Sept. 1, 1942. E. G. GAGE 2,294,843

MEANS FOR SAFELY SERVICING DANGEROUS ELECTRICAL APPARATUS

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Fig. 1.

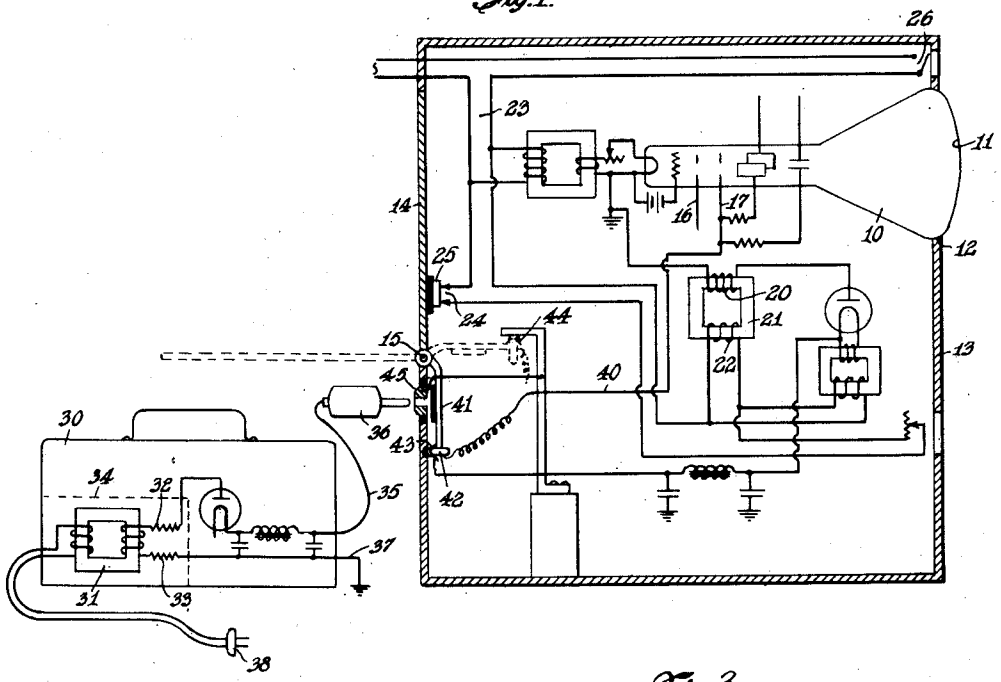


Fig. 2.

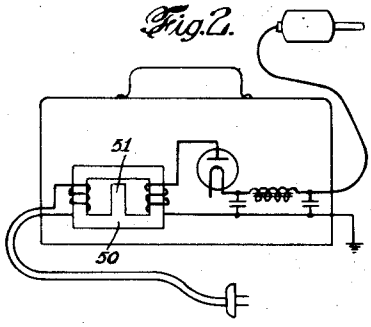


Fig. 3.

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MEANS FOR SAFELY SERVICING DANGEROUS ELECTRICAL APPARATUS

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9 Claims. (Cl. 250—27)

The invention relates to means for safely servicing high voltage electrical apparatus such as television receivers, radio transmitters and the like which normally require a dangerous voltage and a dangerous current for their optimum operation.

It is well known that this apparatus may be of such a character as to cause serious injury or death to a person contacting the high voltage conductors when the current is on.

For this reason it has hitherto not been possible to service commercially such sets except when these are provided with interlocking switches which completely cut off all power when the cabinet door with which they are cooperative is opened to admit of access to the interior of the cabinet enclosing the entire apparatus. As a temporary but dangerous expedient, servicemen have placed jumpers across such switches to enable them to more thoroughly test the set.

In a recent U. S. Patent #2,254,214 granted to me, I have shown how it is possible to render such high voltages safe to handle for servicing, by inserting resistance in the anode supply of a thermionic tube, the resistance being located, for example, so close to the source that all conductors lie between such resistance and the tube, the resistance, also, being of such high magnitude that upon establishment of a closed circuit through the exposed circuit parts and the human body, the current in such closed circuit is reduced by this resistance to a safe value.

Under certain conditions, but to a less degree, magnetic leakage transformers may also be used with thermionic apparatus to reduce the current while maintaining sufficient voltage for operation of the device.

In my copending application Serial #415,894, filed October 21, 1941, I have shown how either of these expedients may be used in conjunction with suitable switching means which cooperate with a closure member of the enclosing cabinet of the apparatus to render the safe servicing of such apparatus carrying normally dangerous voltage and current within the cabinet.

My present invention has for an object to admit of the servicing of such apparatus with the aid of a portable auxiliary piece of apparatus containing the required safe high voltage supply which may be plugged into apparatus not equipped with such safety circuit whereby to enable the said apparatus to be safely serviced.

A further object of the invention is to provide, as an alternative, means to allow of the auxiliary supply being located inside the cabinet of a television or a radio transmitter or receiver.

Another object is to provide suitable switching mechanism whereby the main source of supply may be connected to the apparatus only when a sealing member for the cabinet is closed; and, when it is opened, to connect in the auxiliary or safe power supply to the apparatus to give a smaller indication, such as a meter reading, in the case of a transmitter, or a dimmer picture, in the case of a television receiver.

In carrying out the invention, the enclosing casing for the apparatus is provided with a movable closure member and with means, cooperating therewith when the member is moved to admit of access to the interior of the casing, to deenergize the power supply which operates normally said apparatus, and to restore the said supply when the closure member is applied to the casing to close the same. Provision is made, furthermore, whereby at the same time that the main power supply is interrupted, an auxiliary or safe power supply is connected in, either manually or automatically and during the period required for servicing the apparatus.

In the case of high power radio transmitters which require more current than television receivers or low power radio transmitters, owing to the fact that relatively less sensitive instruments such as meters must be operated, an independent safe power supply embodying more than one power lead may be used, said leads being connected in parallel, as disclosed in my copending U. S. Patent application Serial #356,460, filed September 12, 1940, and a corresponding number of switching means provided. In this arrangement, the parallel paths of independent voltage and current are to be joined at the anode of the transmitting tube, this juncture being shielded from bodily contact as set forth in the said application.

The nature of the invention, however, will best be understood when described in connection with the accompanying drawing, in which:

Fig. 1 is a diagrammatic view illustrating cathode ray apparatus, and the independent safe power supply therefor.

Fig. 2 is a diagrammatic view of a modified form of the independent safe power supply.

Fig. 3 illustrates a modification in the location of the independent power supply.

Referring to the drawing, more particularly Fig. 1 thereof, there is disclosed, by way of example, the circuit connections for operating a thermionic asymmetric device such as the cath-

ode ray tube 10 having a screen 11 which is located at the opening 12 of a casing 13 for housing the entire tube and network so that access may not be had directly thereto. However, a movable back portion 14 is provided, the same being pivoted as at 15 intermediate the top and bottom of the casing so that, when required, access may be had to the interior of said casing 13.

The two anodes 16 and 17 of this cathode ray tube are energized at more or less high and dangerous voltages and dangerous currents, in the present embodiment the second anode only being considered as operated under such conditions in order to simplify the electrical connections, no provision being made for the energization of the first anode which is accomplished in the usual manner. In the case of the latter or second anode, however, this is to be energized from the secondary winding 20 of a transformer 21 whose primary winding 22 is connected to the supply main 23. One lead of the said main is designed to be opened as at the contacts 24 which normally are bridged by a contact piece 25 carried by a movable back portion 14, when said member is positioned to seal the casing 13 so that access may not be had to the interior thereof. Under these conditions, the dangerously high voltage and dangerous current will be applied to the anode 17 for operating the cathode ray tube 10, the control switch 26 then being closed.

Such arrangement is usual in television and like apparatus employing cathode ray tubes so that bodily contact may not be had with dangerous portions of the circuits involved, and when access must be had to the interior the power supply will be entirely cut off. This, however, does not permit of proper servicing of the apparatus which requires at times that the power be on. In accordance with the invention, provision is made for connection to the thermionic device or cathode ray tube, when the closure member has been moved to admit of access to the interior of the casing, for supplying temporarily to the said thermionic device an independent source of potential and current which is of a safe but operative value.

Thus, an external and preferably portable means, which may be housed in a suitable casing 30, is provided for connection to the system or network within casing 13, said auxiliary casing 30 providing a substantial duplicate of the power supply system within casing 13 but safeguarded to provide an independent source of potential and current, the latter being reduced to a magnitude insufficient to effect serious results should contact be made with any portion of the apparatus. This reduction in the current to a safe value may be effected, for example, in the manner set forth in my U. S. Letters Patent #2,254,214; and as indicated in Fig. 1 of the drawing, the power-supplying transformer 31 has connected in series with its secondary leads resistances 32 and 33, respectively, designed to reduce the current to a safe value, the resistances being located as close as possible to said transformer and enclosed with the transformer in a protective casing 34. All points of the circuit beyond these resistances are therefore safe to contact, and the outlet lead 35 is connected to a plug 36, the other lead 37 being grounded. Power may be introduced to the transformer 31 through a suitable plug 38 adapted to fit the usual outlets.

In accordance with the invention, provision is further made to connect the anode 17 through its lead 40 to the power lead 35, said lead 40 having been interrupted when the closure member 14 is opened. This may be effected by attaching to an extension 41 of the closure member a contact element 42 designed to engage, when the closure member is brought to the closing position, a further contact element 43, the interrupted lead 40 having its ends connected respectively to the contact elements 42 and 43. When the closure member 14 is swung open, the normal connection to anode 17 is interrupted by the separation of contact elements 42 and 43, and when the closure member is open to its full extent, substantially to a horizontal position, contact element 42 will engage with a further contact element 44 which is in electrical contact with a socket 45 mounted in the casing wall and designed to receive the plug 36. This effects a direct connection between the secondary of transformer 31 and the anode 17 such that this electrode will be supplied with the required high potential but at a current of substantially reduced and safe value. The desired service may then be accomplished, whereupon when the closure member is again brought to its normal position to prevent access to the interior of the casing 13, the original and dangerous conditions will be restored for normal operation of the apparatus.

It will be observed, also, that the extension 41 prevents the introduction through socket 45 of plug 36 as well as of any article into the interior of casing 13 when these dangerous conditions prevail.

Other power-reducing means may be utilized, for example, such as embody transformers with magnetic leakage and as indicated in Fig. 2 of the drawing. The transformer 50 shown therein is provided with an intermediate core 51 affording sufficient magnetic leakage to reduce the current as may be required to render the same safe, the safeguarding resistances 32 and 33 utilized in connection with the independent power supply indicated in the embodiment shown in Fig. 1 then being omitted.

Instead of providing a portable external source of auxiliary power for temporary use in connection with the apparatus, as indicated in Fig. 1, such independent source of power for affording voltage and a current at safe but operative value may be embodied directly within the apparatus casing. Referring to Fig. 3 of the drawing, the casing 55 is shown as containing the cathode ray tube 56 with anode 57 and a lead 58 from said anode designed to be interrupted at the contact elements 59 and 60, as in the previous embodiment. The power main 61 is also arranged to be interrupted at the contacts 62 when the closure member 63 is moved to admit of access to the interior of casing 55, similarly to the arrangement illustrated in Fig. 1 of the drawing.

To provide the independent source of power for the anode 57, a transformer 65 is installed in the casing having its primary circuit arranged to be normally interrupted at contacts 66 when the closure member 63 is in position to close the casing. As another means of providing a safe current from the secondary of transformer 65, the expedient of winding the same of high resistance wire 65' may be employed, for example, as more particularly set forth in my copending application Serial #330,636, filed April 20, 1940.

When the said closure member 63 is swung open and to a substantially horizontal position, a bridging element 67 carried by an extension of the closure member bridges the contacts 66 to provide energizing current to the primary of

transformer 65 from the main 61. The power circuit to the transformer 68 for normal energization of anode 57 has been interrupted in the meantime at the contact 62. This removes the dangerous condition from the circuits to the anode 57, and it remains only to connect the secondary of transformer 65 thereto to provide a servicing current and voltage. This is accomplished by the contact element 59 engaging a further element 69 when closure member 63 is brought to the substantially horizontal position, said element 69 being connected through lead 70 and intermediate electrical means to the secondary of transformer 65 which has become energized upon the bridging of contact 66. The anode 57 is then furnished with a supply of power independent of the normal supply furnished by transformer 68 and of a safe but operative value.

I claim:

1. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of means including an alternative connection to the thermionic asymmetric device, operative when the closure member is moved to open the casing, for supplying temporarily to the said thermionic asymmetric device an independent source of nominally dangerous potential and current of a safe but operative value.

2. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of means cooperating with the closure member, when the latter is moved to admit of access to the interior of the casing, adapted for connection to the thermionic asymmetric device for supplying temporarily to the latter an independent source of voltage and current of a safe but operative value.

3. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of means including a supplemental connection to the thermionic asymmetric device when the closure member is moved to admit of access to the interior of the casing, together with means external the casing for supplying temporarily through the supplemental connection an independent source of nominally dangerous potential and current of a safe but operative value.

4. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of portable means including a supplemental connection to the thermionic asymmetric device when the closure member is moved to admit of access to the interior of the casing.

5. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of means external the casing adapted to afford a temporary independent source of potential and current of a safe but operative value and adapted for connection to the thermionic asymmetric device when the closure member is moved to admit of access to the interior of the casing, together with means movable with the closure member to prevent said connection when said closure member is in position to close the casing.

6. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of a source of electrical power supply including a transformer having a core and a primary and a secondary winding thereon adapted to afford an independent source of potential and current of a safe but operative value, and means including an alternative connection operative to connect said secondary winding to the thermionic asymmetric device when the closure member is moved to admit of access to the interior of the casing.

7. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally

at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of a source of electrical power supply including a transformer having a core and a primary and a secondary winding thereon adapted to afford an independent source of potential and current of a safe but operative value, and means to deenergize the source of dangerously high potential and current and simultaneously therewith to connect said secondary winding to the thermionic asymmetric device when the closure member is moved to admit of access to the interior of the casing.

8. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of a portable source of electrical power supply external the casing including a transformer having a core and a primary and a secondary winding thereon adapted to afford an independent source of potential and current of a safe but operative value, and means including a supplemental connection operative to connect said secondary winding to the thermionic asymmetric device when the closure member is moved to admit of access to the interior of the casing.

9. The combination with an electrical circuit having a source of dangerously high potential and dangerous current and a thermionic asymmetric device connected therewith to operate normally at said potential and current, a casing enclosing said source and asymmetric device, said casing including a movable closure member, together with means cooperating with the closure member to deenergize the source of dangerously high potential and current when said closure member is moved to admit of access to the interior of the casing and to restore the same when the said closure member is applied to the casing to close the latter; of a source of electrical power supply including a transformer located within the casing having a core and a primary and a secondary winding thereon adapted to afford an independent source of potential and current of a safe but operative value, and means cooperating with the closure member to deenergize said source of dangerously high potential and voltage and to energize simultaneously therewith said independent source of potential and safe but operative current when said movable closure member is moved to admit of access to the interior of the casing and to connect said secondary to the thermionic asymmetric device.

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