May 5, 1931. R. P. LANSING 1,803,908

SWITCH MECHANISM

Filed Oct. 23, 1928

Fig. 1.

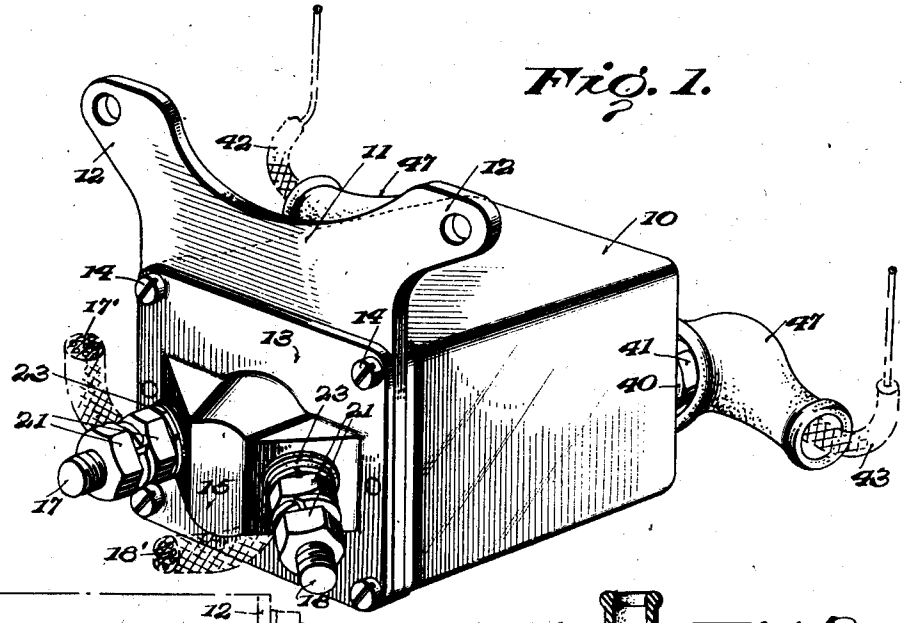


Fig. 2.

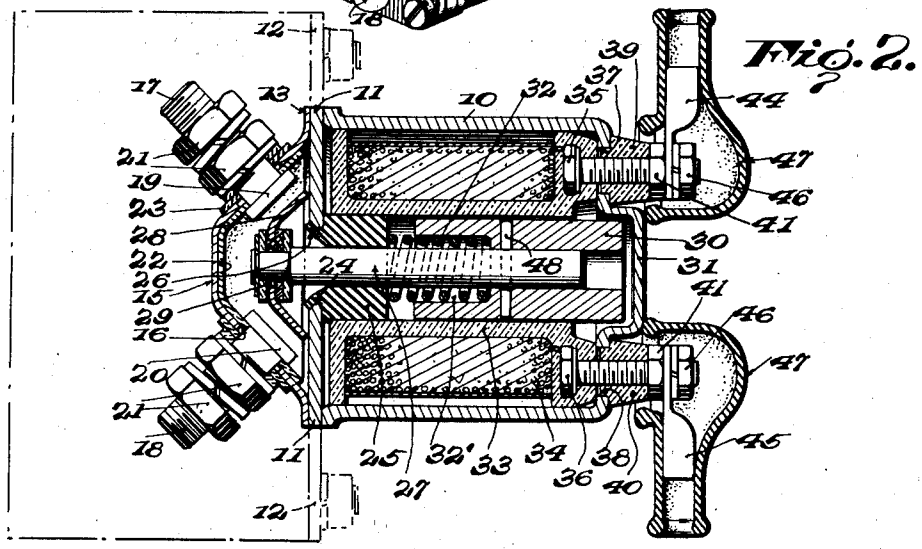
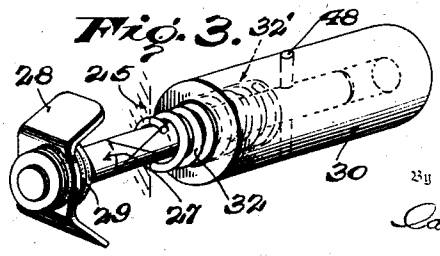


Fig. 3.



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UNITED STATES PATENT OFFICE

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SWITCH MECHANISM

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This invention relates to solenoid switches, and more particularly to a magnetic solenoid switch of the type which is frequently used to control electrical circuits for starting motors for internal combustion engines.

Switches of this type have been used in order to provide a remote control for the starting switch, so that the starting switch may be located directly between the battery and starting motor, thus allowing the battery leads to be as short as possible, while a remote control switch may be located on the dash of the vehicle or in any other convenient location for the operator.

Such devices as heretofore proposed, however, have been subject to serious defects in operation, chief among which have been the burning and sticking of the movable contact member causing failure of the switch to operate, or to release. Moreover, unless the solenoid is highly efficient it causes an undue drain on the battery through the solenoid coil, thus reducing the effective energy of the battery available for actuating the starting motor.

The current supplied to a starting motor for starting an internal combustion engine must be very heavy, sometimes amounting to hundreds of amperes when the engine is stiff, and in case of a failure of the engine to start on the first trial this current must be broken by the starting switch. The arcing caused by breaking this heavy current, increased by the self inductance of the motor windings, causes the contacts in the starting switch to burn and stick unless means such as a heavy release spring is used to break the contact quickly and positively. On the other hand, a heavy release spring requires a corresponding increase in the power of the solenoid and a consequent increase in drain upon the battery unless means are provided to increase the efficiency of the solenoid. Furthermore, the magnetic reluctance of a large and powerful magnet with its iron casing retards the breaking of the contacts which tends to increase the arcing and burning of the latter.

It is an object of the present invention to provide a solenoid switch which is positive in action, but which operates with small current consumption.

It is another object of the invention to provide such a device which embodies a release spring amply strong to insure a positive, quick break under all circumstances.

Another object is to provide a device of the above character which is designed to have a highly efficient magnetic circuit, causing firm effective contact without undue current consumption.

A further object is the provision of such a device which is comparatively small and light so as to provide a quick, clean break of the contacts.

Another object is the provision of such a device which is inexpensive to manufacture, and in which the parts may be readily assembled or taken down for inspection or replacement.

Other objects and advantages will be apparent from the following description taken in connection with the disclosure in the accompanying drawing.

In the drawings—

Fig. 1 is a perspective view of an assembled device constituting one embodiment of the present invention;

Fig. 2 is a horizontal mid-sectional view thereof; and

Fig. 3 is a perspective detail of the movable contact member and its operating elements.

Referring first to Fig. 1 of the drawing, numeral 10 indicates a cup-shaped shell or casing member perferably formed as a steel stamping. The member 10 is closed at its open end by a plate 11 which extends laterally therefrom and is provided with arms 12 forming a bracket by which the switch may be mounted upon the casing of the starting motor, which is diagrammatically indicated in dotted lines in Fig. 2, or upon any other suitable support.

A terminal plate 13 of non-magnetic material is secured on the outer face of the closure plate 11 by suitable means such as screws 14 which traverse the two plates and are threaded into the shell 10 to hold the parts in assembled relation. Terminal plate 13 is provided centrally thereof with an outward-

ly projecting portion 15 having a pair of angularly related openings 16 in which terminal members 17 and 18 for heavy motor and battery cables 17′ and 18′ of the motor circuit are mounted. These terminal members are in the form of threaded bolts of good conducting material, such as copper or brass, having heads 19 and 20 which overlap the edges of openings 16 within the portion 15 and act as the stationary contacts of the switch. Suitable nuts 21 are threaded onto the outer portions of the bolts for securing the same to the terminal plate 13 and for attaching the motor and battery cables to said bolts. A strip of insulating material 22, and suitable insulating washers 23 are interposed between the terminal plate 13 and the heads and nuts of the terminal members 17 and 18 in order to prevent electrical contact thereof with the terminal plate.

The closure plate 11 is provided with a central opening 24, and a guide member 25 is mounted with its outer end suitably fixed in said opening as by means of the lip 26 expanded therein. The member 25 extends inwardly from the closure plate into shell 10 concentrically therewith, and constitutes a fixed magnetic pole piece for the solenoid. A connecting member in the form of a rod 27 of non-magnetic material is mounted to slide freely within guide member and pole piece 25, and is provided at its outer end with a contact plate 28 which may be swiveled thereon and is insulated therefrom in any suitable way as by means of the insulating material 29 in which said contact plate is imbedded. Contact plate 28 is located intermediate terminal heads 19 and 20 and closure plate 11 and is adapted to contact evenly with said heads and short circuit the terminal members 17 and 18 when the rod 27 is moved toward the left, as viewed in Fig. 2.

Connecting member 27 carries on the end thereof which extends into shell 10 a plunger 30 of magnetic material having a slightly smaller diameter than the outside diameter of guide member 25. The plunger is suitably fixed to said connecting member as by means of a pin 48 and serves as a movable pole piece to cooperate with the fixed pole piece 25. A spring 32 is located on member 27 between the pole pieces 25 and 30, seating in a recess 32′ in pole piece 30 and normally maintaining said member in a position such that movable contact 28 is out of engagement with terminal heads 19 and 20.

The shell 10 is provided with a cylindrical extension 31 at its closed end having an internal diameter slightly greater than the external diameter of the movable pole piece 30. Said pole piece is arranged to telescope within said extension so that no gap is formed between the shell and the inner end of said pole piece in any operative position of the latter.

A spool 33 of suitable insulating material is located within the shell 10, and is adapted to fit closely within said shell and around the guide member and pole piece 25 on the closure plate 11. Spool 33 carries a solenoid winding 34 having terminal posts 35 and 36 which extend outwardly through openings 37 and 38 in the shell member 10 and which are insulated from the shell by means of suitable bushings 39 and 40. Terminals 35 and 36 are fixed to the inner head of spool 33 in any suitable way as by being locked or molded therein, and are clamped in assembled position by suitable nuts 41, which bear on bushings 39 and 40 and thus securely hold the spool 33 within shell 10. Conductors 42 and 43 of the control circuit, which includes a remote control switch of any suitable type (not shown) and a source of current such as a battery, are provided with terminals 44 and 45 which are clamped to the terminal posts 35 and 36 by suitable means such as nuts 46. Insulating heads 47 are preferably provided for posts 35 and 36 and terminals 44 and 45.

Shell member 10, cover plate 11, guide member 25 and plunger 30 are all made of easily permeable magnetic material so that they form a magnetic circuit which is complete except for the gap between the guide member 25 and plunger 30, said gap being normally maintained by the spring 32.

When the control circuit through the solenoid winding 34 is closed by the operator in any suitable manner as by means of the remote control switch located on the dash of the vehicle, the magnetic flux produced in said winding 34 will move the plunger 30 forcibly to the left as viewed in Fig. 2, compressing the spring 32 and forcing the contact plate 28 into intimate engagement with the terminal heads 19 and 20 of the main starting circuit. This closes said main circuit through the battery and starting motor, and causes the operation of the motor to start the engine. When the control switch is opened by the operator, the magnetic flux of the solenoid drops almost instantly to zero, and spring 32 instantly and forcibly retracts the rod 27 carrying contact plate 28 away from the terminal heads 19 and 20 in spite of any burning together of the surfaces thereof which may have taken place, and so rapidly that any appreciable amount of arcing is prevented.

Although the spring 32 is sufficiently strong and stiff to forcibly retract the contact member 28 even though it should become burned to the terminal heads 19 and 20, nevertheless the efficiency of the solenoid circuit is so great that the contacts will be closed and held in firm engagement so long as the battery is in condition to operate the starting motor, and without diverting any serious proportion of the energy of the battery from

its primary function of operating said motor.

It will be noted that assembling the above structure is an extremely simple operation, since the four main elements thereof, namely the shell 10, the spool 33, the movable contact and cover plate assembly and the terminal plate assembly may all be readily fitted one to the other, the spool being retained by the clamping nuts 41 on the control circuit terminals 35 and 36, and the remaining elements being held in assembled relation by means of the cap screws 14.

Although but one embodiment of the invention has been shown and described in detail, it is to be understood that the illustrated embodiment is not exclusive, and various other embodiments will now suggest themselves to those skilled in the art, while changes may be made in the construction, arrangement and proportions of the parts without departing from the spirit of the invention. Reference is therefore to be had to the claims hereto appended for a definition of the limits of the invention.

What is claimed is:

1. In a solenoid switch, a shell closed at one end, an insulating spool within said shell and secured thereto at its closed end, a solenoid coil carried by said spool, closure means for the shell embodying a magnetic pole piece, switch operating means embodying a slidable pole piece adjacent said first named pole piece, said spool constituting a guiding member for said slidable pole piece, and means for yieldably separating the pole pieces.

2. In a solenoid switch, a shell closed at one end, a solenoid coil within the shell and secured thereto at said end, closure means for the shell embodying a magnetic pole piece, a rod of non-magnetic material slidably mounted in the closure means, a pole piece mounted on said rod adjacent the first pole piece, means yieldably separating the pole pieces, a movable contact plate carried by the rod, and angularly disposed terminal members carried by said shell for engagement with said contact plate.

3. In a solenoid switch, a shell formed as a cup-shaped stamping, a solenoid coil fixed therein, closure means for the shell embodying a magnetic pole piece, a non-magnetic connecting member slidable through said pole piece, a movable switch member on said connecting member outside the shell, a magnetic pole piece mounted on and secured to said connecting member within the shell, a terminal plate having angularly disposed surfaces carried by said shell, terminal members extending through said angularly disposed surfaces and adapted to be engaged by said movable switch member, and means for yieldably separating the pole pieces.

4. In a solenoid switch, a cup-shaped shell of magnetic material, a solenoid coil therein, means detachably fixing the coil to the bottom of the shell including members extending through the shell and constituting terminal posts for said coil, a closure member for the shell embodying a pole piece for the solenoid, switch operating means slidably mounted within the solenoid and embodying a non-magnetic rod and a second pole piece for the solenoid, and means between the pole pieces for yieldingly thrusting them apart.

5. In a solenoid switch, a cup-shaped shell of magnetic material, an insulating spool therein, a solenoid coil wound on said spool, means detachably fixing said spool to the bottom of the shell, a closure and mounting means detachably connected to the shell and embodying a pole piece for the solenoid, switch terminals detachably mounted adjacent the closure means, a switch member mounted to cooperate therewith, operating means therefor including a non-magnetic connecting member and a second pole piece for the solenoid secured thereto, and means between the pole pieces for yieldably thrusting them apart.

6. In a magnetic switch, a cup-shaped shell member, a closure member for the open end thereof having a central guide member forming one pole piece of the magnet, a plunger slidably mounted in telescopic relation with the bottom of the cup in alinement with the guide member, normally spaced therefrom and forming the second pole piece of the magnet, a solenoid coil within the cup and surrounding the pole pieces, an integral contact plate having angularly disposed faces actuated by said plunger, a terminal plate secured to the shell and having a projecting portion, and angularly disposed terminal members extending through said terminal plate and adapted to be engaged by said contact plate.

7. In a solenoid switch, a cup-shaped shell of magnetic material, a solenoid coil therein, means detachably securing the solenoid to the bottom of the shell, a closure and mounting means detachably secured to the shell and embodying one pole piece for the solenoid, a terminal plate of non-magnetic material secured to the closure means and having an outwardly projecting central portion with angularly related openings in the sides thereof, a pair of insulated terminal members mounted in said openings and having contact heads within the terminal plate, a movable contact member mounted adjacent said terminal heads and adapted to be moved to bridge said heads, a magnetic plunger slidably mounted within the solenoid and constituting a second pole piece for the solenoid, connecting means for the movable switch member and plunger slidably mounted within said closure means and first pole piece, and yielding means mounted on said connecting means for normally maintaining the contacts and pole pieces separated.

8. In a solenoid switch, a cup-shaped shell of magnetic material, a solenoid coil therein, means detachably securing the solenoid to the bottom of the shell, a closure and mounting means detachably secured to the shell and embodying one pole piece for the solenoid, a terminal plate of non-magnetic material secured to the closure means and having an outwardly projecting central portion with angularly related openings in the sides thereof, a pair of insulated terminal members mounted in said openings and having contact heads within the terminal plate, a connecting member slidably mounted in said closure means and first pole piece, an insulated contact member mounted thereon adjacent the terminal heads, a magnetic plunger secured to said connecting member within the solenoid and constituting a movable pole piece for said solenoid, said plunger having an axial recess opening toward the first said pole piece, a spring mounted in said recess and normally separating said pole pieces, said shell having an axial extension in its bottom, and the inner end of said plunger being arranged to telescope within said extension of the shell.

9. In a solenoid switch, a cup-shaped shell of magnetic material, an insulating spool therein, means detachably securing said spool to the bottom of the shell, a solenoid coil wound on said spool, a closure plate of magnetic material detachably connected to the open end of the shell and having an enlarged central portion forming one pole piece for the solenoid, said portion projecting tightly within the bore of said spool, a terminal plate of non-magnetic material secured to the shell and having an outwardly projecting central portion with angularly related openings in the sides thereof, a pair of insulated terminal members mounted in said openings and having integral contact heads within the terminal plate, a movable contact member mounted adjacent said terminal heads and adapted to be moved to bridge said heads, a plunger of magnetic material loosely guided within the bore of said spool and constituting a second pole piece for the solenoid, a non-magnetic rod rigidly connecting said plunger and said movable switch member and slidably mounted within said first pole piece, and yielding means mounted on said rod and interposed between said first and second pole pieces for normally maintaining the contacts and pole pieces separated.

In testimony whereof I have signed this specification.

RAYMOND P. LANSING.