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GROUNDING SAFETY SWITCH AND ALARM FOR ELECTRICAL APPARATUS

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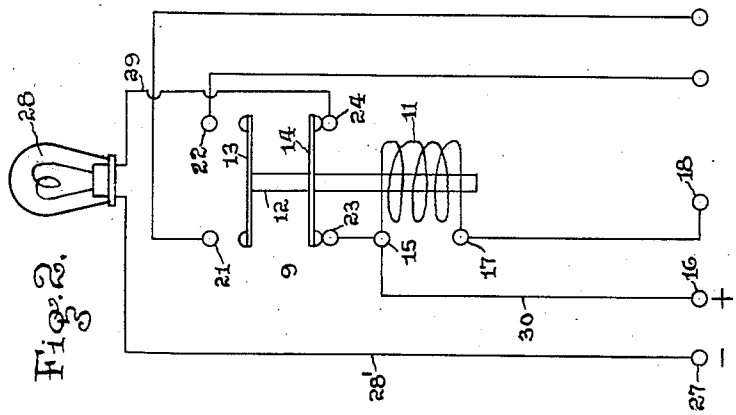


Fig. 2.

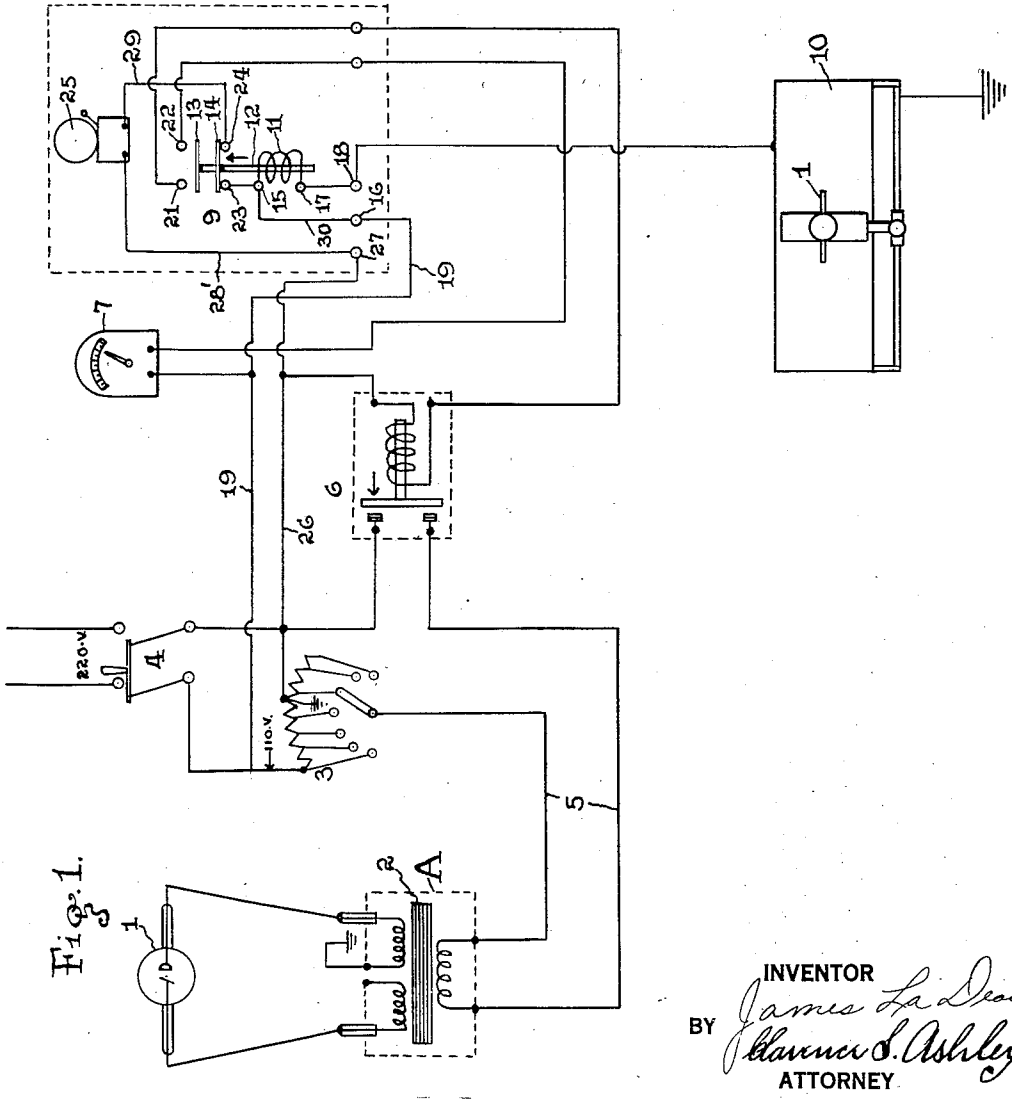


Fig. 1.

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GROUNDING SAFETY SWITCH AND ALARM FOR ELECTRICAL APPARATUS

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5 Claims. (Cl. 250—93)

This invention relates to safety switches for electrical apparatus, and more particularly it is an object of this invention to provide means designed and arranged to be employed in conjunction with high voltage apparatus and to be automatically operative to disconnect the apparatus from the power when the said apparatus becomes ungrounded and to prevent the said apparatus from being operated when it is not grounded.

It is a further object of this invention to combine with the safety switch mechanism a signalling device, of a visual or audible character, designed and arranged to be operative when the main power switch is closed and the apparatus happens to be ungrounded, or when, in operation, the apparatus should become ungrounded.

While the invention has been specifically applied to high voltage apparatus such as X-ray machines, it is clear that the same may be applied to any electrical device, and such application of the invention is regarded as being within the purview of this disclosure.

In X-ray apparatus it is particularly necessary to provide a safety switch, since the liability to serious injuries and even death is very great should the apparatus be or become ungrounded when the high voltage current is on.

In the accompanying drawing:

Fig. 1 is a circuit diagram of X-ray apparatus embodying my safety switch and signal alarm; and

Fig. 2 is a circuit diagram of the safety switch and signal of another character.

Referring to the said drawing, the X-ray apparatus A of Fig. 1 comprises an X-ray tube 1 connected to a step-up transformer 2 the voltage of which is controlled by a step-down or auto-transformer 3 connected to the power inlet switch 4. The primary circuit 5 of the transformer 2 is controlled by a series switch of contactor 6 which is operated normally by the electric timer 7 or a foot switch (not shown). The normal control circuit is then from the outer leg of the auto-transformer 19, through the timer 7, the magnet coil of the contactor 6, and back to the middle part of the auto-transformer; but this circuit is now modified so as to include and to be controlled by my safety switch invention.

As will be seen from the drawing, the main relay will not operate to close the primary circuit 5 unless the contacts 21 and 22 of the relay 9, constituting my safety switch, are closed. These contacts, however, are closed only if this relay is actuated, and this cannot occur if the X-ray table 10 is not grounded. The said relay 9 comprises a solenoid 11, one of the terminals of which is connected to the outer leg of the auto-transformer 3 whose center is grounded and the other terminal of which is connected to the grounded part, in this case the X-ray table 10. Furthermore, in the event that the solenoid 11 is not properly connected to the table, or the table is not grounded, and the main control board switch is closed, the relay solenoid 11 will not receive voltage and a visual or audible signal is caused to be operated to apprise the operator of the fact and the relay 9 remains in such position as to maintain the circuit of relay 6 open. In the event the table is grounded and the relay 9 properly connected to the table, then when the main control board switch is closed, relay 9 is actuated, the circuit through relay 6 is closed and simultaneously the signalling device is disconnected, as will be described more fully.

My safety switch comprises a two-position relay switch 9 having a solenoid or electro-magnetic winding 11, as before stated, which said solenoid is designed to actuate a plunger 12 carrying a pair of bridging or contact closing members 13 and 14. One end of the solenoid is connected to a terminal 15 which is in turn connected to a terminal 16. The other end 17 of the solenoid is connected to terminal 18 which is in turn connected to the table 10. Terminal 16 is connected to a 110 volt tap of the auto-transformer 3 by conductor 19. The circuit through the solenoid 11 is therefore from the grounded midpoint of the auto-transformer through the auto-transformer and through conductor 19, coil 11, terminal 18, and grounded table 10 and thus back to the grounded part of the auto-transformer 3.

When the power switch 4 is closed and the solenoid 11 is properly grounded through the table 10, current will flow through the solenoid to pull the plunger 12 upwardly so that bridging member 13 makes bridging contact with terminals 21 and 22 to close the circuit through the solenoid of relay 6 and the electric timer or foot-switch 7. At the same time, when the plunger 12 is pulled upwardly, the bridging member 14 carried by the plunger is moved out of engagement with the terminals 23 and 24, to open the circuit of the signalling device, bell 25 (Fig. 1), or lamp 28 (Fig. 2).

Thus when the terminal 18 is properly grounded through the grounded table, closing the power switch 4 causes the relay 9 to be actuated to close the circuit through relay 6 enabling the X-ray tube to be operated, while at the same time the signalling device is disconnected. Should the

table be ungrounded or relay terminal 18 be not connected to the table when the main control board switch is closed, then current will flow through the signalling device but not through the solenoid 11, the circuit through said signalling device being middle of auto-transformer 3, conductor 26, terminal 27, conductor 28', signal 25 (28), conductor 29, contact 24, bridging member 14, contact 23, post 15, conductor 30, post 16, conductor 19, and outer leg of auto-transformer 3.

Should the table become ungrounded during the operation of the apparatus, the solenoid 11 of relay 9 will become immediately de-energized, causing the plunger 12 to drop and thereby break contacts 21—13—22 and make contacts 23—14—24, whereby the high voltage current is automatically cut-off and the signal turned on.

From the above, it will be seen that I have provided grounded electrical apparatus provided with a safety switch which is normally connected across the terminals of a signal device and adapted, when the main switch is closed and the apparatus is grounded, to automatically connect the operative parts of said apparatus to the power supply and disconnect simultaneously said signal device when said apparatus is grounded, the purpose of this arrangement being to notify the operator, by means of the signal, should the apparatus be ungrounded. In other words, by my invention, should the main switch 4 be closed when the apparatus is ungrounded, the signal 25 (28) will be operated to apprise the operator of that fact. When the apparatus is grounded, the safety switch moves to connect the apparatus to the power source, otherwise not.

Having described my invention, what I claim is:

1. A ground-and-safety indicating device for X-ray apparatus, comprising in combination with a high voltage generator, an X-ray tube and parts with which the patient may come in contact and which for safety must be grounded, an electromagnetically operated contactor in the supply line for said high voltage generator and having an electro-magnetic circuit for opening and closing said contactor, a two-position electro-magnetically operated relay having contacts two of which serve to close the circuit for said contactor when said relay is operated and thereby actuate said contactor, and two of which serve to close a circuit through a source of voltage and an indicating signal device when said relay is not operated and a circuit to operate said relay including the electro-magnetically operating device of said relay, a source of voltage and one end terminating to ground and the other end to said parts assumed to be grounded whereby in the absence of secure grounding of said parts the said contactor will be opened and said signal device will noticeably indicate.

2. A ground-indicating and safety device comprising, in combination with an X-ray transformer-rectifier apparatus and an X-ray tube to be energized and having parts with which the patient may come in contact and said parts to be grounded, a means for opening and closing the power supply for said X-ray transformer, said means having control means actuated by a relay, a two-position relay having in each position a pair of normally closed and a pair of normally open contacts and when in one position, said closed contacts completing a circuit containing an indicating safety signal device and when in the second position said normally open contacts being closed and completing a circuit actuating said opening and closing means for the power supply and an electro-magnetic control circuit for said relay comprising a connection to ground, a source of voltage, said relay and the said grounded parts with which the patient may come in contact.

3. A ground-indicating and protective device comprising an electrical apparatus having a grounded part and being energized from a power supply line through a main switch, an electromagnetically controlled contactor in the supply line and in series with one leg of said main switch, a two-position electro-magnetically controlled relay having in each position one normally closed and one normally open pair of contacts, said closed pair when said relay is not energized actuating an indicating signal device and the normally open pair when said relay is energized closing said contactor, and a control circuit for said relay connected to ground and to said grounded part.

4. A ground-indicating and safety device for an electrical apparatus having parts with which persons may come in contact and which parts for safety must be normally securely grounded, comprising in combination with such an apparatus, a power disconnecting device having electromagnetic opening means, a relay having a control circuit from ground through said relay and a source of voltage to said grounded parts whereby when said parts are securely grounded the said relay is actuated, said relay having two pairs of contacts and closing means therefor, one pair of contacts being connected to the electro-magnetic opening means of said power disconnecting device said last named contacts being closed when said relay is actuated and the other pair of such contacts being closed when said relay is not actuated and actuating a signal device thereby indicating that said normally grounded parts are not securely grounded.

5. A ground-indicating and protecting device comprising, in combination with an electrical apparatus having parts normally not connected to a potential and normally grounded and being energized from a power supply line, a contactor having actuating means and contacts to be closed and opened connected in series with one leg of said supply line to open and close said supply line, a two-position electro-magnetically actuated relay, a signal device having actuating means and an actuating circuit for said relay connected to ground and to said grounded part, said relay when in one position energizing the actuating means of said signal device and when in the second position energizing the actuating means of said contactor to close said contactor.

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