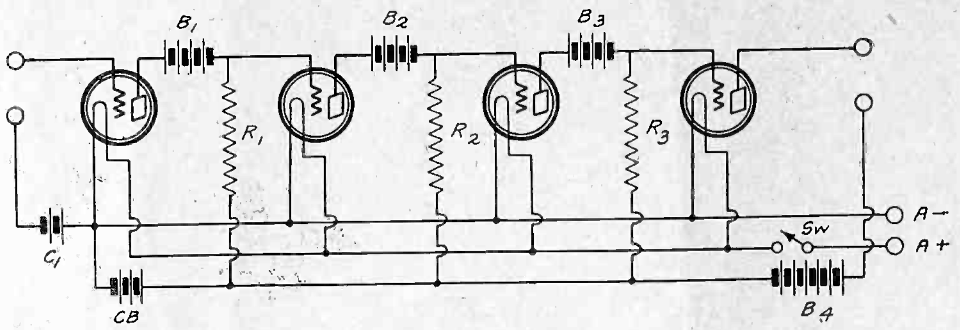


FIG. 4

A DISTORTIONLESS AMPLIFIER IN WHICH THE EXCESS GRID BIAS OBTAINED FROM THE VOLTAGE DROPS IN THE COUPLING RESISTORS IS COMPENSATED FOR BY A COMMON GRID-PLATE BATTERY CB

The analysis of Fig. 3 to determine the degree of amplification is simply a special case of the analysis which determines the oscillation, regeneration or amplification suppression in a resistance coupled amplifier having a common impedance in the plate circuits. Analysis will show that when the coupling resistors R1, R2 and R3 are of the order of one megohm and the mu of the tubes is 30, less than 2,000 ohms below the tap will suffice to cause oscillation in the circuit.

Use of Common C Battery

It is clear that in a circuit like that shown in Fig. 2 the C batteries may be combined into one. How this may be done is shown in Fig. 4. CB not only serves as a common C battery to counteract the excessive drop in the resistors, but it also serves as part of the B battery for all of the tubes.

Suppose that the value of B1 is 9 volts and that CB has the same value. Let us further assume that the grid bias C1 and the plate resistance R1 are such that a current of 14 microamperes flows through R1. Then the drop in R1 is 14 volts. Hence the bias on the second tube is 14 less 9 volts, or 5 volts, since CB tends to neutralize the drop in R1. But 5 volts is too much for the second grid. The bias may be reduced by several possible changes in the circuit. R1 may be decreased. C1 may be increased. CB may be increased and B1 decreased. Or CB may be increased alone, which is probably the best. The adjustment should be made so that the net negative bias on the grid of the second tube is about 1½ volts.

The adjustment of the second plate circuit should be confined to B2, and it should be made so that the bias on the second grid is about 3 volts.

Let us now assume that the last tube in the circuit is a -71A type with a total effective plate voltage of 180 volts. The bias should be 40 volts. This may be obtained by adjusting B3, or by returning R3 to some point on battery or some other point which will give a net bias of 40 volts on the last tube.

Adjustments of Circuit

Although all the coupling resistors in the circuit are returned to the same point in Fig. 4, it is not necessary in adjusting the circuit. CB and B4 may be considered as one battery with many taps on it. R1 may be returned to one tap, R2 to another and R3 to still another, depending on the voltage adjustments necessary. The object is to get the desired effective plate voltage on each of the tubes and the required net grid bias on each tube.

The adjustments are best carried out with the aid of a vacuum tube voltmeter, one which does not draw any current. The effective grid voltage on any tube should be measured from the grid of a given tube to the negative end of the filament.

The effective plate voltage should be measured from the plate of a given tube to the negative end of the filament.

But in a circuit of this type it is not the effective plate voltage which is of chief interest, but the total applied voltage in any plate circuit. This can be obtained by measuring the various batteries with an ordinary voltmeter and then adding up the voltages of the batteries in a given circuit. For example, to get the total applied voltage in the first plate circuit the voltages of CB and B1 may be measured and the results added together. The sum is the total applied voltage in the plate circuit of the first tube which determines the plate circuit.

It is the grid voltage which must be measured with a vacuum tube voltmeter because this depends on the drop in the coupling resistance as well as the grid return, and the current flowing normally in the coupling resistor is much smaller than the current required by any high resistance voltmeter available.

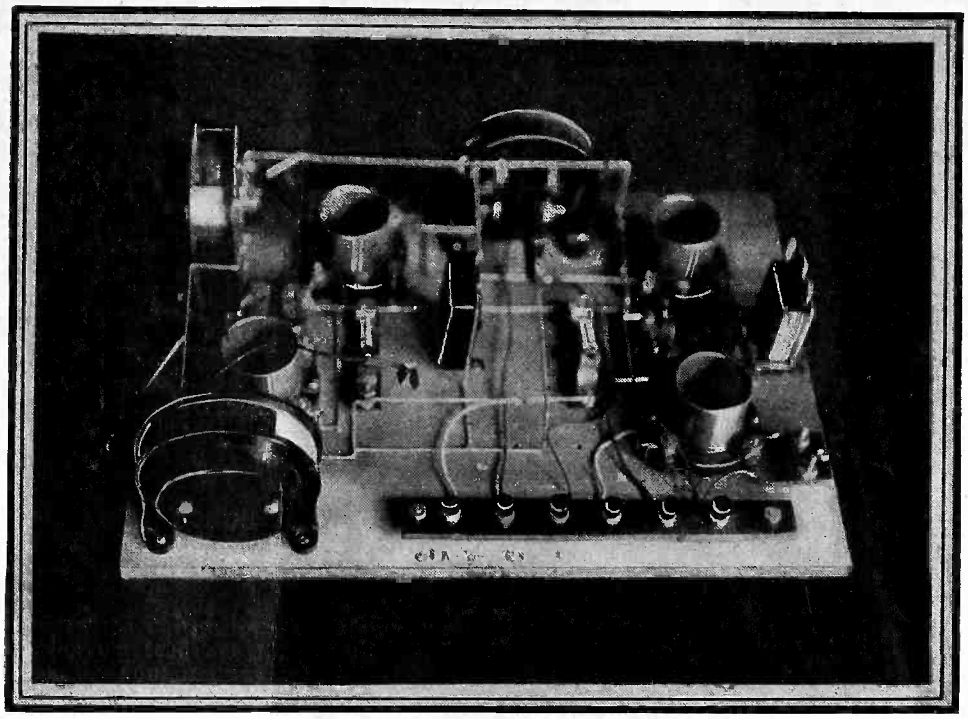
Common Impedance Possible

Since CB is common to three plate circuits this battery is a possible source of regeneration and oscillation. Its internal resistance constitutes a coupler among the three tubes, and the net feedback is in phase with the current in the first plate circuit. It will not take much resistance in CB to cause the circuit to oscillate, particularly when the normal amplification in the circuit is high. Therefore CB should be kept fresh so that its resistance is negligible, or else a very large condenser should be connected across it, say 20 mfd.

Since the voltage of battery CB is low, it is necessary to use a high voltage condenser across it, and therefore the cost need not be high. An ideal condenser for this purpose is an electrolytic one. This type of condenser may be had in capacities over 100 microfarads in a very small container. The use of this condenser is well worth while even no oscillation or noticeable distortion is present without it.

[This subject of distortionless amplifiers will be pursued further in these pages. Some very remarkable circuits are under investigation and they will be presented as soon as possible to our readers.]

The Versatile Mixer



TWO EXPERIMENTAL STAGES OF SCREEN GRID INTERMEDIATE AMPLIFICATION AND ONE STAGE OF RESISTANCE AUDIO, FED BY A SHORT WAVE MIXER, AND OPERATING A SPEAKER. THE INPUT WAS MADE AT LEFT FOREGROUND, DIRECT TO THE COIL. THE AUDIO TUBE WAS AT RIGHT FOREGROUND

[The publication of one form of a short wave mixer for Super-Heterodynes, in the July 7th issue of Radio World, and a design for an intermediate amplifying channel, in the July 14th issue, brought an exceptional response, showing great interest in this subject by experimenters. There are unusual difficulties attending the construction of such a mixer, and the experiments are commended only to advanced Super-Heterodyne students. Meanwhile the simplification progress is going on in several laboratories, so that a circuit may be developed and reduced to blueprint form for any novice or experienced builder to follow successfully. This week the author shows a somewhat different form of mixer, using commercial plug-in coils. Again the circuit not only tunes in the short waves but the broadcast band as well.—Editor]

* * *

ONE important consideration in the construction of a Super-Heterodyne is to have good selectivity in the modulator (first detector). This may be obtained by the use of regeneration, but an easier, simpler and perhaps better way is to use a screen grid tube in the modulator circuit, operating it for grid bias detection. Such a use is shown in the schematic diagram herewith.

The screen grid tube as a grid bias detector gets its selectivity from the absence of a damping grid leak, absence of grid current and from the presence of the bias itself. The volume is not so great as when this same tube is used as a space charge detector, but volume is not what is so necessary in the modulator. The need is for selectivity here, because in that way secondary or "image" interference is materially reduced. Such interference may be defined as that arising mainly from the oscillator beating with off-resonant frequencies and from squeals arising from the intermediate frequency being at or near the difference in frequency between two broadcasting stations.

Oscillator Never Selective

A great many squeals develop when the modulator oscillates uncontrolably, and since there is no oscillation control in the hookup shown, the plan is to eliminate regeneration up to the point of oscillation.

Assuming the use of commercial short-wave coils, the feedback condenser may be omitted from the modulator, since a Super-Heterodyne should be sensitive enough in the intermediate channel to require no regeneration in the modulator for sensitivity objectives.

When it comes to selectivity, regeneration would be needed, save for the use of the screen grid tube as shown, and of course the intermediate channel must aid the selectivity. The oscillator itself does not increase, decrease or in any way affect selectivity, and the fact that you can tune with the oscillator at all is due only to the fact that the intermediate channel has selectivity at a fixed frequency. How sharply the oscillator seems to tune, therefore, is due only to how sharply the intermediate channel actually is fixedly tuned.

Novel C Battery Placement

Bear in mind therefore that for considerations of selectivity and sensitivity it is necessary to have the mixer for short waves and long waves so proportioned electrically that not only are the signals brought in, but the secondary interference is kept at a low level. This has been the greatest problem in connection with all Super-Heterodynes, due in part to the fact there may be as many as 10,000,000 different, simultaneous frequencies in the oscillator alone!

Since commercial short-wave coils commonly have the end of the primary and the end of the secondary terminating at one lug on the coil form, so that there are only five connecting points, although six coil ends, the mixer can be adapted to the use of those coils by following the grid bias battery placement as diagrammed. CB is the C battery, and it may be 22½ volts for a plate voltage of 135.

Notice that A minus is grounded, which puts the oscillator tuning condenser rotor at ground potential, whereas the positive side of the C battery is grounded. The fact that a slightly higher radio frequency potential exists at the rotor of C1, the modulator tuning condenser, does not mean there is body capacity effect in C1.

A bypass condenser of .006 mfd. or higher capacity may be placed across the C battery, which battery, by the way, well may be one of the small type batteries used for portable sets and for grid bias in home receivers.

Circuit Analysis

Analyzing the circuit, the modulator is seen to be conventional, with primary in the antenna circuit, secondary in the tuned grid circuit, and tertiary coil in the plate circuit provided with a switch, however, so that in the broadcast band the plate coil may be shorted out. Indeed, sometimes on the short waves it is well to short out this coil to avoid regeneration.

Another way of stopping regeneration on short waves is to leave the plate coil in and tighten the coupling between antenna coil and secondary, a method practical only when short wave coils that have adjustable primaries are used.

In the oscillator circuit we find that the grid return for the modulator is completed through the primary of the second set of short wave coils. This, if adjustable, also permits government of selectivity. We do not need to tamper with the oscillator for reasons of controlling oscillation, as at all times this circuit must be oscillating, and the oscillation is provided by commercial coils' plate windings.

If you can't get the oscillator to oscillate at short waves, put a radio frequency choke coil of from 65 to 125 milli-

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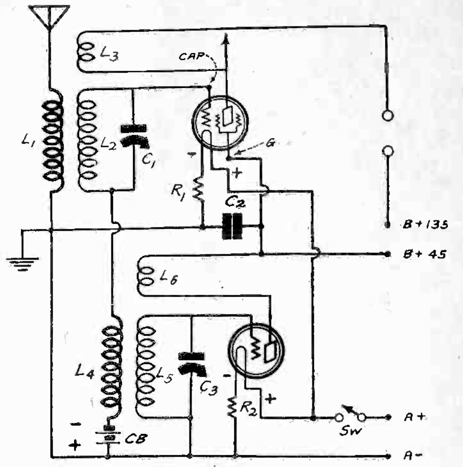


A MIXER FOR SHORT AND BROADCAST WAVES. CONNECT B— TO A—

LIST OF PARTS FOR MIXER

L1, L2, L3, L4, L5, L6—Two sets of commercially-made short-wave coils. (In some instances the experimenter will have to wind his own coil to reach the top of the broadcast band.)

C1, C2—Two .00014 mfd. tuning condensers.

C2—0.5 mfd. bypass condenser.

R1—One 20-ohm resistor

R2—One 4-ohm resistor.

CB—One 22½-volt battery.

SW—One switch (another optional).

One .006 mfd. fixed condenser, optional across C battery.

Four binding posts (Ant., Gnd., P and B).

Two standard sockets.

One 7x10-inch front panel.

One 7x9-inch subpanel.

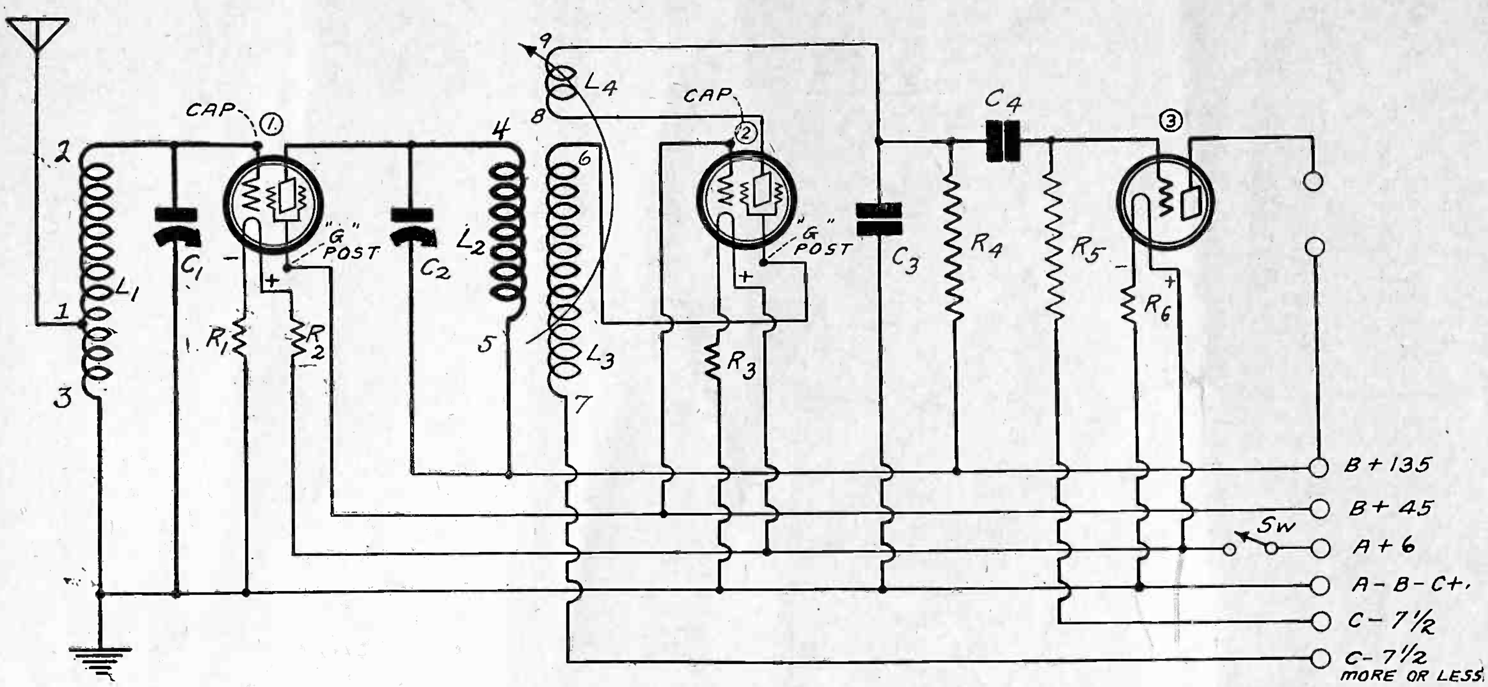
Two dials.

One six-volt A battery.

135 volts of B battery or equivalent B supply.

Wonders on Three Tubes

By Herman Bernard



GRID BIAS DETECTION, USING THE SCREEN GRID TUBE AS A SPACE CHARGE DETECTOR, PERMITS THE DEVELOPMENT OF SUFFICIENT VOLTAGE INPUT TO A 112A TUBE, WITH RESISTANCE COUPLING IN BETWEEN, TO GIVE SATISFACTORY SPEAKER OPERATION. HENCE ONLY ONE AUDIO STAGE IS USED, I. E., THE LAST TUBE. THE VOLTAGE DEVELOPMENT IS MATERIALLY AIDED BY A TUNED PLATE PRIMARY WITH A STEPPED UP SECONDARY IN THE THREE-CIRCUIT TUNER. REGENERATION MAKES THIS UNUSUALLY ECONOMICAL CIRCUIT SUFFCIENTLY SELECTIVE.

SUMMARY

Two unusual features in circuit design are presented by the author: (1) a full impedance load on the tuned plate of a screen grid radio frequency amplifier, with the first embodiment of voltage step-up to the succeeding tube; (2), grid bias detection, using a screen grid tube as a space charge detector. The radio frequency voltage is amplified with the aid of regeneration so as to provide sufficiently large detector input whereby the square of that quantity will be enough to tax a 112A tube or even feed a —71A tube satisfactorily. The combined result is the first three-tube non-reflexed circuit of more than average selectivity, sensitivity and volume, operating a loudspeaker exceedingly well.

THE more we learn about the screen grid tube the better we are able to use it and, what is almost as important, the better we are able to avoid abusing it. Used properly it has wonderful possibilities. Abused, it is a source of trouble and is expensively short-lived.

Two remarkable uses are exhibited in the diagram, which shows a three-tube set that operates a reproducer, not merely by courteous concession of some indebted friend, but by actual comparison with five, six and seven-tube factory-made receivers! It is the first design ever to be presented in wide print where only three tubes were used, without any reflexing, and yet supported by a circuit network and proper constants to give more than average selectivity, range and speaker volume. The circuit will drive a 112A output tube to its limit of undistorted power and even will work the low mu —71A tube, which calls for a grid swing around 20 to 30 volts before effectiveness asserts itself.

The Two Outstanding Uses

The two uses around which pivot the compelling novelty and efficiency of this economical circuit are:

(1) Out of a screen grid tube as the radio frequency amplifier is a form of coupling that consists of a tuned plate primary coil, a secondary with a step-up ratio, and a tickler for feedback. The new idea is embodied in the step-up ratio, as no other coil model has been published for a screen grid TRF set that provides maximum tuned impedance in the plate circuit, with increased voltage to the input of the next tube. In the grid circuit it has been customary to use a damping leak, while the grid and plate are isolated by a fixed condenser. The present method avoids the reduction of selectivity and volume arising from the damping effect of a leak, and instead actually gives a step-up of whatever ratio is handy to use. About 1-to-2 is easily practical.

(2) The detector tube is a screen grid used as a space charge detector, but instead of leaky condenser rectification grid bias detection is adopted. This is otherwise called plate rectification or plate bend detection. Grid bias detection is necessary if one is to operate a speaker without more than one stage of audio amplification, for by the leaky-condenser system the relatively large grid swing necessary in the detector would be hopelessly excessive, and distortion severe.

LIST OF PARTS

L1—One auto-transformer for antenna coupling (three connections, Nos. 1, 2 and 3).
L2L3L4—One three-circuit tuner, with special secondary winding (six connections, Nos. 4, 5, 6, 7, 8 and 9.)
C1, C2—Two .00035 or .0005 mfd. tuning condensers.
C3—One .0005 mfd. fixed condenser, mica dielectric (optional).
C4—One .5 mfd. bypass condenser.
R1, R2—Two 10-ohm resistors.
R3—One 20-ohm resistor.
R4—One .5 meg. or higher.
R5—One 5 to 10 meg.
SW—One switch.
Three standard sockets.
One flexible coupling.
One dial.
Two one-inch knobs.
Four binding posts (Ant., gnd., speaker +, speaker —).
One 7x18-inch front panel.
One 8x17-inch subpanel.
One five-lead battery cable.
Two No. 45 Universal Peewee clips.
135 volts of B supply.
One 7½-volt C battery.
Two screen grid tubes and one 112A tube.

The RF Tube

Considering first the radio frequency amplifier and the coupling medium, we find that the antenna input is taken through an auto-transformer, a single winding tapped for the antenna connection. The primary consists of that part of the winding from (1) to (3), while the secondary consists of the entire winding (2) to (3). As only a few turns of wire separate ground from antenna, say 10, for example, while the entire winding will be around 50 turns for popular diameters, we start with a step-up of 1-to-5 and use the simplest sort of coil. Any other good type of antenna coupling may be substituted.

Not many turns may be used for the primary part of the auto-transformer because of the introduction of too large a part of the antenna capacity effect into the tuned circuit. While it is a good plan to locate the antenna tap so as to afford best compromise between selectivity and sensitivity, a third component in the compromise well may be introduced if one desires to gang the two tuning condensers, C1 and C2. This new component is the

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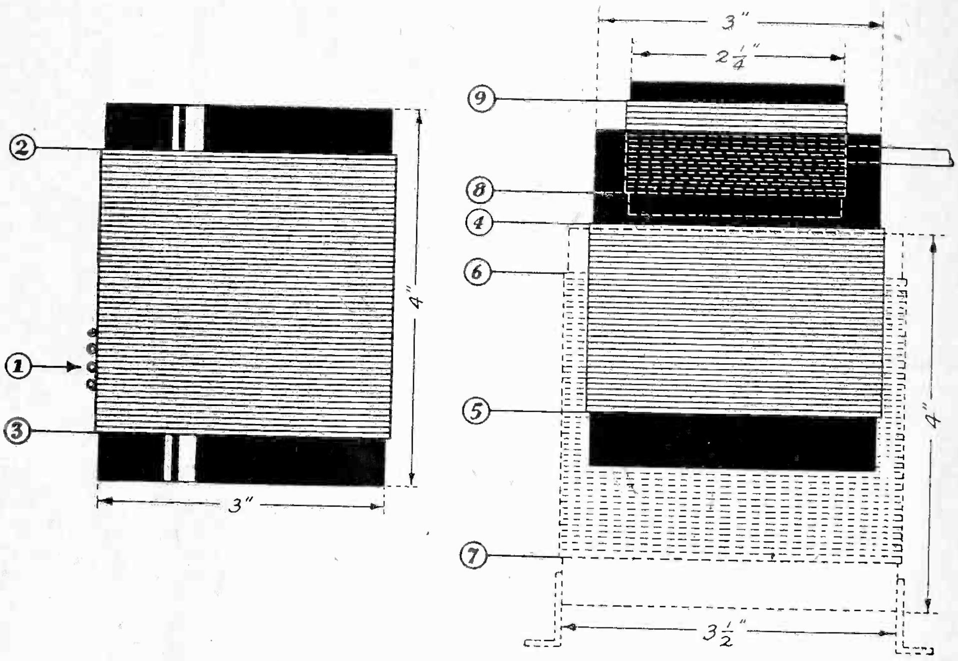
One Stage of Audio In Three-Tube



COIL DATA FOR THE ECONOMY THREE

For tuning with .0005 mfd. condeners the auto-transformer L1 consists of 55 turns between terminals (2) and (3), tapped for the antenna at the 41st, 45th and 47th turns to permit determination of the most suitable tap for your antenna. L2L3L4, the three-circuit tuner, may be a reconstructed commercial coil, with the econdary for .0005 mfd. tuning, used here as the primary, terminals (4) and (5). The new secondary, (6) to (7) you will wind on a larger diameter, putting on as many turns as possible, in 4 or 4½ inch axial length, without superimposing turns. Place the three-circuit tuner inside this new coil. The tickler may not provoke oscillation, due to the use of grid bias detection, unless you add more turns. Keep adding until the detector regenerates on 545 meters. For .00035 mfd. tuning L1 has 65 turns, tapped at the 51st, 55th and 57th turns, while the other coil, L2L3L4, is the same as previously, except that the tuned primary has 65 turns. No. 24 wire, either double silk or silk over cotton or simply cotton-covered is used throughout, except on the tickler, which may have No. 26 or 28 wire. If you can't tune low enough remove primary turns.

(*Continued from preceding page*)

location of the tap so as to afford equal capacity at some high broadcast frequency, in other words, for detuning compensation.

The bias for the screen grid RF tube is rather critical, so if two ten-ohm resistors are placed in the filament circuit of the first tube, one in each leg, the six-volt source will be dropped to 3.3 volts. The filament resistors are in series, hence their resistances add, and the addition is just right, because the resistance precisely required is 20.22 ohms, so 20 ohms gives an accuracy to 1 per cent, which is fine indeed.

The drop in the negative leg resistor is 1.32 volts, and by tieing the grid return to negative A battery (not negative filament), the drop is used for negative bias, which is always reckoned from the negative filament.

The Detector Input

Looking out of the first tube, then, we find the primary of the three-circuit tuner has as many turns as a secondary usually has, therefore an existing three-circuit tuner, with proper capacity for C2, will suit the requirements. The tickler should have a generous inductance. That would leave only the small primary of a commercial coil unused. This primary may be removed or connected in series aiding with the tickler.

Now the secondary is required, and you will have to wind it yourself if you want to convert an existing three-circuit coil to the present use. Get a tubing with diameter a little larger than the inside diameter of the present coil and have it about four inches long. On this wind all the wire possible without doubling up. No. 24 or 26 wire is suggested. The new coil may be anchored to a baseboard or subpanel with brackets. If physically easy to perform, you may use a smaller diameter, and after winding the new form, fit it inside the commercial coil.

Connect terminals properly, so as to avoid losses due to phase displacement. If you point the form's axis to the ceiling and if the coils are all wound in the same direction, then (4) for RF plate, (6) for screen grid and (9) for detector plate should point to the ceiling. The tickler coil need not be studied over-carefully in this regard, as you need merely operate the set and determine whether the greater regeneration is afforded by tighter or looser coupling. If looser coupling gives more regeneration you have reverse feedback, so reverse the tickler connections (at the binding posts of the coil) to obtain positive feedback.

Grid Bias Detection

We now come to the second consideration—the grid bias detector. One point to stress at once is that the bias is more than one might imagine simply by looking at the voltage marked on the post of a C battery to which the detector grid return (7) is connected. The voltage drop in R3 is additive, just as was the drop in R1, only the total is higher, 2.7 volts negative bias being contributed. Hence if you tie the grid return to the 4½-volt post of a C battery, you get 7.2 volts negative grid bias, and when the detector is worked in this fashion, with resistance coupling feeding the output tube, a —71A tube may be worked at 30 volts root mean square grid swing. Hence the bias on the —71A would not have to exceed 32 volts negative. The plate voltage on the —71A of course would have to be around 167½.

However, it was the intention to operate the circuit with a 112A tube in the output, because the amplification constant of that tube is about twice that of the other, and all the amplification ahead of the last tube, both at radio and audio frequency, normally requires no more than a 112A. Hence the external negative grid bias on the detector tube, from C battery, really need not exceed 4½ volts, and the designation "C—7½ more or less" should be given liberal construction, especially as the total becomes 7.2 volts, as previously explained.

Use Large Condenser

From the detector tube the usual connections are made for resistance coupling, the precaution being taken, however, to use a large capacity isolating condenser, C4, for best frequency response. A safe capacity is .5 mfd. While as little as .01 mfd. may be used with small attenuation of the lower audio frequencies, the .5 mfd. capacity seems to make an audible difference on low note response.

The RF shorting condenser C3 may not be necessary in some instances, but its inclusion is a safeguard that the radio frequency impedance in the plate circuit be low, while the audio frequency impedance of course is high.

For the plate resistor any value from .5 meg. to 10 meg. may be used, depending on the plate voltage and grid bias adjustments and the volume allowable, but in any instance the grid leak R5 should be at least twice as large as the plate resistor. These two resistors are in parallel and a small leak reduces the impedance. Values of .5, 1 and 2 meg. worked well in the plate circuit, the higher values giving more volume, while high leaks should be used in the grid circuit without fail, say, from 5 to 10 meg. Small values of audio grid leaks act as a soft pedal on low notes.

The circuit as diagrammed, with voltages used as stated, except for optional values of negative grid bias on the detector, requires no output filter, as the plate current in the last tube is around

Works a Speaker Economy Set

10 milliamperes, and this is no danger to No. 38 or even No. 40 wire, commonly employed in the magnet coils of speakers.

Watch Voltages Carefully

Particularly adhere to the 45 volts for the screen grid of the radio amplifier and the customary control grid of the detector (the cap, used here as screen grid). If a 180-volt B supply is at hand, the 112A as well as the first tube may be worked from the B plus Amp. post, while th 180-volt tap is connected only to B plus detector. Or, if you do not mind reducing somewhat this tube's life, you may connect the 112A also to 180 volts, including an output filter to protect the speaker coil windings.

The danger of tampering with voltages is that the amplification of the screen grid tube depends on those voltages. Once the voltages are stated, and the loads known, the action is well-established, the amplification constant is a certainty and the problem defined, hence work with 45 volts and 135 volts used as diagrammed. There will be no motorboating, because the amplification of the entire circuit is kept within safe limits.

Too much amplification seriously affects the common coupling of the circuits through the B supply and develops motorboating.

Therefore here is one circuit using resistance coupling that is the most economical in construction cost and operation and yet which does not give rise to nuisances otherwise encountered.

As the circuit employs no shielding it is possible for a tube to oscillate, and the stuttering sound will be mistaken for motorboating. Slightly decrease the voltage on the G post of the RF tube until oscillation disappears. A Vac-Shield placed over the RF tube also helps to prevent oscillation.

Efficiency With Resistance

It will be a surprise to many to learn that from a single stage of resistance coupling so much can be accomplished, because there have been statements aplenty—not in these columns, however—that resistance coupling is "inefficient." Rather it might have been said that the tubes used were inefficient. Given the right tube, resistance coupling will develop as much voltage from stage to stage as will coupling with good transformers, nearly all of which are now of low ratio. Really the tubes do the trick, but the coupling method should get the credit, as it previously got the blame, just to cancel the injustice.

The so-called "inefficiency" of the resistance coupling was ascribed to the voltage drop in the plate resistor. This was set down as a "loss." In fact, however, this drop constitutes the input to the next tube. The greater the drop the better, so long as there is enough plate current flow to respond to a wide grid swing. All the voltage is in the circuit. Looking at the tube as a circuit from zero to maximum D C voltages, the total voltage in use is the positive plate voltage plus the negative bias voltage, or, if the grid is positive for detection, then the plate voltage minus the grid bias voltage. Only plate voltage is dropped in the plate resistor. A typical instance is that 180 volts at the source becomes 90 at the plate post, due to the drop. At .5 milliampere plate current, which is very high in a detector, the plate circuit resistance (counting the load resistor only) was therefore 180,000 ohms (90 divided by .0005).

The Tube's the Thing

Because tubes had low mu, whereby the load impedance could not be successfully fixed at high values, the amplification with resistance coupling was low, but with high mu tubes, especially screen grid, the deficiency of the tube for resistance coupling disappeared. You used to see resistance coupling consisting always of three audio stages, whereas now you see it consisting of only one stage for speaker operation. The coupling has undergone no change save a wiser choice of resistance and capacity values. But the tubes certainly have changed and at last you have resistance coupling with all its merits and none of its vices.

A true insight reveals, also, that the tube is the asset in the detector circuit. It is a common saying that grid bias detection is not nearly so sensitive as leaky-condenser rectification.

Again the tube is the culprit. It would not be advisable to suggest grid bias detection using an —01A or a special detector tube, for then there is a great disadvantage against the tube. But as the mu is increased and the characteristic curve becomes more abrupt, the rectification by the grid bias method becomes much better, so that with the high mu tubes, like CeCo type G, Cunningham CX340 and R. C. A. UX240, the sensitivity difference becomes small. And when the screen grid tube is used the improvement is so marked that it is possible to attain even greater sensitivity by the grid bias method than by the leaky condenser hookup, and also without introducing the distorting influence of flow of direct current in the grid.

The mu of the screen grid tube may be increased by increasing the positive voltage on the otherwise control grid (cap of the detector) so that the 112A tube in the last stage may be easily overloaded before the detector input is called This is stated simply because it is so, not because such increase is recommended.

Noise Not the Goal

Some may try connecting the detector grid return to positive A, and will notice that signals are a little louder, even with no leak and condenser, but the detector overloads fast and draws grid current. Degrees of volume are fairly comparable only when the purity of the current is assumed to be the same. In other words, quantity of noise is not the goal, but undistorted signal strength is.

The screen grid radio frequency amplifier should give long life, when the voltages are right, but the space charge detector may prove short-lived indeed if the clip of the B plus 45 lead, intended for the cap of this tube, is placed on the cap after the set is turned on.

This will cause a sudden current surge from the cap or positively charged control grid (here used as screen grid) to the filament, and likely will burn out the filament, particularly if the 45 volt recommendation is exceeded.

Play safe by being certain to place the clip on the cap before the set is turned on.

And so you have the picture of the Economy Three—the theory and enough contruction data to enable you to build and operate the set understandingly. The most from the fewest tubes is now within easy reach, and the parts probably won't cost more than $20.

[In next week's issue, dated Aug. 4, will appear another absorbing article dealing with unbroached phases of the Economy Three.]

Sales Representatives Added by Polymet

The Polymet Manufacturing Corporation, of 599 Broadway, New York City, announced the appointment of two more sales representatives for the entire Polymet line. J. L. Simon, of 1746 Commonwealth Avenue, Boston, Mass., will cover New England. I. Schubot, of 707 Hoffman Building, Detroit, Mich., will cover the Michigan territory and Northern Ohio.

Condenser Catalogue Gives Eliminator Data

A catalogue containing a complete line of condensers and condenser blocks for the A and B circuits of the socket power set, as well as special interference elimination devices, has just been published by the Dubilier Condenser Corporation with sales offices at 10 East 43rd Street, New York City.

The catalogue specifies condenser blocks for various standard radio power circuits and rectifiers. An analysis of each Dubilier condenser block is given, showing the capacity and the maximum DC working voltage of each section. The dimensions of the standardized "cans" in which condensers and blocks are enclosed are also given. A copy of this catalogue, together with that dealing with Dubilier Micadons, Metaleaks, Light Socket Aerial and other devices, will be sent on request. Mention RADIO WORLD when writing for a catalogue.

The Regin

By James I

Contributing Editor; Associa

THE most fascinating study in radio, is that of the vacuum tube. It therefor behooves the fans to absorb all possible knowledge of this "little bottle full of sunshine and music."

The first radio tube was the two-element valve invented by Professor James Ambrose Fleming of England, and in this form it was merely an improved detector for telegraphy. However, it may be that the first radio tube was really Aladdin's lamp, which is inscribed on the rolls of history through the medium of Arabian Nights. Certain it is that no djinn summoned by Aladdin was more powerful than the great Djinn of radio that answers the call of every radio fan when a tube is placed in the socket of a receiver.

Earlier Developments of the Tube

The tube as developed by Fleming was infinitely more sensitive in the reception of radio signals than any device that had been perfected up to that time. It remained for our own Dr. Lee De Forest however, after a long series of brilliant experiments, to perfect it by adding the third and most important element, the grid, thus raising it from the class of a more or less scientific makeshift to the plane of a marvelously sensitive instrument capable of detecting the most infinitesimal electrical energy. Since then a fourth element has been added, giving us the screen-grid tube which has wonderful possibilities.

The radio tube was necessitated by the tremendously high frequency currents used in radio transmission. The shortcomings of the human ear which, in the average adult case, is incapable of hearing vibrations of more than 20,000 cycles per second, makes a detector a vital necessity in the audible reception of radio signals.

The radio wave as sent out from the transmitter reaches a high maximum amplitude, gradually tapering to zero. Nevertheless, while the amplitude decreases, the distance between the peaks of the wave train remains the same. It is therefore necessary to bring the radio waves from the supersonic, or inaudible range of vibrations, down to the audible field where they can be heard and distinguished by the human ear. This is the function of the detector tube.

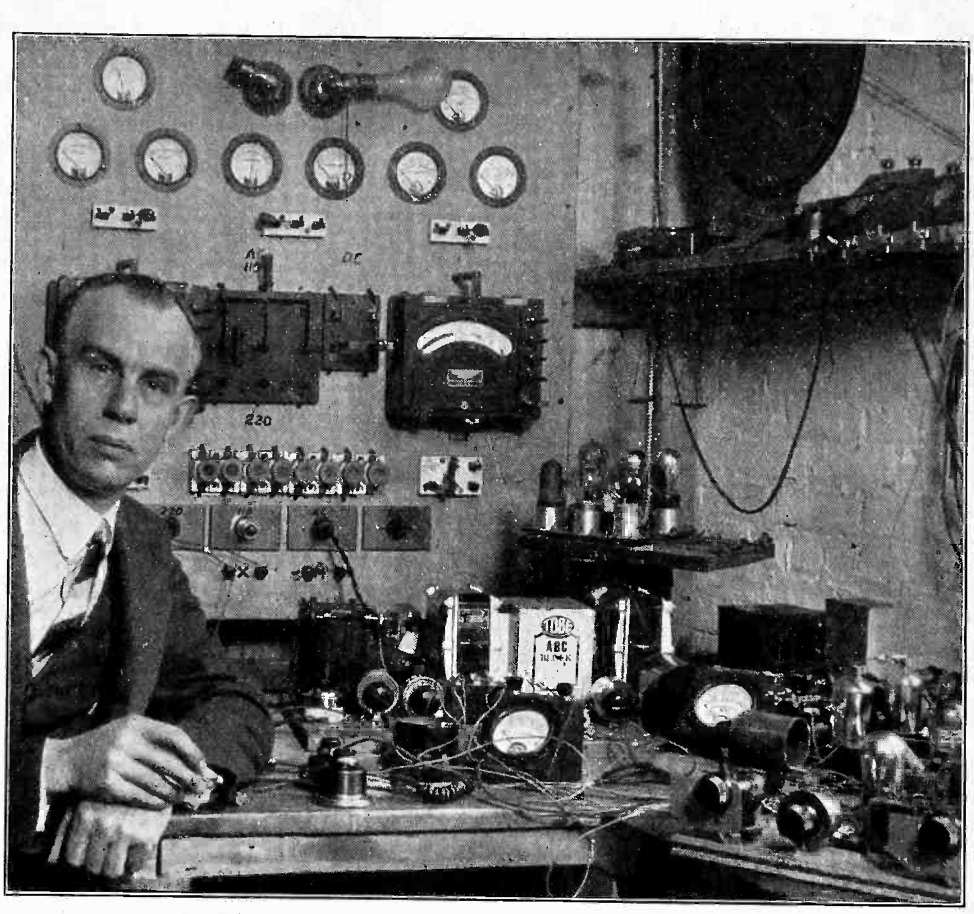
Developments Lead the Field

In the fast moving art of radio, since its inception as a public service and necessity, the pace has been set by the vacuum tube. The tremendous growth of radio in the main has been made possible by tube developments. When a new tube is developed, new radio equipment is brought forth to work efficiently with it. Witness the screen-grid and the -50 type power tube.

In the last few months, the greatest developments in radio have been chiefly in the tube field followed by circuit refinement and power amplifier design to use these newer type tubes to best advantage. Even the dynamic speaker is made possible by power tube improvement.

A visit to a tube factory is an education in itself. A factory, such as that of the CeCo Mfg. Company, at Providence, R. I., makers of the nationally known CeCo tube, which is one of the largest tube factories in the world, making every type of tube for radio use, is a revelation in itself. Here acres of ground are covered with modern factories and shops with banks of almost human machines tended by skilled workers turning out perfect tubes by thousands.

Machinery is no small factor in the making of good tubes. Machines that can "almost think" and that cost small fortunes to produce are necessary. First-class tested, materials are vital; skilled workers plus meticulous care and exactness are all concomitants of the modern radio tube.



JOHN MUCHER, PRESIDENT, IN A SECTION OF THE CLAROSTAT LABORATORY, TESTING TUBES WITH CLAROSTATS

Pioneers Limited in Choice

Veterans will remember the joy brought by the first available tubes, superseding our crystals. As high as $12 a piece was paid for some of these tubes at the time, which is only the price of the finest power tube today. Due to the scarcity of storage batteries then, when we were building our three-circuit tuners, many of us fell back on the WD-12, which could be heated with dry-cells working on 1.5 volts, although the amperage draw was .25. This was a fair tube, highly microphonic. As tube shields and Benjamin spring sockets were not then procurable, many a rubber bath sponge was pressed into howl-arresting service. Then the supreme thrill when KDKA was brought in on the speaker, loud enough to be heard across the room. Then followed an influx of awed auditors who were cautioned to step softly so as not to start "bells ringing."

Then came the A type, or six-volt valve, and the tube came into its own. The small band of pioneers expanded into a vast army of set builders and radio became a fixture in the American home. At that period of feverish hope and expectation there were but three types of tubes available for fan and layman experimenter, the WD-12, the —01 and the newly developed 199. Today, there are several special types for detection, for radio frequency, many special types for audio frequency amplification covering the needs of transformer, resistance and impedance coupling, there are hi-mu and low-mu tubes and a wide variety of rectifier tubes, half and full-wave, including gas filled types, also glow and protector tubes, and the giant rectifier for A, B and C eliminators, not to mention the television tubes.

Present-Day Tubes

Taking our present-day tubes in order of use, we find first the general purpose tube, the —01A type, which is an all-around handy tube for general use, though outclassed as to certain functions by special purpose tubes. This tube can be used as a detector, radio frequency or audio frequency amplifier working on 5 volts with filament amperage of .25, plate voltage 22 to 135.

The super detector tube is a development that has done much to advance radio reception and will give much better results as a detector than the —01A. This tube can be used efficiently only in the detector socket. The —12A type tube also makes a splendid detector and is also coming into favor in the radio frequency stages. A receiver with three RF stages, using three —12A tubes, a super detector and a 112 feeding into a push pull transformer coupled audio with two 171 type tubes or a single —10 makes a good one for DX and good tone quality.

The so-called power tubes do not give extra power, but more efficiently, handle the increased power fed into the last audio stage, permitting undistorted and rounded output. Having twice the filament emission of the general purpose tube, the power tube can pass greater

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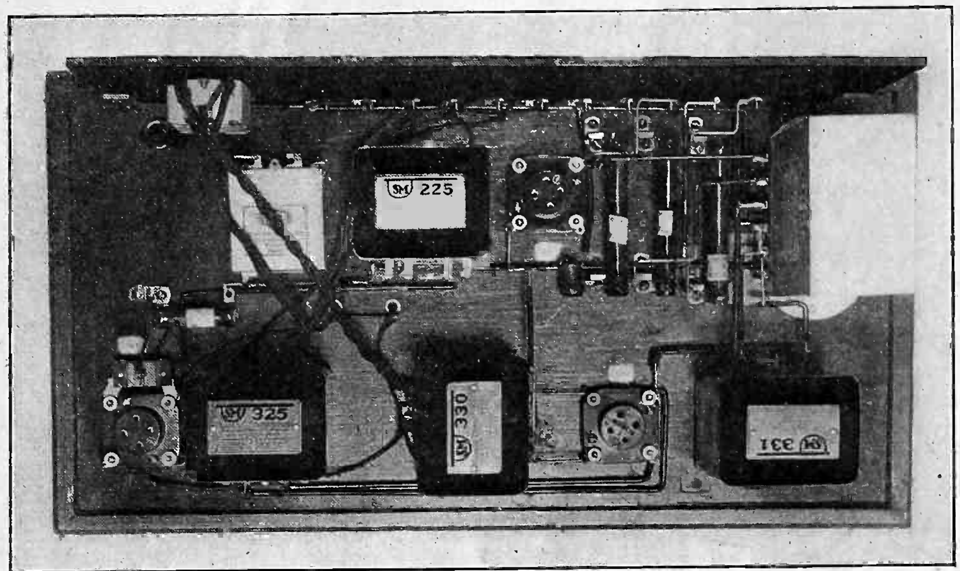


ONE FAN BUILT A B SUPPLY, WITH FIRST-STAGE AF TRANSFORMER AND PUSH-PULL SECOND STAGE AS SHOWN. THE POWER TRANSFORMER WAS LOCATED IN THE RECEIVER (NOT SHOWN), WHILE THE FIRST AUDIO TUBE WAS LEFT THERE, ALSO. FIGS. 3, 4 AND 5

current with a much lower percentage of distortion. The —12 and the —12A are the first of the power tubes, so called. Next in order is the —71A, type one that gives a most clear and pleasing tone, handling more input than the —12. The working range of plate voltages for the —12 is 90—157.5 volts with grid bias of 4.5 to 10.5. The —71A has a working range of from 90 to 180 plate volts with C bias of approximately 16 to 40 volts.

Real Giants of Power

We progress next to the giant class of power tubes, first of which is the —10 type. This tube requires a filament voltage of 7.5 volts, draws 1.25 amperes and requires plate voltage of from 180 to 425 volts with a grid bias ranging from 12 to 45 volts. This tube gives wonderful undistorted output with deep, full and rich tone quality.

Greater output can be gained, however, by the use of the new super power —50 type tube, newly on the market. This tube is the daddy of all power tubes, so to speak. The filament of the finest made tubes of this type, such as the CeCo L-50, is of the improved oxide-coated type. The filament voltage and amperage are the same as that of the —10, but the permissible plate voltage runs from 250 to 450 volts with a negative grid bias of from 45 to 84 volts maximum. It might be remarked that the prescribed bias on all power tubes is somewhat elastic, depending on circuit conditions. The best working bias in each case is obtained by experimentation.

The maximum undistorted output of the —50 type tube at the highest rated voltages is 4,650 milliwatts, a substantial gain over that of the —10. The tone characteristics are somewhat similar to the —71 type.

Other Special Purpose Tubes

Another modern tube worthy of mention is the —40 type tube. This tube fills a very useful purpose for amplification and detection in resistance and impedance coupled circuits, where audio transformers are not used and the burden of amplification falls upon the tube. This tube works best on 5 volts, has a draw of .25 amperes, applied plate voltage of 22½ to 225 and grid bias around 5 to 9 volts.

The screen grid tube is in a class by itself among the modern radio tubes. Originally brought out as a radio frequency amplifier, it is being found to possess useful characteristics as a space-charge detector and experiments now being made may prove it to be also a good amplifier. It works on 3.3 and 1.5 volts grid bias and a maximum plate voltage of 135 volts.

This tube cannot be used in a haphazard manner. A working knowledge of its use and application to the circuit is necessary. Special circuits are being designed to bring out the fullest advantage of its constants. A good example of a successful circuit of this kind being the National Screen-Grid Five recently described by James Millen in these columns.

While new to us, a tube of this kind has been in use for some time in Europe, its design being prompted by the need of high amplification factor with the use of the fewest possible tubes.

The —99 type tube is still in use with its concurring power tube, the —20.

Tubes for Rectification

Rectifier tubes have come into prominence during the past year or so with the increasing use of multi-tube sets and the development of dependable socket power devices and power amplifiers. The rectifier tube is a utilization of the property of the radio tube which allows an electric current to flow through it in one direction only. The tube developed to change the alternating house current into direct current for the operation of the radio tubes in the receiver rectifies the alternating current which is flowing first in one direction, then in the opposite—the rapidity of change in direction being dependent on the number of cycles—into a smooth flowing, unidirectional current, called direct current.

These tubes are not for use in the receiver. There are two kinds of rectifiers, the half-wave and the full-wave, the distinction being based upon whether they rectify only one side or the wave or both sides. There are two filament types, differing in capacity, large and medium. The large capacity half-wave is the —81 type, filament voltage 7.5, filament amperage, 1.25, maximum plate voltage, 750, maximum output, 110 milliamps.

The medium capacity half-wave type is the —16B, filament voltage 7.5, filament amperage 1.25, plate voltage 550 and maximum output 65 milliamps. The full-wave filament type is the —80 type, large capacity, filament voltage 5, filament amperage 2, plate voltage 300 and maximum output 125 milliamps. The —13 type is medium capacity, the same filament requirements with plate voltage of 220 and maximum output of 65 milliamps. These types of tubes as developed for present day use are highly dependable, long lived with proper use, economical and efficient in all kinds of socket power devices factory made, or home built.

Also popular are the gaseous rectifiers, made by the Raytheon Manufacturing Company, leaders in its field.

Alternating Current Tubes

The long-looked for alternating current tubes have made their debut, passed through the experimental stages and are now accepted for everyday use. There are many good makes on the market, and with the new receivers and circuits released in the Fall they will be found to work dependably and satisfactorily. These tubes cannot be used in old type receivers without rewiring or harnessing.

For general use there are two types, the —26 type used as a radio and audio frequency amplifier, and the —27 detector. —26 works on 1.5 volts, drawing 1.05 amperes, with plate voltage ranging from 90 to 180 volts and grid bias of 6, 9, 12, 13.5 volts. A five-prong socket is required on the —27 type, which works on 2.5 volts, drawing 1.75 amperes, plate voltage 45 to 90. This tube also, is sometimes used as an amplifier with the proper voltages and C bias. Step-down transformers of many types are available for use with these tubes and a B power unit is required for plate voltages. A voltage regulator cut in on the line will render an AC installation more stable and dependable.

There will also soon be available for the fan and experimenter an AC —71 type tube that will work specially well direct from the line. AC screen-grid tubes have appeared already, also AC high mu both made by CeCo.

With the tube situation as it is today, tubes plentiful, quality high, all types available at low prices, there is no excuse for any set not being up-to-date. Those who cannot afford extensive alterations can bring their sets to greater efficiency by the use of the proper special purpose tubes. Spare tubes should always be kept on hand for emergencies, especially in the case of rectifier and AC tubes.

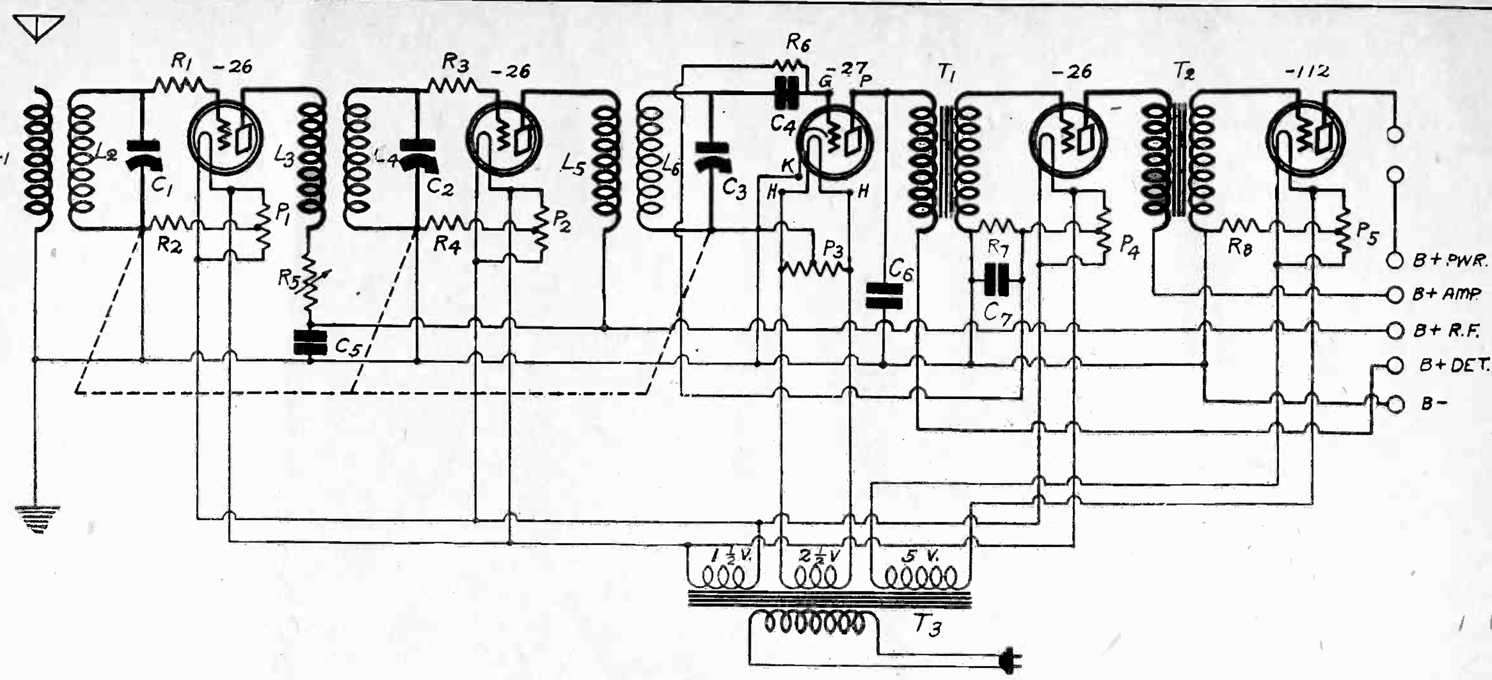


FIG. 701

A GENTLEMAN FROM IRELAND DESIRES TO KNOW WHETHER A FIVE-TUBE CIRCUIT WILL GIVE HIM GOOD RESULTS IN DONEGAL. THE ABOVE CIRCUIT ANSWERS HIS SPECIFIC QUESTION REGARDING WHERE TO PLACE BIASING RESISTORS.

Radio University

A QUESTION and Answer Department conducted by RADIO WORLD, by its staff of experts, for University members only.

IS IT all right to use grid suppressors in an AC receiver, or do they introduce hum?

(2)—Would I get adequate sensitivity for reception in Ireland by using a five-tube circuit?

(3)—Please explain how the various biasing resistors should be placed. I am able to calculate their resistance value myself, as I will know the amount of current flowing.

PATRICK RYAN,
Milford, County Donegal, Ireland.

(1)—The grid resistors are all right. They are an easy way of stifling self-oscillation, although they are "lossers." They do not increase the hum. Be sure you have alternating current before you decide to build an AC set, as most of the current in your part of the world is DC, we are told.

(2)—Yes, but you could not expect to bring in many stations from the Continent. A few now and then would come in. Be careful to get the right inductances and capacities for the wide wavelength scale you will have to cover, due to European conditions.

(3)—The explanation of the bias resistor connections is best given by a diagram. See Fig. 701.

* * *

I HAVE NOTICED that when a type-27 tube is used in a circuit the midtap of its heater winding is sometimes connected to plus 45 volts, sometimes to minus 45, sometimes to the cathode and sometimes it is not connected to anything. Which is correct?

(2)—What is the advantage of making a connection to the midtap?

(3)—I have a transformer with a 2½ volt winding intended for one of the -27 tubes. Will three similar tubes work on this winding if they are connected in parallel?

EMORY PROUDFOOT,
Des Moines, Iowa.

(1)—The same connection does not work the best in all receivers and therefore there can be no general agreement as to which is correct. It may be said safely, however, that the midtap should be connected to a definite point, for if it is left floating there is considerable hum in the receiver. The object of the connection is in every case the reduction of hum.

(2)—When the midtap on the 2½ volt winding is connected to some point on the cathode or battery circuits the heater becomes balanced with respect to this point and the effect is similar to centering the grid return on the filament in an AC heated tube like the -26, although the effect is not so pronounced.

(3)—If the 2½-volt winding on the transformer is rated at 5¼ amperes or more it is possible to operate three -27 type tubes with it. The leads from the tubes to the transformer terminals should be made of heavy wire, say No. 14 or equivalent.

* * *

I HAVE a B battery eliminator which shows 190 volts when no current is drawn, but shows only 90 volts when five tubes are put on it. The last of these tubes is a 112A. When I put in a -71A in the last socket the voltage drops to 76 volts. What is wrong?

(2)—How can I remedy this condition? I want to use a type -71A tube in the last socket and I want an output voltage of 220 volts.

ADOLPH SUGARMAN,
Brooklyn, N. Y.

(1)—There may be several reasons for the poor regulations of the B battery eliminator. First, the input transformer may have too high resistance and it may be too small for the work. Second, the rectifier tube you use may not have high enough electron emission to supply the necessary current. Third, the filter chokes may have too high resistance. Fourth, the voltage divider may have too low resistance.

(2)—Try a new rectifier tube first. If that does not improve the regulation it will be necessary to rebuild the eliminator with parts which will handle greater current.

* * *

WOULD YOU ADVISE me to build a Super-Heterodyne with an intermediate frequency of 450 kc? I have been told that such a receiver is more sensitive, more selective, and that it can be made "one spot" very easily.

(2) If an intermediate frequency of 450 kc has any disadvantages please state them.

(3) Has such a frequency any advantages when used in a Super?

(4) Could a band pass filter be used for such a Super, and if so would it be of much advantage?

(5) Could the screen grid tube be used to amplify the 450 kc intermediate frequency to good advantage?

JESSE FROUD,
Atlanta, Ga.

(1) It is not advisable to build a Super-Heterodyne with an intermediate frequency as high as 450 kc because such a frequency would defeat the two main advantages of the Super-Heterodyne principle. These are selectivity of a high order and a high degree of amplification with stability. The high intermediate frequency will not make the circuit more sensitive, more selective, nor exclusively a "one spot." The reverse is true for selectivity and sensitivity. It will retain the two-spot feature for the high frequencies in the broadcast band.

(3) About the only advantage is that image interference can be reduced. That means the circuit will not squeal quite so much as a receiver with lower intermediate frequency.

(2) It is less sensitive, less stable, less selective than a circuit using a lower intermediate frequency.

(4) Yes. No particular advantage at that frequency, unless the circuit is made regenerative in the intermediate frequency level.

(5) Yes.

* * *

I HAVE JUST completed the Karas short wave receiver but I am doubtful about one connection. The terminal marked F on the coil receptable is not connected to anything in the wiring diagram. It seems to me that it should be connected to the negative end of the filament. Am I correct?

ADRIAN PARSONS,
Kansas City, Mo.

(1)—You are correct. The circuit will not work right without this connection.

* * *

WILL AN ORDINARY detector tube, followed by a resistance coupled stage, give enough volume if the detector tube is grid biased for rectification?

(2) How would it work with a transformer coupled stage after the resistance stage?

EDMUND FARQUHAR,
Mineola, N. Y.

(1)—No, you can not get enough volume that way. Grid bias detection is insensitive unless a high mu tube is used, followed by a suitable plate load impedance. Therefore use a mu 30 tube for the detector, with a 250,000 ohm plate resistor,

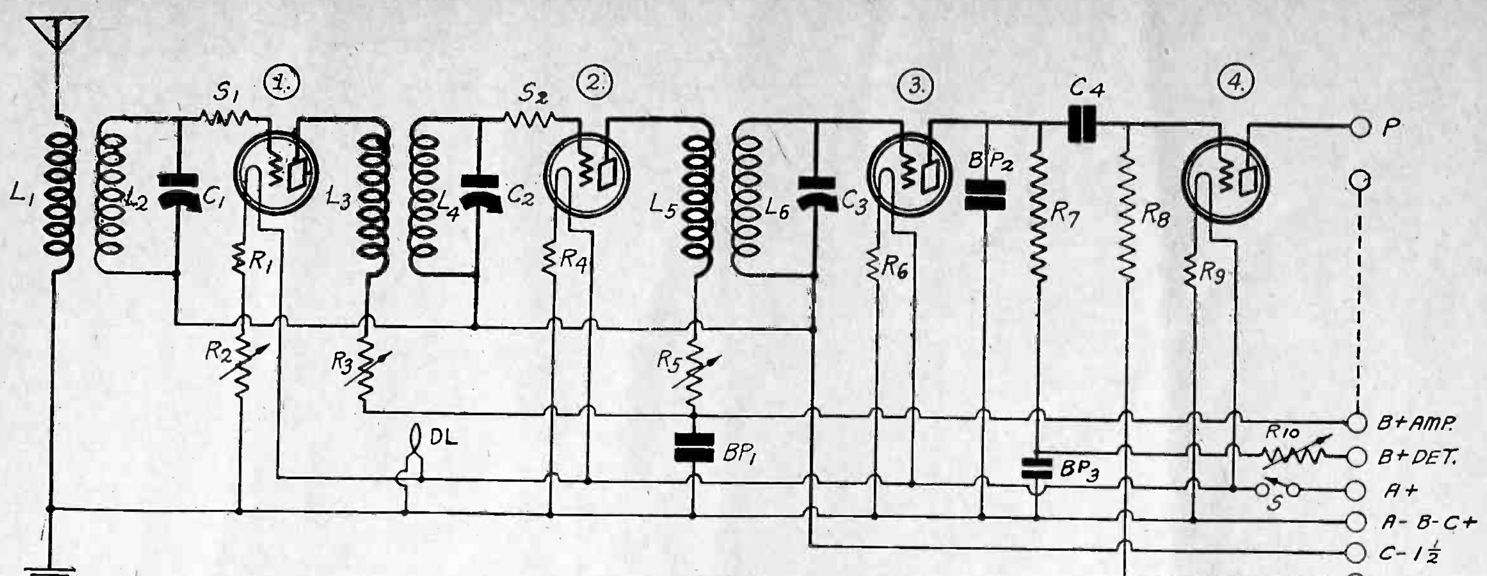


FIG. 702

GRID BIAS DETECTION, USING A HIGH MU TUBE, LIKE THE MU 30, AFFORDS SENSITIVITY EQUAL TO THAT OF THE -01A USED AS A DETECTOR WITH LEAKY-CONDENSER RECTIFICATION.

R7 in Fig. 702. Arrange the negative grid bias to afford rectification with the plate voltage you will use. The source voltage for the detector plate may be 135 or more, even up to 300 volts, but the bias must be increased, too.

(2)—A transformer coupled stage would do nicely, after a proper radio channel and grid biased high mu detector. The grid bias detector of this variety is as sensitive as an —01A detector tube is by the leaky-condenser rectification method. Usually a bypass condenser in the plate-to-ground circuit is necessary. Use .0005 mfd. or .001 mfd. Ground A minus

* * *

IS IT PRACTICAL to use 120 type tubes in push-pull in the last stage of an audio amplifier?

(2) How much undistorted output power can be expected from such a receiver, asuming that the input voltage to the push-pull stage is undistorted?

(3) Can the filaments of the 120 type tubes be heated with AC when used in push-pull?

(4) If such a stage is practical please give the value of the grid bias resistor for the two 120 type tubes.

AARON DAVIDSON,
Cleveland, Ohio.

(1) It is.

(2) About 450 milliwatts.

(3) Yes, provided that the transformer voltage is 3.3 volts. If a higher voltage is available, 5 volts for example, it may be dropped by putting ballast resistors in the circuit. A 5-ohm resistor should be put in each lead of the 5-volt winding.

(4) The grid bias resistor should be 1,730 ohms. This is best obtained by using a 2,000 ohm resistor and adjusting its setting to 1,730 ohms, or so that the bias on the tubes is 22½ volts.

* * *

AS SOON AS I turn up the volume of my four tube screen grid Diamond of the Air the speaker breaks into a loud squawk. I have tried new grid leaks and have tested all the voltages and can find nothing wrong. Except for this trouble the receiver is great. Will appreciate any suggestion which will remedy the trouble.

ANTHONY C. GROVE,
Newark, N. J.

The obvious solution is not to turn up the volume too high. But shielding of the first tuner from the second should help, for the trouble is undoubtedly due to feedback.

* * *

PLEASE GIVE the correct voltage for a screen grid tube.

(2) What is the amplification constant of a screen grid tube?

(3) Does any current flow in the screen grid circuit?

(4) What voltage amplification can be obtained with a screen grid tube?

PHILIP DAVIS,

(1) Using the tube as a screen grid amplifier, the filament voltage should be 3.3 volts, the plate voltage 135 volts, the screen grid voltage 45 volts and the control grid voltage 1½ volts.

(2) When the tube is used as a screen grid amplifier the amplification constant is 300. When used as a space charge tube the constant is 60.

(3) Yes.

(4) Voltage amplification as high as 60 per stage can be obtained when the tube is used as a screen grid amplifier.

* * *

WHAT IS the principle of the photo-electric cell? In what respect does it differ from a thermionic tube, or ordinary vacuum tube?

(2) What function does the photo-electric cell play in television?

(3) Are photo-electric cells commercially available?

(4) Do photo-electric cells function in the same manner as selenium cells.

JUSTUS LUNDBECK,
St. Paul, Minn.

(1) The photo-electric cell is akin to the thermionic tube but the electrons are released from the cathode by the action of light instead of the action of heat. The number of electrons released in a photo-electric cell for any given color of light is proportional to the intensity of the illumination. Hence for a constant anode or plate voltage the current through the cell is proportional to the amount of light that enters the cell, provided the color composition of the light does not vary.

(2) The photo-electric cell serves the same purpose in television that the microphone serves in sound transmission.

(3) Yes, they are available in different sizes and types.

(4) The principles of operation of the photo-electric cell and the selenium cell are entirely different. In the photo-electric cell electrons are released from the cathode by the action of light. In the selenium cell the light varies the resistance of the selenium. The photo-electric responds to changes in light instantly. The selenium cell is sluggish in its action.

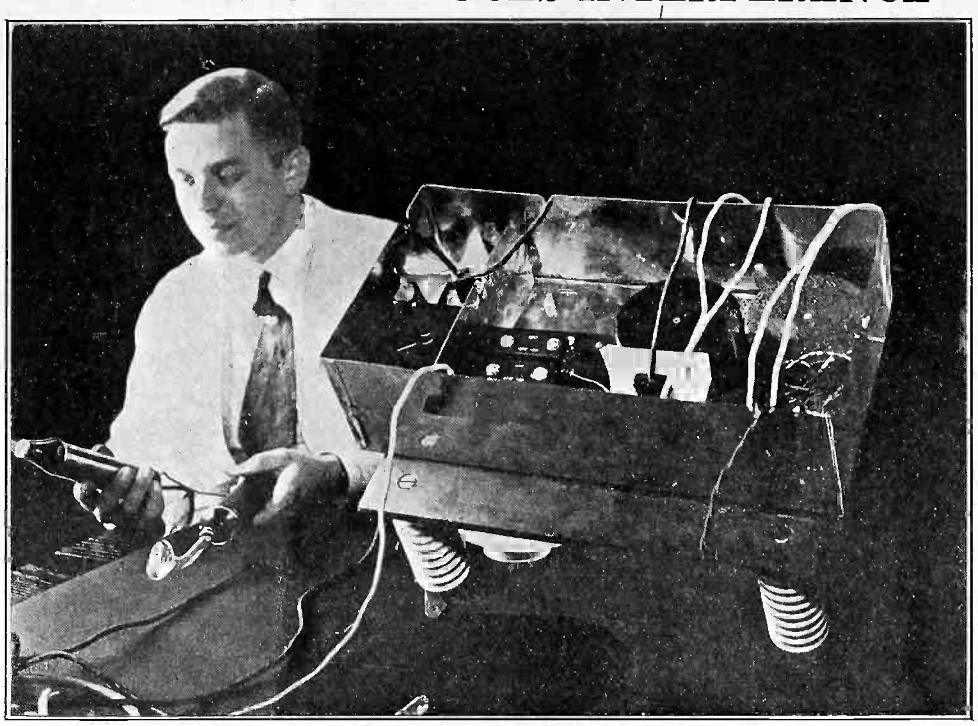
* * *

WHAT IS a baffle as used in a loud speaker? The term seems to be applied to everything connected with a loud speaker for which there is no other name.

OSSIAN SEMLOH,
Scranton, Pa.

(1) It seems so indeed. There are baffle boards and baffle boxes and baffle rings and just plain baffles. And often the purposes of all of them are baffling. A baffle ring is used to prevent the edges of a cone from rattling. A baffle board is used to bring out the low notes by aiding the vibrating surface to take hold of the air. A baffle box is likewise a low-note helper for small-sized diaphragms.

NEW DEVICE REDUCES INTERFERENCE



(Telna)

A VIENNESE ENGINEER HAS CONSTRUCTED A DEVICE THAT CONSIDERABLY REDUCES STATIC. HE IS GAZING AT IT IN RAPTURE

U. S. Seeks Set to Aid Forest Fire Fighting

Washington

Use of radio in the National Forests as a means of communication at time of forest fires is being tested by the Forest Service to determine whether low-powered radio waves will be affected by trees and rough topography, it was announced by the Department of Agriculture.

The full text of the statement follows:

The National Forests are to be tested for the use of radio communication in fire protection work. The advice of national authorities on radio and preliminary trials of radio apparatus disclose the fact that, while radio communication under ordinary conditions is fairly reliable, no one knows whether it can be made to work under National Forest conditions where low-powered radio waves will be affected by absorption by trees and the deflecting influence of rough topography.

The only way to find out is painstakingly to test the National Forests to see of they are adapted to radio. Radio apparatus must be tried under all kinds of conditions of topography, nearness to trees and density of timber in order to determine the conditions under which radio can be depended on and the limitations to its use in mountainous and timbered country.

Everyone familiar with forest fire-control work will appreciate the desirability of a radio set light enough to be carried on a man's back with his emergency rations, enabling a fireman when he reaches a fire to inform headquarters either that he does or does not need help.

Whether this extreme requirement for lightness can be met is uncertain. But it now appears reasonably sure that a low-power code-transmitting and voice-receiving set can be developed that will be light enough to be packed on a horse and sturdy and simple enough to be used in the thousands of trail-construction camps maintained on the National Forests during the fire season.

It is vital to keep these camps in communication in order that the trail makers may be summoned to help in fighting fires, but it is practically impossible to keep them all tied in with emergency lines to the existing system of telephone communication. Trial camps move frequently, and there are too many of them to permit of fully workable communication by ground wire.

Connecticut Dealers Form an Organization

Waterbury, Conn.

Fostered by officers and members of the Waterbury Radio Dealers' Association, the Connecticut Radio Dealers' Association was organized at a meeting of representatives of State dealers held in Waterbury.

Representatives of 140 dealers were present at the meeting, all of whom are members of city associations. Other city associations will be organized during the summer and fall, and all are expected to join this important state association. The first important convention of the state organization is to be held in Waterbury the early part of September.

Officers elected include president Homer Blair of Waterbury; vice-president, A. P. McCoy, of Hartford; treasurer, Sherman Whiting, of Bridgeport; secretary, E. J. Frey of Waterbury; executive committee, A. G. Brodrib, of New Haven; William More, of Meriden; Ted Lyford, of Torrington, and Fred E. Judd, of New Britain. Those who attended the session included Phillip Allen, Sherman Whiting, Frank Buckley, A. P. McCoy, D. R. Daniel, Gordon Brodrib, Arthur Geary, William Hennessey, William More, Lewis Reynolds and Ted Lyford.

RADIO KILLER OF INSECTS IS STOPPED

Washington

Successful experiments conducted in the extermination of insect pests infesting orchards, through the use of an electric high frequency machine, have been brought to a stop because of lack of a license to operate the machine, Commissioner Harold A. Lafount of the Federal Radio Commission was informed in a telegram from Herbert E. Smith, of Seattle, Washington.

Mr. Smith stated that the future use of the machine means a saving of millions of dollars to the country in the insect pest fight and that it would increase growers' profits through better crops.

The radio supervisor of Seattle, however, the message said, gave notice that operation of the machinery be stopped until a license is procured, and pending the determination of the status of the machine.

Favors Granting Request

Commissioner Lafount stated that he was favorable to granting the request but would have to receive the approval of a majority of the Commission.

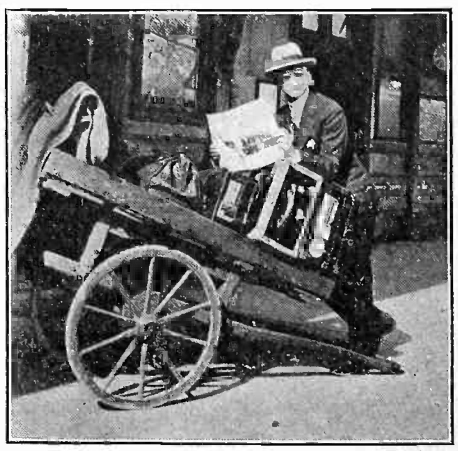
The full text of Mr. Smith's telegram follows:

"American Radex Corporation, located at Wenatchee and Cashmere, have been operating electric high frequency machine for treatment of orchards to kill insect pests and eliminate use of poison sprays. The operation is highly successful and should be continued until fruit is ripe. Future use will mean saving of millions to country in insect pest fight and increase growers' profits though better crops.

Identical to X-Ray

"The Radio supervisor of Seattle has notified the corporation to stop operation and advises that we ask for permit to operate pending determination of status of machine. It is identical to X-ray with addition of aerial wires over trees treated. Permission is requested to continue treatments early morning hours to 10 a.m. at half-hour intervals or as you may direct. Otherwise year's work and heavy expenditures will be lost. Treatment season ends August 30. Matter urgent as apple worm eggs hatch four to seven days. Operation has been discontinued five days and unless resumed proof of effect of process."

HIS STANDBY



ROBERT S. ALTER, OF CINCINNATI, OHIO, AN ARDENT RADIO ENTHUSIAST, WAITING FOR A TRAIN AT CULOZ, IN SOUTHERN FRANCE, READS RADIO WORLD.

Stations Off Wave Blame Piezo Crystals

Washington

Responsibility for failure of stations to keep within their frequency allocations, causing interference with the programs of other stations, was placed upon the radio manufacturing industry by witnesses appearing before the Federal Radio Commission.

Broadcasters appearing to show cause why their stations should be granted renewal of licenses and not be deleted from the lists of stations for alleged failure to serve the public interest, contended that manufacturers had sold them "defective" crystal controls that did not serve their intended purpose.

Declaring that many of the stations among the 164 cited for inefficient public service were so listed for failure to keep within frequency, the Chairman of the Commission, Ira A. Robinson, said that three of the stations shifted the responsibility to their crystal controls. These stations, he added, declared that they purchased their crystals from the Radio Corporation of America.

Can't Achieve Constant Accuracy

The manufacturers cannot be held entirely liable, however, it was explained, as an absolutely constant crystal never has been developed.

Chairman Robinson declared that if the manufacturers and not the broadcasters were to blame for off-frequency, the manufacturers should be called for hearing.

More objections to the general order of the Commission proposing to deny renewal of licenses to the 164 stations if they cannot prove their public interest were entered.

Opening the hearing before that part of the Commission taking testimony for stations in Zones 1 and 2, Former Representative Frank D. Scott, of Mich., presented the cause of WPCH, of Hoboken, N. J. He asked what the specific charges against the station were, and informed by Commissioner Caldwell, in charge of the First Zone, that they constituted alleged non-adherence to frequency, said that he would confine his arguments to that charge. Commissioner Caldwell stated that non-adherence to frequency had caused interference with reception of other stations, with the result that the public interest was not being served.

Twice Replaced Already

Witnesses appearing in behalf of WPCH were Ralph C. Powers, jr., radio engineer of the station; Captain Robert S. Wood, radio editor, New York "World"; Edgar H. Felix, technical engineer and an editor of "Radio Broadcast"; N. V. Pearce and Walter J. Neff, program directors, and M. K. Gillian, owner of the station.

Mr. Powers said that the "crystal control" purchased by the station to guide it in keeping on its frequency had been inaccurate, and caused the charges against the station. These inaccuracies, he said, have been for the most part corrected, since the defective crystal was replaced, but not entirely corrected.

Declaring that the crystal was purchased from the Radio Corporation of America, Mr. Powers testified that the crystal twice had been replaced but still did not keep the station as close to its assigned frequency as was necessary under the ruling of the Commission.

Not Slow to Call R. C. A.

Former Representative Scott stated, replying to Chairman Robinson, that at the present stage of radio transmission development it is "absolutely impossible for any station in the world to absolutely adhere to its frequency 24 hours every day." There always is a fluctuation, he said.

Observing that several stations already had complained that they received "defective instruments" and shifted the responsibility for "off-frequency" to the manufacturers, Chairman Robinson said that he was of the opinion that there should be more technical evidence on this point, to ascertain whether the stations or the manufacturers are responsible.

"Are these crystal controls inaccurate?" he asked.

"Yes, they are," Mr. Powers replied.

"We have no hesitancy in calling the Radio Corporation on this as quickly as any of the broadcasting stations," Chairman Robinson stated.

Victim of Circumstances

WPCH has high grade equipment and "is a victim of unfortunate circumstances" as far as variations of frequency are concerned, Mr. Felix testified. "No average broadcasting station can remain continuously within its frequency," he said. "Some of the outstanding stations of the country are ofttimes as many as 500 kilocycles off frequency," he stated.

"Shall we dismiss all charges as to off-frequency?" asked Chairman Robinson.

Mr. Felix said that 100 per cent frequency adherence cannot be had, but that it should be restrained to a minimum to eliminate interference and heterodyning.

Some Stations, Ordered Off, Face Probation

Washington.

The issuance of "probationary licenses" to some of the radio stations appealing for renewal of broadcasting authority to determine whether they are operating in the public interests, was suggested by Chairman Ira A. Robinson of the Federal Radio Commission.

Mr. Robinson's view was expressed in connection with the hearings being conducted by the Commission as the result of order citing 164 stations throughout the country for revocation of their license for failure to operate in the public interest, convenience and necessity.

The power to issue such "probationary licenses," Mr. Robinson explained, rests with the full membership of the Commission and the question will not be considered until after the hearings scheduled for more than 100 protesting stations have been concluded.

Lion's Share of Waves Proposed for Locals

Declaring that there is room on the air for all existing broadcasting stations and that chain stations are "permitted to use as many as twenty-five frequencies for the same program while an effort is being made to cancel the licenses of a large number of independent community stations," the Independent Broadcasters Association presented resolutions to the Federal Radio Commission demanding the immediate allotment of a "major portion" of the nation's radio facilities to independent community stations.

The resolutions stressed the importance of community stations as part of the educational and entertainment life of the nation.

"Lost and Found" Ads Broadcast by WGBS

What is believed to be the first regular broadcast of "Lost and Found" advertisements was inaugurated through Gimbel Brothers' station, WGBS, New York City. At 11:30 every day people who have lost articles of value may have descriptions of the missing objects read over the air. This series of broadcasts is planned to fill a want that has been manifested by numerous people going to the studio and asking for such a service.

JOHN B. DANIEL TO WED

Lieutenant William A. Cable, U. S. N., and Mrs. Cable of Washington, D. C., have announced the engagement of their daughter, Miss Bertha Palmer Cable, to John B. Daniel, senior announcer at WRC, Washington. The wedding will take place early in the Fall.

PAT KILEY IS MARRIED

Pat Kiley, was married recently. The popular representative of radio manufacturers became the husband of Myrtle L. Houtz, of New Bremen, Ohio. The couple live at 285 Palisade Avenue, Union City, N. J.

NEXT WEEK'S ISSUE

An article on screen grid detectors will be published in RADIO WORLD, issue dated Aug. 4th.

Microphone Proposal Unites Musical Pair

Mr. and Mrs. Howard Milholland returned recently from their honeymoon in the Northwest.

Only a few close friends knew that Milholland, studio manager of KGO, San Francisco, had proposed marriage to Eva Garcia, studio pianist, on Christmas Eve, as the pianist finished playing "Romance." The proposal was made before the microphone—but KGO had left the air about 10 seconds before.

It was not until the couple returned from their wedding trip that announcement of the marriage was made.

They met six years ago, when Miss Garcia appeared on the opening program of the General Electric station as a substitute, when the staff pianist became ill. Since that time she has appeared in countless KGO programs as soloist and accompanist.

History repeated itself when Milholland made his proposal after hearing Miss Garcia play "Romance." The pianist's mother won her father's love while playing love ballads on a guitar.

A THOUGHT FOR THE WEEK

RADIO is quite impartial in its attitude toward political candidates. So far as the microphone is concerned, a Republican is as good as a Democrat and vice versa. All "Mike" asks for is good diction, clarity and a certain well-defined resonance. As for principles on platforms—they mean nothing to "Mike." Elections may come and elections may go, but radio runs on forever.

RADIO WORLD

Trade Reg. U. S. Pat. Off.

The First and Only National Radio Weekly

Radio World's Slogan: "A radio set for every home."

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Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage; Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

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1 Page,	7¼"x11"	462 lines	$300.00
½ Page,	7¼"x5½"	231 lines	150.00
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⅛ Page,	4⅛" S. C.	57 lines	37.50
1 Column,	2¼"x11"	145 lines	100.00
1 Inch			10.00
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WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities, 10 cents per word. $1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Why You Got More DX Then Than You Get Now

By Hernstreet W. Foster

There is a decided trend toward fewer tubes in radio design. Fans have come to learn that performance cannot be measured by the number of tubes in a receiver but rather by the efficiency of each tube used. There are ten tube sets of one design that in selectivity, volume and range do not measure up with three tube sets of sensible design.

The reason for this situation is clear to those who understand tubes and circuits. The case is analogous to that of many men trying to move a heavy weight. They do not succeed because the men are in one another's way, preventing anyone from getting a good leverage on the weight. Two or three of the men can do the job easily.

In many multi-tube receivers some of the tubes simply undo what others do. One tube amplifies the signal to a certain level. The next de-amplifies by feeding energy back to the first in reverse phase.

Then there is the definite limitation of volume handling ability of each tube. A tube can handle a certain signal voltage. If a higher voltage is impressed no gain in the signal intensity is obtained for the overloaded tube cannot amplify.

Remarkable Results Then

When radio passed from the crystal stage to the tube stage remarkable results were obtained with a single regenerative tube. Transcontinental reception was recorded many times. And in those days there were no 5,000, 10,000 and 50,000 watt stations either. The maximum power used was 500 watts. Yet the one-tubers reached across the continent.

The reason for the present dearth of long distance records is not that the modern tubes are inferior. They are much better and more efficient than the tubes used seven years ago. The reason is not the lack of broadcast power, for that is from 10 to 50 times greater now than it was then, as the above figures show. The reason is not that the circuits and parts are inferior now than they were some years ago. They are better.

One reason may be that the power available per listener is smaller than it was, for now millions are listening where thousands listened before. Every listener takes a certain amount of the power and therefore the signal strength diminishes more rapidly with distance than it did formerly.

Aerials Not So Good Now

Another reason is that the antennas used now are perhaps not so good as they were. The main object now is to get local stations well, and that can be done with antennas which are not of the highest efficiency. Then the will to receive also enters as a factor.

Another factor is the required selectivity for receiving distant stations through the locals. The sets are so selective that it is difficult to solve the combination of dial settings which will bring in the distance station.

The performance of the one-tuber of seven years ago stands out in the memory of the pioneer listeners. That circuit was sensitive and it was largely responsible for the DX hunting epidemic that swept the country. And it was also responsible for the DX records made by many enthusiasts.

Regeneration Provided Kick

The most successful one-tuber was that which obtained its regeneration by means of a variometer in the plate circuit, or by a variable high inductance in that circuit. It had a remarkable kick.

A similar circuit is no less effective today. It will bring in the distant stations as well now as it did. It is particularly useful in country sections where an outdoor antenna can be erected, where super-selectivity is not required and where electric power is not available.

South Africa Grows Rather Cold to Jazz

Washington.

The growing popularity of radio broadcasting in South Africa, instead of adversely affecting the phonograph business, is giving it a marked impetus, according to a report by Assistant Trade Commissioner E. B. Lawson, Johannesburg, made public in a statement by the Department of Commerce. The full text of the statement follows:

The popularity of certain types of broadcasting programs, Lawson states, reflects to some extent the popularity of phonograph records. These programs contain frequent gramaphone recitals, which, aided by press publicity, have been very effective in promoting sales of records.

So-called "jazz" music, according to observers, is not as popular as heretofore. This is evident from the results of a gramaphone competition carried out in March by the Capetown broadcasting station. Thirteen hundred listeners-in participated in this competition carried out by that station. Seven records were played and listeners were asked to place them in their order of popularity. An analysis of the replies showed that in the five most popular selections not one "jazz" record was included.

Radio Increases Dictionary Demand

Radio sure has created a demand for new editions of all the dictionaries of any importance now on the market. Aviation, **with its many terms unfamiliar to the** man on the street, also helps to increase the demand. Then along comes television with terms already coined and the still larger number to come. **It looks like a busy immediate future for Mr. and Mrs. Webster and all the little Websters.**

Amperite Booklet Gives Circuit Data

The Radiall Company, 50-52 Franklin Street, New York, manufacturers of Amperite, has issued a booklet full of helpful information for the set builder and radio experimenter. It contains a list of filament current and voltage requirements for all standard receiving tubes together with correct amperite to use for each, and discusses voltage regulation for AC tubes.

The booklet also gives brief descriptions and complete lists of parts of many famous circuits such as One-Tube DX Reflex, A Two-Stage Audio Amplifier Unit, A Short-Wave Broadcast Receiver, The Browning-Drake Receiver, The Roberts All-Electric Receiver, The Shielded Grid Diamond of the Air, The Uncle Sam De Luxe Receiver, The Custom Built HI-Q Six, The Ultra-5 Receiver and the Victoreen Super-Heterodyne Receiver. Inquire of the company about a copy and mention RADIO WORLD.

SHORT WAVE ADAPTER

Next week's issue of RADIO WORLD will contain a resistance controlled short wave adapter.

The Radio Trade

Only A Trade Mark Figured in Suit

The decision of Assistant Commissioner Moore, of the Patent Office, on an application by the Sonatron Tube Company, of Chicago and New York, regarding a certain trade mark for "Sonatron," wherein one particular application was denied because of similarity to "Sonora," a mark used in another branch of the radio field, had nothing to do with the use of the name "Sonatron," but only with registration of a particular trade mark.

In the June 23 issue of RADIO WORLD was published a news article dealing with the Assistant Commissioner's decision, and quoting from his opinion. The article made it quite plain that only the trade mark was under discussion. The headline read "Sonora Stops Sonatron In Fight Over Name," and this was regarded as misleading, since it might be construed to refer to use of the name "Sonatron," instead of merely to use a certain style and design petitioned for registration as a trade mark in the Patent Office.

Therefore RADIO WORLD takes pleasure in emphasizing that only the trade mark was at stake.

The company manufactures a very popular line of radio tubes and has developed a tube for use in theatres and homes in the reproduction of talking movies. Also tubes for television transmission and reception are being worked out in the laboratories.

The talking movie project is sponsored by the Voice-A-Phone Company, of Philadelphia, for their Hanaphone. Sonatron announces the Philadelphia company has closed a contract whereby Sonatron is to furnish $500,000 worth of these special tubes in the next five years.

Crosley Gives Stock To Tried Employes

One hundred and sixty-one employes of the Crosley Radio corporation and the National Label company became stockholders in the radio corporation through the generosity of Powel Crosley, Jr., who presented them with shares from his own private holdings. Mr. Crosley is president of the radio corporation and owner of the other company.

To all who had been with his companies for three years or more, Mr. Crosley gave one share of stock for every year of their association with him. In making this gift, Mr. Crosley spoke of it as "a token of appreciation of co-operation in building the success of the business." Both factory and office employees received stock.

The 161 new shareholders do not include the employes who already had bought stock on the open market.

Henger-Seltzer Named Durham Representative

The Henger-Seltzer Company of Los Angeles and San Francisco has been appointed California representative of International Resistance Company.

Consigned stocks of material will be carried at both offices for prompt shipment to those dealers and jobbers who will stock the Durham products made by International of which Francis R. Ehle is president.

BISHOP SELLS MAJESTICS

W. H. Bishop, formerly sales manager of Blackman Distributing Co., is now connected with Grigsby-Grunow Co., manufacturers of Majestic radio sets, as special sales representative in the Metropolitan District. He will co-operate with Herbert E. Young, general sales manager, and work out of the office at 33 West 42nd street, New York City. Mr. Bishop had been associated with the Blackman Distributing Co. for seven years.

SPEAKER CONNECTIONS

In certain types of loudspeakers the steady plate current decreases the strength of the magnetic field. This reduces the sensitivity of the unit and may ruin it permanently. If the leads are reversed the opposite effect takes place. Use the connection which gives best results. Full-floating armature types may be connected either one way or the other, however.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

RADIO WORLD,
145 West 45th St., N. Y. City.

I desire to receive radio literature.

Name ....
Address ....
City or town ....
State ....

Frank Silchrist, 2010 N. 18th St., Philadelphia, Penna.
The Music Box, care of B. Bailey, 1107 Main Street, Goodland, Kans.
Tyler Elec. Co., 145 Ohlman Ave., Massillan, Ohio.
A. H. Willis, 156 Sycamore St., Huntington, W. Va.
George Saylor, care of Risbecks Garage, Donora, Pa. (Washington Co.).
F. M. Spencer, 160 E. 19th Terrace, Miami, Fla.
A. W. Kihhicutt, 209 W. 108th St., New York City.
Solomon Samuelowitz, 338 Powell St., Brooklyn, N. Y.
G. E. Hills, R. F. D. 3, Fort Edward, N. Y.
Frank Rielyway, 512 W. 6th St., Peru, Indiana.
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Sadick Hardware & Paint Co., 64-72 Millbury St., Worcester, Mass.
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C. S. Bovard, Tionesta, Pa.
Hill Beraden, Seneca, S. Carolina.
Asa Haig, Odon, Indiana.
H. C. Zellars, 10 College St., Newnan, Georgia.
Kobel Res. Studio, 251 Aughe St., Frankfort, Indiana.
M. Goldberger, 1641 Ocean Ave., Brooklyn, N. Y.
F. M. Bungay, 202 S. West St., Anaheim, Calif.
B. Cady, 115 East Albany St., Herkimer, N. Y.
Geo. N. Goodrich, 1701 Juliet St., St. Paul, Minnesota.
J. V. Payne, Box 2971, West Palm Beach, Florida.
F. Dunbuque, 19 Church Street, Oswego, N. Y.
Irving E. Horn, 1009 Washington St., Freeland, Pennsylvania.
Robert James, 3620 Central St., Kansas City, Mo.
James W. Berry, 217 Wilgus St., Proctorville, Ohio.
B. R. Kramer Radio Shop, 3818 Leslie Ave., Latonia, Ky.
E. J. Taylor, 639 Edinburgh St., San Francisco, Calif.
H. H. Nathanson, 1262 51st Street, Brooklyn, N. Y.
C. R. Cory, 78 Commercial Place, Norfolk, Va.
C. J. Wagner, 412 McDonough St., Sandusky, Ohio.
O. P. Boulard, 451 Viger Ave., Montreal, Quebec, Canada.
L. V. Singleton, 1216 Hinton St., Raleigh, N. C.
J. G. Miller, 352 Park Ave., Mishawaka, Indiana.
Major L. R. Elkins, Key West, Florida.
M. Schleicher, 11 Cottage Pl., White Plains, N. Y.
Geo. A Seward, Rossville, Georgia.
G. L. Elkins, 431 31st Street, Huntington, W. Virginia.
Chas. W. Thomas, 327 Washington Avenue, Albany, N. Y.
Frank Flandera, 4025 Muriel Avenue, Cleveland, Ohio.
N. E. G. Wadham, 112 Bay Street, Daytona Beach, Florida.
George B. Perrine, 549 Avenue E., Bayonne, N. J.
W. G. Sweske, Box No. 521, Hurley, New Mexico.
G. Shedd, 132 W. Albany St., Herkimer, N. Y.
H. Bernet, 8718 Ridge Boulevard, Brooklyn, N. Y.
P. Coken, 346 Varet St., Brooklyn, N. Y.
B. Reinitz, 18 East 23d St., Brooklyn, N. Y.

NEW CORPORATIONS

Swire Radio Stores, to make radio apparatus—Atty., D. Newman, 366 Broadway, New York, N. Y.

An All-Wave Mixer and Its Problems

(*Continued from page 8*)

henrys in series with the plate return. Open the junction of the B plus lead to L6, where it meets the lead from C2 and the screen grid, and connect the choke coil to the two open wire leads.

The circuit as shown has one slight drawback from a frequency viewpoint. The modulator circuit will not tune according to the charts furnished with commercial coils, because L4 is in series with L2, and L4 therefore acts as a loading coil, boosting the frequency. This increase is relatively the same for all frequencies tuned in with a given coil. Another point, which need not be considered a drawback, but which must be stated at least as a fact, is that the entire broadcast band will not be tuned in with the tuner and oscillator as shown, because only short wave condensers (.00014 mfd. each) are used. Not all commercially-made short-wave kits will bring you well up in the broadcast band, but as the primaries are a part of the coil form, the secondary and tertiary windings may be improvised, since wound wire of the same diameter is available, and the inductance may be obtained readily. Hence if you can't buy a coil to bring you to the top of the broadcast band you yourself can put together such a coil.

The circuit as shown was operated for ten days, and plenty of short wave stations were brought in, near and far, as well as all the broadcasting stations usually obtained on a sensitive receiver. The experimental intermediate frequency channel used is shown in the photograph, the diagram of the intermediate amplifier having been published in the July 14th issue.

—HERMAN BERNARD.

[*The author will be glad to answer questions concerning an all-wave mixer. Address him in care of* RADIO WORLD, 145 *West 45th Street, New York City. In subsequent issues, also, he will discuss the subject from new and absorbing angles.*]

NEW LINE OF PANELS

The Lignole Products Company, Chicago, is ready with an entire new line of beautiful Lignole panels for 1928. All the new colors and finishes are represented and plain and inlaid panels are in stock ready for the trade. Inlaid kit panels are ready for all standard circuits, and a line of drilled and lettered panels is also available for all popular circuits. The Lignole panel is used in the new Isotonic Screened Grid Receiver and phonograph amplifier. Full information on this new line and interesting information for jobbers in New York and New England may be had on application to Lignole Products Company, 377 Fourth Avenue, New York City. Mention RADIO WORLD.

Happiness Bluebird Visits Service Shop

Somebody took a Double Shield Portable into a service shop on Dey Street, New York City, saying it had worked but did not work now, and asking that it be fixed up promptly, as the owner was about to leave on his vacation.

The proprietor of the service shop consulted the diagram, as published in the June 30th and subsequent issues of RADIO WORLD, casually examined the set, but could not find anything wrong that fast, so telephoned to RADIO WORLD.

"I've got one of those Double Shield Portables down here for repair," he said. "It has all the specified Hammarlund parts and it's neatly wired. But 'she don't worka'. Is there any use of my spending any time trying to get that thing to work?"

There was a note of kidding in the speaker's voice, but in all seriousness the assurance was quickly given that not only does the set work on a loop, but it works mighty well.

Nine Places to Look

Thus encouraged, the repairman started to work. If all the specified parts were used and the connections wired properly, the places to look for trouble were first at the battery voltages and second at the tubes. As there are only five different battery voltages, including C battery, and as there are only four tubes, the trouble should be "shot" in nine places, although not at once, Heaven knows.

In quick time the trouble was located as follows: The voltage on the screen grid of one of the tubes (G post of socket) was a little too high, and oscillation control was improved by putting a Vac-Shield over the screen grid detector tube. This work done, the proud proprietor of the service shop telephoned again, saying, in a different tone: "I've had lots of four-tube portables in this place, for construction or repair—mostly for repair—but this one works louder on a loop than any of the others. In specializing on the Double Shield Portable for the rest of the season."

Still Time for Many

"That's fine!" was the congratulation shot back at him. Then a commercial impulse, although a friendly one, too, prompted this advice: "Better get the June 23d, 30th, July 7th, 14th and 21st issues of RADIO WORLD, so you'll get this portable down pat. And don't forget the official blueprint, showing the wiring life sized, from connection point to connection point."

"I can't forget them," he replied. "I have those copies and other issues right on my work bench all the time. Send the blueprint C. O. D."

So the bluebird of happiness flew into two places of the business that day.

Many still desire a portable for their vacation, as August is the most popular vacation month, and many wise ones like the mellow rural atmosphere of September.

Word of Advice

So to them a parting word of advice is: Become acquainted with the constructional details of this portable, for it is a really good one. Only one tuning control, a single Hammarlund .00035 mfd. condenser, tuning the loop. This radio frequency stage is coupled to the detector by a Hammarlund RF choke coil and leak-and-condenser combination. The first audio stage is resistance coupled, which is efficient here because the detector is a screen grid tube with a plate impedance of some 850,000 ohms, while the second stage is transformer coupled, both audio tubes being —99s. Few parts, easy construction, the entire receiver contained in a Hammarlund QS shield!

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

10 cents a word — 10 words minimum — Cash with Order

Index of Features

Published in Radio World, First Half of 1928

Jan. 7—Where Shield Grid Tube Gets Its Terrific Kick, by J. E. Anderson; An AC Operated Amplifier with 210 Push-Pull Output, by A. R. Wilson.

Jan. 14—Two Cents an Hour Runs This Set, by Capt. Peter V. O'Rourke, a description of a high quality five tube set.

Jan. 21—The Biasing Resistor Fallacy Exposed! by J. E. Anderson; How to Banish Buzzes, by Capt. Peter V. O'Rourke; Action of a Condenser Explained for Novices, by Brewster Lee.

Jan. 28—Home Television Demonstrated; Outline of Technique of Home Television Machine, by Dr. E. F. W. Alexanderson; The Impedance of Condensers Explained in a New Way for the Novice, by Brewster Lee; The Pre-Power Unit, by H. B. Herman; An AC Audio Amplifier for Phonograph and Set with B Supply, by Chester Charlton; Quality Factors in Resistance Coupled Audio Amplifiers, by Herman Bernard.

Feb. 4—The Tyrman 70 Super, by Brunsten Brunn; The New Twist That Made Television Spurt, by Neal Fitzalan; The Four-Tube Shielded Grid Diamond of the Air, by H. B. Herman; The Lynch Aero Five, by Percy S. Graffam.

Feb. 11—Still Photo Broadcast, by Neal Fitzalan; The Tyrman 70, Part II.; The Loftin-White Principle, by William Ingles; The Adams 1-2-3, by Dana Adams; An Exposition on Inductance for the Novice, by Brewster Lee; Four-Tube Screen Grid Diamond, Part II, by H. B. Herman.

Feb. 18—The AC Victoreen, by Capt. Peter V. O'Rourke; The First Presentation of a Space-Charge Detector, by H. B. Herman; Why the Even Harmonics Cancel in Push-Pull, Explained for the Novice, by Brewster Lee.

Feb. 25—The Laboratory Super with Screen Grid Tubes, by Ernest R. Pfaff; Television Between New York and London, by Neal Fitzalan; Rectifier Tubes in Parallel, by Ernes Van Imbrie; The AC Victoreen, Part III., by Capt. Peter V. O'Rourke.

March 3—Operation of —50 Type Power Tube, by Chisholm W. Parker; How to Add a Fifth Tube to the Shield Grid Diamond, by Keith Lauderdale; The Screen Grid Tube Analyzed for the Novice, by J. E. Anderson; The Laboratory Super, Part II, by Ernest R. Pfaff.

March 10—How By-Pass Condensers Help, by Herbert E. Hayden; How to Use Meters for Trouble-Shooting, by Jasper Jellicoe; Tuning Phenomena in a Super-Heterodyne, by J. E. Anderson; The AC Model of the Everyman Four, by Fred Ehlert; The Victoreen Power Supply, by Capt. Peter V. O'Rourke, Diamond with SG Tubes, by H. B. Herman.

March 17—Room for all Stations; A System for All Stations on One Wave, by J. E. Anderson; Converted Super, by Tim Turkey; List of Custom Set Builders, by Robert H. W. McCord.

March 24—The World's Record Super Ten, by Brewster Lee; The Lynch-Hammarlund Screen Grid Five, by Spaulding Forrest; AC Tube Problems, by R. H. Manson, of Stromberg-Carlson Co.; A Power Plant for AC Operation, by Percy S. Graffam.

March 31—The Karas Shrot Wave Receiver, by J. E. Anderson; The Supreme AC Six, by H. G. Cisin; Two AC Amplifiers for the Bib New —50 Tube.

April 7—Design Analysis of the Shield Grid Diamond, by H. B. Herman; The Karas Short Wave Receiver, Part II, by J. E. Anderson; Screen Grid Coil Design, by Hemstreet Hilles; A Good Mixer in the Aristocracy of Circuits; A Super for Your Auto, by Bramhall Torrence.

April 14—The National Screen Grid Five, by James Millen; Short Wave Efficiency, by J. E. Anderson; Hissing and Frying Strays, by James H. Carroll; Sources of Audio Frequency Suppression, by Ronald P. Dangerfield.

April 18—How to Make Single Control Work Well, by Herman Bernard; How Bias Voltages Are Obtained Through Resistors, by J. E. Anderson.

April 21—Correct Bias Makes AC Set Work Splendidly, by Capt. Peter V. O'Rourke; The National Screen Grid Five, Part II, by James Millen; A Power Amplifier for the New —50 Tube, by A. R. Wilson, of General Radio Co.; A Solution of Screen Grid Circuit Problems, by J. E. Anderson.

May 5—Hum Eradication, by Brunsten Brunn; Line Voltage Surges, by Dr. Alfred N. Goldsmith; AC Concertrola Construction, by Leo Fenway; Screen Grid Gain Insurance, by Dudley Drake; New Plan to Keep All Stations on Their Assigned Frequencies, by J. E. Anderson; A Realistic Push-Pull Power Amplifier, by P. W. Underwood.

May 12—The High Mu Tuner, by Herbert E. Hayden; How Phases Make or Break Audio Stability, by J. E. Anderson; Positive Bias for AC Detectors, by Humbolt Pratt.

May 19—The Hammarlund Short Wave Adapter, by J. E. Anderson; An Insight Into Magnetic Circuits, by Sebastian de Groot; How Phases Make or Break Audio Stability, Part II, by J. E. Anderson.

May 26—Phonograph Pick-ups, by Sebastian de Groot; Solutions of Single Control Tuning Problem, by Herbert E. Hayden; Pendulums and Phases, by Capt. Peter V. O'Rourke; Too Many Screen Grid Tubes Spoil the Set; by H. G. Cisin.

June 2—A Screen Grid Circuit for Short Waves, (the 'Round-the-World Four), by F. Edwin Schmitt; An Extra AF Stage, by Cromwell Parsons; An AC Harness for the Lynch-Aero 5, by Zeh Bouck.

June 9—Tim Turkey's 4-tube Set, by Tim Turkey; How Teelvision is Tuned In, by Neal Fitzalan; List of Short Wave Stations.

June 16—An AC One-Tube Adapter for Short Waves, by Herbert E Hayden; How to Connect Any Set's Output for Television Reception, by Neal Fitzalan; Automatic Television Synchronizing Apparatus, by Paul L. Clark; Carrier Has No Width, by J. E. Anderson; Meters That Measure Both AC and DC by Reginald Forrester; Electric Recording Effects Equalization, by Sebastian de Groot; A DC-AC Electric Set With Trickle Charger and New A-Filter, by N. C. Felish.

June 23—A Unique Portable—Only 20 Pounds Complete, Part I, by H. G. Cisin; Effects of Wave and Frequency Distortion on Television Reception, by J. E. Anderson; Walls of Audio Distortion Crumble Before Engineers' Long Siege, by Capt. Peter V. O'Rourke.

June 30—A DC Eliminator, by Herman Fuss; Regulation Distortion, by Dennis J. O'Flaherty; Requirements for Television Reception, by J. E. Anderson; Double Shield Portable, Part II, by H. G. Cisin; The Victoreen Audio Amplifier with AC Filament Supply, by Herman Bernard; The Advantages of a Separate C Battery Eliminator, by Herbert E. Hayden.

'Radio Will Elect Next President'—Aylesworth

Radio will elect the next President, M. H. Aylesworth, president of the National Broadcasting Company said in an address before the General Federation of Women's Clubs.

"In the forthcoming campaign, the influence of radio is going to be felt," Mr. Aylesworth said. "Indeed, the day of the fire-eating spellbinder has drawn to a close. This year's campaign orator will be appealing to an audience which, seated in the comfort of the home and far from the red fire and synthetic enthusiasm of the public gathering will be able carefully to weigh and maturely to judge his every statement.

"This is a condition devoutly to be wished, for loose words, high-sounding phrases and mere claptrap have dominated our political life too long. Radio is certain to introduce a sanity in our judgments which can but redound to the national welfare. Radio, in short, will elect our next President."

Speaking of the recent broadcasting of the Republican and the Democratic National Conventions, Mr. Aylesworth said that no expense was spared by the National Broadcasting Company in making the two events available to an unprecedented number of listeners.

Variable Resistors Diversify Meter

When the range of a voltmeter is not great enough to measure a voltage the range can be extended in a few moments by connecting a Clarostat in series with the voltmeter. By adjusting the setting of this Clarostat almost any desired voltage range may be obtained. Similarly it is true that if the milliampere range is not great enough to show the current in plate circuit of the power tube a Clarostat may be connected across the meter. If this cannot be turned down low enough to cut the current with a standard Clarostat, use one of about 50 ohms in the same manner.

If a Duplex Clarostat is used an extra voltage tap is available. Such a device is also useful in dividing the voltage across a resistor which has no tap. For example, suppose that a voltage of 22½ is desired when the lowest voltage provided for in the B battery eliminator is 45 volts. The Duplex Clarostat is connected in parallel with the resistor giving the 45 volt drop and then the two sides of the Duplex Clarostat are adjusted to the same value. The voltage drop between the midtap and the negative end is then 22½ volts.