D. HOLDEN.

IGNITION DEVICE.

APPLICATION FILED JUNE 20, 1907.

1,020,503. Patented Mar. 19, 1912.

Fig. 2.

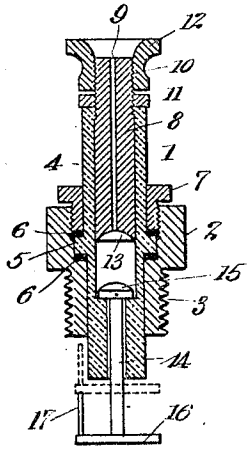


Fig. 4.

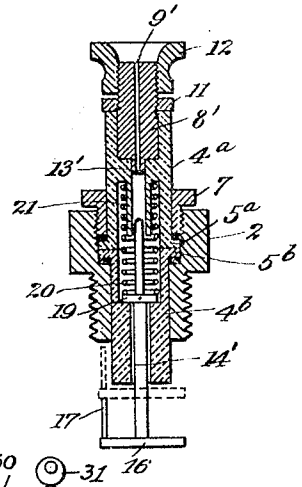
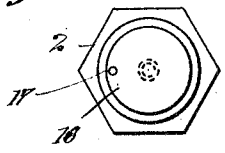


Fig. 3.



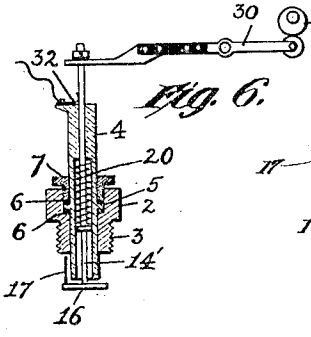


Fig. 6.

Fig. 5.

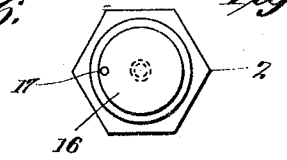
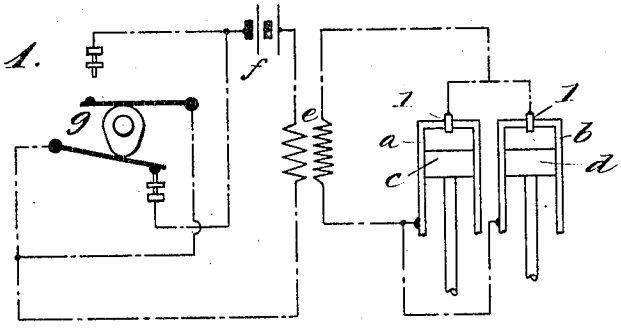


Fig. 1.



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UNITED STATES PATENT OFFICE.

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IGNITION DEVICE.

1,020,503. Specification of Letters Patent. Patented Mar. 19, 1912.

Application filed June 20, 1907. Serial No. 379,825.

To all whom it may concern:

Be it known that I, DELOS HOLDEN, a citizen of the United States, and a resident of Upper Montclair, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Ignition Devices, of which the following is a description.

My invention relates to ignition devices for use in connection with internal combustion engines, for firing the charge at the proper time, and more particularly engines comprising a plurality of cylinders wherein the charges are fired at different times. Heretofore in engines of this character where jump spark igniters have been used, it has been usual to use a separate induction coil for each spark plug, because if two or more of the igniters were connected in multiple the spark at each gap would be greatly diminished in volume and might fail altogether in the cylinder wherein the charge is under compression and where the firing is desired. It has also been proposed to use a rotary distributor in the secondary circuit for connecting several spark plugs consecutively with a single coil so that only one ignition device is in circuit at the time the spark occurs. Such devices are, however, expensive to manufacture as they require very perfect insulation of parts. They are also objectionable in that they require driving mechanism and are subject to considerable wear since they are driven at high speed.

My invention has for its object the provision of an ignition system whereby a plurality of cylinders may be fired by means of a single induction coil, the several igniters or plugs being connected in multiple and provision being made for varying the length of the spark gap of each igniter, preferably by means of the pressure in the cylinder so that a spark will occur in only one cylinder at a time, namely, that in which the charge is under compression and ready to be fired.

My invention consists in features hereinafter set forth and claimed.

Reference is hereby made to the accompanying drawings in which—

Figure 1 is a diagrammatic view of my invention applied to a two-cylinder engine; Fig. 2 is a longitudinal section of one of the igniters or spark plugs preferably used in connection with my system; Fig. 3 is a bottom plan view of the same; Fig. 4 is a longitudinal section of a modified form of igniter; Fig. 5 is a bottom plan view of the same; and Fig. 6 is a sectional view of a modification in which the igniter is operated mechanically instead of by the pressure within the cylinder.

In all the views corresponding parts are designated by the same reference numerals.

Referring to Fig. 1, *a* and *b* are a pair of cylinders of a four-cycle internal combustion engine, the pistons *c* and *d* of which move in the same direction at the same time, the cycles however, alternating so that the charge is being compressed in the cylinder *a* while the cylinder *b* is exhausting and vice versa; each of these cylinders is provided with an igniter 1, the two igniters being connected in multiple with respect to the secondary of the induction coil *e*. The primary of the coil is connected with the battery or accumulator *f* and circuit closer *g* in the usual manner.

The igniter 1 comprises a sleeve or base 2 of metal having a threaded portion 3 adapted to engage a threaded aperture in the wall of the cylinder or combustion chamber and making electric contact through the same with one end of the secondary of the induction coil. Within the sleeve 2 is an insulating sleeve 4 of porcelain or other suitable material having a flange 5 clamped between washers or gaskets 6, 6, by a nut 7 threaded within the sleeve 2. Cemented within the upper portion of the sleeve 4 is a metallic plug 8 having bore 9 extending longitudinally thereof. The upper end of the plug 8 is threaded as shown at 10, to receive nuts 11 and 12 between which the terminal of the conductor leading from the secondary of the induction coil may be clamped. The lower end of the plug 8 is cupped as shown at 13. Within the lower end of the sleeve 4 is a conductor 14 having at its upper end a rounded head 15 and at its lower end a disk 16 provided with a pin 17. The diameter of the conductor 14 is slightly less than the bore of the lower portion of the sleeve 4 so as to allow an unrestrained longitudinal movement of the conductor 14, which permits the pin 17 to move into nearness to the conductor 2 without contacting therewith.

The operation of the device is as follows: As the piston compresses the charge within the cylinder the pressure thereof causes the conductor 14 to rise until the head 15 engages the cup 13 and thereby closes the pas-

sage 9 whereby the escape of the charge therethrough is prevented, at the same time the pin 17 approaches the sleeve 3 until it assumes the position indicated in dotted lines in Fig. 2, so that the current induced in the secondary easily jumps across the gap between the end of the pin 17 and the sleeve 3, thereby firing the charge in the cylinder. In all the cylinders in which there is no compression the weight of the conductor 14 will cause it to remain in the position shown in full lines in Fig. 2, whereby there are two extended gaps in the circuit, one between the plug 8 and head 15, and the other between the pin 17 and sleeve 3; there will, therefore, be no spark produced in such cylinder since the resistance of these spark gaps is too great to permit the passage of a current. As soon as the exhaust in the fired cylinder opens, the pressure falls and the weight of the conductor 14 causes it to drop back to the position shown in full lines. It is evident, therefore, that by causing the compression to take place in the cylinders *a* and *b* alternately, the igniters will operate alternately to fire their respective charges in the same way as though only one were in the circuit and since compression takes place in each cylinder during only one-fourth of the entire time, the system can be readilly applied to engines of either four, three or two cylinders.

In the device of Figs. 4 and 5, the insulating sleeve is formed in two parts, 4^a and 4^b, and the same are clamped within the sleeve 2 by the nut 7. A metallic plug 8′ having a bore 9′ and a cup 13′ is cemented within the insulator 4^a and is threaded to receive the nuts 11 and 12. A conductor 14′ carries at its lower end the disk 16 having a pin 17 and is rounded at its upper end to engage the cup 13′. A collar 19 is secured to the member 14′ and the same is normally held in the position shown by a spiral spring 20, which bears at its lower end against the said collar and at its upper end against the top of the recess 21 formed in the body of the insulator 4^a, the pin 17 being therefore free to move into nearness to the conductor 2 without contacting therewith. The operation of this igniter is substantially the same as that of Fig. 2, the only difference being that the spring 20 is relied upon for holding the conductor 14 in its normal or open circuit position, and the igniter is therefore operative in any position whereas that of Fig. 2 must occupy a position which is substantially vertical.

In the device of Fig. 6, the igniter comprises a central electrode 14′ which passes entirely through the porcelain sleeve 4 and is surrounded by a spring 20, which tends to depress the electrode. The upper end of the rod 14′ engages the forked end of a lever 30 operated by a rotary cam 31 which serves to elevate the rod 14′ and thereby shorten the air gap of the igniter at the time for ignition, the cam for each cylinder being of course set differently from the others and corresponding with the cycle of operation of its own cylinder—current may be applied to the rod 14′ by a contact spring 32 secured to the sleeve 4.

Having now described my invention what I claim as new and desire to secure by Letters Patent is as follows:

1. In an internal combustion engine, the combination of a plurality of jump-spark ignition plugs, each of which is adapted to be fixedly applied to a combustion chamber, a source of high potential current to which said plugs are connected in multiple, the spark gap within each of said plugs being normally too great for the passage of current, and means for successively shortening the spark gaps of said plugs to such an extent as to permit the passage of current in the form of a jump-spark, substantially as set forth.

2. In an ignition system, the combination of a plurality of jump-spark ignition plugs, each of which is adapted to be fixedly applied to a combustion chamber and comprises a member capable of being moved to shorten the spark gap within the plug, means for moving said members successively and a source of high potential current to which the plugs are connected in multiple, substantially as set forth.

3. A jump spark ignition plug adapted to be fixedly applied to a combustion chamber, comprising a fixed conductor, a conductor normally remote therefrom and free to move into nearness thereto, and means for restraining said movable conductor when in a position adjacent but out of contact with said fixed conductor.

4. A jump spark ignition plug adapted to be fixedly applied to a combustion chamber and comprising a fixed conductor and a conductor normally remote and insulated therefrom, and having a projection free to move into nearness to said fixed conductor without contacting therewith, and means for restraining said movable conductor when said projection is in a position adjacent but out of contact with said fixed conductor.

5. A jump spark ignition plug adapted to be fixedly applied to a combustion chamber and comprising a fixed conductor and a conductor normally remote therefrom and free to be moved into proximity thereto by pressure in the combustion chamber to which the device is applied, and means for restraining said movable conductor when in a position adjacent but out of contact with said fixed conductor.

6. In an internal combustion engine, the combination of a plurality of jump-spark ignition plugs each of which is adapted to be

fixedly applied to a combustion chamber and comprises conductors normally remote from and relatively movable into proximity to each other by pressure in the combustion chamber, and means for successively compressing the contents of said chambers and simultaneously energizing the plug applied to the chamber within which the pressure is increased, substantially as set forth.

7. An ignition plug comprising outer and inner conductors insulated from each other, said inner conductor comprising a fixed member and a movable member, said movable member having a projection, and the arrangement being such that there are normally two substantial gaps in the circuit, both of which are shortened by movement of the said movable member.

8. An ignition plug comprising outer and inner conductors insulated from each other, said inner conductor comprising a fixed member having an air opening therethrough, and a movable member adapted to close said opening when subjected to pressure within the cylinder to which it is applied and having a projection adapted to be brought into proximity to said outer conductor without contacting therewith.

9. In an internal combustion engine, the combination of a plurality of jump-spark ignition plugs, each of which is adapted to be fixedly applied to a combustion chamber, an induction coil to the secondary of which the plugs are connected in multiple, the spark gap within each of said plugs being normally too great for the passage of current, means for successively shortening the spark gaps within said plugs to such an extent as to permit the passage of current in the form of a jump-spark, and means for simultaneously energizing the primary of said coil whereby a jump-spark is produced in one of said plugs to the exclusion of the others, substantially as set forth.

10. In an ignition system, a source of high potential current, a plurality of jump-spark ignition plugs adapted to be fixedly applied to combustion chambers, said plugs being connected in multiple to said source of current and each of said plugs comprising means operable by pressure in the combustion chamber for shortening the spark gap within said plug, whereby a spark may be produced in one plug to the exclusion of the others, substantially as set forth.

11. A jump-spark ignition plug adapted to be fixedly applied to a combustion chamber and comprising a pair of conductors normally separated by a gap too great for the passage of the igniting current and free to move with respect to each other without contacting, whereby the spark gap is shortened, substantially as set forth.

12. A jump-spark ignition plug adapted to be fixedly applied to a combustion chamber and comprising a pair of conductors normally separated by a distance too great for the passage of the igniting current, one of said conductors being movable to shorten the spark gap to such an extent as to allow the passage of a jump-spark, substantially as set forth.

13. A jump spark ignition plug adapted to be fixedly applied to a combustion chamber and comprising a pair of conductors insulated and normally remote from each other, and capable of relative movement to shorten the spark-gap, and means for limiting said movement so as to permit the conductors to occupy positions adjacent but out of contact with each other.

14. A jump-spark ignition plug adapted to be fixedly applied to a combustion chamber and comprising a pair of conductors insulated from each other and relatively movable to diminish the length of the spark-gap when the plug is subjected to pressure in the combustion chamber to which the device is applied, and means for restraining said movement when the conductors are sufficiently close to each other to form a workable spark-gap.

This specification signed and witnessed this 19th day of June, 1907.

DELOS HOLDEN.

Witnesses:

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