June 15, 1965 R. D. BECK 3,189,704

PNEUMATIC SWITCH ACTUATOR

Filed Nov. 10, 1961

Fig 1.

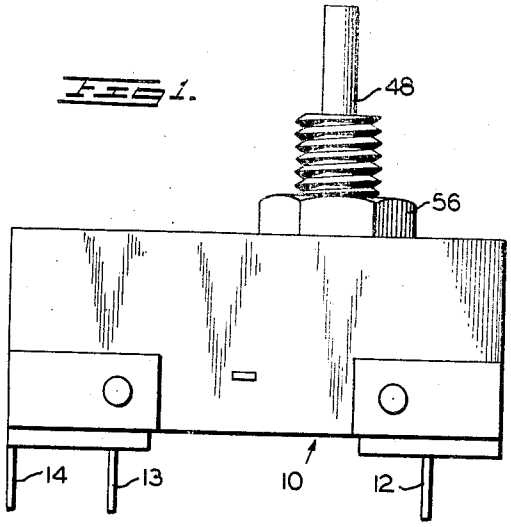
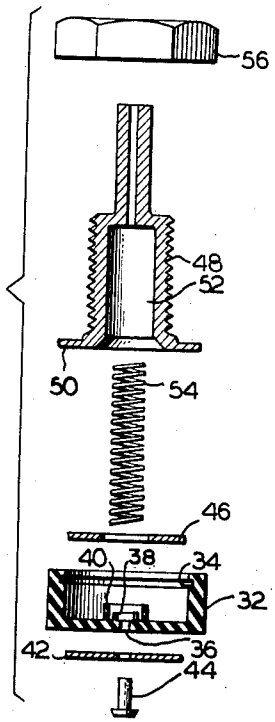
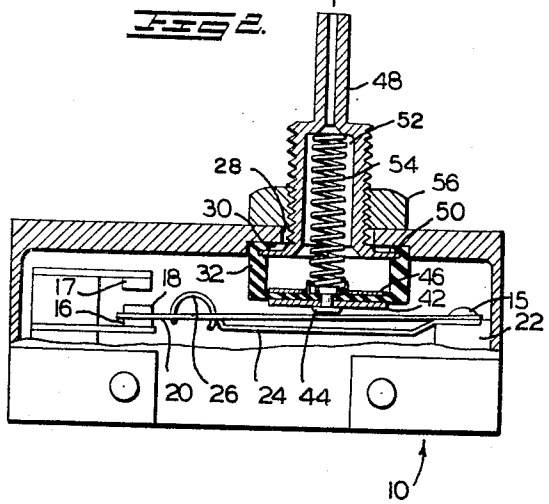


Fig 3.



TO VACUUM

Fig 2.



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PNEUMATIC SWITCH ACTUATOR

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This invention relates to electric switches and more particularly to pneumatically operated electric switches.

An object of this invention is to effect snapping of a pneumatic snap switch by a relatively small actuating force.

Another object of this invention is to provide a snap switch with a small, compact construction which is comparatively inexpensive to manufacture.

This invention has another object in that a snap switch is furnished with a vacuum operation.

It is a further object of this invention to utilize a vacuum source to effect the snap action of a snap switch.

In the preferred embodiment of this invention, a switch casing houses a snap acting mechanism including a movable contact carrying arm for snap movement between a pair of fixed contacts. A pneumatic actuator is carried by the switch casing and includes a vacuum operated element acting on the switch arm to actuate the switch arm with a relatively small actuating force.

Other features and advantages of the present invention will become apparent from the following description of the preferred embodiment taken in connection with the accompanying drawing wherein:

FIG. 1 is a side elevation of a snap switch embodying this invention;

FIG. 2 is a partial section view of FIG. 1; and

FIG. 3 is an exploded view with parts in section of the actuating mechanism shown in FIG. 2.

Referring to FIG. 1, there is shown a casing or switch housing, indicated generally at **10**, having three terminal posts **12**, **13**, and **14** extending therefrom for connection to suitable electrical conductors (not shown). The interior of the housing is substantially hollow and provides a mounting for a common contact **15** and fixed spaced contacts **16** and **17**, which contacts are electrically associated with the terminal posts **12**, **13** and **14**, respectively. A movable contact **18** is secured to a free end of a current carrying blade **20** and is disposed for movement between the spaced contacts **16** and **17**.

The blade **20** constitutes the actuating switch arm of a snap acting mechanism as is well known in the art. As is illustrated in FIG. 2, the switch arm **20** has its fixed end secured to the mounting **22** for the common contact **15**. A rigid support member **24** extends from mounting **22** in spaced parallel relation to the switch arm **20** and has a terminal shoulder portion which engages one end of a U-shaped rolling spring **36**. The spring **26** is operatively disposed in an opening in the switch arm **20** and has its other end engaging a shoulder on the switch arm **20** to form a snap acting mechanism. With such an arrangement an actuating force on the switch arm **20** causes movement of the attached end of the rolling spring **26**; as soon as the moving end of the rolling spring **26** passes a dead center position, the contact carrying end of switch arm **20** is moved with a snap action and contact **18** is snapped from the fixed contact **17** to the fixed contact **16**. When the actuating force on the switch arm **20** is reduced, the snap action is reversed and the contact **18** transfers from the fixed contact **16** to the fixed contact **17**.

The top cover of casing **10** is provided with an aperture **28** and the undersurface of such top cover has an annular recess **30** formed by a counterbore in axial alignment with the aperture **28**. The annular recess **30** constitutes a mounting surface for hermetically sealing a vacuum operated actuating means which is mounted through the aperture **28** and secured to the casing **10**.

The vacuum operated means or pneumatic actuator for the switch arm **20** is best shown in FIG. 3 and includes a generally cup-shaped member or flexible boot **32** made of any suitable resilient material, such as molded rubber. The inner cylindrical wall of the cup-shaped member **32** has an annular recess **34** spaced just below its annular rim. The bottom wall of the cup-shaped boot **32** has a centrally located aperture **36** surrounded by a pair of spaced, upwardly extending annular ribs **38** and **40**. A washer element **42** is securely fastened to the outer surface of the bottom wall by a rivet **44**; a second washer element **46** encircles the annular ribs **38** and **40** and is seated in the bottom of the boot **32**. The two washers **42** and **46** sandwich the bottom wall of the boot **32** to lend rigidity thereto whereby the rivet **44** will always move perpendicularly and will not be tilted out of engagement with the switch arm **20**.

An externally threaded tubular element **48** has an outwardly extending annular flange **50** on its lower edge, which is disposed in the annular recess **34** of the flexible boot **32**; the upper end of tubular element **48** is connected to a vacuum source. The lower portion of tubular element **48** is provided with a counterbore **52** for receiving the upper portion of a coil spring **54** which maintains in axial alignment with its upper and lower ends by having its lower end disposed between the inner and outer ribs **38** and **40**. The coil spring **54** is mounted in compression between the bottom wall of the flexible boot **32** and the shoulder of the counterbore **52** whereby it resiliently biases the rivet **44** into engagement with the switch arm **20**. The assembly is held together by a lock nut **56** threaded onto the tubular element **48** and bearing against the switch housing **10**. The flexible boot **32** is drawn up firmly against the casing recess **30** causing the flexible boot **32** to expand against the walls of the casing recess **30** and thus effect an hermetic seal for a chamber defined by the interiors of the boot **32** and the tubular element **48**.

In the operation of conventional snap switches, an actuating force of a predetermined value x is required to effect initial snap over of the snap acting mechanism. For return action, the actuating force must be reduced to a lesser predetermined value y whereupon the snap acting mechanism operates in the opposite direction. In accordance with the present invention, the coil spring **54** is so designed as to exert an actuating force having a predetermined value slightly larger than x; thus the rivet button **44** is biased against the switch actuating arm **20** which is normally held in its actuated position. The relative positions of the various switch elements are illustrated in FIG. 2 as being in this normal actuated condition.

In order to effect snap action of the switch from its normal position, the construction of this invention presents an arrangement whereby the actuating force on the switch arm **20** requires a reduction of the value of x minus y. Inasmuch as the value of x minus y is relatively small, the effective pressure area of the flexible boot **32** can be quite small resulting in a compact construction that will easily fit into the confines of a miniature snap acting switch casing.

The tubular element **48** of the pneumatic actuator has its outer portion adapted to be connected to a vacuum conduit so that when a suitable valve in the vacuum conduit is opened, the chamber defined by interiors of the tubular element **48** and the flexible boot **32** will be in communication with a vacuum source. If desired, the tubular element **48** may extend through a panel and the lock nut **56** utilized to mount the casing **10** to such a panel. In accordance with some predetermined sequence

of operation with which the switch is associated, the interior of the flexible boot 32 is subjected to a vacuum; because of its resiliency and the exterior pressure area, the flexible boot 32 will contract and reduce the actuating force on the switch arm 20. By the use of vacuum, a small reduction in the actuating force is obtained so that when such reduction reaches the value *x* minus *y*, the switch arm 20 causes movement of the attached end of rolling spring 26 and the movable contact 18 is transferred to the fixed contact 17 with a snap action.

With the above arrangement, it is possible to construct a snap switch that will operate in response to an extremely small actuating force and that may be economically fabricated from relatively simple components into a compact structure.

Inasmuch as various changes and modifications may be made to the present invention, it is intended that the foregoing description of the preferred embodiment shown in the drawing be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A pneumatic actuator for a switch mechanism comprising a switch casing, switching device in said casing, means defining an opening in said casing, a peripheral recess surrounding the opening, a cup-shaped flexible member having a bottom wall engaging said switching device for operating the same and having a rim portion disposed in said recess, an internal groove adjacent said rim portion, a tubular element having a flange portion disposed in said groove and a connecting portion extending through the opening, fastening means on said connecting portion engaging said casing whereby said flange portion

seals said rim portion against said recess to define a pneumatic chamber in said flexible member, coil spring means mounted between said tubular element and said bottom wall to maintain said bottom wall in biased engagement with said switching device, and means on said tubular element for subjecting the pneumatic chamber to a pneumatic condition, said cup-shaped flexible member being flexed in response to the pneumatic condition whereby said bottom wall is moved to actuate said switching device.

2. The combination as recited in claim 1 wherein said bottom wall comprises a pair of spaced rib elements and said coil spring means has one end mounted between said spaced rib elements.

3. The combination as recited in claim 2 wherein said bottom wall further comprises washer means to define a rigid end for engaging said switching device.

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