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BATTERY IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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FIG. 1

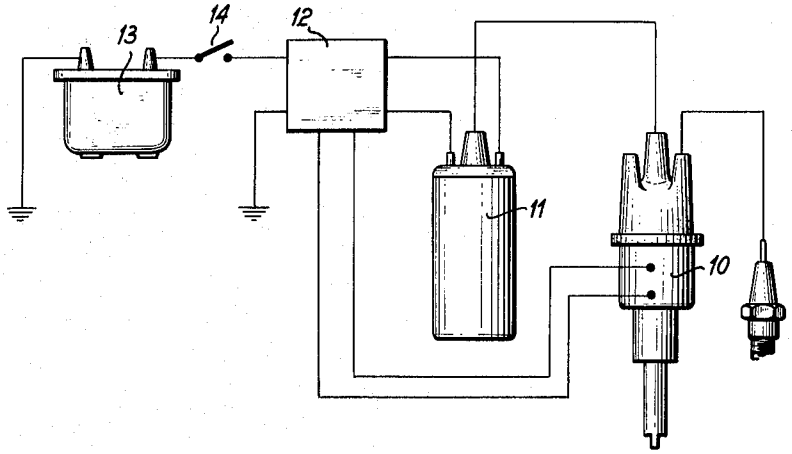
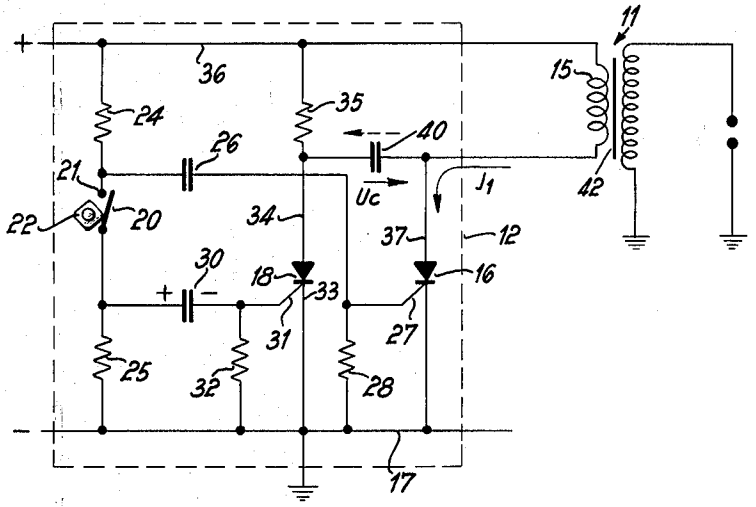


FIG. 2



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BATTERY IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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The present invention concerns a battery ignition system for internal combustion engines. Ignition systems of this type conventionally include an ignition coil having a primary winding and a secondary winding, and a source of direct curret voltage e.g. a storage battery. More particularly, the invention concerns a battery ignition system as mentioned above which comprises also in a circuit with the source of direct current voltage some circuit interrupting device which is operated by the engine in synchronism therewith for periodically interrupting the direct current supply to the primary winding of the coil, and with a plurality of semiconductor rectifiers as control elements between the circuit interrupter device and the primary winding of the coil.

There are already known to the art battery ignition systems of the general type mentioned above except that grid controlled gas discharge tubes are used instead of semiconductor rectifiers, the gas discharge tubes being arranged in two parallel circuits or circuit portions, each circuit portion containing a resistor, a capacitor and one gas discharge tube. In operation each of the gas discharge tubes is ignited and extinguished alternatingly with the other tube.

However, it has been found that in an arrangement which for reasons of economy and efficiency and for other reasons is equipped with controlled semiconductor rectifiers it is very difficult to interrupt the flow of current through the rectifiers after they have been rendered conductive.

Therefore, it is an object of this invention to provide for a battery ignition system of the type described above and equipped with controlled semiconductor rectifiers in which, however, the change from non-conductivity to conductivity and back from conductivity to non-conductivity of the individual rectifier can be effected reliably and promptly with the simplest possible means under the control of one single circuit an interrupter device cooperating jointly with both rectifiers.

With above object in view the invention includes in a battery ignition system for internal combustion engines an igition coil having a primary winding and a secondary winding, and a source of direct current voltage, in combination, first controllable semiconductor rectifier means having its main electrodes connected in series with the primary winding of the ignition coil; second controllable semiconductor rectifier means having its main electrodes and a first resistor connected in series between the poles of said source; circuit interrupter means operated by the engine in synchronism therewith and cooperating with both said semiconductor rectifier means for alternatingly rendering one conductive and the other non-conductive, and vice versa; and circuit means comprising a series-combination including a second and a third resistor with said circuit interrupter means therebetween being connected between the poles of said source, a connection from one end of said second resistor to the control electrode of said first semiconductor rectifier containing a first capacitor, and a connection from one end of said third resistor to the control electrode of said second semiconductor rectifier containing a second capacitor, and a reversibly chargeable third capacitor being connected between that main electrode of said first semiconductor rectifier which is connected with said primary winding of said ignition coil, on one hand, and that main electrode of said second semiconductor rectifier which is connected with said first resistor, on the other hand.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing, in which:

FIG. 1 is a diagrammatic illustration of a battery ignition system comprising an ignition coil, a storage battery and two controlled semiconductor rectifiers incorporated in a control circuit; and

FIG. 2 is a circuit diagram of an embodiment of the invention corresponding to FIG. 1.

The battery ignition system according to FIG. 1 comprises a high voltage ignition distributor **10** of conventional type, a high voltage ignition coil **11** and an electronic control circuit arangement **12** which is illustrated in its details in FIG. 2 within the dotted frame. The ignition system is supplied with energy from a storage battery **13** whenever the ignition switch **14** is moved to closed position.

The control circuit **12** comprises a first controllable semiconductor rectifier **16** which is connected with its main electrodes in series with the primary winding **15** of the ignition coil **11** between the negative supply line **17** and the positive supply line **36** coming from the storage battery **13**. There is additionally provided a second controllable semiconductor rectifier **18** which is intended to be rendered conductive and non-conductive alternatingly with the first rectifier **16** under control of a circuit interrupter device located in, and operated by, the distributor **10**. The circuit interrupter may consist of an interrupter switch arm **20** cooperating with a stationary interrupter contact **21** and periodically changed between circuit closing and circuit-interrupting positions by the rotation of an interrupter cam **22** driven together with the distributor in synchronism with the engine in a well known manner.

In accordance with the invention the interrupter device **20, 21** is connected and arranged as a member of a series-combination, namely, between two resistors **24** and **25**, this series-combination being connected as illustrated between the poles of the source **13** i.e. between the lines **17** and **36**. A connection from that end of resistor **24** which is connected with contact **21** and leading to the control or igniting electrode **27** of the first rectifier **16** contains also a capacitor **26**. This connection is also taken via a resistor **28** to the negative line **17**. In a similar manner a connection is taken from that end of resistor **25** which is connected with the contact arm **20** to the control or igniting electrode **31** of the second rectifier **18** and contains a capacitor **30**. This connection is also taken via a resistor **32** as illustrated to the negative line **17**.

It can be seen that one of the main electrodes of the second rectifier **18**, namely, its cathode **33** is connected with the negative line **17** while the other main electrode, the anode **34** is connected via a resistor **35** with the positive line **36**. Another important element of the circuit arrangement is a capacitor **40** which is connected between the anode **34** of the second rectifier **18** and the anode **37** of the first rectifier **16** which is connected with the primary winding **15** of the ignition coil **11**. The function and significance of this third capacitor **40** will be described further below.

In operation, when the interrupter contact arm **20** is in the illustrated open position while the ignition switch **14** is moved to its closed position, the still not charged

capacitor 26 acts like a short-circuit and causes the control electrode 27 to assume a potential which is strongly positive relative to the negative line 17 whereby the semiconductor rectifier 16 is rendered conductive. Consequently a strong current J_1 flows through the primary winding 15 and through the semiconductor 16. This current generates in the iron core of the ignition coil 11 a strong magnetic field which furnishes in a well known manner the ignition energy. On account of this strong current flow J_1 the potential at the anode 37 and at the electrode of capacitor 40 connected therewith drops to a value which is only slightly above the potential of the negative line 17 with the result that the capacitor 40 which has its other electrode connected with the positive line 36 is charged to a potential which is approximately equal to the voltage furnished by the battery 13. This charge potential U_c of the capacitor 40 is symbolically indicated in FIG. 2 by an arrow. As soon as now the interrupter arm 20 due to the start of rotation of the cam 22 reaches circuit-closing position and engages the stationary contact 21. The control electrode 31 of the second rectifier 18 is connected with the positive line 36 through the capactior 30 which is not charged at this time and acts like a short-circuit. Consequently, the second rectifier 18 is rendered conductive whereby simultaneously the first rectifier 16 is rendered non-conductive. This is effected by the fact that the second rectifier 18 upon getting conductive causes a strong current flow through the resistor 35 which causes the anode 34 and the electrode of capacitor 40 connected therewith to assume a low potential which is only a few volts above that of the negative line 17. However, due to the charge stored in the capacitor 40 the other electrode of the capacitor 40 which is connected with the anode 37 of the first rectifier 16 is at a potential the difference being the amount of the voltage U_c, and this causes the anode 37 of the first rectifier 16 to remain negative relative to the negative line 17 until said charge of the capacitor is dissipated so that under these circumstances the rectifier 16 must change to non-conductive condition.

The change from conductivity to non-conductivity of the second semiconductor rectifier 18 is effected in a similar manner as soon as the interrupter contact arm 20 is again lifted from the stationary contact 21. The capacitor 30 has been charged during the duration of the closed position of the interrupter 20, 21 to a potential which due to the resistors 24 and 25 of equal resistance value is one-half of the battery voltage. Consequently, during this period of time, the capacitor 30 will have a positive charge at its end connected with the resistor 25 and at its electrode connected with the control electrode 31 a negative charge. However, when the circuit is interrupted by the action of the interrupter 20, 21 the one side of the capacitor 30 is connected via the resistor 25 with negative potential and thus renders also the control electrode 31 negative relative to the main electrode 33. Simultaneously, by the movement of the interrupter 20, 21 to open position the capacitor 26 which before this moment had a chance of discharging via the closed contact 20, 21 and resistors 25 and 28 is now connected in series with the full battery voltage and thus renders the first rectifier 16 conductive. The reversibly chargeable capacitor 40 was enabled, during the non-conductive condition of the rectifier 16 and the simultaneous conductive condition of the second rectifier 18, to change to a voltage which is symbolically indicated in FIG. 2 by an arrow shown in broken lines and pointing in opposite direction. This reversed charge is caused by a positive charge potential on the capacitor electrode connected with the winding 15 and a negative charge potential at the other electrode connected with the resistor 35. As soon as now the first rectifier 16 is rendered conductive the potential at the anode 37 drops very much on account of the again starting magnetizing current J_1 flowing through the primary winding 15. Due to the just mentioned charge of the capacitor 40 the potential at the anode 34 of the second rectifier 18 becomes more negative than the potential of the negative line 17 so that the second rectifier 18 whose control electrode 31 had been rendered strongly negative due to the action of the capacitor 30, is now completely blocked and non-conductive.

It will be understood that a particular advantage of the above described arrangement according to the invention resides in the fact that although two controllable semi-conductor rectifiers are incorporated in the circuit only one single control device i.e. a circuit interrupter device is required for controlling the action of both rectifiers. It is also evident that in the operation of the circuit arrangement according to the invention, the change of each of the rectifiers from conductive to non-conductive condition is very prompt so that in this manner the operation of this arrangement is greatly superior to that of known circuits provided for similar purposes.

It should be understood that the circuit interrupter means do not have to be represented by a cam operated contact arm cooperating with a stationary contact but may be represented by any suitable equivalent device e.g. an electronic impulse generator provided with the latter is arranged between the resistors 24 and 25.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of battery ignition systems for internal combustion engines differing from the types described above.

While the invention has been illustrated and described as embodied in a battery ignition system for internal combustion engines comprising two controllable semiconductor rectifiers and a circuit interrupter cooperating with both rectifiers, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a battery ignition system for internal combustion engines including an ignition coil having a primary winding and a secondary winding, and a source of direct current voltage, in combination, first controllable semiconductor rectifier means having its main electrodes connected in series with the primary winding of the ignition coil; second controllable semiconductor rectifier means having its main electrodes and a first resistor connected in series between the poles of said source; circuit interrupter means operated by the engine in synchronism therewith and cooperating with both said semiconductor rectifier means for alternatingly rendering one conductive and the other non-conductive, and vice versa; and circuit means comprising a series-combination including a second and a third resistor with said circuit interrupter means therebetween being connected between the poles of said source, a connection from one end of said second resistor to the control electrode of said first semiconductor rectifier containing a first capacitor, and a connection from one end of said third resistor to the control electrode of said second semiconductor rectifier containing a second capacitor, and a reversibly chargeable third capacitor being connected between that main electrode of said first semiconductor rectifier which is connected with said primary winding of said ignition coil, on one hand, and that main electrode of said second semiconductor rectifier which is connected with said first resistor, on the other hand.

2. In a battery ignition system for internal combustion

engines including an ignition coil having a primary winding and a secondary winding, and a source of direct current voltage, in combination, first controllable semiconductor rectifier means having its main electrodes connected in series with the primary winding of the ignition coil; second controllable semiconductor rectifier means having its main electrodes and a first resistor connected in series between the poles of said source; circuit interrupter means operated by the engine in synchronism therewith and cooperating with both said semiconductor rectifier means for alternatingly rendering one conductive and the other nonconductive, and vice versa; and circuit means comprising a series-combination including a second and a third resistor with said circuit interrupter means therebetween being connected between the poles of said source, said second and third resistors being at least approximately of equal resistance value, a connection from one end of

said second resistor to the control electrode of said first semiconductor rectifier containing a first capacitor, and a connection from one end of said third resistor to the control electrode of said second semiconductor rectifier containing a second capacitor, and a reversibly chargeable third capacitor being connected between that main electrode of said first semiconductor rectifier which is connected with said primary winding of said ignition coil, on one hand, and that main electrode of said second semiconductor rectifier which is connected with said first resistor, on the other hand.

No references cited.

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