

Aug. 30, 1966

G. A. GARIEPY ET AL
MAGNETICALLY OPERATED MERCURY SWITCH WITH IMPROVED
SLIDABLE AND ROTATABLE MAGNETIC ACTUATORS
Filed Feb. 21, 1963

3,270,165

FIG. 1

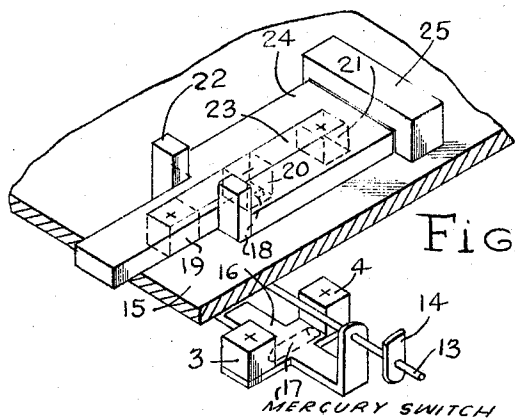
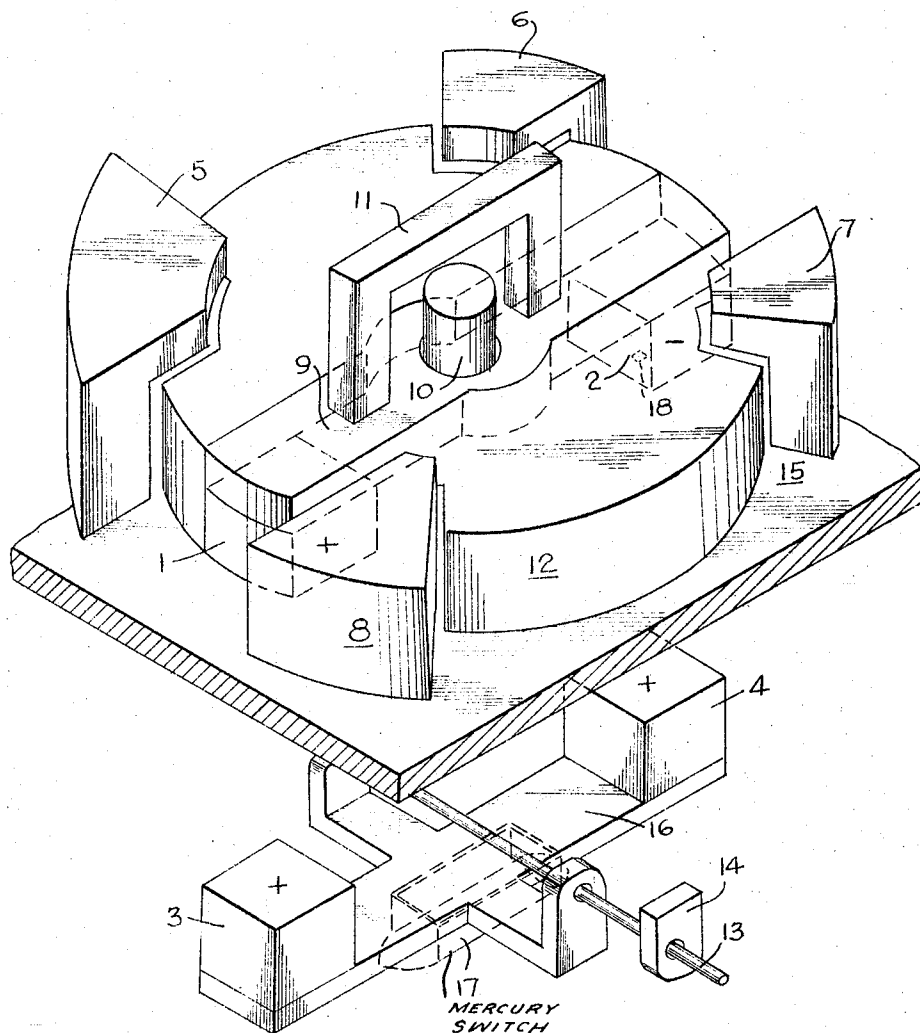


FIG. 2

INVENTORS
GEORGE A. GARIEPY &
OTIS R. PANNELL
BY *James A. Hill*

ATTORNEY

1

3,270,165

MAGNETICALLY OPERATED MERCURY SWITCH WITH IMPROVED SLIDABLE AND ROTATABLE MAGNETIC ACTUATORS

George A. Gariepy, Springfield, and Otis R. Pannell, Alexandria, Va., assignors to the United States of America as represented by the Secretary of the Army

Filed Feb. 21, 1963, Ser. No. 260,338

11 Claims. (Cl. 335-54)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to us of any royalty thereon.

The invention herein relates to a magnetically operated mercury switch particularly adapted for use inside sealed enclosures.

The principal object of this invention is to provide a mercury switch that can operate through a solid wall without any electrical or mechanical connection between the switch elements on the inside of the wall and the switch handle on the outside.

Another object of this invention is to provide a mercury switch in which the working mechanism can be removed and the switch remain constantly in either its on or off position.

FIG. 1 is a pictorial view of the magnetically operated mercury switch with a rotating disc mechanism actuating the switch; and

FIG. 2 is a pictorial view of the magnetically operated mercury switch with a sliding bar mechanism actuating the switch.

The switch as shown in FIG. 1 is comprised of two main parts. The first part is the rotating handle and switching assembly and the second part is the rocker and vial assembly. Separating the two elements is a non-magnetic plate 15 that might easily be a wall of an enclosure containing an explosive media. If the conventional snap switch having electrical contacts were used it would be dangerous because this type of switch produces a spark when it is snapped between its on and off positions. Here, in this invention the hazard of fire and explosion is eliminated because the handle and the rocker arm assemblies have no electrical or mechanical connections between them, and the electrical contacts are sealed within a mercury filled chamber. The entire motive coupling between the two assemblies is accomplished with permanent magnets. As there is no necessity for connecting linkage between the inside and outside of the wall this switch can be conveniently used where electrical switching is needed inside an evacuated or pressurized compartment.

On one side of the non-magnetic plate the handle and switching element is found. This assembly is comprised of a circular nonmagnetic member 12, L-shaped lugs 5, 6, 7 and 8, handle 11, magnetic poles 1 and 2, and center post 10. Center post 10 is welded to the top or outside of plate 15 in a normal position to it. Also welded to the plate 15 and equally spaced about the center post 10 are the four inverted L-shaped lugs 5, 6, 7 and 8. Circular disc 12 has a center hole which allows it to be slipped over post 10 and rotate about said post. Around the periphery of the plate 12 are notches coinciding to the overlapping portion of the four lugs. When the disc is in a particular position the disc can be lifted off the center post by handle 11 because the notches allow it to slide up past the overhang of lugs 5, 6, 7 and 8. Handle 11 is fastened to the disc at its center so the disc will be balanced when it is lifted off.

At diametrically opposite positions of circular disc 12 are recesses to receive a magnet having a south pole 1 and north pole 2. Across the top of disc 12 is a groove connecting the two recesses. With the interconnecting groove the disc thus is provided with a groove or recess up one

2

edge, across the top and down the opposite edge. This will give a sort of a U-shaped groove for a horseshoe type magnet with south pole 1, back member 9, and north pole 2. A widened portion in the back member of the magnet and the recess in which it fits provides sufficient metal in the backing member for strength and for the lines of force in the permanent magnet. The hole for post 10 enabling disc 12 to rotate goes through this widened portion in back member 9.

The rocker and vial assembly is directly below the handle and switching mechanism and on the opposite side of wall 15. Comprising the rocker and vial assembly are; rocker arm 16, rectangular magnets 3 and 4, rocking pin 13, supports 14 and mercury filled vial 17. Rocker arm 16 is rotated about its center through two upturned ears centrally located, each having a hole through which is placed pin 13. At each end of the rocker arm are rectangular magnets so oriented that the south pole of both magnets are on the top side, the north pole being on the bottom, both of said magnets being secured to the ends of the rocker arm. Supports 14 are welded to the under side of plate 15 and have holes for pin 13 on which rocker arm 16 is rotated. The supports 14 are positioned so that the magnets of the rocker assembly are directly beneath the magnets of the switching and handle assembly. This allows the magnet 3 to be either attracted by magnet 2 or repelled by magnet 1 depending on which position the rotating disc is in. Likewise, magnet 4 can be either attracted or repelled.

Fastened on the bottom of the rocker arm and at its center is the mercury filled vial 17. This vial is the conventional vial used in all mercury switches. It has a pair of contact electrodes sealed in one end of the vial and protruding into the inside of said vial. When the vial is tipped in one direction, the mercury all runs to the lowest end. If the two electrodes which are sealed in one end of the vial are at the lower end, the mercury flows down and serves as a conducting media between the two electrodes. Conversely, if the two electrodes are at the higher end, the mercury flows to the opposite end, leaving no conductor between the two electrodes thereby breaking the circuit.

Locking means is necessary to hold the vial and the pivot arm in either the on or off position when the rotating disc 12 is removed. Such locking means is comprised of a small piece of ferromagnetic material embedded in the isolating plate 15 directly above magnet 4. This small ferromagnetic element will cause the magnet to cling to the underside of plate 15 when the switch mechanism is rotated so that magnet 2 attracts magnet 4. When magnet 4 comes in contact with the small piece of ferromagnetic material 18, the magnet clings to it thereby lifting the end of rocker arm 16 having magnet 4. With the rocker arm in this position the rotating disc containing magnets 1 and 2 can be lifted off the center post. Removal can be easily accomplished with the disc oriented so as to cause magnet 4 to be attracted to magnet 2, because this is the position of the disc 12 which will allow it to be lifted off the retaining lugs 5, 6, 7 and 8. Hence, the lugs provide an orientation guide for the removal of disc 12 which leaves the rocker arm locked either in its on or off position depending on which end of the vial the electrodes are embedded.

A modification of the locking means is brought about by the insertion of another small ferromagnetic element in the bottom of plate 15 directly above magnet 3. This will give an element for either magnet 3 or 4 to cling to. By revolving circular disc 12 180° and removing it, the rocker arm can be locked either in the on or off position regardless of which end of the mercury vial the electrodes are embedded. By using two pieces of ferromagnetic ma-

3

terial instead of only one such element as 18 explained above, an alternate locking position is achieved.

Still another modification involves leaving the circular disc on the spindle or post all the time. Where all that is needed is momentary contact instead of sustaining the switch in the on position, the circular plate with its handle can be spring biased so that it always returns to its off position when the handle is released.

FIG. 2 shows a different type actuating means for operating the mercury switch. Here, the switch is operated by a sliding bar mechanism instead of a rotating plate. Beneath wall 15 the rocker arm and vial assembly is identical with the rocker arm and vial assembly of the switch shown in FIG. 1. The difference over the rotating disc switch is above wall 15 where a sliding T-shaped member 24 carrying permanent magnets 19, 20 and 21 embedded within it actuates the rocker arm assembly. The rectangular permanent magnets have alternating poles adjacent to wall 15. Magnet 20 has its negative pole adjacent to wall 15 while magnets 19 and 21 have their positive poles adjacent to the wall 15. Connecting all three of the magnets is a ferromagnetic strip 23 embedded in the top of sliding bar 24. A U-shaped guide 25 permits the sliding bar to be moved back and forth but prevents lateral movement of the bar. This guide holds the sliding bar in position so that the magnets embedded within the bar are directly over the magnets of the rocker arm assembly when the sliding bar is at either of its two extreme positions. A pair of stops 22 serve to limit the movement of the sliding bar and also guide the bar in its reciprocal motion. The narrow handle portion at one end of the sliding arm is easily grasped to manually operate the switch.

When the sliding arm is positioned with the wide portion butting against the stops 22, the whole sliding arm can be removed by lifting it vertically off wall 15. A small piece of ferromagnetic material 18 is embedded within the bottom surface of wall 15 directly above magnet 3. When the sliding bar is pulled into its removal position, magnet 20 which is negative attracts magnet 3 which is positive. Rocker arm 16 will rotate and magnet 3 will swing up until it is in contact with the underside of wall 15. Upon contact with wall 15 at the point where the piece of ferromagnetic material 18 is embedded magnet 3 will cling to the underside of wall 15. Sliding bar 24 can then be removed without disturbing the angular position of the vial 17. Removal of the sliding bar eliminates the accidental actuation of the switch because of the positive action required to turn the switch on and off. The sliding arm must be inserted before the switch can be moved. Also, with the sliding arm removed, the switch is somewhat tamperproof because the switch can only be turned on or off with the sliding bar or a similar arrangement of magnets. In both of these respects the magnetically operated mercury switch is much safer than a switch such as the toggle type.

Operation of the switch is accomplished by inserting the sliding bar 24 in position between guide 22 and guide 25 and pushing the bar to the right until magnet 19 is directly over magnet 3. Magnet 19 being positive and magnet 3 being positive, these magnets will repel and the magnetic repulsion will be greater than the attraction of magnet 3 for the embedded ferromagnetic material 18. The rocker arm 16 will then swing to its other extreme and will be stopped when magnet 4 contacts the underside of wall 15, and the mercury in vial 17 will run to the opposite end either making or breaking electrical contact.

We claim:

1. An electrical switch comprising:

- (a) A mercury filled vial having two electrodes sealed in one end and mounted on one side of a non-magnetic supporting wall through tiltable vial supporting means;
- (b) A movable support member for a series of permanent magnets, said support member being mounted

4

the opposite side of the supporting wall and having guide means allowing said movable member to be removed from the supporting wall; and

- (c) Permanent magnets carried by said movable support member and tiltable vial supporting means capable of magnetically coupling the movable support member to said tiltable vial support means.

2. An electrical switch comprising:

- (a) A mercury filled vial with two electrodes sealed in one end of the vial, said vial being mounted on one side of a non-magnetic supporting wall through tiltable supporting means;
- (b) A removable circular disc rotatably mounted on the opposite side of said wall by means of a center post normal to the wall, said disc having orientation and guide means for its removal; and
- (c) Magnets within said circular disc and vial supporting means capable of magnetically coupling the rotating disc to said tilting vial support means.

3. An electrical switch comprising:

- (a) A circular nonmagnetic disc having a series of peripheral notches and a permanent U-shaped magnet with spaced poles projecting downward fitted within a U-shaped recess within the top of said circular disc, said disc having an axial hole through its center;
- (b) A center circular post for the circular disc to rotate about, attached to and also normal to a non-magnetic supporting wall for the switch;
- (c) Inverted L-shaped lugs welded to the sides of the wall having the center post with the overhanging lips of the lugs facing the center post and mating with the peripheral notches of the circular disc;
- (d) A rocker arm assembly pivotally supported on the side of the support wall opposite the circular disc;
- (e) A vial partially filled with mercury and having two electrodes sealed in one end, said vial being fastened to the center of the rocker arm; and
- (f) A rectangular magnet secured to each end of the rocker arm, said magnets having like poles nearest the supporting wall, said like poles being diametrically opposed to the poles of said U-shaped magnet within said circular disc.

4. An electrical switch comprising:

- (a) A rocker assembly of
 - (1) a mercury filled vial having two electrodes sealed in one end,
 - (2) a rocker arm supporting said mercury filled vial, said rocker arm pivotally connected to one side of the non-magnetic wall supporting the switch,
 - (3) a rectangular magnet at each end of the rocker arm, each magnet having like poles closest to the supporting wall; and
- (b) A rotating magnet assembly of
 - (1) a circular non-magnetic disc grooved to receive a horseshoe magnet having widely spaced poles, said disc having a series of notches about its periphery and a handle for lifting,
 - (2) a center post welded to the supporting wall and normal to it about which the circular disc can rotate, said post being welded to the side of the supporting wall opposite from the side with the rocker arm assembly,
 - (3) and a series of inverted L-shaped lugs equidistant about the said post and mated to the peripheral notches in the circular disc.

5. An electrical switch as claimed in claim 3 having a ferromagnetic element embedded in the supporting wall directly above one of the rectangular magnets of the rocker arm assembly.

6. An electrical switch as claimed in claim 3, having a ferromagnetic element embedded in the supporting wall directly above each rectangular magnet of the rocker arm assembly.

7. An electrical switch as claimed in claim 3, in which the rotatable circular disc is spring biased.

8. An electrical switch comprising:

- (a) A T-shaped sliding bar of non-magnetic material slidably mounted on and removable from one side of a non-magnetic supporting wall, said T-shaped sliding bar having recessed in one face three spaced rectangular permanent magnets, the center magnet having its negative pole exposed on one face of said T-shaped bar, and the two end magnets having their positive poles exposed on the same face surface of said T-shaped bar;
 - (b) A U-shaped guide secured to the supporting wall, said U-shaped guide receiving a first portion of said T-shaped bar and allowing the T-shaped bar to be reciprocally moved while having its surface containing the exposed poles of said permanent magnets in face relationship with the supporting wall;
 - (c) A pair of spaced guide stops secured to the supporting wall and spaced to receive a second portion of said T-shaped bar;
 - (d) A rocker arm assembly pivotally supported on the side of the support wall opposite said T-shaped bar;
 - (e) A vial partially filled with mercury and having two electrodes sealed in one end, said vial being fastened to the center of said rocker arm; and
 - (f) A rectangular magnet secured to each end of said rocker arm, said magnets having like poles nearest the supporting wall.
9. An electrical switch comprising:
- (a) A removable sliding bar carrying a series of permanent magnets spaced along said bar, each magnet

being so oriented that its poles are reversed from the magnet adjacent to it;

(b) Guide means to limit said sliding bar to reciprocal movement along one side of a non-magnetic supporting wall; and

(c) A rocker arm assembly mounted on the opposite side of the supporting wall, said rocker arm assembly comprising a pivoted rocker arm, a mercury vial switch element attached to said rocker arm, and permanent magnets fixed to said rocker assembly that are attracted or repelled by the permanent magnets of the sliding bar in such a manner as to cause the rocker arm and mercury vial to be tilted when the sliding bar is moved in either direction.

10. An electrical switch as claimed in claim 8 wherein the nonexposed poles of the three recessed permanent magnets are connected by a ferromagnetic strip recessed along the length of said T-shaped sliding bar.

11. An electrical switch as claimed in claim 8 wherein a piece of ferromagnetic material is embedded within the supporting wall directly above one of the permanent magnets of said rocker arm assembly.

References Cited by the Examiner

UNITED STATES PATENTS

2,577,165	12/1951	Thorsheim	-----	200—112	X
2,622,136	12/1952	Christensen	-----	200—112	X
2,634,348	4/1953	Tingley	-----	200—112	

30 ROBERT K. SCHAEFER, *Primary Examiner*.

KATHLEEN H. CLAFFY, *Examiner*.

J. R. SCOTT, *Assistant Examiner*.