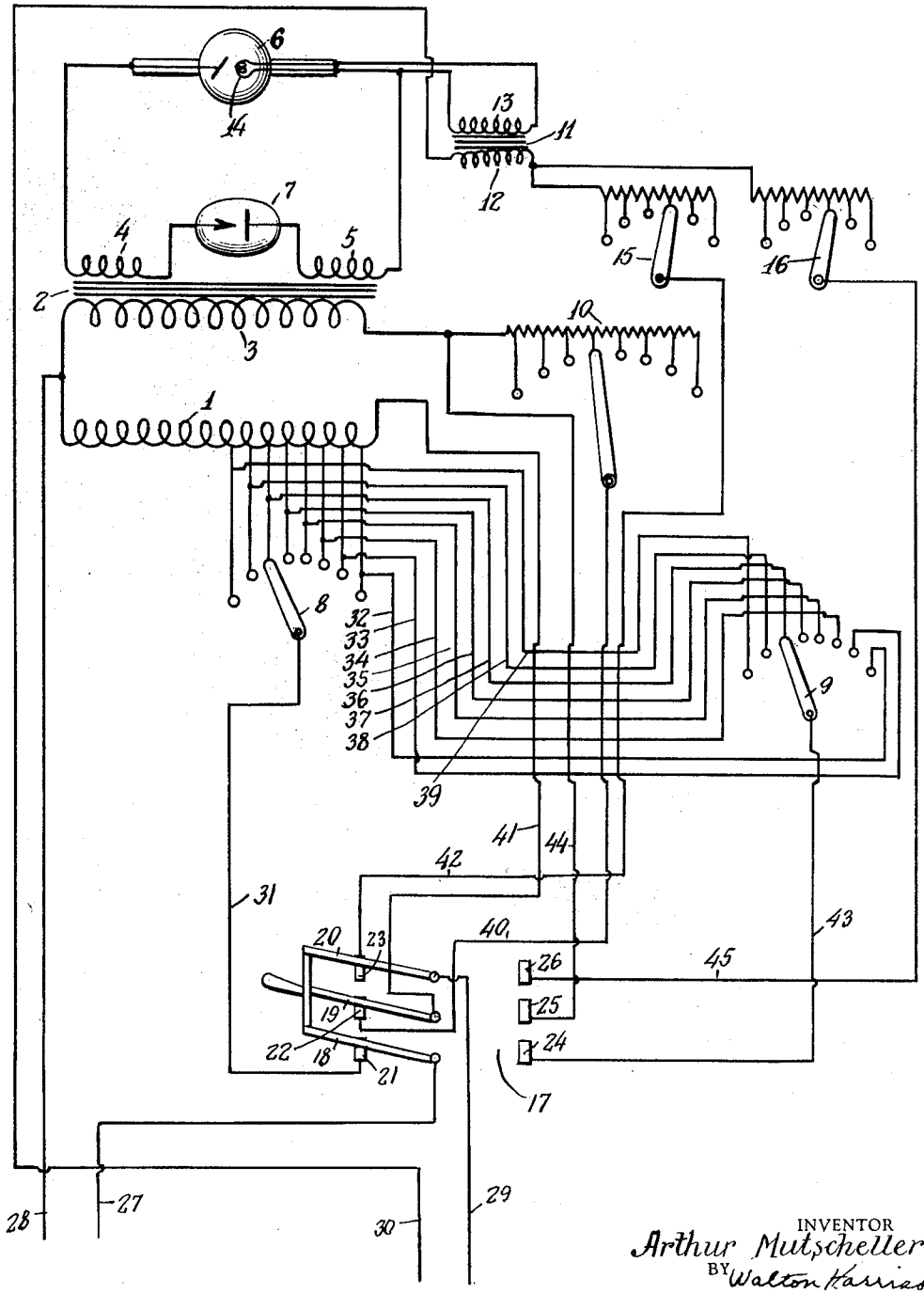
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CHANGE-OVER SYSTEM

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CHANGE-OVER SYSTEM

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My invention relates to change-over systems for high tension circuits. My invention admits of general use, but is especially adapted for high tension circuits used for X-ray work.

More particularly stated I seek to provide an X-ray tube suitable for both fluoroscopic work and radiographic work, and to use this X-ray tube in association with a system whereby the tube may first be energized for purposes of fluoroscopy, and quickly thereafter may be energized for purposes of radiography, the circuits for these two purposes being more or less distinct from each other; the number and character of such circuits being such as to enable different parts of the X-ray tube to be taken care of in different ways, according to the requirements of the X-ray tube, as changed from one of its adaptations to the other.

As is well known in this art, it is very desirable to use a single X-ray tube for two distinct purposes, and to have one of these purposes follow the other in rapid succession. For instance, it frequently happens a physician is making a fluoroscopic examination of a living stomach; he sees an abnormal contraction or other distortion of the organ, and wishes to make a photograph of the organ as thus contracted or distorted. For this purpose he must work very quickly, as the noted condition may be of short duration. In instances of this kind the ideal thing to do, of course, is to make a photographic exposure as quickly as possible after the phenomenon is first noticed. This means to make a change in the environment of the X-ray tube, to adapt the tube for photography instead of fluoroscopy. And this means, in practice, to change a number of different connections leading to or associated with the X-ray tube.

What I seek to do by my invention is to employ a single X-ray tube for purposes of both fluoroscopy and photography; and by appropriate connections and a change-over switch associated therewith, to enable a single throw of the switch to bring about all such changes in the character of the circuits as may be required to convert the X-ray tube and parts associated therewith from a fluoroscope into a photographic apparatus, and vice versa.

Reference is made to the accompanying drawing forming a part of this specification, in which the figure is a diagram illustrating my invention.

An auto-transformer 1 is connected with the primary winding 3 of a high tension transformer 2. This transformer has two secondary windings 4, 5, which are in series with an X-ray tube 6 and with a valve tube 7, the latter serving as a rectifier.

A control switch 8 is connected with the auto-transformer 1, for the purpose of controlling the power supplied to the high tension transformer 2. Another switch 9 serves as an auxiliary control switch for the auto-transformer 1, as hereinafter more fully described.

A variable resistance switch 10 is used for controlling the current induced in the auto-transformer.

A small sized low voltage transformer 11, provided with a primary winding 12 and a secondary winding 13, is used for generating currents to energize the filament 14 of the X-ray tube 6.

Two small switches 15 and 16 are connected in parallel with the primary winding 12, and are adapted for use at different times and independently of each other for controlling the low tension transformer 11.

The main switch is shown at 17, and is provided with three blades 18, 19 and 20, movable as a unit. Associated with these blades are six contact members 21, 22, 23, 24, 25, 26.

The leads of the main circuit are two conductors 27, 28, the conductor 27 being connected with the blade 18, and the lead 28 being connected with the auto-transformer 1 and with primary winding 3 of the main transformer 2.

A pair of leads 29, 30 are used for energizing the low tension transformer 11, and are thus under control of the switches 15 and 16, employed for supplying currents used in heating the filament 14. The conductor 29 is connected with the blade 20, and the conductor 30 is connected with the primary winding 12 of the low tension transformer 11.

A conductor 31 extends from the contact member 21 to the control switch 8. From this switch to the auxiliary switch 9 there extend a number of cross-conductors 32, 33, 34, 35, 36, 37, 38 and 39. By virtue of these conductors, either of the switches 8, 9 can be brought to control the auto-transformer 1.

A conductor 40 extends from the contact member 22 to the switch 10, and a conductor 41 extends from the switch blade 19 to the auto-transformer 1. From the contact member 23 a conductor 42 extends to the switch 15. A conductor 43 extends from the contact member 24 to the switch 9. A conductor 44 is connected with the contact member 25, and also with the variable resistance 10 and the primary winding 3. From the contact member 26 a conductor 45 leads to the switch 16.

With the main switch 17 in the condition indicated for it in the figure, the apparatus is adapted

for fluoroscopy. With the switch handle thrown over to the right, so that the blades 18, 19, 20 are disconnected from the contact members 21, 22, 23 and in contact with the contact members 24, 25, 26, the apparatus is in condition for use in X-ray photography.

With the system in use for fluoroscopy, or practically speaking with the switch handle thrown to the left, the variable resistance 10 is in series with the primary winding 3 of the main transformer 2. With the main switch thrown into its alternative position, however, so that the system is adapted for photography, the variable resistance 10 is thrown out of circuit altogether.

It will be noted that the switches 8 and 9 may be adjusted from time to time independently of each other. This means, in effect, that the amount of current supplied to the auto-transformer 1 may be different when the system is used for fluoroscopy than when it is used for photography, and that the respective settings of the two switches 8 and 9 for this purpose may be more or less permanent, as required.

Similarly it may be noted that the current supplied to the low tension transformer 11, and consequently the amount of current therefrom used for heating the filament 14, may be different when the system is used for fluoroscopy than when it is used for radiography, and that the respective settings of the switches 15 and 16 may be permanent or not, as required.

I will now trace the circuits, assuming first that the switch blades 18, 19 and 20 are in engagement with the respective contact members 21, 22, and 23.

The main circuit, for energizing the auto-transformer 1, is as follows:—

Conductor 27, switch blade 18, contact member 21, conductor 31, switch 8, auto-transformer 1, conductor 28 to source of current supply, thence back to conductor 27. This energizes the auto-transformer 1, and induces therein a current which may be traced as follows:—

Auto-transformer 1, conductor 41, switch blade 19, contact member 22, conductor 40, variable resistance 10, primary winding 3 of main transformer, and back to auto-transformer 1. This circuit energizes the high tension transformer 2, to an extent determined by the variable resistance 10.

The circuit controlling the low resistance transformer 11 may be traced as follows:—

Conductor 29, switch blade 20, contact member 23, wire 42, switch 15, primary winding 12 of low tension transformer 11, conductor 30 to source of low tension current supply, thence back to conductor 29. This energizes the transformer 11, the secondary circuit of which may be traced as follows:

Secondary winding 13, through filament 14, and back to secondary winding 13. This secondary circuit heats the filament 14.

The high tension transformer 2 having been energized as above explained, its secondary circuit may be traced as follows:—

Secondary winding 4, X-ray tube 6, secondary winding 5 and valve tube 7, back to secondary winding 4. This energizes the X-ray tube 6 and valve tube 7, for purposes of fluoroscopy.

Suppose, next, that the main switch 17 be actuated, so as to disconnect the blades 18, 19, 20 from the contact members 21, 22 and 23, and to bring them into engagement with the contact members 24. 25 and 26.

The main circuit may now be traced as follows:—

Conductor 27, blade 18, contact member 24, conductor 43, switch 9, cross connection 37, auto-transformer 1, conductor 28 to source of current supply, thence back to conductor 27.

This energizes the auto-transformer, and induces therein a current which may be traced as follows:

Auto-transformer 1, conductor 41, switch blade 19, contact member 25, conductor 44, primary winding 3 of high tension transformer 2, back to auto-transformer 1.

This circuit energizes the high tension transformer 2, but to an extent entirely independent of the variable resistance 10, which is now completely out of circuit. The circuit now controlling the lower resistance transformer 11 may be traced as follows:—

Conductor 29, switch blade 20, contact member 26, wire 45, switch 16, primary winding 12 of low tension transformer 11, conductor 30 to source of low tension current supply, thence back to conductor 29.

This circuit energizes the low tension transformer 11, which is now under control of the switch 16 and thus independent of the switch 15.

From the foregoing description may readily be seen that the main switch in one of its normal positions the system as a whole is in condition for fluoroscopic work, and with the main switch in its other normal position the system is in condition for radiographic work.

By means of my system there can be effected a considerable saving of time, at the precise moment when the saving of time is of very great value. For instance, a physician may be using the system as a fluoroscope, and therewith making an examination of a patient; he sees some phenomenon, such, for instance, as the displacement of an organ. He wishes to make a photograph of the organ thus displaced; and for this purpose all he has to do is to shift the main switch. This assumes that all preparations have been previously made for taking a photograph, except to make the necessary changes in the various electrical circuits.

With most of the types of apparatus heretofore used it was first of all necessary to make changes in the condition of rheostat, the auto-transformer and the filament control. These changes were necessary, and all required time. The result is what might easily be expected, namely that sometimes before the changes could be made, the physiological condition which was to be recorded had disappeared.

By means of my system, many observations of the kind above discussed can be easily taken radiographically whereas under the old system it was impracticable to take them during the short period of time while conditions were favorable for the purpose.

I do not limit myself to the precise mechanism shown, as variations may be made therein without departing from my invention, the scope of which is commensurate with my claims.

I claim:

1. A change-over system comprising an X-ray tube, a high tension transformer connected with said X-ray tube for energizing the same, an auto-transformer connected with said high tension transformer for energizing said high tension transformer, a plurality of controlling switches connected with said auto-transformer for controlling the power supplied to said X-ray tube as

energized by said high-tension transformer, and a change-over switch adapted to be connected with said controlling switches for rendering one of them active and another one of them inactive.

2. A change-over system comprising an X-ray tube, a high tension transformer connected with said X-ray tube for energizing the same, an auto-transformer connected with said high tension transformer for energizing said high tension transformer, a plurality of controlling switches connected with said auto-transformer for controlling the latter, a change-over switch adapted to be connected with said controlling switches for selectively rendering one of them active and another inactive in order to vary the power supplied to said X-ray tube as energized by said high tension transformer, and a variable resistance switch adapted to be connected with said change-over switch in order to be thrown into and out of action thereby, said variable resistance switch being connected with said high tension transformer and operable manually for the purpose of further varying the power supplied to said X-ray tube.

3. A change-over system comprising an X-ray tube provided with a heat-controlled cathode, a high tension transformer connected with said X-ray tube for energizing the same, a low tension transformer provided with a primary and secondary winding for energizing said cathode, a plurality of primary circuits including the primary winding of said low tension transformer for energizing the latter, a switch included in each of said primary circuits to control said low tension transformer, an auto-transformer connected with said high tension transformer for energizing the latter, a plurality of power circuits for energizing said auto-transformer, a switch included in each of said power circuits to enable said auto-transformer to be controlled by the switch of each respective power circuit, and a change-over switch operable to complete one of said power circuits to render the same with its respective switch active and to interrupt the other of said power circuits to render it inactive, said change-over switch being also operable to complete one of said primary circuits to render the same active and to interrupt the other of said primary circuits to render it inactive.

4. A change-over system comprising an X-ray tube, a high tension transformer connected with said X-ray tube for energizing the same, an auto-transformer adapted to be connected with said high tension transformer for supplying energy to said high tension transformer, a variable resistance switch adapted to be connected to said high tension transformer and said auto-transformer for varying the energy supplied by the latter to said high tension transformer, a plurality of power circuits for energizing said auto-transformer, a controlling switch included in each of said power circuits for varying the energy supplied by each respective power circuit to said auto-transformer, and a change-over switch operable to one position to connect said variable resistance switch to said auto-transformer and said high tension transformer, and to complete one of said power circuits and render the same with its respective controlling switch active to energize said auto-transformer while interrupting the other of said power circuits and rendering it inactive, and said change-over switch operable to another position to connect said high tension transformer to said auto-transformer and disconnect said variable resistance switch therefrom, and to complete another of said power circuits with its respective controlling switch and render the same active to energize said auto-transformer while interrupting the other of said power circuits and rendering it inactive.

5. A change-over system comprising an X-ray tube provided with a heat controlled cathode, a high tension transformer connected with said X-ray tube for energizing the same, a low tension transformer connected with said cathode for energizing the same, a plurality of primary circuits including said low tension transformer for selectively energizing said low tension transformer, a hand switch included in each of said primary circuits for controlling the energization of said low tension transformer, an auto-transformer adapted to be connected to said high tension transformer for energizing the same, a variable resistance switch adapted to be connected to said high tension transformer and said auto-transformer for varying the energy supplied by the latter to said high tension transformer, a plurality of power circuits for energizing said auto-transformer, a controlling switch included in each of said power circuits for varying the energy supplied by each respective power circuit to said auto-transformer, and a change-over switch operable to one position to connect said variable resistance switch to said high tension transformer and said auto-transformer, and to complete one of said power circuits and render the same with its respective controlling switch active to energize said auto-transformer while interrupting the other of said power circuits and rendering it inactive; and said change-over switch operable to another position to connect said high tension transformer to said auto-transformer and disconnect said variable resistance switch therefrom, and to complete another of said power circuits with its respective controlling switch and render the same active to energize said auto-transformer while interrupting the other of said circuits and rendering it inactive; said change-over switch being also operable to complete one of said primary circuits with its respective hand switch and render the same active to energize said low tension transformer and to interrupt the other of said primary circuits and render the same inactive simultaneously with the completion of one or the other of said power circuits.

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