

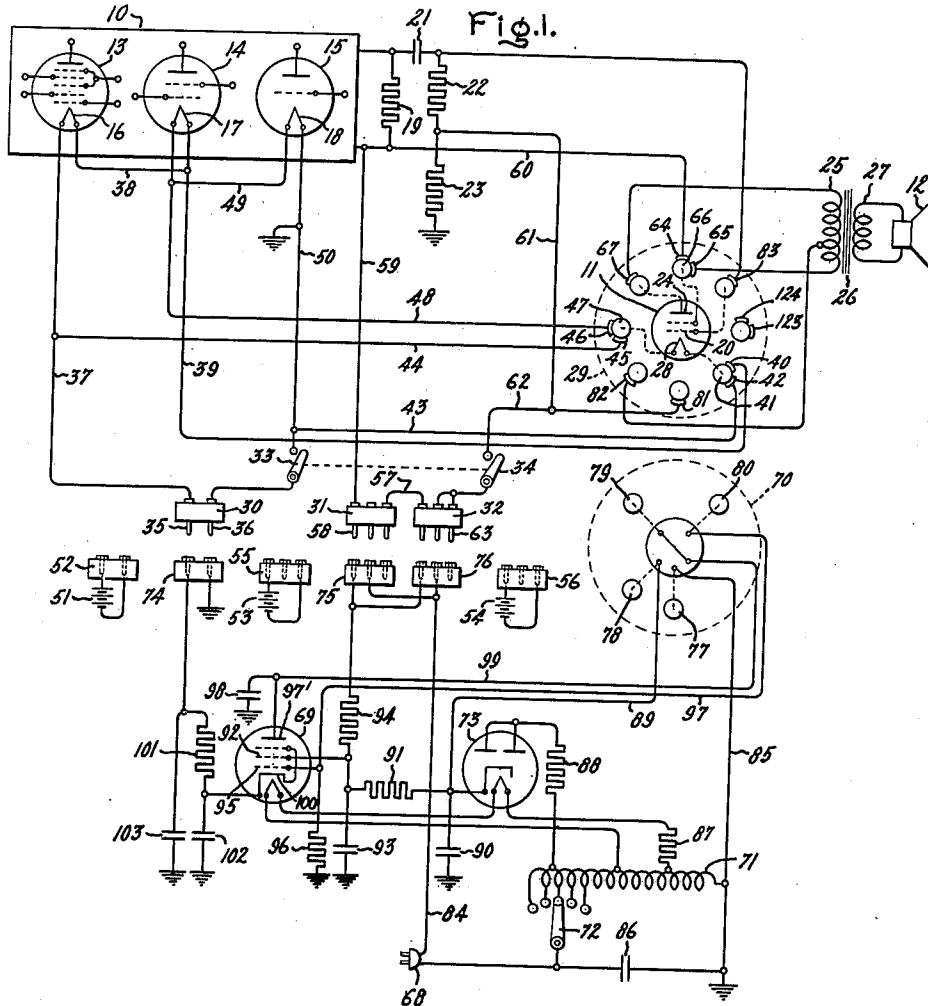
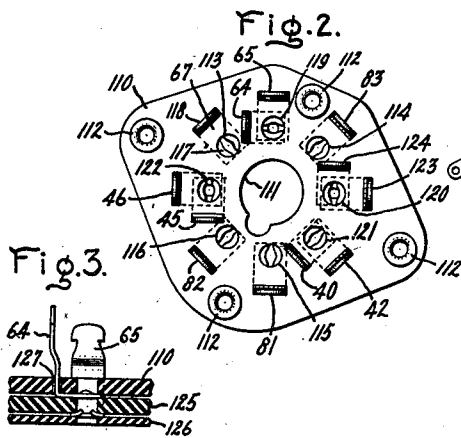
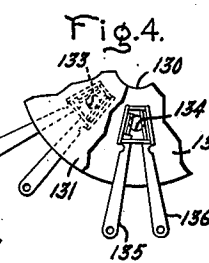
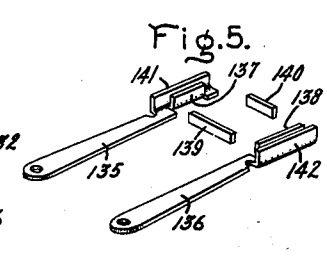
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ELECTRON DISCHARGE APPARATUS

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ELECTRON DISCHARGE APPARATUS

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11 Claims. (Cl. 250—27)

My invention relates to electron discharge apparatus, such as radio receivers, and has for one of its objects to provide such apparatus which is readily adaptable to energization from power supply sources of different character.

Radio receiving apparatus is frequently designed for operation from storage batteries, or dry cells, of relatively low capacity. Such receivers are usually designed for portability, and for use where main power lines are not available. The discharge devices employed therein are designed especially for low power consumption, have filamentary cathodes of the directly heated type, and require low anode operating potential.

Another object of my invention is to provide means for use with such apparatus, where power from mains is available, whereby such apparatus may be energized from such mains and utilized to greater advantage. Of course, where power from mains is available, it is desirable to employ a discharge device of higher capacity, particularly in the output stage of the receiver, and preferably to apply higher operating voltages to other of the discharge devices. To this end, an object of my invention is to provide a power supply assembly which may be connected to the receiver by removing the last discharge device therein from its socket and inserting a plug having a cord leading to the power supply apparatus. This apparatus may have a discharge device mounted thereon of higher capacity than that which is removed from the receiver and which it may replace through connections including said plug and socket. Additional means may be included in the power supply assembly for rectifying the mains power and supplying it to the other discharge devices.

Another object of my invention is to provide an improved socket assembly capable of establishing certain switching connections necessary to my invention when the battery-operated discharge device of the last stage is removed and the plug inserted.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 illustrates apparatus embodying my invention; Fig. 2 illustrates a socket especially adapted for use in the apparatus of Fig. 1; Fig. 3 is a sectional view of the socket of Fig. 2; Fig. 4

is a fragmentary view of an alternative type of socket, and Fig. 5 is an exploded view of certain parts illustrated in Fig. 4.

The upper portion of Fig. 1 illustrates a radio receiver which includes a high frequency amplifier and detector 10, an audio amplifier 11 and a speaker 12. The high frequency amplifier and detector 10 may include the three electron discharge devices 13, 14 and 15 which, as illustrated, may respectively perform the functions of converting an incoming radio wave to a fixed intermediate frequency, amplifying the intermediate frequency, and detecting audio modulations of the intermediate frequency wave. The devices 13, 14 and 15 respectively, have filamentary cathodes 16, 17 and 18.

The audio system of the receiver includes a load resistor 19 across which the output from the detector 15 is impressed and coupling means for impressing voltage variations across the resistor 19 upon the control electrode 20 of the device 11. This coupling means comprises a condenser 21 and a pair of series connected resistors 22 and 23, which are connected between the control electrode 20 and ground, which is the receiver chassis.

In the output circuit of the device 11 the anode 24 thereof is connected to the primary 25 of an output transformer 26, whose secondary winding 27 supplies audio signals to the speaker 12. The device 11 has a filamentary cathode 28 and is provided with a suitable connecting base having a number of contact pins projecting therefrom to cooperate with a socket in the receiver which is represented by the dotted circle 29. Operating current is supplied to the receiver for heating the filaments of the devices 11, 13, 14, and 15, and for maintaining their electrodes at suitable potentials through three connecting plugs 30, 31 and 32. A pair of mechanically connected switches 33 and 34 are included in the receiver for controlling respectively the filament heating current and the discharge current through the discharge devices in the receiver.

Considering now the connections within the receiver, the connecting plug 30, which is utilized in the filament heating current circuit, has two connecting pins 35 and 36. An electrical path extends between the pins 35 and 36 through a wire 37 to the filament 16, through wires 38 and 39 to a contact 40 of the socket 29, from the contact 40 through a pin 41 to a contact 42 and then through a wire 43 and through the switch 33 to the pin 36 of the plug 30. The contact 40 of the socket 29 is adapted to touch the pin 41 of the

device 11 when the electron discharge device is plugged into the socket. The other contact 42, which is normally insulated from the contact 40, is also adapted to touch the pin 41 when the device 11 is plugged into the socket 29. Thus this circuit for filament 16 of discharge device 13, which may be the superheterodyne converter of the receiver, is completed only when the pin base of audio amplifier 11 is plugged into its socket.

A second conducting path extends between the pins 35 and 36 through the wires 37 and 44 to a contact 45 of the socket 29, pin 47 when the amplifier is plugged in and contact 46, wire 48, filament 17, wire 33, contact 40 on socket 29, pin 41 and contact 42, through the wire 43 and switch 33 to the pin 36. These contacts 45 and 46, like contacts 40 and 42, are normally insulated from each other, but both contact with pin 47 when the discharge device is plugged into its socket.

A third conducting path extends between the pins 35 and 36, through the wires 37 and 44, contact 45, pin 47, and contact 46, wires 48 and 49, filament 18, wire 50, which is grounded to the receiver chassis, and switch 33 back to the pin 36. These last circuits supply heating current to the filaments 17 and 18 respectively.

A fourth conducting path extends between pins 35 and 36 to supply heating current for the filament 28 of the device 11. It may be traced from the pin 35 through the wires 37 and 44, contact 45, pin 47, filament 28, pin 41, contact 42, wire 43, and switch 33 back to the pin 36.

It should be noticed that the filaments 16, 17, 18, and 28 are all connected in parallel between the pins 35 and 36 of the plug 30. A battery 51 may be supplied with a suitable connecting socket 52 which cooperates with the plug 30 to supply low voltage heating current to the four filaments.

A pair of batteries 53 and 54 may be supplied respectively with connecting sockets 55 and 56, which cooperate with the connecting plugs 31 and 32 to supply a relatively high voltage between the electrodes of the devices 11, 13, 14 and 15 to produce discharge currents therein. A conductor 57 connects the plugs 31 and 32 together so that the batteries 53 and 54 are in series. A pin 58 of the plug 31 is connected through the socket 55 to the positive terminal of the battery 53. A conducting path extends from the pin 58 through a wire 59 to a wire 60, from which the path branches through various coupling devices respectively to the anodes of the devices, not shown, 13, 14, and 15, then through their electron discharge paths to the cathodes 16, 17 and 18 of these devices and through the wires 38, 39, 43, and 50 to ground, from ground, which is the receiver chassis, through the resistor 23, conductors 61 and 62, switch 34, pin 63 of the plug 32, which is connected to the negative terminal of the battery 54.

Another conducting path extends from the pin 58 through conductors 59 and 60, contact 64 of the socket 29, pin 66, contact 65, primary 25 of the output transformer 26, contact 67 of the socket 29 to the anode 24 of discharge device 11, through the electron stream to the cathode 28, through the pin 41 and contact 42, conductors 43 and 50, ground resistor 23, conductors 61 and 62, and switch 34 to the pin 63. The contacts 64 and 65 cooperate with the pin 66 of the device 11 in the same way as the contacts 40 and 42 and the pin 41. All anode circuits are connected through the switch 34 and all heating circuits through the switch 33, so that upon opening these switches the entire receiver is deenergized.

Electron discharge current flowing from the cathodes of the devices 11, 13, 14, and 15 through the resistor 23 back to the pin 63 maintain upon the resistor a negative bias for the control electrode 20.

The lower portion of Fig. 1 illustrates a power supply assembly adapted to replace the batteries 51, 53 and 54, and the electron discharge device 11. Since this assembly derives its energy from an alternating current power line to which a plug 68 may be connected, it is practicable to use an audio amplifying device 69 of higher power output and greater capacity in the receiver in place of the battery operated device 11. Such higher capacity devices may require more heating current, more anode voltage, and more discharge current than can economically be supplied from batteries, such as are adapted for household use. It is convenient to select such a discharge device whose discharge current is of suitable value to pass serially through the filaments 16, 17 and 18 to heat them. The power supply assembly, the apparatus of which may be assembled in a unitary assembly or pack, easily mountable in a radio receiver, accordingly includes a plug, illustrated by a dotted circle 70. The plug 70 is adapted to replace the device 11 in the socket 29 when the power pack is used. An autotransformer 71 is provided with a tap changing switch 72 so that line voltages applied to the plug 68 may be transformed to a suitable value for rectification through a rectifying device 73. The power pack also includes three connecting sockets 74, 75 and 76 which are adapted respectively to cooperate with the plugs 30, 31 and 32, so as to connect the power pack to the receiver to supply filament heating current and discharge current for the devices 13, 14, and 15.

The plug 70 has pins 77, 78, 79, and 80 which, when the plug is inserted in the socket 29, are adapted to touch respectively a contact 81 which is connected to the wire 62, a contact 82 which is connected to an intermediate point of the primary 25, contact 67, and a contact 83 which is connected to condenser 21 to receive the audio output from the detector 15.

A conducting path for energizing the autotransformer 71 extends from the plug 68 through a conductor 84, the middle electrodes of socket 76 and plug 32, switch 34, conductor 62, contact 81, pin 77 on plug 70, through a wire 85 of the power supply assembly to ground, which is the chassis of the power pack, and through the autotransformer 71 and switch 72 back to the plug 68. It is therefore apparent that when the power pack is in use the switch 34 controls energization of the autotransformer 71 and hence controls current for the entire receiver.

Since the manual control for the mechanically connected switches 33 and 34 is conveniently placed upon the control panel of the radio receiver, the power pack may be easily controlled without the necessity of removing the plug 68 from an alternating current supply socket or actuating a switch in the power pack itself.

The movable member of the switch 72 is bypassed to ground by a condenser 86 which acts to reduce the amount of noise pulses passing to the power pack from the plug 68. Cathode heaters for the devices 69 and 73 are supplied serially with heating current from a suitable portion of the autotransformer 71 through a resistor 87.

The rectifying device 73 supplies discharge current for the devices 13, 14, 15 and 69. The

anodes of the device 73 are connected to a point of the autotransformer 71 remote from ground through a resistor 88. The cathode of the device 73 is connected through a conductor 89 to the pin 78 and is by-passed to ground through a condenser 90. This cathode is also connected to the second or screen electrode 92 of the device 69, which is by-passed to ground through a condenser 93 through a filter resistor 91. The electrode 92 is connected through a resistor 94 to the connecting socket 75 so as to impress a continuous positive potential on the pin 58.

The control electrode 95 of the device 69 is connected through a resistor 96 to ground and through a conductor 97 to the pin 80 of the plug 70. The anode 97' of the device 69 is by-passed to ground through a small condenser 98 and is connected through a wire 99 to the pin 79 of the plug 70. The cathode 100 of the device 69 is connected to the socket 74 to transfer discharge current therethrough to pin 35 through a filter comprising a series resistor 101 shunted to ground at each end respectively by by-passing condensers 102 and 103.

The path through which the discharge current of the device 69 flows, which current serves also as heating current for the filaments 16, 17 and 18, may be traced from the autotransformer 71 through resistor 88, rectifying device 73, conductor 89, pin 78, contact 82, the upper portion of primary 25 of output transformer 26, contact 67, pin 79, conductor 99, anode 97' of the device 69, and then through the electron discharge path of the device 69, cathode 100, resistor 101, pin 35, conductor 37, filament 16, conductor 38, filament 17, conductor 49, filament 18, through conductor 50 which is grounded, switch 33, and pin 36 to the chassis of the power pack, and through wire 85 back to the autotransformer 71.

It is apparent that, by removal of the device 11 from the socket 29, connections are broken between contacts 45 and 46, between contacts 40 and 42, and between contacts 64 and 65. The result of this breaking of connection is to arrange the filaments 16, 17 and 18 in series as explained above. The wire 60, which was the high voltage supply of the device 11 previously, is disconnected from the primary 25 of the output transformer 26, and an intermediate point of primary 25 is connected to a higher voltage source comprising the device 73 through the plug 70.

The resistor 91 shunted at each end respectively by condensers 90 and 93 forms a smoothing filter which supplies high voltage to the screen electrode 92 of the device 69 from the cathode of the rectifying device 73.

Connection of the plugs 31 and 32 with the sockets 75 and 76 completes paths for supplying anode voltage to the devices 13, 14 and 15 from the autotransformer 71 through resistor 88, rectifying device 73, resistors 91 and 94, pin 58, wires 59 and 60, through respective coupling devices, not shown, and then through the several electron discharge paths of the devices 13, 14 and 15 to the filaments 16, 17 and 18, through the wires 38, 49 and 50 to ground, through switch 33 and pin 36 to the power pack chassis, and then back to the autotransformer 71.

It should be noted that discharge current from the devices 13, 14 and 15 no longer flows through the resistor 23 which is now short circuited through wires 61 and 62, contact 81, pin 77, wire 85, through the power pack chassis and through the socket 74 to the pin 36, through the

switch 33, wire 50 and through the receiver chassis back to the resistor 23. Operating bias potential for this control electrode is provided by the voltage drop produced by flow of discharge current through the resistor 101 and through the filaments 16, 17 and 18.

Because resistor 23 is short-circuited the average potential of the control electrode of device 69 is maintained at the chassis potential. The audio output of device 15 is impressed across resistor 22, and thus excites the control electrode of device 69.

Referring to Fig. 2, there is illustrated a preferred form of socket which may be utilized as socket 29 of my invention. In this figure there is illustrated a bottom view of the socket in which a lower insulating sheet, or wafer, 110 has a central perforation 111 and eight smaller perforations spaced therearound. The insulating sheet 110 is fastened to other insulating sheets by suitable fasteners 112. Four of the eight small perforations 113, 114, 115 and 116 cooperate with contacts 67, 83, 81 and 82 respectively. These contacts, which are represented schematically in Fig. 1, are formed of flat metal bent into an L-shape. The contact 67 thus has a flat portion 117 lying in a plane parallel to the sheet 110 between two wafers, and an upstanding portion 118 at right angles thereto. The flat portion 117 is slotted at its end and is centrally distorted so as to receive a conducting pin of the plug 70 or of the device 11. Such a conducting pin, when passed through the perforation 113 in the socket 9, is firmly gripped by the portion 117 so that the pin makes good electrical contact therewith.

Four other perforations 119, 120, 121, and 122 each have two such contacts which are respectively illustrated schematically in Fig. 1 as contacts 64 and 65, contacts 123 and 124, contacts 40 and 42, and contacts 45 and 46.

Fig. 3 affords a clearer illustration of the manner in which two of these contacts, such as contacts 64 and 65 cooperate with a pin inserted into the perforation 119. Affixed to the insulating sheet 110 there is illustrated in section a second insulating sheet 125 and a third insulating sheet 126, both perforated similarly to sheet 110. The slotted and distorted portion of the contact 65 lies between the insulating sheets 125 and 126 and the upstanding portion thereof passes outwardly through the insulating sheets 125 and 110 through suitable slots. The slotted and distorted portion of the contact 64 lies between the insulating sheets 110 and 125 and the upstanding portion thereof passes outwardly through a slot 127 cut in the sheet 110. The upstanding portions of the contacts 64 and 65 lie in planes at right angles to each other so that there is no electrical connection between these clips when no conducting pin is within the perforation 119 to make contact with the respective slotted portions of the clips. When such a pin is inserted, these contacts 64 and 65 are electrically connected together through the pin.

Fig. 4 illustrates a fragmentary portion of a somewhat differently constituted socket for achieving similar results. There is a large central perforation 130 through a pair of insulating sheets 131 and 132, through which smaller perforations 133 and 134 are made. Lying between these sheets and held in place by suitable slots cut in the sheet 131, there are a pair of contacts 135 and 136 adjacent the perforation 134.

Referring to Fig. 5, the cooperation of the con-

tacts 135 and 136 with each other and their relation to a connecting pin of a discharge device may be more easily seen. Each of the contacts 135 and 136 is provided respectively with an opposite facing portion 137 and 138, which portions are adapted to grip therebetween a conducting pin upon its being placed within the perforation 134. Small bars of insulating material 139 and 140 are held between the sheets 131 and 132, so as to maintain upturned portions 141 and 142 respectively of the contacts 135 and 136 in separated relation when no conducting pin lies between the contacts 135 and 136. By this construction it is provided that no electrical connection exists between the contacts 135 and 136 unless a connecting pin is inserted through the perforation 134.

It is, of course, clear that sockets constructed as those described above are well adapted to perform a switching action by their cooperation with the conducting pins of a plug, discharge device, or the like, to be placed in the socket. While, as they are illustrated and described, these sockets are especially adapted for a particular switching operation, it is obvious that such switches can be used for many sorts of switching and circuit rearrangement.

While I have shown a particular embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto, since different modifications may be made both in the circuit arrangement and instrumentalities employed, and I aim by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, an apparatus including a plurality of interconnected electron discharge devices arranged for battery operation, one of said devices having a socket from which it is removable and an output device, a power supply assembly arranged for operation from mains, said assembly including a plug arranged for insertion in said socket when said one discharge device is removed therefrom, and an additional discharge device adapted for operation from mains and arranged for connection with said other discharge devices and said output device through said plug and socket to replace said one discharge device, an anode supply circuit for said additional discharge device extending from a mains' supply through said plug and output device in succession to the anode of said additional discharge device, and means to supply operating energy from said mains through said power supply assembly to all of said devices when said plug is inserted in said socket.

2. In combination, an apparatus including a plurality of cascade-connected electron discharge devices arranged for battery operation, one of said devices having a socket from which it is removable, a power supply apparatus including an assembly separate from said first apparatus, said assembly comprising a rectifier, an additional discharge device, and a plug adapted for insertion in said socket when said one discharge device is removed therefrom, said additional discharge device being mounted in said assembly and arranged for operation in said cascade connection through connections including said plug and socket, means to supply current from the output of said rectifier through said plug and socket to said additional discharge device, and means to supply current from the output of said

rectifier to the others of said discharge devices in said cascade connection when said plug is inserted.

3. In combination, an apparatus including a plurality of cascade-connected, battery-operated electron discharge devices, the last of said devices having a socket from which it is removable, mains operated power supply apparatus including a discharge device of higher capacity than said last discharge device and a plug for insertion in said socket when said last discharge device is removed therefrom, and connections through said plug and socket between said additional devices and said cascade-connected devices whereby said additional device replaces said last device in the cascade connection, and means to energize all of said devices from said mains when said plug is inserted in said socket, said means including means to pass the anode current of said additional discharge device through the filaments of other discharge devices in the cascade connection to heat said filaments.

4. In combination, an apparatus including a plurality of interconnected electron discharge devices arranged for battery operation, said discharge devices having cathode heating circuits arranged in parallel, and one of said devices being provided with a socket from which it is removable, a power supply assembly arranged for operation from mains, said assembly including a plug arranged for insertion in said socket when said one discharge device is removed therefrom, and an additional electron discharge device of higher capacity than said one device, means to connect said interconnected discharge devices to said additional discharge device through said plug and socket whereby said additional discharge device replaces said one discharge device in said apparatus, means in said socket to interrupt said parallel connections to arrange said cathode heating circuits in series when said plug is inserted in said socket, and means to supply heating energy to said cathode heating circuits in series from said power supply assembly.

5. In combination, a plurality of cascade-connected, battery-operated electron discharge devices, the last of said devices having a socket from which it is removable, others of said devices having filaments connected in a series path, said socket including a plurality of pairs of contacts insulated from each other, each pair arranged to be connected together when said last device is in said socket, means connecting said filaments in parallel through said pairs of contacts when said last device is in said socket, a mains-operated power supply apparatus including an additional discharge device and a plug for insertion in said socket to connect said additional device to replace said last device in the cascade connection while providing no connections between said pairs of contacts, and means to supply power from said mains to all of said discharge devices and to pass the anode current of said additional device through said series path thereby to heat the filaments included therein.

6. In combination, a plurality of cascade-connected electron discharge devices arranged for battery operation and each having a filament, the last of said devices having a socket and a base, said base having contacts connected to electrodes in said last device and arranged to engage contacts in said socket, one of said base contacts engaging a plurality of contacts in said socket so connected that the filaments of said discharge devices are in parallel when said base is in said

socket, and when said base is removed from said socket the filaments of the remaining devices are in series, a mains operated power supply apparatus including a plug arranged for insertion in said socket, and an additional discharge device arranged to replace said last discharge device in the cascade connection through connections extending through said plug and socket, said plurality of contacts remaining disconnected from each other when said plug is inserted, whereby the filaments of said remaining devices are in series, and means to pass the anode current of said additional device through said series connected filaments to heat said filaments.

7. In combination, an apparatus including a plurality of interconnected, battery-operated electron discharge devices, the last of said devices having a socket from which it is removable, mains-operated power supply apparatus including a discharge device of higher capacity than said last device and a plug for insertion in said socket when said last device is removed therefrom, connections through said plug and socket between said additional device and said interconnected devices whereby said additional device replaces said last device in said first apparatus, and means to energize all of said devices from said mains when said plug is inserted into said socket, said means including means to pass the anode current of said additional discharge device through the filaments of other discharge devices in said apparatus to heat said filaments, and means providing an operating bias voltage for said additional device from the potential drop produced by said anode current flowing through said filaments.

8. In combination, an apparatus including a plurality of interconnected electron discharge devices arranged for battery operation, one of said devices having a socket from which it is removable, a power switch connected to the terminals of said devices and connections through said switch to said devices for supplying operating current thereto, a power supply assembly arranged for operation from mains, said assembly including a plug arranged for insertion in said socket when said one discharge device is removed therefrom, connections to supply current to said device from said assembly, said connections extending from said mains and passing through said switch, said plug and said socket to said devices, whereby said power switch controls energization of said devices from batteries

through said first connections or from said assembly when said plug is inserted in said socket.

9. In combination, an apparatus including an electron discharge device arranged for battery operation and a socket interconnected therewith, a power switch and connections through said switch to said device for supplying operating current thereto, a power supply assembly arranged for operation from mains, said assembly including a plug arranged for insertion in said socket when mains operation of said apparatus is desired, said assembly also including means for converting power from said mains to a form usable by said device, connections to supply current to said device from said converting means, and connections to supply current from said mains through said switch, said plug, and said socket to said converting means, whereby said power switch controls energization of said device from batteries through said first connections or from said mains when said plug is inserted in said socket.

10. The combination, with an electric circuit, of means to perform a switching operation in said circuit, said means comprising an electron discharge device having a contact pin connected to an electrode therein, and a socket for said device, said socket having a receptacle for said pin and a plurality of contacts adjacent thereto and insulated from each other, said contacts being connected in said circuit and arranged to connect portions thereof through said pin upon insertion of said device into said socket.

11. The combination, with a plurality of electron discharge devices, each having a filament and said filaments being connected in a series circuit with a source of potential, of means for connecting the filaments of said devices in parallel, said means comprising another electron discharge device having a filament connected between a pair of contact pins, a socket for said other device having a receptacle for each of the pins of said device, each of said receptacles having a pair of contacts adjacent thereto arranged to touch the respective contact pin upon its insertion therein, and means to connect said contact pins to such points of said series circuit that, upon insertion of said other device in said socket, said filaments are all connected in parallel through the contacts of said socket and through the contact pins of said other device lying between said contacts.

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