How *to* Build *the* GENERAL RADIO RAYTHEON "B" ELIMINATOR *and* POWER AMPLIFIER

Installation and Operation

When used with a highly sensitive radio set the kit should be located at least three and preferably five feet away. If used with a less sensitive receiver it may be found, on trial, that a smaller distance will be satisfactory. On the other hand, a much greater separation is not desirable. The attachment plug and cord, extended if necessary, should be run to a lighting receptacle or wall outlet and should be kept as far as practicable from all wires leading to the radio set, including antenna and ground.

Two or three wires for carrying the "B" battery potentials to the set may be run in the usual manner. The output from the radio receiver should be carried to the input terminals of the kit by a double telephone cord or a pair of twisted leads which should be kept separate from the "B" battery leads. A similar conductor should be used connecting the loudspeaker to the output terminals.

Under certain conditions better quality can be obtained merely by interchanging the input leads at the input terminal posts.

The majority of radio sets have the positive or negative filament terminal connected to ground. This provides a sufficient grounding for the eliminator. With sets wherein the filaments are not grounded and those employing an ungrounded loop, it may be advisable to ground them through a condenser of from two to four M. F. capacity. This ground is unnecessary in many cases but under certain conditions it is desirable to reduce the alternating current hum. If the kit is used merely as a power amplifier it may be desirable to ground the B— terminal.

A word of caution should be added here concerning the attempt to measure the voltage at the "B" battery terminals of the kit. The ordinary, inexpensive, voltmeter draws so much current that the increased load on the kit lowers the voltage considerably so that the readings of such a meter are meaningless unless the meter load is known and taken into account. Reliable results may be obtained by using a five milliampere meter connected in series with a resistance of 100,000 ohms. Such a voltmeter draws only one milliampere per 100 volts deflection, which is permissible.

Tests have shown that, on the average, using the type HB Raytheon and with the UX-171 tube in the circuit, the open circuit voltage at the +90 terminal is about 145. This potential drops at a rate of 3.25 volts per milliampere of current drawn from this terminal. The open circuit voltage at the +40 volt terminal is about 50 and this diminishes at a rate of 2.23 volts per milliampere load from this terminal. These values meet the requirements of the great majority of radio receivers.

It is possible to use either a UX-112 or a UX-210 tube for the power amplifier, but for the best quality of reproduction the UX-171 tube is recommended.

Constant "B" Voltage *with* Power Amplification

Improved quality of reception, free from anxiety caused by steadily deteriorating "B" batteries, is now possible through the use of a properly designed "B" eliminator.

Expensive and bothersome battery renewals are now quite unnecessary. Wherever A. C. 110 volt (60 cycle) lighting current is available the "B" eliminator is by far the most practical and satisfactory method of supplying "B" voltage for all kinds of radio receiving sets. Once installed a "B" eliminator requires no further attention and is ready for years of unfailing 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.

A properly assembled General Radio Raytheon "B" Eliminator and Power Amplifier will enable your loudspeaker to deliver greater volume with a tone quality that is amazing.

Price of kit, including all parts and drilled baseboard, $50.00.

GENERAL RADIO
INSTRUMENTS

"Behind the Panels of Better-Built Sets"

INSTRUCTIONS *for* Assem

ONE of the necessary requirements of any radio receiver using vacuum tubes as detectors or amplifiers is the so-called "B" battery, the chief function of which is to supply a relatively high positive charge to the anodes or plate terminals of the tubes. This positive potential is necessary in order that the negatively charged electrons emitted from the hot filament of the tube may be drawn across the intervening space to the plate and a current of electricity established.

The most universal method of supplying this positive potential is by the use of small dry cells, which are usually supplied assembled in block units of multiples of 22½ volts. Such batteries are limited in their useful life and, upon aging, are apt to give an unsteady voltage which introduces troublesome noises into the radio receiver. Furthermore, they deteriorate even while not in use, affording, thereby, an uncertain service and requiring inconvenient and rather expensive renewals.

Batteries constructed of groups of small capacity storage cells are frequently used for supplying the desired "B" voltage. Such units, while quite satisfactory for the purpose, require proper charging and considerable attention to keep them in prime condition. They are cumbersome and difficult to keep properly clean and so are rather undesirable to the average man who desires a maximum amount of service for a minimum amount of attention from his radio.

The electric lighting service with which the great majority of homes are equipped affords a very inexpensive source of electrical power for "B" battery purposes. Except within limited metropolitan areas this service is almost universally supplied by 60 cycles alternating current. Before this alternating current can be utilized for the purpose it must first be rectified or made to flow in a single direction and then filtered to convert the intermittent ripple of current into a continual steady flow. The rectifying device and the filtering system constitute the chief components of the "B" battery eliminator.

The great majority of radio sets using low power vacuum tubes, that is, tubes having filaments which draw such small currents that they may be lighted by means of dry cell "A" batteries, are rarely able to supply a sufficient power output to operate a loudspeaker successfully without danger of overloading the last tube of the audio amplifier. Such over-

mbling *the* General Radio Type 39
and Power Amplifier Kit

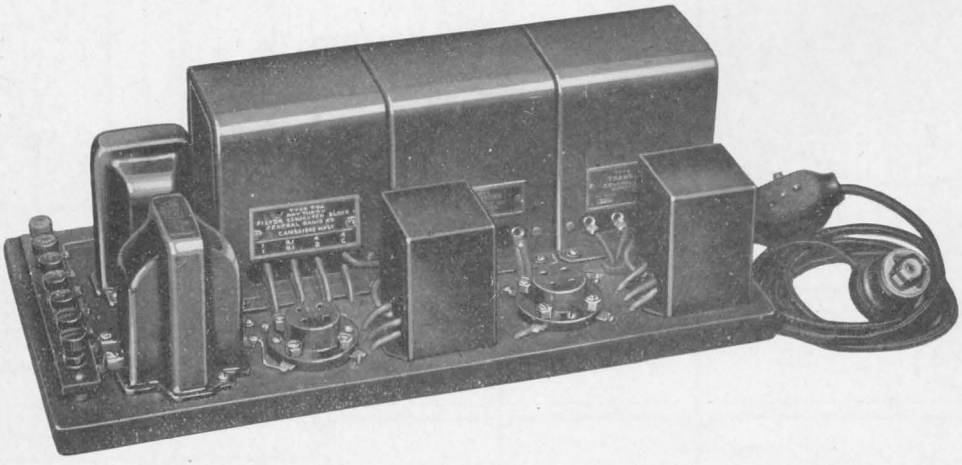


Figure 1

Showing the General Radio Type 395 Raytheon "B" Eliminator and Power Amplifier Kit fully assembled and ready for operation.

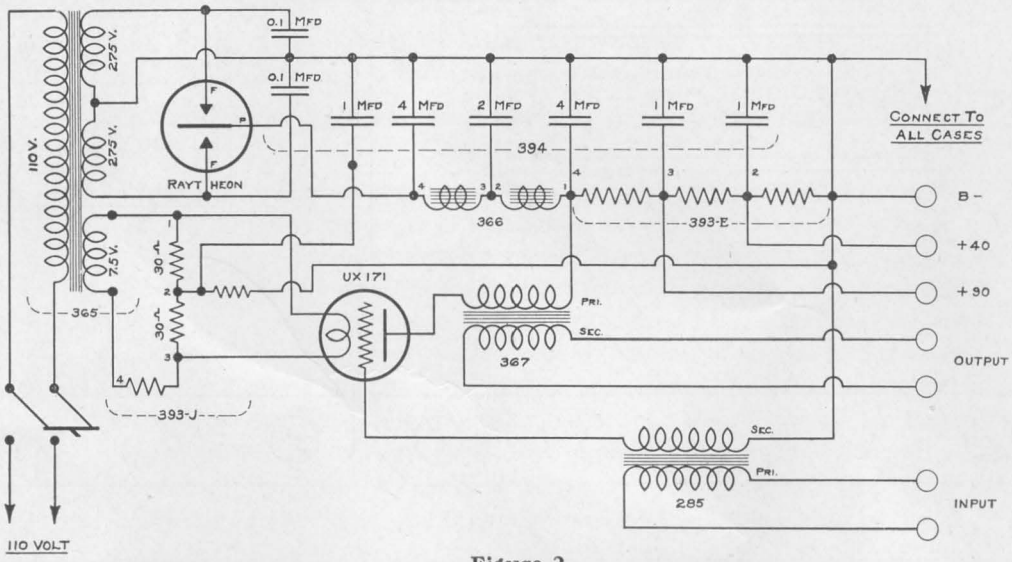


Figure 2

Schematic Diagram of the Type 395 Raytheon "B" Eliminator and Power Amplifier.

95 Raytheon "B" Eliminator

loading invariably causes a distortion of the reproduced music or speech and seriously cripples what would otherwise be an excellent radio set. The use of a higher power tube in the last audio stage is, then, quite desirable, but such tubes require more filament current than may be economically drawn from dry cells, while on the other hand, a storage battery is so troublesome that many persons continue to use the smaller power tubes.

To overcome this difficulty the General Radio Company have incorporated a power amplifier unit into their "B" eliminator kit. This power amplifier, which should comprise the last stage of audio amplification, employs alternating current of the proper voltage for lighting the filament of a vacuum tube designed to handle a sufficient intensity of signal to give true and undistorted music and speech on a loudspeaker with all the volume desired under any ordinary circumstances.

The Type HB Raytheon tube rated at 80 milliamperes is used as the rectifying device in this kit. A suitable transformer, Type 365, was designed for use with this tube. The primary coil is connected through a switch to the ordinary 110 volt 60 cycle house lighting current. The transformer has two secondary coils, one of which has an open circuit voltage of 550 and is provided with a center tap. The other secondary coil provides a voltage of about 7½ and is intended to afford current for lighting the filament of the power amplifier tube.

The filter circuit comprises two choke coils mounted in a single unit, Type 366, and a block of waxed paper condensers mounted as a separate unit, Type 394. Extensive experiments have shown the filter combination of four, two, and four microfarads to be quite satisfactory for the purpose. The Type 394 unit also contains two 1 microfarad condensers used as by-pass capacities across certain portions of the resistance unit, and also two 0.1 MF condensers which are required across the high voltage secondary coils to afford the proper operation of the Raytheon tube. Such a filter system passes a steady flow of current with an entirely negligible amount of hum. Any noticeable hum observed on a radio set used with this kit must necessarily arise from some other source such as induction from power mains, etc.

In order that the various "B" battery voltages may be obtained for use in the radio set the Type 393-E resistance unit is connected across

the output of the filter. Various "B" eliminators on the market make use of adjustable resistances for this purpose, whereby variations of voltage may be obtained according to the output of current furnished to the set. In the great majority of cases such adjustments are troublesome and are of little real value. Furthermore, the various resistance units employed are of such a nature that they are apt to be quite irregular in action giving rise to troublesome noises in the circuits. The Type 393-E resistance unit is constructed of a series of wire-wound fixed resistances so proportioned, after careful study, as to give the desirable voltages required by the great majority of sets and to maintain these voltages with a sufficient approximation with the "B" battery currents which are drawn by all except the abnormally heavy duty sets.

Two voltage taps are provided for use with the radio receiver, one giving about 40 volts and the other about 90 volts. For use on the detector tube and the small power amplifier tubes the 40 volt tap is recommended, while the 90 volt tap provides a source of higher potential for use with amplifier tubes when desired. The still higher voltage required by the UX 171 power amplifier tube is supplied directly from the set, likewise the 30 to 40 volt "C" bias required by this tube.

By substituting a different resistance unit for the Type 393-E a variation in the available voltages may be obtained, but it was decided that the unit as designed would fit the great majority of sets, would require no bothersome adjustments, and would be thoroughly reliable in operation.

The Type 393-J resistance unit contains a resistance of 60 ohms, which is connected directly across the filament of the power amplifier tube. This 60 ohm unit is tapped at its center point to provide a symetrical return for the grid circuit, a procedure which is desirable when employing alternating current for heating the filament of the power amplifier tube. The 393-J unit contains also the proper series resistance to give the correct voltage across the filament of the power amplifier tube and an additional resistance for biasing this tube.

For use with the power amplifier the Type 285 input transformer having a ratio of 1:6 is employed. This operates very well in conjunction with the UX 171 tube. This tube has only a moderate amplification factor but is designed to handle an unusually large signal without distortion, which is the more important consideration in a power amplifier. No rheostat is used with this tube, the proper voltage being obtained by the use of the 393-J resistance unit as described above. Thus there are no adjustments whatever to cause trouble, a desirable feature.

The Type 367 output transformer is used in the plate circuit of the power amplifier tube. This removes the direct current from the loudspeaker, helps still further in reducing distortion, and is in other ways desirable.

Assembly of the Kit

The kit contains the following parts:

1. One panel board properly drilled for mounting the various pieces of apparatus.
2. One power transformer, Type 365.
3. One filter choke, Type 366.
4. One filter condenser block, Type 394.
5. One input transformer, ratio 1:6, Type 285.
6. One output transformer, Type 367.
7. One resistance unit, Type 393-E.
8. One resistance unit, Type 393-J.
9. One vacuum tube socket, Type 349, for the Raytheon tube.
10. One vacuum tube socket, Type 349, for the power amplifier tube.
11. One terminal strip.
12. One attachment plug and cord.
13. One Cutler-Hammer through cord switch.

Figure 2 shows the schematic wiring diagram and Figure 3 illustrates the actual arrangement of parts and the interconnecting wires. A large part of the wiring is done under the panel which is drilled to accommodate the various wires. It is best to have this under-panel wiring run in straight lines, point to point, so that the wire may be pulled taut and be free from sagging. For convenience the terminals of the condenser block and the two resistance units are brought out in the form of flexible leads. Care should be taken in soldering the various joints to obtain firm and clean junctions, avoiding excess of soldering paste.

It is advisable to follow the procedure outlined below in assembling the kit:

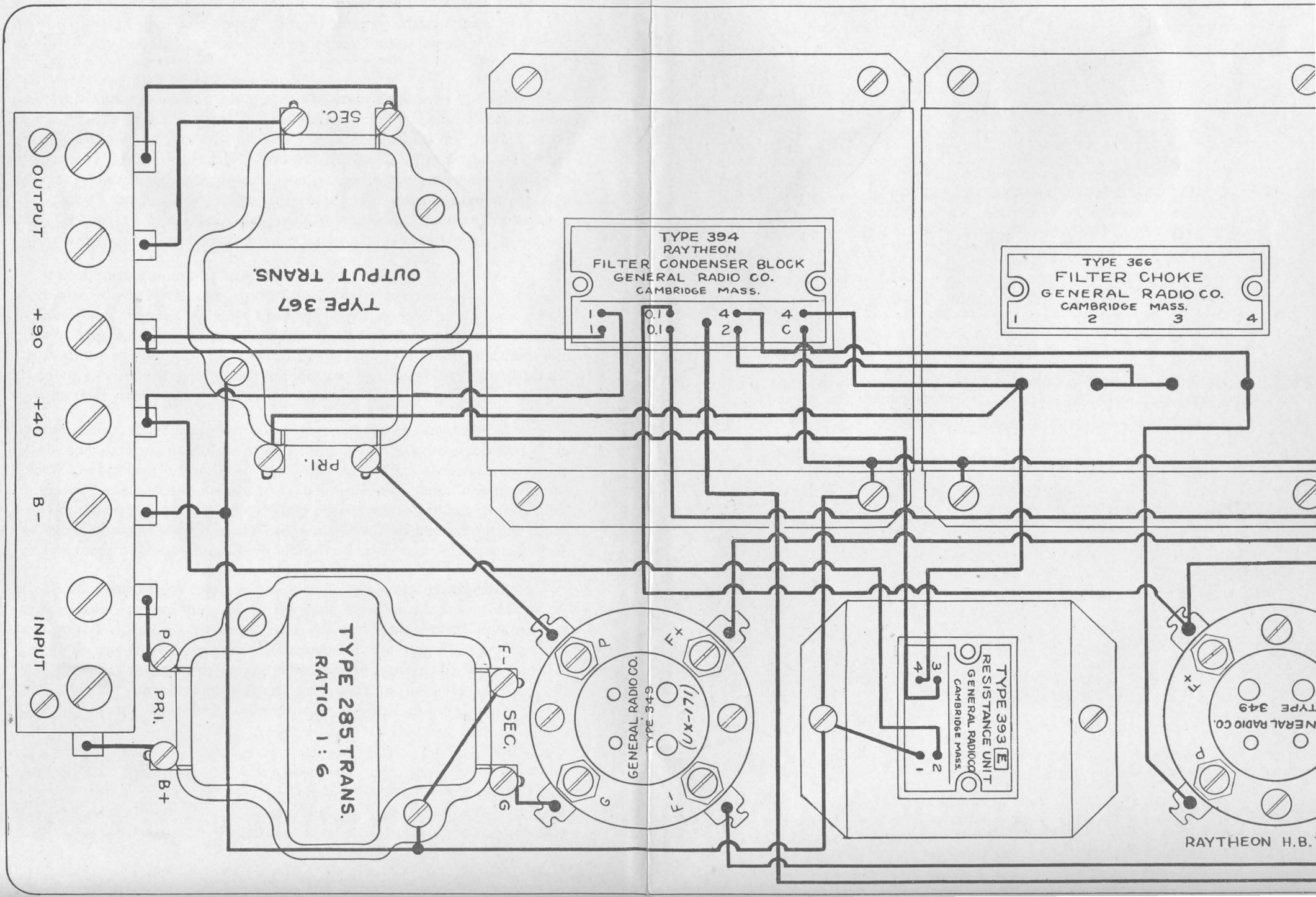
1. Mount all parts on the panel in exactly the arrangement shown in Figure 3. The three large cases are mounted with four through machine screws, each having a nut and washer underneath the panel. Each of the four small cases is mounted with one through machine screw and one wood screw. The two sockets and the terminal panel are mounted with wood screws, metal spacers being used to raise the latter above the panel. The socket between the resistance units is to hold the Type HB Raytheon Tube; the UX 171 amplifier tube being placed in the socket adjacent to the Type 285 Transformer.
2. By means of a continuous bare wire run under the panel join, with soldered connections, one screw of each of the seven cases of items 2 to 8 (inclusive) above, and bring this wire to the B— terminal post.
3. Connect onto this "common" wire, the center tap of the 550 volt transformer secondary, the "C" lead of the condenser block, the F— terminal of the Type 285 transformer, and the No. 1 lead of the Type 393-E resistance unit.

4. Connect the primary terminals of the power transformer (marked 110) through the snap switch to the attachment plug. The attachment cord should run through a bushing in the board; should then be fastened with a fiber clamp under the board and finally passed through the cord switch to the attachment plug.
5. Connect the No. 1 lead of the Type 393-J resistance unit under the panel to the No. 4 terminal of the Type 365 transformer.
6. Connect the No. 4 lead of the Type 393-J resistance unit above the panel to the No. 3 terminal on the Type 365 transformer.
7. Connect the No. 2 lead of the Type 393-J resistance unit under the panel to the single terminal on the condenser block.
8. Connect the No. 3 terminal on the Type 393-J resistance unit under the panel to the F— terminal of the amplifier socket.
9. Connect the F+ terminal on the amplifier socket under panel to the No. 4 terminal of the Type 365 transformer.
10. Connect the two terminals of the 480 volt secondary coil under the panel to the F+ and F— terminals of the Raytheon tube socket.
11. Connect the P terminal of the raytheon socket under the panel to the No. 4 terminal of the filter choke unit.

11. Connect the P terminal of the Raytheon socket under the panel to terminal No. 4 on the choke. Connect the other 4 MF condenser lead above panel to the No. 1 terminal of the choke.

13. Connect the 2 MF condenser lead under panel to terminals No. 2 and No. 3 of the choke, which should be tied together with a jumper.
14. Connect one of the 1 MF condenser leads under panel to terminal post +90 and the other to terminal post +40.
15. Connect one of the 0.1 condenser leads under panel to the F+ and the other to the F— terminal of the Raytheon tube socket.
16. Connect the No. 2 lead of the 393-E resistance unit under panel to the +40 terminal post.
17. Connect the No. 3 lead of the 393-E resistance unit under panel to the +90 terminal post.
18. Connect the No. 4 lead of the 393-E resistance unit above panel to the No. 1 terminal of the choke.
19. Connect the primary terminals of the Type 285 transformer to the input terminal posts as shown.
20. Connect the secondary terminal of the Type 285 transformer, MARKED G, to the grid terminal of the amplifier tube socket.
21. Connect the secondary terminals of the Type 367 transformer above panel to the output terminal posts as shown.
22. Connect one primary terminal of the 367 transformer above panel, as shown, to the plate terminal of the amplifier tube socket.
23. Connect the other primary terminal of the 367 transformer under panel to the No. 1 terminal of the choke, completing the assembly.

Full-Scale Pictorial Diagram of General Radio F and Power Amplifier



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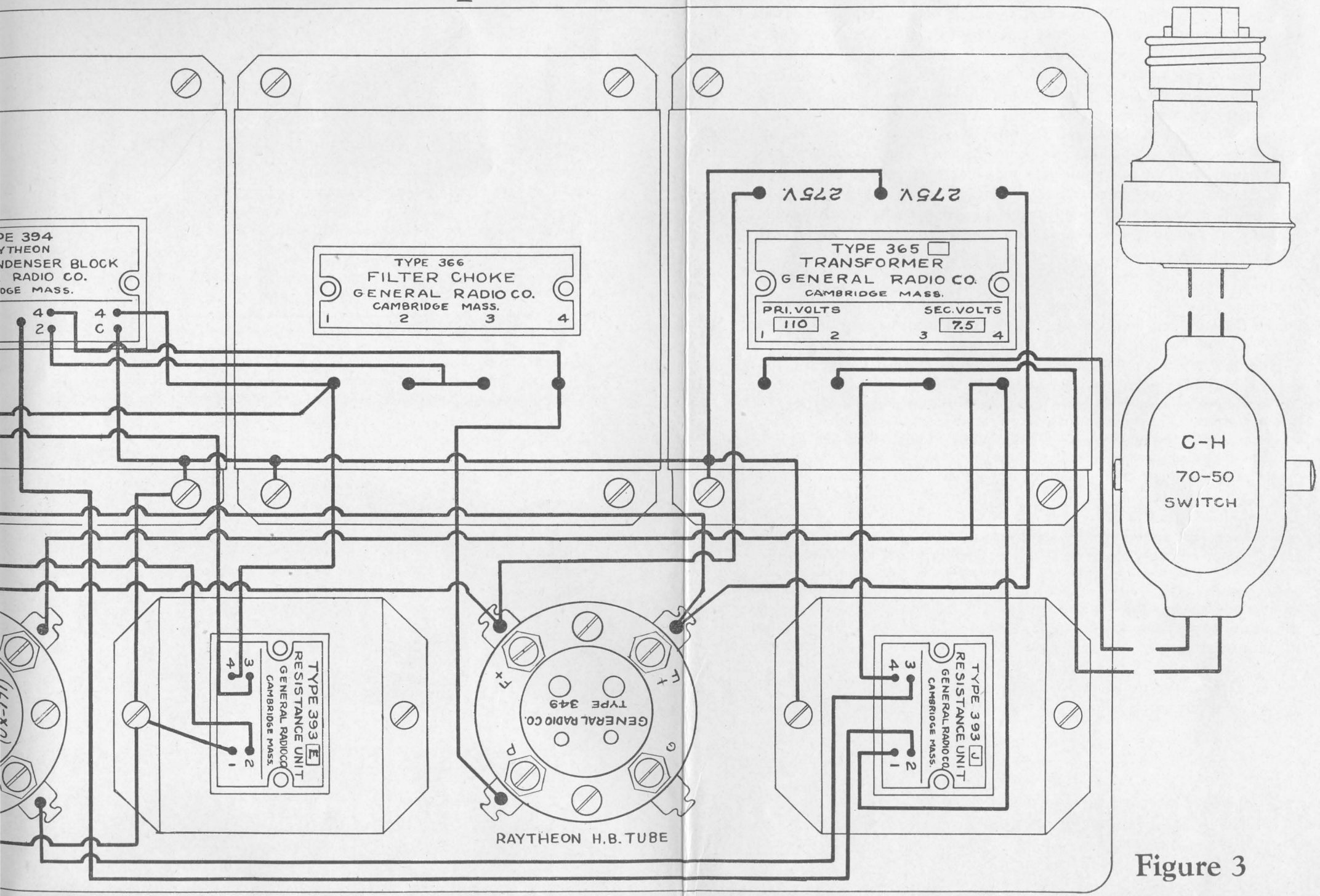

Figure 3