March 27, 1962 B. E. SHLESINGER, JR 3,027,435

MULTIPLE CONTACT SWITCH

Filed Oct. 14, 1960

Fig. 1

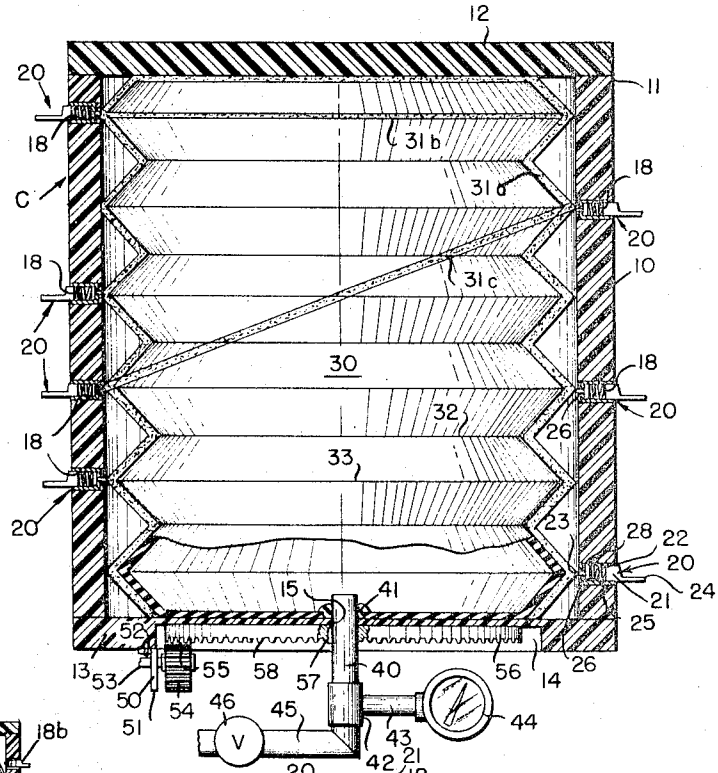


Fig. 4

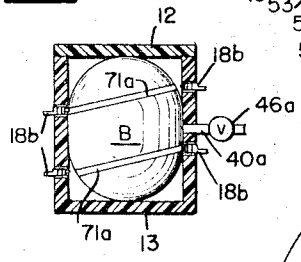


Fig. 2

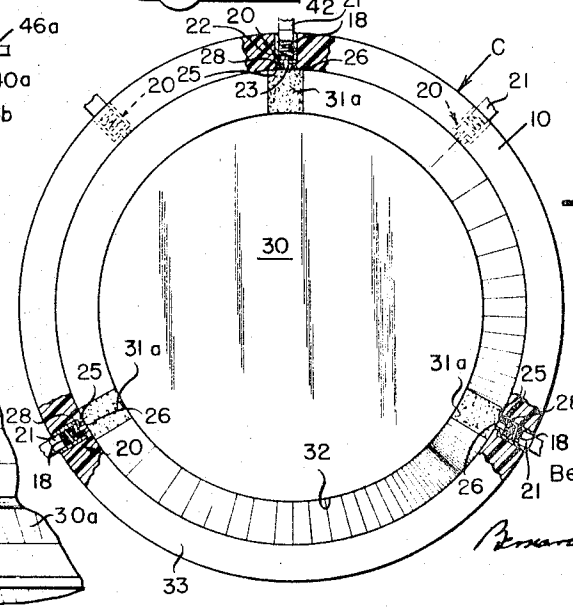
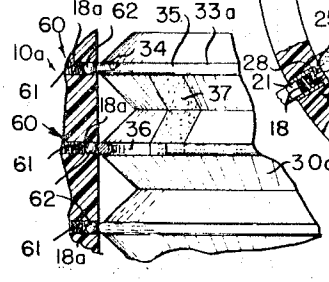


Fig. 3



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3,027,435
MULTIPLE CONTACT SWITCH

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The invention relates to improvements in multiple contact switches and the like. The present invention provides certain variations of multiple contact switches as disclosed in my patent application Serial No. 700,354, filed December 3, 1957, now Patent No. 2,874,237, issued February 17, 1959.

It is an object of this invention to provide a multiple contact rotary switch which has an unlimited number of combinations.

It is an additional object of this invention to provide a contact switch which is simple in construction and inexpensive to manufacture.

It is a further object of this invention to incorporate the use of printed circuits in a multiple contact switch.

It is a further object of this invention to provide a multiple contact switch which is compact and readily assembled.

Still another object of this invention is to provide a contact switch which may be used for programming, computing, aircraft, rockets, telemetry and telephony and the like.

It is another object of this invention to provide a multiple contact switch which may be kept relatively free from dust and moisture.

Still another object of this invention is to provide a switch which may be operated by changes in atmospheric pressures.

Other objects and various further features of the invention will be pointed out or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side elevation showing the casing in section and a portion of the bellows broken away;

FIGURE 2 is a plan section of the structure shown in FIGURE 1 exemplifying one possible situation;

FIGURE 3 is a fragmentary section of the modified form of FIGURE 1;

FIGURE 4 is a vertical section showing a further modification of this invention.

The switch comprises a cylindrical casing C of any suitable insulating material having a wall **10**. The casing will be mounted on a component by brackets or the like depending on the position where it is located. The casing C has sealed or otherwise secured to its top portion at **11**, a closure wall **12**. The base **13** may be fastened to casing C in any suitable manner, for example, by threading base **13** to casing C (not shown). The base **13** has an inset portion **14**. The inset portion **14** has a centralized cylindrical opening **15**. Wall **10** of casing C has openings **18** extending through to the inside. The openings **18** have electrical contacts **20** inset therein. The contacts **20** may be located as desired depending upon the type of installation required. Electrical contact **20** comprises lug **21**, spring **22**, and contact **23**. The lug **21** is set in opening **18** and has an arm **24**. The arm **24** is for connecting electrical wiring thereto. The spring **22** urges contact **23** towards the inside wall **10**. The openings **18** have shoulders **25** on the inside wall **10**.

The shoulders **25** only allow the tip **26** of contact **23** to extend past the edge of opening **18**. The shoulders **28** of contact **23** engage with shoulders **25** of the opening **18** to prevent further movement of the contact **23**.

The casing C contains a collapsible bellows **30**, which is made of a nonconductive material. The bellows **30**

has on its surface printed circuits, for example, **31***a*, **31***b* and **31***c*. The printed circuits may be of any configuration so desired. For example, printed circuits **31***a* are shown on a vertical plane electrically connecting inner rim **32** of bellows **30** with an outer rim **33** and back to another inner rim **32** and so on until a conductive circuit is completed between two or more electrical contacts **20**. Other examples shown in FIGURE 1 are printed circuit **31***c* going from one electrical contact **20** diagonally across the bellows **30** to another electrical contact **20**, and printed circuit **31***b* going horizontally across the bellows **30** from one electrical contact **20** to another electrical contact **20**.

Bellows **30** has a vacuum line **40** in sealing and keyed engagement at **41** for rotation about its axis as will be explained hereafter. Vacuum line **40** extends through opening **15** and is connected to a coupling **42** provided with a seal (not shown). The coupling **42** has a line **43** which is connected to a gage **44** and a line **45** which is connected (not shown) to a vacuum pump or other means of compression. A valve **46** in line **45** permits closure of the vacuum line **40**.

Base **13** has an L-shaped frame **50** mounted on the exterior side. Frame **50** has an arm **51** extending down perpendicular to the base **13**. The arm **51** is flush with the edge of inset portion **14**. Arm **51** has a centralized cylindrical opening **52**. The opening **52** has a rotatable shaft **53** extending therethrough. The shaft **53** may be connected to (though not shown) a rotating source, such as a controlled electric motor. The opposite end of shaft **53** has a gear **54**, which is keyed to shaft **53** and is locked on by any suitable means. The gear **54** has teeth **55** which are parallel to the axis of rotation of shaft **53**. In mesh with gear **54** is a second gear **56**. The gear **56** is keyed at **57** to vacuum line **40**. Teeth **58** of gear **56** are perpendicular to the axis of rotation of vacuum line **40**.

For illustration purposes the printed circuits **31***a*, **31***b* and **31***c* of FIGURE 1, are shown thicker than normal. A thin film is all that is essential for carrying a current. If the printed circuit is too thick some resistance will be created to the rotary motion of the bellows, particularly at the contacts. Also a ball bearing may be used in place of contact **20** to prevent excess wear. In this case the rim **33** would have a rounded edge.

In the modified form of FIGURE 3 the bellows **30***a* shows the outer rim **33***a* having a groove **34**. The groove **34** has a ring **35** which encircles the bellows **30***a* on each outer rim **33***a*. The ring **35** is made of a conductive material and can be broken as shown at **36**. In place of broken portion **36**, portions of the ring may be of a nonconductive material or coated with a nonconductive material to vary the circuitry as desired. The ring **35** may be electrically connected as shown with printed circuit **37** which underlies the rings **35**. The modified electrical contact **60** sets in opening **18***a* of wall **10***a* and comprises a spring element **61** which has a contact ball **62** connected thereto.

In FIGURE 4, bellows **30** is replaced by a balloon B which has printed circuit **71***a*. Air may be pumped into balloon B through air line **40***a* to cause expansion of balloon B toward the wall **12** and the base **13**, thereby changing the position of printed circuit **71***a*. Valve **46***a* permits closure of air line **40***a*. The balloon B may be made of any flexible nonconductive material.

No rotation means are shown for the balloon B; however, this may be applied in the manner shown in FIGURE 1, but collapsing of the balloon B will be necessary before rotation can be made, and after proper indexing, the balloon B will thereupon be inflated again.

Air pressure between wall **12** and the balloon B will

normally be relieved through contact openings **18***b* as also would be the case where the bellows **30** is used. Any other means of relief could also be applied. It is also obvious that any fluid may be used in place of air for expanding bellows **30** or balloon B.

Operation

From the foregoing description it will now be readily seen in FIGURES 1, 2 and 3 that upon rotation of shaft **53**, gear **54** will rotate. Gear **56** will also rotate being meshed with gear **54**, and vacuum line **40** will rotate with gear **56**. Bellows **30** being in sealing engagement with the vacuum line **40** will rotate, changing the relationship of contacts **20** in regard to the outer rim **33**. It is obvious that other connection and rotation means may be provided for the bellows **30** depending upon the type of equipment in which the switch is to be used. The showing here is merely illustrative of one way of carrying out the teaching of this invention. In FIGURE 2 it may be seen that upon rotation of the bellows **30** to the right will change contacts of the printed circuits **31***a* with the next succeeding contact **20**.

On actuation of vacuum pump the air in bellows **30** is evacuated thereby compressing bellows **30** toward the base **13**. As the result of the evacuation the outer rims **33** change position in regard to electrical contacts **20**.

Upon rotation of shaft **53** simultaneously with evacuation of bellows **30**, the bellows **30** is rotated and compressed thereby changing electrical contacts **20** in regard to the outer rim **33**.

It is obvious that atmospheric changes in pressure on the outside surface of balloon B or the bellows **30** can be used to collapse or expand the balloon B or the bellows **30** to change circuits.

It can now be readily seen that innumerable contact positions can be devised on the inside cylindrical surface of casing C, as well as on the bellows **30** or the balloon B.

While the invention has been described in connection with different embodiments thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general the principles of the invention and including such departures from the present disclosure as come within knowing, or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth and fall within the scope of the invention or the appended claims.

Having thus described my invention what I claim is:

1. A multiple contact switch comprising an insulated casing member, an insulated deformable member, at least three contacts in the wall of said casing member, said deformable member carrying contact means for contacting said contacts, said contact means comprising at least two distinct printed circuits separated at least in part by a non-conducive surface, means for rotating one of said members, means for deforming said deformable member, whereby upon rotation of one of said members, or deformation of said deformable member or both, the circuit between said contacts and said contact means will be changed.

2. A multiple contact switch as in claim 1 and wherein said deformable member is fluid operated.

3. A multiple contact switch as in claim 1 and wherein said deforable member includes a bellows.

4. A multiple contact switch as in claim 1 and wherein said deformable member includes a balloon.

5. A multiple contact switch as in claim 1 and wherein said contact means is a printed circuit.

6. A multiple contact switch as in claim 1 and wherein said deformable member includes a fluid expandable chamber.

7. A multiple contact switch as in claim 1 and wherein said deformable member includes a sealed chamber having an expandable fluid therein.

8. A multiple contact switch as in claim 1 and wherein said deformable member includes a fluid expandable chamber, said switch including valve means for controlling said fluid in said chamber.

9. A multiple contact switch as in claim 1 and wherein said deformable member includes a bellows, said bellows having a ring member secured to each peak of said bellows for providing electrical contact between said contacts and said deformable contact means.

10. A multiple contact switch as in claim 1 and wherein said deformable member includes a bellows, said bellows having at least one ring member secured to each peak of said bellows for providing electrical contact between said contacts and said deformable member, said ring member being interrupted by non-conductive sections.

11. A multiple contact switch as in claim 1 and wherein said deformable member includes a fluid operated deformable member having at least one ring member secured at intervals thereto and in wiping contact with the wall of said casing for providing electrical contact between said contacts and said deformable member.

12. A multiple contact switch as in claim 1 and wherein said deformable member includes a fluid operated deformable member having at least one ring member secured at intervals to the outside thereto and in wiping contact with the wall of said casing for providing electrical contact between said contacts and said deformable member, said ring being interrupted by non-conductive sections.

13. A multiple contact switch as in claim 1, and wherein said deformable member includes a bellows, said bellows having outer rims, said outer rims of said bellows being in constant frictional engagement with the inside surface of the cylindrical wall of said casing.

14. A multiple contact switch as in claim 1 and wherein at least a portion of said deformable member is in continuous wiping engagement with the wall of said casing member, and said wiping portion including portions of said two distinct conductive surfaces.

15. A multiple contact switch comprising an insulated casing member, an insulated deformable member including a distortable printed circuit, contacts on the wall of said casing member for contacting said printed circuit, means for rotating said deformable member and said printed circuit, and means for distorting said printed circuit, whereby upon rotation or distortion, or both, of said printed circuit, the circuit between said contacts and said printed circuit will be changed.

16. A multiple contact switch comprising an insulated casing member, an insulated deformable member including a deformable printed circuit, contacts on the wall of said casing member for controlling said printed circuit, means for deforming said deformable member and said printed circuit, said deforming means including a fluid supply and exhaust system, whereby upon distortion of said printed circuit, the circuit between said contacts and said printed circuit will be changed.

17. A multiple contact switch, comprising an insulated casing member, an insulated deformable member including a distortable printed circuit, contacts on the wall of said casing member for contacting said printed circuit, and means for moving said deformable member and said printed circuit in more than a single plane to effect contact between said contacts and said printed circuit whereby to change from one circuit to another, said moving means including a fluid supply and exhaust system.

18. A multiple contact switch comprising a non-conductive casing, at least three stationary contacts in wall of said casing, a rotatable and compressable member contained inside of said casing, printed circuits on outside surface of said member, said printed circuits comprising at least two distinct printed circuits separated at least in part by a non-conductive surface, means for rotating said member without compression, means for com-

pressing said member without rotation, and combined means for simultaneous rotation and compression of said member, thereby changing relationship of said printed circuits to said stationary contacts.

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