

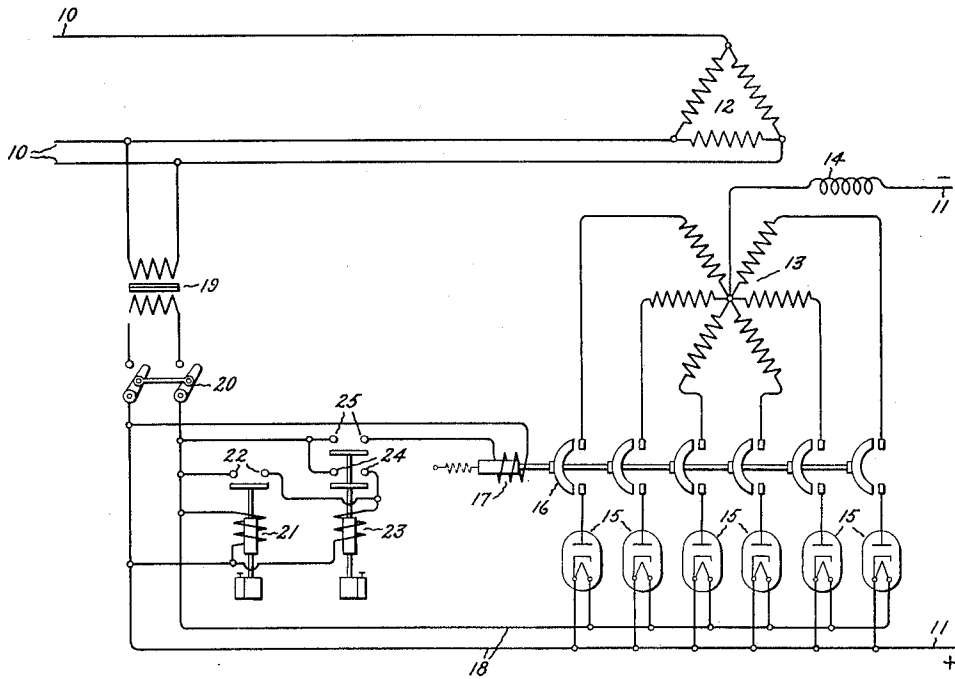
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ELECTRIC VALVE CIRCUITS

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ELECTRIC VALVE CIRCUITS

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3 Claims. (Cl. 175—363)

My invention relates to electric valve circuits and more particularly to such circuits employing valves of the thermionic cathode type.

It is well known that, in the operation of electric valves with thermionic cathodes and particularly of such valves operating with a vapor electric discharge, it is highly undesirable to allow the full plate or anode current of the valve to flow until the cathode has reached its proper operating temperature. A failure to observe this precaution may, under certain circumstances, result in the destruction of the thermionic cathode by positive ion bombardment. It has heretofore been proposed to delay the flow of plate current in such a valve by means of a time delay relay, the operating coil of which is connected to the cathode heating circuit and the contacts of which are effective to control either directly, or indirectly through an auxiliary contactor, the flow of plate current in the output circuit of the electric valve. In the case of electric valves of very large power rating, however, such as have now found commercial application, it may require a period of as long as thirty minutes for a cathode to reach its proper operating temperature when starting from a cold condition. Upon an interruption of service of the supply circuit which may amount to only a few seconds, such a time delay relay must completely retime in order to insure adequate protection for the cathodes of the electric valves. However, upon the occurrence of only a momentary interruption, the cooling of the cathodes of the electric valves may be negligible so that it is highly undesirable that the cathode heating cycle should be completely retimed.

It is an object of my invention, therefore, to provide a new and improved electric translating circuit including a valve of the thermionic cathode type in which the cathode of the electric valve will be protected from operation before it reaches its proper operating temperature, but in which the flow of current in the output circuit of the valve will be interrupted upon the occurrence of a momentary failure of the source of supply only for the duration of the failure.

It is another object of my invention to provide an electric translating circuit including a valve of the thermionic cathode type in which the flow of plate current in the valve is normally delayed for an interval of time sufficient for the cathode of the valve to reach its proper operating temperature, but in which the flow of current in the valve will be interrupted, upon the failure of the source of supply, only for the duration of the fail-

ure, unless the failure persists for more than a predetermined interval.

In accordance with one embodiment of my invention, an alternating current supply circuit is connected to energize a direct current load circuit through a rectifying apparatus including a plurality of electric valves, each provided with a thermionic cathode. The heating circuit for the cathodes of the electric valves is energized from the alternating current supply circuit and a time delay closing relay energized from the cathode heating circuit is effective to control an auxiliary instantaneous closing, time delay opening relay, the operating coil of which is also energized from the cathode heating circuit. The contacts of this latter relay control the energizing circuit of the operating coil of a switch mechanism interconnecting the plates of the several electric valves with the phase terminals of the supply transformer. With such an arrangement, the operation of the switch mechanism is delayed for a predetermined interval of time after the energization of the cathode heating circuit, but the circuit of the operating coil switch mechanism is not interrupted during a momentary deenergization of the supply circuit, so that the switch mechanism will immediately reclose when power is restored to the supply circuit.

For a better understanding of my invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims. The single figure of the drawing illustrates an arrangement embodying my invention for transmitting energy from an alternating current supply circuit to a direct current load circuit through an electric valve rectifier including six electric valves of the thermionic cathode type.

Referring now more particularly to the single figure of the drawing, there is illustrated an arrangement for transmitting energy from a three-phase alternating current supply circuit 10 to a direct current load circuit 11 through an electric valve rectifying apparatus. This rectifying apparatus includes a transformer comprising a three-phase primary network 12 connected to the circuit 10 and a six-phase secondary network 13 provided with an electrical neutral connected to the negative side of the direct current circuit 11 through a smoothing reactor 14 and with end terminals connected to the positive side of the direct current circuit 11 through a plurality of electric valves 15. Electric valves 15 are each provided with an anode and a thermionic cathode which

may be of either the directly heated type or the indirectly heated type as diagrammatically illustrated in the drawing. Electric valves 15 preferably operate with a vapor electric discharge. There is also provided a switch mechanism 16 having contacts interposed between the terminals of the network 13 and the anodes of the associated valves 15 and having an operating coil 17. The cathode heaters of the several electric valves 15 may be energized from a common cathode heating circuit 18, which may serve also as a control bus, energized from one phase of the alternating current supply circuit 10 through a control transformer 19 and a manually operated switch mechanism 20. If desired, the switch mechanism 20 may be included directly in the main alternating current circuit 10, or in certain cases, may be entirely omitted.

In order to delay the operation of the switch mechanism 16 for an interval of time sufficient to allow the cathodes of electric valves 15 to reach their proper operating temperature there is provided a time delay closing relay 21, the coil of which is connected directly to the circuit 18 and the contacts 22 of which serve to connect the operating coil of an instantaneous closing, time delay opening relay 23 across the circuit 18. Relay 23 is provided with main contacts 25 which complete the circuit for energizing the operating coil 17 of the switch mechanism 16 from the circuit 18. The relay 23 is also provided with auxiliary holding contacts 24 for a purpose hereinafter set forth.

The general principles of operation of the above described electric valve rectifying apparatus will be well understood by those skilled in the art, and it is believed that a detailed explanation is unnecessary. The manner in which the apparatus operates to prevent the flow of plate current in the electric valves 15 until their cathodes reach a proper operating temperature and at the same time maintain a flow of plate current in case the source of supply is deenergized for a predetermined interval, may be understood by assuming that, initially, the switch 20 is in the open position as illustrated, and that the alternating current circuit 10 is energized. Under these conditions, the operating coil 17 of the switch mechanism 16 is deenergized and the plate circuits of the electric valves 15 are disconnected from the supply transformer network 13. Upon closing the control switch 20, heating current is supplied to the cathode heating circuit 18 and the operating coil of the relay 21 is energized. This relay starts timing, closing its contacts 22 an interval of time after the closing of the switch 20 sufficient to allow the cathodes of the electric valves 15 to reach their proper operating temperature. When the relay 21 closes its contacts 22, the operating coil of the relay 23 is energized and this relay picks up at once, closing its contacts 25 to energize the operating coil 17 and close the switch mechanism 16. Thus the flow of plate current in electric valves 15 is delayed until the cathodes reach their proper operating temperature.

Upon the occurrence of a momentary deenergization of the supply circuit 10, the relay 21 will become deenergized and open its contacts 22 immediately. The relay 23 will not open its contacts 25 immediately, however, due to the time delay opening feature. In case the interruption of service on the supply circuit 10 obtains for an interval greater than the time delay of the relay 23, the switch mechanism opens to interrupt the anode circuits of the electric valves 15, the con-

tacts 25 open and, upon subsequent energization of the supply circuit 10, the above described timing cycle is repeated. However, in case the interruption of service on the supply circuit 10 is only momentary, relay 23 will not open its contacts 25, the circuit of the operating coil 17 will not be interrupted, and the switch mechanism will immediately reclose when power is restored to the supply circuit 10. However, due to the fact that, when service is restored on the circuit 10, the relay 21 will not close its contacts for an interval of time, which, in the case of electric valves of large power rating, may be as much as thirty minutes, the holding contacts 24 are required on the relay 23 to complete a circuit for the operating coil of the relay 23 as soon as service is restored on the supply circuit 10. In this manner, the flow of plate current in the electric valves 15 is interrupted only during the interruption of service on the supply circuit 10 unless this interruption persists for a predetermined interval of time sufficient to allow a dangerous cooling of the cathodes of the electric valves 15.

While I have described what I at present consider the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention, and I, therefore, aim in the appended claims to cover all such changes and 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. An electric translating circuit comprising a source of current, a load circuit, means including an electric valve for controlling the transmission of energy from said source to said load circuit, said valve being provided with a thermionic cathode, a heating circuit for said cathode energized from said source, circuit controlling means interposed in the plate circuit of said valve, a time delay closing relay energized from said cathode heating circuit and an instantaneous closing, time delay opening, relay controlled by said time delay closing relay and connected to effect the closing of said circuit controlling means an interval of time after the energization of said cathode heating circuit and an opening of said circuit controlling means only after said cathode heating circuit has been deenergized for a predetermined interval of time.

2. An electric valve rectifying system comprising an alternating current supply circuit, a load circuit, an electric valve rectifier interconnecting said circuits to transmit energy therebetween, said valve being provided with a thermionic cathode, a heating circuit for said cathode energized from said source, circuit controlling means interposed in the plate circuit of said valve and provided with an operating coil, a time delay closing relay energized from said source, and an instantaneous closing, time delay opening relay controlled by said time delay closing relay and effective to close the circuit of said operating coil from said source an interval of time after the energization thereof and to open the circuit of said operating coil only after said source has been deenergized for a predetermined interval of time.

3. An electric valve rectifying system comprising an alternating current supply circuit, a load circuit, an electric valve rectifier interconnecting said circuits to transmit energy therebetween, said valve being provided with a thermionic cathode, a heating circuit for said cathode energized from said source, circuit controlling means inter-

posed in the plate circuit of said valve and provided with an operating coil, a time delay closing relay energized from said source, and an instantaneous closing, time delay opening, relay controlled by said time delay closing relay, said second mentioned relay being provided with auxiliary holding contacts in parallel with the contacts of said time delay closing relay and with main contacts arranged to connect said operating coil to said source an interval of time after the energization thereof and to disconnect said coil from said source only after said source has been deenergized for a predetermined interval of time.

CHANCY F. WHITNEY.

10	85
15	90
20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150