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R. VARLEY & A. D. SCOTT.

SPARK IGNITION SYSTEM FOR EXPLOSION ENGINES.

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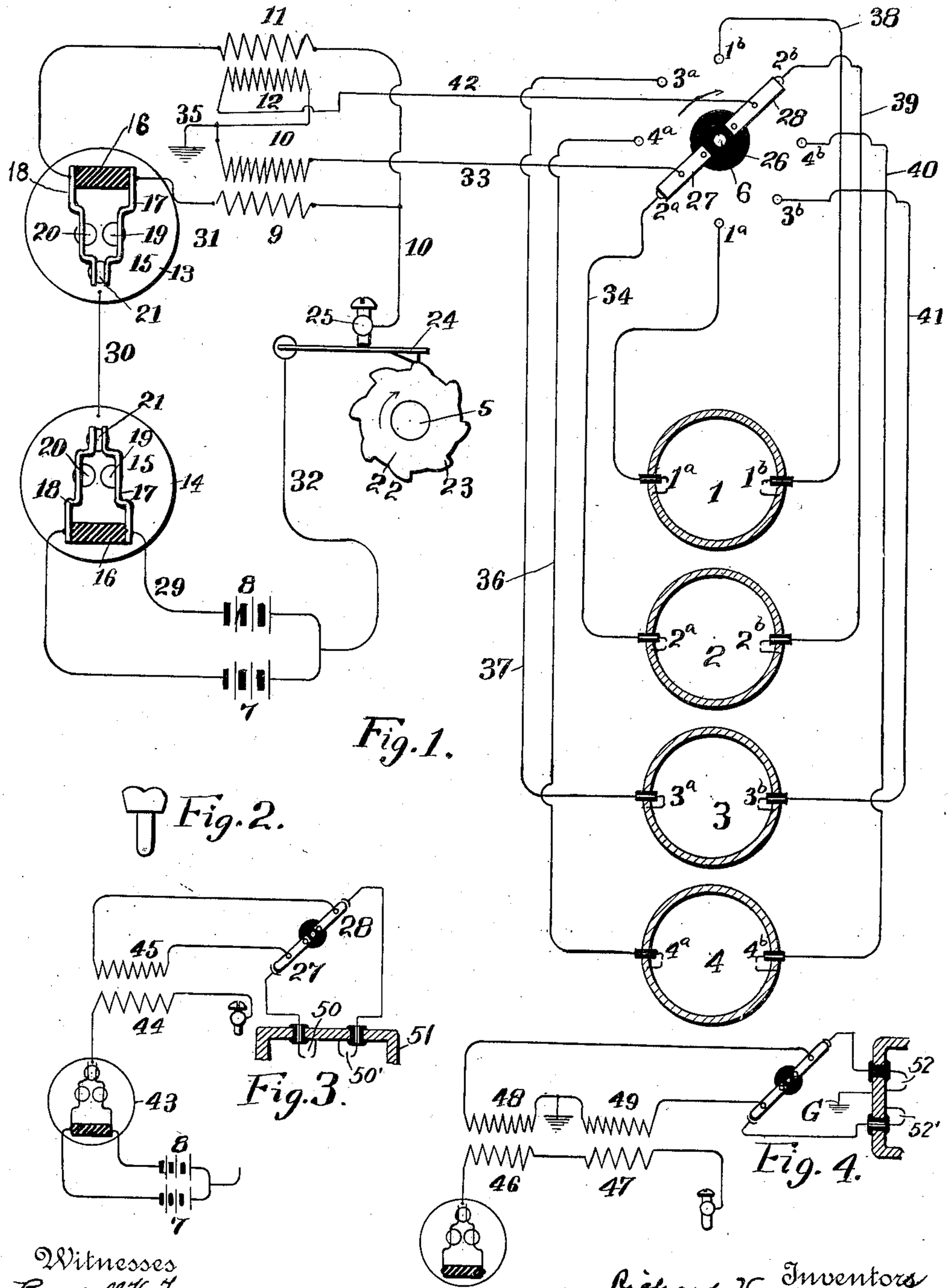

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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SPARK-IGNITION SYSTEM FOR EXPLOSION-ENGINES.

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To all whom it may concern:

Be it known that we, RICHARD VARLEY and ARCHIBALD DOUGLAS SCOTT, citizens of the United States, residing at Englewood, county of Bergen, State of New Jersey, and Providence, county of Providence, and State of Rhode Island, respectively, have invented certain new and useful Improvements in Spark-Ignition Systems for Explosion-Engines, of which the following is a full, clear, and exact description.

This invention relates to the ignition system of explosion motors or engines, and comprises a system and apparatus involving two sources of electricity, two potential transformers or induction-coils, and two sets of electrodes or ignition devices in the engine cylinder or cylinders, in combination with means whereby either one of each of said pairs of apparatus or devices can be thrown into use at will, or, if desired, both members of each or any pair of said apparatus may be likewise brought into use at will. Such a system, it will be apparent, affords many advantages in the operation of such engines, it being possible, for instance, to shift from one battery to another on account of the weakening of the first, or to use both batteries simultaneously when they are needed, likewise to shift from one induction-coil to another in case one becomes incapacitated, or to use both, if desired; also, to use one ignition device or set of ignition devices in the engine cylinder or cylinders, or to use both sets of ignition devices in each cylinder when that is desirable.

In the operation of explosion-engines it has been determined by experiment that when the explosive mixture is fired at two distant points in the body of the charge combustion of the charge takes place more quickly and a percentage of power is gained. Our invention provides for the use of a double set of igniting devices in the cylinder or cylinders of the engine, the special form of such devices illustrated, by way of example only, being known as the "jump-spark."

The invention will be described in detail and its various advantages pointed out in connection with the accompanying drawings, in which—

Figure 1 is a conventional representation of the apparatus and circuits involving our invention. Fig. 2 is a view of a switch-plug, and Figs. 3 and 4 are modifications.

The invention will be described in connection with a four-cylinder explosion-engine, although it will be understood that it is applicable to an engine having any number of cylinders from one upward.

The cylinders of the engine are indicated by 1, 2, 3, and 4.

5 is a shaft driven from the engine-shaft at one-quarter of the speed thereof, and 6 is the same or a similar shaft driven at the same speed.

Each of the cylinders of the engine is provided with two spark-plugs or other igniting devices, (represented by 1^a 1^b, 2^a 2^b, 3^a 3^b, and 4^a 4^b.)

7 and 8 are two sources of electricity, which may be either batteries or mechanical generators.

9 and 10 are respectively the primary and secondary windings of one induction-coil, while 11 and 12 are the primary and secondary windings of a second induction-coil.

13 and 14 are two cut-out switches, the former adapted to connect in circuit either one or both of the induction-coils and the latter either one or both of the batteries. Each cut-out comprises a metallic plate 15, carrying a block of insulating material 16, supporting two metallic springs 17 and 18, the plate having three plug-holes 19, 20, and 21, adapted to receive a metallic plug, such as shown in Fig. 2. The plug in entering one of these holes bears against one or the other of the springs 17 18 and connects either one or both of said springs with the plate 15.

22 is a cam-disk on shaft 5, having eight lugs 23 equally spaced around its periphery, which are adapted to act successively upon a spring-blade 24 to force the same into contact with a contact-screw 25, and thus close and open a circuit that leads through the blade and screw.

On the shaft 6 is a hub 26, of insulating material, having two diametrically-arranged metallic arms 27 and 28, which are caused by the rotation of the shaft to simultaneously come into contact successively with four pairs of contact-points, which have the same designations in the drawing as the spark-

plugs in the cylinders of the engine and correspond thereto. Contact is made with these points just before the contacts are made between the blade and screw 24 and 25.

The operation of the system so far described and the circuits comprised therein will now be given.

If it be desired to operate the engine with one battery—say 8—and one induction-coil—say 9 10—and one set of sparking-plugs at a time, the switch-plug, Fig. 2, will be inserted in the hole 19 of switch 14 and a similar plug in hole 19 of switch 13. In this way it will be seen that battery 8 is put into series with primary winding 9 over the following circuit: by wire 29, spring 17, switch-plug, plate 15, wire 30, plate 15 of the second cut-out, switch-plug, spring 17, wire 31, primary 9, wire 10, contact-screw 25, blade 24, and wire 32 to battery. Thus each time cam 22 closes this circuit a current will flow from the battery 8 through the primary winding 9, while the battery 7 and primary winding 11 will be out of circuit. It will be understood that the induction-coils may be equipped with the usual vibrators to give a series of rapid interruptions whenever the battery-circuit is closed by the cam. The high-tension current thus induced in the secondary winding 10 will flow by wire 33 to the arm 27, to which said wire is permanently connected, thence to one of the contact-points upon which at that instant the arm is in connection. Assuming it to be 2^a, current will then pass along the wire 34 to one terminal of the plug 2^a in cylinder No. 2, then across the spark-gap to the terminal of said plug, which is connected to the cylinder and frame of the machine. Thence the circuit leads through the frame to the ground-terminal of the secondary winding 10 (shown at 35) and is so completed, the charge being fired in cylinder 2. When the main crank-shaft has turned through another half-rotation and shafts 5 and 6 have in the same time turned through one-eighth rotation, the circuit is again closed between blade 24 and screw 25, and another impulse is sent out from secondary winding 10, which on this occasion passes by way of contact 4^a, wire 36, plug 4^a in cylinder 4, and back to the secondary through the frame. At the next half-rotation of the crank-shaft and corresponding eighth rotation of shafts 5 and 6 the secondary impulse flows through contact 3^a, wire 37, and plug 3^a in cylinder 3, and on the next closure the secondary impulse will travel by way of contact 1^b and wire 38 to plug 1^b in cylinder 1. Next the current will pass by contact 2^b, wire 39, to plug 2^b in cylinder 2, next by contact 4^b and wire 40 to plug 4^b in cylinder 4, and next by contact 3^b, wire 41, to plug 3^b in cylinder 3. Thus the charge is fired first in cylinder 1, then in cylinder 2, then in cylinder 4, and then in cylinder 3 in accordance with the usual practice, and after each of the four cylinders have been fired from one set of plugs they are each fired by the other set of plugs, and so on, the sets of plugs being alternately brought into operation. Each plug therefore does only one-half the service of a plug used in an engine where there is but a single plug in each cylinder and is consequently less liable to get out of order.

If battery 8 weakens, battery 7 can be thrown in to take its place by shifting the plug in switch 14 from the hole 19 to the hole 20, and when battery 7 weakens both batteries can be connected in multiple by inserting the plug in hole 21 and their combined currents made available. Either of these combinations can be used in connection with the same induction-coil by leaving the condition of cut-out 13 as before described, and the operation of the cylinders will likewise be the same as before described. If the induction-coil 9 10 becomes incapacitated for any reason, the coil 11 12 can be thrown into circuit by shifting the plug from hole 19 of cut-out 13 to hole 20. With this connection the same operation will take place in the engine-cylinders; but the circuit will include wire 42, permanently connected to arm 28, instead of wire 22 and arm 27.

If now it is desired to fire the charge in the engine by means of two plugs acting simultaneously in each cylinder, the plug in cut-out 13 will be shifted to hole 21, thus putting the two primaries into multiple connection with one or both batteries. With this connection it will be seen that the secondary current flowing from winding 10 will pass to arm 27, contact 2^a, wire 34, plug 2^a in cylinder 2 to ground at the same time that the current from secondary winding 12 passes to ground, cylinder 2, plug 2^b, wire 39, contact 2^b, arm 28, and the igniting spark will occur at the same instant in both plugs, and the charge will be accordingly ignited at two different points, affording quick combustion and more power. On the next closure the two currents will flow by way of contacts 4^a and 4^b to the fourth cylinder, on the next closure by way of contacts 3^a and 3^b to the third cylinder, and on the next closure by way of contacts 1^b and 1^a to the first cylinder. Here it will be seen that the current from secondary 10 has shifted from the plugs on the left-hand side of the cylinders to those on the right-hand side of the cylinders, while the current from secondary 12 has shifted from plugs on the right-hand side of the cylinder to those on the left-hand side. The respective secondaries are so wound and connected that during the alternate half-rotation of shaft 6 the direction of the current impulses through the firing-plugs, which are caused by the "breaks" at the vibrator, is reversed, and the reversal will continue to

occur after each four charges are fired. This follows directly from the structure shown in Fig. 1, it being evident that the brush 27 receives discharges of different polarity from the coil 10 than does the brush 28. In other words, if the brush 27 receives positive discharges from the wire 33 the brush 28 will receive negative ones from the wire 42. Accordingly the sparks at the plug 2^a will be first in one direction and then in the other as the brushes 27 and 28 successively pass over the contact 2^a. An advantage is obtained from this operation in the fact that the tips or electrodes of the plugs will wear evenly, and the passage of the arc does not cause the wearing away of one electrode and the building up of the other, as is the case where the hotter arc or spark, due to the breaks at the vibrator, passes constantly in the same direction.

The hub 26 with the arms 27 28 and the various contact-points with which they engage are known in the art as the "distributer;" but we believe we are the first to use a double distributer or one adapted to convey currents from either one or both of two induction-coils to one or two sets of igniting devices in the engine.

It is obvious that a single induction-coil can be used in such a way as to create a spark simultaneously at the two plugs in an engine-cylinder. How this can be done is shown in Fig. 3, where by means of a cut-out 43 either one of two batteries 7 and 8 can be connected with the primary 44 and where the terminals of the secondary 45 lead, respectively, to the arms 27 and 28. In this case when the two arms are on two of the contacts of the distributer the current from the secondary winding 45 will pass to both plugs 50 50′ and unite in the material of the cylinder 51, both plugs being grounded thereon.

Fig. 4 shows how the primary windings 46 and 47 of two induction-coils can be connected in series, while their secondary windings 48 and 49 are connected in series, respectively, with the two plugs—that is to say, the current from secondary 48 passes at a given instant to one plug 52 in a cylinder and back to the secondary through the frame or ground G, while the current from 49 passes to the other plug 52′ in the same cylinder and back to the same cylinder through the frame.

Having described our invention, we claim—

1. In an ignition system for explosion-engines, an engine-cylinder, having a plurality of igniting devices, in combination with a rotary distributer for making connection with said igniting devices, a plurality of induction-coils, and means whereby said igniting devices may be connected with the secondary of any induction-coil through the distributer in any predetermined order.

2. In an ignition system for explosion-engines, a pair of induction-coils, a firing device having two electrodes, and means for impelling a unidirectional discharge of current across said electrodes, for a certain interval of time in one direction and then a second unidirectional discharge across said electrodes in the opposite direction, said means acting to utilize for this purpose the current of first one coil and then the other, said coils being connected to discharge in opposite directions.

3. The combination of a multiple-cylinder engine, two igniting devices in each cylinder, two induction-coils and a distributing-switch constructed and arranged to direct current successively through each pair of igniting devices at successive explosions in the respective cylinders.

4. The combination of a multiple-cylinder engine, two igniting devices in each cylinder, two induction-coils and a distributing-switch constructed and arranged to direct current successively through each pair of igniting devices, and to reverse the direction of current at successive explosions in the respective cylinders.

5. In an ignition system for explosion-engines, the combination of a plurality of sources of electricity, a plurality of induction-coils, an igniting device and a single switch whereby any one of said sources of electricity can be connected with any induction-coil and the latter connected with the igniting device.

6. In an ignition system for explosion-engines, the combination of an engine-cylinder having two igniting devices, two induction-coils having their secondaries respectively connected with said igniting devices with reversed polarities, and a single primary circuit including the primaries of both induction-coils whereby sparks in opposite directions are passed across the terminals of said igniting devices.

7. In an ignition system for explosion-engines, the combination of an engine-cylinder having a plurality of igniting devices, a plurality of induction-coils and a single switch for connecting the primary of any coil whereby its secondary circuit successively discharges through said igniting devices in a predetermined order.

In witness whereof we subscribe our signatures in the presence of two witnesses.

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Witnesses:
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