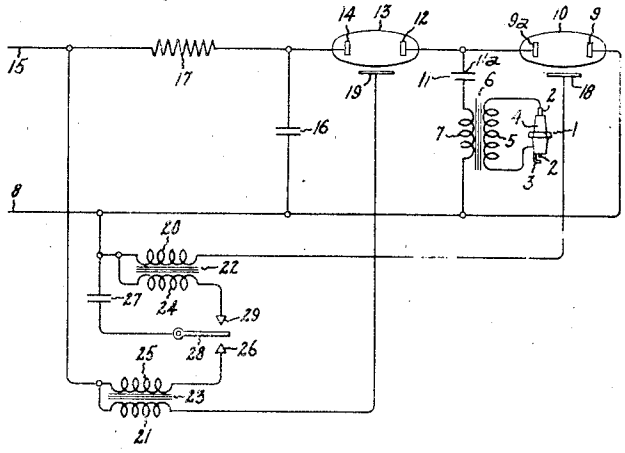
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ELECTRICAL DISCHARGE DEVICE AND SYSTEM

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Inventor:
Henry de Boyne Knight
by Harry E. Dunham
His Attorney.

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ELECTRICAL DISCHARGE DEVICE AND SYSTEM

Henry de Boyne Knight, Rugby, England, assignor to General Electric Company, a corporation of New York

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6 Claims. (Cl. 123—148)

My invention relates to electrical discharge devices and systems, and more particularly to internal combustion engine ignition systems, or similar arrangements.

An object of my invention is to provide an improved discharge system, wherein an auxiliary circuit is arranged to control the voltage for energizing the discharge device.

Further objects and advantages of my invention will become apparent and my invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In the drawing, the single figure is a diagrammatic illustration of a discharge system embodying my invention.

Referring to the drawing, I have shown my invention applied to a discharge device adapted to be used in the ignition system of an internal combustion engine or the like, and including a spark plug or similar discharge device 1 having spaced apart electrodes 2 and 3 insulated from each other by any suitable insulator 4. The electrodes 2 and 3 are connected across the terminals of an inductive device, such as a transformer secondary winding 5 of a main transformer 6 arranged to energize the spark plug. The main transformer 6 is provided with a primary winding 7, one terminal of which is connected to a side 8 of a source of electrical power supply and to a main electrode 9 of an electrical gaseous space discharge tube 10, and the other terminal of which is connected in series with a main capacitor 11. In order to produce the desired primary transformer current variation to induce the required transformer secondary voltage for the spark plug 1, the terminal 11*a* of the main capacitor 11 is connected to main electrodes 9*a* and 12 is gaseous space discharge tubes 10 and 13, respectively. These space discharge tubes may comprise any suitable space discharge devices having electrodes arranged to provide a discharge path having such resistance that the circuit therethrough is normally non-conductive. These space discharge tubes may be filled with air or other suitable gas or vapor at any suitable pressure. The space discharge tube 13 is provided with another main electrode 14 connected to the other side 15 of the source of electrical power supply, and an auxiliary reserve capacitor 16 also is connected across the source of electrical power supply in series with a current-limiting resistor 17, and serves as a booster across the space discharge devices 10 and 13 and the main capacitor 11. These space discharge tubes 10 and 13 provide the desired impulses of electric current through the main capacitor 11 and the main transformer primary winding 7, as the current flows between the respective main tube electrodes. In order to obtain the desired flow of current through these tubes, the gaseous medium therein is ionized at the desired time in any suitable manner, as by subjecting the discharge paths between the electrodes in the tubes 10 and 13 to the fields of auxiliary regulating electrodes 18 and 19 arranged intermediate the two main electrodes in the tubes 10 and 13, respectively. The main tube electrodes may be made of any suitable material and may be activated or coated with an electron emissive material, or may be formed of liquid mercury or amalgam to reduce the wear thereof.

In order to obtain the desired regulation of the discharges through the tubes 10 and 13, an electrical impulse is applied to the respective auxiliary electrodes 18 and 19. These impulses may be obtained in any suitable manner, as by connecting the auxiliary electrodes 18 and 19 to secondary windings 20 and 21 of auxiliary transformers 22 and 23, in which the required impulse voltage is induced by varying the primary electric current flowing through auxiliary transformer primary windings 24 and 25, respectively. The transformer primary winding 25 is connected to the side 15 of any suitable direct current source of electrical power supply and to a contact 26, and arranged to be connected to the other side 8 of the source of electrical power supply through an auxiliary capacitor 27 by closing a contactor 28 on the contact 26. In this manner, when the contactor 28 engages the contact 26, a charging current flows through into the auxiliary capacitor 27 and energizes the primary winding 25 of the auxiliary transformer 23. This induces the desired voltage in the auxiliary transformer secondary winding 21, which provides the required electrical impulses to the auxiliary electrode 19, and ionizes the gaseous medium in the space discharge tube 13. This produces an electrical discharge between the electrodes 12 and 14 and a charging current passes into the main capacitor 11 and energizes the main transformer primary winding 7, thereby inducing the required voltage in the main transformer secondary winding 5, and producing the desired electrical discharge between the electrodes 2 and 3 of the spark plug 1.

In order to utilize the discharge current of the various capacitors to energize the spark plug 1, the primary winding 24 of the auxiliary transformer 22 may be connected to the other side 3 of the source of electrical power supply and across the auxiliary capacitor 27 through a contact 29 and the contactor 28. When the contactor 28 engages the contact 29, the circuit of the primary winding 25 of the auxiliary transformer 23 is opened, and the potential on the auxiliary electrode 18 is removed, so that the potential differences between the main electrodes 12 and 16 of the space discharge device 13 become insufficient to produce an electrical discharge therebetween. When the contactor 28 closes a circuit of the primary winding 24 of the auxiliary transformer 22 through the contact 29, the auxiliary capacitor 27 discharges through the primary winding 24 and induces a voltage in the auxiliary transformer secondary winding 26, which provides an electrical impulse to the auxiliary electrode 18 of the space discharge tube 10 to ionize the gaseous medium therein. This provides an electrically conductive path between the main electrodes 9 and 9a of the space discharge tube 10, and the main capacitor 11 discharges through this tube and produces the required electric current flow through the main transformer primary winding 7 to induce a voltage in the main transformer secondary winding 5, and produces an electric discharge between the electrodes 2 and 3 of the spark plug 1. The contactor 28 may be operated in any desired conventional manner and may comprise any conventional circuit breaker, commutator, or cam-operated contactor operating at any predetermined desired speed or frequency to obtain the desired timing of the spark plug discharges.

While I have illustrated and described a particular embodiment of my invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangement disclosed, and I intend in the appended claims to cover all modifications which do not depart from the 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 discharge system including a discharge device, an inductive device arranged to provide electrical energization to said discharge device, a capacitor connected in circuit with said inductive device, a source of electrical power supply, means for connecting said source of electrical power supply to said capacitor, said connecting means including an electric discharge path connected in series between said capacitor and said source of electrical power supply and having such resistance that said source of electric power supply connecting means across said capacitor is non-conductive through said discharge path, and means including an auxiliary source of electrical impulse for providing an electrically conductive path through said electrical discharge path providing electrical energization to said discharge device.

2. An electric discharge system including a discharge device, an inductive device arranged to provide electrical energization to said discharge device, a capacitor connected in circuit with said inductive device, a source of electrical power supply, means for connecting said source of electrical power supply to said capacitor, said connecting means including an electric gaseous discharge path connected in series between said capacitor and said source of electrical power supply and having such resistance that said source of electric power supply connecting means across said capacitor is non-conductive through said discharge path, and means including a second inductive device for providing an electrically conductive path through said electrical discharge path by ionization thereof providing electrical energization to said discharge device.

3. An electrical discharge system including a discharge device, a transformer arranged to provide electrical energization to said discharge device, a capacitor connected in series with said transformer, a source of electrical power supply, means for connecting said source of electrical power supply to said capacitor, said connecting means including a second electrical discharge device connected in circuit with said capacitor and having main electrodes arranged to provide such resistance therethrough that said source of electrical power supply connecting means across said capacitor is non-conductive therethrough, means including an auxiliary electrode arranged to provide an electric field between said main electrodes for providing an electrically conductive path therebetween, an inductive device arranged to energize said auxiliary electrode, and means for providing an electrical impulse to said inductive device.

4. An electric discharge system including a discharge device, an inductive device arranged to provide electrical energization to said discharge device, a capacitor connected in circuit with said inductive device, a source of electrical power supply, means for connecting said source of electrical power supply to said capacitor, said connecting means including an electric discharge path connected in circuit with said capacitor and having such resistance that said source of electric power supply connecting means across said capacitor is non-conductive through said discharge path, means including an auxiliary source of electrical impulse for providing an electrically conductive path through said electrical discharge path providing electrical energization to said discharge device by the charging current of said capacitor, a second electrical discharge path connected in circuit with said inductive device and said source of electrical power supply, and means including a second auxiliary source of electrical impulse for providing an electrically conductive path through said second electrical discharge path providing electrical energization to said discharge device by the discharge current of said capacitor.

5. An electrical discharge system including a discharge device, a transformer arranged to provide electrical energization to said discharge device, a capacitor connected in circuit with said transformer, a source of electrical power supply, means for connecting said source of electrical power supply to said capacitor, said connecting means including a set of electrical discharge devices connected in circuit with said capacitor and having main electrodes arranged to provide such resistances therethrough that said source of electrical power supply connecting means across said capacitor is non-conductive therethrough, an auxiliary electrode arranged to provide an electric field between said main electrodes of one of said discharge devices of said set of discharge devices, an inductive device arranged to energize said auixiliary electrode, means for providing an electrical impulse to said inductive device providing electrical energization to said first-mentioned

discharge device by the charging current of said capacitor, a second auxiliary electrode arranged to provide an electric field between said main electrodes of another of said discharge devices of said set of discharge devices, a second inductive device arranged to energize said second auxiliary electrode, and means for providing an electrical impulse to said second inductive device providing electrical energization of said first-mentioned discharge device by the discharge current of said capacitor.

6. An internal combustion engine ignition system including a spark plug, a transformer arranged to provided electrical energization to said spark plug, a capacitor connected in circuit with said transformer, a source of electrical power supply, means for connecting said source of electrical power supply to said capacitor, said connecting means including an electric gaseous discharge tube connected in circuit with said capacitor and having main electrodes arranged to provide such resistance therethrough that said source of electrical power supply connecting means across said capacitor is non-conductive therethrough, means including an auxiliary electrode arranged to provide an electric field between said main tube electrodes for providing an electrically conductive path therebetween, an auxiliary transformer arranged to energize said auxiliary electrode, an auxiliary capacitor connected to said auxiliary transformer, and means for providing an electrical impulse to said auxiliary transformer through said auxiliary capacitor to energize said auxiliary electrode.

HENRY DE BOYNE KNIGHT.