

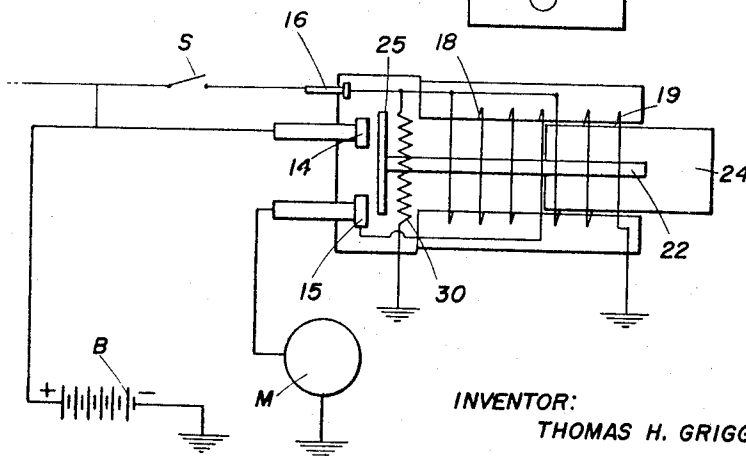
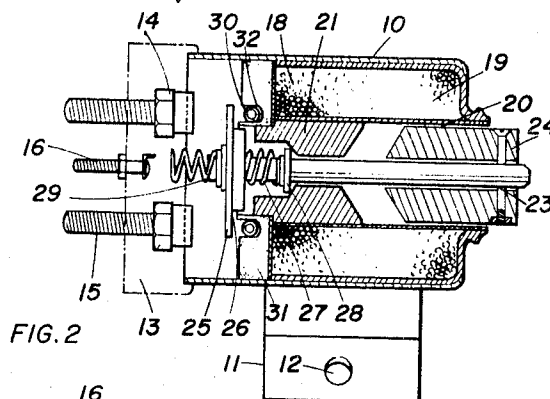
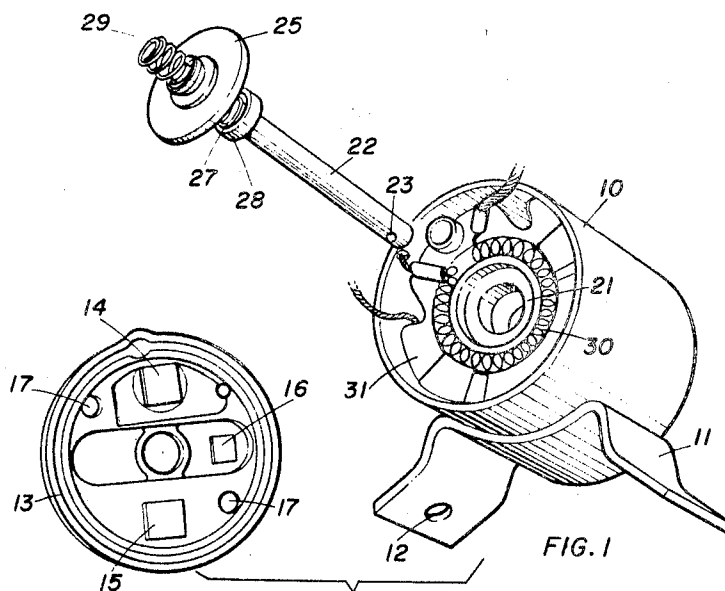
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STARTER SOLENOID WITH ELECTRICAL HEATING MEANS

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STARTER SOLENOID WITH ELECTRICAL HEATING MEANS

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ABSTRACT OF THE DISCLOSURE

A solenoid switch for an automobile starter motor is connected in a control circuit. The solenoid switch comprises a housing, a core, two coils (pull-in and hold-in) and fixed and movable contacts. The switch further includes an electric resistance heater located in immediate heat exchange relation with the contacts. A ceramic plate disposed in the housing separates the heater from the coils. The heater is connected in the control circuit and is energized simultaneously with the operation of the solenoid to prevent ice accumulation on the contacts.

The invention relates to a starter solenoid incorporating electrical heating means.

The starter motor of an automobile is usually controlled by a solenoid operated switch due to the very heavy currents passing through the starter motor during use and with a view to avoiding the use of heavy copper cables of great length and heavy currents passing through the ignition or other control switch. The solenoid switch is usually located on the starter motor housing and controlled by a control circuit having a switch mounted on the instrument panel or dashboard of the automobile, and usually incorporated in the ignition switch. In many cases, due to the location of the starter motor adjacent the lower portion of the crank case of an automobile engine and in close proximity to the flywheel and flywheel housing for engagement with the starter gear ring on the flywheel, the solenoid switch is exposed to the elements. As a result, it is an all too common occurrence, particularly in wet or cold weather, for the solenoid switch to become inactivated due to an accumulation of dirt, oils and in many cases of ice which becomes hardened and impacted on the terminals of the solenoid switch. When so effected, the solenoid switch is virtually completely insulated and is incapable of operation in response to the control switch on the instrument panel or dashboard and usually the only way in which the automobile can be started is by pushing, the trouble being subsequently put right by stripping the solenoid switch and cleaning the contacts or, by storing the automobile in a heated garage for a length of time sufficient to melt the ice on the contacts.

Accordingly, it is a general objective of the invention to provide a starter motor solenoid incorporating a heater element designed to free the contacts from icing.

More particularly, it is an objective of the present invention to provide a solenoid having the foregoing advantages in which the heater is electrically operated and is activated by the act of operating the dashboard control switch, usually incorporated in the ignition switch.

More particularly, it is an objective of the present invention to provide a starter solenoid having the foregoing advantages in which an electrical heater is incorporated in circuit with the solenoid control circuit in such a way as to avoid interference with the operation of the electromagnetic coils of the solenoid itself.

The foregoing and other advantages will become apparent from the following description of a preferred embodiment of the invention which is here given by way of example only and with reference to the following draw-

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ings in which like reference devices refer to like parts thereof throughout the various views and diagrams, and in which:

FIGURE 1 is an exploded perspective view of a starter motor solenoid incorporating a heater assembly according to the invention;

FIGURE 2 is a sectional side elevation of the solenoid of FIGURE 1 assembled; and

FIGURE 3 is a circuit diagram of the solenoid and heater assembly shown in FIGURES 1 and 2.

Referring now to FIGURES 1 and 2 the starter solenoid according to the invention will be seen to comprise a generally cylindrical metallic housing 10 having attachment bracket 11 welded thereto and provided with holes as at 12 for attachment in any suitable location, usually on the outside of the starter motor housing itself so as to reduce the length of the heavy duty connector cables to a minimum. Housing 10 is provided with an insulating end cap 13 made of suitable plastic material which may be of any of a number of constructions, in this case being provided with two heavy duty terminals 14 and 15 for carrying the main starting current from the battery to the starter motor and a third and smaller terminal 16 for connection to the starter button or ignition switch of an automobile. Any suitable attachment means for cap 13 are provided such as threaded bolts (not shown) passing through holes 17 in cap 13 in known manner.

Within casing 10 is provided two electrical windings of approximately equal turns area and identified as pull-in coil 19 and hold-in coil 18 wound about tubular sleeve 20. Within tube 20 is provided the metallic bushing 21 staked or otherwise retained within sleeve 20 providing bearing means for the solenoid rod 22 for sliding there-through. Solenoid rod 22 is provided at one end with drilling and bolt 23 or other suitable attachment means for attachment to a soft iron solenoid core 24 in any suitable manner (not shown), core 24 being dimensioned to fit within sleeve 20. At the other end of solenoid rod 22 is provided a copper contact plate 25 of a diameter sufficient to make electrical contact 14 and 15 and provided on its reverse face with an insulating coating 26. A buffer spring 27 is provided around rod 22 in contact with the reverse face of contact 25 and provided with a buffer collar 28 fitting around rod 22 for contacting bushing 21. On the operating face of contact 25 is provided the return spring 29 for returning the solenoid rod and solenoid 22 and 24 and contact 25 after release of the same.

The solenoid heating apparatus according to the invention comprises a coiled electrical wire heating element 30 supported by means of a heat resistant ceramic insulating plate 31 which is provided with a retaining groove 32 for reception of coil 30 while at the same time insulating the same from any close contact with coils 18 and 19 which might otherwise have a harmful effect upon the insulation thereof. In addition, the location of coil 30 in the use of insulating member 31 is such that the major portion of the heat developed by coil 30 is retained within the relatively small chamber defined by casing 10 and end cap 13 and will be such as to rapidly heat up contacts 14 and 15 and contact plate 25 and thereby free the same for operation.

Heating coil 30 is preferably connected to contact 16 in cap 13 for operation by the automobile starter switch in the manner described below.

The electrical circuit diagram is illustrated in FIGURE 3. The automobile battery *b* is connected directly to contact 14 and also to contact 16 through the starter switch indicated as *s*. Contact 16 is connected both to heater coil 30 and also to pull-in coil 19 and to hold-in coil 18, all of these connections being in parallel. Heater coil 30 and pull-in coil 19 are connected to ground

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and hold-in coil 18 is connected to contact 15, which is also connected to starter motor indicated as *m* the other side of which is connected to ground.

In operation, the driver will close the switch *s* thereby applying twelve volts to contact 16 and thereby heating up heating coil 30 and at the same time energizing coils 19 and 18. The fields developed by both coils 19 and 18 will act on solenoid core 24 in the same way and draw the same inwardly along tubular sleeve 20 thereby carrying with it the solenoid rod 22 and forcing contact plate 25 into contact with contacts 14 and 15 and at the same time slightly compressing spring 29. As soon as contact is made between contacts 14 and 15 current will flow from battery *b* directly through contact 14, contact plate 25 and contact 15 into starter motor *m* and then to ground thereby operating the starter motor. As a result, the potential at contact 15 will be the same as the potential as at contact 14, that is to say, twelve volts which is also the same as the potential at contact 16 and thus, the current previously flowing in coil 18 will cease to flow thereby making the maximum amount of current available from battery *b* for starting of the motor *m* and reducing the magnetic field strength acting on solenoid core 24. However, current will continue to flow through coil 19 holding solenoid core 24 in its forward or inward position when the motor has fired and the driver releases switch *s* current will cease to flow through coil 19 and return spring 29 will then be free to throw solenoid core 24 rearwardly thereby disconnecting contact 14 from contact 15, buffer spring 27 cushioning the rebounding of contact plate 25 which might otherwise be considerable due to the substantial mass of core 24.

During this operation, it will be noted that heating coil 30 is activated as soon as switch *s* is closed by the driver thereby providing heat around contact plate 25 and contacts 14 and 15 from the moment the switch *s* is operated. In the event that ice on contacts 14 and 15 and contact plate 25 prevent either electrical contact being made between them or in some cases prevent any movement thereof at all, the switch *s* can simply be kept closed without any damage resulting to any parts, the heating coil 30 continuing to deliver heat which is insulated from contact with any parts of the mechanism which it might damage by means of ceramic insulating plate 31. As soon as the icing condition is rectified, normal starting will take place automatically.

The foregoing is a description of a preferred embodiment of the invention which is here made by way of example only. The invention is not to be taken as limited to the specific steps described but comprehends all such variations that come within the spirit and scope of the appended claims.

What I claim is:

1. A solenoid switch for an automobile starter motor or the like and comprising: electrical contact means connectible in an electrical circuit to make and break the same and including at least one fixed contact and one movable contact means; electrical solenoid means connected in a control circuit and operable to move said movable means, said solenoid means including one coil connectible between a source of electrical power and an electrical ground connection and another said coil connectible between said source and a said fixed contact; and electrical heating means located adjacent and in immediate heat exchange relation with at least a said contact and connected in said control circuit for energization simultaneously with operation of said solenoid means, said heating means being connected in parallel with said one

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coil between said source and said electrical ground connection.

2. In combination with an electrically controlled solenoid switch for the starter motor of an automobile, said switch including at least one fixed contact and one movable contact operable by said solenoid for making and breaking the circuit to said starter motor, heating means for said switch comprising: electrical heating coil means located adjacent and in immediate heat exchange relation with at least a said contact and connected in said control circuit for energization simultaneously with operation of said solenoid means; and a heat insulation member mounted between said solenoid means and said heating means.

3. A solenoid switch for an automobile starter motor or the like and comprising: means defining a housing; at least two electrical contacts located in predetermined spaced relation in said housing and adapted for connection in circuit between a source of electrical power and a said motor; a conductive member dimensioned to make contact with both said contacts simultaneously and located within said housing; electrical solenoid means connected in a control circuit and operable to move said conductive member; electrical heating means located adjacent and in immediate heat exchange relation with at least a said contact and connected in said control circuit for energization simultaneously with operation of said solenoid means; and a heat insulation member mounted between said solenoid means and said heating means.

4. A solenoid switch for an automobile starter motor or the like and comprising: electrical contact means connectible in an electrical circuit to make and break the same and including at least one fixed contact and one movable contact means; solenoid controlled means operable to move said movable contact for making said circuit; electrical heating means located adjacent to and in immediate heat exchange relation with said contact means and operable simultaneously with said solenoid controlled means to generate heat therearound; and a heat insulation member mounted between said solenoid means and said heating means.

5. A solenoid switch for an automobile starter motor or the like and comprising: electrical contact means connectible in an electrical circuit to make and break the same and including at least one fixed contact and one movable contact means; electrical solenoid means connected in a control circuit and operable to move said movable means, said solenoid means including at least one coil connectible between a source of electrical power and an electrical ground connection; electrical heating means located adjacent and in immediate heat exchange relation with at least a said contact and connected in said control circuit for energization simultaneously with operation of said solenoid means; said heating means being connected in parallel with said one coil between said source and said electrical ground connection; and a heat insulation member mounted between said solenoid means and said heating means.

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