

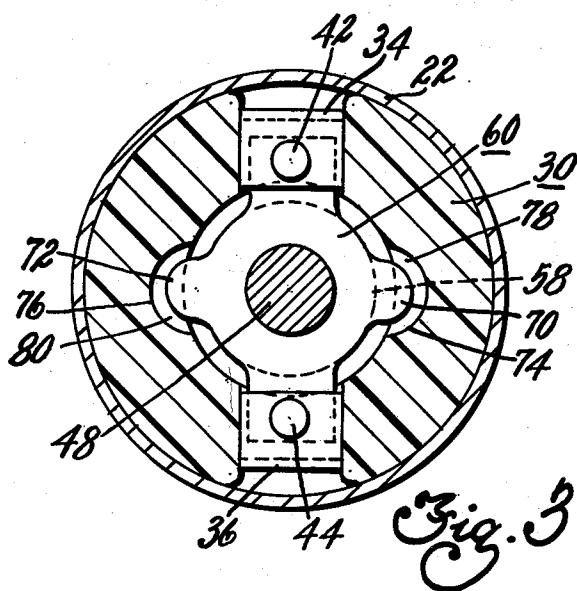
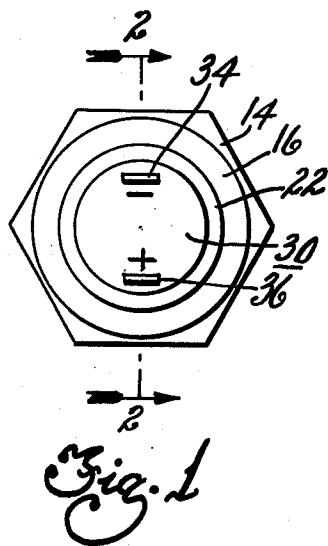
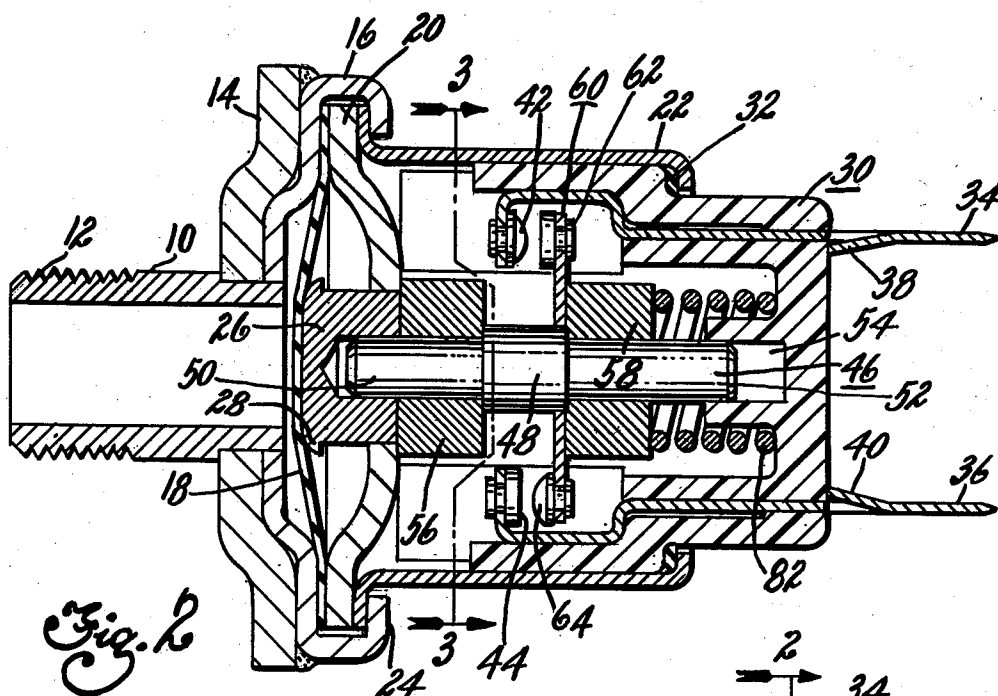
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MAGNETICALLY OPERATED ELECTRIC SWITCH

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MAGNETICALLY OPERATED ELECTRIC SWITCH
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This invention relates to electric switches and more particularly to an electric switch wherein the shiftable contacts of the switch are moved by magnetic means into and out of engagement with one or more fixed contacts.

One of the objects of this invention is to provide a snap acting switch wherein a shiftable contact of the switch is carried by a freely movable member formed of magnetic material which is shifted in opposite directions with a snap action by magnets that are shifted toward and away from the member that carries the contact.

Another object of this invention is to provide an electric switch wherein a non-magnetic plunger member carries a pair of magnets and a magnetic plate that carries the shiftable contact or contacts of the switch, one of the magnets normally holding the magnetic plate by attraction so that under certain conditions, the plunger, one of the magnets and the plate may be shifted as a unit, the switch further including stop means for engaging the plate during movement of the plunger in one direction to cause a separation of the magnetic plate and one of the magnets, the other of the magnets then attracting the plate to cause a snap acting movement of the plate.

A further object of this invention is to provide an electric switch that is actuated by hydraulic pressure and which includes magnetic means providing for snap action of the shiftable contact or contacts of the switch.

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

In the drawings:

FIGURE 1 is an end view of switch made in accordance with this invention.

FIGURE 2 is an enlarged sectional view taken along line 2—2 of FIGURE 1.

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 2.

Referring now to the drawings, and more particularly to FIGURE 2, the reference numeral 10 designates a tubular metal conduit having a threaded portion 12 which is adapted to be threaded into the hydraulic brake system of a motor vehicle or into any other pressure developing device. The conduit 10 is brazed to the metal plate members 14 and 16. The plate members 14 and 16 are also brazed together, but it is apparent that the tubular member 10 and the members 14 and 16 may be secured together in any other suitable fashion.

A rubberized diaphragm designated by reference numeral 18 is provided and it is seen that this diaphragm is held between the metal plate member 20 and the plate member 16. A shell member formed of metal material is designated by reference numeral 22 in the drawings and it is seen that the member 16 has a crimped over portion 24 which secures the diaphragm 18, the member 20, and the shell member 22. A piston member designated by reference numeral 26 is provided and it can be seen that this piston member slides within an opening formed in the metal member 20 and has a head portion 28 which engages the diaphragm 18 and which prevents the piston member from sliding through the opening in the member 20.

The shell member 22 serves to support a housing designated by reference numeral 30 which is formed of

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a suitable plastic insulating material. A resilient gasket 32 is interposed between a portion of the plastic housing 30 and one end of the shell member 22 and serves as a cushion. The housing member 30 is formed with two parallel slots which receive the brass terminals 34 and 36. When the terminals are inserted into the plastic housing 30, they are prevented from sliding out of the housing by the lanced out tabs 38 and 40. The terminal 34 carries a silver alloy contact 42 which is staked thereto and in a similar fashion the terminal 36 carries a silver alloy contact 44 which likewise is staked thereto. It is apparent that the contacts 42 and 44 are the fixed contacts of the switch.

The switch of this invention is provided with a plunger member which is generally designated by reference numeral 46 and which is formed of a suitable non-magnetic material. It is seen that the plunger member 46 has an enlarged annular collar portion 48 and reduced cylindrical portions 50 and 52. The portion 50 of the plunger 46 fits within a hole drilled in the piston member 26, whereas the portion 52 of plunger 46 slides within a hole 54 formed in the plastic housing 30.

It can be seen from FIGURE 2 that the portion 50 of the plunger member 46 carries a drum-shaped permanent magnet 56, whereas the portion 52 of the plunger 46 carries another drum-shaped permanent magnet 58. The collar member 48 of the plunger 46 carries a plate member 60 which is formed of a suitable magnetic material. This plate member carries the contacts 62 and 64 which cooperate respectively with the fixed contacts 42 and 44. The plate member 60 which is formed of magnetic material has extensions 70 and 72 which are positioned within recesses 74 and 76. The recesses 74 and 76 terminate in stop ledges 78 and 80 which limit the movement of the plate 60. It can be seen from FIGURE 3 that the portions of the magnetic member 60 that carry the contacts 62 and 64 are also positioned within recesses that receive the ends of terminals 34 and 36. It is to be pointed out that the magnetic member 60 is freely slideable on the collar portion 48 of the non-magnetic plunger 46 and is prevented from rotating by the provision of the recesses which cooperate with the extensions on the magnetic member 60. A spring designated by reference numeral 82 is interposed between the plastic housing 30 and one end of the drum-shaped magnet 58 as is clearly apparent from FIGURE 2.

When no hydraulic fluid is being applied to the switch of this invention, the parts of the switch will take the position as illustrated in FIGURE 2. In this position it can be seen that the magnetic member 60 is attracted into engagement with the drum-shaped magnet 58 and that the shiftable contacts 62 and 64 of the switch are out of engagement with the fixed contacts 42 and 44. The switch is now in an open position.

When fluid pressure acts on the diaphragm 18 to shift the piston 26 rightwardly in FIGURE 2, it can be seen that the piston 26, the magnet 56, and the plunger 46 will all be moved as a unit rightwardly in FIGURE 2. This rightward movement will also cause the magnet 58 and the attracted magnetic plate 60 to move rightwardly. At some point in this rightward movement the extensions 70 and 72 formed on the magnetic plate 60 will engage the stop ledges 76 and 78 formed on the plastic housing member 30. When this occurs, the magnetic plate 60 will become separated from the magnet 58, the magnet 58 continuing to move rightwardly while the collar portion 48 of the plunger 46 slides through the now stationary magnetic member 60. As this rightward movement continues, the magnet 56 will at some point in this movement move close enough to the magnetic member 60 to cause the magnetic member 60 to move with a snap action leftwardly and thus cause the contacts 64 and 62 to be

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rapidly snapped into engagement with the fixed contacts 42 and 44. The switch now, of course, will be in a closed position and a circuit will be complete between the terminals 34 and 36.

Assuming now that the switch has been actuated by fluid pressure to a circuit closed position, if the pressure is now reduced below a certain value, the spring 32 will be operative to shift the magnet 58 and the plunger 46 leftwardly in FIGURE 2. It can be seen that during this shifting movement, the magnet 56 will be carried away from the magnetic plate 60 and the magnetic plate 60 will be prevented from moving leftwardly by its engagement with contacts 42 and 44. The magnetic plate 60, of course, will have little or no tendency to move leftwardly since the only force applied to it during the leftward movement of the plunger would be any frictional force between the collar member 48 and the magnetic plate member 62. It can be seen that during this leftward movement the magnet 56 will be moving away from the magnetic plate 60, whereas the magnet 58 will be approaching the magnetic plate 60. At a predetermined point in this leftward movement of the plunger 46, the magnetic plate 60 will suddenly be attracted into engagement with the magnetic plate 58 to cause a snap acting opening movement of the switch. The final at rest position of the switch will then be as shown in FIGURE 2 with the magnetic plate 60 being attracted into engagement with the magnet 58.

As an example of opening and closing pressures, the switch contacts may close when the pressure within conduit 10 reaches 45 p.s.i. and upon increasing pressure and the switch contacts may open upon decreasing pressure at approximately 30 p.s.i. The switch is also designed to stand 1800 p.s.i. for 30 seconds without leakage. Because of the construction of the plate members 14, 16, and 20, the switch is capable of withstanding 3500 p.s.i. without major leakage.

It can be seen from the foregoing that a snap acting hydraulically operated switch has been provided that is snap acting both on the contact closing operation of the switch and the contact opening operation of the switch.

It also can be seen that this snap action is provided by the use of a magnetic member 60 that is freely slideable on the collar member 48 and which is caused to move with a snap action under the influence of the magnets 56 and 58.

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

What is claimed is as follows:

1. An electric switch comprising, fixed contact means, a support member, a plate member formed of magnetic material slideably supported by said support member and carrying an electrical contact that is adapted to be brought into and out of engagement with said fixed contact, first and second magnets carried by said support member and positioned on opposite sides of said magnetic plate member, said support member providing a predetermined constant spacing between said magnets, and means for supporting said support member for slideable movement along a fixed axis whereby said magnets may be shifted relative to said magnetic plate member to cause said plate member to shift with a snap action.

2. An electric switch comprising, fixed contact means, a plunger member formed of non-magnetic material having a central collar portion and oppositely extending reduced portions, a member formed of magnetic material freely slideable on said collar portion and carrying an electrical contact that cooperates with said fixed contact means, first and second magnets supported by said plunger member and engageable with the collar portion of said plunger member, and means for supporting said plunger member for slideable movement, said plunger member and magnets being shiftable relative to said magnetic plate member to cause said magnetic plate member to

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shift in opposite directions with a snap action to cause said contact carried by said magnetic plate member to shift into and out of engagement with said fixed contact means with a snap action.

3. An electric switch comprising, fixed contact means, a support member formed of non-magnetic material, a magnetic plate member slideably supported by said support member and carrying an electrical contact that is shifted into and out of engagement with said fixed contact means, a pair of magnets supported by said support member and located on opposite sides of said magnetic plate member, and stop means adapted to engage said magnetic plate member when said support member is shifted in one direction to cause said magnetic plate member to separate from one of said magnets and to be attracted toward the other of said magnets to cause said magnetic plate member to shift in such a direction as to provide engagement between said electrical contact and said fixed contact means.

4. An electric switch comprising, fixed contact means, a magnetic plate member carrying an electrical contact that is adapted to cooperate with said fixed contact means, a shiftable support member, said magnetic plate member being freely slidably supported by said shiftable support member, first and second magnets carried by said shiftable support member and positioned on opposite sides of said magnetic plate member, said magnetic plate member being normally attracted into engagement with one of said magnets and shiftable therewith when said shiftable support means is shifted, and stop means engageable with said magnetic plate member for causing said magnetic plate member to separate from one of said magnets when said shiftable support means is shifted in one direction, the other of said magnets causing said magnetic plate member to shift toward it during movement of said shiftable support means in the direction to cause separation of said magnetic plate member and one of said magnets.

5. An electric switch comprising, fixed contact means, support means having a fixed axis, a magnetic plate member slideably supported by said support means for movement along said fixed axis and carrying an electrical contact that is shifted into and out of engagement with said fixed contact means, spaced magnetic means carried by said support means and positioned on opposite sides of said magnetic plate member, and stop means adapted to engage said magnetic plate member to cause said magnetic plate member to separate from one of said magnetic means when said support member is shifted in one direction, the other of said magnetic means attracting said magnetic plate member during said shifting movement.

6. An electrical switch comprising, a housing member formed of electrical insulating material, first and second terminals carried by said housing member each carrying an electrical contact, a plunger member formed of non-magnetic material slideable relative to said housing member, said plunger member having a central collar portion and oppositely extending reduced portions, a plate member formed of magnetic material slideably supported on said collar portion, said plate member carrying a pair of electrical contacts that are adapted to become engaged and disengaged with the contacts carried by said terminals, first and second magnets carried by the reduced portions of said non-magnetic plunger member and positioned on opposite sides of said magnetic plate member, and stop ledge means formed on said housing member for causing a separation of said magnetic plate member and one of said magnets when said plunger member is shifted in one direction, the other of said magnets attracting said plate member to cause the contacts carried by said plate member to shift with a snap action into engagement with the contacts carried by said terminals.

7. An electric switch comprising, fixed contact means, a plunger member formed of non-magnetic material, a magnetic plate member freely slideably supported by said plunger member and carrying an electrical contact that

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becomes engaged and disengaged with said fixed contact means, first and second magnetic means carried by said plunger member and positioned on opposite sides of said magnetic plate member for causing said magnetic plate member to shift with a snap action when said plunger member is shifted, and means including a diaphragm responsive to fluid pressure for causing a shifting movement of said plunger.

8. An electric switch comprising, a housing member formed of insulating material, fixed contact means carried by said housing member, a plunger member formed of non-magnetic material slideably supported by said housing member, a plate member formed of magnetic material slideably supported on said plunger member, said plate member having extensions fitting within recesses formed in said housing member to prevent rotation of said plate member, and first and second magnets carried by said plunger member and positioned on opposite sides of said magnetic plate member, said magnetic plate member carrying an electrical contact that becomes engaged and disengaged with said fixed contact means when said plunger and magnets are shifted to cause a snap acting movement of said magnetic plate member.

9. An electric switch comprising, a housing member formed of insulating material, fixed contact means supported by said housing member, a plunger member formed of non-magnetic material slideably supported by said housing member, a plate member formed of magnetic material slideably supported on said plunger member, said plate member carrying an electrical contact that is engageable and disengageable with said fixed contact means, and first and second magnets carried by said plunger and positioned on opposite sides of said magnetic plate member, said housing having at least one recess receiving a projecting portion of said magnetic plate member to prevent rotation of said magnetic plate member, said recess terminating in a stop ledge portion which is adapted to engage said magnetic plate member to cause a separation of said magnetic plate member and one of said magnets when said plunger member is shifted in one direction, the other of said magnets approaching said magnetic plate member to cause said magnetic plate member to shift with a snap action into engagement with the other of said magnets.

10. An electric switch comprising, means including a diaphragm and a tubular conduit defining a pressure chamber that is adapted to be connected with a fluid pressure source, a piston member engaging said diaphragm, a plunger member formed of non-magnetic material having a central collar portion and reduced end portions, one of said end portions fitting within said piston member, a first magnet positioned between said piston member and the collar portion of said plunger member, a member formed of magnetic material freely slideably supported on said collar portion of said plunger member, a second magnet supported on the other reduced portion of said plunger member, a housing member, fixed contact means supported by said housing member, resilient means interposed between said housing member and one of said magnets for urging said plunger and magnets in one direction, and an electrical contact carried by said magnetic plate member that is engageable with said fixed contact

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means, said magnets being shiftable relative to said magnetic plate member for causing said magnetic plate member to be shifted by magnetic attraction to open and close said switch.

11. An electric switch comprising, a housing member formed of insulating material, a pair of terminals supported by said housing member each carrying an electrical contact, a plunger member formed of non-magnetic material supported for slideable movement, said plunger member having a central collar portion and oppositely directed reduced portions, first and second magnets fitted on said reduced portions and engaging shoulders formed by said collar portion, a plate member formed of magnetic material freely slideably supported on the collar portion of said plunger, said plate member carrying electrical contacts that cooperate with the contacts carried by said terminals, a piston member engaging one of said magnets, and a diaphragm engaging said piston member for shifting said piston member, plunger member and magnets when a fluid pressure is applied to said diaphragm.

12. An electric switch comprising, a fixed contact, a plate member formed of magnetic material carrying an electrical contact that cooperates with said fixed contact, means supporting said magnetic plate member for free non-tiltable sliding movement along a fixed axis, and first and second magnets, means for supporting said magnets and for maintaining said magnets at a predetermined distance from each other, said magnets being positioned on opposite sides of said magnetic plate member and being shiftable relative to said fixed contact and to said magnetic plate member to cause said magnetic plate member to shift with a snap action in either of two directions.

13. An electric switch comprising, a fixed contact and a cooperating movable contact, a magnetic plate member for shifting said movable contact into and out of engagement with said fixed contact, means supporting said magnetic plate member for movement along a fixed axis, first and second magnetic means positioned on opposite sides of said magnetic plate member and movable together, said first and second magnetic means attracting said magnetic plate member toward a respective magnetic means as said first and second magnetic means are shifted to cause an engagement and a disengagement of said fixed and movable contact, and stop means for separating said magnetic plate member from one of said magnetic means when said magnetic means is holding said magnetic plate member and moving it in one direction, said other magnetic means then attracting said magnetic plate member toward it when said plate member has been separated from said first magnetic means by said stop means.

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