

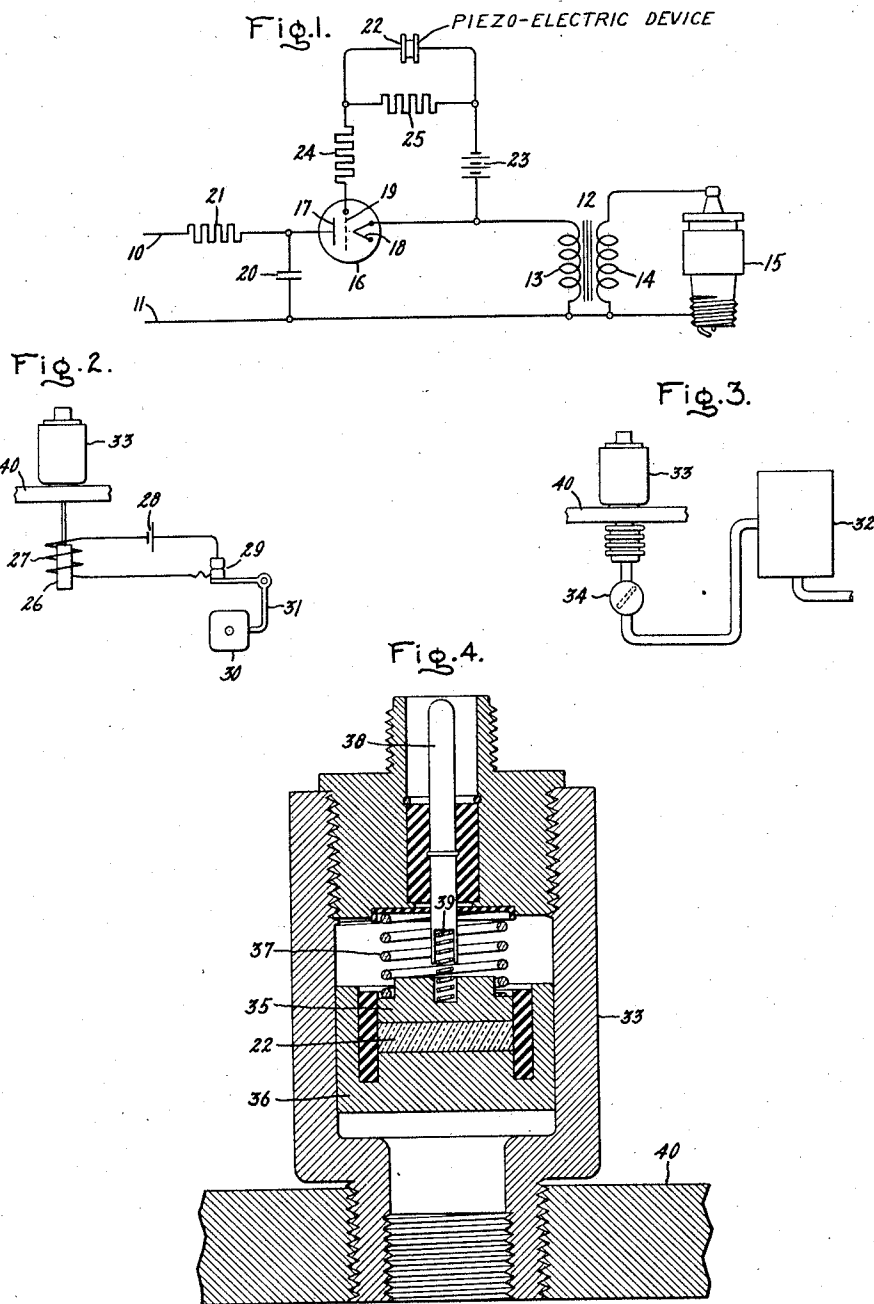
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ELECTRIC IGNITION SYSTEM

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ELECTRIC IGNITION SYSTEM

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This invention relates to an electric ignition system for an internal combustion engine.

Heretofore it has been proposed to utilize electric valves in the circuit of an electric ignition system of the type in which the current is allowed to pass through the valve when an appropriate potential is applied to the control electrode.

An object of my invention is to provide an improved ignition system of the above-mentioned type.

I accomplish this and other objects by providing a piezo-electric device in the control circuit of an electric valve which is placed in the circuit of an electric ignition system and applying the necessary pressure to the piezo-electric device so that the electric valve may be made conductive at the time when an ignition spark is desired in the internal combustion engine.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out in the claims annexed to and forming a part of this specification.

In the drawing, Fig. 1 diagrammatically illustrates an ignition circuit provided with an embodiment of my invention, and Figs. 2, 3 and 4 illustrate arrangements for applying suitable pressure to the piezo-electric device employed in the circuit illustrated in Fig. 1.

Referring to the drawing, I have illustrated diagrammatically an ignition circuit for internal combustion engines including a source of suitable potential which is connected across lines 10 and 11, a step-up transformer 12 having a primary winding 13 and a secondary winding 14, and a spark plug 15. Only one spark plug is illustrated but it is, of course, to be understood that any suitable number of spark plugs may be used, and when more than one spark plug is used a conventional distributor may be placed between the secondary of the transformer and the spark plugs. In order to provide an electrical impulse in the transformer at the time when an ignition spark is desired in the internal combustion engine, I place an electric valve 16 between the source of potential and the primary of the transformer. This electric valve may be of any suitable type having a plurality of electrodes including an anode 17, a cathode 18, and a control grid 19. The ignition circuit may also be provided with a capacitor 20 connected across the lines 10 and 11 and a current limiting resistor 21 connected in the line 10. It may be seen, therefore, that when a spark is desired at the plug 15, the elec-

tric valve may be made conductive and the capacitor will be discharged and current will then pass through the valve and the primary winding 13 of the transformer. This current impulse will induce a voltage in the secondary 14 and thus a current impulse will appear across the electrodes of the spark plug 15.

In order to control the electric valve 16 so that it may be made to conduct current at the proper time, I provide a piezo-electric device 22 which may be connected to the electric valve in any suitable manner. In the illustrated embodiment of my invention the piezo-electric device is connected between the grid 19 and the cathode 18 with its positive plate connected to the grid. In order to provide a normally non-conductive electron tube I provide a source of biasing voltage 23 between the grid and the cathode which, when pressure is not applied to the piezo-electric device, is sufficient to bias the grid so that substantially no current will pass between the anode and the cathode. In order to limit the current flowing in the control circuit a resistor 24 may be connected between the grid and one side of the piezo-electric device and a resistor 25 may be connected to the resistor 24 and to the other side of the piezo-electric device and to the source of biasing voltage. The piezo-electric device is therefore so connected between the grid and the biasing source that when a suitable pressure is applied a sufficient potential will be developed to counteract the potential of the biasing source 23 and thereby allow the control grid 19 to become sufficiently positive so that current will begin to flow from the anode to the cathode of the electric valve 16.

Any suitable arrangement may be adapted for applying the suitable pressure to the piezo-electric crystal 22 at the instant the spark is required. For example, a magnetic device may be used, as illustrated in Fig. 2, in which the pressure is applied as a magnetic armature 26 moves under the influence of a magnet or coil 27. The coil is energized whenever the spark is desired by a circuit which includes a battery 28, and a breaker 29 which is operated in timed relation with the motor in any suitable manner, such as through a cam 30 and a cam follower 31. Alternately the piezo-electric device may be subjected to fluid pressure impulses from any suitable source of fluid, such as oil or air, as illustrated in Fig. 3. In such a case the source of fluid may be kept under a constant pressure such as in a tank 32, the fluid source being connected to a chamber 33 containing the piezo-electric device through a

port 34 which opens the moment the spark is required. A control arrangement for the port may be synchronized with the internal combustion engine so that the port may be opened at the proper time so as to insure correct timing of the internal combustion engine. The chamber 32 may be of any suitable type, and as illustrated in Fig. 4 includes a pair of movable plates 35 and 36 between which is placed the piezo-electric crystal 22. The fluid pressure upon opening of the port 34 will act to move the plate 36 relative to the plate 35 which is held relatively stationary through a spring member 37. In order to connect electrically the crystal to the grid 19 a terminal 38 may be connected to the plate 35 by a spring 39 the terminal being in turn connected through a conductor to the resistors 24 and 25. The other connection to the negative terminal of the battery may be made through the plate 38 and a suitable supporting plate 40 which may be grounded, the negative terminal of the battery also being grounded.

It will be seen, therefore, that I have provided an improved arrangement for controlling an electric valve which is connected in an electric ignition circuit, having a piezo-electric device in the control circuit thereof.

Modifications of the particular arrangements which I have disclosed embodying my invention will occur to those skilled in the art, so that I do not desire my invention to be limited to the particular arrangements set forth 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 ignition system for an internal combustion engine including a spark plug, a source of potential, means including an electric valve for connecting said source to said spark plug, a piezo-electric device connected to said electric valve, and means operable in synchronism with said internal combustion engine for exerting a pressure on said piezo-electric device so that said electric valve will be made conductive at the time an ignition spark is needed at said spark plug.

2. An ignition system for an internal combustion engine including a spark plug, a source of potential, a condenser connected across said source, means including an electric valve for connecting said condenser in electrical circuit with said spark plug, a piezo-electric device connected to said electric valve, and means operable in synchronism with said internal combustion engine for exerting a pressure on said piezo-electric device so that said electric valve will be made conductive and said condenser may be discharged at the time an ignition spark is needed at said spark plug.

3. An ignition system for an internal combustion engine including a spark plug, a source of potential, a current limiting resistor connected to said source, a condenser connected in series with said resistor and across said source, means in-

cluding an electric valve for connecting said condenser in electric circuit with said spark plug, a piezo-electric device connected to said electric valve, and means operable in synchronism with said internal combustion engine for exerting a pressure on said piezo-electric device so that said electric valve will be made conductive and said condenser may be discharged at the time an ignition spark is needed at said spark plug.

4. An ignition system for an internal combustion engine including a spark plug, a source of potential, means including an electric valve having a control grid for connecting said source to said spark plug, a source of biasing voltage connected to said grid, a piezo-electric device connected to said grid and to said biasing source, and means operable in synchronism with said internal combustion engine for exerting a pressure on said piezo-electric device so that the effect of said biasing source is overcome and said electric valve made conductive.

5. An ignition system for an internal combustion engine including a spark plug, a source of potential, a transformer having primary and secondary windings, means including an electric valve for connecting said source to said primary winding, said secondary being connected to said spark plug, a piezo-electric device connected to said electric valve, and means operable in synchronism with said internal combustion engine for exerting a pressure on said piezo-electric device so that said electric valve will be made conductive at the time an ignition spark is needed at said spark plug.

6. An ignition system for an internal combustion engine including a spark plug, a source of potential, means including an electric valve for connecting said source to said spark plug, said electric valve having a plurality of electrodes including a control grid and a cathode, a source of biasing voltage connected to said grid and to said cathode, a piezo-electric device connected to said grid and to said biasing source, and means operable in synchronism with said internal combustion engine for exerting a pressure on said piezo-electric device so that the effect of said biasing source is overcome and said electric valve made conductive.

7. An ignition system for an internal combustion engine including a spark plug, a source of potential, means including an electric valve for connecting said source to said spark plug, said electric valve having a plurality of electrodes including a control grid and a cathode, a source of biasing voltage connected to said cathode and to said grid through a resistor, a piezo-electric device connected to said biasing source and to said grid through a portion of said resistor, and means operable in synchronism with said internal combustion engine for exerting a pressure on said piezo-electric device so that the effect of said biasing source is overcome and said electric valve made conductive.

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