Nov. 3, 1942. R. M. NARDONE 2,301,071

ENGINE STARTING MECHANISM

Filed Dec. 3, 1940 4 Sheets-Sheet 1

FIG. 1.

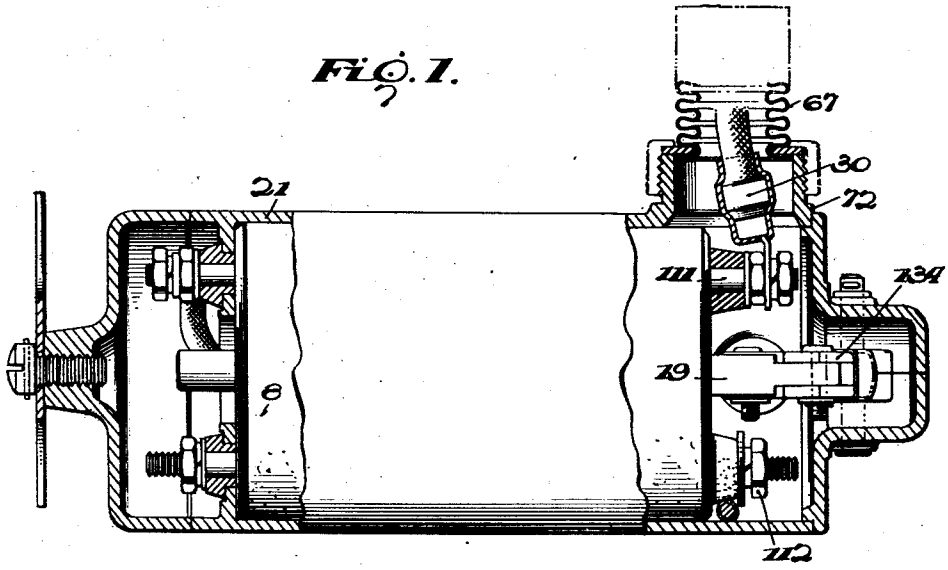
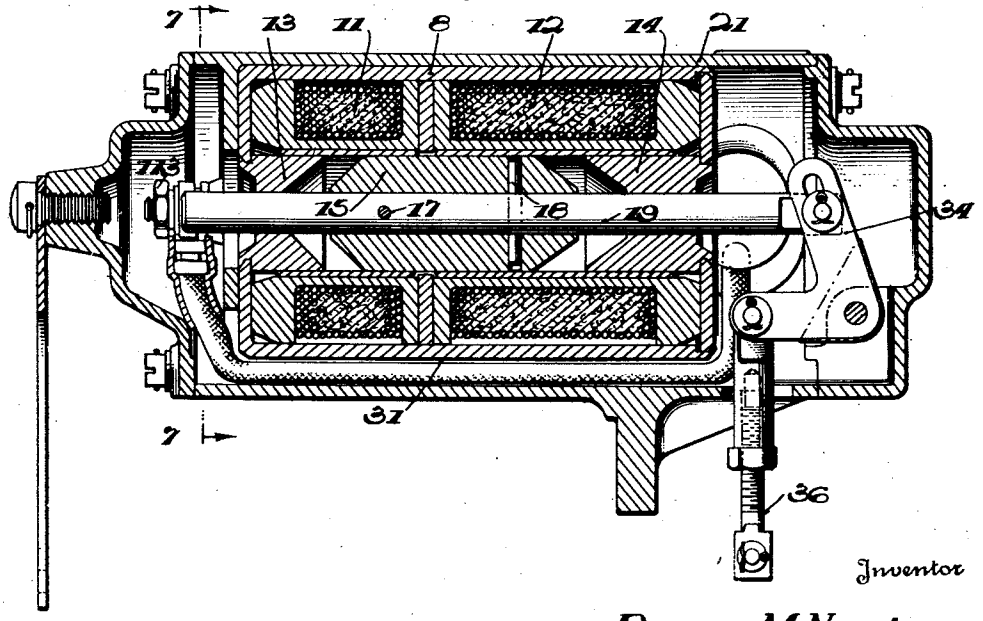


FIG. 2.



Inventor

Romeo M. Nardone.

By Martin J. Finnegan

Attorney

Nov. 3, 1942. R. M. NARDONE 2,301,071

ENGINE STARTING MECHANISM

Filed Dec. 3, 1940 4 Sheets-Sheet 2

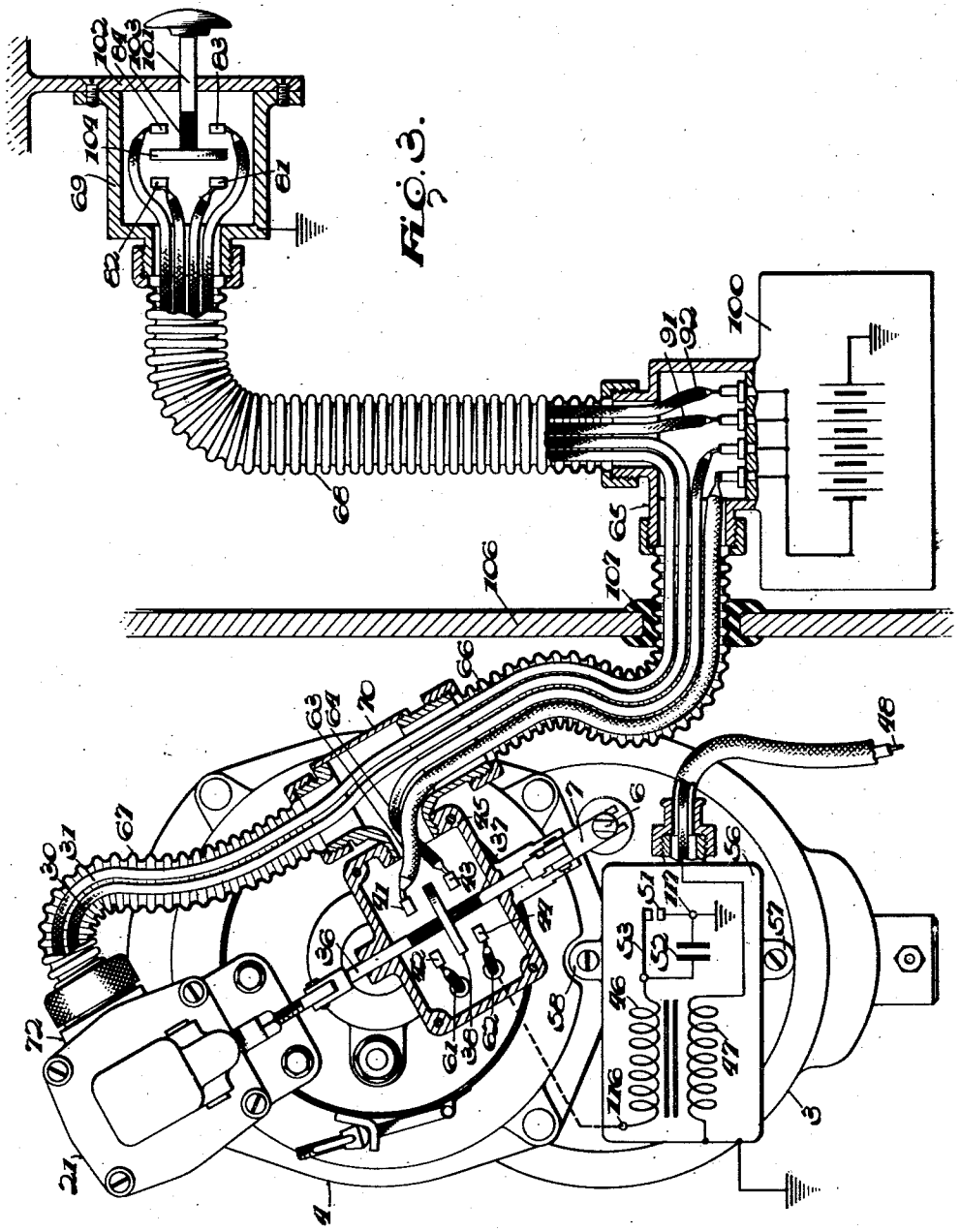


Fig. 3.

Inventor

Romeo M. Nardone.

By Martin J. Finnegan.

Attorney

Nov. 3, 1942. R. M. NARDONE 2,301,071

ENGINE STARTING MECHANISM

Filed Dec. 3, 1940 4 Sheets-Sheet 3

FIG. 5.

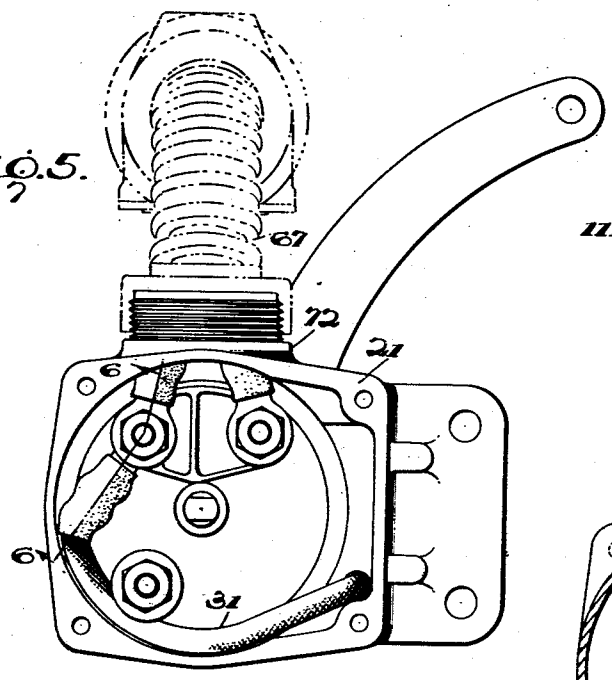


FIG. 6.

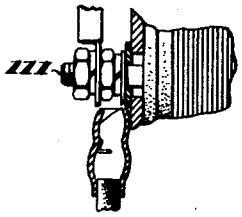


FIG. 7.

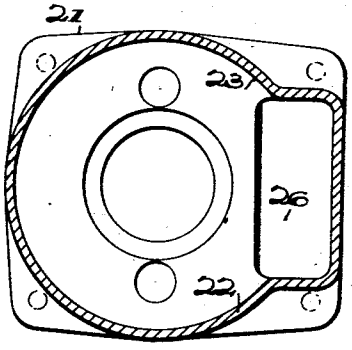
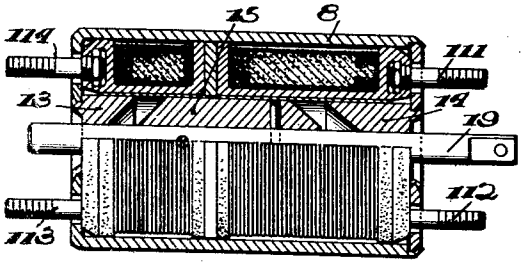


FIG. 4.



Inventor

Romeo M. Nardone.

By Martin J. Finnegan

Attorney

Nov. 3, 1942. R. M. NARDONE 2,301,071

ENGINE STARTING MECHANISM

Filed Dec. 3, 1940 4 Sheets-Sheet 4

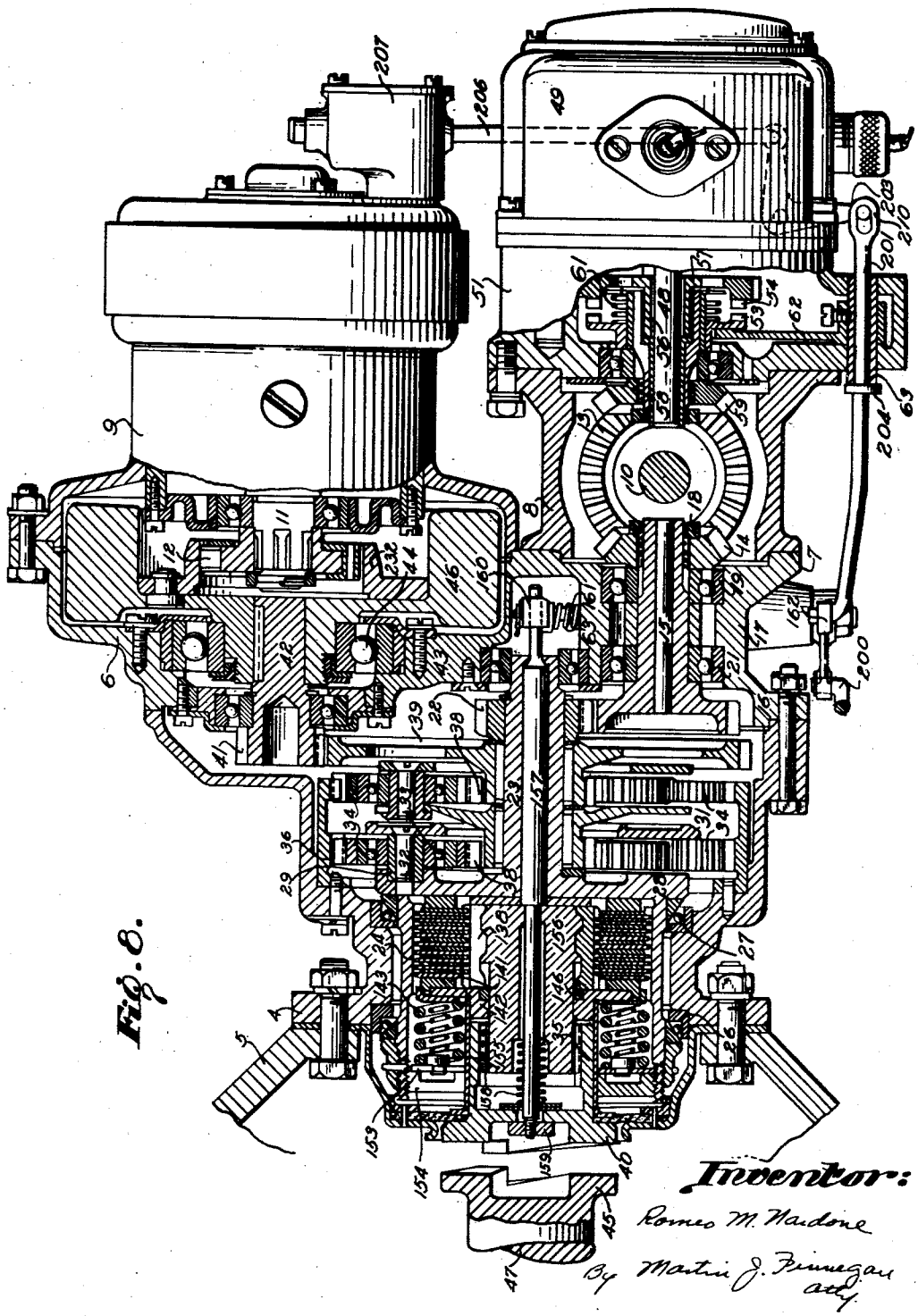


Fig. 8.

Inventor:
Romeo M. Nardone
By Martin J. Finnegan
Atty.

Patented Nov. 3, 1942

2,301,071

UNITED STATES PATENT OFFICE

2,301,071

ENGINE STARTING MECHANISM

Romeo M. Nardone, Westwood, N. J., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application December 3, 1940, Serial No. 368,412

7 Claims. (Cl. 123—179)

This invention relates to starting mechanisms, and more particularly to starters for engines of the internal combustion type.

One of the objects of the invention is to provide in an engine starter, novel means for producing engagement between the cranking member and a member of the engine to be started.

Another object is to provide in an engine starter of the inertia type, novel means for controlling the cranking and acceleration of the inertia member.

Another object of the invention is to provide means serving to establish a definite relationship between operation of the accelerating and engagement producing means above referred to.

Still another object is to provide novel electrically controlled means for achieving the objects above set forth.

A further object is to provide ignition facilitating means operable in response to movement of the engagement producing means above referred to.

Still another object of the invention is to provide novel circuit controlling means for operating said ignition facilitating means.

A further object is to provide novel circuit controlling means for producing joint operation of said ignition facilitating means and said engagement producing means.

Another object is to produce apparatus of the foregoing character which is of relatively simple construction and readily accessible in all of its component parts, yet having all of its component electrical parts fully encased in metal, for protection of adjacent radio equipment against reception-impairing interference.

Other objects and advantages to be derived from the use of the invention disclosed will become evident on an inspection of the following description when made with reference to the accompanying drawings illustrating one embodiment of the invention. It is to be expressly understood however that said drawings are for the purpose of illustration only and are not to be construed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings:

Fig. 1 is a view, partly in section and partly in elevation, of one of the units of a starting system embodying the invention;

Fig. 2 is a sectional view of the unit of Fig. 1, as it appears from a different angle;

Fig. 3 is a view, partly sectional and partly diagrammatic, of the system of which the unit of Figs. 1 and 2 forms a part;

Fig. 4 is a longitudinal sectional view of the inner assembly of the unit of Figs. 1 and 2;

Fig. 5 is an end view with end-plate removed, of the unit of Figs. 1 and 2;

Fig. 6 is a sectional view along line 6—6 of Fig. 5;

Fig. 7 is a transverse sectional view of the unit of Figs. 1 and 2; and

Fig. 8 is a longitudinal sectional view of an engine cranking mechanism upon which the disclosure of Figs. 1 to 7 may conveniently be incorporated.

In Figs. 3 and 8 the system is shown as including an engine cranking mechanism enclosed in a housing having two major sections 3 and 4, which are shown in Figure 3 as they appear when viewed from the rear-end, that is, from the end remote from the engine-engaging clutch member (not shown). As shown in Fig. 1 the cranking mechanism may correspond to that which is disclosed in Fig. 1 of my Patent No. 2,156,602, granted May 2, 1939. Such a mechanism includes an engine-engaging clutch member 40, a flywheel 46, a motor 9 for energization of said flywheel, reduction gearing drivably connecting the flywheel with the clutch member 40, and a meshing rod 157 operable to move the clutch member 40 to the engine-engaging position; the said meshing rod 157 having at its rearward end a formation (as indicated at 6 in Fig. 3) adapted to receive and be operated by a bell-crank 7 which is in turn connected to and operated upon by a rod 36 (see Fig. 3) hereinafter more fully described.

The novel electrical unit of Figs. 1, 2 and 4 is adapted to control not only the actuation of clutch meshing rod 157, but also, as heretofore indicated, the successive energization of, first, the motor accelerating flywheel and, subsequently, the ignition facilitating unit which supplies high tension current to the engine during the actual cranking period. For these purposes the unit includes two electro-magnet coils, 11 and 12, the former adapted to energize a magnetic pole-piece 13 rigidly secured within the coil enclosing shell 8, and the coil 12 being adapted to energize a magnetic pole-piece 14 similarly secured within the opposite end of the shell 8. Slidably mounted in pole-pieces 13 and 14 is a non-magnetic plunger 19 having transversely disposed pins 17, 18, to unite said plunger with a central pole-piece 15 adapted to complete the magnetic field of the pole-piece 13, or the magnetic field of the pole-piece 14, depending upon

which of the two coils 11 and 12, is energized; there being novel means provided for selectively energizing either of said coils, but not both, at any one time. Such novel energizing means will now be described.

For energization of magnet coil 11, and also to provide novel supporting and electrical shielding means for both coils 11 and 12 and their terminals, the supporting and shielding housing 21 of the unit has a partly circular and partly rectangular contour, the circular portion being of just sufficient extent to provide arcuate sections 22, 23 extending below the widest part of the shell 8 and therefore adequately supporting said shell; while the rectangular lower portion of the housing 21 provides a shallow chamber 26 extending along the entire length of the shell 8 and therefore providing a space to receive the cable 31 constituting the current feeding means for the coil 11. With this construction the housing 21 serves the two-fold purpose of supporting the shell 8 and at the same time providing radio shielding encasement for the current conducting winding and the conductor leading thereto, without the necessity of the special metallic covering for the conductor itself.

In addition to actuating bell-crank 7 and mesh-rod 6, the plunger 19 of unit 21 has the function of controlling energization of the flywheel accelerating motor and the ignition facilitating unit, as heretofore indicated. To this end the rod 36, which links plunger actuated bell-crank 24 with mesh-rod actuating bell-crank 7, (Fig. 3) is provided with an insulating section 37 carrying a metallic collar 38 adapted to bridge one or the other of two sets of terminal contacts when moved from the normal (central) position by energization of coil 11 or coil 12 of the unit 21. The upper set 41, 42 of terminal contacts constitute part of the motor circuit, while the lower set 43, 44 constitute part of the circuit to primary and secondary windings 46 and 47 of the high tension current producing unit which connects with the engine-driven ignition current distributor (not shown) by way of a metal-covered insulated conductor 48 leading from the secondary or high tension side 47 of the induction coil. This induction coil unit may be of a conventional type having contacts 51, an armature 53 in the magnetic field of the coil, and an associated condenser 52 in circuit with the primary winding, wherefore each vibration of armature 53 interrupts current flow and causes a passage, by induction, of a high tension current through secondary winding 47 and a resultant spark in the engine cylinder whose spark-plug is at that moment in circuit with the rotating distributor arm to which the lead 48 connects in the usual manner, not shown. The entire coil assembly is mounted in a grounded metallic housing 56 attached to the starter proper, as shown at 57, 58, wherefore radio-shielding encasement of all electrical parts is effected. Corresponding radio-shielding of the conductors 61, 62, 63 and 64 is provided; the conductors 61 and 62 being confined within the starter housing itself, and the conductors 63 and 64 being confined within the flexible metallic tubing section 66 which extends from the metallic battery outlet fixture 65 to the metallic junction box 70 which screws into metallic switch housing 45, the latter being mounted on starter housing section 4. Elements 67, 68 and 69 complete the radio-shielding of the electrical control circuits; the element 67 being a flexible tubing section extending from junction box 70 to conductor inlet boss 72 of the electro-magnetic unit 21, and the element 68 being a similar flexible tubing section extending from battery fixture 65 to the housing 69 for the manually controlled switch terminals 81, 82, 83 and 84. The switch terminals 81 and 83 receive the battery conductors 91 and 92, respectively, while the switch terminals 82 and 84 receive the conductors 30 and 31, respectively; the conductor 31 being the one heretofore described as leading to coil 11, and the conductor 30 being the one leading to coil 12. A hand-operated plunger 101 projects from the panel-board 102 upon which housing 69 is mounted, and said plunger has an end section 103 of insulating material to receive a metallic collar 104 adapted to bridge contacts 81 and 82 when moved to the left of neutral position; and when moved to the right of neutral position, said collar bridges the contacts 83, 84. A fire-wall 106 separates the engine starter from the operator's compartment, and is apertured to receive a rubber supporter 107 and the tubing section 66 bearing thereon.

With the foregoing in mind, it will be apparent that upon movement of plunger 101 to the left, current will flow from battery 100 to coil 12 of the unit 21, the circuit being by way of conductor 91, contacts 81, 104 and 82, conductor 30 to terminal 111 of coil 12, and back from coil 12 to the battery by way of the grounded terminal 112 (Figs. 1 and 4); the opposite side of the battery being similarly grounded as indicated.

The flow of current through the coil 12 which is thus produced establishes a magnetic field to attract the movable pole-piece 15 into engagement with the stationary pole-piece 14 and thereby produce a shifting of the plunger 19 to the right as viewed in Fig. 2, whereupon the rod 36 of Fig. 3 is moved upwardly to an extent sufficient to cause collar 38 to bridge the contacts 41 and 42. A circuit is thereby established from the battery 100 to the flywheel-accelerating motor, the circuit being traceable by way of conductor 63, contacts 41, 38 and 42, and the conductor 61 leading by an interior path from the terminal 42 to the commutator brushes or equivalent current feeding means of the flywheel-accelerating motor. The resulting rotation of the motor and the flywheel stores energy in the latter, which energy will thereafter be transferred to the engine to impart initial rotary movement thereto, whenever the operator elects to cause a shifting of the engine engaging member of the starter to the engine engaging position. The operator will indicate this election by shifting the plunger 101 to its extreme right position, in which position the coil 11 of the unit 21 will be energized, the path of current flow to said coil 11 being by way of conductor 92, contacts 83, 104 and 84, and conductor 31 leading to the terminal 113 of the coil 11; the return circuit from coil 11 being by way of the grounded terminal 114 of the said coil. The magnetic field resulting from this energization of the coil 11—the field formerly prevailing having now collapsed by reason of the interruption of the circuit to the coil 12—results in a shifting of the plunger 19 to its extreme left-hand position as viewed in Fig. 2, whereupon rod 36 moves downwardly to cause collar 38 to engage contacts 43 and 44, and also to cause bell-crank 7, to shift the mesh-rod 6 into the position in which it moves and holds the engine engaging

member in the engine engaging position. The energy previously stored in the starter will now be transferred to the engine and simultaneously with such transfer a series of fuel igniting sparks will occur in the combustion chambers of the engine by reason of the high tension current producing action of the ignition facilitating unit 56 which is now energized by reason of the flow of current from battery 100 to the induction coil 46, the said current flow being by way of conductor 64, contacts 43, 38 and 44, and conductor 62 leading by an interior path from contact 44 to the terminal 116 of the coil winding 46; the opposite terminal 117 of the unit being grounded as indicated. When these concurring cranking and spark producing operations result in a starting of the engine under its own power, the engine engaging member moves back to the disengaged position by reason of the conventional construction well understood in the art, and the operator brings the energization of the ignition facilitating unit 56 to a conclusion by returning the plunger 101 to the neutral position indicated in Fig. 3, in which position flow of current to the coil 11 ceases and both the rod 36 and plunger 19 return to the central neutral positions indicated in Figs. 3 and 2, respectively.

What is claimed is:

1. In combination with a source of current, an electric motor, and an ignition facilitating coil, means for selectively connecting said motor or said coil with said source of current, said connecting means comprising a single movable switch element, and electro-magnetic means for moving said switch element into either of two circuit-establishing positions.

2. In combination with a source of current, an electric motor, and an ignition facilitating coil, means for selectively connecting said motor or said coil with said source of current, said connecting means comprising a single movable switch element, electro-magnetic means for moving said switch element into either of two circuit-establishing positions, means for conducting current from said source to said electro-magnetic means, and radio shielding enclosing means common to both said last-named means and said first-named means.

3. A radio shielding means for the starting system of an internal combustion engine, said system including a starting motor, an ignition facilitating coil and a source of current, said shielding means comprising a metallic housing for said motor, a metallic housing for said coil, said housings being attached one to the other, conductors leading from said source to said motor and coil, and a single metallic manifold enclosing all of said conductors.

4. In combination with an engine-engaging member, a source of current, and an ignition facilitating coil, means for moving said engine-engaging member to engine-engaging position, means for rotating said engine-engaging member, and radio-shielded means carried by said first-named means for selectively connecting said source of current to said coil and rotating means.

5. In combination with an engine-engaging member, a source of current, and an ignition facilitating coil, means for moving said engine-engaging member to engine-engaging position, means for rotating said engine-engaging member, electro-magnetic means for operating said moving means, electro-magnetic means for controlling energization of said rotating means, and unitary radio-shielding means for both said electro-magnetic means.

6. In combination with an engine-engaging member, a source of current, and an ignition facilitating coil, means for moving said engine-engaging member to engine-engaging position, means for rotating said engine-engaging member, electro-magnetic means for operating said moving means, electro-magnetic means for controlling energization of said rotating means, a magnetic pole-piece common to both said electro-magnetic means, and means shiftable by said pole-piece to connect said source of current with said ignition facilitating coil.

7. In combination with an engine-engaging member, means for moving said engine-engaging member to engine-engaging position, means for rotating said engine-engaging member, electro-magnetic means for operating said moving means, electro-magnetic means for controlling energization of said rotating means, and unitary radio-shielding means for both said electro-magnetic means.

ROMEO M. NARDONE.