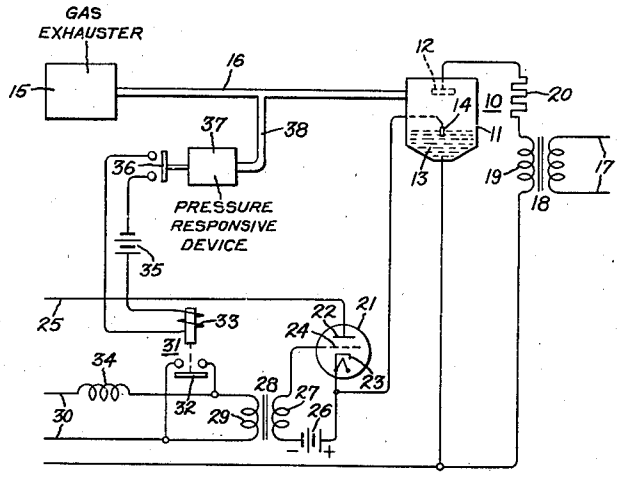
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ELECTRIC CIRCUIT

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ELECTRIC CIRCUIT

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My invention relates to electric circuits, and more particularly to electric protective circuits for electric valve means.

Electric valve means comprising a vessel within which spaced electrodes and a control member are mounted and to which is connected an exhaust pump for maintaining the pressure within the vessel at a very low value have been widely used. It is found that pressure rises within the vessel interfere with the normal operation of the electric valve means and in the case of electric valve means having an immersion igniter type of control member render the control member inoperative to form a cathode spot and in this way control the time of initiation of discharge between the anode and cathode of the electric valve means. This failure of the control member to perform its normal function is believed to result from the wetting of the igniter of the control member with mercury and probably from the formation of an amalgam on the surface of the control member due to the presence of oxidized mercury resulting from a rise in pressure within the vessel housing the electrodes of the electric valve means. If the control member or igniter is energized after it fails to accomplish its normal function it rapidly deteriorates and in addition results in a waste of energy since the igniter is ineffective to render the electric valve means conductive. In accordance with the teachings of my invention I provide a new and improved protective circuit for electric valves which prevents energization of the control electrode thereof when the pressure within the vessel housing the electrodes of the electric valve rises to such a value as to render the control electrode ineffective to accomplish its normal function.

It is an object of my invention to provide a new and improved electric protective circuit.

It is another object of my invention to provide a new and improved protective circuit for preventing the destruction of an immersion igniter type of control member by energization thereof when the pressure within the vessel housing the igniter and associated cathode rises above a predetermined value.

My invention will be better understood by reference to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. In the drawing the single figure is a schematic representation of one embodiment of my invention.

Referring now to the drawing, I have shown my invention embodied in a protective system for an electric valve means 10 of the type comprising a vessel or container 11 within which are mounted an anode 12, a pool type cathode 13 of conducting liquid such as mercury, and an immersion igniter type of control member 14. The control member is formed of resistance material having a high specific resistance with respect to the specific resistance of the liquid cathode and may be formed of a carbonaceous material such as silicon carbide. The pressure within the vessel 11 is normally maintained at a very low value by means of a suitable gas exhauster illustrated schematically by the numeral 15 and which communicates with the interior of the vessel by means of a conduit 16. While the electric valve means 10 has been illustrated as comprising the single anode 12 and pool type cathode 13, it will be apparent that various other arrangements of electrodes may be employed if desired.

In the particular embodiment illustrated the anode-cathode circuit is energized from an alternating current supply circuit 17 by means of a transformer 18, the secondary winding 19 of which has one end terminal connected to the cathode 13 and the other end terminal connected with the anode 12 through a direct current load circuit illustrated by the numeral 20. As is well understood by those skilled in the art, the control electrode 14 normally functions to produce a cathode spot on the pool type cathode upon the passage of a predetermined current therethrough. In the arrangement shown in the drawing, the current through the control member 14 is controlled by an auxiliary or firing valve 21, preferably of the type employing an ionizing medium, such as a gas or vapor, and comprising an anode 22, a cathode 23 and a control member or grid 24. The cathode is connected to the control member 14 of valve means 10 and the anode 22 may be connected to the anode 12 of the electric valve means 10 or, as illustrated, may be connected to a suitable source of periodic voltage (not shown) by the conductor 25. The control member 24 of the auxiliary electric valve 21 is energized by a direct current voltage component supplied by the battery 26 and by an alternating current component supplied by the secondary winding 27 of a transformer 28 having the primary winding 29 thereof connected to a suitable source of alternating current voltage 30. If desired, the circuit 30 may be energized from the alternating current supply circuit 17 through a suitable phase shifting device (not shown). With the arrangement described thus far, it will be readily understood that current periodically

flows through the auxiliary valve 21 and the control member 14 to form a cathode spot on the cathode 13 at a predetermined time in the cycle of the alternating current voltage of circuit 17 dependent upon the phase relation of the alternating current voltage impressed on the control member 24 by the winding 27. In order to prevent the energization of the control member 14 in the event that the pressure within the valve 11 rises to such a value that the control member is no longer effective to produce a cathode spot in accordance with its normal function, I provide a relay 31 having the movable contact 32 thereof arranged to short circuit the primary winding 29 of transformer 28 when control 32 of the relay is closed. In order to prevent the closure of contact 32 from short circuiting the alternating current source 30 a suitable current limiting reactor 34 is provided in one of the lines of circuit 30. The relay is provided with an operating coil 33 which is energized from a source of voltage, such as batterry 35, under the control of a movable contact 36 of a pressure responsive device illustrated schematically by number 37. The device 37 may be any suitable arrangement for controlling the movable contact 36 to effect energization of the operating coil 33 in response to a rise in pressure within the vessel 11 of the electric valve means which is sufficient to render the control electrode 14 ineffective to establish a cathode spot upon the passage of current therethrough. Device 37 is shown connected through conduit 38 to conduit 16 and the interior of the vessel 11.

In the operation of the illustrated embodiment of my invention the control member 14 is periodically energized by current flowing through the auxiliary valve 21 to form a cathode spot on the pool type cathode 13 and permit the electric valve means 10 to conduct current as soon as the anode thereof is rendered sufficiently positive with respect to the cathode. If the gas exhauster fails to maintain the pressure within the vessel 11 sufficiently low so that the control member 14 is effective to accomplish its normal function of establishing a cathode spot, the device 37 operates to energize the coil 33 of relay 31 and remove the alternating voltage component from the circuit of control member 24. This leaves only the negative bias voltage of battery 26 on the control member 24 and in this way valve 21 is rendered nonconductive and the control member 14 is effectively deenergized. In this manner a simple and reliable arrangemnt is provided for protecting the control member 14 from destruction and eliminating waste of electrical energy by interrupting the supply of energy to the control member as soon as the prssure within the vessel 11 rises sufficiently to prevent the normal operation of the control member.

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. In combination, electric valve means comprising a vessel within which are mounted an anode, a cathode of conducting liquid and a control electrode formed of material having a high specific resistance with respect to the specific resistance of said conducting liquid and having a portion thereof immersed in said cathode, said control electrode being adapted to produce a cathode spot upon the passage of a predetermined minimum current therethrough, a control circuit including an auxiliary electric valve for supplying current to said control electrode, said auxiliary electric valve including a control member, a circuit for energizing the control member of said auxiliary electric valve, means tending to maintain said vessel at a predetermined pressure, and means for rendering said auxiliary valve nonconductive and thereby deenergize said control electrode including means operated upon the occurrence of an increase in pressure within said vessel sufficient to render said control electrode ineffective to produce a cathode spot.

2. In combination, electric valve means comprising a vessel within which are mounted an anode, a cathode of conducting liquid and a control member formed of material having a high specific resistance with respect to the specific resistance of said conducting liquid and having a portion thereof immersed in said cathode, said control member being adapted to excite said cathode upon the passage of a predetermined minimum current therethrough to permit the initiation of discharge between said anode and cathode, an energizing circuit for energizing said control member; means tending to maintain a predetermined pressure within said vessel, and pressure responsive means responsive to the pressure within said vessel for rendering said circuit ineffective to energize said control member if the pressure within said vessel rises sufficiently to prevent normal operation of said control member.

3. In combination, electric valve means comprising a vessel within which are mounted an anode, a cathode of conducting liquid and a control member having a portion thereof immersed in said cathode, said control member being adapted to form a cathode spot upon the passage of a predetermined current therethrough, an energizing circuit for energizing said control member, means operated in accordance with the pressure within said vessel for changing the circuit connections of said energizing circuit to prevent the passage of current through said control member in response to a rise in pressure within said vessel sufficient to prevent said control member from forming a cathode spot.

4. In combination, electric valve means comprising a vessel within which are mounted an anode, a cathode, and a control member, means tending to maintain a predetermined pressure within said vessel, a control circuit for energizing said control member to control the conductivity of said electric valve means, a circuit including a source of unidirectional voltage and a source of alternating current voltage, a pressure responsive relay responsive to the pressure within said vessel for controlling the application of said alternating current voltage to prevent said electric valve means from being rendered conductive when said pressure reaches a predetermined value.

5. In combination, electric valve means comprising a vessel within which are mounted an anode, a cathode and a control member, means tending to maintain a predetermined pressure within said vassel, a control circuit for energizing said control member to control the conductivity of said electric valve means, and means responsive to pressure within said vessel

for rendering said control circuit ineffective to energize said control member in response to a predetermined change in pressure within said vessel.

6. In combination, electric valve means comprising a vessel within which are mounted an anode, a cathode, and a control member of the make-alive type, means tending to maintain a predetermined pressure within said vessel, a control circuit for energizing said control member to control the conductivity of said electric valve means, and means responsive to pressure within said vessel for rendering said control circuit ineffective to energize said control member under predetermined pressure conditions within said vessel.

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