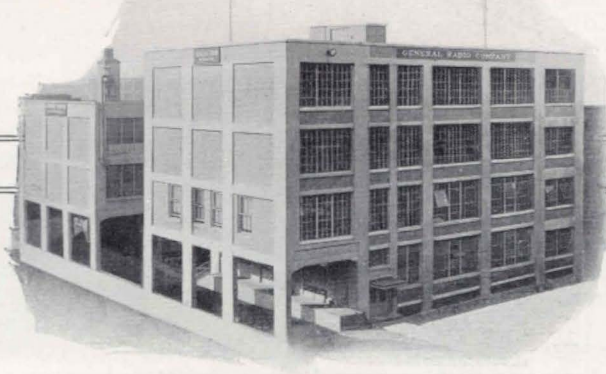
The GENERAL RADIO
EXPERIMENTER



VOL. I NO. 2 JULY, 1926

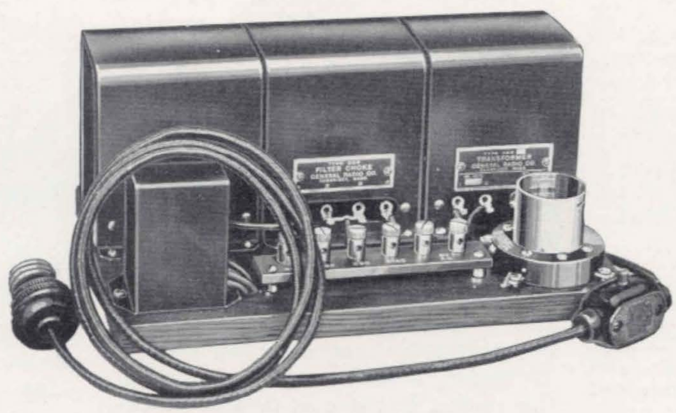
The "B" Battery Eliminator

By H. W. LAMSON, Engineering Department

A careful study has recently been made concerning the design and operation of the "B" battery eliminator using either the Raytheon rectifying tube or the thermionic rectifier, as exemplified by the UX 213 Rectron.

In order that an alternating current, such as that obtained from the ordinary AC lighting circuit, may be available for supplying the "B" battery power for a radio receiver it must first be rectified, that is, made unidirectional in character. One method of doing this consists of utilizing the limited "one way" conducting power of the rectifier tube. If this tube is operated as a "single wave" rectifier one-half of each cycle is suppressed so that, with a sixty cycle AC source, sixty unidirectional pulses of current are passed through the tube per second. Between every two of these pulses there exists a "dead" interval approximately one-half a cycle or 1/120 of a second long during which no current flows through the tube.

When the rectifier is of the "double wave" form 120 unidirectional pulses are passed per second. A double wave rectifier actually consists of two separate rectifiers built into a single unit. It is used in conjunction with a transformer having a center tap on the secondary coil. The two individual anodes of the tube are connected to the extremities of the transformer secondary coil while the common cathodes are connected through the output load to the center tap of the coil. In this manner one of the anodes passes the positive and the other the negative half of each cycle so that there are no "dead" intervals.



Above illustration shows a Raytheon "B" battery eliminator constructed of all General Radio parts. Note neat arrangement of parts and compactness.

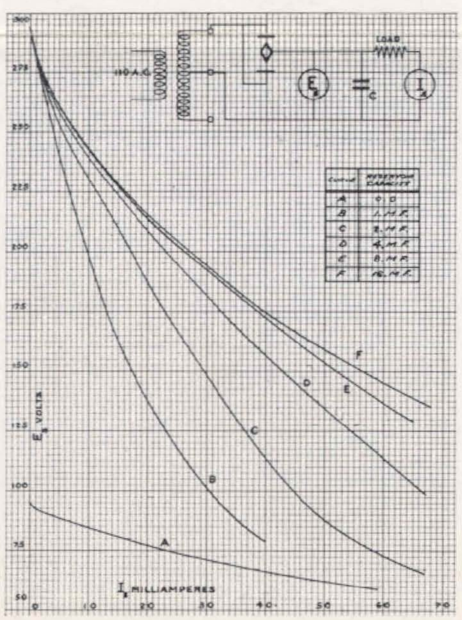


Fig. 1. Showing fall of output voltages as load is increased in single wave rectification using "Rectron" tube.

We shall first consider the "regulation characteristics" of the Rectron tube as a single wave rectifier. (See Fig. 1.) The curves show the fall of the output terminal voltage E_s as the load is increased. Load current I_s was measured with ordinary DC milliammeters while the terminal voltage was measured with a special DC voltmeter drawing only about one microampere per volt, a negligible load. When measuring a pulsating current both instruments give, ordinarily, an integrated mean value of current or voltage. The filaments of the Rectron tube may be conveniently heated by an additional low voltage secondary on the transformer delivering 2 amperes at 5 volts.

Curve A shows that the mean terminal voltage of the rectifier is very low due to the single wave rectification and that it falls with increase of load due to the internal resistance of the tube. When, however, a reservoir condenser of even a moderate value (curve B) is placed across the output the open circuit voltage jumps up to approximately the peak value supplied by the transformers. This is because a few instantaneous applications of this peak voltage are sufficient to force enough charge into the condenser to raise its potential to this value and, if this charge cannot leak away, due to the "one way" conductivity of the tube, the peak voltage is maintained when there is no external load. When, however, an external load is drawn from the tube the output voltage falls rapidly as the limited charge thrown on the condenser at the peak of every other half-cycle leaks away to supply the load current during the "dead" intervals. The remaining curves of Figure 1 show how increasing the capacity of the reservoir condenser serves to maintain the output voltage under a load, causing, thereby, a slower drop from the open circuit peak value.

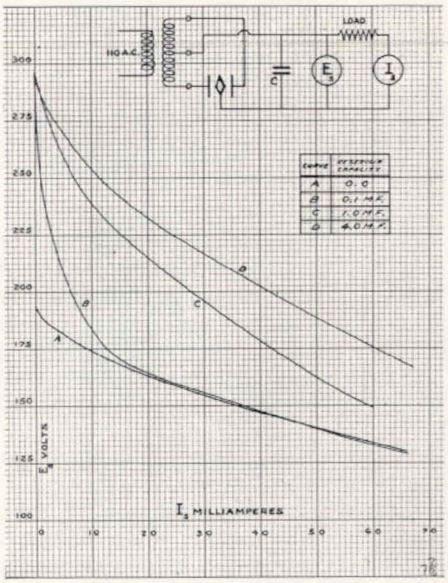


Fig. 2. Showing fall of output voltages with double wave rectification as load is increased using Rectron tube.

Figure 2 shows a similar set of curves for the Rectron tube used as a double wave rectifier. It will be noted that curve A (no reservoir condenser) is considerably higher than in Figure 1. This is, of course, due to the fact that mean values of 120 impulses are being measured, there being no "dead" alternate half cycles. As before, the addition of a reservoir raises the open circuit voltage to approximately the peak value of the transformer. The improvement in regulation and increase in capacity of reservoir is not so pronounced as in the case of the single wave Rectron. This is, of course, to be expected.

Figure 3 shows a set of characteristic curves taken in a similar manner with the Raytheon tube used "double wave." With no reservoir condenser (Curve A) the output voltage drops very sharply for the first few milliamperes of load and subsequently falls away more slowly. The introduction of a reservoir condenser raises the initial open-circuit voltage to a certain peak value. Increasing the reservoir improves the regulation, as in the case of the Rectron. A comparison of figures 2 and 3 shows that, with the same reservoir condenser, a given load may be drawn from the Rectron at a considerably higher voltage than in the case of the Raytheon. This is due in part to the fact that the Raytheon does not "break down" and pass current until a considerable fraction of the peak voltage is applied to it, causing thereby a greater drop of voltage in the tube.

Having rectified a sixty cycle alternating current into a pulsating current with a frequency of 120 the next step consists of "filtering" or smoothing out the impulses to give a steady flow of current into the load. Figure 4 shows a set of curves taken with the Raytheon tube using a one-section filter net work. This consists of a choke coil of approximately thirty henrys in series with the output load and two condensers, C1 and C2, connected in shunt across the line leading to the load. The choke coil offers a strong opposition to a pulsating current so that the successive impulses from the tube tend to pile up a charge on the reservoir condenser C1, which, however, immediately proceeds to discharge at a uniform rate through the choke with little difficulty, as the resistance of the choke to a steady direct current is comparatively low. A small amount of ripple, however, passes through the choke, but this is, to a large degree, absorbed by the reservoir action of the second condenser, C2. If we desire a more perfect filtering

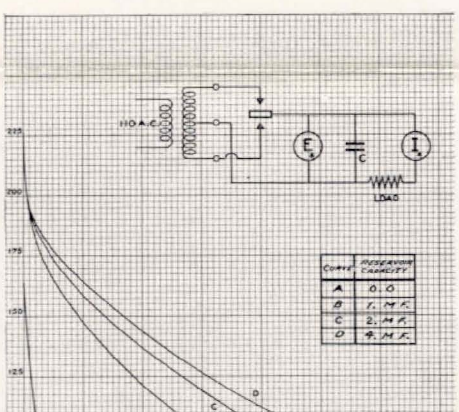


Fig. 3. Curves illustrate voltage drop with increased load using double wave rectification with Raytheon tube.

a two section filter composed of two chokes and three shunt condensers may be employed.

Referring again to Figure 4, the curve A shows a regulation obtained when each condenser has a value of 2 MF. Curve B shows the improvement in regulation when the output condenser, C2, is increased to 8 MF, while curve C shows the greater improvement obtained, on the other hand, by increasing the reservoir condenser to 8 MF. We see thus that the reservoir condenser is more important in controlling the regulation.

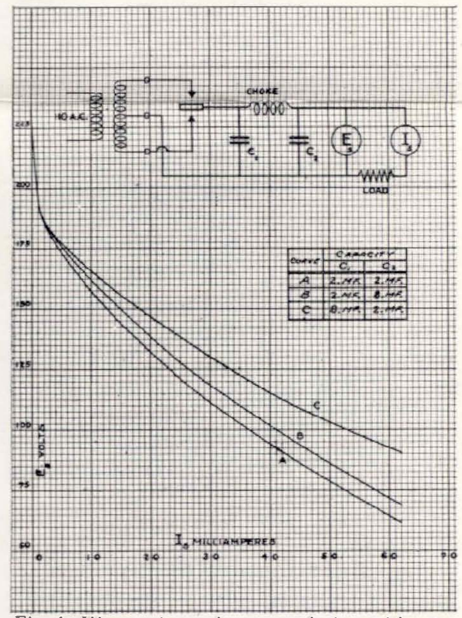
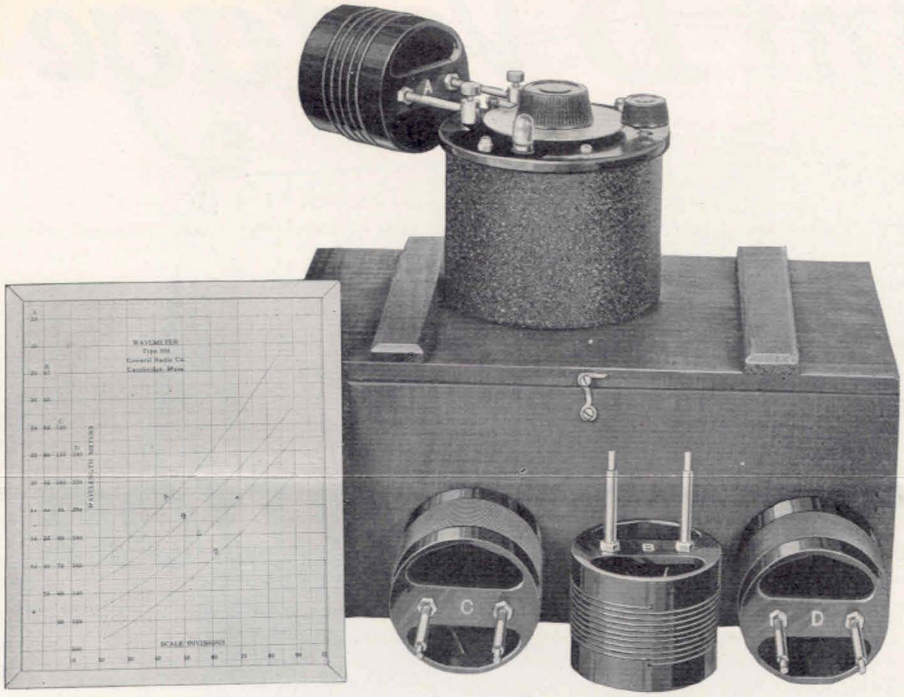


Fig. 4. Illustrating voltage regulation with various filter combinations using Raytheon tube.

Measurements of the ripple passing into the output load, made by means of an oscillograph, show, on the other hand, that the output condenser, (that directly adjacent to the load) is most effective in eliminating the ripple (hum) in the output. These considerations hold equally well with a filter of three or more actions.

Increasing the size of any one of the condensers improves both the regulation and the hum. However, a practical limit is soon reached at from three to four microfarads each in the three condensers of a two-section filter. Both experiment and theory verify the fact that, given a certain total capacity to the filter, the best regulation and the least hum are always obtained by dividing this total capacity into equal units, that is, making all the condensers of the same value. This applies to the hum actually coming through the filter and not to any ripple which may be picked up independently on a radio receiver fed by the eliminator. This latter point is being investigated at present.

A New Amateur Wavemeter



In the type 358 wavemeter, illustrated above, the General Radio Company presents a wavemeter particularly designed for amateurs.

For the lack of a more accurate standard of checking his wavelength the amateur has had to rely largely upon some one else receiving his signals to determine his wavelength.

Though this method is generally satisfactory the advantages of using a carefully constructed and accurately calibrated wavemeter are apparent without further comment; especially in view of the increasing interest in two way short-wave-length communication.

On the short wavelengths particularly, only a slight swing in wave-length is required to carry the note of a station beyond audibility—thus interfering with the quality and intensity of signals.

By using a reliable wavemeter the operator of a transmitting station may conveniently check his wave-length and consequently assure himself that his full power output is radiated on the wavelength he is intending to use.

The type 358 wavemeter is designed particularly for experimental use. As it covers a wavelength range of 15 to 225 meters it covers all the amateur bands in common use. In general appearance the 358 wavemeter is somewhat similar to the well known type 247 wavemeter and filter. The coupling coil of the latter has been dropped, however, and an indicating lamp has been substituted.

The wavemeter consists of a mechanically rugged coil of low loss construction, mounting directly on the binding posts of a shielded condenser. The condenser capacity is 125 MMF. Mounted on the condenser panel and connected in series between the condenser and coil is a resonance indicator in the form of a small lamp. The lamp socket is so arranged that it is short circuited when the lamp is removed.

The range 15 to 225 meters is covered by means of four coils, plugged into a condenser which is enclosed in a metal can. Unlike the type 247W meter which uses a direct reading dial with a multiplication factor for the various coils, the new instrument is supplied with a calibration curve for each coil, with an accuracy of 1%.

The coil ranges, providing adequate overlaps, are as follows.

Coil A	14 to 28
Coil B	26 to 56
Coil C	54 to 114
Coil D	105 to 220

Coil A, B and C are space wound on threaded bakelite forms. This assures accurate and permanent calibration.

The condenser, coils and chart are contained in a wooden carrying case which provides proper protection for the instrument when not in use.

The wavemeter complete, sells for $22.00.

A New Tube and a New Transformer

A new tube of great interest to all owners of storage battery sets has been announced by the Radio Corporation. It is the 200A detector tube. This tube is said to have all the good qualities of the old type 200 without its high current demand and sensitivity to plate voltage variation.

The new tube requires only one quarter ampere filament current at 5 volts, the same as the 201A type. The plate potential is not critical but 45 volts is recommended.

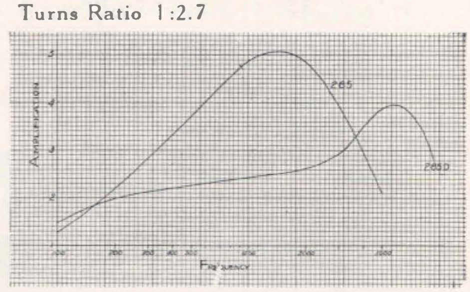
"The UX-200A has a greater sensitivity than any existing special detector tube," it is claimed. "It may be used in any receiver of the storage battery type without change or special adjustment." "Its internal resistance is such that it may be used with either resistance or transformer coupling. The new detector tube is absolutely stable and provides reliable operation at all times with no more critical adjustment than required with standard 'hard' tubes."

The tube data is as follows:
Design—same as standard UX 201A
Base—same as standard UX 201A
Filament voltage—5
Filament current—.25 amp.
Plate voltage—45 maximum
Plate current—2 milliampere
Plate impedance—28,800 ohms
Grid leak—2 megohm
Grid condenser—.00025 microfarads

Attention is called to the very high plate impedance of the 200A tube which makes necessary the use of a transformer particularly designed for it if good quality is to be obtained.

To meet this need, the General Radio type 285D transformer has been designed. This transformer has a sufficiently high input impedance to work efficiently with the new tube. Its characteristics are as follows:

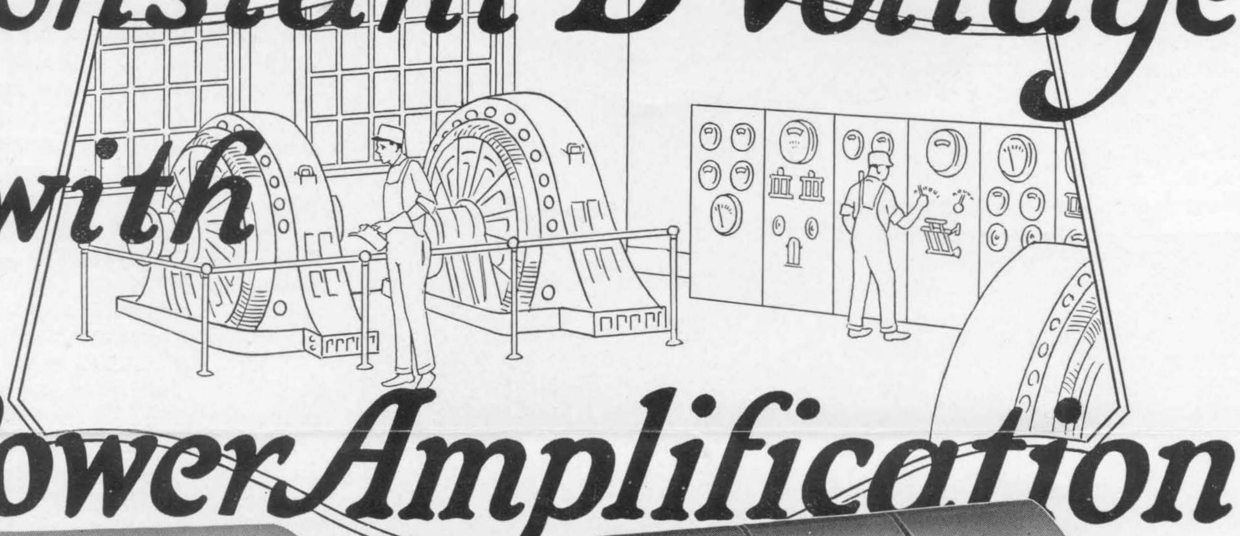
Pri. Imped. 375,000 ohms—Resist. 2200 ohms.
Sec. Imped. 3,000,000 ohms—Resist. 8300 ohms.
Turns Ratio 1:2.7

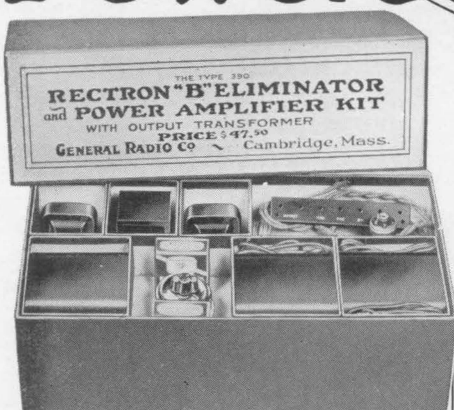


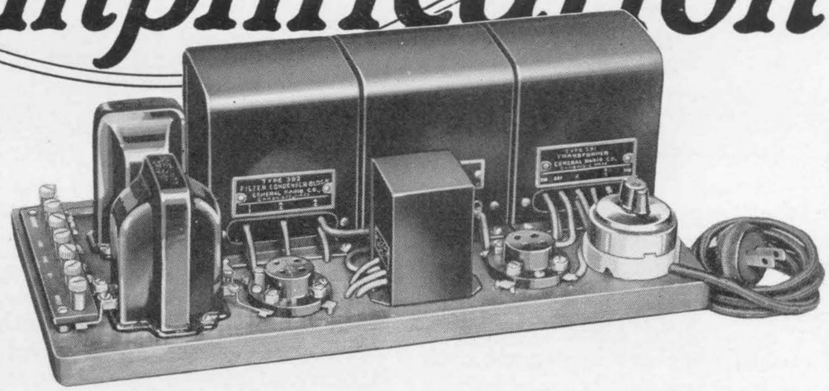
The curve above gives a comparison between the type 285D and the type 285 transformers, when both are used in the output of a 200A tube.

This advertisement appears in the August issue of Radio Broadcast, Popular Radio and Radio

Constant "B" Voltage with Power Amplification







For a dependable "B" eliminator—power amplifier unit which will enable your loudspeaker to deliver greater volume with a tone quality that is amazing, buy a General Radio Rectron "B" Eliminator — Power Amplifier kit and carefully follow the few simple instructions for assembling the unit.

Price of Kit, including all parts and drilled baseboard

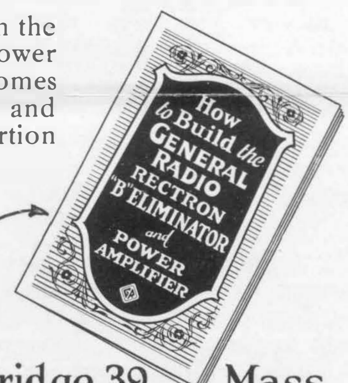
$47.50

A properly built "B" eliminator operated from the lighting circuit noticeably improves the consistent quality of reception. It provides a constant, silent flow of current that makes it as dependable as the power station itself.

Worry whether the "B" batteries are run down and their continual replacement is forever abolished by the use of a reliable "B" voltage supply unit. Once installed and adjusted is ready for years of constant service.

A Power Amplifier in conjunction with the "B" eliminator permits the use of a high power tube in the last audio stage. This overcomes the tendency toward tube overloading and removes the most common cause of distortion in loudspeaker operation.

Get this Booklet



Ask your dealer or write today for our pamphlet "How to Build a Rectron "B" Eliminator and Power Amplifier."

GENERAL RADIO Co. Cambridge 39, Mass.

GENERAL RADIO
INSTRUMENTS

Behind the Panels of Better Built Sets