Radio Power Bulletin

COMPILED FOR RADIO ENGINEERS, SERVICE MEN AND RADIO EXPERIMENTERS BY THE ENGINEERING STAFF OF THE

Raytheon Manufacturing Company

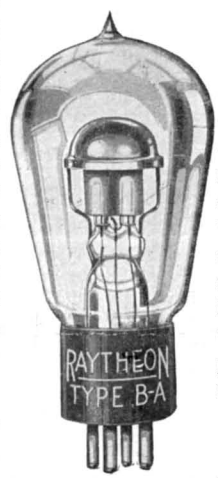
BULLETIN TS5 1928-1929 SEASON

Raytheon, Type BA, 350 milliamperes

The Rectifying Tube for Series Filament Operation

THE RAYTHEON BA TUBE is a super-power full wave gaseous rectifier capable of delivering a comparatively large amount of direct current. Although it has many uses, it was designed primarily to serve as the means of eliminating all batteries by supplying the A-B-C voltage requirements to radio receivers using standard type 201-A ¼ ampere storage battery tubes in series. When used in a suitable power unit with such receivers, this rectifier provides the simplest form of complete radio power

DESCRIPTION: The Raytheon BA tube is an achievement of the Raytheon Research Laboratory, the result of many years of intensive research in gaseous conduction. The tube makes use of the reliable ionized helium method of rectification. It is based on the UX or long-prong base to fit the Navy standard or the UX push type socket. The anodes or positive electrodes make connections with the "Filament" terminals of the socket, while the cathode or negative electrode makes connection with the "Plate" terminal of the socket. The "Grid" terminal is not used. The connections on the bottom of the base are shown in Figure 1



RAYTHEON TYPE BA

ELECTRICAL CHARACTERISTICS Current rating — 200 to 350 milliamperes. Anode voltages recommended — 200 to 350. Maximum anode voltage recommended — 350 volts per anode. Due to the new construction of the BA tube, its characteristics are such that increasing the current increases the voltage drop through the tube very slightly. This rectifier, therefore, possesses considerable inherent regulation, that is, the decrease in voltage output as the load current is increased is very small. Regulation curves of the BA tube are shown in Figure 2 for various input voltages to the rectifier Note, for example, that for an input of 350 volts per anode, the drop in voltage as the load current is increased from 200 M. A. to 350 M. A., is only 20 volts. This is shown in Curve 2, Figure 2. The BA tube is not recommended for loads less than 200 M. A., its range of maximum efficiency lying between 200 and 350 M. A.

USES: The Raytheon BA was primarily designed for use in A-B-C power units for furnishing D C. for radio sets at loads not exceeding 350 M. A. nor less than 200 M. A. at any voltage up to 250 volts. Various other applications of interest are as follows:

1 To charge storage batteries in series without the necessity of disconnecting the units and placing them in a parallel arrangement.

2 To supply current for field and electro-magnets.

3 To energize the field of electro-dynamic speakers.

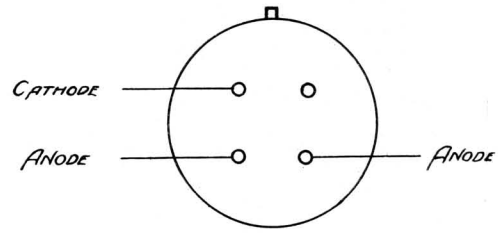
4. To supply direct current for small electro-plating plants.

RAYTHEON A-B-C- POWER UNIT The A-B-C power unit shown in Figure 3 is made up of standard parts and is as easy to build as the familiar B-power unit, and will furnish complete A-B-C power for sets employing from one to ten tubes of the 201A type. This gives an attractive and economical means of securing adequate power for your radio receiver without the use of any batteries whatsoever It should be noted that any receiver operating from the lamp socket, whether it uses A-C tubes or an A-B eliminator, must have a B-power unit for suppling the B and C voltages. With Raytheon BA a complete A-B-C power unit can be built for slightly more than the B - C unit.

APPARATUS: For the proper operation of Raytheon A-B-C power units, a centre-tapped transformer having 350 volts per side at no load is required. This component should be of Raytheon-approved make, properly balanced for inductance, resistance and capacity of both halves of the secondary, and with electrostatic shielding between the primary and secondary windings, in order to keep line noises and outside interferences out of the power supply circuit and the radio receiver.

The proper filter for the Raytheon BA consists of two sections, as shown in Figure 3 The choke coils should have a minimum inductance of 10 henries at 350 M. A. of D. C. Chokes of smaller inductance will cause excessive hum. The D. C. resistance of the chokes should lie between 150 and 200 ohms per choke.

TYPE BA



BASE CONNECTIONS

FIG. 1

Suitable transformers and chokes are made by Acme Electric and Mfg. Co., Thordarson Electric Mfg. Co., Dongan Electric Mfg. Co., Jefferson Electric Mfg. Co., Ford Mica and Radio Co., and others.

The minimum capacities for the various condensers are: C_1 — 1 mfd.; C_2 — 4 mfd.; C_3 — 8 mfd.; C_4 — 1 mfd. The condensers should be of high quality, and of sufficient voltage rating to meet the high potentials impressed upon them when there is no load on the unit. Filter condensers with a working voltage rating of 400 volts D. C. continuously are recommended. The 1 mfd. buffer condensers should be of extra high voltage rating, while the 1 mfd. by-pass condensers across the various voltage taps may be of somewhat lower voltage rating.

The resistance bank is available from a number of radio manufacturers. Wire-wound resistances are particularly desirable in this class of service because they maintain a steady flow of current at constant voltage output. The various resistance values should be as follows:

R1, R2 and R3 should be 120 ohms, each rated at 300 M. A.

R4, 140 ohms, rated at 300 M. A.

R5 and R6, 100 ohms, each rated at 300 M. A.

R7, 80 ohms rated at 300 M. A.

R8, 4000 ohms rated at 75 M. A.

R9, a 200-ohms potentiometer

Voltage Regulation Curves of Raytheon 350 M.A. Full Wave Rectifying Tube.

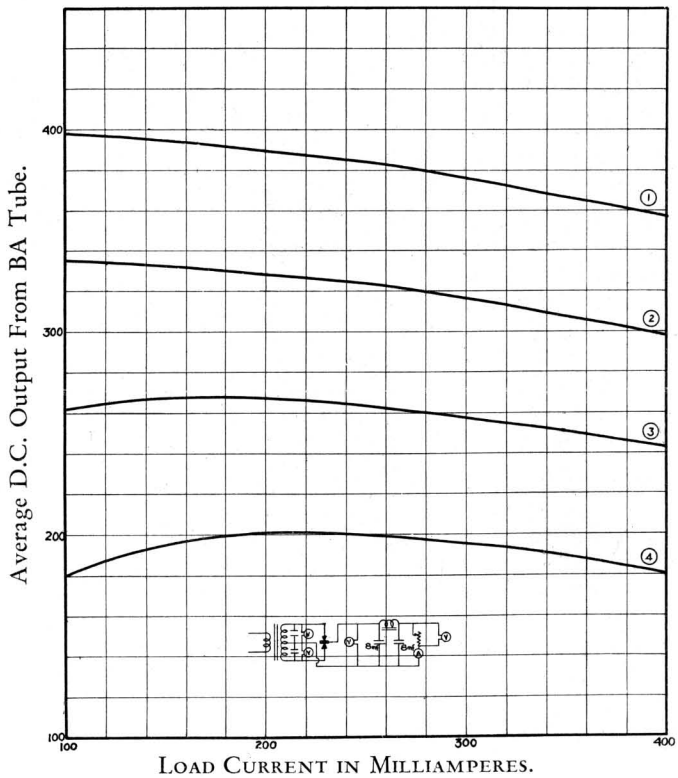


FIG. 2

Curve 1 = Input to tube constant at 400 volts per anode
Curve 2 = Input to tube constant at 350 volts per anode
Curve 3 = Input to tube constant at 300 volts per anode
Curve 4 = Input to tube constant at 250 volts per anode

CAUTION: The BA tube, in conjunction with its associated equipment, is capable of delivering a high voltage with enough power to give a disagreeable shock. When working on a B-power unit of the radio receiver which it supplies be sure the B-power unit is disconnected from the 110 volt power line.

NOTE: This resistance is designed to give proper voltages for various types of radio sets having from five to nine tubes; hence the number of taps for B plus voltages. The adjustable tap on the potentiometer R9 will provide any C voltage up to 45 volts.

Raytheon ABC Power Unit

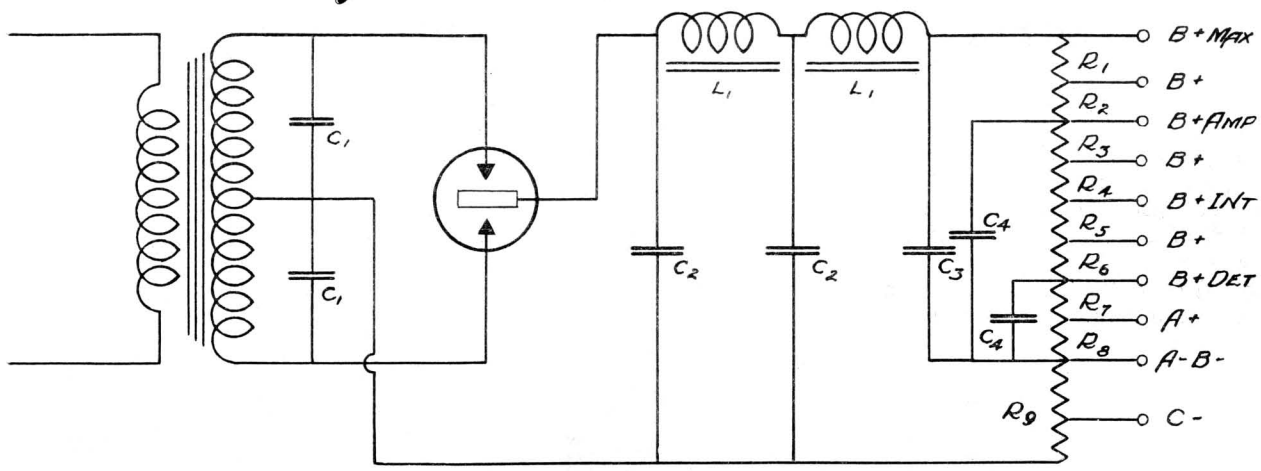


FIG. 3

SERIES FILAMENT OPERATION: By using the Raytheon BA tube in the above circuit the unit will deliver smooth D. C. current for the A-B-C requirements of series filament connected receivers using from one to ten tubes.

One valuable feature of the series filament connection is that the total filament current required for any number of tubes in series is no greater than that taken by one tube. This important fact stands out in contrast with the parallel filaments scheme which demands more filament current as more tubes are added to the set. As the cost and difficulty of filtering increases with the increased current, it is at once seen how desirable it is to keep the filament current as low as possible.

Utmost reliability, satisfaction, tone quality and freedom from servicing is obtained from the electric set which uses the series filament connection. The receiving set will be stable, sensitive, selective and the residual hum noticeable in most electric receiving sets can be wholly eliminated. These are some of the reasons why a number of prominent set manufacturers have been making series filament electric sets for the last two years.

Almost any popular receiver now on the market using D. C. tubes can quickly be rewired by the experimenter for use with an A-B-C power pack using the BA tube. For instance, using only a pair of plyers, a screw driver and a soldering iron it takes only one hour to rewire the Atwater Kent model (30) receiver for series filament operation, as shown in Figure 4.

This method of electrifying the millions of direct current sets now in use will be a dependable source of revenue for experimenters, set builders and service men who will use it.

The Raytheon Laboratories have rewired practically all the well known radio receivers for operation with the BA power pack. See Figure 4 for the Atwater Kent Model 30. A data sheet has been prepared for each receiver giving a simple wiring diagram. You are urged to write the Technical Service Department at once for your copy, telling them specifically the name and model of the set you wish to rewire.

RATING

Maximum AC Input Voltage (per anode) 350 r.m.s. volts
Maximum Rectified Output (both anodes) 350 milliamperes
Maximum Output Voltage, 250 volts.

PRICE $7.50

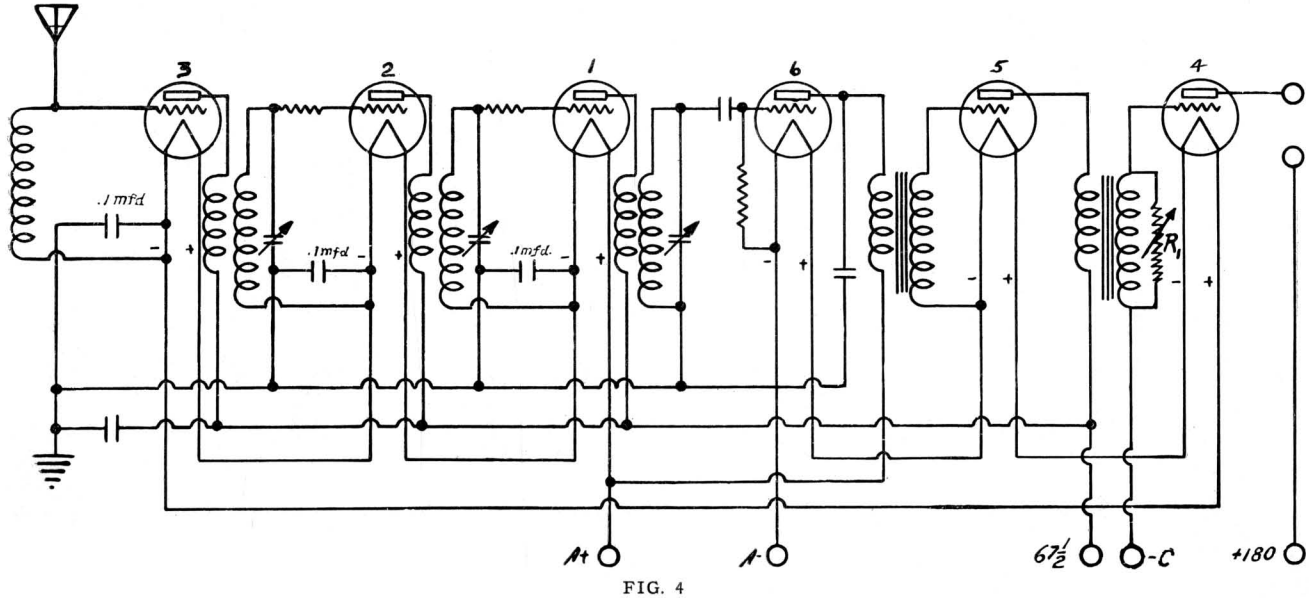


FIG. 4

Raytheon Type BH, 125 milliamperes
Series Filament Operation with 199 Tubes

RAYTHEON BH is a higher power full-wave gaseous rectifying tube which fills a distinct need not met by other rectifiers. It is especially intended for use in (1) B-power units, (2) power supply for amplifiers using the 171 power tube, and (3) complete A-B-C power units for full A-C operation of special radio receivers using the type 199 tubes.

RAYTHEON
TYPE BH

Since the Raytheon BH will furnish 125 M. A., it is evident that a single tube in a suitable power unit can furnish complete A-B-C power for sets employing from 1 to 9 tubes of the 199 type, together with B and C power for an additional power tube. The filaments of this power tube may be operated from a special winding on the transformer of the power unit, or from a separate filament lighting transformer The A-B-C power unit is shown in Figure 5

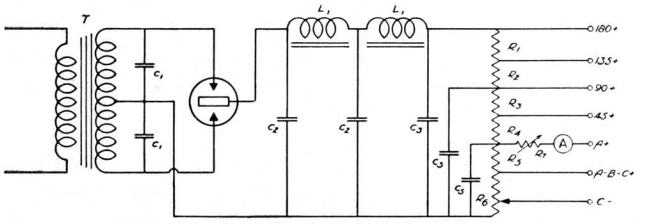


FIG. 5

A centre-tapped transformer of sufficient capacity with a no-load secondary voltage of 350 volts per side is required. The choke coils must have an inductance of 25 henries at 90 M. A. D. C. The minimum capacities for the condensers of the filter circuit are 2, 2 and 8 for the first, second and third condensers, respectively .1 mfd. buffer condensers are placed across each secondary winding to absorb stray radio frequency current which may be present.

The values of the various resistances in the voltage divider are as follows: R1 and R2 are 600 ohms at 85 M. A.; R3, 700 ohms at 75 M. A.; R4, 300 ohms at 65 M. A., R5, 10,000 ohms at 10 M. A.; R6 is a 500-ohm potentiometer at 90 M. A., and R7 is a 500-ohm rheostat at 90 M. A.

BY-PASS condensers of 1 mfd. are placed across various voltage taps; and it may prove necessary in certain cases to by-pass the grid biasing resistance R-6.

A typical set, employing 199 tubes rewired for series filament operation is shown in Figure 6 Inductances, capacities, etc., are not indicated. The necessary grid bias for each of the amplifying tubes may be obtained by making use of the voltage drop in the preceding tube of the filament series. Hence, each grid is connected from the negative side of the preceding tube filament. To prevent overloading the various filaments with the plate current of the preceding tube, it is necessary to by-pass this extra current through shunt resistors. The values of the resistors in figure six are as follows: R1, 225 ohms, R2, 275 ohms; R3, 375 ohms; R4 and R5, 500 ohms.

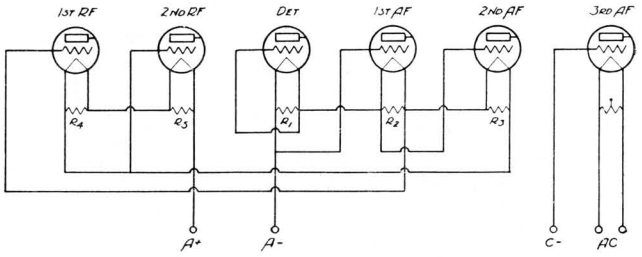


FIG. 6

It is essential that a milliameter with a scale reading of 0-100 or 0-75 M. A. be inserted in series with the A plus tap, to control the filament current which is adjusted by means of rheostat R7 The filament should never be allowed to exceed 60 M. A., and it will be found that a filament current of 58 M. A. will give excellent results.

RAYTHEON TYPE BH LONG LIFE RECTIFIER
Maximum Current Output 125 M. A. — Price $4.50

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RAYTHEON MANUFACTURING COMPANY
TECHNICAL SERVICE DEPARTMENT, CAMBRIDGE, MASS.

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THE HEART OF RELIABLE RADIO POWER