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IGNITION SYSTEM FOR MULTICYLINDER INTERNAL COMBUSTION ENGINES.

APPLICATION FILED MAY 17, 1909.

1,003,424. Patented Sept. 19, 1911.

Fig. 1.

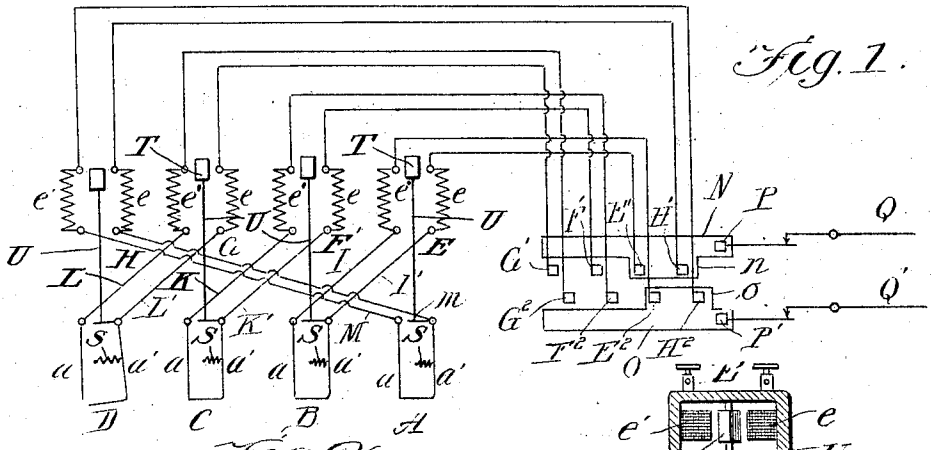

Fig. 2.

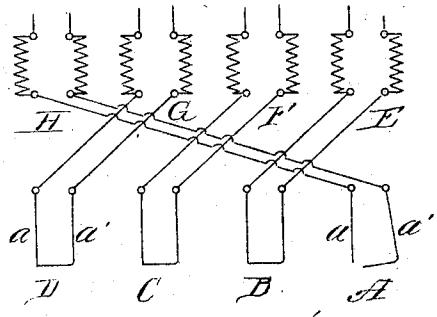

Fig. 3.

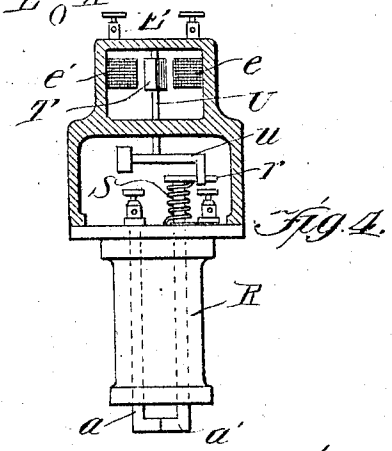

Fig. 4.

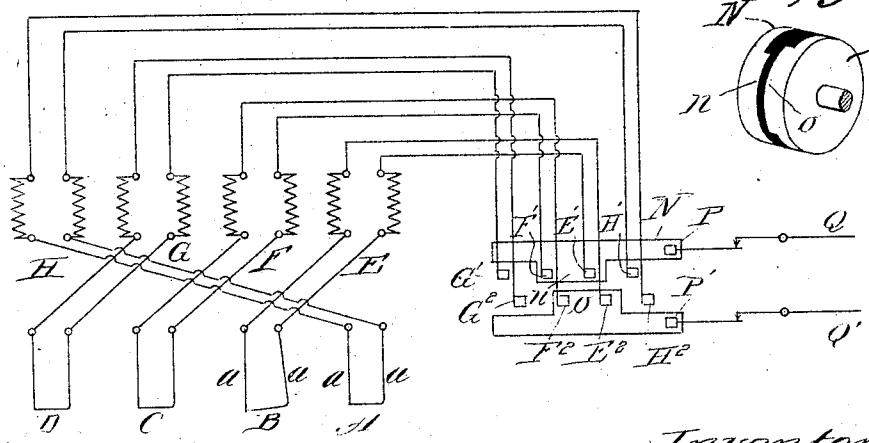

Fig. 5.

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IGNITION SYSTEM FOR MULTICYLINDER INTERNAL-COMBUSTION ENGINES.

1,003,424. Specification of Letters Patent. Patented Sept. 19, 1911.

Application filed May 17, 1909. Serial No. 496,566.

To all whom it may concern:

Be it known that I, RUFUS L. BOND, a citizen of the United States, residing at Gary, county of Lake, State of Indiana, have invented certain new and useful Improvements in Ignition Systems for Multicylinder Internal-Combustion Engines, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

In multi-cylinder internal combustion engines of high power it is common to make use of electro-magnetically-actuated spark-drawing devices whose operation is controlled by means of a timer driven from some movable element so as to fire the cylinders in proper succession. Breaking the circuit at the timer is very injurious to the timer and soon destroys it. It has been proposed to effect the breaking of the circuits in oil, but even this expedient does not overcome the objection noted while its use is attended with other disadvantages.

The object of my invention is to provide simple and novel control system for the spark-drawing devices of multi-cylinder engines whereby the disadvantages incident to the system to which I have referred are entirely obviated.

In carrying out my invention I so arrange the circuits that the deënergization of the actuating or controlling magnets is accomplished by the spark-drawing devices so that whenever one of these devices is actuated, it simultaneously draws an arc or spark and interrupts the circuit of one of the actuating or controlling magnets of the series.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawing, wherein:

Figure 1 is a diagram showing my improved system applied to a four-cylinder engine, the conditions of the parts being those just before the first cylinder is fired; Fig. 2 is similar to Fig. 1, the controlling switch and some of the connections being omitted and the condition of the parts being that which takes place immediately after the conditions indicated in Fig. 1 have been reached; Fig. 3 is a view similar to Fig. 1 showing the condition of the parts when the second cylinder has fired; Fig. 4 shows a form of spark-drawing device which may be employed; and Fig. 5 is a perspective view of the movable member of the master switch.

I have illustrated my invention as applied to a four-cylinder engine wherein there is a single spark-drawing device associated with each cylinder. It will, of course, be evident that my invention is not limited to engines having any particular number of cylinders or any particular number of spark-drawing devices for any one cylinder. Neither is my invention limited to any one form of spark-drawing device or to the mechanical construction of the master switch. In Fig. 4 I have, however, shown a common form of spark-drawing device by way of illustration.

Referring to Fig. 1 of the drawing, A, B, C and D represent the spark-drawing devices of a four-cylinder engine, there being one of these devices for each cylinder, and E, F, G and H are the controlling coils for these devices, each coil being arranged directly above the spark-drawing device which it controls. The spark-drawing devices are indicated as being of the type wherein there are two relatively-movable contact members a and a^1 which are caused to move apart so as to draw a spark when the corresponding electro-magnet is energized. Springs S tend to keep the contact members a and a^1 in engagement with each other. The movable armatures, T, of the electro-magnets are connected to the movable contact pieces a^1 by stems U, so that when one of the electro-magnets is energized the corresponding contact pieces are moved apart. Each of the electro-magnets is indicated as being made in two parts e and e^1, but this arrangement is, of course, not essential.

Electro-magnet E is connected in series with the arc-drawing device B by means of connections I and I^1; electro-magnet F is connected in series with the spark-drawing device C by means of conductors K and K^1; electro-magnet G is connected in series with the spark-drawing device D by means of conductors L and L^1 and electro-magnet H is connected in series with the spark-drawing device A by means of conductors M and m. It will therefore be seen that it is possible to maintain each electro-magnet energized until the electro-magnet on the

following cylinder has been energized so as to actuate the spark-drawing device in the cylinder, so that, by means of a suitable master switch which will maintain the circuit through one electro-magnet until the succeeding electro-magnet has been energized, the duty of interrupting the circuits is taken away from the master switch and is imposed upon the spark-drawing devices without, however, making the work to be done by the spark-drawing devices more severe than where their duty is simply to draw a spark for making an ignition. Any suitable type of master switch, preferably of the revolving type driven from some moving part of the engine, may be employed. In the diagram the switch is shown in developed form and is illustrated as comprising a movable element made up of two insulated plates N and O and a series of brushes. The plates N and O are in the form of continuous rings having short laterally-extending sections *n* and *o*, respectively.

P and P^1 are a pair of brushes connected to a source of current supply indicated by conductors Q and Q^1 and bearing respectively upon the members N and O. One terminal of each of the electro-magnets is connected to a brush lying in the path of movement of the projection *n* and the other terminal of each of the electro-magnets is connected to a brush lying in the path of movement of the section or projection *o*. The two sets of brushes are indicated at E^1, F^1, G^1, H^1 and at E^2, F^2, G^2, and H^2. The brushes of each series are spaced apart a distance less than the length of one of the sections *n*, *o*, so that each of these sections at times bridges two of the brushes.

In Fig. 1 the left-hand cylinder has been fired but the contacts of the spark-drawing device D, associated therewith, are still held apart because the electro-magnet H remains energized, current flowing through this electro-magnet from line Q, through brush P, plate N, brush H^1, coil *e* of this electro-magnet, conductor *m*, spark-drawing device A, conductor M, coil e^1 of this electro-magnet, brush H^2, plate O, brush P^1 and back to conductor Q^1. The right-hand cylinder is just about to fire, the brushes E^1 and E^2 having just come into contact with the projecting sections *n* and *o*, respectively. A second circuit may be traced from line Q through electro-magnet E and spark-drawing device B back to line Q^1. As soon as current flows through this latter circuit, electro-magnet E is energized and the spark-drawing device A assumes the position indicated in Fig. 2, namely that which produces a spark to fire the right-hand cylinder. When the spark-drawing device A is actuated, it not only provides a spark for firing the cylinder but it also, at the same time, interrupts the circuit for the electro-magnet H and consequently the spark-drawing device D assumes the closed position as indicated in Fig. 2. As the movable member of the master switch continues to revolve, the brushes, H^1 and H^2 leave the projecting sections *n* and *o* respectively, and the energizing circuit for the electro-magnet H is disconnected from the source of current, but at a time when no current is flowing therethrough. After the circuit for the magnet H has been thus interrupted at the master switch, it cannot be again completed, even when the spark-drawing device A closes, until the movable member of the master switch rotates through a sufficient angle to bring the sections *n* and *o* into engagement with the brushes H^1 and H^2. The condition of the parts remains the same as indicated in Fig. 2 until the members *n* and *o* of the master switch come into contact with the brushes F^1 and F^2 which are connected with the terminals of electro-magnet F. This engagement is effected before the engagement with the brushes E^1 and E^2 is interrupted. Consequently electro-magnet F is energized before electro-magnet E is deenergized and the deënergization of this latter magnet is effected at the spark-drawing device B, which is included in series with the electro-magnet E. As soon as this occurs the spark-drawing device A returns to the closed position indicated in Fig. 3. Then, when the sections *n* and *o* are carried out of engagement with the brushes E^1 and E^2 there can be no arcing at the master switch, since there is no current flowing through these brushes. In the same way the electro-magnets G and H are energized in succession, each actuating its spark-drawing device and breaking the circuit of the magnet which preceded it until, finally, all of the cylinders have been fired and it is again the turn of the right-hand cylinder, which then is fired in the manner previously described. It will thus be seen that the breaking of the circuit for each of the electro-magnets is accomplished by means of one of the spark-drawing devices, so that the master switch need only make the circuits and prevent them from being again closed, after having once been broken, until the proper time arrives.

In Fig. 4 I have shown a common form of spark-drawing device and its actuating magnets, *a* indicating a stationary contact, and a^1, a movable contact mounted upon the lower end of a revoluble rod R. The rod R is provided with an arm *r* at its upper end and with a spring S which, when free to do so, holds the rod in a position wherein the contact a^1 engages with the contact *a*. *e* and e^1 represent the two coils of the electro-magnet E and T represents a swinging armature arranged between these coils and carried upon a revoluble shaft U. Upon

the lower end of the shaft U is a finger u which, when the electro-magnet is energized, strikes against the arm r and rotates the rod R quickly, carrying the contact a^1 out of engagement with the contact a. As long as the magnet remains energized the two contacts a^1 and a remain out of engagement; but, as soon as the magnet is de-energized, the spring returns the rod R to its normal position and brings the contacts into engagement with each other.

While I have described in detail only a single preferred form of my invention I do not desire to be limited but intend covering all forms and arrangements which fall within the terms employed in the definitions of my invention constituting the appended claims.

What I claim is:

1. In combination, supply conductors, a plurality of spark-drawing devices, actuating magnets for said devices, and means for successively connecting said magnets to said supply conductors, said means including a controlling circuit for each magnet containing the spark-drawing device actuated by the succeeding magnet.

2. In combination, a plurality of spark-drawing devices, actuating magnets for said devices, and energizing circuits for said magnets, each circuit including one of the magnets and one of the said devices actuated by another of said magnets.

3. In combination, a plurality of spark-drawing devices, a controlling magnet for each of said devices, energizing circuits for said magents, each circuit including one of the magnets and one of the said devices controlled by another magnet, supply conductors and means for connecting the energizing circuit of each magnet to said supply conductors before disconnecting the circuit containing the spark-drawing device corresponding to the circuit which is being connected.

4. In combination, a plurality of spark-drawing devices, a controlling magnet for each of said devices, controlling circuits for said magnets, the controlling circuit for each magnet including one of said devices which is controlled by another of said magnets, supply conductors, and means for successively connecting said controlling circuits to said supply conductors, said means being constructed and arranged to connect each circuit before disconnecting the one containing the spark-drawing device corresponding to the circuit which is being connected.

5. In combination, a plurality of spark-drawing devices, a controlling magnet for each of said devices, energizing circuits for said magnets, supply conductors, and a switch mechanism for connecting said circuits successively to said supply conductors, each of said circuits containing one of said magnets and the spark-drawing device controlled by the succeeding magnet, and said switch mechanism being so constructed and arranged as to connect each circuit to said source before disconnecting another of said circuits.

6. In combination, a plurality of spark-drawing devices, actuating magnets for said devices, each of said magnets being connected in a circuit in series with one of said devices actuated by another of said magnets, a source of current, and means for connecting said circuit successively to said source.

7. In combination, a plurality of spark-drawing devices, actuating means for said devices, controlling circuits for said actuating means, each of said controlling circuits containing one of the said devices controlled by another of said circuits, supply conductors, and means for connecting said circuits successively to said supply conductors, said means being constructed and arranged to connect each circuit before disconnecting the one containing the spark-controlling device controlled by the circuit which is being connected.

In testimony whereof, I sign this specification in the presence of two witnesses.

RUFUS L. BOND.

Witnesses:
WM. F. FREUDENREICH,
H. S. GAITHER.