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15
CENTS

TELEVISION CIRCUIT

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327th Consecutive Issue—Seventh Year

Regulation Distortion

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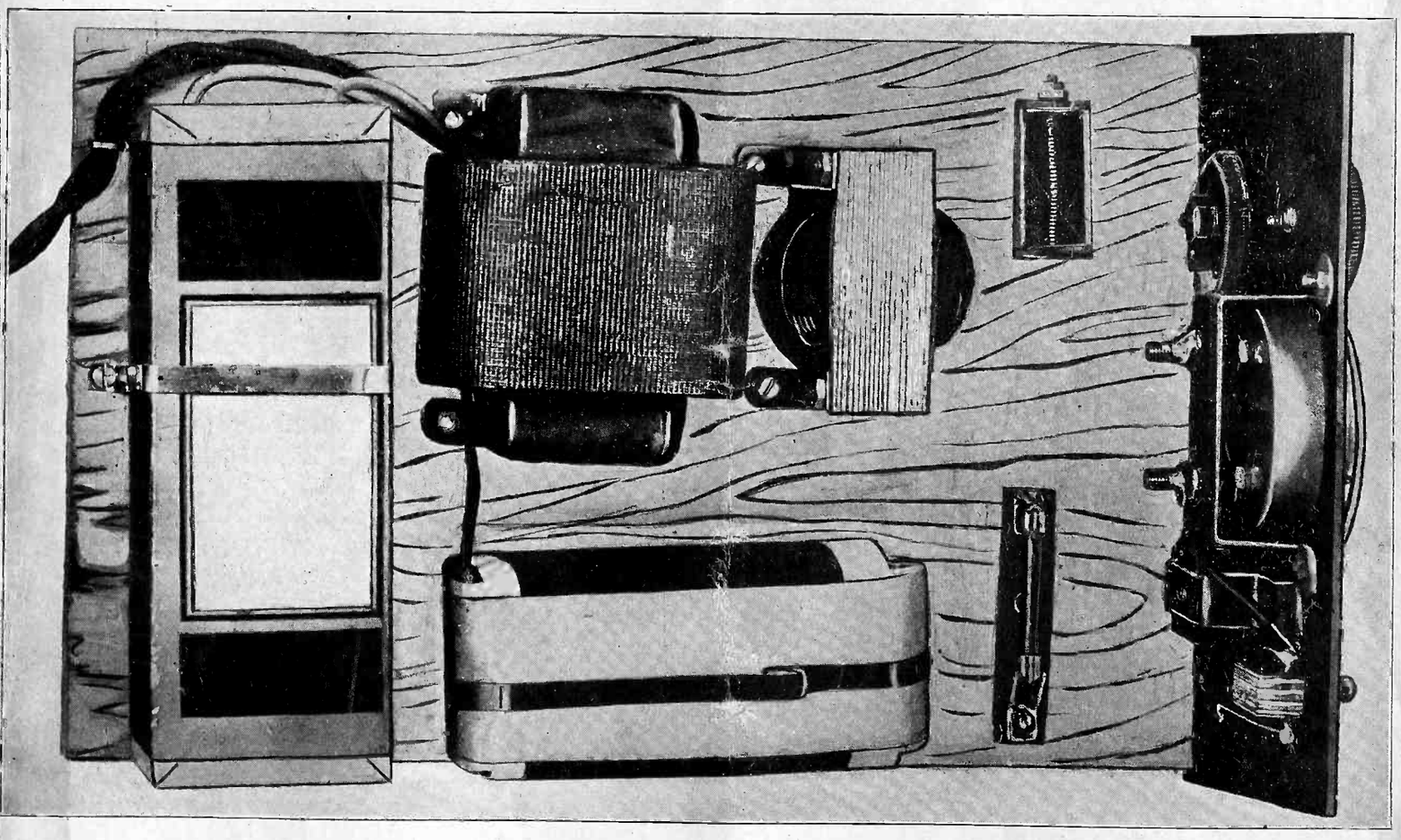
MIDGET PORTABLE

"A" AND "B" ELIMINATOR FOR DC



It is very easy to make a DC eliminator for supplying "A" and "B" voltages and currents. View of one is shown above. See page 3.

A "C" ELIMINATOR AND ITS IMPORTANCE

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Up-to-date Topics Masterfully Treated—See Which Ones You Must Become Fully Acquainted With to Round Out Your Radio Knowledge and Experience

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NOV. 12—The New Nine-in-Line Receiver, by John Murray Barron; Part II on how to construct the Electric Concertrola; Unbiased Facts About Underbiased Grids, by Roger C. Brooks; Data on Meters, by Frank De Rose.

NOV. 19—Part I on how to build the Improved Laboratory Model Super-Heterodyne (Silver-Marshall Jewelers Time Signal Amplifier), by E. R. Pfaff; Part III of a four-part article on the Electric Concertrola; New Model DC Set, by James H. Carroll.

NOV. 26—The Four Tube DX Fountain, by Herbert E. Hayden; concluding installment on the Fenway Concertrola; A Squealless 5-Tuber, by Joseph Bernsley; Secrets of DX in a Creative Receiver, by J. E. Anderson.

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DEC. 10—Seven-page article on the Magnaformer 9-8, the best presentation in the history of radio literature, by J. E. Anderson (this article complete in one issue); The Object of a Power Amplifier, by C. T. Burke, engineer, General Radio Co.; Constructional Data on the Everyman 4 (Part II); The 2-Tube Phonograph Amplifier, by James H. Carroll.

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DEC. 31—How DC Sets Are Converted to AC Operation, by W. G. Masson-Burbridge; Cures for Uncanny Noises, by J. E. Anderson; Part II of two-part article on the Victoreen with a Stage of Audio; Complete Driver for an AC Set, by Robert Frank Goodwin.

JAN. 7, 1928—The Shielded Grid Six, first national presentation of loop and antenna models of the new Silver-Marshall circuit, utilizing the new tubes of strong amplification, Part I, by McMurdo Silver; How to Build a Power Amplifier and 210 Push-Pull Unit, by A. R. Wilson, of General Radio Co.

JAN. 14—Assembly and Wiring of Shielded Grid Six, Part II, by McMurdo Silver; Meter Range Extensions, by Bramhall Torrence; Uses of B Batteries and Power Devices, by E. E. Horine, National Carbon Co.; A 5-Tube Set Costing but 2 Cents an Hour to Run, by Capt. Peter V O'Rourke.

JAN. 21—Bias Resistor Fallacy Exposed, by J. E. Anderson; The Shielded Grid Six, Part III (conclusion); How the "Victory Hour," Reaching 30,000,000, Was Broadcast, by Herman Bernard.

JAN. 28—How to Build the AC Five, a Batteryless Receiver, by H. H. Chisholm; Technique of Home Television Machine, by Dr. E. F. W. Alexanderson; A Quality Analysis of Resistance Coupling, with Trouble Shooting, by Herman Bernard.

FEB. 4—Tyrman "70" with Shielded Grid Tubes (Part I of four-part article), by Brunsten Brunn; The Four-Tube Shielded Grid Diamond, by H. B. Herman; Television's Stride, by Neal Fitzalan, Radio Vision Editor.

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A DC Eliminator

Voltages and Currents Supplied for A and B Power —Simple, Effective Device Solves Problem

By Herman Fuss

IN the congested sections of many large cities where power distribution distances are short, direct current is used. Such current always presents difficulties when radio receivers are to be electrified. B battery eliminators usually are not designed for this service and they cannot be used. The use of step-up or step-down transformers is not possible.

But there is a constant demand for A and B battery eliminators for this service.

We shall describe such an eliminator, beginning at the convenience outlet.

A plug and a cord are provided for insertion in the socket. In each lead of this cord a fuse F of suitable size is inserted, not only for protecting the radio installation against accidental short circuit but also for protecting the general house fuse from annoying and untimely blowouts. These fuses are placed on the control panel of the A and B battery eliminator where they can be reached for replacement without opening the instrument. They may be 1 to 3 amperes.

In the positive side of the line an "On-Off" toggle switch S1 is placed. This controls the power supply as far as the receiver is concerned. An extra switch, to open the filament circuit, is optional, and purely decorative, to balance the panel.

Filament and Plate Supplies in Parallel

At the "On-Off" switch the circuit divides into two parallel circuits, one for the plate supply and the other for the filament supply.

We shall first follow the plate supply. There is a 2 mfd. by-pass condenser C1 across the line. Then there is a 30 henry choke coil L1 in series. This is followed by a 4 mfd. by pass condenser C2 across the line. When the supply voltage is taken from a DC source one section of the filter is usually sufficient, because the current is partly filtered at the source.

The highest voltage obtainable from this B battery eliminator will depend on the voltage at the source, the resistance in the choke coil L1 and on the plate current that is taken. The drop in the coil will average 10 volts, so that if the supply voltage is 115 volts, as is usually the case, the net voltage for the receiver will be 105 volts. This is used for both the power amplifier and the RF stages. This is used for both the power amplifier and the RF stages. Hence two binding posts, B plus Amp. and B plus RF, are provided at the point of highest available filtered voltage.

Voltage Lowered for Detector

Ordinarily the voltage required on the plate of the detector does not exceed 45 volts. To get this effective voltage for the detector, a 50,000 ohm resistor R2 is connected between the high voltage point and the B plus Det. binding post. This does not need to be variable since the detector voltage is not critical.

In order to obtain additional filtering on the detector, a 4 mfd. by-pass condenser C3 is connected between the B plus Det. and minus A. This condenser would not be necessary in a non-regenerative circuit but since many receivers are regenerative at some frequencies, either by design or by accident, the condenser is included. It will help greatly in taking out the last trace of hum on the low waves where regeneration is most likely to occur.

This concludes the B battery eliminator part of the circuit. It is very simple. The A battery eliminator part is no more complex, and we now take that up.

The A Battery Eliminator

To the receiver side of S1 is connected a plug-in socket marked R1. At this point is inserted a suitable heavy-duty resistor which will carry all the filament current required for the set and at the same drop the voltage down to the required 5 volts.

The filament current first encounters the dry electrolytic condenser C4, which takes out practically all the hum in the current. This condenser can withstand a peak voltage of 18 volts, which is more than three times the requirements.

The filament current also passes through the choke coil L2, which is a low inductance coil with a current carrying capacity of 2 amperes. This coil is a part of a filament current ripple filter.

Relay Switch Used

RL, which is also in series with the filament line, is the magnetizing coil of a relay. This relay automatically connects the electrolytic condenser across the line as soon as the line switch S1 is closed and disconnects it when the line switch is opened. Thus the condenser C4 is connected only when the set is in operation. S2 is part of the relay.

Since the value of R1 will not be just right to give the proper filament terminal voltage in all cases, a shunt rheostat R3 is connected in parallel with the filaments. As this is adjusted the current flowing through R1 changes and hence the voltage drop in it changes.

The setting of R3 is adjusted until the voltage indicated by the voltmeter V is 5 volts. The maximum value of R3 is 20 ohms.

Choice of R1

The value of R1 can be determined only when the number of tubes used and the current required are known. Suppose the set contains five .25 ampere tubes and no other current drawing devices. The total current then is 1.25 amperes. The line voltage may be assumed to be 115 volts. It is therefore necessary to drop 110 volts in R1. Hence the value of R1 must be 88 ohms when R3 is open.

A 90 ohm resistor having the necessary current carrying capacity is available. This will admit just a little less than the required 1.25 ampere when R3 is open

(*Continued on next page*)

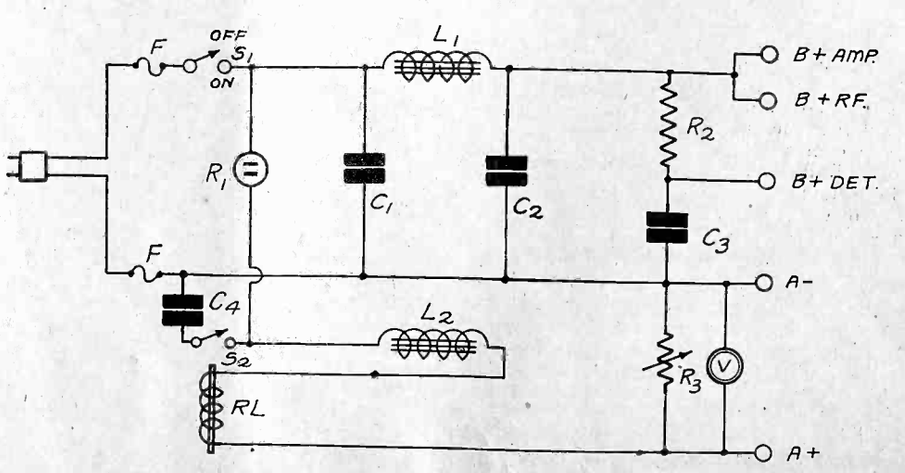


FIG. 1

COMPLETE CIRCUIT DIAGRAM OF THE VERSATILE A AND B BATTERY DC ELIMINATOR

Eliminator for DC Also Shows A Voltage

(*Continued from preceding page*)

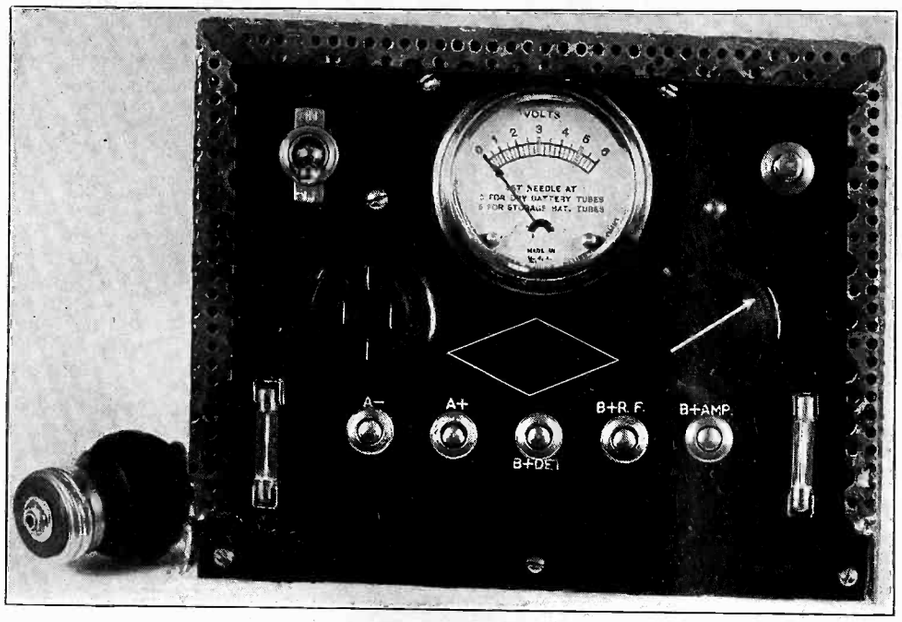


FIG. 2

VIEW OF THE PANEL. THE SWITCH AT RIGHT UPPER IS ORNAMENTAL, TO BALANCE UP THE LAYOUT. IT NEED NOT BE USED, OR IF INCLUDED, NEED NOT BE CONNECTED ANYWHERE

and when the line voltage is 115 volts. If the line voltage is 117.5 volts the current will be just right. The voltage often has that value.

Now suppose the set requires only 1 ampere and the 90 ohm resistor is used. Again suppose that the line voltage is 115 volts. It is necessary to drop 110 volts in R1. How much of R3 should be used to cause a drop of five volts across it?

The total current must be 11/9 amperes. The set takes 1 ampere. Therefore the current through the rheostat is 2/9 ampere. Hence 5 volts equals 2/9 times R3, or 22½ ohms of the rheostat must be used. If only three tubes are used only 10.6 ohms should be used.

If more than 5 tubes are used a lower resistance than 90 ohms must be used for R1. The drop in R1 should always be as near as possible to the line voltage less 5 volts. Hence to determine R1 the formula (V-5)/I may be used, in which V is the line voltage and I is the current drawn by the tubes in the set and the rheostat R3. When obtaining supplies always state the total filament current or the total number and types of tubes used.

LIST OF PARTS

F, F—Two fuses, automobile type, 1 to 3 amperes.
S1—One toggle switch.
S2, RL—One relay type switch.
L1—One 30-henry choke coil.
L2—One 2-ampere choke coil.
C1—One 2-mfd. condenser.
C2, C3—Two 4-mfd. by-pass condensers.
C4—One dry electrolytic condenser.
R1—One 90-ohm heavy duty resistor.
R2—One 50,000-ohm resistor with mounting clips.
R3—One 20-ohm rheostat.
V—One 0-6 DC voltmeter.
Seven binding posts.
One standard universal plug-in socket.
One six foot cord with plug.
One 1 foot cord with plug.
One 5¾ x 7 x 1/8 inch panel.
One 7 x 11 inch baseboard.
One double compartment perforated metal container with carrying handle.

Precautions Necessary

When using this A and B battery eliminator care should be taken that no tube is taken out of a socket without first turning off the power at S1, and that the power be not turned on unless all the tubes are in the sockets.

It is also well to remember that damage may be caused to the voltmeter if all the tubes are taken out and the power is turned on. If all the tubes are out and the rheostat R3 is open, the voltage across the meter will be almost the whole line voltage. That is, the meter may be overloaded in the ratio of 10 to 1. If there is a filament switch in the set this should never be opened while the power is on at S1.

Panel Arrangement

The panel contains the line switch S1, the rheostat knob R3, the two fuses FF, the filament voltmeter V, all the binding posts and the socket for R1. All the rest of the parts are mounted on a 7 x 10 inch wood baseboard and inclosed in a perforated metal container.

The resistance to be inserted in socket R1 is contained in a separate perforated metal compartment mounted on top of the rest and connected with the socket by means of a short well insulated cord provided with a plug.

R1 is held in the middle of its compartment, which is thoroughly ventilated by the perforations on all sides. Thus the heat generated in the resistor is carried away by the draft set up.

Size of Fuses

The size of the fuses should be determined by the current which the eliminator is to deliver.

It is well to use fuses having a current capacity of twice the current needed by the set. Thus if about 1 ampere is drawn the fuses should be able to carry up to 2 amperes. At all times the fuses used should be smaller than the house fuses otherwise they would serve no purpose.

C bias should be supplied by batteries, as the full voltage is better used for the receiver filaments and plates, rather than parting with any of this for the grid bias.

Microphone Reveals Artists' Distraction

"A true and sincere interpretation of a dramatic role is essential if a broadcast drama is to hold its audience," said Emma Dunn, actress, who now devotes part of her time to radio drama. She recently has spoken in "Biblical Dramas" broadcast over stations associated with the National Broadcasting Company.

"An actor may fool an audience, but he won't fool the microphone," Miss Dunn said. "The 'mike' has an uncanny ability to detect the true feelings of the speaker, no matter what are the lines he is speaking. Radio registers the thought behind the tone so accurately that it is impossible to cheat in a single instance, no matter how beautiful the voice.

Must Be Sincere

"An artist, speaking into the microphone, cannot see his audience and has no way of telling whether he is 'going over.' There is only one thing for him to do—that is to play the part with every bit of sincerity and fervor that he has within him.

"If he is a sincere actor, then he need not worry. If he is playing a happy-go-lucky juvenile role and at the same time is worried about some personal problem, the 'mike' and the loudspeaker will reveal the fear that is in him. If he allows his thoughts to wander, then the mind of the listener, too, will wander.

"For instance, during a radio rehearsal, I was sitting in the adjoining control room listening to a young actor I knew speak his lines. I heard them as they came from the reproducer.

Hunger for Food, Not Love

"He was rehearsing a beautiful love scene, but I found it difficult to keep my mind on what he was saying.

"After the rehearsal I asked him what he had been thinking about while speaking his lines. He said, 'I came down this morning without breakfast and I am terribly hungry.' Though he had been saying one thing, he had been thinking of something else.

"Because of this peculiarity of radio reproduced tone, people are noticing vocal sounds that are objectionable, but that have heretofore gone unnoticed. Radio is doing more to teach us the true value of tone than anything that has come into human experience."

Miss Dunn recently wrote a series of articles for a national publication on "Thorough Quality in Voice." The article was very interesting.

Regulation Distortion

By Dennis J. O'Flaherty

POOR regulation of B battery substitutes may be a source of distortion of the signal. In fact, it is largely because of poor regulation that many B battery eliminators have failed to give satisfactory service.

What is meant by regulation? It means the variation of the voltage across the output terminals with variations in the current drawn from the device. As the current drawn increases the voltage across the terminals decreases. This is due to the voltage drop in the rectifier tube, power transformers and choke coils. If the voltage decrease is slow as the current increases, the regulation is good. If the voltage decrease is rapid, the regulation is poor.

Examples of Regulation

As an illustration of the voltage drop with current increase we may take a full wave rectifier of the —80 type in a typical circuit, including the filter. The root mean square, or effective voltage per anode of the tube was 220 volts. This would mean a peak voltage of 311 volts per anode.

The voltage across the output terminals of the B eliminator when no appreciable current was flowing was found to be 300 volts. When the current flow was 20 milliamperes the voltage had dropped to 230 volts. At 40 milliamperes the voltage was 204 volts. At 80 milliamperes the voltage was down to 166 volts.

Fair Regulation

While this regulation is by no means good, it is far better than that on many eliminators now in use. It may be considered fair regulation.

It is of interest to observe that the regulation for small changes in current improves as the current increases. For very small currents the regulation is very poor, as the drop in voltage is very rapid. As the current increases the regulation curve flattens out. It is for this reason that the resistance of the voltage divider is chosen so that the current drawn from the rectifier is greater than that required by the set.

Poor regulation means that the impedance, particularly the DC resistance, of the B battery substitute is very high. When a device with poor regulation is used to power an amplifier all the troubles caused by the common impedance assume serious proportions. Blasting occurs on certain notes, suppression of the amplification on other notes, and at some frequency there may be howling or oscillation.

Not one receiver, no matter what the type may be, is immune to this trouble. It is most severe in resistance coupled amplifiers and it is serious on all good quality circuits. It is present in poor quality receivers too but a little more or less distortion in these makes little difference. It is only when actual oscillation sets in that it becomes troublesome.

Perfect Regulation

The only plate voltage supply in which the regulation approaches the ideal is a storage B battery. The internal resistance of such a battery is negligibly small and the change in output voltage with current drain is almost immeasurable.

The distortion caused by the common impedance of a poor regulation device is not the only type of distortion resulting from it. One is due to the low effective voltage applied to the amplifier tubes. If the tubes are supposed to operate on an effective plate voltage of 180 volts and the voltage drops to half that value due to poor regulation serious overloading will occur in the amplifier and the quality of the output will be extremely poor.

"Tail-Effect" Distortion

There is another form of distortion which has been called the "Tail-Effect." This occurs mainly on low notes. A sound of low pitch of given intensity has a much greater amplitude than a note of higher frequency and the same intensity. That means that when a low note is sounded the input voltage swing on the tubes is very large.

As the grid voltage swings widely so does the plate current. If the plate current does not swing in proportion to the grid swing the signal will be distorted. The correct proportion will obtain if the plate voltage on the tube remains constant. But if the tube is served by a battery substitute with poor regulation the plate voltage will not be constant.

Amplification Reduced

When the grid goes more negative the plate current decreases and the voltage on the plate increases. As the grid goes less negative the plate current increases and the voltage drops. The result of this is to decrease the effective amplification. The amplitude of the output will not be so great as it would be for the same input if the regulation of the voltage supply were perfect.

This effect is greater the lower the frequency and therefore poor regulation causes frequency distortion. In a typical case the amplification in a power tube was decreased from 2 to 1.7 times, a reduction of 15 per cent.

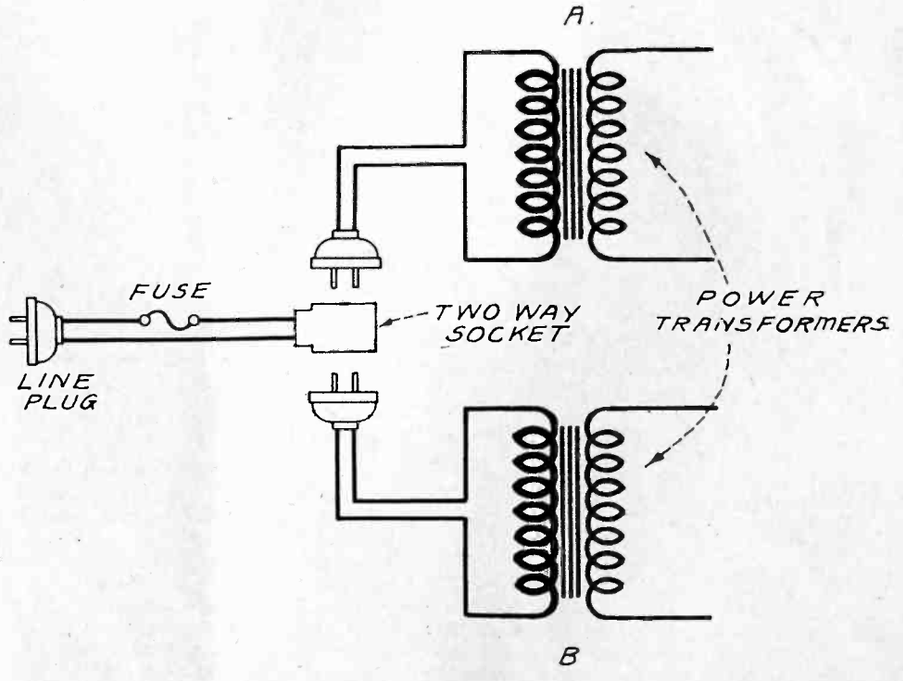
Greatly Exaggerated

But the "Tail-Effect" is not as serious a distorting influence as has been claimed. Arguments have been put forward tending to prove that the distortion is of the first order of magnitude. The above example which showed only a distortion of 15 per cent on the low notes was an extreme case. That is it was for DC or very slow swings, at which by-pass condensers had no effect.

But the by-pass condensers play an important role even at the lowest audible frequencies. When the grid goes less negative the extra current required is not drawn from the line but from the charge stored on the condensers. Also when the grid goes more negative the lowered current demand does not mean that less current is drawn from the rectifier. It means that the condensers have an opportunity to charge up again. Thus when large condensers are present poor regulation does not play an important role at all. The condensers and the chokes in the filter help to keep the current steady, and thus the voltage, no matter whether the fluctuations occur in the supply or in the demand.

The "tail-effect" is not a serious cause for distortion if a good filter with large condensers is used. The effect of the common impedance, which may be high in a device with poor regulation, is a greater source of distortion and poor results. So is the reduction in the steady output voltage. The common impedance causes frequency distortion. The reduction in the steady voltage causes wave form distortion.

WHERE TO PUT THE VITAL FUSE



WHEN A RADIO RECEIVER IS WHOLLY OR PARTIALLY OPERATED FROM SOCKET POWER A ONE AMPERE FUSE SHOULD BE PUT IN THE SUPPLY LINE TO PROTECT THE INSTALLATION AGAINST SHORTS AND OVERLOADS

Requirements for

By J. E

Technical

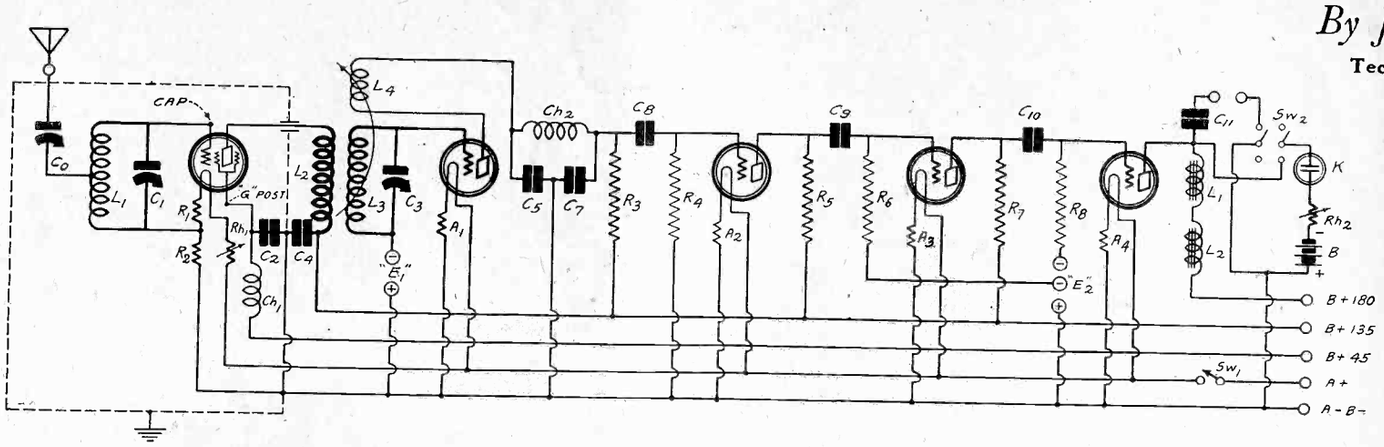


FIG. 1

THE CIRCUIT DIAGRAM OF A RECEIVER SUITABLE FOR TELEVISION RECEPTION. IT IS DESIGNED FOR SENSITIVITY AND HIGH SIDEBAND FREQUENCY REPRODUCTION

RADIO fans are flocking to television in great numbers everywhere. And if they continue the way they are now flocking there will be a mighty wave of reaction which will kill popular interest for a long time. The reason for this is that the fans are misled.

Many of those who are selling so-called television equipment do not have any idea of the requirements, and they care less so long as they can dispose of a lot of trash in the name of television.

If the experimenters who would go into television do not stop, think and study they will have nothing to show for their expenditure of time and money but a collection of useless parts.

Best is Imperfect Yet

The television fan will do well to realize at the outset that the best available in television at this time is far from perfect. The best they can hope for is ghostlike, shadowy suggestions of a face, a hand, a profile.

Much of the apparent life in the received images is due to imperfections in the technique rather than to the actual motion of the object transmitted!

Another important fact to remember is that there are now several systems of television, or rather variations of the same system, which are used in broadcasting. All employ the revolving scanning disc, but all do not employ the same number of scanning lines nor the same scanning speed. One variation uses 24 scanning holes in the disc, another 36 holes and still another 48 holes. One scans at the rate of 18 per second, another at 10 and another at 22½.

A disc having 48 scanning holes cannot be used interchangeably with one having 24 holes or 36 holes. But fans are told that it can be done by only changing the speed of the motor driving the disc. For example, they are told that a scanning disc having 48 holes can be used to receive signals with a disc having 24 holes by simply driving the 48-hole disc at half speed.

Few Public Demonstrations

There have been very few public demonstrations of television reception. The one outstanding demonstration was that given by the Bell Laboratories before the Institute of Radio Engineers. But this system is not used in broadcasting and it is not available to the radio fans. A receiver of this kind would cost $5,000 or more.

Another demonstration was that given by the General Electric Co. in Schenectady, N. Y. The system used in this demonstration is the basis of television broadcasting at this time. A receiver would cost about $100.

Both of these demonstrations were essentially laboratory affairs conducted under ideal conditions and by the men who had developed the systems used.

Many claims of television reception have been made by various experimenters. But none of the claimants has been willing to demonstrate. Always excuses have been given for not demonstrating when requests have been made.

Proper Receiver Prerequisite

Many experimenters who understand the requirements of television reception have tried to receive without success and they have said so frankly. If experimenters who understand the problem cannot receive with the equipment now available, what chance have those who do not know what the scanning is for, nor why it is necessary to synchronize, nor what synchronism means?

The first requirement for receiving television from any station sending out image modulated signals is a receiver which will bring in the signals. A radio receiver which will not receive WGY, for example, in the evening is useless for attempting to receive the television signals sent out in the middle of the day. The receiver used must be able to bring in that station with loudspeaker volume in full daylight.

The receiver used must not be too selective. If it is, the high frequency modulation which the picture contains cannot be received. This rules out nearly all broadcast receivers, for most of them are too selective for television if they are selective enough to be satisfactory for sound reception without crosstalk from other stations.

Requirements of Receiver Discussed

The audio frequency amplifier used in the television receiver also must be able to amplify the high frequencies as well as the low. There are very few broadcast receivers which satisfy this requirement. Even the very best receivers for sound reception may be entirely inadequate for television reception.

This does not mean that the average broadcast receiver cannot be used to bring in television in some form. It means that it cannot be used to bring in as clear an image as is possible with a receiver specially designed for television.

We shall discuss the requirements of the receiver by referring to a specific diagram, Fig. 1.

Sensitivity is the first necessary condition. This may be obtained partly by using a screen grid tube for the radio frequency amplifier. To make this tube deliver the highest practical voltage step-up it should be placed inside a metal shield together with all the parts which pertain to the first stage.

The antenna is coupled directly to the first tuned circuit through a variable condenser Co. Its value would depend on the length of antenna that is used as well as on the frequency of the carrier of the signal desired. No definite value can be given, but it is not critical if a long antenna is used. A condenser having a maximum capacity of .00025 mfd. should meet most conditions.

Rheostat Volume Control

The volume control is a 20-ohm rheostat Rhl in the positive leg of the filament of the screen grid tube. This should be used as much as possible. The tickler is the second volume control which should be used if the volume is not great enough when all of the rheostat is cut out. The volume may also be adjusted with the variable condenser in the antenna circuit.

The three-circuit tuner L2L3L4 may be one of any good make provided that the primary L2 is wound to a screen grid tube. If it is not, the number of turns on it should be increased so that it is about ¾ as many as on L3 the secondary.

The tuning condensers C1 and C3 should have a capacity of .0005 mfd. each and the coils should be chosen for this capacity.

Grid Bias Detection

Aside from keeping the selectivity of the circuit moderately high, the first step taken to retain the high sideband frequencies is the use of bias detection in place of the usual grid leak and condenser method. The grid bias method detects without frequency discrimination. The other and more usual method suppresses the high frequencies. The grid bias is obtained with a battery "E", which may be combined with the battery used for the power tube.

It is customary to put a radio frequency choke coil of 85 mh in the plate circuit of the detector to prevent the transmission of radio frequencies to the audio circuit. But the coil also suppresses the high sideband frequencies. To prevent this suppression a different arrangement

Television Reception

Anderson

Editor

is necessary. A low pass filter consisting of a 5 millihenry choke coil Ch2 and two .00025 mfd. condensers C5 and C7 is used. This combination has a very sharp cut-off, preventing any of the radio frequency currents from passing to the audio amplifier without suppressing any of the essential high audio and super-audio frequencies.

Choice of Plate Resistors

It is well known that if the plate resistors in a resistance coupled amplifier are high, the high frequencies are suppressed by the resulting high effective input capacities of the tubes. Hence when it is necessary to amplify high frequencies as well as low, the plate resistors cannot be very high. They should not exceed 100,000 ohms. Lower values may be used for a slight relative increase in the amplification of the high frequencies, but when lower values are used the overall amplification drops and the circuit becomes insensitive. Therefore 100,000 ohm resistors are recommended.

In the output circuit two audio choke coils L1 and L2 are used. There are two objects for employing two. One is to provide a high choking effect at low frequencies and the other is to reduce the distributed capacity of the windings so that the choking effect will be high for high frequencies also.

As a further aid in preventing the high frequencies from by-passing through the distributed capacity of the windings a radio frequency choke coil may be connected in series with the two audio chokes.

Low Note Effectiveness

It will be worth while to summarize the steps taken to insure that the high side-band frequencies be transmitted to the Kino-lamp. They are a moderate selectivity grid bias detection, a sharp cut-off low pass filter in the plate circuit of the detector, moderate values of plate circuit resistors and reduction of the effect of the distributed capacity in the windings in the output choke coils.

If the amplifier is to be used for loudspeaker reception as well as for image reception the low notes must be amplified as well as the high. The conditions necessary in a resistance coupled circuit for low frequency amplification are high value grid leaks, large stopping condensers in the grid leads, a high value inductance in the output circuit, and a large condenser in series with the loudspeaker.

The value of each grid leak may be 1 megohm or more. If motor-boating is encountered lower values may have to be used in order to stop it, but it must be remembered that it is stopped only by lowering the amplification of the low notes.

The larger the stopping condensers are, the better the low notes will be brought out. But there are two factors which tend to limit the size. One is the leakage through a large condenser and the other is motorboating. A good compromise value is .01 mfd. Condensers of this size may be had with mica dielectric, and these have practically no leakage.

Loudspeaker or Kino-lamp

Provision has already been made for a high output choke. L1 and L2 may each have a value of 30 henrys. If a radio frequency choke is used in addition, it may have a value of 250 millihenrys.

LIST OF PARTS

Co—One .00025 mfd. variable condenser.
C1, C3—Two .0005 mfd. variable condensers.
C2, C4, C8, C9, C10—Five .01 mfd. condensers.
C5, C7—Two .00025 mfd. fixed condensers.
C11—One 4 mfd. condenser.
L1—One tuning coil for .0005 mfd. condenser with antenna tap.
L2, L3, L4—One three circuit tuner for .0005 mfd. condenser and screen grid tube.
Ch1—One 85 millihenry RF choke coil.
Ch2—One 5 millihenry RF choke coil.
L1, L2—Two 30 henry audio frequency chokes, and one (optional) 250 millihenry RF choke.
Rh1—One 20-ohm rheostat.
Rh2—One 2,000-ohm variable resistor.
R1, R2—One 20-ohm mid-tapped resistor.
R3, R5, R7—Three .1 megohm plate resistors.
R4, R6, R8—Three .1 megohm grid leaks.
Sw1—One filament switch.
Sw2—One double pole, double throw switch.
A1, A2, A3, A4—Four No. 1A amperites.
K—One Kino-lamp.
"E1"—One adjustable grid bias batery, about 4½ volts.
"E2"—One tapped grid bias battery, not less than 40½ volts.
Six standard X type sockets.
One shield for screen grid tube and associated parts.
Eight binding posts.
One scanning disc.
One universal motor.

The condenser C11 in series with the speaker should not be less than 4 mfd.

It is well to design the output of the circuit so that either the loudspeaker or the Kino-lamp can be switched in. This may be done with the aid of a double pole double throw switch SW2 as shown in the drawing. Such a switch is obtainable in cam type (like a jack with a knob on it).

If a receiver having the characteristics of that shown in Fig. 1 is already available it may be changed for television reception by making the necessary changes in the plate circuit of the last tube. A 250 millihenry radio frequency choke should be added in series with the output choke, the switch Sw2 should be installed and the Kino-lamp circuit connected as shown.

Connection of Kino-lamp

The Kino-lamp K is connected in series with a 2,000 ohm variable resistance Rh2 and a 67½ volt battery, B. The object of the resistance is to limit the current through the Kino-lamp and so protect the lamp. The purpose of the battery is to boost the voltage already available until the total voltage in series with lamp is above that necessary to start a glow.

The starting voltage in this case is 180 volts plus the 67½ volts, or a total voltage of 247½ volts. This is higher than the necessary ionization voltage. Note that the positive terminals of the 67½ volt battery are connected to the negative of the B battery. This polarity is necessary of the two voltages are to add.

R1 and R2 are two sections of a screen grid ballast resistor having a total of 20 ohms, the tap being in the middle. C2 and C4 are by-pass condensers of .01 mfd. capacity used for preventing the radio frequency currents from wandering into the power source. The choke coil Ch1 serves the same purpose. Its inductance should be 85 millihenrys.

A1, A2, A3 and A4 are amperites suitable for the tubes used. Sw1 is the filament switch placed in the positive leg of the filament circuit.

The voltage on the screen grid should be 45. That on the plate of the detector and on the first two audio tubes should be 135 volts. The volts on the plate of the last tube should be 180 volts.

The grid bias for the screen grid tube is derived from the drop in R1. The voltage on the grid of the detector must be found by experiment. It depends on the effective plate voltage on the tube and on the tube used. It should be varied between zero and 6 volts negative for a mu 30 tube, which is recommended. The optimum value will probably be near 4 volts.

The bias for the first AF tube is derived from the drop in the amperite A2. A higher bias is needed for the next tube and therefore the grid return is connected to a suitable point on the bias battery "E2" for the power tube. The correct bias is about 3 volts, although 1½ may be found sufficient. The bias for the second audio tube may be obtained also from the battery "E1", or both these batteries may be combined into one, as previously stated.

The bias on the power tube should be 40 volts.

Television Equipment

The parts specially needed for television are a Kino-lamp K, a scanning disc having the appropriate number of holes, a universal motor for driving the disc and a suitable speed controller for the motor.

The Kino-lamp, a Raytheon product, is available in radio stores. It has two square plates 1½ inches on the side placed inside an evacuated glass envelope about the size of a 300-mil. rectifier tube. The small neon lamps for sale in stores on credulous Cortland Street are wholly unsuitable for television, and it is a fraud for the stores to advertise these small neon lamps as "television" bulbs.

The scanning disc should be an exact replica of the scanning disc used at the transmitter. If it is not exactly the same size as the transmitting disc all its dimensions should have been increased or decreased in proportion.

The universal motor need not be larger than 1/20 horsepower. Many household appliances contain motors which are just right for driving the television disc. Such motors salvaged from worn-out electrical appliances can be had often for a few dollars.

The speed controller may either be a tangential brake on the motor shaft or a rheostat in the line feeding the motor. The rheostat is perhaps the simpler as well as the more satisfactory method. To provide for vernier control one 30-ohm rheostat may be connected in series with a 2 ohm rheostat. The 30-ohm instrument is then used for coarse adjustment of the speed and the 2-ohm for fine adjustment.

Requirements for

By J. E
Technical

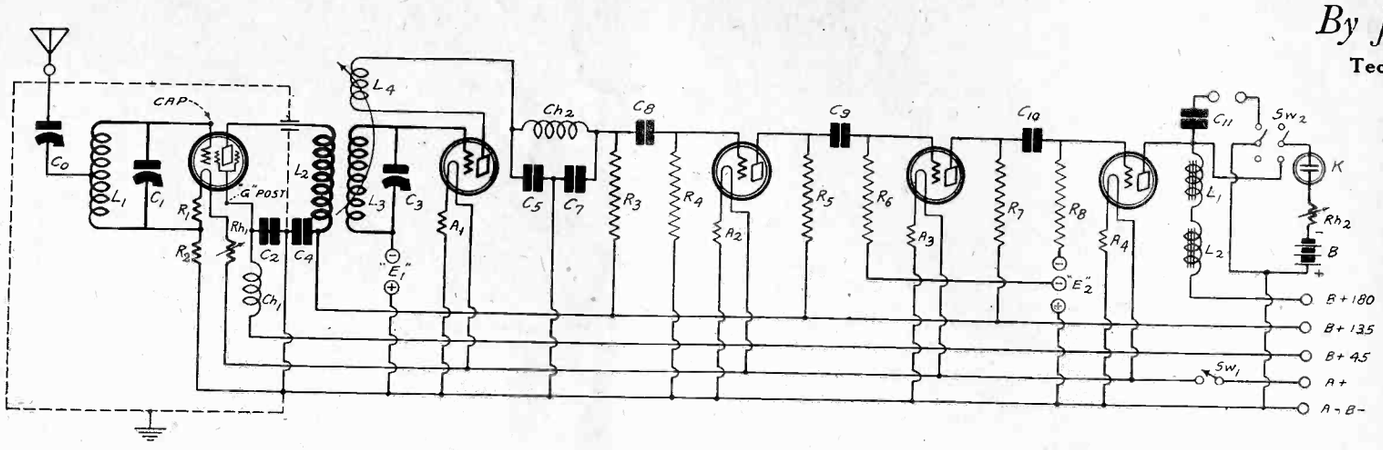


FIG. 1

THE CIRCUIT DIAGRAM OF A RECEIVER SUITABLE FOR TELEVISION RECEPTION. IT IS DESIGNED FOR SENSITIVITY AND HIGH SIDEBAND FREQUENCY REPRODUCTION

RADIO fans are flocking to television in great numbers everywhere. And if they continue the way they are now flocking there will be a mighty wave of reaction which will kill popular interest for a long time. The reason for this is that the fans are misled.

Many of those who are selling so-called television equipment do not have any idea of the requirements, and they care less so long as they can dispose of a lot of trash in the name of television.

If the experimenters who would go into television do not stop, think and study they will have nothing to show for their expenditure of time and money but a collection of useless parts.

Best is Imperfect Yet

The television fan will do well to realize at the outset that the best available in television at this time is far from perfect. The best they can hope for is ghostlike, shadowy suggestions of a face, a hand, a profile.

Much of the apparent life in the received images is due to imperfections in the technique rather than to the actual motion of the object transmitted!

Another important fact to remember is that there are now several systems of television, or rather variations of the same system, which are used in broadcasting. All employ the revolving scanning disc, but all do not employ the same number of scanning lines nor the same scanning speed. One variation uses 24 scanning holes in the disc, another 36 holes and still another 48 holes. One scans at the rate of 18 per second, another at 10 and another at 22½.

A disc having 48 scanning holes cannot be used interchangeably with one having 24 holes or 36 holes. But fans are told that it can be done by only changing the speed of the motor driving the disc. For example, they are told that a scanning disc having 48 holes can be used to receive signals with a disc having 24 holes by simply driving the 48-hole disc at half speed.

Few Public Demonstrations

There have been very few public demonstrations of television reception. The one outstanding demonstration was that given by the Bell Laboratories before the Institute of Radio Engineers. But this system is not used in broadcasting and it is not available to the radio fans. A receiver of this kind would cost $5,000 or more.

Another demonstration was that given by the General Electric Co. in Schenectady, N. Y. The system used in this demonstration is the basis of television broadcasting at this time. A receiver would cost about $100.

Both of these demonstrations were essentially laboratory affairs conducted under ideal conditions and by the men who had developed the systems used.

Many claims of television reception have been made by various experimenters. But none of the claimants has been willing to demonstrate. Always excuses have been given for not demonstrating when requests have been made.

Proper Receiver Prerequisite

Many experimenters who understand the requirements of television reception have tried to receive without success and they have said so frankly. If experimenters who understand the problem cannot receive with the equipment now available, what chance have those who do not know what the scanning is for, nor why it is necessary to synchronize, nor what synchronism means?

The first requirement for receiving television from any station sending out image modulated signals is a receiver which will bring in the signals. A radio receiver which will not receive WGY, for example, in the evening is useless for attempting to receive the television signals sent out in the middle of the day. The receiver used must be able to bring in that station with loudspeaker volume in full daylight.

The receiver used must not be too selective. If it is, the high frequency modulation which the picture contains cannot be received. This rules out nearly all broadcast receivers, for most of them are too selective for television if they are selective enough to be satisfactory for sound reception without crosstalk from other stations.

Requirements of Receiver Discussed

The audio frequency amplifier used in the television receiver also must be able to amplify the high frequencies as well as the low. There are very few broadcast receivers which satisfy this requirement. Even the very best receivers for sound reception may be entirely inadequate for television reception.

This does not mean that the average broadcast receiver cannot be used to bring in television in some form. It means that it cannot be used to bring in as clear an image as is possible with a receiver specially designed for television.

We shall discuss the requirements of the receiver by referring to a specific diagram, Fig. 1.

Sensitivity is the first necessary condition. This may be obtained partly by using a screen grid tube for the radio frequency amplifier. To make this tube deliver the highest practical voltage step-up it should be placed inside a metal shield together with all the parts which pertain to the first stage.

The antenna is coupled directly to the first tuned circuit through a variable condenser Co. Its value would depend on the length of antenna that is used as well as on the frequency of the carrier of the signal desired. No definite value can be given, but it is not critical if a long antenna is used. A condenser having a maximum capacity of .00025 mfd. should meet most conditions.

Rheostat Volume Control

The volume control is a 20-ohm rheostat Rhl in the positive leg of the filament of the screen grid tube. This should be used as much as possible. The tickler is the second volume control which should be used if the volume is not great enough when all of the rheostat is cut out. The volume may also be adjusted with the variable condenser in the antenna circuit.

The three-circuit tuner L2L3L4 may be one of any good make provided that the primary L2 is wound to a screen grid tube. If it is not, the number of turns on it should be increased so that it is about ¾ as many as on L3 the secondary.

The tuning condensers C1 and C3 should have a capacity of .0005 mfd. each and the coils should be chosen for this capacity.

Grid Bias Detection

Aside from keeping the selectivity of the circuit moderately high, the first step taken to retain the high sideband frequencies is the use of bias detection in place of the usual grid leak and condenser method. The grid bias method detects without frequency discrimination. The other and more usual method suppresses the high frequencies. The grid bias is obtained with a battery "E", which may be combined with the battery used for the power tube.

It is customary to put a radio frequency choke coil of 85 mh in the plate circuit of the detector to prevent the transmission of radio frequencies to the audio circuit. But the coil also suppresses the high sideband frequencies. To prevent this suppression a different arrangement

Television Reception

Anderson

Editor

is necessary. A low pass filter consisting of a 5 millihenry choke coil Ch2 and two .00025 mfd. condensers C5 and C7 is used. This combination has a very sharp cut-off, preventing any of the radio frequency currents from passing to the audio amplifier without suppressing any of the essential high audio and super-audio frequencies.

Choice of Plate Resistors

It is well known that if the plate resistors in a resistance coupled amplifier are high, the high frequencies are suppressed by the resulting high effective input capacities of the tubes. Hence when it is necessary to amplify high frequencies as well as low, the plate resistors cannot be very high. They should not exceed 100,000 ohms. Lower values may be used for a slight relative increase in the amplification of the high frequencies, but when lower values are used the overall amplification drops and the circuit becomes insensitive. Therefore 100,000 ohm resistors are recommended.

In the output circuit two audio choke coils L1 and L2 are used. There are two objects for employing two. One is to provide a high choking effect at low frequencies and the other is to reduce the distributed capacity of the windings so that the choking effect will be high for high frequencies also.

As a further aid in preventing the high frequencies from by-passing through the distributed capacity of the windings a radio frequency choke coil may be connected in series with the two audio chokes.

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Double Shield Portable

By H. G. Cisin

[*Part I of this article, which described the construction of the four-tube Double Shield Portable, was published last week. The final instalment follows.*]

IN constructing the Double Shield Portable, the four-tube receiver in one Hammarlund QS shield, and the batteries in another identical shield, it is very handy indeed to have a layout of parts. For the benefit of constructors of this receiver, therefore, a half-scale layout is published herewith, together with a front panel dimensional plan. The front is merely one of the walls of the aluminum shield.

The A dry cells are arranged in a row, and laid inside the shield, so that they do not short one another. The partition of the shield must be omitted. Then three of the small 22½-volt B batteries are placed in a row, and in the remaining space two such batteries and the C battery are located.

Protect Terminals

Cardboard or similar substance may be used for preventing batteries from shorting one another, because of contact of their terminals with the shield. The A minus lead may be connected directly to the battery shield, since this is ground and A minus. So, when the battery shield is fastened to the other shield, the A minus and ground connections are automatically made, likewise the rotor of the single tuning condenser is properly connected, without wiring. This is due to the condenser rotor and frame being the same connection, the frame being fastened to the front of the shield, as explained last week.

Permanent connection of battery compartment to receiver shield may be made simply by soldering the protruding caps or heads of the shield screws. The batteries and the shield containing them weigh a little less than 13 pounds, and the solder, applied at the six points where these screwheads emerge and hence contact, is plentifully strong enough to carry this weight, indeed, would easily hold more than fifty pounds.

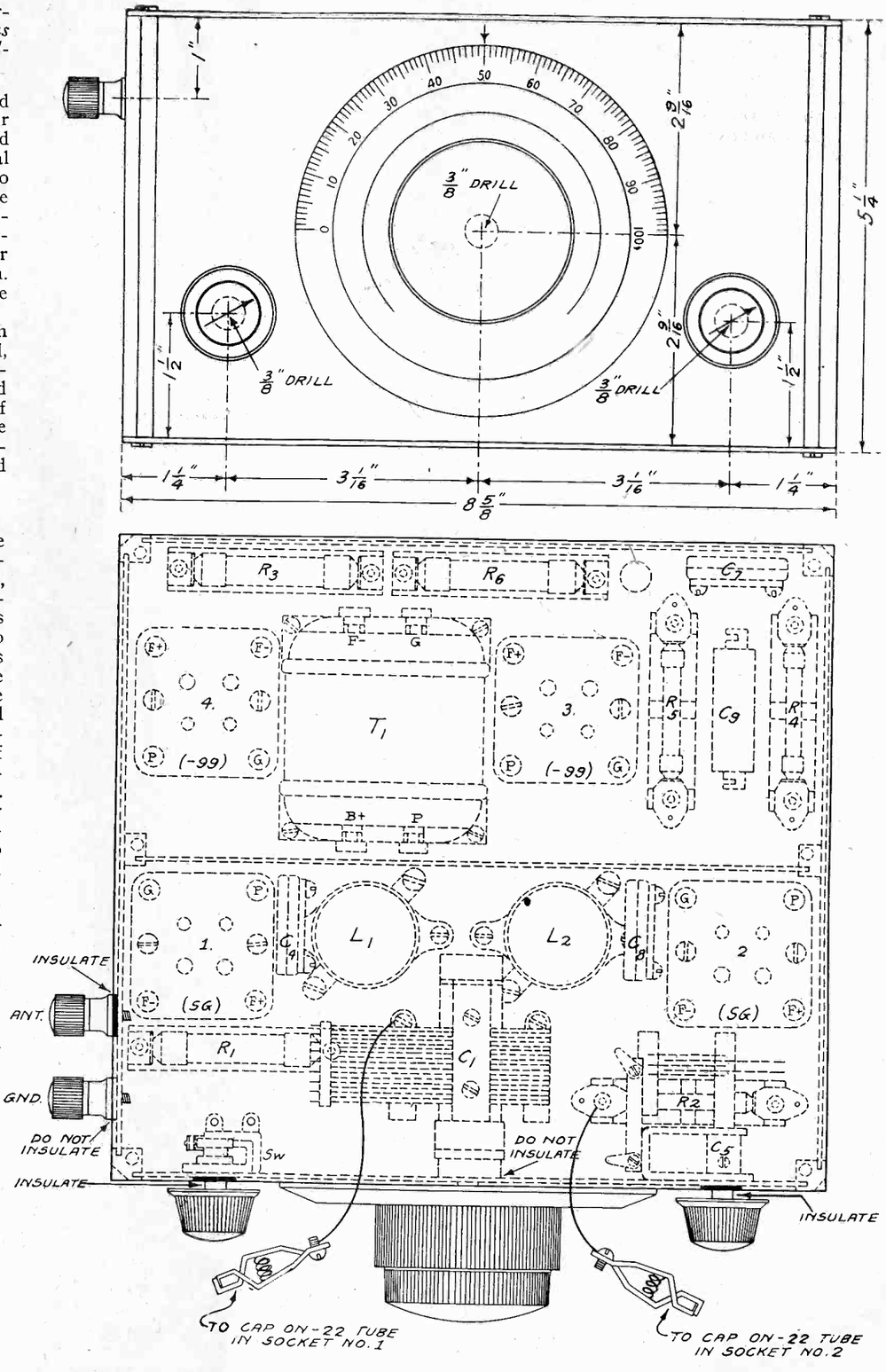
Compensating for Nuts

The hexagonal nuts used for various purposes of security and connection in building the receiver, and protruding from the bottom of the receiver compartment, may be slightly higher than the anchoring screws of the shield, so insert a brass washer to take up the difference, and apply the solder both to washer and screwheads of receiver bottom and battery compartment top.

Those who prefer not to affix the one to the other, because they will carry speaker and loop, with the receiver and separate battery supply, in a suitcase, may bring out all five leads from batteries—common A minus, B minus and C plus; C minus; B plus 22½; B plus 45; and B plus 112. For this purpose a five-lead cable is used. A hole in the bottom of the receiver takes care of the input of battery voltage and current, while a corresponding hole on the top or side of the battery compartment permits the exit of the cable leads.

The wiring may be done after the parts have been secured to the receiver base according to the plan published this week on half scale. The schematic diagram, republished this week, shows where the respective leads go, and omits optional by-pass condensers shown last week. These by-pass condensers may be safely omitted.

(*Continued on page 23*)



THE FRONT AND THE LAYOUT OF PARTS OF THE DOUBLE SHIELD PORTABLE ARE SHOWN HALF-SCALE. THE RECEIVER, CONSISTING OF FOUR TUBES, IS IN ONE SHIELD. ANOTHER SHIELD (NOT SHOWN) CONTAINS THE BATTERIES.

An All-Range Meter

By Harold Davidson

THERE is ample use for an accurate instrument with a multiplicity of ranges incorporating both voltmeter and millimeter. This provides for the testing of B battery eliminators and power amplifiers, checking of the milliampere current drain up to one ampere, also for measurements of various resistances and testing continuity. It tests tubes while in operation.

The instrument has only one meter for all the various purposes used, the most useful meter being a 0 to 1 milliammeter. The cost of the meter alone is about $12. The resistors to afford versatility are additional. But the device is excellent for set builders, experimenters and service men. The entire apparatus fitting nicely into the average size brief case along with a complete set of tools, as well as a 3-range AC meter which it is advisable to add.

The construction consisting of the 0-to-1 milliammeter is such that when the meter is used as a voltmeter with the proper resistor in series, the meter has a resistance of 1,000 ohms per volt. On full scale deflection at any range desired it draws only 1 milliampere. This is suitable for accurate testing of B battery eliminators that have an extremely low current output.

The series resistors used for voltmeter ranges are available in various sizes, in grid leak cartridge form, wire wound and have a very low temperature co-efficient. That is, they carry sufficient current without any change in total resistance due to heating. An accuracy of 1% for regular stock sizes is attained. At a very slight additional cost an accuracy of ¼ of 1% can be obtained.

Trivial Error Is O. K.

The error of any or all of the voltage ranges entirely depends on the error of the series resistors used. For the average applications an accuracy of 1% plus or minus results in an error that is insignificant.

The voltage ranges should be properly selected to meet the requirements of the user. Certainly do not provide for 2,000 or 1,000 volt ranges if they will not be needed. Each step in voltage range would be the equivalent of a regular single range meter at that desired voltage.

For ranges decided upon, this can be determined by a simple calculation.

The range desired, for example, is 10 volts. Multiply this voltage by 1,000, and divide by the size of milliammeter you intend using, which becomes R. The result is I or resistance in ohms desired to be placed in series.

$$\frac{E \times 1{,}000}{R} = I$$

$$\frac{200\ V \times 1{,}000}{1\ m.a.} = 200{,}000\ ohms$$

The resistance of the meter itself is sufficiently low that it does not enter into the calculation.

Find the Factors

After the proper and gradual selection of voltage ranges is obtained, factors are then determined. The range of each separate voltage tap is divided by the number of scale divisions engraved on the face of the particular meter used.

$$\frac{200\ volts}{20\ Divisions} = 10\ Voltage\ Factor.$$

This factor is used on a reading by selecting the range to be used, and multiplying the deflection reading in divisions of the scale, by the voltage factor. The product becomes the actual voltage. A chart of ranges of voltages as well as their factors is kept handy.

Some multi-tap switches, used for cutting resistance in or out for milliamperes, have as a feature a special low resistance contact, due to the stationary taps being concave. The movable arm, which has the same construction, fits securely to the stationary taps when making the contact. This provides an efficient back of panel switch, which is small, neat in appearance, and admirably suited for the purpose. A double jack switch for volts is also used to connect the multi-tap switch for volts or to the multi-tap switch for milliamperes.

Used as Milliammeter

Various ranges of milliamperes in gradual stages are obtained by shunt resistors. That is, the various sizes of resistances are connected in parallel, selected as desired by the multi-tap switch.

These units also have grid leak cartridge forms. These are wound with varying sizes and lengths of German silver, or better, manganin wire. The smaller gauge, the lower the range. The length of wire shunt decreases, as well as gauge becoming larger, with the higher ranges. The proper size and length of shunt for ranges desired can best be determined by the cut and try method.

A guide to as well as a check on the extending of ranges is an external high range milliammeter. The additional meter is connected in series with a good wire-wound variable high resistance and a small battery of steady current. This combination, after being adjusted to the required milliampere range, is connected in series with the low milliammeter, with its correct shunt resistor. The resistor wire length is adjusted very carefully, so as to obtain exactly the correct maximum on the low range milliammeter. The setting of the high range meter should not be disturbed during the adjustment of the shunt.

Care in Extending Ranges

After completing the shunt while in circuit, solder carefully to grid leak end and mounting clip. When this is done there is a slight variation in shunt when soldering, keeping the low meter at exactly maximum.

Extreme care should be taken in extending the ranges. Serious injury to the low range meter can be prevented by taking care that the shunt is not suddenly disconnected when used as a high milliammeter. The determination of milliammeter ranges is very much harder to explain than to accomplish. With a little care and patience it will prove quite easy.

The successful multiplication of the original range to 1,000 times its milliampere reading has been accomplished.

The factor for the milliampere multiplier scales are much easier. Multiply reading obtained, using the factor.

Obtain a 0-to-5 volt voltmeter. Throw the multi-tap switch to the desired tap, which has been connected in series with a small 4.5 volt C battery. Spring clips hold the battery into place for easy renewal. The battery can be used for about six months of continuous service without any appreciable deflection of maximum.

An Appropriate Ohmmeter

This combination can be used as an approximate high resistance ohmmeter. The checking of ratio as well as resistance of audio transformer primary and secondaries is made easy. Variable resistor regulation can be tested, also circuits in sets, with visible indication of high resistance leakage paths. These usually are the case in so-called mysterious sets, which fail to operate and the trouble still cannot be found.

A complete test usually discloses a high resistance leakage path through audio transformer primary to secondary. Leakage in fixed and bypass condensers as well as improperly insulated wire and connections that were made with too much soldering flux, which has spread toward other connections, will show up as scale readings. This is true of hurriedly soldered jacks that were partly soaked with the so-called non-corrosive mixtures.

An additional use of a 4 wire cable, with tube bases on each end, and a cord and phone plug, enables the meter to be used as an extremely efficient tube tester. This is done by plugging in the meter with the correct range for the use desired, for testing the DC filament voltage or plate voltage.

Readings During Operation

By throwing the jack switch and again selecting the proper range desired, test the DC filament amperage or plate milliamperes. This is all accomplished while the set, power amplifier or transmitter is in operation. The tube under test is removed from the set and placed in the socket of tester. Actual indication of potentials on tube while the tube is in operation is obtained.

Thus the all-range DC meter serves a variety of purposes, all with the use of only one meter. The cost should not greatly exceed twenty-odd dollars.

With the meter described by the author, eight voltage ranges were available as also were nine milliampere ranges, including continuity circuit tester and tube tester.

LIST OF PARTS

One 0-to-1 milliammeter.
Two Yaxley No. 90 inductance switches.
One Yaxley No. 760 switch.
Two Yaxley No. 701 jacks.
Two Yaxley No. 702 jacks.
One Yaxley No. 75 plug.
Six Yaxley No. 415 improved tip plugs.
Two Benjamin No. 9040 sub-panel sockets.
Sixteen Daven No. 50 mountings.
One Super Davohm 5,000 ohms (5 V.).
One Super Davohm 10,000 ohms (10 V.).
One Super Davohm 50,000 ohms (50 V.).
One Super Davohm 100,000 ohms (100 V.).
One Super Davohm 200,000 ohms (200 V.).
One Super Davohm 500,000 ohms (500 V.).
One Super Davohm 1,000,000 ohms (1,000 V.).
One Super Davohm 2,000,000 ohms (2,000 V.).
Two General Radio No. 138-Z binding posts.
One box and panel, sub-panel, wire and hardware.

Double Shield Portable

By H. G. Cisin

[*Part I of this article, which described the construction of the four-tube Double Shield Portable, was published last week. The final instalment follows.*]

IN constructing the Double Shield Portable, the four-tube receiver in one Hammarlund QS shield, and the batteries in another identical shield, it is very handy indeed to have a layout of parts. For the benefit of constructors of this receiver, therefore, a half-scale layout is published herewith, together with a front panel dimensional plan. The front is merely one of the walls of the aluminum shield.

The A dry cells are arranged in a row, and laid inside the shield, so that they do not short one another. The partition of the shield must be omitted. Then three of the small 22½-volt B batteries are placed in a row, and in the remaining space two such batteries and the C battery are located.

Protect Terminals

Cardboard or similar substance may be used for preventing batteries from shorting one another, because of contact of their terminals with the shield. The A minus lead may be connected directly to the battery shield, since this is ground and A minus. So, when the battery shield is fastened to the other shield, the A minus and ground connections are automatically made, likewise the rotor of the single tuning condenser is properly connected, without wiring. This is due to the condenser rotor and frame being the same connection, the frame being fastened to the front of the shield, as explained last week.

Permanent connection of battery compartment to receiver shield may be made simply by soldering the protruding caps or heads of the shield screws. The batteries and the shield containing them weigh a little less than 13 pounds, and the solder, applied at the six points where these screwheads emerge and hence contact, is plentifully strong enough to carry this weight, indeed, would easily hold more than fifty pounds.

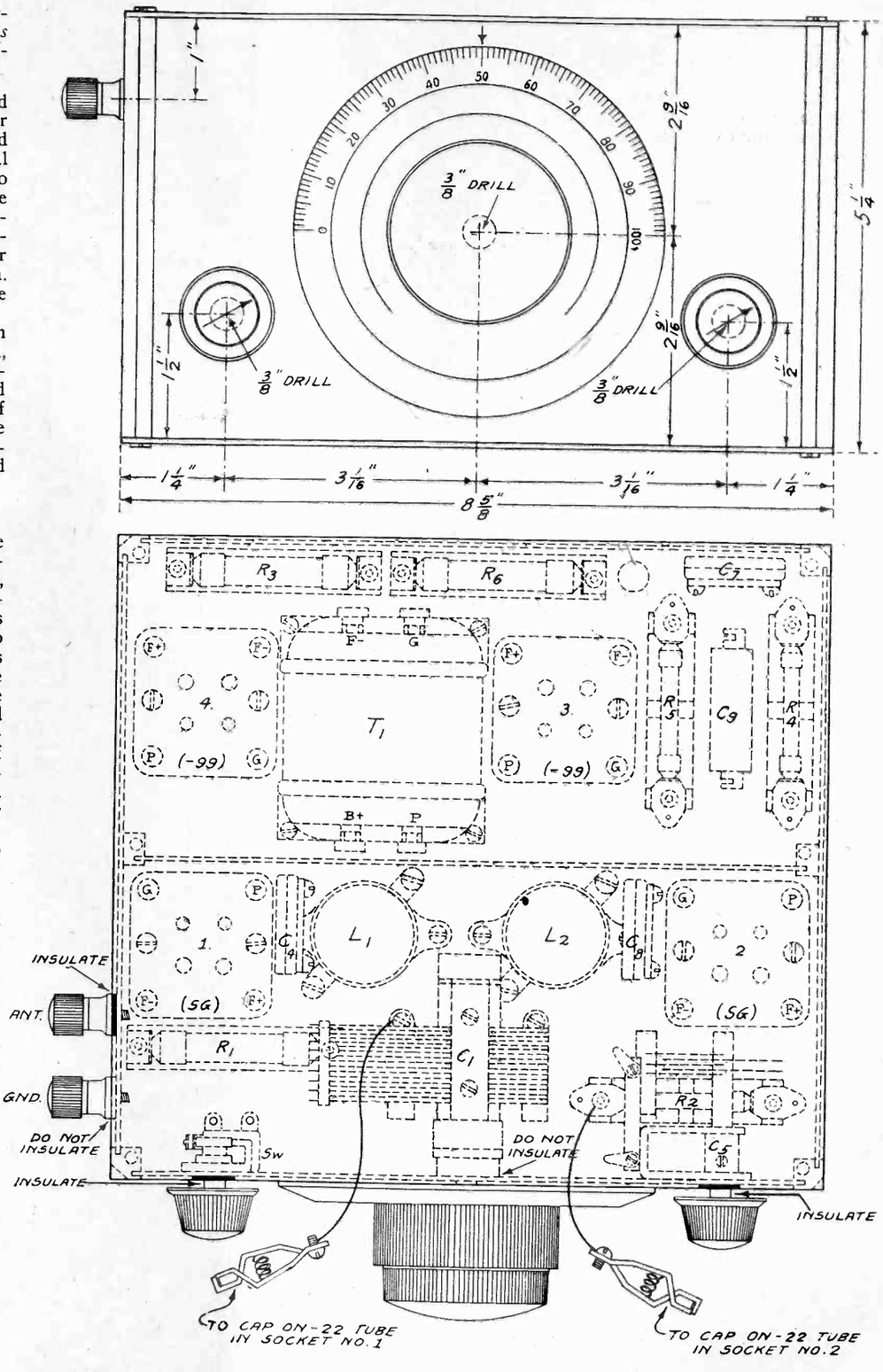
Compensating for Nuts

The hexagonal nuts used for various purposes of security and connection in building the receiver, and protruding from the bottom of the receiver compartment, may be slightly higher than the anchoring screws of the shield, so insert a brass washer to take up the difference, and apply the solder both to washer and screwheads of receiver bottom and battery compartment top.

Those who prefer not to affix the one to the other, because they will carry speaker and loop, with the receiver and separate battery supply, in a suitcase, may bring out all five leads from batteries—common A minus, B minus and C plus; C minus; B plus 22½; B plus 45; and B plus 112. For this purpose a five-lead cable is used. A hole in the bottom of the receiver takes care of the input of battery voltage and current, while a corresponding hole on the top or side of the battery compartment permits the exit of the cable leads.

The wiring may be done after the parts have been secured to the receiver base according to the plan published this week on half scale. The schematic diagram, republished this week, shows where the respective leads go, and omits optional by-pass condensers shown last week. These by-pass condensers may be safely omitted.

(*Continued on page 23*)



THE FRONT AND THE LAYOUT OF PARTS OF THE DOUBLE SHIELD PORTABLE ARE SHOWN HALF-SCALE. THE RECEIVER, CONSISTING OF FOUR TUBES, IS IN ONE SHIELD. ANOTHER SHIELD (NOT SHOWN) CONTAINS THE BATTERIES.

An All-Range Meter

By Harold Davidson

THERE is ample use for an accurate instrument with a multiplicity of ranges incorporating both voltmeter and millimeter. This provides for the testing of B battery eliminators and power amplifiers, checking of the milliampere current drain up to one ampere, also for measurements of various resistances and testing continuity. It tests tubes while in operation.

The instrument has only one meter for all the various purposes used, the most useful meter being a 0 to 1 milliammeter. The cost of the meter alone is about $12. The resistors to afford versatility are additional. But the device is excellent for set builders, experimenters and service men. The entire apparatus fitting nicely into the average size brief case along with a complete set of tools, as well as a 3-range AC meter which it is advisable to add.

The construction consisting of the 0-to-1 milliammeter is such that when the meter is used as a voltmeter with the proper resistor in series, the meter has a resistance of 1,000 ohms per volt. On full scale deflection at any range desired it draws only 1 milliampere. This is suitable for accurate testing of B battery eliminators that have an extremely low current output.

The series resistors used for voltmeter ranges are available in various sizes, in grid leak cartridge form, wire wound and have a very low temperature co-efficient. That is, they carry sufficient current without any change in total resistance due to heating. An accuracy of 1% for regular stock sizes is attained. At a very slight additional cost an accuracy of ¼ of 1% can be obtained.

Trivial Error Is O. K.

The error of any or all of the voltage ranges entirely depends on the error of the series resistors used. For the average applications an accuracy of 1% plus or minus results in an error that is insignificant.

The voltage ranges should be properly selected to meet the requirements of the user. Certainly do not provide for 2,000 or 1,000 volt ranges if they will not be needed. Each step in voltage range would be the equivalent of a regular single range meter at that desired voltage.

For ranges decided upon, this can be determined by a simple calculation.

The range desired, for example, is 10 volts. Multiply this voltage by 1,000, and divide by the size of milliammeter you intend using, which becomes R. The result is I or resistance in ohms desired to be placed in series.

$$\frac{E \times 1{,}000}{R} = I$$

$$\frac{200\ V \times 1{,}000}{1\ m.a.} = 200{,}000\ ohms$$

The resistance of the meter itself is sufficiently low that it does not enter into the calculation.

Find the Factors

After the proper and gradual selection of voltage ranges is obtained, factors are then determined. The range of each separate voltage tap is divided by the number of scale divisions engraved on the face of the particular meter used.

$$\frac{200\ volts}{20\ Divisions} = 10\ Voltage\ Factor.$$

This factor is used on a reading by selecting the range to be used, and multiplying the deflection reading in divisions of the scale, by the voltage factor. The product becomes the actual voltage. A chart of ranges of voltages as well as their factors is kept handy.

Some multi-tap switches, used for cutting resistance in or out for milliamperes, have as a feature a special low resistance contact, due to the stationary taps being concave. The movable arm, which has the same construction, fits securely to the stationary taps when making the contact. This provides an efficient back of panel switch, which is small, neat in appearance, and admirably suited for the purpose. A double jack switch for volts is also used to connect the multi-tap switch for volts or to the multi-tap switch for milliamperes.

Used as Milliammeter

Various ranges of milliamperes in gradual stages are obtained by shunt resistors. That is, the various sizes of resistances are connected in parallel, selected as desired by the multi-tap switch.

These units also have grid leak cartridge forms. These are wound with varying sizes and lengths of German silver, or better, manganin wire. The smaller gauge, the lower the range. The length of wire shunt decreases, as well as gauge becoming larger, with the higher ranges. The proper size and length of shunt for ranges desired can best be determined by the cut and try method.

A guide to as well as a check on the extending of ranges is an external high range milliammeter. The additional meter is connected in series with a good wire-wound variable high resistance and a small battery of steady current. This combination, after being adjusted to the required milliampere range, is connected in series with the low milliammeter, with its correct shunt resistor. The resistor wire length is adjusted very carefully, so as to obtain exactly the correct maximum on the low range milliammeter. The setting of the high range meter should not be disturbed during the adjustment of the shunt.

Care in Extending Ranges

After completing the shunt while in circuit, solder carefully to grid leak end and mounting clip. When this is done there is a slight variation in shunt when soldering, keeping the low meter at exactly maximum.

Extreme care should be taken in extending the ranges. Serious injury to the low range meter can be prevented by taking care that the shunt is not suddenly disconnected when used as a high milliammeter. The determination of milliammeter ranges is very much harder to explain than to accomplish. With a little care and patience it will prove quite easy.

The successful multiplication of the original range to 1,000 times its milliampere reading has been accomplished.

The factor for the milliampere multiplier scales are much easier. Multiply reading obtained, using the factor.

Obtain a 0-to-5 volt voltmeter. Throw the multi-tap switch to the desired tap, which has been connected in series with a small 4.5 volt C battery. Spring clips hold the battery into place for easy renewal. The battery can be used for about six months of continuous service without any appreciable deflection of maximum.

An Appropriate Ohmmeter

This combination can be used as an approximate high resistance ohmmeter. The checking of ratio as well as resistance of audio transformer primary and secondaries is made easy. Variable resistor regulation can be tested, also circuits in sets, with visible indication of high resistance leakage paths. These usually are the case in so-called mysterious sets, which fail to operate and the trouble still cannot be found.

A complete test usually discloses a high resistance leakage path through audio transformer primary to secondary. Leakage in fixed and bypass condensers as well as improperly insulated wire and connections that were made with too much soldering flux, which has spread toward other connections, will show up as scale readings. This is true of hurriedly soldered jacks that were partly soaked with the so-called non-corrosive mixtures.

An additional use of a 4 wire cable, with tube bases on each end, and a cord and phone plug, enables the meter to be used as an extremely efficient tube tester. This is done by plugging in the meter with the correct range for the use desired, for testing the DC filament voltage or plate voltage.

Readings During Operation

By throwing the jack switch and again selecting the proper range desired, test the DC filament amperage or plate milliamperes. This is all accomplished while the set, power amplifier or transmitter is in operation. The tube under test is removed from the set and placed in the socket of tester. Actual indication of potentials on tube while the tube is in operation is obtained.

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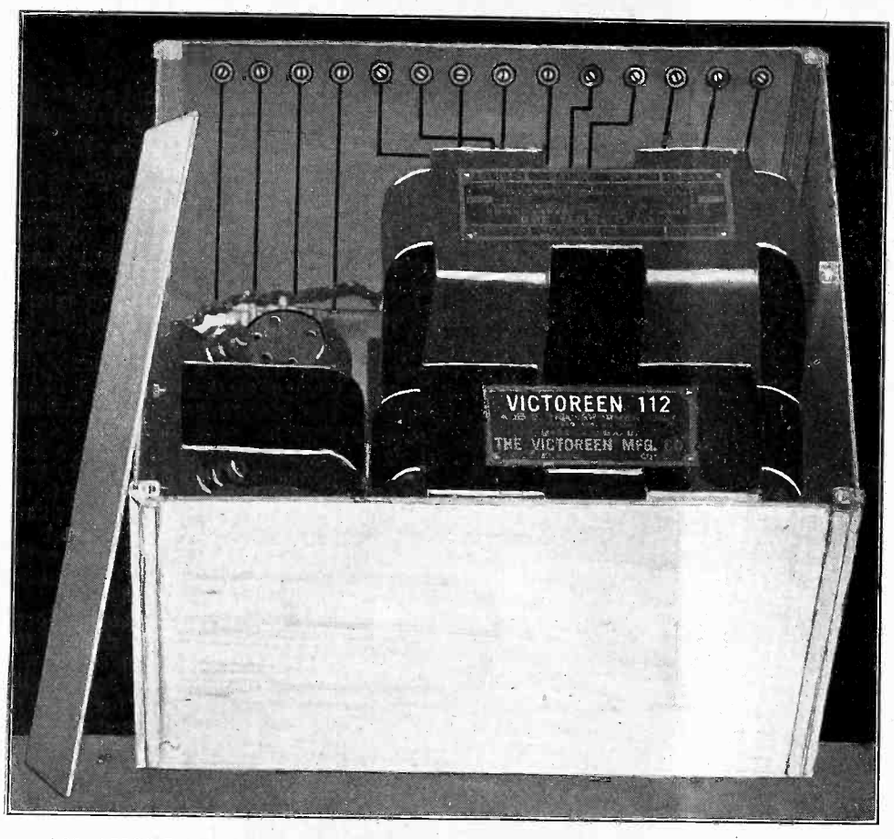
Two General Radio No. 138-Z binding posts.
One box and panel, sub-panel, wire and hardware.

An AC Audio Ampli

By Herman



AN ANGULAR SQUINT AT THE AC FILAMENT SUPPLY AND AUDIO AMPLIFIER SHOWS THE TOP AND THE PARTITION OF THE SHIELD REMOVED. PLACEMENT OF THE 112 TWO-STAGE AUDIO AMPLIFIER AS SHOWN KEEPS THE GRID LEADS AWAY FROM THE FILAMENT TRANSFORMER. THE BINDING POSTS TOWARD THE LEFT ARE FOR FILAMENT SUPPLY OUTPUT, TO SERVE EXTERNAL TUBES. THOSE TO THE RIGHT ARE INPUTS FROM A B POWER DEVICE.

ONE night I heaved a sigh of desire for a filament supply for AC tubes, with an audio amplifier built in, and although I had enough parts about the house for such a combination, I suddenly was sorry I hadn't put them together. Also, I knew that three of my friends, in their experimental radio work, raised the point that such a combination was highly desirable, since all of them, like myself, had a B supply, and also a radio frequency receiver.

I looked through several issues of radio magazines, hoping to find a hook-up, so that I might have my work simplified by the experience of others, but no such hook-up did I find. Finally I worked out my own, and here you see it, a most successful A supply and audio amplifier.

Its uses are several and rather obvious.

If you build a short wave set of the one-tube or two-tube variety, that is, simply a tuner, you still need audio, and here it is, with the audio tubes AC heated. You may have a receiver working elsewhere in the home or shop, and want your short wave speaker reception all for yourself in a private nook or corner, and you have it.

Hook in for other Tubes

You may have an AC receiver for testing—one you built or one perhaps not so good, made in a factory—and you have your doubts about the regulation and other features of the filament transformer. Well, all you need do is to hook up the filament or heater leads or both to the binding posts of your neat filament supply for AC tubes that require 1½, 2½ or 5 volts. (By the way the AC detector tube had better be worked at 2¼ to 2 volts, rather than at full 2½ volts).

Maybe you have your doubts about the audio department of some AC or DC type receiver. You can easily cut in the amplifier which is patterned herewith, for it is self-operating, save for the B supply, and you may make comparisons to your heart's content.

Maybe you've built a receiver, either AC or DC, up to and including the detector. If it is a DC receiver it may have a trickle charger that affords only ¾ amperes or less, either for trickle charging in regular fashion, or for use of the charger with an A filter to constitute an electric DC filament supply. In that event you can't well include a couple of more tubes for audio, drawing at least .5 ampere, for you would overtax the charger. Simply add the filament AC supply and audio amplifier, and you have a complete receiver.

Good-Looking Shield Used

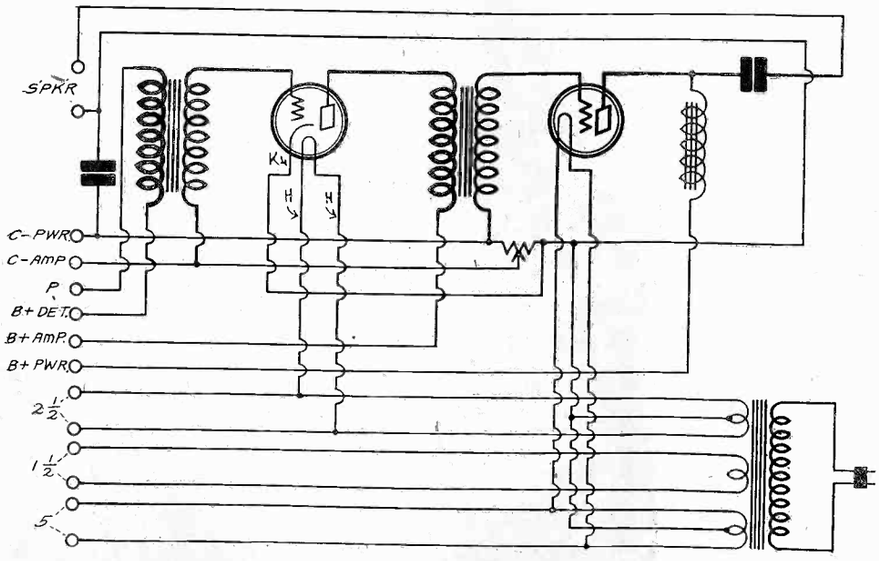
Besides, you have, as explained, ready access to AC filament voltages of 1½, 2½ and 5, with first and second audio voltage drop in a tapped resistor, and C bias automatically provided, with the the first audio bias available for any external purpose.

The combination may be built on a breadboard, without encasement, or, to be in better style, and at slightly extra cost, you may use one of the satin-finish aluminum shields, such as the Hammarlund type QS, in which the present outfit was housed with the nice fit of a nice glove.

The Hammarlund shield gives you just enough room to place the filament transformer and two sockets in one of the sections created by insertion of the aluminum partition, and just enough room to accomodate the two-stage audio amplifier, output choke and condensers in the other, provided the choke is mounted on the wall, as it were.

The parts used in the present instance were of Victoreen manufacture, and as these parts are good-sized, it may be accepted that as a general rule there will be sufficient room to duplicate the installation.

When the shield is put together, in any



A SCIENTIFIC CIRCUIT DESIGN FOR A TWO-STAGE AC AUDIO AMPLIFIER, WITH FILAMENT TRANSFORMER AND FILTERED OUTPUT AND BUILT-IN C SUPPLY. THE B VOLTAGES ARE TO BE RECEIVED BY THIS UNIT AND THE FILAMENT VOLTAGES ARE TO BE DELIVERED BY IT TO THE TUNER. THE TUBES USED ARE ONE —26 AND ONE 112 OR —71. NOTE THAT THE MIDTAP OF THE 2½-VOLT WINDING IS MADE POSITIVE IN RESPECT TO THE CATHODE. THIS GREATLY REDUCES HUM.

fier with Filament Supply

Bernard

order you prefer, except that the top must be put in last, you will find, just before you put on the lid, that there's the partition to be inserted, and that it does not exactly divide the shield, hence one portion is slightly larger than the other, and this larger space is used for the two sockets and the filament transformer.

Reasons for Selection

The principal reasons for such choice are that the sockets, when put side by side, just fit in place (although this depends on the make of sockets used), and the long string of binding posts is erected in that portion of the shield.

As for the sockets, even if they don't fit, because somewhat more expansive than required, it will be due to lugs extending from the prongs for soldered connections. Snip off these lugs and the sockets will hug each other with just enough clearance for decency.

Do not so place the sockets as to create any likelihood of the remaining ridge of one lug contacting with any remainder of any lug on the other socket.

You may solder to the socket binding post screws for connection.

There are plenty of binding posts, to be sure, but if any one can suggest a good reason for omitting even one it would be a new one on me.

Grouped broadly, these binding posts are (1) for filament AC voltage output; (2) for C bias output; (3) for speaker output, and (4) for B power and audio amplifier input. No midtap is brought out for any secondary of the filament transformer, as an additional resistor is better for RF tubes particularly, and is present in nearly every RF hookup for AC operation. Also there will be no AC tube using 5 volts in a radio part of a receiver. Whatever midtapping is necessary for the unit as described herewith is taken care of in its construction.

Insulate each binding post from the shield with washers. Ground the lower speaker post.

Don't Hang Midtap

A consideration worthy of extraordinary attention is the method of biasing and connecting the midtap of the 2½-volt winding, so that the midtap is maintained at a DC potential different from the average potential of the output of this secondary.

As is not generally known, the inexpert constructor will leave this midtap connected to nothing save to itself, although this is counter to advice given in circulars enclosed in tube cartons. You may be confused, of course, because the recommendations for the connection of this midtap are contradictory.

Sometimes you are asked to try the most negative point (the C bias for the power tube) and again you are asked to experiment as to other points on the bias resistor, always in a negative direction, or you may be asked additionally to connect to B plus detector.

This lack of agreement induces many to make no connection at all to the midtap of the secondary that powers the heater of the -27 type tube.

Should be Different

Another deterrent is the misconception that a positive voltage, particularly if around 22½ or so, may endanger the heater—blow it out, in fact, since reports current picture this tube as none too sturdy in life or operation.

The main point to remember is the midtap should be connected to a different potential than the average established in the secondary of the filament transformer, and that this difference may be positive or negative, under varying conditions due to circuit differences and dissimilarities in tubes of the same class but of different manufacture. On the other hand, actual experience has taught that a positive bias, if you can call it that, works better as a general rule.

The sole object is to reduce the hum to a minimum, and one strong point to be argued in favor of the heater type of AC tube is that the hum will not be troublesome if positive midtap connection is properly applied. In the present design the positive effect is attained in an interesting and curious way.

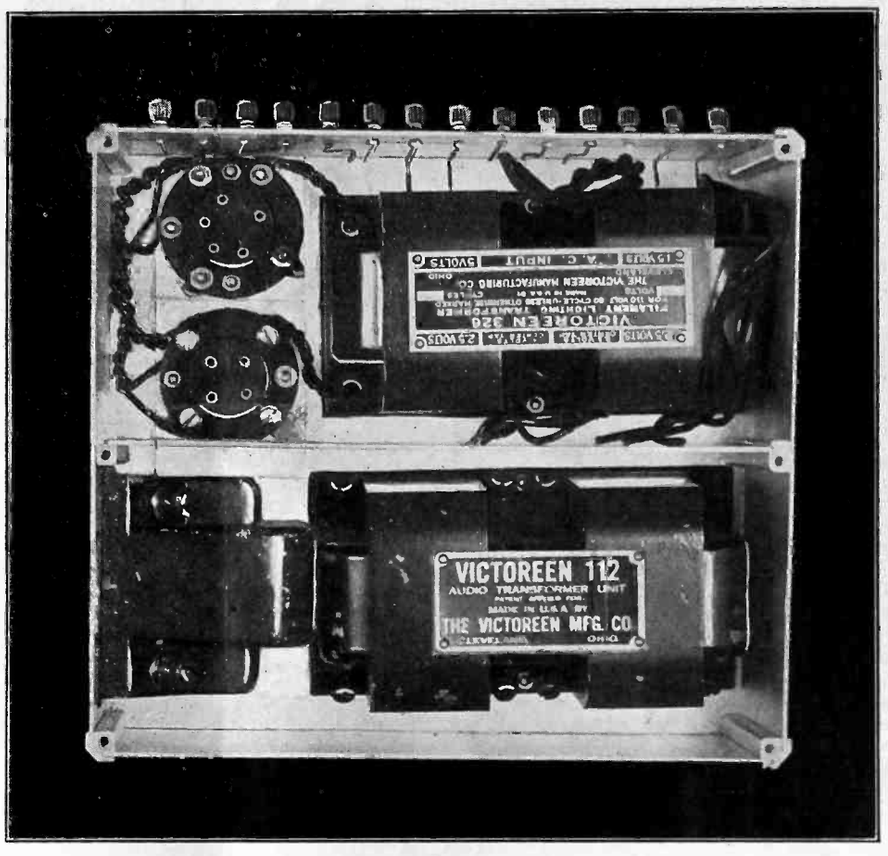
Equal Opposite Biases

There is a biasing resistor, shown at the low end of the second audio transformer secondary. Through this resistor flows the plate current of the last tube, and of the last tube only. Whenever current flows through a resistor the two cause a voltage drop, so that, at the end equal to the point of introduction or input, you have the original supply voltage, while at the other end you have something less. Granting equal increase of resistance per linear unit, the reduction of voltage is steady, gradual, proportional, and at any intermediate point some equivalent voltage in between may be tapped off.

Now, the cathode K of the -27 tube (in the first audio stage in diagram) is connected to the midtap of the 5-volt secondary, and this of course is the positive side of the biasing resistor, since it is the equivalent of A minus in a DC set, and all bias points are negative in respect to it.

Well, if the cathode, or electron emitter, is positive, any voltage along the biasing resistor will be negative in respect to the cathode. In that way, you can see, a negative bias is obtained from the biasing resistor, for the first audio tube, even though that tube's plate current is not permitted to flow through that resistor.

Continued on page 20)



EXACT PLACEMENT OF PARTS PERMITS PARTITIONING THE FILAMENT TRANSFORMER AND TWO SOCKETS FROM THE TWO-STAGE AUDIO COUPLING AND THE OUTPUT CHOKE (LOWER LEFT). NOTE THAT THE CHOKE IS "HUNG ON THE WALL."

LIST OF PARTS

One Hammarlund QS Shield (aluminum).
One Victoreen 112 audio transformer unit (consisting of two audio transformers in one casing).
One Victoreen No. 326 filament transformer (one 1½ volt winding without midtap, one 2½-volt winding with midtap, and one 5-volt winding with midtap).
One Victoreen No. 115 output choke.
One Benjamin Y-27 socket.
One Benjamin 4-prong socket.
Two Tobe 2 mfd. 600-volt bypass condenser, connected (to be parrallel connected for filter condenser).
One Electrad Truvolt potentiometer (1,500 ohms for F12A, 2000 ohms for J-1).
Fourteen binding posts (see diagram).
One CeCo type -27 tube.
One CeCo type F12A or J-71 tube.

League of Nations Address

Washington.

The League of Nations is conducting a series of experiments in broadcasting messages in four languages from Geneva to all parts of the world. The text of one of these messages, which was broadcast in Dutch, English, French and Italian, has recently been received by the Department of State.

Transmission takes place over telephone cable to the Dutch Kootwijk station, which automatically broadcasts the speeches. According to the League message, 28,000,000 people in Europe listen in on radio programs. The object of using radio is to create good-will among peoples and assist thus in the preservation of peace.

Here is the Message

The message broadcast on Wednesday, May 30, follows in full:

Hello! Hello! Hello! It is the Secretariat of the League of Nations which is speaking to you through the Dutch station at Kootwijk.

The call letters are PCLL; wavelength 18.4 metres; power 25; Kootwijk works on a directional aerial with Java, but it has also been heard in other parts of the world.

The trials we are conducting today, which will be renewed every Wednesday over a certain period, are made on a nondirectional aerial. Will all those who hear us be good enough to address a card to the League of Nations, Geneva, Switzerland?

Heard in Palestine

Last week and the week before we explained to you the technical details of our short wave broadcast trials, which we have been able to organize, thanks to the very helpful collaboration of the Dutch, Swiss and German telephone administrations.

We are now beginning to receive reports announcing to us that our transmissions have been received under more or less favorable conditions. For instance, one from Algeria, a second one from Palestine and a third one from a Dutch ship at sea.

We express our warmest thanks to the senders of these reports, and we hope that among those who hear us today many others will also report to us on the conditions of their reception. Reports of this kind are our only means to control the result obtained by our transmissions and to find out whether it is practically possible to reach from Geneva by a combined long-distance cable and short-wave broadcast-transmission oversea-countries.

We want to seize the opportunity of today's, our third trial, to tell you something on broadcasting in Europe.

Hit Stride in 1922

European broadcasting stepped out into its present stride at the end of 1922. There may have been 50,000 listeners in the whole of Europe at that time.

Today in 12 countries alone (not including France, Spain or Italy for which no definite figures are available) 5,000,000 homes are licensed to receive the broadcast programs and are making regular payments towards the presentation of those programs. There are probably an additional 2,000,000 homes unregistered in France, Spain, Italy, Holland and Belgium—which means that, assuming there are on an average four persons to each household, no less than 28,000,000 persons in Europe listen at one time or another to what is happening at their local studio or some other more distant place.

The staff of one organization alone, the British Broadcasting Corporation, has already about 1,000 persons, not including artists.

Long Waves for DX

There exist in Europe roughly four types of broadcasting stations. First of all there are a limited number of the stations of relatively high-power working on wave-lengths above 1,000 metres. Such stations are to be found at Zeezen (Germany), Lahti (Finland), Motala (Sweden), Daventry (England), Kalundborg (Denmark), Warsaw (Poland), Eiffel Tower (France), Radio Paris Clichy (France), Hilversum and at Huizen (Holland), Stamboul (Turkey), Kovno (Lithuania), Rome (Italy).

The first four have serial power ranging from 25 to 40 kilowatts and most of the remainder radiate more than ten kilowatts. The great value of these long-wave stations lies in their effective daytime radiation.

After the high-power and long-wave

Sponsored Programs

Chicago.

Broadcasting as an industry is perching on a high level of achievement, just as it its related industry, radio receiver manufacture, said Thomas F. Logan, of Lord & Thomas and Logan, New York advertising agency. He addressed the Radio Division of the National Electrical Manufacturers Association at its annual meeting.

There is no longer any question about who is to pay for broadcasting in America, the speaker pointed out. directly or indirectly, the cost of operating broadcasting stations has been charged in one way or another against advertising budgets.

The first stations were built by radio manufacturers to provide programs for the buyers of the apparatus, he recalled. Then came stations operated by other interests—newspapers, theatres, churches, manufacturing companies, retail stores, etc., but all for the purpose of advertising something. Then came the building up of large chains which in turn called for programs worthy of the expense of the chains. This led to the development of high grade chain programs which were provided by national advertisers.

Must Be Different

"I have never had any doubt as to the proper place of advertising in broadcasting," said Mr. Logan. "It has just as legitimate and useful a place in the broadcast program as it has in the pages of our newspapers and magazines. None of us today would buy a newspaper that carried no advertising, for advertising is a business and buying guide of as great value as the editorial contents.

"Advertising over the microphone must necessarily be of a different character than that which comes from the printing press. I think that the radio public is almost unanimously of the opinion that the radio programs sponsored by national advertisers are the most interesting and valuable features now on the air.

"We have seen the end of the more or less academic debate as to whether broadcast advertising is acceptable to the radio audience. I do not say that all broadcast advertising is acceptable. Some

England Enjoys U. S.

In three days seven letters were received by officials of broadcasting stations WABC and 2XE reporting the reception of programs strong and steady in various parts of England.

Albert T. Williams, of No. 19 Warton Terrace, Liverpool, England, writes in part:

"It may be of interest to you to learn that I picked up the transmission of your WABC on the low wave length, about sixty meters, and much enjoyed the excellent program and the wonderfully steady transmission.

"It is quite by accident I came across your station.

"I often used to listen to KDKA on 62.5 meters but of late this transmission has faded away and I have not bothered with him for a time. I was firmly convinced that the sixty meter band was useless at this time of the year, but WABC gets across.

"I intended to try KDKA once again on Friday last, and was pleasantly surprised to hear what I took to be them coming in rather well, but I was still more greatly pleased to learn that it was WABC New York. I heard the Black Rock Boys in some syncopated items. Then I heard the blow-by-blow description of the fights from Madison Square Garden, which I enjoyed immensely.

"As you are probably aware, the British Broadcasting Co. has only on two occasions given commentaries on boxing matches. We in England don't get half enough, but, thanks to short wave stations such as WABC we can enjoy real commentaries by real commentators. Driven from home, as it were, we seek out the best from the U.S.A. and now that I have found my pet station, WABC, I don't intend losing him. I should like to attend the radio reception of the fights every week.

"I have picked up WABC on succeed-

Three Short Waves Used Often by KDKA

KDKA uses the short wavelengths of 26 meters, 43 meters and 62 meters.

No schedules are maintained for this experimental work but the short waves are used on nearly all evening programs beginning at 6 o'clock E. S. T. KDKA's regular wave is 315.6 meters.

Uses 18.4 Meters to World

stations come a number of what are known as "main" stations, stations intended to cover a radius of 20 or 30 miles with good crystal reception and perhaps 100 miles with valve reception. Actually they are listened to at greater distances than these, but with interest rather than with pleasure. About 60 of these main stations exist.

Next in order come the small stations intended to cover small densely populated areas that are not otherwise accessible. These have power ranging up to half a kilowatt and are in number between 80 and 100 all told.

Peculiar Problem

The problem peculiar to Europe in radio as in many other matters is the proximity (within a relatively small area) of over 20 nationalities each with distinctive ideals and separate administrations. Alongside this is the fact that wireless waves know nothing of frontiers and that therefore the good or evil of which they are capable can pass far beyond the land of their birth.

In the first days of broadcasting wavelengths were granted to broadcasters on a purely national basis. The result was that, as the power of the transmitters increased it was discovered that they were causing interference to and suffering interference from other transmitters, some of them in quite distant places.

Union Planned Cure

It was with the immediate object of endeavoring by unofficial means to obtain order in the European ether out of a threatening chaos that nearly all the European broadcasting organizations came together three years ago and formed the Union Internationale de Radiophonie. The interference question was handed to a Committee of Technical experts and a plan was formed for re-arranging the European wavelengths.

The plan was submitted to all interested Governments and on receiving an almost unanimous approval was put into practice. It has resulted in a much improved state of affairs, but as is consistent with all developments of a progressive character, has to be re-examined at regular intervals, to make certain that it is satisfying the latent needs.

No Easy Matter

It is admittedly not a simple task to find an uninterrupted position for each existing station. This would be entirely impossible but for the mutual good will existing amongst the European broadcasters who meet together at short intervals and discuss systematically all their difficulties.

These frequent meetings have resulted in the establishing of personal friendships of great international value. Through such friendships it has been possible to arrange a mutual pact that every possible effort shall be exercised to ensure that no broadcasting station radiates material likely to be offensive to another country.

Exchange Proposed

The European broadcasting stations are doing all within their power to make better understood the work of the League.

Amongst the many other studies now taking place amongst European broadcasters for the development of the public services with which they are entrusted is a series for the exchange of programs between countries.

This it is proposed to do through the medium of the new telephone cables as thereby it becomes possible to transfer sounds over great distances without picking up the atmospheric disturbances which hinder so seriously long distance wireless reception.

The problems on the technical side are similar to those which have had to be mastered to make possible today's demonstration, but they are more difficult because whereas the cable between Geneva and Kootwijk over which we are now speaking was constructed for the transmission of speech; the programs which are to be transferred from one country to another are those of music.

Hopes for World Hearing

The problem is to make the cables so sensitive to music that they will transmit it without distortion.

We have now come to the end of our statement, which we hope, has been received all over the world.

In conclusion may we repeat our request: Will all those who hear us be good enough to address a card to the League of Nations, Geneva, Switzerland?

Called Fine Assets

of it is in such bad taste that it is bound to die a natural death, but the general average is very high."

Does It Pay?

Mr. Logan contended that broadcast advertising pays, and pointed out that there are now fifty-seven nationally known firms sponsoring nationwide radio programs regularly each week. Some of these have been on the air continuously since 1924 and only five outstanding advertisers have gone off the air after having definitely established themselves as users of this medium.

Lord & Thomas and Logan have found that radio broadcast advertising, when properly planned and intelligently handled, is a highly valuable collateral means of building sales and good will. "It is a collateral means," said Mr. Logan, "because newspaper or magazine advertising, or both, is the foundation upon which any profitable advertising campaign must be built. The microphone carries on where the printing press leaves off."

Radio touches many other fields of activity and some fears for its competition are still felt in the newspaper and entertainment field. Radio has brought the newspaper larger circulations and larger revenues, said Mr. Logan, pointing out that the radio industry now spends annually in newspapers and magazines $20,000,000.

Fears in the artistic world are groundless, for radio has shown the way toward larger uses and is developing new sources of revenue, Mr. Logan contended. Talking movies owe their development to radio progress, concert artists have found in radio a means of increasing their income and popularity. Broadcasting is bringing new artists to popularity, and politics is finding radio influencing and guiding their campaigns.

"National broadcasting chains can survive only by reason of their public service," said Mr. Logan. "The force of public opinion is regulating radio broadcasting, rather than the Federal Radio Commission, or any other agency.

Low-Power Short Wave

ing nights and enjoyed all programs, particularly the Grand Opera from Madison Square Garden Sunday night."

Another County Heard From

J. P. Skinner, of No. 18 Ellesmore Road, Burngreave, Sheffield, England, writes in part:

"I have pleasure in informing you that I received early this morning your short wave transmission from the ringside in Madison Square Garden on a three tube set. It was 2XE broadcasting the WABC programs that I heard.

"I might mention that you came through clearer and louder than the Pittsburgh station KDKA, although at times I had some difficulty in getting names, due to the speed of the announcer. However, the general description came through very well and I thoroughly enjoyed it."

From San Juan, Porto Rico, comes a letter from Dr. R. del Valle Sarraga, who is vice-president of the Radio Club of Porto Rico. He says:

"I heard your short wave transmission of 58.5 meters very well and with clear and excellent modulation to-night. I was using a three tube receiver and the concert for the entire evening was obtained with loud speaker volume. I congratulate you for your decision to increase the wattage to 1,000.

"I would suggest that besides 58.5 meters you employ also a lower wave either around twenty or thirty meters."

Used Only Two Tubes

E. D. G. Taylor, No. 14 Gladstone Road, Ware, Hertfordshire, England, writes:

"It may interest you to know that I picked up your transmission at 3 a.m. Sunday and held it until you signed off at 10:36 Eastern Standard Time. I used a two tube receiver."

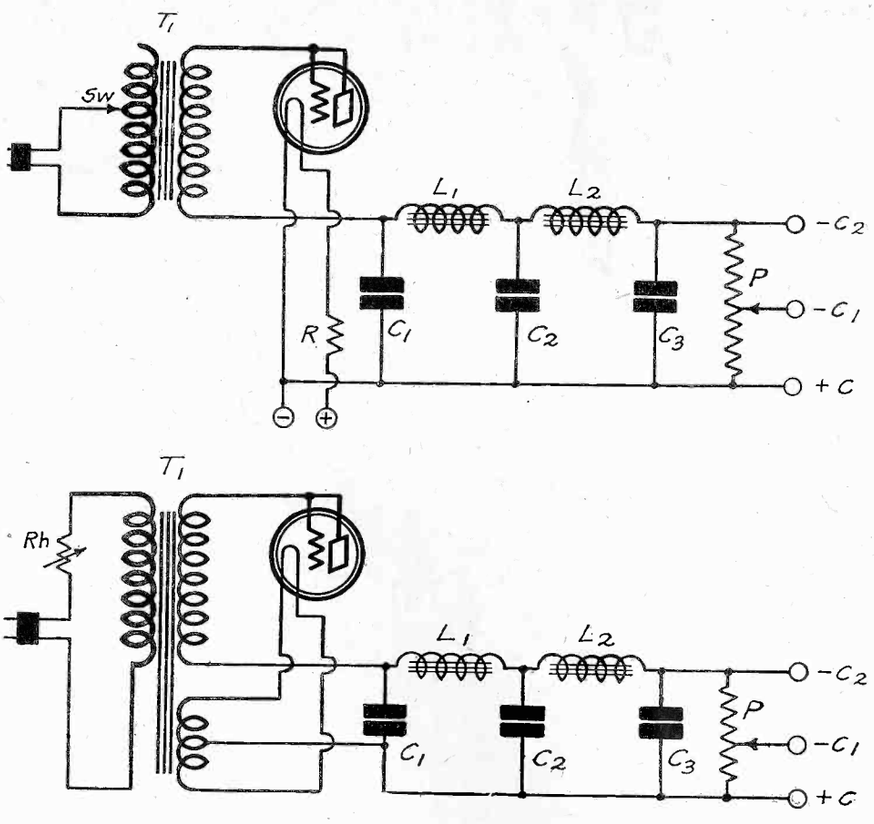
2XE, the Grebe short wave station which carried the WABC programs, used only 250 watts.

Grebe's Short-Wave Station on Every Day

2XE, 5,121.6 kilocycles, about 58.5 meters, operated by A. H. Grebe & Co., Richmond Hill, N. Y., is on the air from 6 p. m. to midnight daily, and on Sunday from 10:40 a. m. until midnight. The WABC program is sent.

The Advantages of Elimi

By Herbert



THE CIRCUIT DIAGRAM OF A SIMPLE C BATTERY ELIMINATOR UTILIZING A —99 TYPE TUBE FOR RECTIFICATION. (FIG. 1, TOP) THE FILAMENT OF RECTIFIER IS HEATED FROM RECEIVER STORAGE BATTERY. THE CIRCUIT USING AN AC HEATED TUBE FOR RECTIFICATION. (FIG. 2, LOWER) THE VOLTAGE IS REGULATED WITH A RHEOSTAT RH IN THE PRIMARY OF THE SUPPLY TRANSFORMER.

THE use of a —50 type power tube with high grid and plate voltages has introduced another problem into receiver design, namely a practical and satisfactory way of getting the required grid bias.

What is wrong with the resistor method of obtaining the bias? Is not that method simple, convenient and satisfactory?

That it is simple no one can deny. That it is also convenient is admitted. But that it is most satisfactory is open to argument. The grid bias resistor may produce some undesirable effect.

The grid bias resistor may rob the plate of voltage which it should have. This is not a serious objection when high mu and general purpose tubes are used, in which the grid bias required is low. But for power tubes requiring a high grid bias a large proportion of the available voltage is taken from the plate circuit and put in the grid circuit.

For example, suppose that a —50 type tube is to be used and the voltage available is 450 volts. At this voltage the grid bias should be 84 volts. When this is taken from the available voltage only 366 volts remain for the plate. A similar voltage division takes place when a —71A tube is used, and in this case an even greater proportion of the available voltage is taken away from the plate.

Feedback Through Resistor

To make up for the loss in plate voltage when the resistor is used for grid bias it is necessary to boost the total voltage in the B battery eliminator. This in turn requires the use of more expensive condensers which will stand the higher voltage.

But the loss of voltage is not the only consideration. The feedback through this resistor from the plate circuit to the grid is serious. This feedback is in reverse phase so that the amplification in this power tube is cut down. Some tubes may not even amplify when the grid bias resistor is used, indeed, may even reduce amplification! Whereas in a —710 tube the power output per volt input should be 1 milliwatt, it is only .184 milliwatt. This is the output into a 4,000 ohm resistor, not the output into this resistor and that into the 2,000 ohm grid bias resistor.

The corresponding figures for the —50 tube are 2.67 milliwatts output per volt input without the grid bias resistor and .396 milliwatt per volt input with the resistor.

The reduction in the power output seems unreasonably large, but it is no more than can be expected from an output tube, especially when the grid bias resistor is not by-passed. A by-pass condenser nullifies the feedback through the resistor at the higher frequencies.

Effect on Low Notes

It is only on the low notes that the by-pass condenser is not sufficient to offset the reduction in the amplification. Hence the effect of the grid bias resistor is to suppress all notes when no by-pass condenser is used and to suppress only the low notes when one is used. If the condenser is 6 mfd. or more the low note suppression is small.

Distortion is the result in any instance, and this distortion is greater, the smaller is the condenser across the grid bias resistor.

When the grid bias is obtained from a battery all the troubles introduced by the grid bias resistor are eliminated. There is no reverse feedback through the battery, hence there is no reduction in the amplification. Also the full output voltage of the B battery eliminator can be applied to the plate of the tube. This

Sunken Tarpot Used As Ground in Arctic

Pittsburgh.

George A. Wendt, Canadian radio representative of Westinghouse Broadcasting stations, received the following letter from Alex Smoot of Fort Crimo, Ungava Bay, Hudson Straits:

"The Arctic broadcasts from KDKA and WBZ were received O. K. Conditions varied somewhat on different nights, but the reception was always distinct enough to be heard without straining.

"Good ground is hard to find in this neighborhood. Ours consists of a two-gallon tarpot sunk about four or five feet, and a seven-foot piece of piping driven its whole length into the ground and connected up with the tarpot.

Eskimos Like to Listen

"We were always looking forward to these Arctic broadcasts and we appreciate very much the kindness of your stations in setting apart these evenings for our special benefit.

"The Eskimos are very much interested in these broadcasts. We have always to tell them when the next one is taking place so that they too can listen in.

"These messages from the old folks can reach us in a fraction of a second but this letter will take three months to reach you. The mail leaves tomorrow for Fort McKenzie, by dog team. From Fort McKenzie an Indian shall take it (by toboggan and after open water by canoe) to Seven Islands.

Duly Appreciative

"One has to live far from civilization fully to appreciate the godsend that the radio has been. It has been the means of our spending many, many pleasant evenings and has curtailed the feelings of isolation, which have to be contended with to fully realize its demoralizing influences.

"Wishing you a pleasant summer and hoping to hear the cheery and joking voices of KDKA and WBZ announcers next winter.

"Yours faithfully,

"ALEX. SMOOT."

a Separate C Battery

nator

E. Hayden

grid battery delivers no current and therefore its life in the set is the same as its shelf life. But that is not indefinitely long and the grid battery must be replaced at intervals. Also when a bias of 84 volts or more is required, the grid battery takes considerable room, about as much as did one's total B supply two years ago.

The C Eliminator

One simple solution of getting a grid bias without a grid resistor and without a grid battery is to use a C battery eliminator. This device works exactly the same as the B battery eliminator. It is simply made on a smaller scale. It can be made smaller than the size of a B battery, and it is permanent. It will not run down, except for the rectifier tube. But this tube, with proper design of the eliminator should last at least a year.

Any type of receiving tube may be used as the rectifier tube in the C battery eliminator. The filament of the tube may be AC or DC heated. A —99 type tube will give as good service as a —71A or a —12A.

The power input transformer may be an ordinary audio transformer of low ratio. The best ratio for a C battery eliminator intended to deliver grid bias to a -50 type tube the best ratio of transformer is probably 1-to-1. This on a 110 volt line will give a maximum of about 150 volts on no current. By varying the current drawn, this voltage can be dropped to any desired value lower than 150 volts. The choke coils in the output filter also may be windings from audio transformers or they may be chokes designed for impedance coupling.

Parts Used

Refer to Fig. 1, a schematic diagram of a C battery eliminator which is actually in successful use. T1 is a 1-to-1 audio transformer. L1 and L2 are the two choke coils in a commercial dual impedance coupler. The coupling condenser in this unit was short-circuited by connecting the two windings in series. The condensers have the following values: C1 and C2, each 0.5 mfd. and C3, 2. mfd. The output potentiometer used in this case had a value of 0.5 megohm.

Various tubes were used as rectifiers but as a —99 gave as good results as any of the larger that was finally used. R is a 6V-199 Amperite.

Note that the choke coils L1 and L2 have been placed in the negative side of the line. That is necessary, because the tube is heated from the storage battery which supplies the other tubes in the receiver, and C plus and A minus should be at the same AC as well as DC potential.

The slider on the potentiometer is used to supply an intermediate grid bias and the maximum, C2, is used for the power tube. The maximum grid bias can be adjusted in any one of a number of ways. A Clarostat may be put in the secondary of the transformer or it may be put in the primary. The voltage put into the transformer can be varied also by using taps in the primary winding.

May Use Two Sliders

The transformer used had two taps and one of them happened to be just right to give the desired output voltage when the 0.5 megohm potentiometer was connected across the line.

The bias also may be varied by using a potentiometer of two sliders, connecting C2 to one of them.

The output voltage cannot be measured with ordinary voltmeters. Even a meter of high resistance per volt will not give correct readings. The voltage should be adjusted by its effect on the plate current in the tube which is served by the C battery eliminator.

Fig. 2 shows essentially the same circuit as in Fig. 1, except that the filament of the rectifier tube is heated with AC. The winding heating the filament may be on the same core as the winding supplying the high voltage, or it may be on a different core. The positive line may be connected either to one side of the filament or to a tap in the center of the filament winding. No tap is shown in the primary of T1 in this circuit, and the voltage output is controlled by means of rheostat Rh.

Marshall Makes Plea for Series Filaments

While the trend of radio engineering is decidedly towards socket-power operation, at least for sets intended for the metropolitan markets, the possibilities of series-filament technique are obviously being overlooked in the wild rush for AC tubes, according to L. K. Marshall, general manager of the Raytheon Manufacturing Company.

"The series-filament method of socket power operation," states Mr. Marshall, "is the oldest and no doubt the best established method even at this late date.

"Let it be recalled that it was with the threefold object of providing an inexhaustible and low-priced source of B or plate current, more power for power tube operation, and better tone quality through ample plate voltage, that the Raytheon organization introduced the gaseous rectifier and B power units several years ago. In fact, this organization may justly lay claim to being the pioneer organization in socket-power operation. Today there are more Raytheon-equipped devices in use than any other form of radio power supply. As was natural, the B power unit, already accepted as the ideal form of plate current supply, was greatly enlarged so as to furnish sufficient current for the operation of series-connected tube filaments in addition to the B and C requirements.

"The Raytheon organization not only developed suitable high-capacity rectifiers, but also the circuit technique whereby series filaments might be employed in any receiving circuit. The advent of the AC tubes, on the surface, has promised a more direct solution, since stepped down, raw AC energy is used in this case. Nevertheless, it is our sincere belief that the series-connected filament technique is worthy of far more attention than it is now receiving. It is economical. It is positive. It makes use of tested and perfected tubes for all purposes. It is efficient. And with early promise of low-current consumption tubes of very high efficiency, the series-filament technique will be still more desirable as a solution to the problem."

ONCE A BALL PLAYER

Charles Robinson, bass-baritone of the Revelers, heard in National Broadcasting Company network broadcasts, once was a professional ball player and a good one. During the war he was a quartermaster aboard a tiny sub-chaser. He formerly was a member of the Shannon Four.

DENVER RADIO SHOW

The 1928 Denver Radio Show, which opens in Denver July 1, will commemorate the first anniversary of the hook-up of KOA with the NBC networks.

Marconi Tries Out New Revolving Beam

London.

Senator Marconi, who has just returned to England from a cruise in his yacht Electra, announced that he is experimenting on a beam radio transmission which may be turned around like a huge searchlight and pointed at any point in the world.

"As beam stations are fixed at present," he said, "America cannot be turned on to Japan, and India cannot be utilized for Russia or the North Pole. Now I am going to try a type of station which can be turned by machine in the same way as a searchlight is turned. Where there is a revolving beam, if you want to transmit it to a certain country, you merely direct the beam toward that country. The results will thus be very important if the tests are successful."

Mr. Marconi added that one result of turnable beam transmitter might be the elimination of many beam stations, since where traffic is not so heavy between two points as to occupy the entire time the beam could be turned on some other receiving station. He also stated that it has been possible to reduce the angle of the transmitted beam from 50 to 90 degrees. This narrowing of the beam permits of communication over longer distances with small power and it also helps greatly to make the messages secret.

"Dead patches" which have been encountered in the use of short waves on land are absent at sea, according to Senator Marconi.

Air Lessons Become Educational Factor

Washington.

College and university courses given by radio are "becoming general," L. R. Alderman, Specialist in Adult Education, Bureau of Education, Department of the Interior, has just stated.

Only a few years ago, Mr. Alderman said, the giving of courses of study over radio was not considered advisable, and all that was broadcast by the universities was a program of entertainment. Now, however, he points out, for a small fee a student may register with the extension division of a university, have his assignments corrected, and receive credit for his work. The full text of the statement follows:

"Instruction by means of radio is becoming general with college and university extension divisions. This method, which usually supplements the textbook or other lesson material, involves the broadcasting by the institution of detailed information in regard to the lesson, outlining the main points, explaining the different passages.

Advantages Cited

"The student, after receiving the radio instruction and supplementing it by the study of textbooks or other material writes out his lesson as in regular correspondence courses and sends it to the instructor in charge of the subject at the university.

"Some of the advantages of extension work by radio are: (1) It creates more interest and probably reaches many more people than does regular correspondence instruction. (2) It saves time required otherwise for transmitting the lesson by mail to the student. (3) It enables the instructor to give whatever emphasis is needed by using the voice instead of the pen. (4) It enables the instructor to bring into his discussion more timely illustrations of the subject studied than is possible by correspondence courses alone.

Used by 65 Institutions

"Sixty-five institutions report the use of radio either in giving lectures or in conducting other extension work.

"That radio courses vary widely may be seen if one considers the subjects listed by even one extension department. Since it was organized four years ago, the division of university extension of the Massachusetts State Department of Education has included in its radio courses the following subjects:

"Household management. appreciation of music, contemporary American literature, short-story writing, French, the making of a music lover (with piano illustrations), chief English writers of our day, business psychology, backgrounds of English literature, psychology of understanding people, literary values in new books, journalism, new developments in economics, essentials of drama, appreciation of symphonies, real estate law, psychology of personal problems.

Five Thousand Enrolled.

"That there are many men and women in all parts of the country who are interested in radio instruction is evidenced by the fact that 5,000 people have enrolled for the courses given through the above-named university extension department alone. In addition to those who are studying by radio, the total number of which is unknown, there are many thousands who listen in on the courses given by colleges and universities.

"The process for enrollment in correspondence courses by radio is usually simple and the fee charged, while varying slightly, is small.

"In some of the extension departments a fee of but $1 is charged for this type of service, while in others the fee may be the same as that charged for the regular correspondence courses. In any event, for a small fee a student may register with the extension division of the university giving the radio correspondence course, have his assignments corrected, and receive credit for his work.

A Mayor Takes a Course

"Of the students who have taken courses by radio, the division of university extension of the Massachusetts State Department of Education states:

"'Students in former courses have been widely representative of American interests: The Mayor of a city of Louisiana; the Minister of Agriculture of a Province in Canada; clergymen of all denominations; sisters in convents in two States; school-teathers and officials; mothers and fathers who are unable to leave home in the evenings; people on farms in remote sections, one a rancher in Canada, 50 miles from a city. Barbers, electricians, grocery clerks, merchants, lawyers, politicians, baseball players, and just plain people, all answered the voice which came, as it were, out of nothing.'

"The following are examples of expressions received from radio students:

"'Your university extension courses by radio are as interesting to us as are general entertainment features. We have formed a class at my home, and nine of us are studying for certificates.'

Courses Analyzed

"As to the lessons themselves, the extension division of the State University of Iowa states in regard to its work during a certain term:

"'Each course consisted of 12 lectures, one a week for 12 weeks, the lecture period being 20 minutes. There were regular lesson assignments on textbook work and on the lectures. Six papers were prepared during the course of the 12 weeks, and there was a final examination.

"'It was planned that the work covered in such a course would be the same as that covered by a regular correspondence course giving two hours credit; so that these courses gave two hours credit with the exception of one in the third series. That was the course on Iowa birds, which gave only one hour credit. The regular fee was the same as for other correspondence courses. An interesting feature was that the percentage of completion was far greater than it had ever been with any regular correspondence.'

"The extension division of the foregoing university gave seven lectures a week during the season of 1926-27 and has planned 12 lectures per week for the year 1927-28. While the enrollment for the 1926 season of radio correspondence study courses was only 98, the estimated number of people who listened in on the courses, either in clubs or groups (in many communities groups meet in homes or public buildings to hear these courses), was between 2,500 and 3,500.

Study of Novel Broadcast.

"During February, 1927, the University of Nebraska gave a radio correspondence course for credit on 'The Study of the Novel.' This course was divided into 15 lectures. For the correspondence work of the course, outline questions were sent to the students. These questions referred directly to the author's literary art and meaning. Members of the class who desired university credit prepared written reports on all assignments. In addition brief summaries of each lecture were written. The reports were sent to the university extension division for credit and suggestions. An especial effort was made to have the corrected papers returned promptly to the correspondents.

"Correspondence students through the medium of the radio are the newest members in the household of the college and university extension family.

Now Well Established

"Only a few years ago such a course of study given over the radio was not considered advisable. All that was broadcast by the universities at that time was a program of entertainment—music, a lecture, and the news of the university. That men and women could take a course for credit in such a manner was unthought of and beyond the plans of professors. After four years, courses are given by radio that reach from one State into many States and even to students in other countries."

Second Millionth Set by Kent Due in Fall

A. Atwater Kent, whose factory is the largest radio plant in the world, is highly optimistic over the outlook for radio in the United States this year. He said he will produce his second millionth set early this Fall. The first four months of the current year he produced 200,000 radio receiving sets, which is six times the production in the same period of any previous year. That he looks forward to a banner radio year is evidenced by the fact that he is installing new machinery and taking advantage of every spare foot of space in his 15½-acre factory to add to his production facilities.

"Radio has become permanent just as have the automobile and airplane industries. The potential value of radio to every phase of our lives, from the lighter side of entertainment to the more serious side of our daily business and education, can not well be estimated."

"I foresee a big radio year," said he. "There was great advancement in every division of radio in 1927. There is now stabilization in every field of the industry. I believe more radio sets and speakers will be sold this year than in any year before. One reason for this is the general acceptance of the AC, or house current set, for which batteries are not required. There will be many replacements of battery sets with house current sets everywhere except in sections where alternating electric current is not provided.

"Another reason for my optimistic view is that broadcasting facilities have been vastly improved. Another is that manufacturers are turning out reliable sets and equipment, simplified in operation and maintenance, and at reasonable prices. The purchasing public need no longer hesitate to buy radio receiving sets, either because of unsatisfactory broadcasting conditions or because of uncertainty as to the quality and character of the set.

McNamee Enters 6th Year Before "Mike"

Six years ago it is doubtful if 500 persons, outside his own personal friends, could identify Graham McNamee.

Today it is safe to estimate that McNamee's voice is known to forty million Americans and that his face would be recognized in any crowd anywhere in the United States.

That is what radio has done for Graham McNamee, once a concert baritone whose singing voice supported him, but didn't bring him fame.

It was five years ago that radio and McNamee formed an alliance for the mutual benefit of both.

Old Enough to Talk

On a hot June day in 1923 a well-built young man wandered into the studios of radio station WEAF at 195 Broadway. The young man said that his name was Graham McNamee; that he was a concert singer and that he was looking for a job. Didn't WEAF need another announcer? He could talk as well as sing, he explained.

McNamee was given an audition. Five minutes later he was hired with the agreement that he might quit radio and return to the concert stage in the Fall. Summer moved along and the new announcer failed to startle the world.

Then came the Greb-Wilson bout in late Summer. McNamee described the battle to a radio audience. The response to his word picture of the bout was so overwhelming that McNamee, and WEAF executives, decided his place was before the microphone and not before a sheet music held in outstretched hands.

More Laurels

In the Fall McNamee stepped into the breach and described the Giants—Yankees world's series battle after another man had failed to please the radio audience. More laurels for McNamee.

Football games followed and the radio reporter became known wherever radio sets were installed. In June, 1924, he turned political reporter and "covered" the Democratic National convention. In the months that followed he introduced to the radio audience President Coolidge, John W. Davis, Charles G. Dawes and other famous figures.

The years to follow took McNamee from world's series games to football, from football to championship boxing bouts and through events of national and international importance. Memorial Day this year saw him add the Indianapolis motor races to his list of sports broadcasts.

Expects Nineteen Years More

He described the Republican convention the other week.

He has made numerous personal appearances and occasionally sings over the radio. He has written a book and numerous magazine articles.

He says he expects to celebrate his tenth anniversary as a radio announcer and he hopes to have a twenty-fifth anniversary before the "mike," if not a fiftieth."

Zetka Gets Backing of Clarence H. Mackay

Zetka Laboratories, Inc., a Delaware Corporation, has obtained the support of the Mackay interests. The Radio Communication Company, Inc., of the Mackay System, is affiliated by direct investment in and contract with Zetka Laboratories, Inc., for Zetka tubes for the Mackay Companies, which the Communication Company is using in the radio service it is developing throughout its world-wide system of communication.

Pupin's Aid Obtained

A contract of the Postal Telegraph-Cable Co., with Zetka made available the services of Postal's engineering staff and the advice of Dr. M. I. Pupin, professor of physics and electro-mechanics, Columbia University, N. Y., together with the service of patent counsel of the Postal. In his annual 1926 report to stockholders of The Mackay Companies, Clarence H. Mackay, President stated:

"Under the direction of engineers of the Mackay Companies, new thermionic tubes, which infringe no patents, were devised."

Zetka Laboratories, Inc. is also now supplying the Tri-State Telephone & Telegraph Co. of St. Paul, Minn. with tubes for radio programs to subscribers over their telephone wires. The Tri-State Telephone & Telegraph Co. has over 63,000 subscribers.

Profits Cited

A prospectus sets forth the following:

"The factory of Zetka Laboratories Inc., at Newark, N. J. is equipped to produce 234,000 Zetka tubes annually. Its first years business (1927) during the period of development and equipment, amounted to $144,955.15. For 1928 sales are estimated at $2,362,500 and net profits before taxes at $835,000. A still larger volume of business may reasonably be expected thereafter for Zetka thermionic tubes to supply the vast cable, telephone, telegraph and wireless system operated throughout the world, by the Postal Telegraph & Cable Corporation, representing the recent merger through J. P. Morgan & Co. of the Mackay Companies with the International Telephone & Telegraph Co. and their many associated and affiliated companies with resources of more than one third of a billion dollars."

2,850 Out of 3,000 Fail in 'Mike' Test

The Judson Radio Program Corporation recently explained how it conducts auditions.

The applicant submits a complete history of his or her musical training and experience, with previous experience in operatic, concert, theatrical or broadcasting fields. The applicant is given a number. A committee of six then holds the audition. The committee, except one man, do not know the name of the applicant, nor do they see him or her before or during the audition, but go by the number only. They listen in an audition room or at their desks which are equipped with loudspeakers. They are, however, supplied with a record of each applicant's past musical history, which is identified by the number.

No Bias

The audition committee decides only upon the transmission of the voice or instrument, being unbiased by the personal equation. In short, they are able to judge, just as the radio audience will judge, having no personal contact with the performer.

Since the inception of the corporation about a year ago more than 3,000 applicants have been heard and less than 150, or about 5%, passed as qualified. Some rejected ones make good on a subsequent trial.

"No one fault ranks as the greatest barrier between the applicant and microphone success," says George E. Collins, in charge of this work. "It is generally a combination of two or more faults that spells downfall. An artist generally either qualifies or it is found that he or she is handicapped in several departments of the musical art.

Reasons Stated

"Among the main reasons for failure are the following: microphone fright, temperamental unfitness for broadcasting, ignorance of microphone technique, voice or instrumental technique unadaptible for microphone transmission, faulty diction, a limited repertoire and lack of musicianship."

HIS NAME TURNS "PRO"

Nick Canzonne, who is "Nick the Hand Organ Man" in the Gold Spot Pals program heard on the Blue network, henceforth desires to be known as Nicolai Camponne. "I got professional name, now," he explained.

Coolidge at Lodge Hears N. B. C. Programs

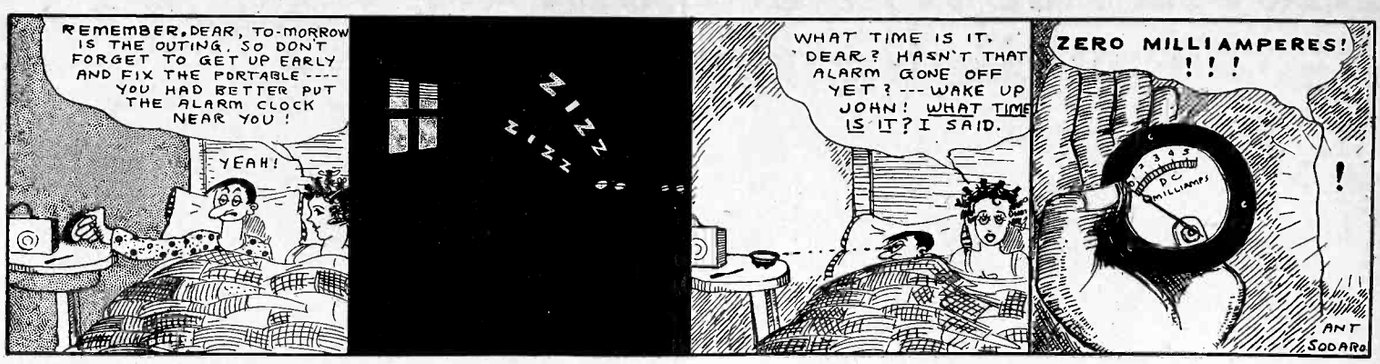
President Coolidge was able to listen in on nationally famous radio programs during his vacation at Brule Lake, Wisconsin. WEBC, owned and operated by the Head of the Lakes Broadcasting Company, at Superior, Wis., became associated with the National Broadcasting Company's system until September 1.

WEBC recently was granted an increase in power by the Federal Radio Commission because of the establishment of the broadcasting to be done by the nation-wide chain.

The proximity of WEBC to Brule Lake assured the President of clear reception at the Summer White House at Brule Lake. WEBC was in the National Broadcasting Company's broadcast of both conventions and, on a weekly basis, will broadcast approximately twelve hours of "sustaining programs," as the type sponsored by the N. B. C. and associated stations are called. These are also interesting.

CURRENT CHRONOLOGY

By Anthony Sodaro



A THOUGHT FOR THE WEEK

ANYBODY will say nobody wants television more than he does. Nobody will say anybody can have it who wants it. Not yet.

RADIO WORLD

Trade Reg. U. S. Pat. Off.

The First and Only National Radio Weekly

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

TELEPHONES: BRYANT 0558, 0559
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Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage; Canada, 50 cents.

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

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1	Page, 7¼"x11"	462 lines	$300.00
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⅛	Page, 4⅛" S. C.	57 lines	37.50
1	Column, 2¼"x11"	145 lines	100.00
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Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities, 10 cents per word. $1.00 minimum.

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

Third Station Quits; Board Plan Winning

Washington.

Radio broadcasters in the Fourth Zone (Mid-West) are alive to problem confronting the Radio Commission in its efforts to carry out the spirit of the amendment to the Radio Act, which requires an equal distribution of radio facilities, said Commissioner Sam Pickard in an oral statement. He had just returned with Radio Commissioner Judge Eugene O. Sykes from a tour of inspection in the zone.

Many proposals for consolidation and for further division of time by which it may be possible for some of the 95 stations in the Fourth Zone now on probation to retain their licenses after August 1 were considered, he said. In the zone, less than 10 per cent of the stations now on the proscribed list will appear in Washington July 9 to contest the right of the commission to revoke their licenses, he declared.

Confident of Solution

While the situation is very acute in this zone because of the congestion, Mr. Pickard felt certain that a solution will be found which will be fair to the broadcasters, improve radio reception and standardize broadcasting.

As evidence of the fine spirit shown by some broadcasters, the Federal Radio Commission made public a letter from Lawrence D. Yont, general manager of Browning-Drake Corporations, Cambridge, Mass., in which Yont voluntarily offers to surrender the license of WLBM. The full text of the letter follows:

"Dear Mr. Caldwell: With reference to the situation concerning our broadcast station, please let me say that I am very much in sympathy with what the Commission is doing and believe that if you could eliminate 200 or 300 stations, the gain will be much more important than the loss of a few insignificant stations such as our own.

Bows to General Good

"As an attorney, the writer recognizes some of the constitutional questions involved, but it is sincerely hoped that the work of the Commission will not be interfered with by legal action.

"We, of course, would like to have our station in operation, but believe that the general good calls for the elimination of at least as many stations as you have scheduled to be dropped."

S. W. Huff, president of the Third Avenue Railway System, a few days previously voluntarily relinquished the license of WEBJ, New York City. WOO, Wanamaker station, Philadelphia, recently quit.

The action of these stations, located in Zone 1, in charge of Commissioner Caldwell, in view of the present emergency in the radio situation, is very pleasing to the Commission, which praised the unselfish patriotic spirit manifested.

Fine Public Spirit

The recent order of the Commission calling upon 162 stations to show cause on July 9 why their licenses should not be revoked August 1 has brought forth a flood of commendatory letters from radio fans. The majority of the stations seems disposed to co-operate with the Commission in its efforts to clear the air and to equalize radio facilities throughout the country to conform with recent legislation.

Board's Plan Praised

A letter to O. H. Caldwell, a member of the Federal Radio Commission, from George C. Waldo, Jr., of the Post Publishing Company, Bridgeport, Conn., congratulating Commissioner Caldwell and the members of the commission on steps taken to eliminate unwanted radio stations, was made public by the commission. The text of the letter follows:

"Dear Commissioner Caldwell:

"Heartiest congratulations to yourself and the other members of the commission on the step you are taking to clear the air by the elimination of unwanted radio stations.

"Your first proposed elimination is a beginning and I hope it will be followed by another cut of equal proportions.

"Don't be bluffed by the wails of interested parties. The right of the public to have good programs is the paramount right.

"I have talked with many interested radio fans and without exception they feel the same as I do. There are too many stations playing the part of dog-in-the-manger and spoiling the programs of really superior stations."

KFI Heard Again in New Zealand

Bringing in KFI on a five-tube set was the record of L. B. Scott of Christchurch, New Zealand, according to a recent dispatch from the Christchurch Star.

Mr. Scott picked up the powerful American station at 10:05 on Sunday night on February 19 and listened to the program for 30 minutes. This is considered quite a record, inasmuch as the Winter season in New Zealand is now over.

Station Cut Protested in State's Rights Plea

Washington

Protests on behalf of New Jersey complainants that the State's rights as to broadcasting are discriminated against, have been laid before the Federal Radio Commission in a series of memoranda and letters, Senator Edwards (Dem.), of New Jersey, announced.

He made public correspondence between himself and certain companies and individuals in the State and with the Commission objecting to curtailment of the broadcasting facilities. He also has received a protest against elimination of the Debs Station WEVD, New York City.

"General Order No. 32, dated May 25," he said, "substantially wipes out New Jersey with the exception of an Atlantic City station and this in the face of Commissioner Caldwell's written assurance given in April that 'I look for a greatly improved situation from the New Jersey standpoint.'"

Plea for State's Rights

The latest in the file of these communications against the New Jersey situation is an official communication received from the Board of Public Works of Elizabeth, New Jersey. It forwards the following resolution adopted by the board.

"Whereas, the Federal Radio Commission, by Order No. 32, dated May 25, 1928, purposes to terminate the licenses of eight New Jersey broadcasting stations, including WIBS of Elizabeth, N. J.; now therefore, be it resolved, that the Board of Public Works, in meeting assembled this 15th day of June, 1928, does hereby record itself as opposed to the elimination of any bona fide station of this State before a reallocation among the zones and States has been made, in accordance with the mandatory provisions of the Radio Act of 1928, whereby the respective rights of the States and stations can be intelligently ascertained."

A letter from W. J. Butterfield, Plainfield, N. J., made public by Senator Edwards to whom it was addressed for reference to the Commission, asked for "equity and fair play in radio.' It stated that the question is one "not only involving State rights but also raises the issue of Monopoly vs. United States Government for control of the most powerful instrument for good or evil, politically and otherwise.'

Raises Monopoly Question

Mr. Butterfield said "we find that instead of the so-termed monopoly and its affiliated stations having 35 per cent of the total power it is proposed that 93½ per cent of such total shall be given to the favored few."

"But this is not all," he added. "High powered stations must have a separation of 20 kilocycles or more. With but 20 kc. separation, 50 such stations would cover the entire broadcast band from end to end. Not a single high-powered station is ruled off the air by the list of 162 stations to be deleted nor has there been any attempt to bring about equality by reducing the power of the stations aimed at by the 1928 act.

"As to the smaller New Jersey stations, I know nothing as to the facts but is it not strange that New Jersey is swept clear of its smaller stations for alleged failure to keep on their wave-lengths and not a single one of the entire third zone is found to be wanting in this respect?"

"Indubitably, the set-up compiled by Mr. Caldwell, increasing the present total U. S. power from 600,000 to 1,712,000 watts, is the antithesis of the prime purpose of the Davis-Dill amendment.

"The real question is whether or not the spirit of the law is to be flaunted by a Commission created by Congress to carry out its mandates, and all powerful interests impose their wishes upon our Government."

Socialist Sends Protest

G. August Gerber, managing director of WEVD, the Debs Memorial Radio Station, in a letter to Senator Edwards, says that station is among those listed for hearing.

"The Federal Radio Commission," Mr. Gerber said, "has notified 162 stations that on July 9 they are to appear in Washington and show cause why their licenses should not be revoked. Those unable to convince the Commission that public interest, convenience and necessity will be served by their continuance will be obliged to discontinue after August 14.

"Among the stations listed for hearing is WEVD, the Eugene V. Debs memorial station, established by friends and admirers of the late Socialist leader on a free-speech station from which minority opinions and political and economic questions might be broadcast.

"Those who hold unpopular opinions and support unpopular causes have the same legal rights as those who are in the momentary majority.

Wants Free Forum Kept

"But on the air they are virtually kept away by prohibitive charges. WEVD alone makes a point of giving them the fullest opportunity freely to express their opinions. It is unnecessary to agree or even to sympathize with their ideas to realize the vital importance of maintaining this only free forum on the air."

This letter quotes Representative Celler (Dem.), of Brooklyn, N. Y., who has protested to the Federal Radio Commission against the revocation of this station's license, as voluntarily announcing his intention to appear before the Commission to argue for its continuance.

* * *

State's Rights Plea Backed by Edwards

Washington

Senator Edwards (Dem.), of New Jersey, authorized the statement that every effort will be made to protect the State rights of New Jersey, insofar as radio broadcasting, wave allocations and wattage are concerned, before the Federal Radio Commission. "I am thoroughly convinced," he also stated, in a letter to D. H. Applegate, Jr., of Red Bank, N. J., "that in view of the wide powers given the Radio Commission by the Radio Act of 1928 that many independent broadcasters throughout the country will undoubtedly test the right of the Commission to eliminate them from the air by bringing proper suits for injunction in the Federal equity courts."

Mr. Applegate and others, including the mayor of Long Branch, N. J., had protested to the Senator against the removal of WJBI at Red Bank. Mr. Applegate forwarded a memorandum which stated that not only New Jersey but Connecticut, Maryland, Virginia, Wisconsin, Missouri, and Nebraska are "outstanding examples of great inequality as compared with New York."

REPORT ON TRIP MADE BY LAFOUNT

Washington

Radio has served to stimulate interest in public affairs and is bound to increase interest and participation in national elections in November, said Harold A. Lafount, a member of the Federal Radio Commission.

Mr. Lafount, who had just returned from an inspection tour of the fifth radio zone, said that people, who have known little or nothing of the workings of the Federal Government and the machinery by which National elections and nominations for office are carried out, are obtaining the information from the radio.

In Touch with World

"It is putting them in touch with the rest of the world educationally and culturally as well as furnishing them with high class amusement,' said Mr. Lafount.

Commissioner Lafount said that he checked up on 44 stations in Washington, Oregon, California, Utah, Idaho, Montana, Illinois, and Wyoming, to see if they measured up to the required standards of efficiency and service.

He also visited several in Ontario, he said, to compare the service rendered by Canadian stations with that given by American stations. He said that he wanted to see what the Canadian Government was doing to improve broadcasting in Canada, and if many people in that country were receiving programs from the United States.

Interest Growing

"I found that interest in radio is increasing everywhere," he said. "Merchants report sales of receiving sets are on the increase, while radio stations report the number of letters received commenting upon the programs or offering suggestions is greater than ever.

"There is more demand for high class programs almost everywhere, and programs are generally becoming more and more instructive and educational. People want dance music and light entertainment, but they also want classical music, speeches, plays, and cultural programs."

Radio Bible Dramas Are Now in Book Form

"Biblical Dramas," broadcast every Sunday night over stations associated with the National Broadcasting Company, now are obtainable in book form.

The book, entitled "Bible Dramas," is from the pen of William Ford Manley, a "Workshop 47" playwright. It contains twelve of the best-known of the long series of radio dramas. Fleming H. Revell Company. New York, publish the book.

Alabama Transferred to Fourth District

Washington.

Effective July 1, 1928, the State of Alabama will be transferred from the Fifth Radio District to the Fourth Radio District, under the jurisdiction of the Supervisor of Radio, No. 524 Post Office Building, Atlanta, Ga., according to an announcement by the Department of Commerce.

NEW PRODUCTS

New Voltage Divider Fits All B Supplies

Since the introduction of the first eliminator there has been a demand for a complete resistance unit so constructed that by simply connecting it to the output terminals of the filter, proper plate and grid voltages for the radio receiver would be obtained under any condition. This resistance unit would be practically universal in eliminator circuits, that is, it would eliminate the use of a special resistance unit for every new design of eliminator or receiver.

To meet this demand on the part of both the professional and amateur builder of B power units, Electrad, Inc., New York City, has designed and placed in production the Electrad Truvolt Divider, a universal voltage separater which greatly simplifies the construction of a B eliminator.

Fine for Power Packs

The Truvolt Divider is an ideal resistor around which to build a power pack. By simply connecting it to the output terminals of the filter circuit of the eliminator it will deliver proper plate and grid voltages to any receiver of present or anticipated design. This is accomplished in the Truvolt Divider by using a wire-wound resistor having five adjustable contacts.

With the Divider connected to the output terminals of a BH, 213 or 280 type eliminator, the following voltages may be obtained from the Divider: a maximum fixed voltage approximately 180 volts, a variable 135 volt, a variable 90 volt, and a variable 45 volt; also two grid biases, each with a voltage variation of about 15 volts. With a conventional receiver the variable B voltage taps may be varied at least 15 volts above or below the mean voltage. Thus the 135 volt tap will supply any voltage between 160 and 110 volts, the 90 volt tap will supply any voltage between 110 and 65 volts, the 45 volt tap will supply any voltage between 55 and 20 volts.

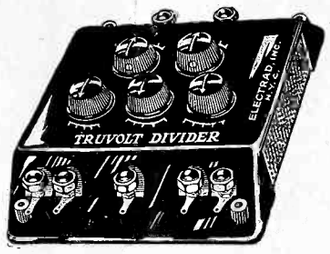
The intermediate grid bias tap will supply a grid bias of from minus 1 to minus 20 volts, the grid maximum bias tap will supply a bias voltage from minus 20 to minus 40 volts. The Truvolt Divider is capable therefore of supplying practically any desired voltage required by a radio receiver.

Versatile Mounting

The Truvolt Divider is not only flexible for all receiver current conditions but it possesses the new quality of calibration of the adjustable contacts. It is also possible by the use of either tables or graphs to adjust the Divider to give the proper specified voltages without the use of an expensive high resistance voltmeter. Tables and graphs with complete instructions are furnished with this unit.

The Truvolt Divider may be mounted in any desired position. It may be screwed down to a baseboard, holes being provided at each corner for this purpose. Included with the Divider comes a mounting angle to set the Divider vertically. Its neat appearance, due to its bakelite base and knobs, lends itself admirably for mounting as a front panel of the eliminator.

Connecting the Truvolt Divider to the eliminator is quite simple. All that is required is to connect the high voltage positive side of the filter to number 1



THE NEW VOLTAGE DIVIDER FOR B SUPPLY OUTPUT, KNOWN AS THE ELECTRAD TRUVOLT DIVIDER

binding post of the Divider, and the negative terminal or low voltage end to number C-7 binding post on the Divider. Soldering lugs are provided on each tap for connecting by-pass condensers.

Then, after the Divider is completely connected both to the eliminator and receiver, the voltage taps may be adjusted to suit the particular conditions of the receiver.

Complete information on the Divider may be obtained by addressing Arthur Moss, c/o Electrad, Inc., 175 Varick Street, New York City, and mentioning RADIO WORLD.

Socket Aerial New Product by Tobe

A NEW SOCKET AERIAL EXPERTLY ENGINEERED

The Tobe 4-Purpose Light Socket Aerial, a new product, plugs into any electric lamp socket or convenient outlet as an antenna, doing away with the outdoor antenna. It provides a safe and efficient antenna for those who live in crowded city apartments. It does away with lightning arrestor, ground switches and similar contraptions. The manufacturer, Tobe Deutschmann Co., Cambridge, Mass., says:

"It is the only antenna plug which allows the use of the light socket for an electrical purpose, such as floor lamps or other electrical attachments, while at the same time providing a safe and efficient antenna for the radio receiving set.

"Also it is the only antenna plug which will fit in any standard baseboard, wall or other type flush receptacle, allowing the use of the receptacle without additional attachments. No need to remove a light from the light fixture to insert an antenna plug, obtaining an aerial at the expense of light.

"Increased selectivity and volume without distortion are obtained. It minimizes static and gives a good clear tone, both on local and distant stations. It uses no current. There is no danger from shocks. The appearance is neat and attractive."

Complete information on this product is obtainable by writing to Mr. Tobe Deutschmann, 11 Windsor Street, Cambridge, Mass. Mention RADIO WORLD.

Victoreen Filament and Audio Supply

(*Continued from page* 11)

In the same fashion exactly is the midtap of the secondary (or center of the heater feeder) made positive in respect to the cathode, for the cathode and the midtap of the 2½-volt winding are connected to the same point. This makes the midtap of the heater feeder positive in respect to the cathode to the same degree that the grid return of the first audio tube is made negative in respect to the cathode.

In other words, the negative grid bias for the first audio tube is obtained in exactly the same way that the positive bias is obtained for the midtap of the secondary feeding that tube.

It will be noted, therefore, that the midtap of the 5-volt winding and the midtap of the 2½-volt winding are connected together. This is what is actually done in physical construction. But electrically they are apart, since there is no circuit link between the two secondaries, each going to a separate tube. You could take three pipes, one feeding water to the two others that spouted water to its destination and none of the water of either of the fed pipes would flow through the other similar pipe. Two horses may drink at the same fountain with the same effect of disunited circuits.

The negative bias afforded by the resistor, from its midtap, for the -27 tube is available for any other tubes in an external circuit, granting the diagrammed hookup is operated and fed with B supply. The lower speaker post is C plus, while C minus Amp. is the negative post.

Once current flows through a resistor the drop is there. No additional connection is required to avail oneself of this drop for an external circuit, except to tap in as required. At a bias or 3 to 4½ volts negative, all radio frequency biases for voltages from 67½ to 100, the only range in practical use, are obtainable. The bias on the first audio tube may be anything more than 1½ volts up to 4½, for a 112 output tube or even a -71 tube. There exists an interrelated effect between the biases of the two tubes.

The leads from the filament transformer to the binding posts may be twisted, if desired, as sometimes this reduces hum. The leads to the pair of tubes in the shield may as well be twisted.

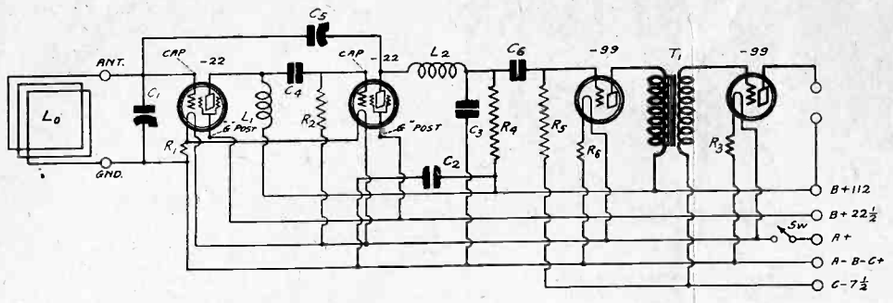
Television in Fall?

London.

John Y. Baird, the Scottish television inventor, hopes to be able to broadcast his first picture program early in September. Anyone who is then provided with a $250 "viewing" attachment to his radio receiver will be able to look in on the newest for home entertainment, he says.

It is planned to have singers sing, actors act, and prominent persons speak before the microphone and the televisor.

Double Shield Set Makes Fine Portable



SCHEMATIC DIAGRAM OF THE DOUBLE SHIELD PORTABLE, WITH OPTIONAL BY-PASS CONDENSERS OMITTED, TO CONFORM PRECISELY TO THE OFFICIAL BLUEPRINT

(*Continued from page 8*)

The layout of parts and particularly the wiring are greatly simplified by following the unique blueprint. This gives the layout in actual size. Next to the layout is a vertical template for the wiring, the various points of connection being shown exactly as on the diagram of the parts layout, but the parts themselves being omitted, only their terminals appearing. This novel method of showing the wiring is exceptionally clear, revealing the wires, and anybody can correctly wire the portable simply by consulting this life-size wiring plan on the blue print. A schematic diagram and list of parts are on this blueprint, besides the actual size layout of parts and the picture diagram of the wiring.

The blueprint diagram is official and correct, and all options are disposed of to best advantage. The parts needed, and those specified on the blueprint, are the same as those published this week.

Some points of reconciliation should dispose of the last details concerning this really attractive and performing receiver.

(*Continued on page 23*)

A and B Eliminator for DC

THE COMPLETED DC ELIMINATOR

Provides A current and voltage for sets using from 4 to 10 tubes, from the direct current house line, also maximum plate voltage of about 105, with 45 volt tap for detector.

Can Easily Be Built, Using Dry Electrolytic Type Condenser. Complete Parts for Any Drain, 4 to 10 Tubes.

$22.50

Perforated Metal Case FREE with each order

WHAT YOU GET—

- Two fuses, automobile type
- One toggle switch
- One relay type switch
- One 30 henry choke coil
- One 2 ampere low inductance choke coil
- One 2 mfd. by-pass condenser
- Two 4 mfd. by-pass condensers
- One electrolytic condenser
- One 90 ohm Ward-Leonard heavy duty resistor
- One 50,000 ohm resistor with mounting clips
- One 20 ohm rheostat
- One 0-6 DC voltmeter
- Seven binding posts
- One standard universal plug-in socket
- One six foot cord with plug
- One 1 foot cord with plug
- One 5¾x7x⅛ inch panel
- One 7x11 inch wooden baseboard

(SEND NO MONEY!)

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Please send me C. O. D. at $22.50 plus small express charge complete parts for DC eliminator to provide A and B current and voltage.
My set draws ( ) filament amperes at ( ) volts or uses the following tubes: .....
.....
NAME .....
ADDRESS .....
CITY..... STATE.....

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USED MOTORCYCLES. Low terms. Also Parts. Accessories. Catalog Free. Western Motorcycle Co. 947 East 15th St., Kansas City, Mo. 12-5-28.

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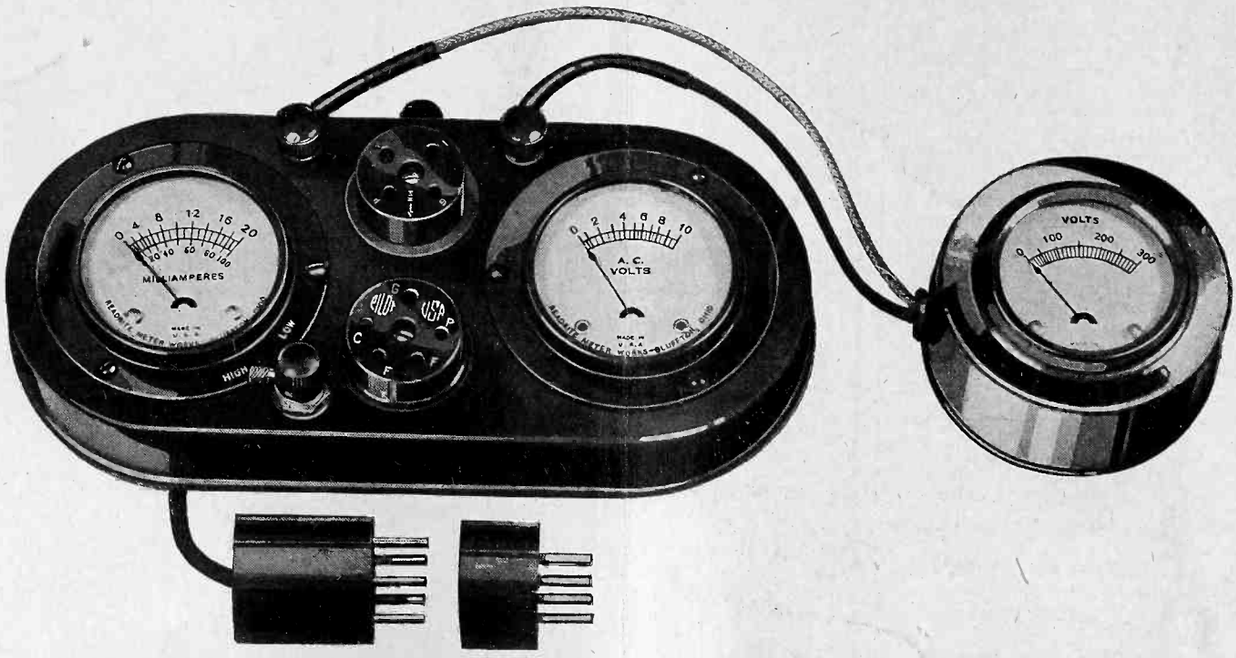
KARAS SHORT WAVE SET, three tubes, 13 to 750 meters, described in the March 31, April 7, 14, 21 and 28 issues. Send 60 cents for these five issues and get blueprint free. RADIO WORLD, 145 W. 45th St., N. Y. City.

THE NATIONAL SCREEN GRID 5, described by James Millen in April 14th, 21st and 28th issues. Fully illustrated, including picture diagrams of wiring. Uses screen grid tube for the single RF stage, four other tubes standard. Send 45c for these three copies and get blueprints free. RADIO WORLD, 145 West 45th St., New York City.

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.,
145 West 45th Street, New York City.

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.

☐ If 0-500 v. high resistance voltmeter No. 347 is preferred, put cross in square and pay $14.50, plus postage, instead of $13.50, plus postage.

☐ One No. 215 alone, $10.00.
☐ One No. 346 alone, $4.50.
☐ One No. 347 alone, $5.50.
☐ Two adapters for UV-199 tubes, $1.00.

NAME .....

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Service Men, Custom Set Builders, Home Constructors, Experimenters, Teachers, Students, Laboratories

Order one of these combination 215 AC-DC testers and 346 meter 0-300 volts. Send no money. Just fill out coupon. If after five-day test you're not delighted, return and purchase price will be promptly refunded! Here's what you get for only $13.50.

(1) One newly-designed Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.
(3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.
(4) One 5-prong plug with 30-inch cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 5-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome noire metal case.
(10) One instruction sheet.

$13.50
SEND NO MONEY

[If 0-500 voltmeter No. 347 is desired instead of No. 346, price of combination is $14.50.]

No. 215 Universal AC-DC Tester Alone..... $10.00
No. 346 high resistance 0-300 voltmeter alone..... $4.50
No. 347 high resistance 0-500 voltmeter alone..... $5.50