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ROENTGEN APPARATUS

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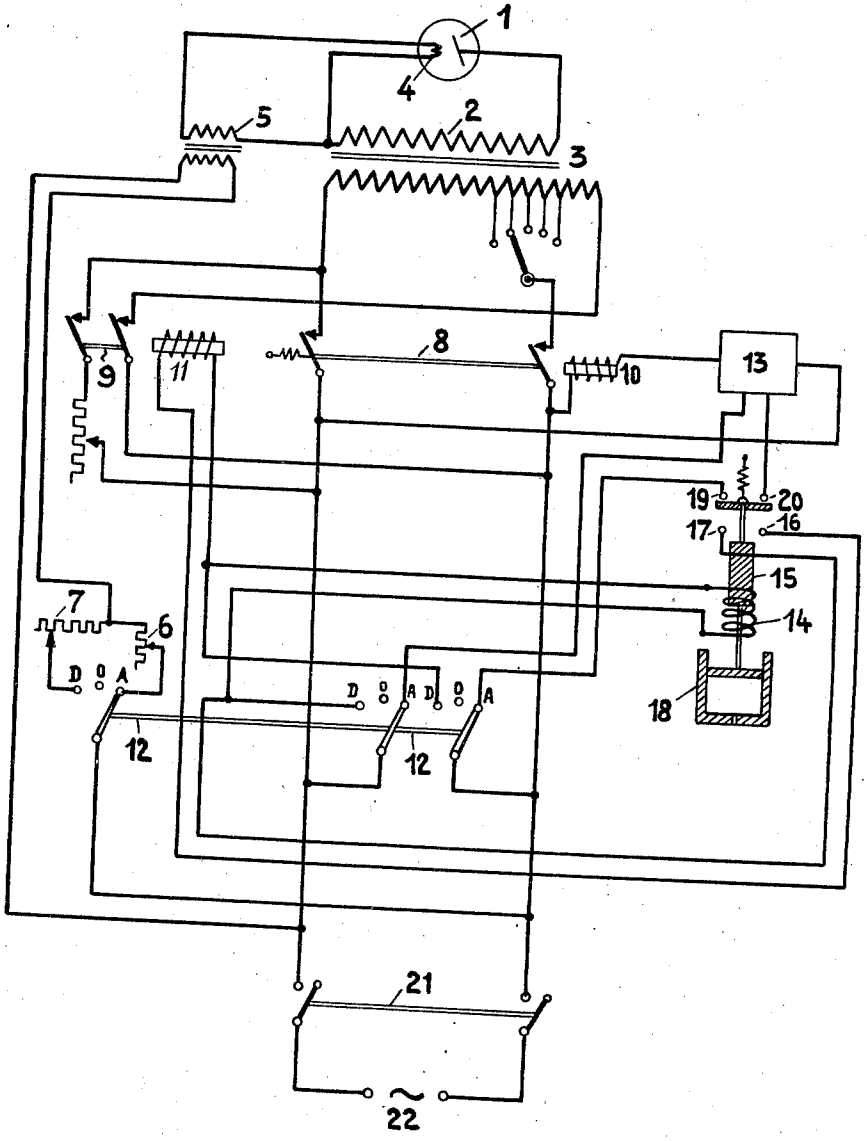

Inventor:
Karl Silbermann
By: Richardson & Quee
Attys.

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ROENTGEN APPARATUS

Karl Silbermann, Erlangen, Germany, assignor to The firm Siemens-Reiniger-Werke Aktiengesellschaft, Berlin, Germany

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5 Claims. (Cl. 250—93)

This invention relates to Roentgen apparatus, and is particularly concerned with a device for controlling the transition from the fluoroscoping to the radiographing operations, and vice versa.

The use of such a device is desirable because of the fact that the anode current is considerably higher during the period of radiographing as compared with the period of fluoroscoping, necessitating an increase in the temperature of the glow cathode during radiographing over the value required for fluoroscoping. The radiographing cannot commence immediately at the moment of terminating the fluoroscoping operation, because a certain time interval or preparatory period is required for the heating of the cathode to the required value, in view of the inertia of the filament. A like preparatory interval is, of course, also required for the transition from radiographing to fluoroscoping, with the difference that time must be given to reduce the temperature of the cathode.

A brief review of the state of the art is given below for the purpose of facilitating the understanding of the detailed description which is to follow.

In order to prevent premature radiographing, the suggestion has been made to equip the timing switch provided for controlling the exposure period with an additional arm or contact finger which starts its operation with the connection of the heating current for radiographing and engages the radiograph exposure contact finger (radiograph release) when the cathode is sufficiently heated, thus initiating the exposure. The drawback of this arrangement resides in the relatively expensive and specially made timing switch and associated equipment which is required. A further shortcoming resides in the fact that this arrangement prevents only an objectionable quick transition from fluoroscoping to radiographing, without furnishing any safeguard for the reverse operation. This is a disadvantage, because the temperature of the incandescent cathode when heated to its radiographing value is so high that upon premature or too quick transition to fluoroscoping, the anode current is a multiple of the usual or required value at the moment of closing the anode circuit for fluoroscoping. The high current causes excessive irradiation of the fluoroscope image, which handicaps the work of the operator. If such control is used in apparatus of the rotating anode type, the anode of the tube may be damaged by excessive current at the start of fluoroscoping, because it does not rotate during this period. The meter for the anode current, which is switched to decreased measuring range for fluoroscoping operation, may likewise be damaged by excessive current.

The above mentioned drawbacks are avoided by the invention according to which a delay means, for example, a suitable slow-acting relay is used, causing automatic completion of the anode circuit of the Roentgen tube for fluoroscoping or for radiographing a short period after closing the tube heating circuit for the corresponding operation. The required delay between the closure of the heating circuit and the closure of the anode circuit may be adjusted, for example, to about half a second, and may be obtained in any suitable manner, for example, by equipping the relay with an air brake or a hydraulic dash-pot. Mercury switching tubes may also be very advantageously used for this purpose.

The invention will now be described with reference to the accompanying drawing, showing an example of a practical embodiment in diagrammatic representation.

The anode circuit of the Roentgen tube 1 is supplied with current from the secondary winding 2 of the high tension transformer 3. The heating transformer 5 serves for heating the cathode 4 of the tube 1. The proper adjustment of the heating current for radiographing is obtained by means of the resistance 6, and for fluoroscoping by means of the resistance 7. Current is supplied to the primary winding of transformer 3 for radiographing by means of the switch 8, and for fluoroscoping by means of the switch 9. These switches are actuated by electro-magnets 10 and 11, respectively. Magnet 10 is operatively connected with the master control switch 12 in position A, which is the radiographing position, under control of the timing switch 13. The magnet 11 is operatively connected with the master control switch 12 in position D, which is the fluoroscoping position. The master control switch 12 is manually operated.

The slow-acting relay 14 permits the operation of relay 11, when it is desired to fluoroscope after completing the radiographing, only after the cathode 4 has sufficiently cooled down; and, vice versa, prepares the apparatus for radiographing only after the cathode has been raised to the required temperature.

The sequence of operations is as follows:

Assuming that main switch 21 is closed, the switch 12 may be operated into the position D

(for fluoroscoping), whereupon relay 14 energizes. This relay actuates its armature 15, and bridges the contacts 16 and 17, thereby closing the circuit for magnet 11, which energizes and completes the primary circuit of transformer 3 through a resistance and thus provides the proper anode potential required for fluoroscoping. This operation is delayed as compared with the closure of the tube eating circuit (switch 12, left hand side, position D), due to the slow-acting feature of relay 14, which may be equipped with an air or hydraulic dash-pot 18. A delay of about half a second is sufficient for adjusting the temperature of the cathode to the value required for fluoroscoping.

If it is now desired to radiograph and the apparatus is quickly switched to the corresponding position (switch 12, position A), the armature 15 is released with delay, and when it reaches its alternate position, it bridges the contacts 19 and 20, thereby actuating the timing switch 13, which causes operation of relay 10 and closing of switch 8. This switch closes the primary circuit of the transformer 3 through a tap switch adjusted to provide the proper anode potential for radiographing. Again, as in the previously described case, the anode potential is supplied only after the cathode 4 has reached the temperature required for this particular operation under the control of resistance 6, which has been connected in position A of switch 12 shown at the left side of the drawing.

The initially described operations take place if it is desired to repeat the fluoroscoping operation; that is, the switch 12 may be operated to position D, closing the proper heating circuit for the cathode over resistance 7, and relay 14 is operated to supply the corresponding anode potential after a certain time interval sufficient to permit the cathode 4 to assume the proper temperature.

Numeral 21 designates the main power switch, and 22 the connection to the power source, which may be the usual commercial power supply.

Changes may be made within the scope and spirit of the following claims, wherein I have defined what I believe to be new and what is desired to have protected by Letters Patent of the United States.

What is claimed is:

1. In a Roentgen apparatus, a Roentgen tube, a master control switch having a fluoroscoping position and a radiographing position, cathode and anode circuits suitable for fluoroscoping established in the first position, cathode and anode circuits suitable for radiographing established in the second position, and means effective whenever the position of said switch is changed for automatically delaying the establishing of the anode circuit corresponding to the new position of the switch, thereby providing time for the cathode to assume the temperature at which it is maintained by the cathode circuit corresponding to such new position.

2. In a Roentgen apparatus, a Roentgen tube, a master control switch, a heating circuit for the cathode completed by operation of said switch, a relay for closing the power circuit over which anode potential is supplied, a circuit for said relay prepared by the said switch operation, and means responsive to said switch operation for completing the circuit of said relay after a predetermined time interval.

3. In a Roentgen apparatus, a Roentgen tube, circuits for supplying different values of heating current to the cathode of said tube, circuits for supplying different anode potentials to the anode circuit of said tube, relays for closing said last mentioned circuits, a master control switch for closing either heating circuit and for determining which of said relays is to be operated, and time delay means for operating the selected relay.

4. In a Roentgen apparatus, a Roentgen tube, two cathode circuits for said tube arranged to provide two different values of heating current suitable for fluoroscoping and radiographing, respectively, a master control switch for closing either of said circuits at will, two circuits for supplying two different anode potentials to said tube suitable for fluoroscoping and radiographing, respectively, separate closing devices for said anode circuits, means included in said master switch for preparing a circuit for the proper closing device each time a cathode circuit is closed, and means controlled by said master switch for completing the prepared circuit after a predetermined time interval.

5. In a Roentgen apparatus, a cathode circuit, a switch for varying the amount of current flowing in said circuit, an anode circuit and source of potential therefor, said switch having contacts for interrupting the supply of potential to said anode circuit each time the value of the current in the cathode circuit is decreased or increased, and means effective automatically a predetermined interval after a change in the cathode current for re-establishing the anode potential.

KARL SILBERMANN.