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WAVE REPEATING SYSTEM

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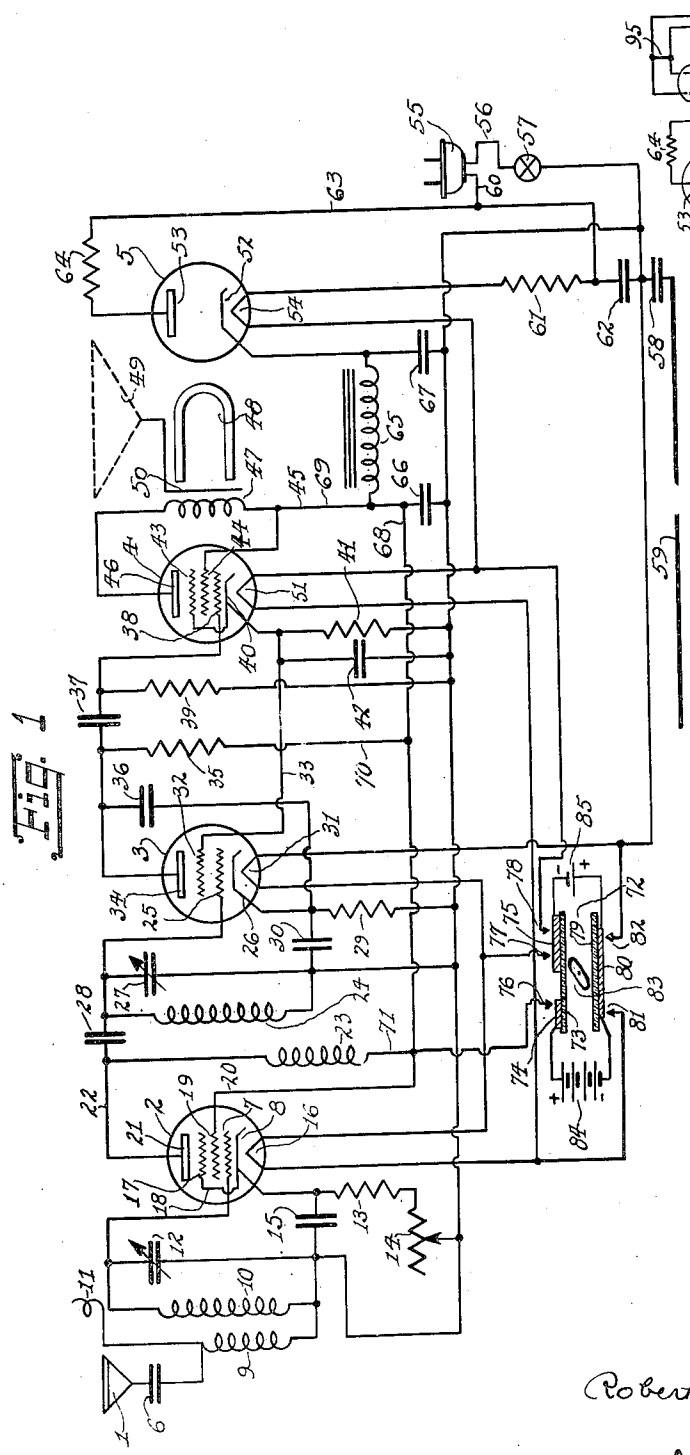


Fig. 1

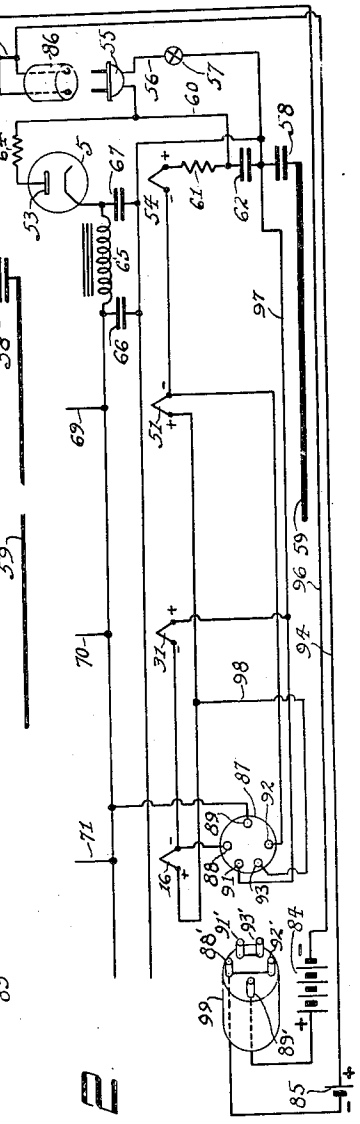


Fig. 2

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WAVE REPEATING SYSTEM

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4 Claims. (Cl. 250—27)

This invention relates to wave repeating systems, and with particularity to systems employing a plurality of electric discharge devices.

An object of the invention is to provide a wave repeating system employing a plurality of electric discharge devices in conjunction with circuit arrangements, whereby said devices may be energized from current sources having widely different characteristics.

Another object of the invention is to provide a wave repeating system employing a plurality of electric discharge devices in conjunction with circuit arrangements and switching means whereby all the devices may be energized either directly from commercial supply mains, or directly from a low voltage source of supply.

A further object of the invention is to provide a wave repeating system employing a plurality of electric discharge devices of the thermionic type in conjunction with circuit arrangements whereby the cathodes of said devices may be heated directly from commercial supply mains without interposition of step-down transformers or the like, in conjunction with switching arrangements for enabling said cathodes to be heated in series, or in parallel.

A feature of the invention relates to a switching arrangement for use in conjunction with a wave repeating system employing filamentary heater means whereby the said heater means may be connected in series directly with a commercial main, or in parallel with a low voltage source.

While the invention will be described as embodied in one particular form of wave repeating system such as a radio receiving set, it will be understood that the invention is not limited to this particular type of system, but is capable of embodiment in any system employing a plurality of electric discharge devices having heaterable members therein.

Accordingly, in the drawing,

Fig. 1 shows the invention embodied in a radio receiving set employing a series of successive wave repeating stages;

Fig. 2 shows a modification of the switching system of Fig. 1.

Referring more particularly to Fig. 1 of the drawing there is shown in diagrammatic form a complete radio receiving system of the general type disclosed in copending application Serial No. 638,549. In this system the numeral 1 represents a signal pick-up device such as a radio antenna or the like. The set to which the antenna is adapted to be connected comprises a radio frequency amplifying stage, embodying a pentode amplifying tube 2, a detector stage embodying a screen grid detector tube 3, an audio frequency amplifying stage embodying a pentode tube 4 and a rectifying stage embodying the rectifier 5. While the system of Fig. 1 shows particular types of tubes in the various stages, it will be obvious that the invention is not limited thereto. For example, ordinary three-element tubes may be employed in one or more of the stages. Similarly, while the rectifier tube 5 is shown as having an independently heated cathode, it will be understood that any other type of rectifier may be employed. The antenna 1 is connected through a small condenser 6, for example one of 0.02 mfds. The received signals are impressed across the control grid 7 and the cathode 8 of the tube 2 by any suitable coupling device such, for example, as a radio frequency transformer comprising a primary winding 9, a secondary winding 10 and an auxiliary winding 11. Preferably the winding 11 is open ended, as indicated in the drawing, although it will be understood that the winding 11 may be omitted if desired. The winding 10 is shunted by the variable condenser 12 to tune the coupling circuit to any desired frequency.

For the purpose of biasing the control grid 7 to the proper point on the working characteristic curve of the tube 2, there is provided a resistance 13 which is connected between the cathode 8 and the lower end of the tuned input circuit. If desired, a variable resistance 14 may also be included in this circuit for the purpose of controlling the output level or volume of the receiving system as a whole. In accordance with standard practice a condenser 15 is shunted across the resistances 13 and 14 to provide signal return between the grid 7 and the cathode 8. As indicated in the drawing, the cathode 8 is of the indirectly heated type and is adapted to be rendered thermionically active by means of a suitable heater represented diagrammatically in the drawing by the filament 16. Preferably, the filament 16 is insulatingly spaced from the cathode 8 in any manner well known in the vacuum tube art. Preferably, although not necessarily, the auxiliary grid 17 of the tube 2 is directly connected to the cathode 8 by means of the jumper wire 18. The shield grid 19 is connected by means of conductor 20 to a suitable source of D. C. potential as described hereinbelow. Similarly, the anode 21 is connected by conductor 22 through the primary winding 23 of a suitable coupling transformer to the D. C.

potential. The secondary winding 24 of the coupling transformer has its terminals connected across the control grid 25 and the cathode 26 of the detector tube 3, and in accordance with standard practice a variable tuning condenser is provided for tuning the detector input. Preferably, although not necessarily, the windings 23 and 24 are connected through a condenser 28. The amplifier 26 is connected to the lower end of the coil 24 through a resistance 29 for biasing the grid 25 to the proper point on the working characteristic of the tube 3, to enable this tube to function as a detector, and in accordance with standard practice the resistance 29 is shunted by a condenser 30 to provide a signal return path to the cathode 26.

As indicated in the drawing, the cathode 26 is preferably of the indirectly heated type and may be heated by any suitable means indicated by the filament 31. The filament 31 is preferably insulatingly spaced from the cathode 26 in any manner well known in the vacuum tube art. The shield grid 32 is connected by conductor 33 to a suitable D. C. potential as hereinbelow described. Similarly the anode 34 is connected through the coupling resistance 35 to the D. C. potential. In accordance with standard practice a condenser 36 is connected across the electrodes 26 and 34 to shunt the radio frequency components of the detected signals away from the coupling resistance 35. The resistance 35 may be of the order of 2 megohms, or any other value ordinarily used in so-called resistance coupling systems. The detected signals are impressed through the coupling condenser 37 upon the control grid 38 of the audio frequency amplifier tube 4. In accordance wtih standard practice a high resistance 39, for example of 1 megohm is connected across the grid 38 and the cathode 40, and also a grid biasing resistance 41 is provided for biasing the grid 38 to the proper point on its working characteristic curve.

In accordance with standard practice the resistance 41 is shunted by a suitable condenser 42. Preferably, the auxiliary grid 43 is directly connected to the cathode 40 by means of a jumper wire, either internally or externally of the tube 4. The shield grid 44 is connected by conductor 45 to a suitable source of D. C. potential, as herein below described. Similarly the anode 46 is also connected through the output coil 47 to the D. C. potential source. If desired the coil 47 may take the form of a field winding for a loud speaker, for example as indicated in the drawing the loud speaker comprises a suitable electromagnet 48 which is provided with a diaphragm 49 and an armature 50, the latter adapted to be vibrated under control of the currents in the winding 47. Preferably, the cathode 40 is provided with a separate heater means, such as the filament 51 which may be insulatingly spaced from the cathode 40 in any known manner. The rectifier tube 5 comprises an electron emitting cathode 52 and an anode 53. Preferably, although not necessarily, the cathode 52 is provided with a heater filament 54 which may be insulatingly separated from the said cathode 52. For the purpose of energizing the filaments 16, 31, 51 and 54 there is provided a plug 55 which may be plugged into any suitable outlet connected to ordinary commercial supply mains. Because of the particular circuit arrangements disclosed the plug 55 may be connected to either A. C. mains or D. C. mains. The wire 56 from the plug 55 is connected through any suitable form of make-break switch 57, thence through a condenser 58, for example of 0.1 mfd. to the ground member 59. This latter member may take any suitable form.

If the radio receiving set is provided with a metallic container or chassis, then the member 59 represents schematically this metal frame or chassis of the set, although it will be understood that the condenser 58 may be connected to any suitable ground such as the chassis of an automobile, or the like. The other wire 60 is connected through a resistance 61, thence through the filaments 54, 51, 16, 31 in series with the wire 56. It will be understood, of course, that the resistance 61 may be omitted if the various filaments have sufficient inherent resistance to properly limit the current therethrough. Preferably, a condenser, for example a 0.1 mfd. condenser 62 is connected across the conductors 56 and 60. The wire 60 is also connected by means of conductor 63 through current limiting resistance 64 to the anode 53 of the rectifier tube. The cathode 52 of this tube is connected to a suitable filter network comprising the choke coil 65 and a pair of condensers 66 and 67, the latter being preferably of high capacity such as ordinarily used in power supply filter systems. The filter network is connected to a conductor 68 which has branch conductors 69, 70, 71 connected respectively to the various electrodes of the tubes 4, 3 and 2. Consequently there is provided for the various electrodes of the device, a steady source of D. C. potential, regardless of whether the plug 55 is connected to A. C. mains or D. C. mains, since the tube 5 rectifies the alternating current and also passes sufficient direct current (in the case of D. C. mains) to provide the necessary working potentials for the system. Since the filaments of all the tubes are connected in series no step-down transformers are necessary, and consequently they may be energized directly from the commercial mains.

For a further description of a system of this type, reference may be had to copending application Serial No. 638,549.

In many cases it is desirable to operate the radio receiving set not only from either A. C. or D. C. mains, but also from a low potential source. For example, the radio receiving set shown in Fig. 1 is provided with switching means and circuit arrangements whereby it may be energized not only from A. C. and D. C. mains, but also may be energized from a storage battery or the like, thus enabling the set to be used on automobiles or in other situations where only a low voltage is available for filaments. For this purpose there is provided a special switch 72. The switch 72 may be of any well known construction. As indicated in the drawing it comprises an insulating arm 73 carrying a pair of contacts 74, 75. Fixedly mounted contact 76 is adapted to engage the contact 74. Another pair of fixed contacts 77, 78 are adapted to engage the contact 75. Similarly, the other insulating arm 79 of the switch carries a contact bar 80 which is adapted to engage a pair of fixed contacts 81, 82. The arms 73 and 79 are normally held away from the associated fixed contacts by a suitable spring or the like, so that all of these contacts are open circuited. Any suitable form of operating member such as the cam 83 may be provided for moving both arms of the switch to close the respective contacts. Connected directly to the contacts 74 and 80 is a high potential battery 84 having its positive pole connected to the contact 74 and its negative pole connected to the contact 80.

Similarly a low potential battery such as a

storage battery 85 has its negative pole connected to the contact 75 and its positive pole connected to the contact 80. When the switch 72 is in its normal position as indicated in Fig. 1, neither of the batteries 84 nor 85 is connected to the radio set. Consequently the set may be operated from commercial supply mains merely by inserting the plug 55. When it is desired to operate the set from the storage battery 85, the switch 72 is operated, as a result of which the filaments 16, 31 and 51 are all connected in parallel with each other, and in parallel with the battery 85. At the same time the branch conductors 69, 70 and 71 of the various stages are connected through contacts 76 and 74 to the positive pole of the high potential source 84. Since the rectifier 5 is not necessary when the switch 72 is operated, as above described, there is no circuit through its filament 54 since the switch 57 may be left open.

With the switch operated as above described all the heater filaments for the several stages, with the exception of the rectifier stage 5, are energized directly from the low potential battery 85 and the radio receiving set functions in the usual manner.

Referring to Fig. 2, there is shown a modified form of circuit and switching arrangement of the plug and socket type. In this embodiment the various conductors and parts which are identical with those of Fig. 1 are designated by the same numerals.

It is to be noted, however, that in the embodiment of Fig. 2, the positive pole of the low potential source 85 is connected to the negative pole of the high potential source 84, by means of a socket member 86, which must be placed in engagement with the plug 55 in order to complete the circuit to the various tubes. By this arrangement, therefore, a fool-proof system is provided in the sense that it is impossible to complete the circuits to the various stages without connecting the plug 55 into the socket 86, thus positively preventing the plug 55 being connected to commercial supply mains when the system is in use with the low potential battery 85. As indicated in Fig. 2, there is provided a five-prong receptacle 87 which may be similar to the receptacles used for the various tubes of the set, and preferably this socket 87 is built into the set to form a permanent part thereof. The socket 87 is provided with contact springs 88, 89, 90, 91 and 92. When the five-prong plug 99 is not inserted into the socket 87 the system functions similarly to the system of Fig. 1, when the switch 72 is in its normal position. In other words, plug 55 may be inserted into any suitable commercial supply outlet, as a result of which the filaments 16, 31, 51 and 54 are all connected in series across the conductors 56 and 60, as described above in connection with Fig. 1. When it is desired to employ the system with a low potential storage battery such as the battery 85 the plug 55 is removed from the commercial supply socket, and is inserted into the auxiliary socket 86, which is preferably built into the radio set to form a permanent part thereof. Then the plug 99 is inserted into the socket 87.

As will be apparent from the drawing, the plug 99 is provided with a set of five contact pins 88', 89', 90', 91' and 92'. The prongs 91' and 92' are short circuited together by means of a jumper wire as are the prongs 88' and 90'. When the plug 99 is inserted into the socket 87, the positive pole of the low potential battery 85 is connected through conductor 94, thence through the jumper wire 95 to the conductor 96, to the negative pole of the high potential battery 84. At the same time the positive pole of the battery 85 is connected through the members 86 and 55 to the conductor 56, and thence by means of conductor 97 to the positive terminal of the filament 31. At the same time the conductor 97 is connected through the contacts 91, 91', 93', 93 and conductor 98, to the positive terminals of the filaments 16 and 51. The negative pole of the battery 85 is also connected through the contacts 88' and 88 to the negative terminal of the filaments 16 and 31 and through the contacts 92' and 92 to the negative terminals of the filament 51 and filament 54. With this arrangement, therefore, in order that the circuits to the various filaments and the battery 85 may be completed, it is necessary to connect the members 55 and 86 together, thus insuring that the plug 55 must be disconnected from the commercial mains before the battery 85 is connected in circuit. From this it will be seen, therefore that when plug 99 is inserted into the socket 87, the filaments 16, 31, 51 and 54 are connected in parallel to the low potential battery 85 and the high potential battery 84 is connected directly to the branch conductors 69, 70, 71.

While the invention has been described in connection with an amplifying stage employing an indirectly heated tube, it will be understood that a so-called filamentary cathode tube may be employed in this stage, as disclosed in copending application Serial No. 638,549, referred to hereinabove. Similarly the rectifier tube 5 may be of the filamentary cathode type, instead of the indirectly heated tube as disclosed in said application.

While specific apparatus and embodiments are disclosed herein, it will be understood that the invention is not limited thereto, and that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A wave repeating system comprising a plurality of discharge tubes having heater members, a rectifier tube having a heater member, means for directly supplying all said heater members with current from commercial supply mains, either A. C. or D. C., and operating said system from said current, means for supplying said heater members with a low potential current source, and switching means for selectively associating said members with said means and said low potential source, and dissociating said rectifier tube from said system.

2. A wave repeating system comprising a plurality of wave repeating tubes having heater filaments and a rectifier tube having a heater filament and a cathode, a plug to connect all of said heater filaments in series to commercial supply mains, a multi-contact socket, connections from the heater filaments of said wave repeating tubes to said socket, a multi-contact plug adapted to engage said socket to connect all the heater filaments of said wave repeating tubes in parallel to a source of low voltage direct current, a wire leading from a contact prong on said multi-contact means for connection to the positive terminal of a high voltage battery, and means connecting the negative terminal of said high voltage battery to the positive terminal of the low voltage battery, the last mentioned means in-

cluding an additional socket for engaging the first mentioned plug.

3. In combination a radio receiving set having a plurality of stages, each stage having a tube with a filament therein, means to connect all of said filaments in series to commercial supply mains, a five-prong socket having connections to all of said filaments, and a five-prong plug for engaging said socket to connect said filaments in parallel to a low voltage D. C. source, a connection from said five-prong socket to the anodes of said tubes, and a wire connected to a prong on said five-prong plug for connection to the positive terminal of a high voltage battery, and means including the first mentioned means for completing a circuit between the positive terminal of the low voltage D. C. source and the negative terminal of the high voltage battery.

4. The combination according to claim 3, in which the means for completing the connection between the positive terminal of the low voltage source and the negative terminal of the high voltage battery includes a short circuiting socket for engaging the terminals of the first mentioned plug.

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