Feb. 27, 1951 J. V. McNULTY 2,543,371

IGNITION SYSTEM

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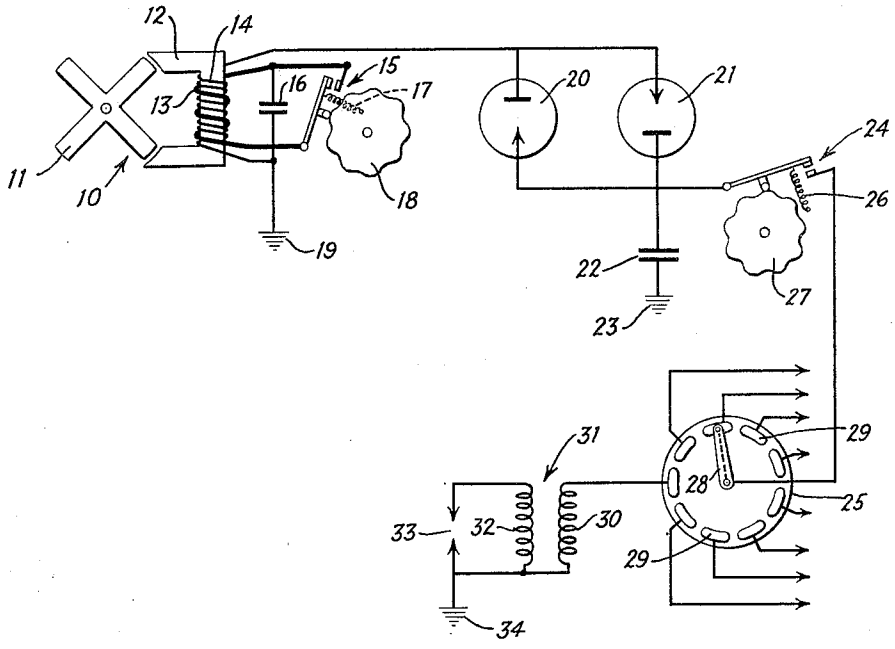

Fig. 1

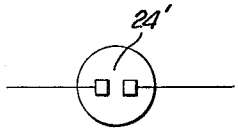

Fig. 2

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IGNITION SYSTEM

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This invention relates to electrical apparatus and more particularly to an ignition system adapted for use on internal combustion engines or the like.

One of the objects of the present invention is to provide a novel ignition system of the capacitor discharge type.

Another object of the invention is to provide a novel ignition system wherein the danger of failure resulting from common sources, such as the fouling of spark plugs, is substantially minimized.

Still another object is to provide a novel ignition system for internal combustion engines which is so constructed that the operating life and efficiency of the less durable parts thereof are materially increased.

A further object is to provide a novel system of the above character wherein the current is distributed to the spark plugs at relatively low voltage and relatively high frequency.

Still another object is to provide an ignition system which is so constructed that the problems of radio shielding the same are minimized.

A still further object is to provide novel means in an ignition system for satisfactorily applying alternate charges of opposite polarity to the discharge condenser in a capacitor discharge type of ignition system.

Still another object is to provide an ignition system of the above character wherein the timing may be effected by means of a contactor or circuit closer.

The above and further objects and novel features of the invention will more fully appear from the following detail description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are not intended to define the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawing, Fig. 1 is a diagrammatic illustration of one form of ignition circuit embodying the present invention and Fig. 2 is a detail diagrammatic view of a spark gap adapted for use in the circuit of Fig. 1 in lieu of the contact maker 24.

In the single embodiment which has been chosen for illustration, by way of example only, the invention is shown as being applied to an ignition system for an internal combustion engine wherein electrical energy is generated and distributed at relatively low voltage and relatively high frequency. In such a system, the radio shielding difficulties and requirements are greatly reduced and the danger of electrical failures and

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losses are minimized. As shown in the drawing, the source of electrical energy consists of a magneto generator 10 having a four-pole magnetic rotor 11 and a two-pole stator 12 on which are wound the primary winding 13 and secondary winding 14 of an ignition coil. It will be understood, however, that other well known types of magnetos and other known sources of electrical energy may be employed. For example, the magneto may be of the stationary magnet type having a rotatable flux distributor.

Connected in circuit in the usual well known manner with primary winding 13 of the magneto is a circuit breaker 15 and a condenser 16. The latter is connected across the ends of the primary winding and in parallel with the contacts of the circuit breaker. Although any of many known types of circuit breakers may be employed, the contacts of the one shown are normally urged toward engaged or closed position by suitable resilient means, such as a spring 17, and periodically moved to open position by a cam 18 which is rotated by the engine crankshaft in timed relation with rotor 11. Although a compensated cam of the type used on radial engines is illustrated, other types of cams may be used, particularly when the system is not used on a radial engine. One end of primary winding 13 and the adjacent end of secondary winding 14 are preferably connected to a common ground as at 19.

For a purpose to more fully appear hereafter, the high potential end of secondary winding 14 is connected in a novel manner to the current distributing portion of the ignition circuit through novel means which prevent the discharge through winding 14 of a storage condenser that is periodically charged by generator 10 and which at the same time provides for applying successive charges of alternate polarity to the condenser. As shown, said means includes a pair of half wave gaseous tube rectifiers 20 and 21, each of which is capable of conducting current in only one direction. Said rectifiers are connected to winding 14 and inversely in parallel with each other so that one will conduct current of one polarity and the other will conduct current of the opposite polarity from said winding to the remainder of the circuit. Rectifiers 20 and 21 are thus alternately conductive because magneto 10 generates alternating current in the coil 13, 14. As diagrammatically shown, the rectifiers are of the character commonly known as cold-cathode point-to-plane rectifiers which become conductive at a predetermined minimum or on-set voltage.

Electrical energy fed through rectifiers 20 and

21 is stored in a condenser 22, one terminal of which is connected to the output terminals of the rectifiers. The other terminal of said condenser is connected to ground in any suitable manner, such as at 23. The electrical charge or energy in joules which is stored in condenser 22 during each reversal of flux in the magneto is equal to one-half CE^2, where C is the capacity of the condenser in farads and E is the voltage of the charge. The capacity C of the condenser is so chosen that the voltage E will be less than the on-set voltage of the rectifiers when the condenser has absorbed the energy supplied by the magneto. With this arrangement the charge built up on the condenser through one rectifier will be unable to discharge through the other rectifier, since the voltage of the stored charge is too low to render said other rectifier conductive. The energy supplied by the magneto at its minimum operating speed must, of course, be at a voltage somewhat higher than the on-set voltage of the rectifiers to render the latter conductive for charging the condenser.

Means are provided for controlling the discharge of the storage condenser 22 at desired intervals for successively firing the spark plugs in the cylinders of an engine in proper timed relation and sequence. In the form shown, said means includes a circuit maker or contactor 24 which may be of the same construction as circuit breaker 15. One of the separable contacts or points of contactor 24 is connected with the ungrounded terminal of condenser 22 while the other contact is connected to a distributor 25 which will be hereinafter described. Thus, each time the contacts of circuit maker 24 are periodically moved into engagement by a spring 26 or other suitable means upon rotation of cam 27 in timed relation with the engine crankshaft, the charge on condenser 22 is released and sets up a high frequency oscillating discharge in the distributor circuit. In view of the fact that successive charges built up on condenser 22 and discharged through the points of contactor 24 are of opposite polarity, the operating life of said points will be materially enhanced because the reversals of polarity prevent the continual building up of one point or contact and the continual deterioration and pitting of the other which takes place when successive charges are of the same polarity. If desired, a spark gap 24' having a predetermined breakdown voltage may be substituted for contactor 24. If such a gap is used, circuit breaker 15 controls the timing of the sparks at the spark plugs.

The connection from contactor 24 or a spark gap used in lieu thereof to distributor 25 is made to the rotating arm 28 which is also driven from the engine crankshaft in timed relation with rotor 11 and cams 18 and 27. The distributor may be of any suitable known type adapted for use in distributing current at low voltage, such as a carbon brush type of distributor. In one suitable type, for example, the rotating arm 28 carries a carbon brush adapted to yieldably and successively contact a series of circularly arranged arcuate contacts 29. Since distributors of this character are well known and do not, per se, constitute a part of the present invention, it is believed to be unnecessary to illustrate and describe the same in more detail.

Each of the contacts 29 of the distributor is connected to a primary winding 30 of a high frequency transformer coil 31, the secondary winding 32 of which is connected across the terminals of a spark plug diagrammatically represented by the spark gap 33. In accordance with usual practice, one terminal of the spark plug or gap 33 and adjacent ends of windings 30 and 32 are connected to ground, as at 34. The high frequency coils 31 are preferably, though not necessarily, mounted directly on or in the radio shielding casings of spark plugs 33.

When a contactor or circuit maker 24 is employed, the voltage across the same is preferably maintained at approximately 300 volts or lower. In one suitable embodiment wherein a distribution voltage of approximately 300 volts was employed, the capacity of condenser 22 was approximately .5 microfarad and the on-set voltage of the rectifiers was about 900 volts. In this system a magneto which would develop 1000 or more volts at lowest operating speeds and about 1500 volts at maximum output was used.

In the operation of the above-described system, the rotation of rotor 11 creates reversals of the magnetic flux through stator 12 in a manner well understood in the art, thereby generating the flow of current in primary winding 13 when the contacts of circuit breaker 15 are in closed position. When said contacts are disengaged by cam 18 current at a desired higher voltage is induced in secondary winding 14. The polarity of the energy thus induced in winding 14 alternates and the voltage thereof is sufficient to render rectifiers 20 and 21 alternately conductive. Current of one polarity flows through rectifier 20 to condenser 22 and current of the opposite polarity flows through rectifier 21 to said condenser. For reasons heretofore pointed out, the voltage of the charge built up on condenser 22 is sufficiently low so that the condenser cannot discharge through one of the rectifiers. Accordingly, when the points of contactor 24 are permitted to close, the condenser discharges through the contactor and distributor 25 to one of the high frequency coils 31. The high frequency discharge of the condenser through primary winding 30 of the coil induces a high frequency, high voltage current in secondary winding 32 and, hence, creates a spark or a series of sparks across the gap 33 which ignites the combustible charge in the engine cylinder.

There is thus provided a novel ignition system wherein the less durable parts have a relatively long operating life and function efficiently. The novel system comprehended also embodies novel means for obtaining alternating condenser discharges across a circuit maker or spark gap in a system wherein the condenser is charged by a magneto generator of the type commonly used in ignition systems. The invention also provides a system which is not materially affected by the normal fouling of the gaps in the spark plugs. Additionally, the system provided is simple, inexpensive and durable.

Although only a single embodiment of the invention is illustrated and described in the foregoing specification, it is to be expressly understood that the same is not limited thereto. For example, the single condenser 22 and contactor 24 may be replaced by a condenser and contactor or spark gap in each of the circuits leading from the distributor contacts 29 to the transformer coils 31. Various other changes, particularly in the design and arrangement of parts illustrated, may also be made without departing from the spirit and scope of the invention as will now be readily apparent to those skilled in the art. For

a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. In an ignition system for an internal combustion engine or the like, a magneto generator for generating alternating impulses of electrical energy, a condenser, means for connecting the output terminals of said generator to said condenser, said means including two half-wave, gaseous-tube, point-to-plane rectifiers of the cold cathode type electrically connected inversely in parallel with each other, a high frequency transformer coil, and means for periodically connecting the high potential side of said condenser to the primary winding of said coil, said last-named means including a contactor, means for periodically opening and closing said contactor and a spark plug connected across the terminals of the secondary winding of said transformer coil.

2. In an ignition system for an internal combustion engine or the like, a magneto generator for generating impulses of electrical energy, alternate impulses being of opposite polarity, a storage condenser, means including a pair of half-wave, gaseous-tube rectifiers connected inversely in parallel for conducting said impulses to said condenser, and means for controlling the discharge of said condenser.

3. In an ignition system or the like, a storage condenser, means including a pair of half-wave rectifiers connected inversely in parallel for building up successive charges of opposite polarity on said condenser, the on-set voltage of said rectifiers being greater than the voltage across said condenser when the latter is fully charged and means for controlling the discharge of said condenser.

4. In apparatus of the class described, a condenser, means for periodically charging said condenser, alternate charges being of opposite polarity, said means including a pair of rectifiers operable to alternately pass current of opposite polarity to said condenser only when subjected to a voltage higher than the voltage across said condenser when the same is fully charged and means for controlling the discharging of said condenser.

5. In an ignition system or the like comprising a source of alternating electrical energy, the combination therewith of a storage condenser, means including a pair of half-wave, gaseous-tube rectifiers connected inversely in parallel with each other for connecting said source to said condenser, a distribution circuit, and means for controlling the discharging of said condenser through said circuit.

6. In an ignition system or the like, a storage condenser, means for periodically charging said condenser, successive charges being of opposite polarity, said means including a pair of half-wave rectifiers connected inversely in parallel a high frequency transformer, and means for controlling the discharging of said condenser through the primary winding of said transformer, said means including means for periodically making and breaking the circuit between said condenser and said winding.

7. In an ignition system wherein a source of electrical energy generates electrical impulses of alternating polarity, a combination therewith of means for converting said impulses into high frequency electrical discharges of alternating polarity, said means including a storage condenser and a pair of half-wave, gaseous tube rectifiers, the latter being connected inversely in parallel with each other between said source and said condenser.

8. In an ignition system of the type having a source of electrical energy for generating electrical impulses of alternating polarity and a circuit for consuming said energy, the combination therewith of means including a storage condenser and a pair of half-wave rectifiers connected inversely in parallel for converting said impulses into high frequency electrical discharges of alternating polarity through said consuming circuit, and periodically operable means for controlling the timing of said discharges.

9. In apparatus of the class described, a condenser, means including a circuit for periodically charging said condenser, successive charges being of opposite polarity, said circuit including a pair of half-wave, gaseous-tube rectifiers connected inversely in parallel with each other and with opposite terminals thereof connected together, and an energy consuming circuit connected to said condenser, said last-named circuit including periodically operable means for controlling the discharging of said condenser therethrough.

10. In apparatus of the class described, a storage condenser, means for periodically charging said condenser, successive charges being of opposite polarity, said means including a pair of half-wave rectifiers connected inversely in parallel, and an energy consuming circuit connected to said condenser and including a spark gap for determining the voltage at which said condenser will discharge through said circuit.

11. In apparatus of the class described, a condenser, a magneto generator for generating impulses of electrical energy, successive impulses being of opposite polarity, periodically operable means for timing said impulses, means connecting said generator and said condenser for conducting said impulses to said condenser, said connecting means including a pair of half-wave rectifiers connected inversely in parallel and, being adapted to prevent the discharge of said condenser through said generator, and an energy consuming circuit connected with said condenser and means in said circuit for determining the minimum voltage at which said condenser will discharge therethrough.

12. In apparatus of the class described, a source of electrical impulses of alternating polarity, a storage condenser, and means connecting said source and said condenser including a pair of half-wave, gaseous-tube rectifiers, the latter being connected in parallel with opposite terminals thereof connected together.

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