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
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Radio Tells Interlude in His Television Talks, by Robert Le Ru, Feb. 3. 

Televisions make it possible to see the same picture that sends it, and as a result of this the chief difficulty in television transmission, that of adequate illumination, is obviated, since the only light intensity on the subject. Also, Television Across the Ocean Claimed by Baird Company. Feb. 4.

Television in Five Years, Not Now. Yes Trade, April 24.

A Scanner Designed by Dr. Alexander and Robert Fink, by Hector Well, Feb. 25. Designs illustrating the principles of transmission and reception of television.

1928

In the Race for Television, By F. W. Alexanderson, June 23.


Television Quits Dream Road for Real Bumps, Also.

The New Twint That Made Television Short, by Neal Hufnagel, an illustrated article comparing the Alexander system with the Baird and the new system of television. The author comments on the new system of television, and also on the advantages of the Alexander system, making up to 1,000,000 different pictures in one second.

New Television Advance Demonstrated. By Ant. Anderson, June 30. The author discusses the necessary conditions for retaining the high and the low frequencies in the side bands in present 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. Also, Automatic Television Image Synchronizing Apparatus, By Paul L. Clark. Richly illustrated article of a new system of automatically synchronizing a television receiver with the television transmitter, invented by the author. Also, Television Across the Ocean Claimed by Baird Company. Feb. 4.


How to Connect Any Set's Outlet for Television Reception. An article with circuit diagrams showing how to connect the television receiving tube to the outlet of any radio receiver. Also, Automatic Television Image Synchronizing Apparatus, By Paul L. Clark. Richly illustrated article of a new system of automatically synchronizing a television receiver with the transmitter, invented by the author. Also, Television Across the Ocean Claimed by Baird Company. Feb. 4.


SEND NO MONEY!
NEW SUPER-SENSITIVE PHOTO-ELECTRIC CELL PICKS UP

Television by Sunlight!

By J. E. Anderson
Technical Editor

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 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.

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

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 30 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...
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 disc may offer 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 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 was used. In place of a 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 of the large stopping condensers is 4 mfd. Also to insure that the grid leak is able to 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 permanency. 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 microscopic 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 filament, 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 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 could be telegraphed to.

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 duplication 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.

Outdoor Scene

Early Limitation Due to Need of Special Equipment Are Possible, Instead of Mere "Head and Shoulders"

50 Holes 1-16 inch Each in Diameter

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
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 repetitions per second.

The transmission is on the regular wave of WGY of 375.5 meters, or 790 kc. The signals are also transmitted on the 31.4 meter wave 2XA E at the same time.

Workmen Far Back Seen on Screen

The new television apparatus developed at the Bell Telephone Laboratories, 463 West 5th 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 this branch of telephony.

The engineers immediately connected with this new development would not predict any startling applications of the system but merely stated what can be done by television.

The improvements in television the engineers in Bell Telephone Laboratories have not stopped 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.

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 sensitivity and generate an electric current which after amplification may be transmitted either by wire or radio.

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

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 15/30, or .5 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 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 battery eliminator. A loudspeaker 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 adjustment. Let us trace the process.

Let us assume that the last tube is a 12AT8 with 125 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 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 50 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 be, 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 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 3½ volts 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 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
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 compensation is simply a special case of the analysis which determines the oscillation, regeneration or amplification suppression of a regenerative amplifier having a common impedance in the plate circuits. Analysis will show that when the coupling resistors R1, R2 and R3 are all lower than one ohm 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 grid of the second tube.

The bias may be reduced by several possible changes in the circuit. R1 may be decreased, R3 may be increased and B1 decreased. Or CB may be increased alone, which is probably the best. The adjustment should be made in such a way that the net negative bias on the grid of the second tube is about 1/2 volt.

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 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, which 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 C3.

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 plate 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.

The grid voltage which must be measured with a vacuum tube voltmeter because this depends on the drop in the coupling capacitance 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 of 100 microfarads, or rather a very large container. The use of this condenser is well worth while even when 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 work 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 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 detector.

Oscillator Never Selective

A great many squeals develop when the modulator oscillates uncontrollably, 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 consideration 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 20,000,000 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 tapped at one lug on the coil form, so that there are only five connecting points, although six coil ends, the method is used to the use of these coils by following the grid bias battery placement as diagrammed, and B 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 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 battery, which do not need to be adapted to 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. Incidentally, 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 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 control 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 65 to 125 milli-
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 PRIMARY COUPLING THAT CONSISTS OF A FORM OF GRID BIAS DETECTION, USING THE SCREEN GRID TUBE AS A SPACE CHARGE DETECTOR, BUT INSTEAD OF LEAKY CONDENSER RECTIFICATION GRID BIAS DETECTION IS ADOPTED. THIS IS OTHERWISE CALLED PLATE RECTIFICATION OR PLATE BEAN 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.

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 MORE WE LEARN ABOUT THE SCREEN GRID TUBE THE BETTER WE ARE TO USE IT AND, WHAT IS ALMOST AS IMPORTANT, TO USE IT AND, WHAT IS ALMOST AS IMPORTANT, TO USE IT.

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 0.0035 or 0.005 mfd. tuning condensers.
- **C3**: One 0.005 mfd. fixed condenser, mica dielectric (optional).
- **C4**: One 0.5 mfd. bypass condenser.
- **R1, R2**: Two 10-ohm resistors.
- **R3**: One 20-ohm resistor.
- **R4**: One 0.5 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 —).**

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 from (2) to (5). 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...
One Stage of Audio In Three-Tube

(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 set by the series resistance of two telegraph resistors, which are inserted in parallel with the filament 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 resistance 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 taping 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 that 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 will 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 3/4-inch diameter about four inches long. On this wind all the wires 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, (5) for screen grid and (9) for detector plate should point to the ceiling. The tickler coil need not be studied here, as care fully in this regard, as you need merely operate the set and determine whether the greater regeneration is afforded by tighter or looser coupling grid lower 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, 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 in higher, 22 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 10½ volts. 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 .05 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 audio frequency impedance in the plate circuit is 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 fall, 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 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 July 28, 1928

COIL DATA FOR THE ECONOMY THREE

For tuning with .0005 mfd. condensers 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 .0005 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.

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
Works a Speaker Economy Set

10 milliamperes, and this is no danger to No. 36 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, and the 45-amp. B post of the amplifier and the customary control grid of the detector. The 45 volts used were inefficient.

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 the 180-volt tap and inefficient output. Or, if you do not mind reducing somewhat the life of the 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 certain and the problem defined, hence work with 45 volts and 135 volts used as designed. Then the work of the output filter, which is the asset in the detector circuit. It is a common saying that grid bias detection is not nearly so sensitive as leaky-condenser detection.

Again the tube is the culprit. It would not be advisable to suggest grid bias detection using an 01A or a special detector tube. The screen grid has 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 5S, Cunningham CXC40 and R. C. A. UX720, 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 for. plate voltage is dropped in the plate resistor. The typical instance is that 180 volts at the source becomes 90 at the plate post, due to the drop. At .5 milliamperes plate current, the plate circuit resistance (counting the load resistor only) was therefore 180,000 ohms (90 divided by .005).

The Tube's the Thing

Because tubes had low mu, whereby the load impedance could not be successively 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 existing always of three audio stages, whereas now 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 common saying that grid bias detection is not nearly so sensitive as leaky-condenser detection.

Again the tube is the culprit. It would not be advisable to suggest grid bias detection using an 01A or a special detector tube. The 112A tube has 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 5S, Cunningham CXC40 and R. C. A. UX720, 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.

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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.

The Polymet Manufacturing Corporation, of 599 Broadway, New York City, announced the appointment of two more sales representatives for the entire Poly- met 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

This 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, Metalaks, Light Socket Aerial filter devices, will be sent on request. Mention Radio World when writing for a catalogue.

Sales Representatives Added by Polymet

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THE most fascinating study in radio, is that of the vacuum tube. It therefore 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. Though the amplitude decreases, the distance between the peaks of the wave train remains the same. It is therefore necessary, in bringing the radio signal 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 in the tube field followed by circuit refinement and power amplifier design to use the tubes to better advantage. Even the dynamic speaker is made possible by power tube improvement.

To visit 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, is one of the largest tube factories in the world, making every type of tube for radio use, is a revelation. Here, thousands of golds 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.

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 sets, many of us fell back on the WD-12, which could be heated with dry-cells working on 1.5 volts, although the ampere 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 aided auditors who were cautioned to step softly as to 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 experimenting, 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-vu and low-cut 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.

TUBES WITH CLAROSTAT-
LABORATORY, TESTING TUBES WITH CLAROSTATS

JOHN MUCHER, PRESIDENT, IN A SECTION OF THE CLAROSTAT-
CONTRIBUTING EDITOR, ASSOCIA-

JULY 28, 1928

The Regine

By James L. Bethune

CONTRIBUTING EDITOR; ASSOCIATE

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Front cover

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Front cover
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 CCo 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 poor grid 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 225 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 one 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, direct 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 of the wave or both sides. There are two filament types, differing in capacity, large and medium. The large capacity halfwave is the -81 type, filament voltage 7.5, filament amperage 1.25, maximum plate voltage, 750, maximum output, 110 milliwatts.

The medium capacity half-wave type is the -16B, filament voltage 7.5, filament amperage 1.25, plate voltage 550 and maximum output 65 milliwatts. The full-wave filament type is the -40 type, large capacity, filament voltage 5, filament amperage 2, plate voltage 300 and maximum output 125 milliwatts. The -13 type is medium capacity, the same filament requirements with plate voltage of 220 and maximum output of 65 milliwatts. These types of tubes as well 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.

Another peculiar 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 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 0.5 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 direct from the line. AC screen-grid tubes have appeared already, also AC line tubes, both made by the Radio Corporation of America.

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 being unable to rectify. 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.
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 values 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 stiffening 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. It is well 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 that the heater becomes balanced with respect to this point and the effect is similar to centering the grid return on the filament. It is much more effective if the grid return is the -26, although the effect is not so pronounced.

(3)—Is the 2½-volt winding on the transformer rated at 5/4 amperes or more to be able 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, 129 Clinton, 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 low 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.

(3)—If an intermediate frequency of 220 kc is used for the high frequency it will retain the two-spot feature for the high frequencies in the broadcast band.

(4)—Yes, there is no 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 receptacle 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, Mishawaka, Ind.

(1)—No, you cannot 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 type 30 tube for the detector, with a 250,000 ohm plate resistor.
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 800 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, assuming that the input voltage to the amplification stage is 221/2 volts.

(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 about 2 volts and the plate voltage 135 volts, the screen grid voltage 45 volts and the control grid voltage 1/2 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 voltage you will use.

(2) A transformer coupled stage would be increased, too.

(3) The source voltage to afford rectification with the plate voltage may be 135 or more, even up to 300 volts, but the bias must be increased too.

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

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 baffles and baffle boxes and baffle rings and just plain baffles. 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.

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And Get Free Question and Answer Service for One or Two years.

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Enclosed find $6.00 for RADIO WORLD for one year (52 nos.); or $12.00 two years (104 nos.) and also enter my name on the list of members of RADIO WORLD'S University Club, which gives me free information in your Radio University Department for the period of this subscription, and send me my secret number indicating membership.

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..Renewal ( ) Put cross here if you are renewing subscription.
NEW DEVICE REDUCES INTERFERENCE

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 means of communication at camps 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 shielded by absorption in the trees and the deflecting influence of rough topography.

The only way to find out is painstakingly to test the National Forests to see if 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.

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 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 the approval of a majority of the Commission.

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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 appeared to show cause why their stations should be granted renewed licenses and for the reasons stated, 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.

Opening 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 said, that they purchased their crystals from the Radio Corporation of America.

Can't Achieve Constant Accuracy

The manufacturers cannot be held entirely responsible in this matter, it was explained, as an absolutely constant crystal never has been developed.

Chairman Robinson declared that if the manufacturers could 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 stations if they cannot prove their public interest were entered.

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 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 numerous stations of other stations if result that the public interest was not being served.

Twice Replaced Already

Witnesses appearing in behalf of WPCH were Ralph C. Powers, i.e., radio engineer of the station; Captain Robert S. Wood, radio editor, New York Grand Central Station.

"World!"; Edgar H. Felix, technical engineer and an editor of "Radio Broadcast"; N. V. Pearce and Walter J. Neff, program directors, and M. G. Gillian, owner of the station.

Mr. Powers said that the "crystal control" purchased by the station to guide it in keeping within 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.

Dean stated 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 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 continuous within its frequency," he said. "Some of the outstanding stations of the country have been 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 here.

Microphone Proposal Unites Musical Pair

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

Only a few close friends knew that Milholland, studio manager of KGO, San Francisco, had proposed marriage to Eva Garcia, stage name of 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 announce-

ment 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.
Why You Got More DX Than You Get Now

By Hernest 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. The basic set of design that in selectivity, volume and range do not measure up with three tube sets of sensitive 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 wire-to-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. Some of the most sensitive receivers were recorded many times. And in those days there were no $5,000, 10,000 and 50,000-watt stations. The maximum power used was 500 watts. Yet the one-tubes reached across the continent.

The reason for the 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 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 there were hundreds listening. 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 an antenna which is not of the highest efficiency. Then the will to receive also enters as a factor.

A similar circuit 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.

Regeneration Provided Kick

The most successful one-tuber was that which obtained 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 as it did. It is particularly useful if there are no outdoor antennas can be erected, where super-selectivity is not required and where electric power is not available.

Amperite Booklet

Gives Circuit Data

The Radiall Company, 50-52 Franklin Street, New York, manufacturers of Amperites, 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 amperites to use for each, and discusses voltage regulation for AC tubes.

The booklet also gives brief descriptions and complete lists of parts for some 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 Built-in Q Six, The Ultra-S Receiver and the Victoria Super-Heterodyne Receiver.

Amperite Booklet

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," which was 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 mark.

In the June 23 issue of Radio World was published a news article dealing with the Assistant Commissioner's decision, and from his opinion. The article made it quite plain that only the trade mark was under discussion. The headline read "Sonoran 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 theaters 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 Employees

One hundred and sixty-one employees of the Crosley Radio corporation and the National Label company became stockholders in the radio corporation through the generosity of Powel Crosley, Jr., who bought stock on the open market.

The 161 new shareholders do not include those employees 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 in 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.

THE DIAMOND OF THE AIR

Using General Purpose Tubes

4 Tubes

Set uses three type A tubes and one 112 type. Any number published in 1928 available for a short while. Six issues 75 cts. 10 issues $1.00. Send stamps, coins or money order NOW, before the issues are sold. Radio World, 145 West 46th Street, New York City.

Guaranty Radio Goods Co.,
145 West 46th Street, New York City.
Please send me one new fly shielded 112 type: blue print or black.

☐ 5-tube Diamond of the Air
☐ 4-tube Diamond of the Air

(30 cts. each)

Address...
City...
State...

New Corporations


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 Sichisch, 200 N. 18th St., Philadelphia, Penn.
The Music Box, care of H. Bailey, 110 Main Street, Goodland, Kansas.
A. H. Willis, 156 Eycamore St, Huntington, W. Va.
F. M. Spencer, 716 S. 19th Terrace, Miami, Fla.
A. W. Kibbick, 209 W. 10th St., New York City.
Solomon Salsolowicz, 338 Powell St., Brooklyn, N. Y.
G. E. Hilla, E. F. D. Jr., Fort Edward, N. Y.
Frank Bidgeway, 512 W. 6th St., Peru, Indiana.
John C. Heberger, 371 Augustine St., Rochester, N. Y.
E. M. Williams, Oakalosa, Iowa.
A. J. Hack, 1000 Simpson St., Bronx, N. Y.
Sadick Hardware & Paint Co., 64-72 Millbury St., Boston, Mass.
John Ryan, 1144 State St., Watertown, N. Y.
Wells, 305 N. La Salle St., Indianapolis, Ind.
G. F. Conkey, 259 E. Town St., Columbus, Ohio.
Leon M. Peirce, LaFayette, R. I.
C. S. Boyd, Ticonesta, Pa.
Hill Beraden, Socoa, S. Carolina.
A. Hess, Odell, Indiana.
H. C. Zellias, 10 College St., Newman, Georgia.
Robinson M. Studio, 251 Anghe St., Frankfurt, Indiana.
M. Goldberger, 1504 Ocean Ave., Brooklyn, N. Y.
F. F. Varney, 212-23 quiz, Mt. St., Anchorage, Calif.
H. Cady, 415 East Albany St., Herkimer, N. Y.
G. T. Goodrich, 172 South Broad St., Peoria, Ill.
A. J. Payolle, Box 9771, West Palm Beach, Florida.
F. Dunbar, 19 Church Street, Oswego, N. Y.
J. J. Harned, 1009 Main St., Warren, Pennsylvania.
Robert James, 3620 Central St., Kansas City, Mo.
James W. Berry, 211 Wilmis St., Pottsville, Ohio.
B. E. Kramer Radio Shop, 3318 Leslie Ave., Lebanon, Ky.
E. J. Taylor, 839 Edithburg St., San Francisco, Calif.
H. H. Nathanson, 1231 3rd Street, Brooklyn, N. Y.
C. R. Cory, 78 Commercial Place, Norwalk, Conn.
C. J. Wagner, 412 Mcloughlin St., Sandusky, Ohio.
A. D. Boulard, 451 Viger Ave., Montreal, Quebec, Canada.
L. V. Singleton, 1216 Estton St., Raleigh, N. C.
G. Miller, 525 Park Ave., Mishawaka, Indiana.
M. J. R. E. Elkins, Key West, Florida.
M. Schleicher, 11 Cottage Pt., White Plains, N. Y.
J. D. Beaward, Roswell, Georgia.
Chas. W. Thomas, 327 Washington Avenue, Asheville, N. Y.
Frank Floridas, 2200 Muriel Avenue, Cleveland, Ohio.
N. E. G. Wadham, 112 Bay Street, Daytona Beach, Florida.
George B. Perrin, 540 Avenue E., Bayonne, N. J.
W. G. Swears, Box No. 52, Hurley, New Mexico.
G. Swafford, 123 W. Albany St., Rochester, N. Y.
H. Bernet, 8718 Ridge Boulevard, Brooklyn, N. Y.
P. Cohen, 364 Saret St., Brooklyn, N. Y.
B. Resnick, 18 East 2nd St., Brooklyn, N. Y.

NEW CORPORATIONS

An All-Wave Mixer

(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 consid-
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 July issues of RADIO WORLD, easily 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 a Double Shield. She doesn't work. Is there any use of my spending any time trying to get that thing to work?"

There was a note of pleading 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 mightily 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 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 season. But 'she don't worka'."

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 0055 mf., 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 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 739A. Few parts, easy construction, the entire receiver contained in a Hammarlund QS shield!

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Quick Action Classified Ads
Radio World's Speedy Medium for Enterprise and Sales

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

USED MOTORCYCLES. Low terms. Also Parts, Accessories Catalog Free. Western Motorcycle Co., 292 East 35th St., Kansas City, Mo.

EVEN Y FRIDAY at 5:40 P. M. (Eastern Daylight Time) Herman Bernard, managing editor of Radio World, broadcasts from WOR, the Great 1350, station in New York, discussing radio topics, mostly television.

BARGAINS—A. C. Filament Transformers, $4.00, Eiseman phones 280 ohms, $2.50, Apo Verzier Booth, 664 Broadway, 145 W. 45th St., N. Y. City; $2.50, many similar items.

BLUERSPRINTS of National Screen Grid, Five, 4-tube Screen Grid Diamond and Karas 3-tube Short Wave, three blueprints—one dollar, Guaranty Radio Goods Co., 145 W. 46th St., N. Y. C.

SCREEN GRID TUBES, famous standard manufacturers, no bootleg, $4.50 each. Special three circuit tuner, high primary impedance for screen grid tuned tube, $2.50. Antenna coil for screen grid circuits, adjustable, 0.50. Aluminum shield caps fit over entire screen grid tube, $1 each. C.O.D. only—Philip Cohen, 236 Varet Street, Brooklyn, N. Y.
Index of Features
Published in Radio World, First Half of 1928

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


Feb. 9—The AC Victorien, by Capt. Peter V. O'Rourke; The First Presentation of a Space-Charging Detector, by H. G. Ehlert; Why the Every-Harmonic Cancel in Power for the Novice, by Brewster Lee; Four-Tube Screen Grid Diamond with SG Tubes, by J. E. Anderson.

Feb. 16—The AC Victorien, by Capt. Peter V. O'Rourke; The AC Victory, by J. E. Anderson; An Exposition on Inducence for the Novice, by Brewster Lee; Four-Tube Screen Grid Diamond with SG Tubes, by J. E. Anderson.

Mar. 3—Operation of 30-Type Power Tube, by Luther E. D. Parker; How to Build a Screen Grid Tube to the Screen Grid Diamond, by Keith Lauderdale; The Screen Grid Diamond with SG Tubes, by J. E. Anderson; The Laboratory Super, Part II, by Dr. E. C. Stimson.


Mar. 17—Design Analysis of the Shield Grid Diamond, by H. B. Herman; The Karas Short Wave Receiver, Part II, by J. E. Anderson; Screen Grid Coll Design, by Hemstreet Hills; Good Mixer in the Circuit, A Super for Your Auto, by Bramhall, Torrence.

Mar. 31—The National Screen Grid Diamond, Part II, by James Millen; Short Wave Receiver, by J. E. Anderson; Rising and Flying Strays, by James E. Anderson; Sources of Audio Frequency Interference, by Ronald P. Dangsfelder.

April 3—How to Make a Control Work Well, by Herman Bernard; How Bias Voltages are Obtained Through a Transformer, by J. E. Anderson.

April 10—Correct Bias Makes AC Set Work splendidly, by Capt. Peter V. O'Rourke; The Karas Short Wave Receiver, Part I, by J. E. Anderson; The Karas Shrot Wave Receiver, Part II, by J. E. Anderson; The Karas Screen Grid Diamond by James Millen; A Power Amplifier for the New —30 Tube, by J. E. Anderson; A Super for Your Auto, by Bramhall, Torrence.

April 17—The National Screen Grid Diamond, Part II, by James Millen; Short Wave Receiver, by J. E. Anderson; Rising and Flying Strays, by James E. Anderson; Sources of Audio Frequency Interference, by Ronald P. Dangsfelder.

May 1—Bias Eradication, by Brunstein Brunn; Line Voltage Surge, by Dr. Alfred N. Goldsmith; AC-Converter for Radio Telephony, by Charles W. Halden; Screen Grid Diamond, by J. E. Anderson; A Power Amplifier for the New —30 Tube, by J. E. Anderson; A Super for Your Auto, by Bramhall, Torrence.

May 8—Improved Termination, by Herman Bernard; How Short Waves Make or Break Audio Stability, by J. E. Anderson; A Power Amplifier for the New —30 Tube, by J. E. Anderson; A Super for Your Auto, by Bramhall, Torrence.


May 22—Trouble Shooting by MSD, by J. E. Anderson; The National Screen Grid Diamond, Part III, by James Millen; Short Wave Receiver, by J. E. Anderson; Rising and Flying Strays, by James E. Anderson; Sources of Audio Frequency Interference, by Ronald P. Dangsfelder.

June 5—How to Make a Control Work Well, by Herman Bernard; How Bias Voltages are Obtained Through a Transformer, by J. E. Anderson.

June 12—Bias Eradication, by Brunstein Brunn; Line Voltage Surge, by Dr. Alfred N. Goldsmith; AC-Converter for Radio Telephony, by Charles W. Halden; Screen Grid Diamond, by J. E. Anderson; A Power Amplifier for the New —30 Tube, by J. E. Anderson; A Super for Your Auto, by Bramhall, Torrence.

June 19—Improved Termination, by Herman Bernard; How Short Waves Make or Break Audio Stability, by J. E. Anderson; A Power Amplifier for the New —30 Tube, by J. E. Anderson; A Super for Your Auto, by Bramhall, Torrence.


July 3—Trouble Shooting by MSD, by J. E. Anderson; The National Screen Grid Diamond, Part III, by James Millen; Short Wave Receiver, by J. E. Anderson; Rising and Flying Strays, by James E. Anderson; Sources of Audio Frequency Interference, by Ronald P. Dangsfelder.
'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 confines 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 wiring 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 not great enough to show the current in the 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 221/2 volts 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 221/2 volts.

On Every Parts List

AMPERITE
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A Strong, Rugged Loud Unit

That Drives Any Cone Speaker and Reproduces Fine Tone at Great Volume!

This unit has a full floating armature, which means that armature is mounted so that it acts like a plunger between two sets of magnets and pole pieces. As the magnetization of the armature is reversed under the influence of the signal it plunges first toward one pair of pole pieces and then toward the other.

The large field magnet used insures a strong and permanent polarizing flux, which protects against loss of sensitivity from self-demagnetization to which some loudspeaker units are subject.

The cone driving pin is directly coupled to the full floating armature at that point on the armature where the force is greatest. This insures against loss of power through complicated levers.

The sturdy construction and heavy weight of the assembled unit prevent motion of the armature in its case. The armature is adjustable from an exposed knob in the back.

Apex, chuck and thumbscrew supplied with each unit!

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12 VITAL TESTS
In Only 4½ Minutes!

The Handsome Outfit, Shown One-Half Scale

With this Scientific Trouble Shooting Combination AC and DC Tester (at left) and the high resistance voltmeter (at right) twelve vital tests were made of tubes and receivers, in 4½ minutes, because the combination can be used quickly for the following purposes:

(1) to measure the filament voltage, up to 10 volts, of AC and DC tubes.
(2) to measure the plate current of any one tube, including any power tube, from less than 1 milliampere up to 100 milliamperes.
(3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more). Open common A and B of set and connect to P of tester socket and to P prong under adapter plug;
(4) to measure the B voltage applied to the plate of tube, the voltage across B batteries or B eliminators, up to 300 volts.
(5) To determine the condition of a tube, by use of the grid bias switch.
(6) To measure any tube’s electronic emission (tester cuts in at no load, hence plate current equals filament emission).
(7) To regulate AC line, with the aid of a power rheostat, using a 27 tube as guide, turning rheostat until filament voltage is 2.5 or 2.25 volts.
(8) To test continuity of resistors, windings of chokes, transformers and circuits generally.
(9) To find shorts in bypass and other condensers, as well as in inductances, resistors and circuits generally.
(10) To read grid bias voltages, including those obtained through drops in resistors (bias read by noting plate current and voltage and consulting chart).
(11) to determine the presence of distortion and overloading, by noting if milliammeter needle fluctuates.
(12) to determine starting and stopping of oscillation, as milliammeter needle reads higher current for oscillation and lower for no oscillation.

GUARANTY RADIO GOODS CO.,
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Please send me at once, on a five-day money-back guaranty, one complete Two-in-One (AC and DC) scientific trouble-shooting test set, consisting of one No. 215 and one No. 346, for which I will pay the postman $13.50, plus a few cents extra for postage.

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(2) One DOUBLE range DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with shunt switch. This reads plate current, which is always DC in all sets.
(3) One 0-500 volt high resistance voltmeter, No. 346, with tipped 30° cord to measure B voltages.
(4) One 3-prong plug with 30-inch cord for AC detector tubes, etc., and one 5-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 3-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome noir metal case.
(10) One instruction sheet.

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(3) One 0-500 volt high resistance voltmeter, No. 346, with tipped 30° cord to measure B voltages.
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(6) One 3-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome noir metal case.
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If 0-500 volt meter No. 347 is desired instead of No. 346, price of combination
is $14.50.