Jan. 28, 1958 I. F. THOMSON ET AL 2,821,610

ACTUATING MECHANISM

Filed March 7, 1957

FIG. 1

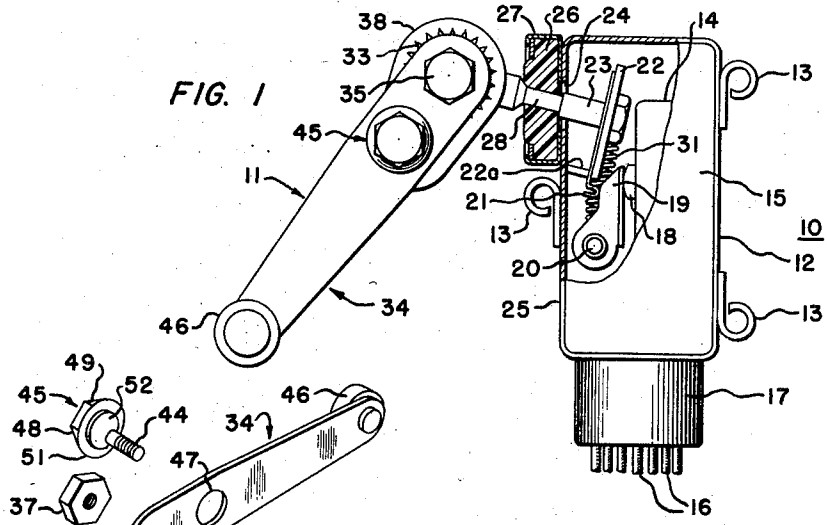


FIG. 2

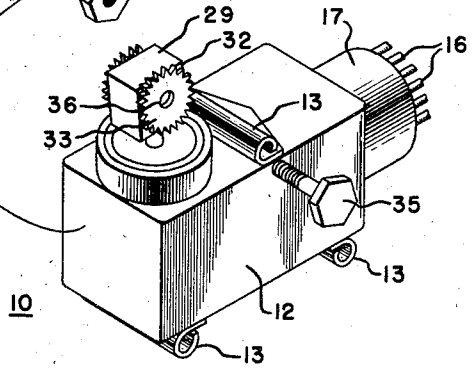
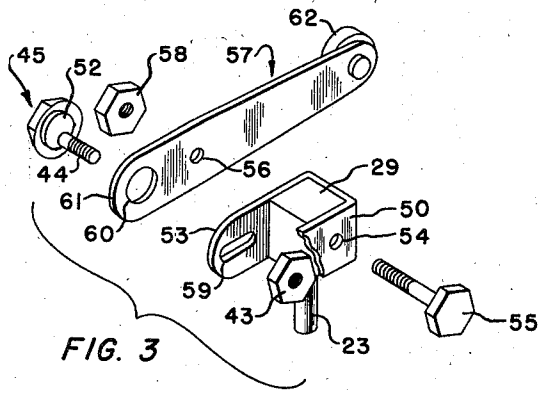


FIG. 3



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ACTUATING MECHANISM

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11 Claims. (Cl. 200—166)

The present invention relates to an improved form of actuating mechanism for electric switch structures.

Electrical control instrumentalities embodying micro-switches find wide use in aircraft and precise and accurate operation of such micro-switches is obviously an important requirement. To achieve the desired accuracy of operation the actuator associated with a micro-switch must be properly located relative thereto. Due to the inherently quick responses of a micro-switch to actuating forces only a very limited travel of the actuator is required to operate the micro-switch between its circuit making and breaking positions. Accordingly, it will be apparent that slight discrepancies in the position or location of the actuator relative to the micro-switch will materially affect the operation thereof.

It is therefore an object of the present invention to provide in a limit switch an improved actuator assembly for operating a micro-switch, such actuator assembly embodying an adjustable construction which permits varying of the operating location of an actuator arm.

Another object of this invention is to provide, in an adjustable actuator assembly of the above character, locating means permitting arcuate adjustment of the actuator arm about its point of attachment.

Another object of this invention resides in providing, in an adjustable actuator assembly of the above character, positive locking means to prevent accidental displacement of the actuator arm after adjustment has been accomplished.

Another object of this invention is to provide an improved actuator assembly for a micro-switch including an adjustable actuator arm having a mounting construction permitting initially an approximate or coarse adjustment and then a fine or vernier adjustment for final adjustment.

Another object of this invention is to provide an adjustable actuator arm of the character above wherein camming means are employed to effect angular adjustment of the actuator arm with respect to the body of the switch with which it is associated.

Another object of the invention is to provide an actuating assembly for a micro-switch which is simple and economical in construction and which is effective in operation.

Other objects and features of the present invention will be readily apparent to those skilled in the art from the following specification and appended drawings wherein is illustrated a preferred form of the invention, and in which:

Figure 1 is an elevational view of a switch employing an actuating assembly in accordance with the present invention, and showing portions of the switch housing and actuating assembly broken away and in section to facilitate the illustration.

Figure 2 is an exploded perspective view showing the switch housing and elements of the actuating assembly; and

Figure 3 is an exploded perspective view illustrating a modification of the actuating assembly.

Referring now to Figure 1 of the drawing a limit switch indicated generally by the numeral 10 embodies an actuating assembly 11 which is in accordance with the present invention.

Limit switch 10 comprises a housing 12 of water-tight construction having appropriate mounting brackets 13 affixed thereto adapted to receive usual bolts (not shown) for securing the switch 10 to convenient structure at the area where it is to be used. Housing 12 serves to enclose a unitary, electric, snap switch 14, of the micro-switch type, in water-tight condition, a cover plate 15 serving to sealably close the opening through which the switch 14 is passed into housing 12. Usual electrical wiring 16 in connection with micro-switch 14 extends to the exterior of housing 12 through a suitable sealing member 17 suitably affixed to housing 12, which wiring is adapted for connection in the particular circuit which limit switch 10 is to serve.

Snap switch 14 may be of the type disclosed in Patent No. 1,960,020 and includes the usual movable contact which moves with a snap action in its circuit making and breaking operations in response to very small movements of its actuating plunger 18 which projects to the exterior of switch 14. It is to be understood that the particular construction of micro-switch 14 forms no part of the present invention.

To effect movement of plunger 18 there is associated for engagement therewith a lever 19 suitably pivotally mounted on a pivot pin 20 carried within housing 12. Lever 19 is adapted to be moved by a leaf spring 21 whose free end lies in contact with lever 19 and whose opposite end is suitably affixed to a plate 22 which is secured to the inner end of a lever member 23. Plate 22 includes a projecting portion 22*a* which serves as a stop as will be described. Lever member 23 projects through an opening 24 in a wall 25 of housing 12 and extends through a resilient sealing member 26 made of any suitable flexible, water-resistant material. Sealing member 26 is located over opening 24 and is held in place by a metallic retaining collar 27 which is suitably affixed to wall 25 of housing 12 as by welding and in surrounding relation to opening 24 to insure against leakage. Sealing member 26 serves as a pivotal support for lever member 23 with the material thereof fitting tightly about a cut-down central portion 28 of lever 23, as shown. The fit of sealing member 26 upon lever 23 is such as to prevent any water-leakage therearound and into housing 12.

The exterior end of lever member 23 is formed to provide an enlarged generally cube-shaped or block-like head 29 to which is mounted the actuating assembly 11 as will be described. Interiorly of housing 12, the inner end of lever member 23 has connected thereto one end of a tension spring 31, the other end of which is secured to the pivot pin 20 which supports lever 19. Spring 31 exerts its bias to urge the inner end of lever member 23 in the direction of lever 19 so that leaf spring 21 normally does not exert an actuating force on lever 19 as would effect inward movement of micro-switch plunger 18. The bias of spring 31 urges lever member 23 toward lever 19 an amount determined by the engagement of stop 22*a* with the inner surface of wall 25 so that lever member 23 is normally disposed in an angular position, that is, it is made to extend angularly to the longitudinal axis of housing 12, as shown.

Enlarged cube-shaped head 29 of lever member 23 is provided on each of opposed faces 32 thereof with a toothed member 33 which is secured in position as by welding. It is apparent that toothed members 33 may be formed integral with head 29 if desired. The outside diameter of toothed members 33 is slightly greater than

the height or width of faces 32 of head 29 but less than the diagonal dimension across the faces 32 for reasons which will hereafter become apparent.

Cube-shaped head 29 with its toothed members 33 serves to mount actuating assembly 11 for effecting operation of lever members 23 and 19 to actuate plunger 18. Actuating assembly 11 comprises an elongated actuator arm 34 which is secured at one end to one side of head 29 by a bolt 35 which passes through an opening in arm 34 and through an aligned axially disposed bore 36 extending through toothed members 33 and head 29 and which bolt carries a lock nut 37 at its projecting end.

At the point of connection of actuator arm 34 to head 29 toothed member 33 spaces the inner face of actuator arm 34 from the adjacent face 32 of head 29 to permit the accommodation, in the space provided, of a generally oval-shaped adjustment plate 38. Adjustment plate 38 is provided adjacent one end with a toothed opening 41 complemental to and adapted to receive and mate with the toothed member 33. Plate 38 when fitted upon toothed member 33 presents surfaces which abut surface portions at the four corners of face 32 whereby plate 38 will be retained on toothed member 33 when actuator arm 34 is in position. Also formed in plate 38 is a slotted opening 42 which extends along the longitudinal axis of the plate and which is spaced a sufficient distance from toothed opening 41 that there will be no interference between head 29 and a lock nut 43 carried by the threaded shank 44 of an adjusting member 45.

Actuator arm 34 which is secured at one end to head 29 of lever 23 by bolt 35 and its cooperating lock nut 37 has rotatably mounted at its free end a usual roller 46 which is adapted to be engaged by a force applying means to effect movement of actuator arm 34.

Actuator arm 34 is provided with a circular opening 47 intermediate its ends which opening is adapted to lie disposed opposite to and in alignment with slot 42, on appropriate location of actuator arm 34 relative to plate 38. With opening 47 and slot 42 in opposition threaded shank 44 of adjusting member 45 will project through slot 42 when adjusting element 45 is fitted to opening 47. Shank 44, for a purpose to be described, is adapted, on rotation of adjusting element 45, to be moved along the defining longitudinal edges of slot 42, and preferably the length of slot 42 is such as will permit a complete rotative movement of element 45 by avoiding wedging of the shank with the ends of the slot.

Adjusting member 45, as shown, comprises, in addition to threaded shank 44, a head 48 having wrench engageable surfaces 49 and a flared shoulder portion 51. Extending from flared portion 51 is a cylindrical portion or boss 52 from which projects the threaded shank 44, which, as shown, is of lesser diameter than portion 52 and is eccentrically disposed relative to head 48 and portion 52. In the mounting of adjusting member 45 to actuator arm 34, cylindrical portion 52 fits within opening 47 of actuator arm 34 and shoulder portion 51 engages the face of arm 34 to limit the extent of movement of adjusting member 45 through opening 47.

With adjusting element 45 fitted into opening 47 and its threaded shank 44 projecting through slot 42 of plate 38 actuator arm 34 will be restrained against free rotation about its mounting bolt 35 since plate 38 itself is fixed in place by reason of its being mounted on toothed member 33. The width of slot 42 relative to the diameter of threaded shank 44 is only such as will permit the ready insertion thereof but not any substantial lateral movement.

In the use of the present invention the limit switch 10 is suitably affixed to convenient structure in the area in which it is intended for use and its actuating assembly 11 then adjusted to place the roller 46 in proper position relative to the particular external force applying means, present in such area, which is to act on roller 46 to operate actuator arm 34 and thereby effect operation of micro-switch 14 to perform a desired electrical operation. It is assumed that the external force applying means is a suitable actuating mechanism which is usually fixed as to operating location and that the present limit switch 10 is to be brought to it and affixed to a convenient bracket in position to be acted upon by such force applying means. Due to the high sensitivity of the micro-switch 14 the actuator arm 34 must be precisely located relative to the means which will apply the force to move it and it is the purpose of the adjustment means of the present invention to effect this precise disposition of the actuator arm.

Accordingly when limit switch 10 has been secured in position its actuating assembly 11 is then mounted. In this mounting, adjustment plate 38 is first fitted upon a toothed member 33 provided on cube-shaped head 29 with the teeth of its opening 41 so mating with the teeth of member 33 as to dispose plate 38 at an angle which approximates the desired angle which actuator arm 34 is to assume. The particular toothed member 33 which is used is, of course, determined by the demands of the location of the force applying means.

After the adjustment plate 38 has been mated with the convenient toothed member 33 then actuator arm 34 is fitted to cube-shape head 29 by the bolt 35 and its nut 37 and will abut plate 38 and serve to maintain it on member 33. Before finally tightening nut 37 actuator arm 34 is moved by hand to extend in the same direction as plate 38 to dispose its opening 47 opposite slot 42 in plate 38. Adjusting member 45 is then fitted in place with its cylindrical portion 52 disposed in opening 47 of actuator arm 34 and its threaded shank 44 projecting through slot 42. Lock nut 43 is then fitted on shank 44 to maintain adjusting member 45 in position on arm 34. A suitable wrench is then applied to the head 48 of adjusting member 45 to effect rotation of the latter in either clock-wise or counterclockwise direction as the mechanic who installs the present invention determines is necessary to move actuator arm 34 to its final position wherein it will be properly related to the force applying means.

It is evident that due to the eccentricity of shank 44 it will press against and ride along a longitudinal edge of slot 42 when adjusting member 45 is rotated. Since plate 48 is locked against rotation by reason of the mating of its toothed opening 41 with toothed member 33 the force of shank 44 pressing on the edge of slot 42 is transmitted to actuator arm 34 to cause it to pivot about its bolt 35. This pivotal movement of actuator arm 34 is continued until the installer determines that actuator arm 34 occupies the required position relative to its associated external force applying means to effect the proper operation of micro-switch 14. After final adjustment of actuator arm 34 has been accomplished, lock nuts 37 and 43 are then tightened on bolt 35 and adjusting member 45 to assure a position lock of the elements.

It is apparent that the amount of pivotal adjusting movement which can be furnished actuator arm 34 is determined by the amount of rotation permitted adjustment member 45. Accordingly slot 42 will be afforded such length as will allow that degree of rotation to occur which will achieve a pivotal adjusting movement of actuator arm 34 which will place it in proper position relative to a particular force applying means having its own particular environment.

It will be further apparent that the slot 42 and opening 47 may be transposed, with the slot formed in actuator arm 34 and the opening 47 provided in adjustment plate 38, whereupon adjusting member 45 would be carried by plate 38 and its shank 44 would project through the slot in the actuator arm 34. With this arrangement pivotal adjustment of actuator arm 34 would obviously still be the same.

In the modification of Figure 3, cube-shaped head 29 of lever member 23, in place of the toothed members 33, supports a generally U-shaped member 50 fitted so that

its legs 53 project laterally from head 29. U-shaped member 50 is rigidly affixed to head 29 by welding or in any other suitable manner. Also if desired legs 53 could be formed integral with head 29 by appropriate machining.

A bore 54 is provided through head 29 and legs 53 to receive a bolt 55 which passes through an opening 56 in an actuator arm 57 and carries a nut 58 to mount actuator arm 57 to head 29. Legs 53 are each provided with a slotted opening 59 while actuator arm 57 has an opening 60 provided adjacent end 61 thereof. Opening 60 is adapted to be disposed in alignment with slot 59 of the leg 53 to which actuator member 57 is adjacent. The present modification also employs adjusting member 45 and the cylindrical portion 52 thereof is receivable within opening 60. With portion 52 fitted into opening 60 threaded shank 44 of adjusting member 45 will project through the adjacent slot 59 and lock nut 43 will serve to hold adjusting member 45 in position.

Dual legs 53 are provided to permit a variation in location of the actuator arm 34 to better accommodate external force applying means which will operate the present invention.

Actuator arm 57 carries a roller 62 at its free end and is similar to actuator arm 34 of the first embodiment differing therefrom in the matter of the location of the mounting and adjustment openings therein as is apparent from the drawings.

Angular adjustment of actuator arm 57 is accomplished by rotation of adjustment member 45 to rectilinearly move threaded shank 44 within slot 59. Thus this modification operates similarly to the first embodiment except that the preliminary or coarse adjustment afforded by use of toothed members 33 is omitted. This modification would not have as wide application as the first embodiment but is useful in those situations where only relatively minor or fine adjustment is necessary to properly relate the actuator arm 34 to the external force applying means.

The present invention has been shown applied to a sealed limit switch but is not limited to use therewith. The present actuating assembly may of course be employed with other forms of electrical switching apparatus employing a micro-switch by appropriately applying a generally cube-shaped head 29 to an actuating lever employed in the lever system which directly functions on the plunger of the micro-switch.

While certain preferred embodiments of the invention have been specifically disclosed it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What we claim is:

1. A switch operating assembly for an electric switch having an operating lever associated therewith, said switch operating assembly comprising an actuator arm, means pivotally mounting said actuator arm on said operating lever, means on said operating lever projecting to a side thereof, said actuator arm and said latter means each having an opening therein, which openings are adapted to be placed in opposition, and an adjusting member receivable within said openings and having a camming action with the defining edges of one of said openings to move said actuator arm into various positions of adjustment.

2. A switch operating assembly for an electric switch having an operating lever associated therewith, said switch operating assembly comprising an actuator arm, means pivotally mounting said actuator arm on said operating lever, means on said operating lever projecting to a side thereof, said actuator arm and said latter means each having an opening therein, one of said openings being of slotted form and the other being circular, said openings being adapted to be placed in alignment, and an adjusting member rotatably supported within said circular opening and having an eccentric coaction with said slotted opening for moving said actuator arm into a variety of positions on said operating lever.

3. An actuating assembly for an electric snap switch having an operating lever associated therewith, said actuating assembly comprising a pivotable actuator arm, an adjustment plate adapted to be mounted in a variety of positions on said operating lever, means for mounting said pivotable actuator arm on said operating lever and for holding said adjustment plate in a selected fixed position on said operating lever, said actuator arm and said adjustment plate each having an opening therein, which openings are adapted to be placed in opposition, and an adjusting member receivable within said openings and having a camming action with the defining edges of one of said openings to move said actuator arm into various positions of adjustment.

4. An actuating assembly for an electric snap switch having an operating lever associated therewith, said actuating assembly comprising a pivotable actuator arm, an adjustment plate adapted to be mounted in a variety of positions on said operating lever, means for mounting said pivotable actuator arm on said operating lever and for holding said adjustment plate in a selected fixed position on said operating lever, said actuator arm and said adjustment plate each having an opening therein, one of said openings being of slotted form and the other being substantially circular, and an adjusting member rotatably supported within said circular opening and having a projection extending into said slotted opening and cooperating with the defining edges thereof for movement of said actuator arm into a variety of positions on said operating lever.

5. An actuating assembly for an electric snap switch having an operating lever associated therewith, said actuating assembly comprising a pivotable actuator arm, an adjustment plate adapted to be mounted in a variety of positions on said operating lever, means for mounting said pivotable actuator arm on said operating lever and for holding said adjustment plate in a selected fixed position on said operating lever, said actuator arm having a generally circular opening therein and said adjustment plate having a slotted opening in alignment with said generally circular opening, and an adjusting member rotatably supported within said opening of said actuator arm, said adjusting member having an eccentrically disposed projection extending into said slotted opening and engageable with the defining edges thereof to move said actuator arm, on rotation of said adjusting member, into a variety of positions on said operating lever.

6. An actuating assembly for an electric snap switch having an operating lever associated therewith, said actuating assembly comprising a pivotable actuator arm, an adjustment plate, means on said operating lever for supporting said adjustment plate thereon in a variety of fixed positions, means for mounting said pivotable actuator arm on said operating lever and for maintaining said adjustment plate in a selected fixed position on said operating lever, said actuator arm and said adjustment plate each having an opening therein, one of said openings being generally circular and the other being of slotted form, and an adjusting member rotatably supported within said circular opening, said adjusting member having an eccentrically disposed projection extending into said slotted opening and engageable with the defining edges thereof to move said actuator arm, on rotation of said adjusting member, into a variety of positions on said operating lever.

7. An actuating assembly for an electric snap switch having an operating lever associated therewith, said actuating assembly comprising a pivotable actuator arm, a plurality of engaging surfaces on said operating lever, an adjustment plate having a plurality of engaging surfaces conforming to and coacting with said first mentioned engaging surfaces for supporting said adjustment plate on said operating lever in a variety of fixed positions, means

for mounting said pivotable actuator arm on said operating lever and for maintaining said adjustment plate in a selected fixed position on said operating lever, said actuator arm and said adjustment plate each having an opening therein, one of said openings being generally circular and the other being of slotted form, and an adjusting member rotatably supported within said circular opening, said adjusting member having an eccentrically disposed projection extending into said slotted opening and engageable with the defining edges thereof to move said actuator arm, on rotation of said adjusting member, into a variety of positions on said operating lever.

8. An actuating assembly for an electric snap switch having an operating lever associated therewith, said actuating assembly comprising a pivotable actuator arm, gear-shaped means on said operating lever, an adjustment plate having an opening whose margins are formed into an outline conforming to said gear-shaped means, said gear shaped means being receivable within said opening for supporting said adjustment plate in a variety of fixed positions on said operating lever, means for mounting said pivotable actuator arm on said operating lever and for maintaining said adjustment plate in a selected fixed position on said operating lever, said actuator arm having a generally circular opening and said adjustment plate having a slotted opening, which openings are adapted to lie in opposition, and an adjusting member rotatably supported within said circular opening of said actuator, said adjusting member having an eccentrically disposed projection extending into said slotted opening of said adjustment plate and engageable with the defining edges thereof to move said actuator arm, on rotation of said adjusting member, into a variety of positions on said operating lever.

9. An actuating assembly for an electric snap switch having an operating lever associated therewith, said actuating assembly comprising a pivotable actuator arm, toothed disc-shaped means on said operating lever, an adjustment plate having an opening whose margins are formed into a circular series of teeth conforming to the teeth of said disc-shaped means, said disc-shaped means being receivable within said opening for supporting said adjustment plate in a variety of positions on said operating lever, means for mounting said pivotable actuator arm on said operating lever and for maintaining said adjustment plate in a selected fixed position on said operating lever, said actuator arm having a generally circular opening formed intermediate its ends, said adjustment plate having a slotted opening adapted to align with said circular opening, and an adjusting member rotatably supported within said circular opening of said circular opening, said adjusting member having an eccentrically disposed longitudinally directed projection extending into said slotted opening of said adjustment plate and engageable with the defining edges thereof to move said actuator arm, on rotation of said adjusting member, into a variety of positions on said operating lever.

10. A switch operating assembly for an electric switch having an operating lever associated therewith, said switch operating assembly comprising an elongated actuator arm, pivot means mounting said actuator arm intermediate its ends on said operating lever, a projecting portion on said operating lever extending transversely of a longitudinal axis thereof, said actuator arm having an opening adjacent an end thereof, said projecting portion having an opening therein in alignment with said opening in said actuator arm, one of said openings being slotted, and an adjusting member receivable within said openings and having a camming action with the defining edges of said slotted opening to move said actuator arm into various positions of adjustment.

11. A switch operating assembly for an electric switch having an operating lever associated therewith, said switch operating assembly comprising an elongated actuator arm, pivot means mounting said actuator arm intermediate its ends on said operating lever, a projecting portion on said operating lever extending transversely of the longitudinal axis thereof, said actuator arm having a generally circular opening adjacent an end thereof, said projecting portion having a slotted opening therein, said openings being adapted to be placed in alignment, and an adjusting member rotatably supported within said circular opening, said adjusting member having an eccentrically disposed projection extending into and coacting with said slotted opening for moving said actuator arm into a variety of positions on said operating lever.

No references cited.