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Barndt

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[54] **MAGNETIC SWITCH**

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[73] Assignee: **Clemence G. Martin,** Salt Lake City, Utah ; a part interest

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[52] **U.S. Cl.** **335/207,** 200/302

[51] **Int. Cl.** **H01h 21/00**

[58] **Field of Search** 335/205, 207, 280; 200/302

[56] **References Cited**

UNITED STATES PATENTS

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Primary Examiner—R. N. Envall, Jr.

[57] **ABSTRACT**

A manually operated switch for making and breaking connection in an electrical circuit, preferably for transferring domestic service and like or lesser currents. The switch employs multiple magnets, and a magnetically attractive contact device. One magnet is moved with respect to the contact device and in a plane perpendicular to the second or fixed magnet to open and close the switch by moving the contact device into and out of engagement with electrical contacts therein. Appropriate alignment of the movable magnet overcomes an attractive force the fixed magnet exerts on the contact device and displaces the device away from at least one of the electrical contacts, thereby opening the circuit. To close the switch, the movable magnet is moved away from the conductive device which is then attracted by the fixed magnet to again move into engagement with both of the contacts.

2 Claims, 4 Drawing Figures

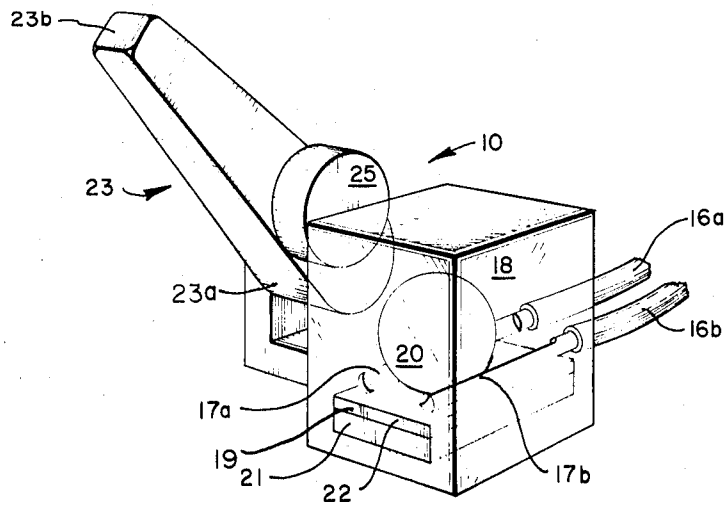


FIG 1

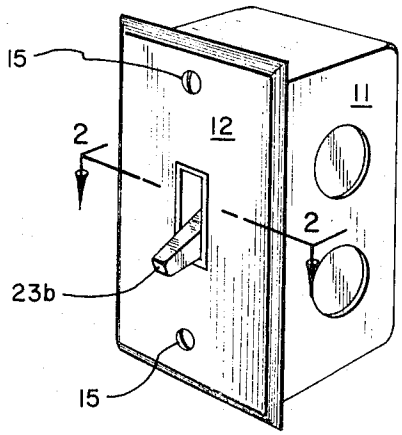


FIG 2

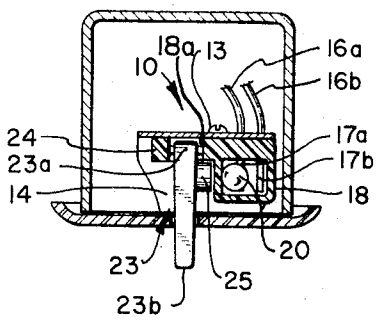


FIG 3

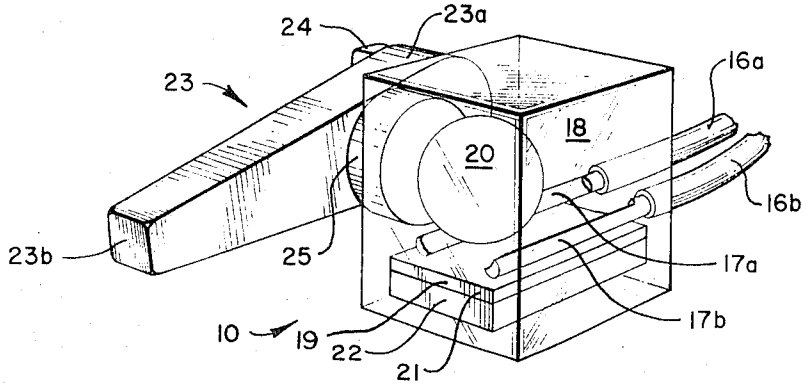
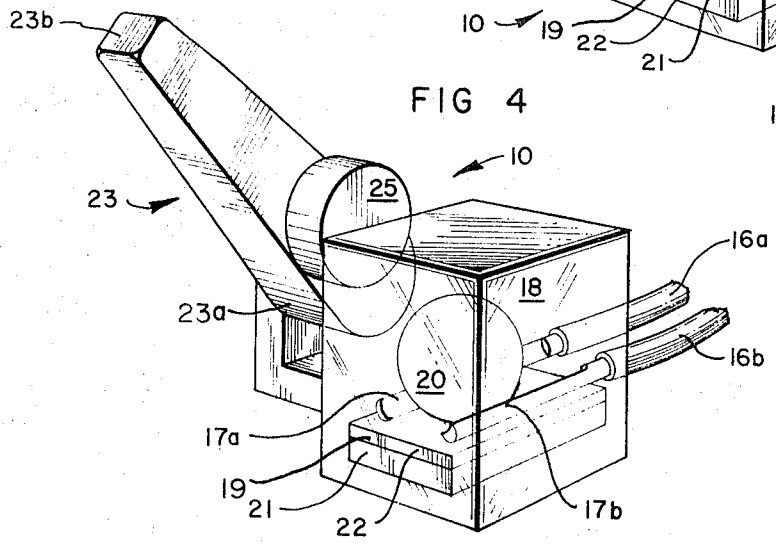


FIG 4



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MAGNETIC SWITCH

BRIEF DESCRIPTION OF THE INVENTION

1. Field of the Invention

This invention relates to electrical switches incorporating magnets for opening and closing an electrical circuit therethrough.

2. Prior Art

Of recent years, countless numbers of devices and circuitry have been introduced utilizing electrical energy for performing a multitude of functions within our society. Yet, any and all such devices and circuitry have one requirement in common—that the device or circuit must be turned on and off by some switch means. Such switch means range from huge knife contactors that travel between greatly spaced contacts, to a miniature toggle switch whose operation moves an electrically conductive material between closely spaced contacts. The spacing requirements of the various switch contacts is, of course, determined by the electrical load to be transferred, which contact spacing should be sufficient to prevent unwanted arcing between the switch contacts when the particular electrical circuit is broken.

It is common knowledge that once a circuit is established, with an electrical current flowing therethrough, the electrical energy flow itself will resist being broken. The circuits resistance to disconnection is evidenced by an arcing between contacts as the contacts are separated. Such arcing is, of course, not desirable and is dependent upon the amount of the energy flow, atmospheric conditions, the speed at which contact separation is executed, and like factors. As the speed of contact separation is a factor in arcing, switches employing means for inducing positive and relatively rapid contact separation have been developed. Such means have included springs, flexible reeds or the like and, of recent times, permanent magnets. Magnet arrangements for initiating contact connection and separation are shown in U.S. Pat. No's. 2,521,723, 2,896,043, 3,025,372, 3,114,809, 3,209,097, 3,261,944, 3,273,091, 3,284,743, 3,407,370, 3,449,700 and 3,458,841 wherein are disclosed switches employing permanent magnets arranged to utilize the mutually attractive or repellant characteristics of their respective poles acting upon each other to effect contact opening and closing. Such magnet switches like the present invention are essentially soundless, employ few if any parts subject to frictional wear and, when properly constructed and aligned, will operate reliably over a long life. However, when a large current is to be transferred, such switches tend to be impractical as large and powerful magnets are required to overcome the natural resistance exhibited by an electrical current to being disconnected.

The switch of the present invention is, however, unlike the aforesaid patents in that it is inexpensive to produce using pairs of small, permanent magnets arranged to attract a separate contact device such that movement of one permanent magnet in one attitude will either lift the contact device off of adjacent electrical contancts or will in another attitude release said contact device allowing it to return, under the urgings of the second of fixed permanent magnets to between the electrical contacts. While arrangements of permanent magnets whose movements in turn displace separate magnetically attractive items are shown in U.S. Pat. No's. 3,187,129 and 3,397,372, these devices involve a pivotally mounted reed or pendulum arrangement that is distinct in both form and operation from the contacting device of the present invention.

No magnetic switch discovered nor any switch within my knowledge prior to the present invention has heretofore incorporated the particular arrangement of permanent magnets acting on a contact device controlling electrical current passage by the positioning of one of the permanent magnets with respect to the contact device, providing a switch that is capable of surely and reliably controlling electrical energy transfer over a wide range of values of current flows.

SUMMARY OF THE INVENTION

It is the principal object of the present invention to provide a switch that utilizes an arrangement of fixed and movable permanent magnets to exert a magnetic force of attraction on a magnetically sensitive electrically conductive contact device such that movement of the one magnet relative to the contact device will move the device either into or out of engagement with electrical contacts arranged in the switch, completing an electrical circuit therethrough.

Another object is to provide a magnetic switch wherein stationary, permanent magnets are arranged to magnetically bias an electrical contact device into engagement with spaced electrical contacts arranged within the switch.

Still another object is to provide a magnetic switch operated by movement of a movable magnet whose force of attraction attracts, dependent upon the location of the movable magnet, a magnetically sensitive, electrically conductive round ball-like item into and out of contact with electrical contacts.

Still another object is to provide a switch that is simple to construct to relatively small dimensions from inexpensive component parts, which switch is capable of reliably switching an electrical energy flow over numerous switching operations.

Principal features of the magnetic switch of the invention include a housing wherein are arranged electrically isolated contacts that are fixed in spaced parallel alignment with one another and can be contoured to conform to the surface of an electrical contact device positioned thereon. A magnetically attractive and electrically conductive contact device, such as a round ferrous ball, is arranged within the housing to move freely against and away from the contacts. The diameter of the round ferrous ball is somewhat greater than is the spacing between the contacts such that, when the ball rests on both contacts, it will conduct an electrical energy flow therebetween.

The switch housing is preferably positioned such that the electrical contacts therein lie in a horizontal plane with the contact device resting therebetween in which attitude the contact device simultaneously engages both contacts. In this arrangement, the force of gravity biases the contact device against both contacts. Further biasing, additional to gravity, is however preferably provided by the inclusion of a magnet secured to the housing below the contacts and contact device, magnetically attracting the contact device into engagement with the contacts, regardless of the attitude of the switch housing.

The switch components thus far described provide a closed circuit arrangement for passing an electrical energy flow therethrough. As a means for breaking or opening the circuit, a second magnet is provided that is arranged to be movable with respect to the contact device. The movable magnet provides a magnetically attractive force which will, when the magnet is positioned appropriately, overcome the gravity and/or magnetic biasing on the contact device so as to displace the contact device out of engagement with at least one of the contacts. The only requirement for effective movement of the movable magnet to displace appropriately the contact device is that its force of attraction not be applied in the same direction as is the force of attraction of the permanently installed magnet. It is preferred, however, that the magnet be movable to a point alongside or normal to the plane of the permanently installed magnet such that the contact device will lift off of a single electrical contact that is furthest therefrom, breaking the circuit. Of course, the movable magnet could be made to pass over the housing in a plane parallel to that of the permanently installed magnet, which arrangement would require that the movable magnet be sufficiently strong to overcome both the attractive force of the permanently installed magnet and the force of gravity. Or, the movable magnet could be made to pass by the housing at any point therebetween, with the angular attitude and proximity of passage of the movable magnet with respect to the contact device determining the relative strength of the magnet required to overcome the magnetic and gravitational forces biasing the contact device.

In practice, the movable magnet is installed on a pivotally mounted bar, beam or the like, or a number of such magnets could be arranged on a rotating wheel such that pivotal movement of the bar or beam or rotation of such a wheel would move the magnet into and out of proximity of the housing, thereby exerting a magnetic force of attraction on the contact device therein. The pivoting arm or wheel could be connected to the switch housing or to a platform arrangement to which switch housing the magnet is connected.

As discussed earlier herein, an electrical current flow has natural resistance to being broken. The magnetically attractive force exerted by the movable magnet must therefore be sufficiently strong to provide a rapid movement of the contact device away from the particular electrical contact so as to prevent unwanted and potentially damaging arcing therebetween. To further limit such damaging arcing, the housing containing the contacts and the contact device could be made air tight with the air therein evacuated, or an inert gas could be included therein. Such an arrangement, because the housing would be sealed, additional to limiting arcing, would allow the switch of the present invention to be sold as an explosion and shockproof switch.

Additional objects and features of the present invention will become apparent from the following detailed description, taken together with the accompanying drawings.

THE DRAWINGS

In the drawings:

FIG. **1** is a front elevation view of the switch of the present invention arranged in a standard wall box as a light switch;

FIG. **2**, a top plan sectional view taken along the line **2—2** of FIG. **1**, exposing the interior of the wall box and the switch;

FIG. **3**, a profile perspective view of the switch of the present invention shown removed from the wall box of FIG. **1**; and

FIG. **4**, a view like that of FIG. **3** showing the pivotally connected switch arm rotated to a second switch arm attitude.

DETAILED DESCRIPTION

Referring now to the drawings:

The invention in a magnetic switch **10** is shown in FIGS. **1** and **2** installed in a conventional wall-mounted switch box **11** with a standard switch plate **12** secured by screws **15** over the switch box open front. The magnetic switch **10** is shown in FIG. **2** maintained by a bolt **13** to a bracket **14** arranged within the switch box **11**, which bracket **14** is in turn connected by fastening means, not shown, to the switch box **11**. Wires **16***a* and **16***b*, shown broken away in FIG. **2**, enter the wall box **11** and connect to the magnetic switch **10** to link the magnetic switch to a source of electrical energy, not shown, and to an apparatus which uses electrical energy such as a lamp, wall plug or the like, not shown.

In FIGS. **3** and **4**, the magnetic switch **10** and wires **16***a* and **16***b* are shown removed from the bracket **14** and wall box **11**, exposing a switch housing **18** into which housing the wires **16***a* and **16***b* are fitted. Wires **16***a* and **16***b* extend parallel to one another within the housing **18**, having the insulation removed from the ends thereof, forming electrical contacts **17***a* and **17***b* that are spaced apart as shown at **19** and are electrically isolated from one another. The electrical contacts **17***a* and **17***b* are preferably contoured, shown herein as being concave, to closely fit against the sides of an electrically conductive contact device, shown herein as a round ball or roller bearing **20**, which ball **20**, it should be assumed, is electrically conductive and is magnetically attractive. The round ball is formed to have a diameter that is somewhat greater than is the gap distance **19** such that the outer circumference thereof will simultaneously rest on both electrical contacts **17***a* and **17***b* when the housing **18** is appropriately positioned. Appropriately contouring the contacts **17***a* and **17***b* to conform to the shape of the particular contact device insures that the contact device will touch the contacts over a wide area, providing a better electrical connection therebetween that is less likely to produce a heat buildup than would single point contact.

The electrical contacts **17***a* and **17***b* within the housing **18** are insulated from one another with the gap distance **19** therebetween prohibiting an unwanted transmission of electrical energy.

FIGS. **2** through **4** show the switch housing **18** positioned such that the electrical contacts **17***a* and **17***b* therein lie in approximately a horizontal plane. In this attitude, the force of gravity will pull the ball **20** into the gap **19** contacting both the electrical contacts **17***a* and **17***b*. Though the ball **20** would transfer electrical energy in this attitude, additional biasing of the ball **20** is preferred and is provided, as shown in FIGS. **3** and **4**, by arranging magnet **21** within housing **18** so as to be directly below and in a plane parallel to the electrical contacts **17***a* and **17***b*. To prohibit an unwanted electrical energy transfer through the magnet **21**, a

layer of insulation **22** is sandwiched between the electrical contacts **17***a* and **17***b* and the magnet **21.** The insulation material **22** could be a plastic, carbon material or a like substance having good insulation properties prohibiting an electrical energy transfer.

The housing **18** is preferably constructed of a plastic or like material that is neither electrically conductive or magnetically attractive. Though the housing **18** is shown in FIGS. **2** through **4** as being formed of a clear material, it is only required that the housing not be electrically conductive or magnetically attractive.

As disclosed thus far, with the housing **18** maintained such that the electrical contacts **17***a* and **17***b* are horizontal, the ball **20,** urged by gravity, will remain at rest in the gap **19** between the contacts, completing electrical connection therebetween. Further biasing of the ball **20** into engagement with the contacts **17***a* and **17***b* is provided by the inclusion of the permanent magnet **21** as described.

To break the electrical connection formed by the ball **20** with the contacts **17***a* and **17***b*, the ball must be displaced off from one or both of the contacts. To effect displacement of ball **20,** shown best in FIG. **2,** the present invention preferably incorporates a lever arm **23** mounting a second permanent magnet **25** thereon. The lever arm **23** is pivotally connected by a screw **24** that is turned through a lever arm end **23***a* into an appropriate hole formed in side **18***a* of housing **18** such that, by displacing the opposite end **23***b* of the lever arm **23,** the lever arm is moved in a vertical plane that extends alongside the housing **18.** The second permanent magnet **25** is attached to the lever arm **23** such that vertical movement of the lever arm moves the magnet either alongside the housing **18,** as shown in FIG. **3,** proximate to the ball **20,** or as shown in FIG. **4,** to a point that is separated from ball **20.** Magnet **25,** when positioned as shown in FIG. **3** alongside the housing **18,** provides a sufficient magnetic attraction to the ball **20** that the gravitational force and magnetic biasing acting thereon will be overcome with the ball **20** being drawn towards the magnet **25,** lifting off of the electric contact **17***b* furthest therefrom, breaking the electrical connection. When the lever arm is moved as shown in FIG. **4,** the magnetic attraction of the magnet **25** is on the ball **20** and lessened such that the strength of attraction of the magnet **21** and gravity will overcome the attractive force of magnet **25** on the ball **20.** The ball **20** is thereby returned to its position between the electrical contacts **17***a* and **17***b* and the electrical energy flow through the magnetic switch **10** is restored.

Although the path of travel of the lever arm mounted magnet **25** is shown herein to be alongside the housing **18,** it should be understood that the path of travel of the magnet **25** might be over the housing **18** or even along the other side thereof. Changes in the path of magnet travel, while perhaps tending to displace the ball **20** differently from the displacement described, would not alter the operation of the magnetic switch **10.** Additionally, while permanent magnets are shown as the preferred forms of magnets **21** and **25,** it should be obvious that electromagnets could be substituted therefor.

An inherent problem with a switch like that of the present invention is arcing between the contact and ball when the ball is lifted thereoff. As relative speed of contact separation of the contact and ball is one factor in either inducing or limiting arcing, it is preferable to incorporate a permanent magnet as the magnet **25,** with sufficient strength relative to the electrical current flow, that the ball **20** will be instantly attracted thereto, with the speed of movement of ball **20** limiting arcing. Additionally, because there is no requirement for physical contact between the permanent magnet **25** and the ball **20,** the housing **18** can be arranged to be air tight, making possible the evacuation of the air therefrom or the inclusion of an inert gas therein, to further limit arcing. Because housing **18** may easily be arranged to be air tight, the switch **10** of the present invention is particularly well suited for use when a shockproof or explosionproof switch is required. Also, because movement of the contact device is in response to magnetic attraction only, the act of opening or closing the switch **10** is essentially soundless, making the switch of the present invention particularly well suited for use with a silent alarm, or the like.

Although a preferred form of my invention has been herein disclosed, it is to be understood that the present disclosure is made by way of example and that variations are possible without departing from the subject matter coming within the scope of the following claims, which subject matter I regard as my invention.

I claim:

1. A magnetic switch comprising

a closed housing formed of non-magnetic material, said housing having a top and a bottom and side walls interconnecting said top and said bottom;

parallel, contact members extending through a wall of the housing and into a plane in the lower portion of the housing;

a first magnet in the housing extending fully beneath the parallel contact members;

an electrically conductive ball of material attracted to the first magnet and adapted to simultaneously rest on the parallel contact members;

an arm;

a pivot shaft extending outwardly of the housing from a wall of the housing;

means mounting the arm on the pivot shaft to pivot alongside the housing in a plane transverse to the plane of the contact members;

a second magnet mounted on the arm, between the arm and the housing whereby when said arm is pivoted between extreme raised and lowered positions, the second magnet is moved from a position wherein it does not attract the ball to a position wherein the ball is attracted theretowards and is raised out of contact with at least one of said parallel contact members.

2. A magnetic switch as in claim **1,** wherein

the parallel contact members each have an arcuate surface portion that is contacted by the ball when said ball rests on both the said contact members.

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