

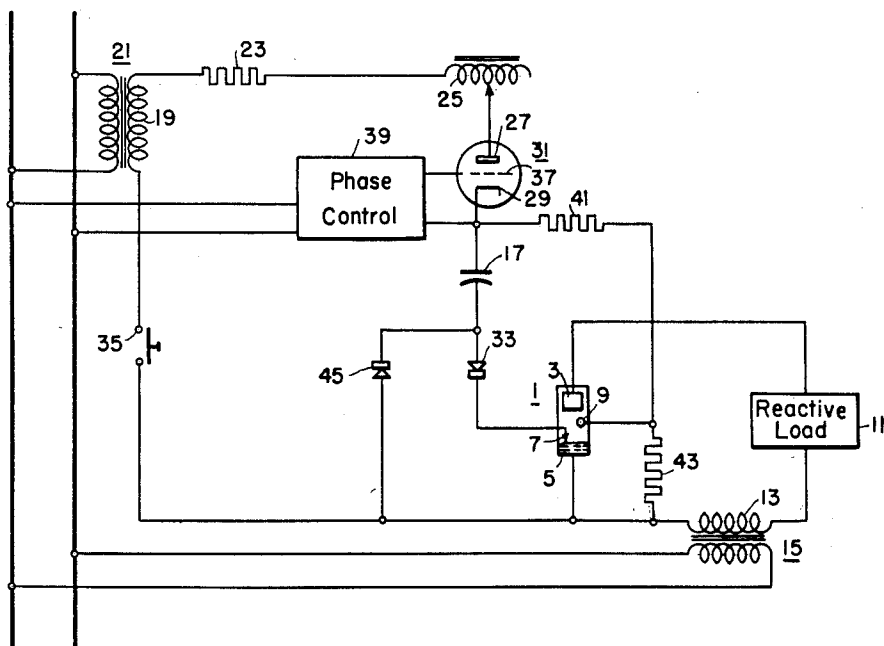
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ELECTRIC DISCHARGE APPARATUS

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WITNESSES:

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ELECTRIC DISCHARGE APPARATUS

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My invention relates to electric discharge apparatus and is particularly related to ignitron circuits.

By the word "ignitron," I mean specifically a discharge tube of the type having a reconstructible cathode, such as mercury or cesium in which is dipped an igniter rod, such as a rod of silicon carbide or boron carbide. My invention is intimately tied up with an ignitron of this type. Within its broader aspects, my invention may also be applicable to ignitrons of the type in which the igniter is insulated from the cathode by air or other insulation, such as glass or porcelain. To the extent that my invention is applicable thereto, apparatus including such ignitrons are also within the scope thereof.

To fire an ignitron, current is transmitted through the igniter and the cathode producing ionization in the region of the igniter. To preserve the igniter and to save power, the igniter current is passed for only a short time interval. By reason of the ionization an arc is ignited between the anode and the cathode, if the anode potential is of the proper magnitude at the instant of the ionization. It sometimes happens that at that instant the anode potential is too low to produce an arc. Such situations arise, for example, when a reactive load is being supplied through an ignitron and the anode potential is materially reduced by the reactive effect of the load at the instant when the ionization is present at the igniter. In particular, this condition arises in flash welding during the flashing interval when the voltage across the ignitron may fall so low as to fail to sustain the arc several times during a period of the supply. In other situations, a motor may be supplied through an ignitron, and the back electromotive force of the motor may reduce the anode potential to such a magnitude that the main arc does not fire when the igniter current is flowing. Since the igniter ionization is available only at a preselected instant, the failure of the main arc to pick up at this instant results in an entire failure of the ignitron to conduct.

This failure of conductivity may be remedied by using the auxiliary anode with which the ignitrons of the type involved here are supplied. The auxiliary anode is connected in a firing circuit which is independent of the main anode circuit, and an arc is fired between the auxiliary anode and the cathode when the firing current is transmitted through the igniter. This arc is maintained until the main arc between the main

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anode and the cathode is fired. In accordance with the teachings of the prior art, the auxiliary circuit customarily includes a complete supply independent of the main anode load circuit. The auxiliary anode circuit is thus costly and relatively complex and its presence results in high maintenance and servicing costs.

It is accordingly an object of my invention to provide a low cost circuit including an ignitron having an auxiliary anode in which the auxiliary anode functions to preserve the ionization until the main arc picks up.

Another object of my invention is to provide a low cost auxiliary anode circuit of simple structure for an ignitron.

Still another object of my invention is to provide a low cost firing circuit for an ignitron.

A still further object of my invention is to provide a novel firing circuit for an ignitron.

A specific object of my invention is to provide a low cost simple circuit for supplying a reactive load such as a flash welder or motor through an ignitron, which circuit shall require a minimum of servicing and maintenance.

In accordance with my invention I provide a firing circuit for an ignitron in which a capacitor is charged through the igniter to fire the ignitron, and the same capacitor is discharged through the auxiliary anode to maintain the auxiliary arc. The firing circuit is thus of simple structure and of low cost requiring a minimum of maintenance and servicing.

The features of my invention which I consider novel are set forth with greater particularity in the accompanying claims. The invention itself, however, together with the advantages and additional objects thereof, may be better understood from the following description of a specific embodiment when read in connection with the accompanying drawing in which the single figure is a circuit diagram of a preferred embodiment of my invention.

The apparatus shown in the drawing includes an ignitron 1 having an anode 3, a cathode 5, an igniter 7 and an auxiliary anode 9. A reactive load 11 which may be a motor or a flash welder is connected between the anode 3 and the cathode 5 through the secondary 13 of a supply transformer 15. In the firing circuit of the ignitron 1, a capacitor 17 is provided. The capacitor is connected in a series circuit including the secondary 19 of a firing transformer 21, a resistor 23, a reactor 25, the anode 27 and cathode 29 of an electric discharge device 31, a rectifier 33, the igniter 7 and the cathode 5 of

the ignitron and a control switch 35 of any suitable type. The discharge device 31 is preferably of the thyatron type and includes a control electrode 37. A phase control circuit 39 is connected between the control electrode 37 and the cathode 29 and controls the instant of firing the device. The rectifier 33 may be of the dry type.

The junction of the cathode 29 and the capacitor 17 is connected through a resistor 41 to the auxiliary anode 9. Another resistor 43 is connected between the auxiliary anode 9 and the cathode 5 of the ignitron. The capacitor 17 is connected to the cathode 5 of the ignitron through a second rectifier 45, preferably of the dry type, poled opposite to the first rectifier 33.

The operation of the apparatus is initiated by closing the switch 35. The anode circuit of the discharge device 31 is then completed and the latter becomes conductive at an instant in the half period of the supply determined by the setting of the phase control network 39. When the discharge device conducts, the capacitor 17 is charged by current which flows through the discharge device, the capacitor 17, the first rectifier 33, the igniter 7 and the cathode 5. Firing current is thus provided for the ignitron. While the ionization at the igniter is still maintained, the capacitor 17 is discharged through the resistor 41, the auxiliary anode 9 and the cathode 5, and the second rectifier 45. An auxiliary arc is thus fired for a predetermined time interval determined by the resistance 41 in the discharge circuit. The resistance is so set that this auxiliary arc is maintained for a sufficiently long interval to provide time for the arc between the main anode 3 and the cathode 5 to be fired.

Under certain circumstances, usually when the ignitron 1 is cold, the auxiliary arc is not fired following the first instant during which firing current is transmitted through the igniter 7. Under such circumstances, the capacitor 17 would become charged and would prevent the transmission of a second firing impulse. To provide for this contingency, a discharge circuit independent of the auxiliary anode 9 is provided for the capacitor 17 through the resistor 43 between the auxiliary anode and the cathode 5. If an auxiliary arc is not fired, the capacitor discharges through the resistors 41 and 43 and the second rectifier 45, and thus becomes reset for a new firing operation.

Modifications of the circuit shown in the drawing will occur to those skilled in the art. The rectifier 33 and the device 31 may be interchanged. The device 31 may be inserted in place of the rectifier and the rectifier entirely omitted. Such modifications are within the scope of my invention.

While I have shown and described a specific embodiment of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. Apparatus for controlling the firing of an ignitron having an igniter and an auxiliary anode comprising in combination a capacitor connected to said igniter; means for charging said capacitor while passing firing current through said igniter, and means for discharging said capacitor through said auxiliary anode.

2. Apparatus for controlling the firing of an ignitron having an igniter and an auxiliary anode

comprising in combination a capacitor connected to said igniter; means for charging said capacitor while passing firing current through said igniter; means for discharging said capacitor through said auxiliary anode; and additional means for discharging said capacitor independently of said auxiliary anode.

3. Apparatus for controlling the firing of an ignitron having an igniter, a cathode and an auxiliary anode comprising in combination a capacitor; a first rectifier connecting one plate of said capacitor to said igniter; a second rectifier poled opposite to said first rectifier connecting said plate to said cathode; symmetrically conductive means connecting the other plate of said capacitor to said auxiliary anode and means for charging said capacitor.

4. Apparatus according to claim 3 characterized by the fact that a resistor is connected between the cathode and the auxiliary anode.

5. Apparatus for controlling the firing of an ignitron having an igniter and an auxiliary anode comprising in combination a capacitor connected to said igniter; a network including an electric discharge device for charging said capacitor while passing firing current through said igniter and means for discharging said capacitor through said auxiliary anode.

6. Apparatus for controlling the firing of an ignitron having an igniter and an auxiliary anode comprising in combination a capacitor connected to said igniter; a network including an electric discharge device for charging said capacitor while passing firing current through said igniter; means for rendering said electric discharge device conductive at a predetermined instant; and means for discharging said capacitor through said auxiliary anode.

7. A capacitor firing circuit for an ignitron having an igniter, an auxiliary anode, and a cathode characterized by a charging circuit for the firing capacitor which includes said igniter so that said igniter is supplied with firing current while said capacitor is being charged and by a discharging circuit for said capacitor including said auxiliary anode and said cathode, so that said capacitor after being charged is discharged through said auxiliary anode and cathode.

8. In combination an ignitron having an igniter, a cathode and an auxiliary anode; a capacitor; a first rectifier connecting said capacitor to said igniter; a second rectifier poled opposite to said first rectifier and connecting said capacitor to said cathode, means connecting said capacitor to said auxiliary anode and means for charging said capacitor through said igniter.

9. In combination an ignitron having an igniter, a cathode and an auxiliary anode; a capacitor; a first rectifier connecting said capacitor to said igniter; a second rectifier poled opposite to said first rectifier and connecting said capacitor to said cathode; means connecting said capacitor to said auxiliary anode and means for charging said capacitor through said igniter, said charging means including an electric discharge device having an anode and a cathode, said cathode being connected to said capacitor.

10. Apparatus for controlling the supply of current from a source through a reactive load comprising an ignitron having an anode, a cathode, an igniter and an auxiliary anode; means adapted to connect said anode and said cathode in circuit with said source and load; a capacitor; means for charging said capacitor through said

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igniter and cathode and means for discharging said capacitor through said auxiliary anode and cathode.

11. Apparatus for controlling the supply of current from a source through a reactive load comprising an igniter and an auxiliary anode; means adapted to connect said anode and said cathode in circuit with said source and load; a capacitor; means including a first rectifier for charging said capacitor through said igniter and cathode and means including a second rectifier for discharging said capacitor through said auxiliary anode and cathode.

12. Apparatus for controlling the supply of current from a source through a reactive load comprising an ignitron having an anode, a cathode, an igniter and an auxiliary anode; means adapted to connect said anode and said cathode in circuit with said source and load; a capacitor; means for charging said capacitor through said igniter and cathode; means for discharging said capacitor through said auxiliary anode and cathode, and impedance means shunting said auxiliary anode and cathode.

13. Apparatus for controlling the supply of current from an alternating source through a reactive load comprising in combination an ignitron having an anode, a cathode, an igniter and an auxiliary anode; means adapted to connect said anode and said cathode in circuit with said source and load; a capacitor; means for charging said capacitor through said igniter and cathode, said charging means including an electric discharge device and means for rendering said device conductive at a predetermined instant in a period of said source; and means for discharging said capacitor through said auxiliary anode and cathode.

14. In combination an electric discharge device having an anode, a cathode and an igniter; a capacitor; means for charging said capacitor

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through said igniter and said cathode, and means for discharging said capacitor through said anode and cathode.

15. A firing circuit for an ignitron having an anode, a cathode, an auxiliary anode and an igniter, which circuit includes a capacitor and terminals for supplying a potential to charge said capacitor and which circuit is characterized by a first network including in series said terminals, said capacitor, said igniter, and said cathode so that said capacitor is charged through said igniter and by a second network including in series said capacitor, said auxiliary anode and said cathode so that said capacitor when charged is discharged through said auxiliary anode and cathode.

16. A firing circuit for an ignitron having an anode, a cathode, an auxiliary anode and an igniter, which circuit includes an electric discharge device having an anode, a cathode and a control electrode; terminals for supplying a potential and a capacitor and which circuit is characterized by a first network including in series the anode and cathode of said discharge device, said capacitor, said igniter and said cathode of said ignitron and by a second network including in series said capacitor, said auxiliary anode and said cathode of said ignitron.

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