Jan. 29, 1963 D. E. COLVILL 3,076,075

SERIES-PARALLEL MAGNETIC SWITCH

Filed March 14, 1960 3 Sheets-Sheet 1

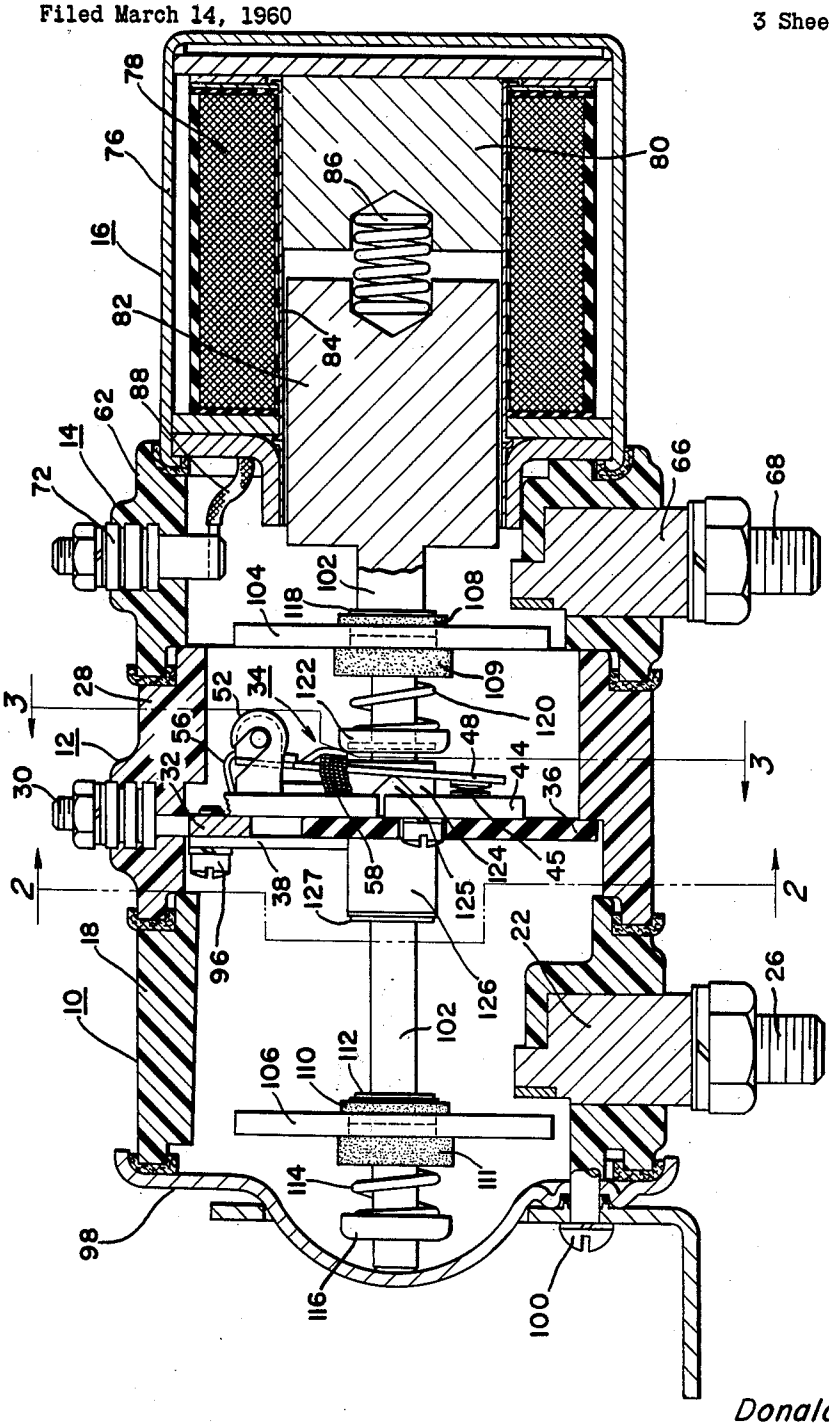

Fig. 1

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SERIES-PARALLEL MAGNETIC SWITCH

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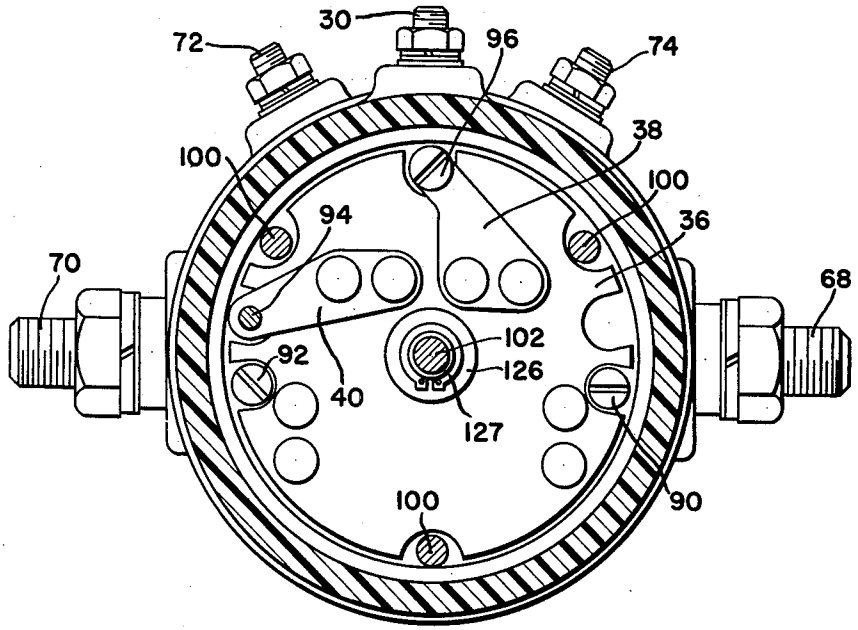

Fig. 2

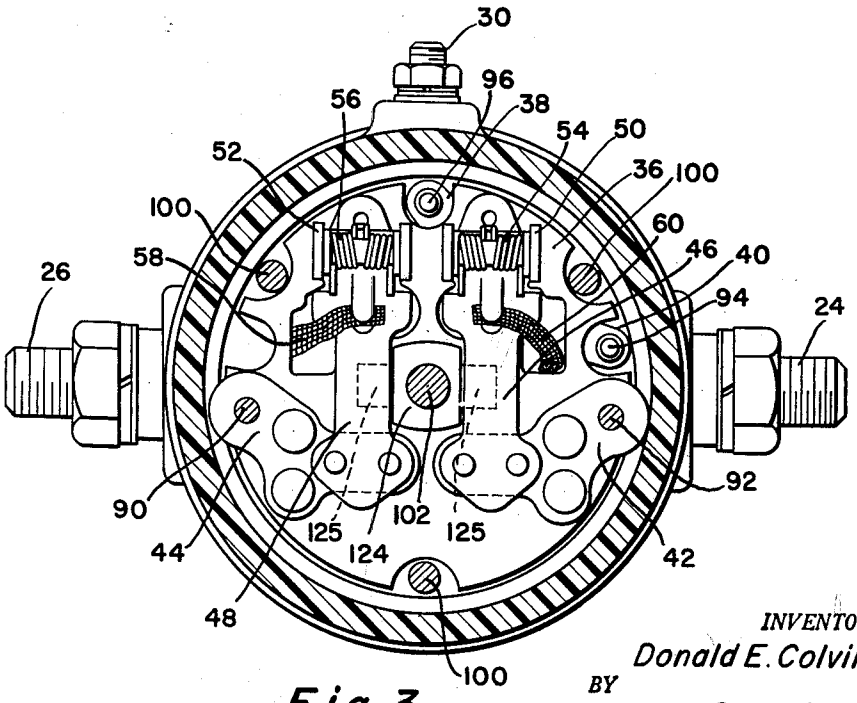

Fig. 3

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SERIES-PARALLEL MAGNETIC SWITCH

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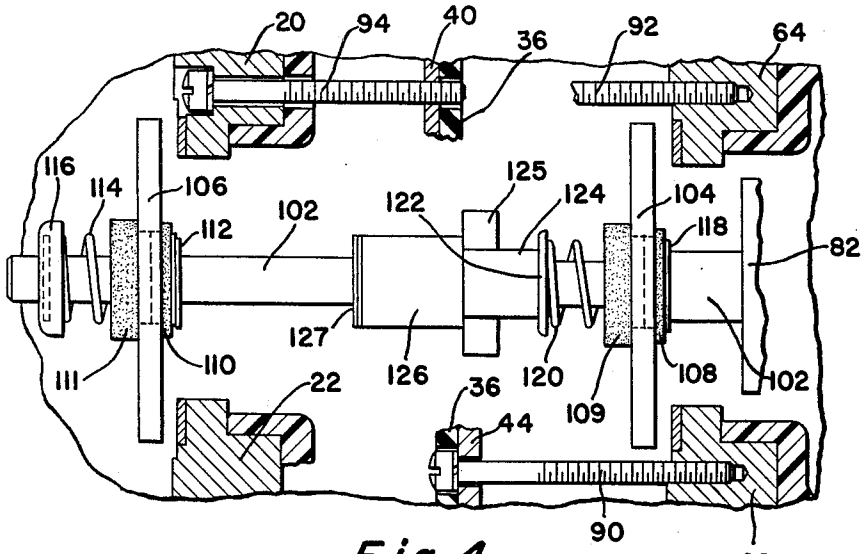

Fig. 4

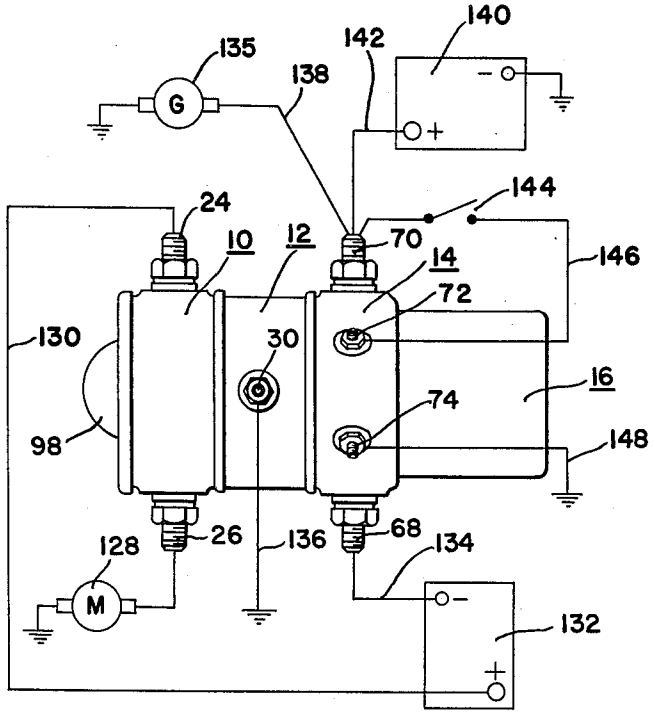

Fig. 5

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SERIES-PARALLEL MAGNETIC SWITCH

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4 Claims. (Cl. 200—104)

This invention relates to electromagnetic switches and more particularly to electromagnetic switches of the series-parallel type that are useful in motor vehicle electrical systems wherein a pair of storage batteries are connected in series when energizing a starting motor and are connected in parallel when being charged by a generator.

One of the objects of this invention is to provide a series-parallel magnetic switch that is economical to manufacture and reliable in operation.

Another object of this invention is to provide an electric switch that is comprised of a plurality of assemblies that are held together by fasteners which also serve to conduct current between contacts of the assemblies.

Still another object of this invention is to provide a series-parallel magnetic switch for connecting a pair of batteries in series when energizing a starting motor and connecting them in parallel when being charged by a generator, the switch including a plurality of assemblies held together by fasteners which serve to carry battery charging current.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a sectional view of a series-parallel magnetic switch made in accordance with this invention with two of the terminals illustrated 90° out of their true position.

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1 and showing the terminals in their true position.

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 1 and showing the terminals in their true position.

FIGURE 4 is a view illustrating a portion of the series-parallel magnetic switch illustrated in FIGURE 1.

FIGURE 5 is a schematic electrical circuit diagram of the connection of the series-parallel magnetic switch of this invention with a generator, starting motor, and a pair of storage batteries.

Referring now to the drawings and more particularly to FIGURE 1, the switch of this invention comprises a first cap assembly **10**, a second cap assembly **12**, a third cap assembly **14** and a coil winding assembly **16**. The cap assembly **10** includes a tubular housing member **18** formed of insulating material which carries a pair of electrical contacts **20** and **22**. The contact **20** has a threaded portion **24** forming a terminal connection and the contact **22** likewise has a threaded portion **26** forming a terminal connection. The contacts **20** and **22** are formed integral with the studs **24** and **26** and these are embedded or molded into the tubular housing **18**. In FIGURE 1, the contact **22** is shown displaced 90° from its true position in order to better illustrate the internal parts of the series-parallel magnetic switch.

The cap assembly **12** includes a tubular housing member **28** formed of suitable electrical insulating material. The tubular member **28** has embedded therein a terminal **30** having a downwardly projecting portion **32**. Fitted within the tubular housing **28** is a contact assembly which is generally designated by reference numeral **34** and which

is illustrated in greater detail in FIGURES 2 and 3 of the drawings. This contact assembly includes an insulator board **36** carrying at one side thereof the strap connectors **38** and **40** which are secured to the insulator board **36** as by riveting. The opposite side of the insulator board **36** carries strap connectors **42** and **44** which are likewise secured to the insulator board **36** as by riveting. The strap connectors **42** and **44** carry electrical contacts **45** which cooperate with pivotally moveable contactors **46** and **48**. The pivotally moveable contactors **46** and **48** are pivoted to support brackets **50** and **52** which are supported by the insulator board **36**. The springs **54** and **56** serve to hold the contactors **46** and **48** normally in engagement with the contacts **45** carried by strap connectors **42** and **44**. A conductor **58** connects the pivotally mounted contactor **48** with its hinge bracket **52** and a conductor **60** connects the pivotally mounted contactor **46** with its hinge bracket **50**. The brackets **50** and **52** are connected respectively with connectors **38** and **40** by rivets passing through insulator board **36**.

The cap assembly **14** includes a tubular housing member **62** formed of electrical insulating material and carrying contacts **64** and **66** which are embedded in the tubular member. The contact **66** has a threaded terminal portion **68** and the contact **64** likewise has a threaded terminal portion **70**. It will be appreciated that in FIGURE 1 the contact **66** and terminal **68** are once more shown shifted 90° out of their true position, the true position of the terminal **68** being indicated in FIGURE 2. The tubular member **62** also carries terminal connectors **72** and **74**, the terminal **72** being illustrated in detail in FIGURE 1.

The coil winding assembly **16** includes a case **76** containing a coil winding **78**. Positioned within the coil winding **78** is a member **80** formed of magnetic material and an armature **82** which is likewise formed of magnetic material. The coil winding **78** and the members **80** and **82** are separated by a sleeve **84**, and it is seen that a spring **86** is positioned between the fixed member **80** and the shiftable armature **82**. One end of the coil winding **78** is conected with terminal **72** via a conductor **88** and the other end of the coil winding **78** is connected with terminal **74** by means of a conductor which is not shown.

The cap assemblies **12** and **14** are held together by a pair of fastener screws **90** and **92** which are illustrated best in FIGURE 4. It is seen that the fastener screw **90** is threaded into the contact **66** carried by the tubular insulator member **62** and that the head of the screw **90** is in electrical contact with the strap connector **44** through a washer. In a similar manner the screw **92** has a portion threaded into the contact **64** and has a head in electrical contact with the strap connector **42**. It will be appreciated that the fasteners **90** and **92** not only serve to hold the cap assemblies **12** and **14** together but also serve to hold the contact assembly **34** fixed with respect to the tubular housing member **28**. These screws serve still another function in that they electrically connect the strap connector **44** with the contact **66** and the strap connector **42** with the contact **64**.

The fastener which is designated by reference numeral **94** has a portion threaded into the strap connector **40** and has a head portion in electrical contact with the contact **20**. It will be appreciated that this fastener serves to hold the cap assemblies **10** and **12** together and also serves to electrically connect the strap connector **40** with the contact **20**.

The strap connector **38** illustrated in FIGURES 1 and 2 is connected with the extension **32** of terminal **30** by a fastener **96** which is threaded into the extension **32** and which has a head portion in electrical contact with the strap connector **38**.

The series-parallel magnetic switch of this invention has an end cap 98 which is held in place by a plurality of through bolts 100, one of which is illustrated in FIGURE 1. These through bolts 100 are threaded into the coil winding assembly 16 and thus serve to hold the coil winding assembly 16 and the end cap 98 in fixed relationship with the cap assemblies 10, 12 and 14. In building up the series-parallel magnetic switch of this invention, the cap assemblies may be first secured together by means of screws 90, 92 and 94 and then the end cap 98 and coil winding assembly 16 are assembled and held to the cap assemblies by the through bolts 100. The tubular insulator members 18 and 28 are formed with slots through which the through bolts 100 pass whereas the tubular insulator member 62 of cap assembly 14 is of sufficient internal diameter to not obstruct the passage of the through bolts 100. It thus is apparent that the through bolts 100 will prevent relative rotation between tubular members 18 and 28 but are not in contact with the tubular insulator member 62.

The armature 82 of the coil winding assembly 16 is connected with a shaft 102 which carries contactors 104 and 106 which are insulated from the shaft by stepped insulating washers 108, 109, 110 and 111. The insulators 110 and 111 are slidable on the shaft and are biased toward a snap ring 112 by a spring 114 which is positioned between stop 116 and the insulator member 111. It will be apparent that the contactor 106 at times will connect the contacts 20 and 22 when the shaft 102 is shifted rightwardly in FIGURES 1 and 4. In a similar fashion, the insulators 108 and 109 are slidable on the shaft 102 with the washer 108 being biased into engagement with a washer 118 that engages a large diameter portion of shaft 102 by means of a spring 120 positioned between stop 122 and the insulator member 109. The contactor 104 will at times engage the fixed contacts 64 and 66 to complete a circuit between them and this will occur when the shaft 102 is shifted rightwardly in FIGURES 1 and 4. The springs 114 and 120 permit some movement of the shaft with respect to the contactors 104 and 106 when they engage the fixed contacts 64 and 66 and 20 and 22. The shaft 102 carries a member 124 having arms 125 which engage the pivotally mounted contactors 46 and 48. The member 124 engages a member 126 located within insulator board 36 and this member is prevented from movement in one direction by snap ring 127. The member 124 engages stop 122 as is apparent from FIGURE 1. It will be appreciated that when the shaft 102 is shifted rightwardly in FIGURES 1 and 4 by the armature 82 the contactors 46 and 48 will be shifted out of engagement with the contacts carried by strap connectors 42 and 44.

Referring now to FIGURE 5, a schematic electrical circuit diagram is illustrated for the series-parallel magnetic switch of this invention. It is seen that the terminal 26 of the switch is connected with a starting motor 128 and that the opposite side of the starting motor is connected to ground. The terminal 24 of the switch is connected with a lead wire 130 which in turn is connected to the positive terminal of the storage battery 132. The negative terminal of the storage battery 132 is connected with terminal 68 via the lead wire 134. The terminal 30 is connected to ground via a lead wire 136.

The terminal 70 is connected to one side of a generator 135 by means of lead wire 138 the opposite side of the generator being connected to ground. The terminal 70 is also connected to the positive terminal of storage battery 140 via a lead wire 142, the opposite side of the storage battery being grounded as shown. A manually operable switch 144 is connected between terminal 70 and a lead wire 146 which is connected with terminal 72. The terminal 74 of the switch is connected to ground via the lead wire 148.

In the operation of the subject series-parallel switch when the manually operable switch 144 is in an open position, the coil winding 78 will not be energized and the contactors 104 and 106 will be in their positions illustrated in FIGURE 1 with the pivotally mounted contactors 46 and 48 in engagement with the strap connectors 42 and 44. With this set of conditions, the generator 135 will charge the batteries 132 and 140 in a parallel connection. The battery 140 will be charged from a circuit that includes the lead wire 138, the terminal 70, and the lead wire 142. The battery 132 will be charged through a circuit that includes the lead wire 138, the terminal 70, the contact 64, the fastener screw 92, the strap connector 42, the pivotally mounted contactor 46, the conductor 60, hinge bracket 50, rivets passing through insulator board 36, the strap connector 40, the conductor screw 94, through contact 20 and terminal 24, through lead wire 130, through the storage battery 132, through lead 134, through terminal 168 and contact 66, through fastener 90 to conductor strap 44, through pivotally mounted contactor 48, through conductor 58 to hinge bracket 52, through rivets passing through insulator board 36 to strap connector 38, through extension 32, through terminal 30 and through lead 136 to ground. It can be seen that this charging circuit for charging the battery 132 makes use of all the fastener members 90, 92 and 94 and also makes use of both pivotally mounted contactors 46 and 48. It will also be appreciated that the contactors 104 and 106 are not used during the time that the generator is supplying charging current to the parallel connected batteries 132 and 140.

When it is desired to energize the starting motor 128 with a voltage that is equal to the series connected voltages of batteries 132 and 140, the manually operable switch 144 is closed. The closure of the manually operable switch 144 completes a circuit for the coil winding 78 which may be traced from lead wire 142, through switch 144, through conductor 146 to terminal 72, through the solenoid winding 78 and then through terminal 74 and lead wire 148 to ground. The energization of relay coil 78 causes the armature 82 to be shifted rightwardly and causes the contactors 104 and 106 to respectively connect contacts 64 and 66 and contacts 20 and 22. Just before this time, the pivotally mounted contactors 46 and 48 are shifted out of engagement with the contacts carried by strap connectors 42 and 44.

The circuit for the starting motor may now be traced from battery 140 through lead wire 142, through terminal 70 and contact 64, through the contactor 104 to contactor 66 and terminal 68 through lead wire 134 through battery 132, through lead wire 130, through terminal 24 and contact 20, through contactor 106 to contact 22 and terminal 26, and then from terminal 26 to the starting motor 128. The starting motor will now be energized by the series connected battery 132 and 140 to cause cranking of an internal combustion engine. In a typical installation, the storage batteries 132 and 140 are 12 volt batteries so that the starting motor is energized with 24 volts whereas the generator has slightly greater than 12 volt output to charge the 12 volt battery 132 and 140 in parallel. It will be observed that during the time that the cranking motor 128 is being energized, none of the fasteners 90, 92 and 94 are in the circuit and neither the contactor 46 or 48 is in the circuit. The current supplied to the starting motor 128 in so far as switching elements is concerned is carried by the contacors 104 and 106 and their mating fixed contacts.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A series-parallel magnetic switch comprising, a plurality of housing members, electrically conductive fastener means securing said housing members together, first and second pairs of fixed contacts carried by said housing members, a solenoid having a shiftable armature, first and second contactors shiftable with said armature and engage-

able with said first and second pairs of fixed contacts, a pair of pivotally mounted contactors, a third pair of fixed contacts cooperable with said pivotally mounted contactors, and means electrically connecting said second pair of fixed contacts with said third pair of fixed contacts including said electrically conductive fastener means.

2. A series-parallel magnetic switch comprising, first, second and third housing members, said first housing member carrying a first pair of fixed contacts, a second pair of fixed contacts carried by said second housing member and a third pair of fixed contacts carried by said third housing member, electrically conductive fastener means securing said housing members together and electrically connecting certain of said fixed pairs of contacts together, said electrically conductive fastener means having one end thereof threaded into respective contacts a solenoid having a shiftable armature, and contact means shiftable by said solenoid armature cooperating with said first, second and third pairs of fixed contacts.

3. A series-parallel magnetic switch comprising, first, second and third housing members, a solenoid assembly engaging one of said housing members, said solenoid assembly including a shiftable armature, a first pair of fixed contacts embedded in said first housing member, a contact assembly supported by said second housing member including a second pair of fixed contacts and a pair of pivotally mounted contactors, a third pair of fixed contacts embedded in said third housing member, a pair of contactors shiftable with said armature into engagement with said first and third pairs of fixed contacts, means carried by said armature for shifting said pivotally mounted contactors out of engagement with said second pair of fixed contacts, means securing said second and third housing members together including electrically conductive fastener means electrically connecting said second pair of fixed contacts with said third pair of fixed contacts, and another electrically conductive fastener member securing said first housing member to said second housing member and electrically connecting one of said first pair of fixed contacts with one of said pivotally mounted contactors.

4. A series-parallel magnetic switch for connecting a pair of storage batteries in series with a starting motor and for connecting said batteries in parallel with a generator comprising, first, second and third housing members formed of insulating material, a first pair of terminals providing fixed contacts supported by said first housing member, a contact assembly including a second pair of fixed contacts and a pair of pivotally mounted contactors supported by said second housing member, a third pair of fixed contacts carried by said third housing member, a solenoid including a shiftable armature, a pair of contactors shiftable with said armature into engagement with said first and third pairs of fixed contacts, said armature causing shiftable movement of said pair of pivotally mounted contactors when it is shifted, first and second electrically conductive fasteners securing said second and third housing members together and electrically connecting said second and third pairs of fixed contacts, and a third electrically conductive fastener securing said first and second housing members together and electrically connecting one of said pivotally mounted contactors with one of said first pair of fixed contacts.

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