

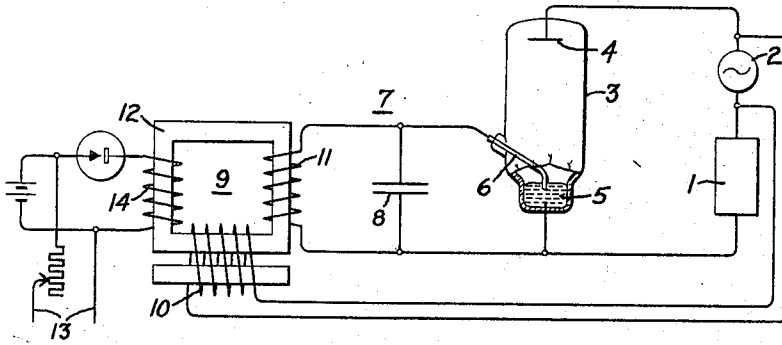
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ELECTRIC VALVE CIRCUIT

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ELECTRIC VALVE CIRCUIT

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My invention relates to electric valve circuits and more particularly to excitation circuits for electric valves of the vapor electric discharge type.

5 In the use of electric valves of the vapor electric discharge type in electric translating circuits, it is desirable to have an excitation circuit which will generate a periodic control potential, the positive portions of which have a relatively steep wave front. It is also desirable to provide an excitation circuit which is not only simple in arrangement and reliable in operation but which is also readily adaptable to the characteristics of any particular electric valve which may be employed.

15 The electric valve device utilized in apparatus of the type to which my invention particularly applies, in general, comprises a plurality of principal electrodes between which an electric discharge is to pass. The electric discharge may be initiated by a suitable ionizing member located in an ionizable medium, or the discharge may be initiated by a control member associated with one of the principal electrodes.

25 Although not particularly limited thereto, in a specific type of electric valve to which my invention may be readily applied, at least one of the principal electrodes may be a conductive liquid or solid in which is immersed an associated control electrode. This type of control electrode, a portion of which is immersed in one of the principal electrodes, may be termed an immersion-ignitor, since it effects ignition of an electric valve when a suitable current is passed through the immersion-ignitor to the associated principal electrode. More particularly, a suitable valve utilizing the immersion-ignitor is one in which the associated principal electrode is mercury and the immersion-ignitor is of a material of relatively high specific electrical resistivity as compared to the resistivity of mercury. In such an arrangement, of course, the mercury pool will form the cathode of the rectifying valve. To initiate the discharge and hence render the electric valve conductive, an electric current is transmitted through the immersion ignitor into the mercury; preferably the polarity of the immersion-ignitor is positive relative to the mercury.

40 It has been found that in order to provide suitable ignition of valves of the immersion-ignitor type with desirable regularity and certainty, relatively large currents must be transmitted through the immersion-ignitor to the mercury. It has also been found that in order to provide excitation of this particular type of electric

valve at precise points in a cycle of alternating potential applied between the principal electrodes, the wave front of the potential applied to the control electrode must be substantially perpendicular or have a so-called peaked characteristic. Of course, it is desirable to provide excitation circuits having these characteristics without necessitating the use of auxiliary apparatus having an electrical rating inordinate to the rating of the electric valve in the particular application.

5 It is an object of my invention to provide for electric valves of the vapor electric discharge type an improved excitation circuit and method of excitation which will have the above-mentioned desirable characteristics and which will be simple and reliable in operation.

10 It is another object of my invention to provide an improved excitation system for electric valves of the vapor electric discharge type which will provide an electric impulse to the control member to render the electric valve conductive at a predetermined point of the positive half cycle of the anode-cathode potential.

15 It is a further object of my invention to provide an improved excitation circuit for an electric valve of the vapor electric discharge type which will supply to the control member an excitation current of predetermined wave form and value to assure precise and satisfactory ignition of the electric valve at a predetermined point in the positive half cycle of the anode-cathode potential.

20 In accordance with the illustrated embodiment of my invention, I provide an improved excitation circuit for a vapor electric valve of the immersion-ignitor type in which the valve is rendered conductive by utilizing a combined voltage peaking and phase shifting arrangement in the excitation circuit for the valve. I also provide an improved arrangement for exciting an electric valve of the immersion-ignitor type in which a potential of substantially perpendicular wave front is impressed upon the immersion-ignitor and a capacitance to effect an increase in the excitation current supplied to the ignitor.

25 For a better understanding of my invention, together with other and further objects thereof, reference may be had to the following description taken in conjunction with the accompanying drawing, and its scope will be pointed out in the appended claims.

30 The single figure of the accompanying drawing illustrates diagrammatically an embodiment of my invention as applied to an electric valve of the type utilizing an immersion-ignitor.

In the single figure of the drawing there is shown diagrammatically an arrangement for supplying a unidirectional current to a load circuit 1 from a source of alternating current 2 through an electric valve 3 having an anode 4, a mercury pool cathode 5, and a control member 6 of the immersion-ignitor type. The immersion-ignitor 6 may be composed of a suitable material having a relatively high electrical resistivity, as compared with the resistivity of mercury, such as boron, boron-carbide, silicon-carbide, or a material such as is disclosed and claimed in U. S. Patent No. 1,822,742, granted September 8, 1931, on an application of Karl B. McEachron and assigned to the same assignee as the present application. The material disclosed in the above-mentioned patent is commercially designated as "Thyrite". Some of the materials which may be used and which have proved satisfactory for this particular use have a very marked positive non-linear volt-ampere characteristic.

An excitation circuit 7 is provided for supplying a suitable current to the control member or electrode 6. This excitation circuit 7 comprises a capacitance 8 which is connected in parallel with the control member 6 and the cathode 5, and a suitable inductive device 9 for supplying a voltage having a peaked characteristic and for shifting the phase of the potential applied to the control member 6 relative to the potential applied between the anode 4 and the cathode 5 of electric valve 3. It will be understood that any conventional voltage peaking and phase shifting arrangement may be used, such as the voltage peaking and phase shifting arrangement disclosed and claimed in U. S. Patent No. 1,918,173, granted September 23, 1931, on an application of Burnice D. Bedford and assigned to the same assignee as the present application. The device 9 which, as illustrated, is of the inductive type comprises primary winding 10 energized from the alternating current source 2, a secondary winding 11, a core member 12 and an auxiliary source of potential 13 for energizing winding 14 to control the point in the cycle of alternating potential at which the resultant magnetomotive force in the core member 12 passes through zero. It will be understood by those skilled in the art that by this means the phase of the peaked voltage may be varied relative to the potential of the alternating current source 2.

The operation of the embodiment of my invention as diagrammatically illustrated in the single figure of the drawing will be explained by considering the circuit when the alternating current source is supplying a potential which renders the anode 4 of electric valve 3 positive relative to the cathode 5. To facilitate the explanation, as well as illustrating the operation of the excitation circuit when a voltage of peaked wave form is supplied to the control electrode 6 in the absence of a capacitance, the energization of the control electrode will be considered under these conditions. The excitation circuit will operate satisfactorily by using any source of voltage having a suitable peaked wave form, such as that furnished by the conventional peaking transformers. It will be readily understood by those skilled in the art that no current will be conducted by the electric valve 3 until the ionizable medium is rendered conductive. During a positive half cycle, the voltage peaking and phase shifting arrangement 9 is adjusted to furnish a voltage of substantially perpendicular wave front, causing a current of relatively large instantaneous value to flow in the

excitation circuit 7. This renders the ionizable medium of the device conductive and current flows in the load circuit from the point of ignition in the cycle until the end of the positive half cycle. The average current flowing of course varies depending upon the point of starting in the cycle and variation in the output is controlled by controlling the point of starting. The magnitude and wave form of this current in the excitation circuit will be a function of the applied voltage and the physical constants of the control electrode 6. It has been found that this arrangement for energizing electric valves of the type having an immersion-ignitor affords a very satisfactory method of starting.

The operation of the embodiment of my invention as illustrated in the single figure of the drawing will next be explained by considering the circuit when the capacitance 8 is connected in parallel with the control member 6. During a positive half cycle, the voltage peaking and the phase shifting arrangement 9 is adjusted to furnish a voltage of substantially perpendicular wave front, causing a current to flow in the excitation circuit 7. The magnitude and wave form of this current will be a function of the applied voltage and the physical constants of the parallel circuit comprising the capacitance 8 in parallel with the control electrode 6 and the cathode 5. One component of this current will be the current required to charge the capacitance 8 and another component of the current will be that current which flows through the control member 6. The component of current required to charge the capacitance will rise practically instantaneously to a maximum value and decrease exponentially at a rate depending on the time-constant of the parallel circuit. The component of current which flows through the immersion-ignitor will attain practically instantaneously its maximum value. If the material used for the immersion-ignitor has a linear volt-ampere characteristic, the current through the immersion-ignitor will increase at a rate corresponding to the first power of the applied potential. However, if a material having a positive non-linear volt-ampere characteristic is used, the current will increase at a higher rate corresponding to the characteristic of the particular material used. In either case, the effect of the capacitance will be to increase the current transmitted through the immersion-ignitor and provide a more reliable and certain method of starting. Immediately after the application of the voltage of peaked wave form to this parallel circuit, the capacitance 8 will discharge through the control member 6 and the cathode 5, thereby resulting in an increase in the value of the exciting current furnished to the control member 6. It will be understood, that by the provision of a capacitance 8 in parallel with the control member 6 and the cathode 5, the wave form of the excitation current may be extended relative to the time axis without necessitating the use of auxiliary apparatus of inordinate proportion.

While I have shown an arrangement of my invention as applied to an electric valve of the vapor electric discharge type using an immersion-ignitor control member, it will be apparent that my invention may be applied to electric valves generally.

I have shown and particularly described a preferred embodiment of my invention and methods of operation embraced therein for the purpose of explaining its principle and showing its applica-

tion, and it will be obvious to those skilled in the art that many modifications are possible without departing from my invention, and I aim, in the appended claims, to cover all such modifications and variations 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, an electric valve comprising at least two principal electrodes and a control member of the immersion-ignitor type associated with one of said principal electrodes for rendering said electric valve conductive, and an excitation circuit for said control member comprising an inductive device for generating a voltage of substantially perpendicular wave front and for impressing said voltage on said control member and means connected across said control member and said one of said principal electrodes to extend in the direction of the time axis the current supplied to said control member.

2. In combination, an electric valve comprising at least two principal electrodes and a control member of the immersion-ignitor type associated with one of said principal electrodes for rendering said electric valve conductive, and an excitation circuit for said control member comprising a peaking transformer having a secondary winding and a capacitance connected in parallel with said secondary winding for impressing a voltage of substantially perpendicular wave front on said control member.

3. In combination, an electric valve comprising at least two principal electrodes and a control member of the immersion-ignitor type associated with one of said principal electrodes for rendering said electric valve conductive, a source of alternating current for impressing an alternating potential between said principal electrodes, a load circuit energized through said electric valve from said alternating current source, an excitation circuit for said control member comprising a capacitance connected in parallel relation with said serially-arranged control member and said one of said principal electrodes, and means for impressing on said control member and said capacitance a voltage of peaked wave form and variable in phase relative to the potential of the alternating current source.

4. In combination, an electric valve comprising at least two principal electrodes and a control member of the immersion-ignitor type associated with one of said principal electrodes for rendering said electric valve conductive, an excitation circuit for said control member comprising a capacitance connected across said control member and said one of said principal electrodes, and means for impressing on said control member and said capacitance a voltage of substantially perpendicular wave front.

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