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ELECTROMAGNETIC SWITCH

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Fig. 1

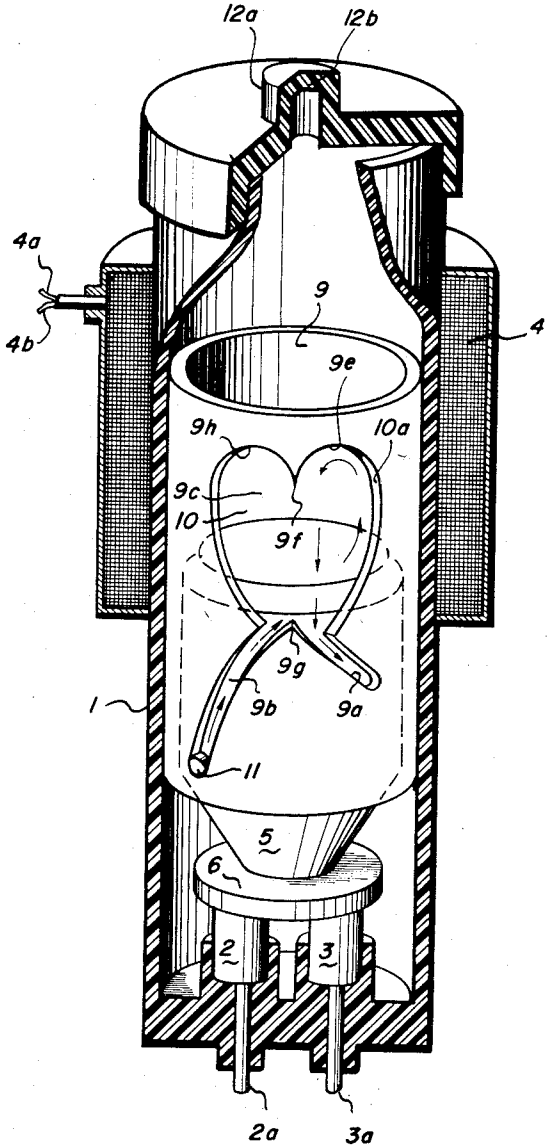
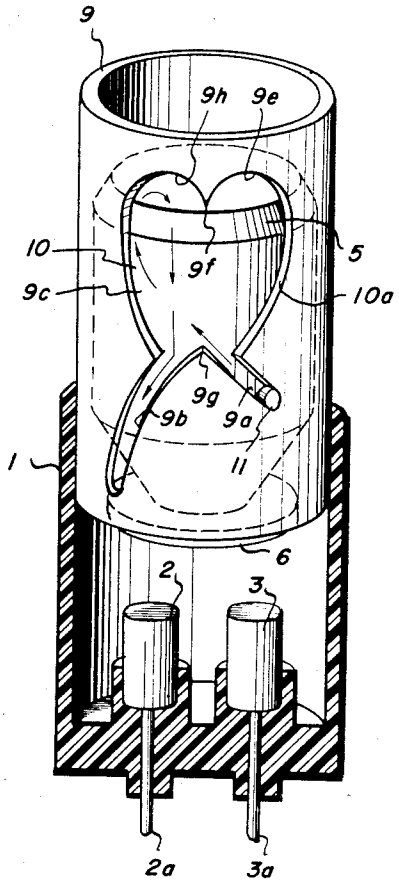


Fig. 2



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ELECTROMAGNETIC SWITCH

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This invention relates to electro-magnetically operated switches, and more particularly to remote control actuated switches of the step-by-step type.

One of the objects of this invention is to provide a magnetically operated switch which utilizes rotary and reciprocal movement of a solenoid plunger or armature to affect the opening and closing of switch contacts upon energizing and de-energizing the coil of the solenoid.

Another object of the invention is to provide a switch which can be manufactured at relatively low cost and which avoids the use of mercury or the like fluid for effecting closure of the switch terminals.

Another object of the invention is to provide a switch wherein the same is operable without the danger of the operator coming in contact with the electric current of the circuit being controlled.

Another object of the invention is to provide a switch having the following important advantages:

(1) To provide a switch which occupies a relatively small space and such, for example, as can be installed under lampshades and the like and which is inconspicuous.

(2) To provide a switch which has a high degree of reliability and which operates utilizing a small current impulse and which is merely sufficient to raise the armature or solenoid plunger.

(3) To provide a switch which is operable without the use of liquid contacting means such as mercury or the like precious metal.

(4) To provide a switch mechanism which is sealed against oxidation, the contact elements being protected by vacuum or inert gas sealed within the switch casing.

(5) To provide a switch mechanism having a minimum number of working parts and which is not subject to wear to any appreciable extent and is long-lasting and durable.

The invention provides a switch which has the advantages hereinabove pointed out and which is useful as a light switch or for controlling electrical circuits in the operation of electrical equipment, as may be desired.

These and other features and advantages of the invention will become apparent from the following description taken in conjunction with the drawings which form a part of this specification.

In the drawings—

Figure 1 illustrates in vertical cross section a switch constructed in accordance with the preferred embodiment of this invention;

Figure 2 is a similar view illustrating the switch in open position, the coil and parts of the casing being broken away to illustrate the operation of the switch more clearly.

Referring to the drawings more in detail, and particularly to Figure 1, an electrical current impulse switch is illustrated which comprises a tube or casing **1** which is adapted to be vacuum sealed or filled with a neutral or inert gas such as helium, argon or the like. In the

lower end of tube **1** there is provided electrical contacts **2** and **3**, the same being connected to wire leads **2***a* and **3***a* which extend from the bottom of the tubular casing **1**, as shown in the drawings. In the upper part of the tubular casing there is arranged a coil **4** which is connected through leads **4***a* and **4***b* with a source of electric current.

The switch mechanism comprises an armature **5** which is loosely fit in the tubular casing **1** so that the same can be raised and lowered. Armature **5** comprises a plunger or core of the solenoid and which is caused to move vertical into the solenoid coil **4** by current flowing through the coil. At the lower free end of the armature **5** there is provided a contact plate **6** which is made of copper or the like electrical conducting material. This contact plate may be formed integral with the armature **5** or threaded thereon to provide a removable contact plate, the same being adapted to rest evenly on the contacts **2** and **3** so as to close the electrical connection between the contacts **2** and **3**. This takes place when the armature **5** is in the position shown in Figure 1.

In the tubular casing **1** there is provided a cylindrical sleeve member **9** which is friction-fit to the inner wall of the tubular casing **1**. The sleeve **9** comprises an apertured side wall which is adapted to form an apertured slot **10** which provides a cam track or guide surface **10***a* for controlling the movement of the armature **5**. The apertured slot **10** in the sleeve member **9** is preferably made of non-magnetic material such as brass or the like, and has the configuration shown in Figures 1 and 2. The sleeve **9** is suitably secured to the outer tube or casing **1** and guides the movement of the armature **5** as it reciprocates under the influence of the solenoid coil and gravity.

To guide the armature **5** during its movement, a pin **11** is provided on the armature **5**, being integral therewith or threaded thereinto. The pin **11**, which may be in the form of a roller, fits loosely in the groove portions **9***a* and **9***b*. Groove **9***a* comprises a short length sector and groove **9***b* a longer and curved slot which communicates with a heart-shaped apertured portion **9***c*.

The heart-shaped apertured guide portion **9***c* connects with the spaced depending short and long grooves and forms an important feature of this invention and functions to give the armature a twisting rotary movement as the same is drawn upwardly upon energizing the solenoid coil **4**. This twisting rotary movement, as produced through the co-action of pin **11** with the arcuate-shaped groove surfaces **9***a* and **9***b*, accurately positions the armature **5** so that the pin **11** enters the proper guide groove upon de-energization of the solenoid coil **4**.

In accordance with the principal feature of the invention, the guide grooves or slots **9***a* and **9***b* of the apertured sleeve member **9** are arcuate-shaped, as illustrated in the drawings. This arcuate shape gives the armature **5** a strong twist, as described, as it moves upwardly under the influence of the coil **4**. This results in placing the pin **11** in the uppermost right hand sector of the heart-shaped guide groove **9***e* when the armature **5** is raised from the position shown in Figure 1. The arcuate shape of the groove in which pin **11** slides or rolls, increases the safety factor of the switch since the provision of the abutments **9***f* and the lower abutment **9***g* of the heart-shaped aperture **9***c* prevent the pin from falling into the wrong groove. The right part of the heart-shaped sector **9***c* of the guide groove positions the pin over the short groove **9***a* so that upon de-energization of the coil **4** the armature drops by gravity and the pin is guided into the short groove **9***a*. This shortened groove **9***a*, as will be seen by reference to Figure 2, maintains the plate **6** out

of contact with the terminals 2 and 3 and thus the switch is held open until the coil 4 is again energized.

In accordance with one embodiment of the present invention the switch elements, for example the tubular member 1, is made of transparent plastic material such as polystyrene or methyl methacrylate thermoplastic resin from which the parts may be readily molded. The lower switch contacts 2 and 3 are preferably maintained under airtight, e. g. vacuum or inert atmosphere, to prevent oxidation effects. This may be readily accomplished by providing a nipple portion as at 12*a*, as illustrated in Figure 1, and withdrawing the air and then sealing the cap portion as at 12*b*, as by fusing the nipple portions together after withdrawing the air. If desired, the interior of the switch casing may be filled with inert gas after withdrawing the air by introducing helium, argon or the like gas therein, as aforementioned.

A switch thus made of plastic material has the advantage of being unbreakable and is light in weight. The upper closure portion 12*a* as well as the body or casing of the switch may also be made of plastic material so that the entire unit is unbreakable.

In the operation of the switch the armature guide pin 11 normally rests in the slot 9*a* which is the shorter of the two slots 9*a* and 9*b*, thus retaining the contact with terminals 2 and 3, as illustrated in Figure 2.

When the solenoid coil 4 is energized as by closure of the switch or the like in the lead lines to the coil, the auxiliary current in the coil causes the armature 5 to be raised and the pin 11 to move out of the slot 9*a* and into the left sector 9*h* of the heart-shaped grooved guide aperture and upon de-energizing of the coil the armature 5 then falls by gravity and the pin 11 engages in the long slot 9*b* and allows the contact plate 6 to come to rest on the terminals 2 and 3 and thus close the circuit through the lines 2*a* and 3*a*.

In the operation, the armature 5 when again operated by excitation of the coil 4, is given a twist or spinning movement so that the guide pin 11 is thrown by the force of the twisting movement into the sector 9*e* and momentarily rests at the top of the sector at the right of abutment 9*b*, as shown in the drawings in Figure 1. In this position the guide pin 11 is thus held directly over the short slot 9*a*. On de-energizing the coil, the armature then falls by gravity and the guide pin 11 enters the short slot 9*a* and retains the contact plate 6 out of contact with the terminals 2 and 3 and the switch is retained open. This operation is repeated upon each excitation of the solenoid coil 4. The heart-shaped grooved aperture in the member 9 makes it substantially impossible for the guide pin 11 to enter the grooves other than the groove immediately below the right or left sector of the heart-shaped grooved aperture. Consequently the armature cannot be made to operate inaccurately where the switch is installed properly.

Energization of the solenoid coil 4 may be effected through a shunt or auxiliary circuit, and the circuit closed momentarily to the coil 4 by a push-button switch as, for example, in use of the device as a light switch or the like. Each time the push-button is operated to momentarily close the circuit to the coil 4, the armature 5 will be raised and pin 11 of the armature moved from groove 9*a* to 9*b* or vice versa depending upon the initial position of the armature. Coil 4 may also be connected for energization in an auxiliary circuit and use being made of a relay contact switch to momentarily energize the coil to actuate the armature 5 of the device.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What is claimed is:

1. An electro-magnetically operated switch comprising a casing filled with inert gas, electrical contacts arranged in the bottom of said casing, a coil arranged around the upper portion of said casing, armature means comprising a plunger forming a core for said coil and which is caused to move vertically upon energizing said coil, said armature comprising a contact plate which is adapted to close said electrical contacts in the bottom of said casing, when the armature is positioned in its lowermost position in said casing, and means comprising a grooved guide member cooperating with said armature for predetermining the position of said armature relative to said electrical contacts, said grooved guide member comprising a heart-shaped apertured member disposed in said casing and fixedly retained thereto, and pin means carried by said armature and cooperating with said grooved guide member for predetermining the position of said armature upon momentary energization of said coil, said grooved guide member comprising a heart-shaped aperture with communicating depending grooves for receiving said pin means carried by said armature.

2. An electro-magnetically operated switch comprising a casing, electrical contacts arranged in said casing, a movable contact member adapted to be moved in position to close said electrical contacts, electro-magnetic means for moving said movable contact members alternatively from a position to close said electrical contacts to a position to retain the same open upon successive operation of said electro-magnetic means when said contacts are open, said electro-magnetic means comprising a solenoid coil and armature cooperating therewith, which armature is raised upon energizing said coil, and means carried by said armature and cooperating with a grooved guide member for predetermining the position of said armature, said grooved guide member comprising a pair of depending grooves communicating with a heart-shaped aperture, and means carried by said armature for slidably fitting in said grooves to position said armature relative to said electrical contacts.

3. An electro-magnetically operated switch comprising a casing filled with inert gas, electrical contacts arranged in the bottom of said casing, a coil arranged around the upper portion of said casing, armature means comprising a plunger forming a core for said coil and which is caused to move vertically upon energizing said coil, said armature comprising a contact plate which is adapted to close said electrical contacts in the bottom of said casing when the armature is positioned in its lowermost position in said casing, and means comprising a grooved guide member cooperating with said armature for predetermining the position of said armature relative to said electrical contacts, said grooved guide member comprising a heart-shaped apertured member disposed in said casing and fixedly retained thereto, and pin means carried by said armature and cooperating with said grooved guide member for predetermining the position of said armature upon momentary energization of said coil, said grooved guide members comprising a heart-shaped aperture with communicating depending grooves, and means carried by said armature for slidably fitting in said grooves to position said armature relative to said electrical contacts.

4. An electro-magnetically operated switch comprising a casing filled with inert gas, electrical contacts arranged in the bottom of said casing, a coil arranged around the upper portion of said casing, armature means comprising a plunger forming a core for said coil and which is caused to move vertically upon energizing said coil, said armature comprising a contact plate which is adapted to close said electrical contacts in the bottom of said casing when the armature is positioned in its lowermost position in said casing, and means comprising a grooved guide member cooperating with said armature for predetermining the position of said armature relative to said electrical contacts, said grooved guide member comprising a heart-shaped apertured member disposed in said casing and fixedly retained thereto, and pin means carried by said armature and cooperating with said grooved guide

member for predetermining the position of said armature upon momentary energization of said coil, said grooved guide members comprising a heart-shaped aperture with communicating depending grooves, and means carried by said armature for slidably fitting in said grooves to position said armature relative to said electrical contacts, said grooves consisting of one long and one short groove, said long groove being adapted to cooperate with said armature to close said electrical contacts and said short groove being adapted to cooperate with said armature to position the armature so as to retain said contacts open.

5. An electro-magnetically operated switch comprising a casing filled with inert gas, electrical contacts arranged in the bottom of said casing, a coil arranged around the upper portion of said casing, armature means comprising a plunger forming a core for said coil and which is caused to move vertically upon energizing said coil, said armature comprising a contact plate which is adapted to close said electrical contacts in the bottom of said casing when the armature is positioned in its lowermost position in said casing, and means comprising a grooved guide member cooperating with said armature for predetermining the

position of said armature relative to said electrical contacts, said grooved guide member comprising a heart-shaped apertured member disposed in said casing and fixedly retained thereto, and pin means carried by said armature and cooperating with said grooved guide member for predetermining the position of said armature upon momentary energization of said coil, said grooved guide members comprising a heart-shaped aperture with communicating depending grooves, and means carried by said armature for slidably fitting in said grooves to position said armature relative to said electrical contacts, said grooved guide members being arcuate-shaped to give said armature a twisting rotary movement as the same is drawn upwardly upon energizing said coil.

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