The Advantages of the B Battery Eliminator

Its Action and Use Fully Described

By "MEGOHM"

AT the present time owners of battery-operated sets, if they have been using dry B batteries for a while, will be looking for some means of obtaining a more dependable source of high-tension current than they have been employing. The wet B battery or accumulator is undoubtedly good and reliable, and its only drawback is the fortnightly or weekly charge and the cost of the necessary charger, or a trip to the charging garage at frequent intervals. The latter method is a workable expedient where no electric current is available, but where such power can be utilised the B eliminator is a most satisfactory solution of the problem. Once the voltages are regulated by means of the variable resistances to suit the several stages of the receivers, there is no further trouble. First the A battery is switched on, then the eliminator, and it will give high-tension current for as long a time as required, and at a trifling cost. There is not much in an eliminator to cause trouble, and being valve operated, there are no liquids to deal with or spill.

Some of the more recent eliminators also provide C or grid-bias voltages up to as high as 40 volts, which suits a large power-valve. The grid-bias is most satisfactory when obtained from a separate rectifying valve for the purpose, but which need only be half-wave, and as there is no actual current flowing, the smoothing condensers may be of comparatively small capacity.

TYPES OF RECTIFYING VALVES.

B ELIMINATORS may be divided into two classes, according to the type of valve used for rectification of the current after it has been stepped up from mains voltage by means of a transformer, where alternating current is concerned. There is the filament valve, which necessitates a separate low-voltage winding on the transformer to supply a 4 or 6-volt current to heat the filament. Several different types of such valves are on the market. Then there is the type of valve that rectifies without the assistance of a heated filament. The Raytheon tube is the most prominent in this class, the BH type being more generally used, as passing a large amount of current suited to the average multi-valve set, and giving a large margin above actual requirements.

The life of a rectifying valve is usually from one to two thousand hours, depending to some extent upon the amount of current drawn from it, and in the case of filament valves, dependent upon the filament being supplied with the correct voltage, with no tendency to overload.

The Raytheon tube fits the UX socket, the two filament connections representing the two plates, which are connected to the outer ends of the respective high-tension windings of the transformer. The positive output is the usual plate connection on the socket and represents the cathode or metal cap within the valve. This connection runs to the chokes and smoothing condensers, and is the B positive output for each valve, voltage being suitably altered by variable resistances.

B POWER SUPPLY CIRCUITS.

REFERRING to the diagrams, two circuits are presented one showing the connections for a filament valve giving full wave rectification, and the other showing connections when the Raytheon BH tube is employed. The smoothing system is identical in both, except that in the Raytheon circuit a resistance R3 is shown across the output, but this resistance is not indispensable, and may be omitted. In the case of the filament valve there is a low-tension winding on the transformer to supply filament current, and this is adjusted by a suitable rheostat. In the filament valve circuit the B positive is from a tap in the centre of the filament winding, the reason for this being that in the process of rectification, current can only flow from plate to filament in the valve, so that it has to be drawn off at an equally balanced point in the filament circuit, and this point, if correctly determined, is the electrical centre. In actual practice, it works quite efficiently and without introducing hum, if the tap is at the central turn of the winding, though it may not be the exact electrical centre.

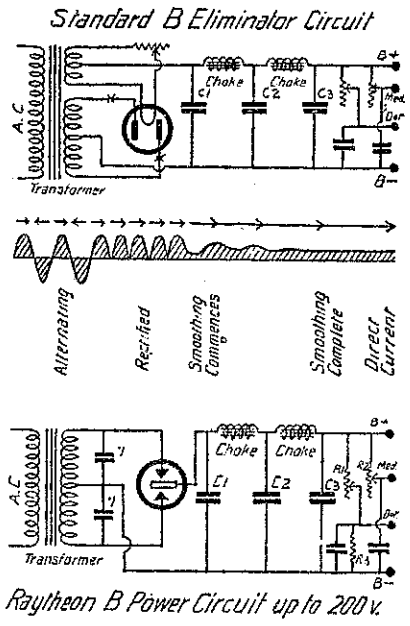
In the Raytheon circuit no filament winding is necessary on the transformer so far as the rectifier is concerned, but in the case of converting a filament valve eliminator to use a Raytheon, the discarded filament winding may be profitably utilised to heat the filament of the last power-valve, and although this current is only raw a.c. at low voltage, no hum is introduced into the receiver.

In the Raytheon circuit two by-pass condensers are placed one across each high-tension winding of the transformer. These assist the action of the valve, and may also have the effect of decreasing any radio-frequency currents induced from the mains. Mains operated sets are frequently said to be less selective than those operating from batteries, but the writer has found that by inserting radio-frequency chokes in a suitable position in the circuit, that eliminator operation can be just as selective as when batteries are used. The presence of these R.F. currents is accounted for by the fact that the mains conveying the current act as efficient aerials and pick up the transmission of a station near the wavelength of that being received, passing these currents into the receiver through the power circuit, ignoring any selective tuning arrangements that may be in the aerial circuit proper. Radio chokes consisting of 1000 turns of fine wire will stop these currents, and all that is needed is to insert a choke in each plate circuit as shown at XX in the standard circuit.

ACTION OF THE CIRCUIT.

BETWEEN the circuit diagrams is one showing the action of the Alternating current is made up of circuit in smoothing out the current. small impulses changing at the rate of 50 to 80 per second. In the case of 50 per second, or "50 cycles," there will be 25 impulses in each direction every second. A few of these impulses are shown in the diagram alternating on either side of a central or neutral line, the short arrows showing the direction of the current for one-half of a complete phase or vibration. This kind of current enters the transformer, and on account of its alternating form, it is able to induce in an adjacent winding a similar amount of current measured in watts, dependent upon the

Standard B Eliminator Circuit



Raytheon B Power Circuit up to 200 v.

ratio between the turns on the secondary winding or windings and the turns on the primary windings. If the number of turns is equal on both primary and secondary, then the same voltage and amperage less a conversion loss, will be obtained from the secondary, and the same gauge of wire would be used on each, unless as in the case of an eliminator, the required output is extremely small. But the number of primary turns must be accurately determined if the transformer is to work efficiently. If secondary turns are more than on the primary, there is a proportional step-up in voltage, but fewer amperes may be safely drawn, so the secondary wire can then be of thinner gauge. If very few turns are on the secondary, we get low voltage, and may draw more amperes to make up the total watts, so that heavy gauge wire must be used, as is the case for filament windings to give say six volts at one or two amperes.

When the current has been transformed, either stepped up or down, it is still alternating, and then passes through the rectifying valve, which only passes current from plate to filament. With the tapped high-tension secondary winding connected as it is, the alternating pulse in one direction travels in the valve from plate to filament from one half of the winding. The next pulse is in the opposite direction, through both windings, but the construction of the valve only allows it to take an impulse from plate to filament, which is now the pulse in the other half of the winding, so that we now have the alternating impulses that were formerly going in opposite directions, now travelling through the output circuit all in the same direction.

The current next encounters in turn smoothing condensers, and one or two choke coils with iron cores. The smoothing condensers have the property of storing up a charge of current momentarily and giving this charge back to the current when its voltage is below that of the stored-up charge. By this means the low-voltage gaps between the "humps" of voltage shown in the diagram are filled in. The action of the choke coil is to stop the passage of fluctuating current, so that only fairly smooth direct current can pass. The last condenser (C3) stores up a charge which is chiefly utilised to provide for any extra demands that may be made on the audio side, and if the placing of a larger power valve in the receiver causes any indication of hum, it is this condenser that should be increased in capacity, the benefit being especially noticeable on the low notes. Output voltages of different values are obtained by reducing the main voltage by means of variable resistances, and in order to prevent any tendency to hum, a fixed condenser is placed across each different output.

TROUBLE FINDING.

AS remarked above, there is little to give trouble in a well-constructed eliminator, but if trouble does develop, it may readily be located and remedied. More often the trouble is in the receiver, and it should be decided by proper tests that the trouble is not in the receiver before commencing upon the eliminator.

The logical place to begin the hunt for trouble in a radio power unit is at the resister bank, and then work backwards through the filter, rectifier tube, and finally the transformer. It is assumed, of course, that the alternating current is known to be flowing through the transformer, and that the rectifier tube is not visibly damaged in any way.

An open-circuited or burnt-out resister will result in no voltage from the tap it controls. If the 10,000-ohm fixed resister becomes open, in the case of the B-power unit, the detecter voltage will immediately increase so that in the tuned radio-frequency receiver the signal strength will be greatly diminished, while in the regenerative receiver there will be constant oscillation.

The simplest method to locate a defective resister is by means of a high-resistance voltmeter, connected to each tap in turn. In fact, this device is essential in adjusting B power voltages to any receiver, in place of the cut-and-dry method. In the absence of this device a 15-watt 230-volt incandescent lamp may be employed. It should glow a dull red on the full output and on the intermediate tap of the B-power unit. If it lights equally bright on the detecter tap, it is an indication of an open or defective 10,000 ohm fixed resister.

If the tap voltages are found to be satisfactory, and the receiver still does not operate well, the trouble may be due to an open or an omitted by-pass condenser. A short-circuited by-pass condenser will act the same as a short-circuited resister.

No Voltage at all Terminals.—This condition can be caused by an open circuit in the wiring transformer, choke coils, or by a broken-down filter condenser.

With power disconnected from the B-power unit and the Raytheon tube removed, a click should be heard in the testing telephone when connected in series with battery between plate terminal of rectifier socket and the positive B of the power unit. A click should also be heard between either filament terminal of the rectifier socket and the negative B of the B-power unit. These clicks should be of equal strength. If one filament terminal gives a much louder click than the other, it generally indicates a defective buffer condenser. If no click is heard on either filament terminal, than the transformer secondary is open-circuited, or the centre tap of the transformer does not connect to the negative B side as it should.

The circuit continuity of the transformer itself may be tested by the click between the two filament terminals of the rectifier socket, with the tube removed. If the transformer secondary tests O.K. on the foregoing procedure, there must of necessity be an open circuit in the negative B lead.

A short-circuit in the secondary of the transformer can be most easily checked by connecting a 25-watt, mains voltage lamp in the series with the primary. The current is now turned on in the usual way, but with the rectifier or Raytheon tube removed from the socket. The incandescent lamp should glow dull, if at all. If it glows bright either the transformer secondary or one of the 1 mfd. condensers is broken down. With the lamp still in the primary, the rectifier tube is inserted in its socket. If the secondary connections are O.K. and the Raytheon is operative, the lamp will increase in brilliancy.

Moving-Coil Loudspeakers.

THE moving-coil loudspeaker is admitted to be the best type at present in existence, and is well suited to large rooms where ample volume combined with quality is required. This type of speaker usually requires about one ampere of continuous current to energise the electromagnet, and this fact makes it somewhat expensive to run, especially where mains current is not available. Its principle depends upon the interaction between the electromagnet and a small coil attached to the back of the cone diaphragm, this coil carrying the current of varying amplitude from the plate circuit of the last audio valve. Small sizes are made with permanent magnets, obviating the heavy current consumption.

New Push-Pull Transformers.

THE first shipment of Ferranti push-pull transformers is aboard the s.s. Westmoreland, shortly to arrive in New Zealand.

B Accumulator Voltages.

The idea of utilising the whole output of a B accumulator and cutting down voltages with resistances in the various plate circuits has one disadvantage, in that a certain amount of current is dissipated in the resistances, thus causing a higher consumption than in the case of employing tappings. The idea is not suited to a dry battery in any case. This method appeared in an American radio journal.

A New Vernier Condenser.

DUBILIER are marketing a new type of variable vernier condenser that will shortly be on sale in New Zealand. This, known as the "Univane," is so designed that each turn of the control knob turns one vane from zero to full-in position, the next turn puts in another vane in the same way until all the vanes are full-in. This allows of very fine tuning in an easier way than when the whole of the vanes move together. To assist in logging, a dial indicates how many vanes are in use. The maximum capacity is .0005 mfd.

WHY VALVES BECOME PARALYSED

PRESENT-DAY dull emitter valves, for the most part, have so-called thoriated-tungsten filaments, the action of which, even at this late date, is not fully appreciated by the average listener. The electronic emission of the thoriated-tungsten filament, according to the chief engineer of the Radiall Company (of America), depends upon the presence of a layer of thorium atoms on the outer surface of the filament.

Thoriated-tungsten.

It will be noted that, unlike the oxide-coated filament found in some valves, the thoriated-tungsten filament is not merely thorium-coated, but it is permeated throughout its entire mass with the rare element thorium. During the normal operation of such a filament the thorium on the outer surface is gradually evaporated, reducing the emission current, and if permitted to continue, rendering the valve short-lived.

However, while the heat of the filament serves to evaporate the thorium particles on the surface, it is also boiling fresh thorium particles out of the mass and up to the surface. Thus the surface is being continually replenished. Just so long as the filament voltage is not increased beyond 10 per cent. above the rated value, this evaporation and replenishing process continues at an equilibrium rate, so that a constant layer of thorium is maintained on the surface.

When subjected to an over-voltage on the filament, however, the evaporation becomes excessive, so that the valve accordingly becomes more or less paralysed. Operating these valves at sub-normal voltages is also liable to paralyse them slowly, as the filament temperature is then so low that the process of boiling out the thorium from the interior of the filament becomes abnormally retarded.

Need for Filament Control.

Hence it is important that the thoriated-tungsten filament valves be operated strictly at their rated voltage by means of hand rheostats with an accurate voltmeter, or, better still and simpler, perhaps by means of self-adjusting rheostats, such as Amperites.

Screen-grid Valve Holder.

A SPONGY rubber valve holder has been introduced for use where the S625 type passes through a screen. The rubber holder is attached to the screen, and holds the centre of the valve in a non-microphonic grip.

QUERIES BY CORRESPONDENCE.

1. Every communication enclosing queries is to be addressed to "Megohm," Box 1032, Wellington, and must be accompanied by a stamped addressed envelope for reply by post.

2. Questions must be written so that a space is left in which the reply may be added.

3. No charge is made for replies.