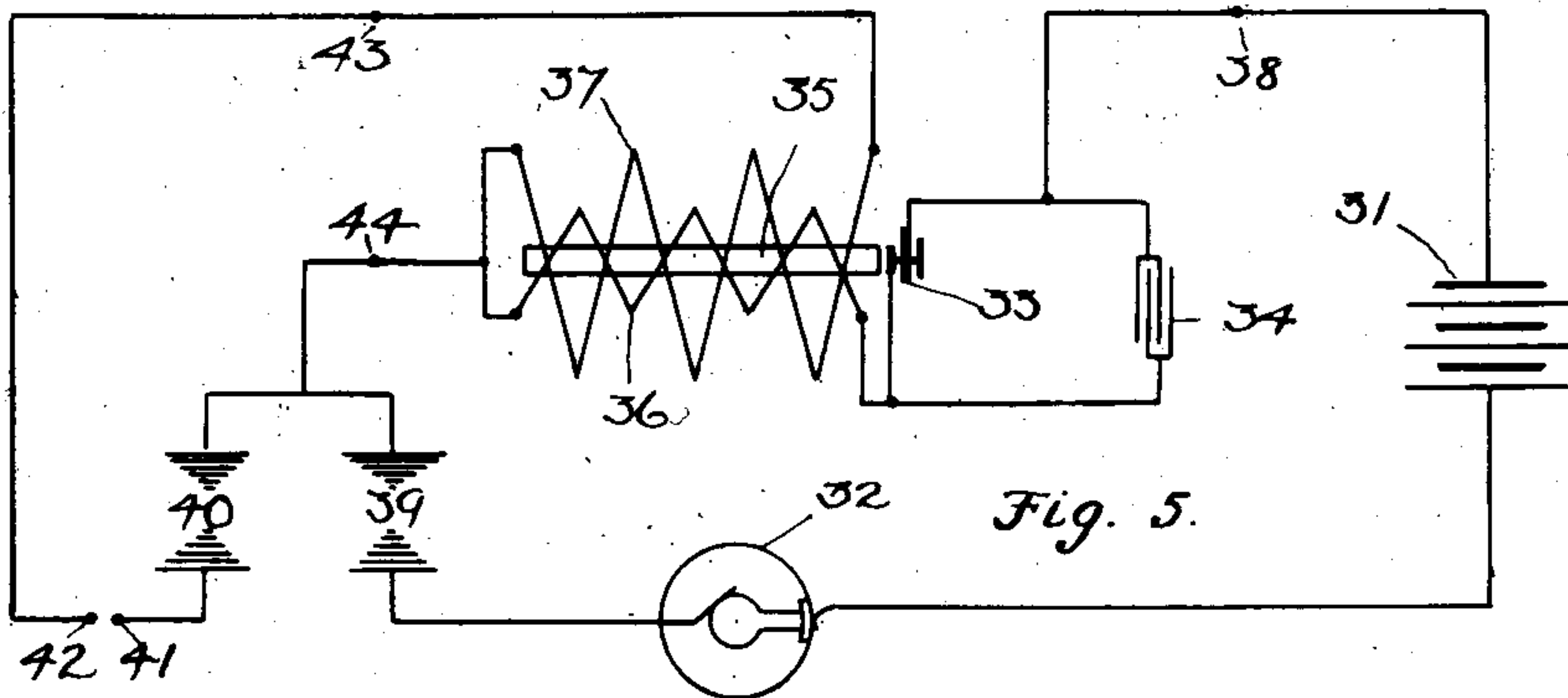
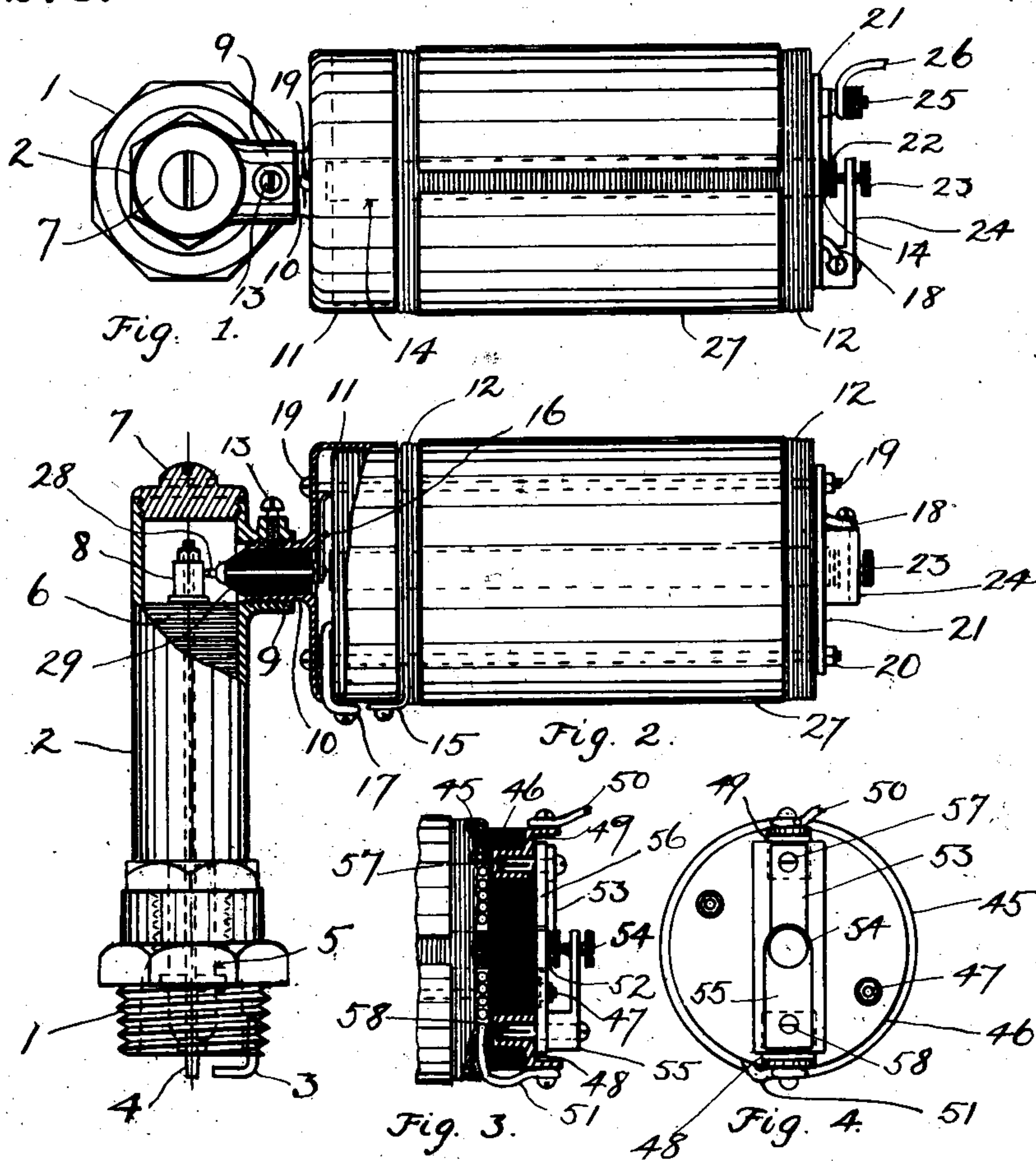


E. S. LINCOLN.  
COMBINED SPARK PLUG AND COIL.  
APPLICATION FILED MAY 5, 1908.

945,278.

Patented Jan. 4, 1910.



Attest:  
Oscar F. Hill  
Clerk & Randall

Inventor:  
Edwin S. Lincoln  
by Nathan B. Day  
Attorney.



# UNITED STATES PATENT OFFICE.

EDWIN S. LINCOLN, OF BROOKLINE, MASSACHUSETTS, ASSIGNOR TO ELECTRIC GOODS MANUFACTURING COMPANY, A CORPORATION OF MAINE.

## COMBINED SPARK PLUG AND COIL.

945,278.

Specification of Letters Patent.

Patented Jan. 4, 1910.

Application filed May 5, 1908. Serial No. 431,025.

*To all whom it may concern:*

Be it known that I, EDWIN S. LINCOLN, a citizen of the United States, residing at Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Combined Spark Plugs and Coils, of which the following is a specification.

My invention relates to spark producing means for exploding a gaseous charge in the cylinder of a hydrocarbon motor, or the like, and consists essentially of a spark plug of usual construction but provided with means whereby the spark coil which supplies the high tension current to said plug may be removably mounted thereon, means being also provided whereby, when the spark coil is so mounted on the spark plug, the coil terminals and the plug spark points are placed in operative relation as to each other.

It has been hitherto the practice most generally adopted in electric ignition systems for explosive motors to install the spark coil, with the batteries by which it is energized, in any convenient location, and to lead wires from the terminals of the secondary winding of said coil to the terminals of the ignition system, which wires are ordinarily led to binding posts of which one is on the spark coil, and the other is grounded on the motor frame. Inasmuch as such connecting wires carry current of high tension, there is a much greater liability for trouble in the working of the ignition system due to leakage of current through defective insulation than would be the case were current of low tension similar to that by which the primary coil of the spark coil is energized, carried by such wires.

My invention is therefore designed to produce a spark plug having provision whereby the coil by which said plug is energized is mechanically attached thereto, provision being also made whereby the electrical connections necessary to place the coil terminals and plug spark points in operative relation as to each other are effected without the use of outside wiring.

Furthermore my invention aims to provide means rendering the spark plug and spark coil individually separable, permitting the spark coil attached to any plug to be removed therefrom, and to be replaced by another coil with a minimum of manipula-

tion; the operative electrical relation between the plug and coil being broken or re-established by the act of mechanically disconnecting or reattaching a coil to a plug.

My invention is illustrated in its preferred form in the accompanying drawings, in which—

Figure 1 is a plan view of my combined plug and coil, and Fig. 2 is a side elevation of the same, partly in section. Figs. 3 and 4 show details of a modification which may be embodied in my invention. Fig. 5 is a diagrammatic view showing the electrical connections of an ignition system in which a combination plug and coil embodying my invention is employed.

Referring to the drawings, the spark plug is shown in Figs. 1 and 2 as being formed with the base portion 1 adapted to screw into the wall of the motor cylinder. Preferably having a threaded engagement with the base 1 is the top portion 2. The spark points are mounted in the base portion of the plug in usual manner; one, 3, being grounded in said base, while point 4 is located at the end of a rod running substantially centrally from a point in proximity to spark point 3 to the upper portion of the top 2, and being insulated throughout its length in any approved manner, as by the use of the porcelain bushing 5 and washers 6 of mica or the like.

The top portion 2 of the plug is preferably tubular, the insulating washers 6 fitting inside the same, and it is provided with a screw cover 7 adapted to close the open end of the same. The upper portion of the rod forming the central spark point 4 is uninsulated, and is exposed within an inclosed space at the upper end of the tubular top portion 2, being preferably provided with a contact washer 8 at that point.

Laterally extending from the upper part of top portion 2 of the plug is a boss 9, located substantially axially opposite to the center of washer 8, and adapted to receive the centrally located neck 10 of a supporting frame 11 to which the spark coil 12 is secured. Preferably neck 10 and boss 9 have a threaded engagement as shown, and a set screw 13 is provided for clamping said neck with reference to the boss 9.

The spark coil 12 is of customary construction, comprising the usual primary



winding, having a vibrator in series therewith, and a secondary winding, associated with the primary winding around the central core 14. The terminals of the secondary winding are shown at 15 and 16, and those of the primary winding at 17 and 18. The coil windings are secured to the frame 11 in any suitable manner, as by bolts 19 passing through the windings and having terminal nuts 20 bearing against an end plate 21, preferably of insulating material.

On the terminal end plate 21 is mounted the vibrator assembled in operative condition, and comprising the vibrating armature 22, located adjacent the end of the core 14 and adapted to contact with the contact screw 25 adjustably mounted in the bracket 24. The terminal 18 of the primary winding is preferably secured to bracket 24, while in electrical connection with armature 22 is a binding post 25, from which a wire 26 leads to one pole of the battery, not shown in Figs. 1 and 2, by which the coil is energized. The other pole of said battery is preferably grounded on the motor frame at some convenient point not appearing in said figures. The second terminal 17 of the primary winding is grounded on frame 11. Thus an electrical circuit is completed through the vibrator, the primary winding, the frame 11, the metallic body of the spark plug, and the motor frame; a timer, not shown in Figs. 1 and 2, being employed in usual manner to permit the flow of current for energizing the said primary winding at the desired instant. If desired a condenser may be employed to increase the efficiency of the spark coil, in which case the said condenser may be wrapped around the outside of the coil as shown at 27, the terminals of the same, which are not shown in the drawings, being connected in around the vibrator in customary manner.

One terminal 15 of the secondary winding is grounded on frame 11, as well as the primary terminal 17 while the other secondary terminal 16 leads to and is connected with a pin 28 which is mounted in insulating material 29 filling the neck 10 of frame 11, said pin 28 extending through said neck 10 and having its end projecting therefrom a short distance as shown. The amount of the projection of pin 28 from neck 10, and the diameter of the contact washer 8 are so related that as the neck 10 is screwed into the boss 9, the end of pin 29 will come into forcible contact with said washer 8, so as to establish an efficient electrical connection therewith. In this manner the spark point 4, which is in electrical connection with washer 8, will be placed in electrical connection with the terminal 16 of the secondary winding of the spark coil, while the other spark point 3 will be electrically connected with the other secondary terminal 15

through the ground afforded by the frame 11, neck 10, boss 9, and the body of the spark plug.

The scheme of the electrical connections and distribution incident to the operation of my combined spark coil and plug is diagrammatically shown in Fig. 5. In said figure, 31 is the battery, 32 the timer, 33 the vibrator, and 34 the condenser connected around the vibrator terminals. The core of the spark coil is indicated by 35, while 36 and 37 are respectively the primary and the secondary windings of the same. At 38 may be indicated the point at which the circuit from the battery is connected to the primary winding as at the binding post 25 of Fig. 1, the circuit through the primary winding being completed through the ground 39. Secondary winding 37 has its circuit completed through the ground 40 and the gap between the spark points 41 and 42. The point 43 may be taken to represent the point at which the separable contact made by bringing the end of pin 28 into contact with washer 8, as shown in Figs. 1 and 2, takes place, thereby placing one secondary terminal of the coil in operative relation as to the spark point 42 of Fig. 5 corresponding to spark point 4 of Fig. 3. In like manner 44 represents the separable contact corresponding to that established between neck 10 and boss 9 of Fig. 2 when the former is screwed into the latter; the engagement of said neck and boss operating to complete the secondary circuit through the spark points and the ground 40, corresponding to that established through frame 11, neck 10, boss 9 and the body of the spark plug as shown in Fig. 2. At the same time the engagement of said neck and boss completes the primary circuit through the ground 39, which is made up of the same elements as above mentioned in connection with ground 40, with the further addition of the motor frame.

From the construction above described it becomes possible to replace a defective coil with a minimum of time or trouble, and without necessitating the stopping of the motor, where a multicylindered motor is employed; the process of making such replacement simply being to disconnect wire 26, and to loosen set screw 13, whereupon the spark coil may be bodily removed from the spark plug by simply unscrewing the neck 10 from the boss 9. By reversing the process a new coil may be inserted into boss 9 and reconnected with wire 26. In such process of replacement it will be noticed that the terminal 16 of the secondary winding of the spark coil is brought into operative relation with the central spark point 4 through the bringing together of the end of pin 28 and the washer 8, which results from the screwing of neck 10 into boss 9, while terminal 15 is brought into operative relation with spark



point 3 through the ground connections completed by the engagement of neck 10 within boss 9; the grounded connection just mentioned also serving to complete the primary circuit, in a manner which has been more specifically pointed out in a previous part of this specification.

In addition to the facility with which any coil may be replaced in a combined plug and coil constructed in accordance with my invention the manner in which the connections between the terminal 16 and the spark point 4 are inclosed and protected from outside injury, and in which the same are insulated with reference to the other terminal of the said secondary coil and the spark point in connection with the same contributes to the efficiency and permanence of the ignition system. Said connections may be embodied in conductors of large size and high conductivity, and the same may be readily insulated from the neck 10 of frame 11, and from the wall of the spark plug, with which the secondary terminal 15 is in electrical engagement through grounding in a permanent and effective manner, as has been more specifically hereinabove described. Thus is eliminated to a large degree the liability to defective working on the part of the ignition system by reason of leakage of the high tension current due to defective insulation. At the same time the rigid support afforded the said connections by reason of the manner in which they are mounted in the plug body and in neck 10, avoid subjecting them to the vibration and consequent liability to fracture by crystallization, which is common in ignition installations of the usual type. Furthermore the protection afforded through the inclosure of such connections within the plug body and neck 10 prevents their being subjected to abrasion or other injury by which injury tending to interrupt the ignition system may result.

In consequence therefore of my combination of the spark plug and coil in the manner above described the possibility of trouble arising in the ignition system either as a result of the fracture of the secondary connections through crystallization, or through defects originally present in the insulation of such connections or arising as a result of use, is reduced to a minimum, and the annoyance due to that cause practically eliminated.

A modification of my invention is shown in Figs. 3 and 4, said modification involving more especially the manner of attaching the vibrator to the coil. It has been my experience that defects in the vibrator are in large measure responsible for the defective working of a coil and it has been my aim in the modification hereinafter described to provide a construction in which the said vibrator is detachably secured to the coil, so

as to permit the same to be easily removed and quickly replaced, should it be deemed advisable so to do, by one known to be in good condition.

My removable vibrator is applied to the spark coil in the following manner. At the end of the spark coil, indicated by 45, in Fig. 3, is a disk 46 preferably of insulating material, secured to the coil end by the bolts 47 by which the coil is made fast to a supporting frame, not shown in Fig. 3, but similar in form and function to that above described in connection with Figs. 1 and 2. In said disk 46 are located two socket plates 48 and 49, made of metal or other electrically conductive material and insulated with reference to each other, and to said plates are respectively connected the wires 50 and 51. Wire 50 leads to one pole of the battery by which the coil is energized, not shown in the figures, while wire 51 is one of the terminals of the primary coil the other pole of said battery, and the other terminal of the said primary being both preferably grounded on the motor frame in similar manner to that above described in reference to Figs. 1 and 2. The end 52 of the spark coil core is adapted to project for a short distance through the disk 46, and to come into working relation with the armature of the vibrator which is superimposed on the disk 46 in a manner to be presently described.

Fig. 3 shows the vibrator in its operative position on the disk, said vibrator comprising the vibrating armature 53, and the contact screw 54 adjustably mounted in the bracket 55, all assembled in usual operative relation upon a base 56. Projecting from the lower surface of base 56 are pins 57 and 58, preferably formed with split and resiliently separated ends, which are adapted to slidably engage within holes which are provided to receive the same in the socket plates 48 and 49. Said pins are located so as to register within the holes in the socket plates, permitting both pins to be simultaneously slid into engagement within the said holes, the friction engagement between the pins and the sides of the holes in the socket plates serving to retain the vibrator in its place at the end of the spark coil. Pin 57 is electrically connected with the vibrator armature 53 and the other pin 58 with the contact screw bracket 55.

When in position at the end of coil 45 with pins 57 and 58 in engagement with the holes of socket plates 48 and 49 as above described, the vibrator will serve to complete the circuit through the primary winding, the current from the energizing battery entering socket plate 49 through wire 50, and passing thence into pin 57 and through the armature 53, contact screw 54 and bracket 55 into pin 58. Thence it will pass



into socket plate 48 and into the primary winding terminal 51 and through the said primary winding, the circuit between the other battery pole and the other primary terminal being completed by grounding through the plug and the motor frame in a similar manner to that above described in connection with Figs. 1 and 2. Thus it is evident that the mere act of pulling the vibrator base with the vibrator elements mounted thereon, from its place of engagement with the socket plates by means of pins 57 and 58, serves to electrically disconnect the same from the circuit which it is intended to control, or the act of putting a new vibrator into place with its projecting pins in engagement with the socket plates serves to electrically connect the same in operative relation with respect to the primary winding without requiring further connection of the coil wiring thereto.

Preferably a cover is supplied which is adapted to slip over the spark coil and vibrator so as to protect the same from dust and moisture. Such cover is however purely a matter of detail not associated with the principles of operation of my invention and is not therefore shown in the drawings nor described in further detail.

It may furthermore be noticed that the location of the spark coil laterally with respect to the plug brings it into such proximity to the motor cylinder as to subject it to the drying influences resulting from the heat which arises from the motor, and thus keeping the coil free from moisture. At the same time the fact that the coil is separate from the plug with but a small area of interengaged surfaces, prevents the conduction of heat from the cylinder wall through the plug body to the spark coil so as to raise the temperature of the same to an injurious degree, as would be the case if the coil were incorporated permanently with the plug so as to form an integral part of the same.

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

1. The combination with a spark plug having spark points, and an induction coil adapted to energize said spark points, of interengaging means in part secured to the coil, and in part secured to the plug, said interengaging means in their engaged rela-

tion being adapted to mechanically support said coil laterally with respect to the plug and embodying electrical connections whereby said coil is placed in operative relation with respect to said spark points.

2. The combination with a spark plug having spark points, and a boss in connection with the body of said plug and extending laterally with respect thereto, of an induction coil embodying primary and secondary windings, and having secured thereto a frame having a neck adapted to removably engage said boss; one of the terminals of said secondary winding being in electrical connection with one spark point, in the engaged relation of the neck and the boss, by means of said frame, said boss, and the plug body, and the other secondary terminal being in electrical connection with the other spark point, in said engaged relation, through a conducting pin carried in said neck and insulated therefrom, and through a conducting bar, carried in, and electrically insulated from, the plug body, leading to said other spark point, and with which said pin is adapted to electrically engage in the engaged relation of said neck and said boss.

3. The combination with a spark plug embodying a top portion provided with a laterally extending boss, a spark point mounted on said plug body, and a central spark point having a conducting bar extending longitudinally with respect to said plug body and said top portion, and electrically insulated therefrom, of a spark coil comprising primary and secondary windings, said coil having secured thereto a frame electrically connected with one terminal of said secondary winding and embodying a neck adapted to engage within said boss, the other secondary terminal being in electrical connection with a conducting pin extending through said neck and electrically insulated therefrom, the end of said conducting pin being adapted to bear laterally against said central conducting bar when said neck and boss are in their engaged relation.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN S. LINCOLN.

Witnesses:

NATHAN B. DAY,

WILLIAM A. COPELAND.