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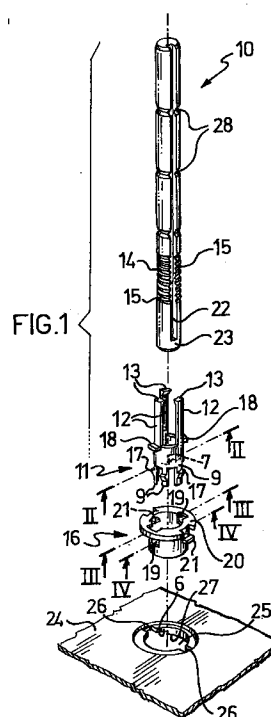
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(54) **An adjustable length push-button actuator**

(57) A push-button actuator of adjustable length comprises a rod (10) coupled with an actuator element (11) provided with a plurality of resilient tongues (10) having terminal gripping teeth (13) forming resilient gripper means which grip annular grooves (15) in the rod (10). For fine adjustment of the length of the push-button actuator, the rod (10) may be pulled or pushed axially so as to overcome the gripping force of the resilient gripper means and vary the relative positions of the rod (10) and the actuator element, thereby adapting the length of the push-button actuator to the requirements of the installation.



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Description

The present invention concerns an adjustable-length push-button actuator for actuating an electrical contact or the like.

In many applications it is necessary for a push-button electrical switch, or the like, to be located in such a position that it can be actuated from a distance which is measured precisely from the surface on which the switch itself is mounted.

For example, in anti-theft devices and burglar alarms, the removal or opening of a protective panel must cause alarm or signalling devices to be activated by the opening or closure of an electrical contact, or the actuation of an equivalent device. To this end, mechanical push-button switch devices are used which are mounted in a predetermined position relative to the panel and are actuated by a change in the position of the panel. When these devices are mounted on a printed circuit board or equivalent support together with other electronic components, the printed circuit must be installed very accurately in a predetermined position relative to the protective closure panel. This is neither easy nor practical.

To overcome this limitation, it has been proposed to use push-button switch actuators in which a rod acts on the switch through a helical compression spring. Pressure exerted on the head of the spring actuates the switch.

These devices are inaccurate and unreliable: in fact, the force transmitted to the switch by the spring varies considerably according to the installation conditions, and may even be so great as to deform or break the switch or its support.

In addition, these devices are not suitable for applications in which the push-button actuator is not actuated by a closure panel but must pass through a protective panel to be actuated in different way, for example, manually.

These disadvantages are overcome by the adjustable-length push-button actuator that is the subject of the present invention, as defined and characterised in general in Claim 1. It is of simple construction, reliable, accurate and sensitive, and is easily adapted to any type of installation.

The characteristics and advantages of the invention will become clearer from the following description of a preferred embodiment given by way of non-limitative example and with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a preferred embodiment of an adjustable-length push-button actuator according to the present invention with the parts separated;

Figures 2, 3 and 4 are transverse sections of details of the push-button actuator of Figure 1; and

Figures 5 and 6 show, in longitudinal section, a par-

ticular use of the push-button actuator of Figure 1 in two different operative positions.

The push-button actuator shown in Figure 1 includes: a cylindrical rod-like element 10; an actuator element generally in the form of a sleeve 11 adapted to receive the rod 10 therein; coupling means formed by three resilient tongues 12 formed integrally with the sleeve 11 and extending in the direction of the axis thereof and a coupling element 14 which is part of the rod 10; and a guide member in the form of a bush 16 which is able to receive the sleeve 11 therein.

Each of the resilient tongues 12 has a coupling tooth 13 which projects radially inwardly of the sleeve 11 and the coupling element 14 has annular V-section grooves 15. The tongues form resilient gripper means for compressively engaging one of the annular grooves 15 and coupling the rod 10 to the sleeve 11.

The sleeve-like actuator element 11 also has two stop teeth 18 which project radially outwards and four integral appendages, or arms, 9 which extend axially and are provided with stop teeth 17. The outer diameter of the sleeve 11 is slightly less than that of the interior of the bush 16 so as to enable the sleeve to slide easily and axially in the bush, while the teeth 17 project beyond the internal perimeter of the bush 16 and, in this example, are shaped like saw teeth.

The bush 16 has two lateral cavities, in this example formed as two apertures 19, which extend axially so as to constitute two seats with end abutments for the axial sliding of the teeth 18 of the sleeve 11, as well as an annular flange 20 and two projections 21.

In addition, the rod 10 has a channel 22 which extends along its entire length apart from a short portion 23 close to one of its ends, and the sleeve 11 has an internal projection 7 for engaging the channel 22.

The rod 10 also has annular notches 28 for fracture at predetermined positions, that is, for defining regions of weakness where the rod itself may easily be broken to allow its length to be adjusted roughly.

The three parts described above may easily be formed from a suitable plastics material by known moulding techniques.

The actuator element 11 is inserted in the bush 16 by force-fitting through the end with the flange 20, that is, downward as seen in the drawing, so as to cause the resilient deformation of the arms 9 and their subsequent return to their rest positions after the stop teeth 17 have passed beyond that edge of the bush 16 opposite that with the flange 20. The axial sliding of the actuator element 11 in the bush 16 is limited in one direction by the abutment of the stop teeth 17 with the lower edge (as seen in the drawing) of the bush 16 and, in the opposite direction, by the abutment of the teeth 18 with the inner ends of the apertures 19. The axial sliding between the two stops constitutes the actuation stroke of the push-button.

The rod 10 is then inserted in the actuator element

11 through the end with the arms 9, that is, upward as seen in the drawing, so that the projection 7 engages the channel 22. In this way the rod 10 is fixed against rotation and its axial sliding is limited in one direction by the contact of the projection 7 with the end of the channel adjacent the portion 23. This prevents the accidental extraction of the rod 10. The working position of the rod 10 relative to the actuator element 11 is determined by the selection of one of the annular grooves 15 for compression engagement by the teeth 13 of the resilient tongues 12.

It should be noted that the shape of the teeth 13 and of the annular grooves 15 is such that the rod may be located in the desired position by an axial pull or push thereon such as to overcome the gripping force of the resilient gripper constituted by the tongues 12 and the teeth 13. The length of the push-button actuator may thus be finely adjusted within a range of variation determined by the length of the coupling element 14.

The flange 20 and the projections 21 of the bush 16 constitute fixing means for anchoring the push-button actuator to a wall or plate 24 of an external structure, for example, a container in which a switch to be actuated is fixed, as will be described below with reference to Figures 5 and 6. To this end, the plate 24 has a circular hole 25 with a slightly greater diameter than that of the bush 16 and two diametrically opposed notches 26 for allowing the projections 21 to pass through. The edge of the hole 25 is formed with two seats 27 for the notches 26. More particularly, two inclined faces 6 allow the fixing of the bush 16 to the plate 24 by virtue of the interference between the flange 20, the plate 24 and the projections 21. Coupling is therefore achieved by the insertion of the bush 16 through the hole 25 so that the flange 20 is brought into contact with the outer surface of the plate, and the rotation of the bush to bring the projections 21 into their respective seats 27.

An application of the push-button actuator described above is shown in Figures 5 and 6. This example relates to a push-button switch device for anti-theft installations and the like in which, as indicated at the start of this description, the removal of a panel causes the activation of alarm or signalling devices.

A push-button switch 30 is mounted on a printed circuit board 31 upon which is cantilevered a leaf spring 32 shaped so that it has a curved operating portion 33 close to the switch control member 34.

The board 31, in its turn, is mounted in a container 35 only part of which is shown in the drawings. The printed circuit 31 and the container 35 together form a support structure for the switch and the push-button actuator. This latter, generally indicated 8, is mounted on a plate in the manner described in relation to Figure 1, the plate being fixed to the container 35 and indicated 24 as in Figure 1. The sleeve-like actuator element 11 is in contact with the free end of the spring 32 by means of the ends of its arms 9. More precisely, the arrangement and dimensions of the various parts are such that the

spring 32 exerts an upward force, with reference to the drawings, which keeps the stop teeth 17 of the arms 9 in contact with the lower edge of the bush 16, as shown in Figure 5. When the push-button actuator 8 is pressed, the actuator element 11 moves axially against the action of the spring 32 until the stop teeth 11 contact the inner ends of the associated apertures 19. This movement causes the curved portion 33 of the spring 32 to act on the switch control member, causing it to switch, that is, to close or open the switch contacts depending on the constructional characteristics of the switch itself.

It should be noted that the stroke of the push-button switch actuator 8, indicated "d" in the drawing, is equal to or only slightly greater than the stroke of the control member of the switch 30.

The length of the push-button actuator, as has been said, is adjustable according to the requirements of individual applications. More particularly, this length may be reduced by the breaking and removal of a portion bounded by a notch 28 to achieve a rough adjustment, and may then be further reduced or increased by a respective push or pull on the rod 10 to vary the position of engagement of the teeth 13 with the coupling element 14 for fine adjustment.

This possibility of adjusting the push-button actuator according to the invention is particularly advantageous when it is wished to indicate the removal of a panel, for example, in an anti-theft installation, or when it is wished to de-activate an electrical panel when the front closure panel is removed. In these applications, the push-button actuator 8 is mounted in position on the support structure of the switch 30 to be actuated, as shown in Figure 5. Before or after the mounting, the rod 10 is shortened, if necessary, by the removal of a portion bounded by a peripheral notch 28 such that its length, with the teeth 13 of the resilient tongues 12 engaged with an annular groove 15 in the coupling element 14 close to the lower end of the rod 10, with reference to the drawing, is such that the upper end of the rod 10 is above the level of the upper edge of the container 35. As shown in Figure 6, when the closure panel 36 of the container 35 is fitted for the first time, its inner surface contacts the upper end of the rod 10 of the push-button actuator, exerting an axially-downward force on the rod itself. As a result of this force, the actuator element 11 first presses the free end of the spring 32 downward and hence actuates the switch 30 through the pressure of the curved operating portion 33 of the spring on the switch control member, and then, when the stroke of the push-button actuator is complete, the resilient tongues 12 open, allowing the coupling element 14 to move downward, with reference to the drawing, until the force exerted by the panel 36 on the push-button actuator 8 is equal to the force exerted by the spring 32. At this point the teeth 13 of the tongues 12 are engaged with an annular groove 15 and define a new, stable coupling position of the rod 10 with the actuator 11 which corresponds to the particular installation

conditions.

It should be noted that the spring 32 has an opening 37 which allows the end part of the rod 10 to pass through.

If the panel 36 is removed, the spring 32 returns to the rest position shown in Figure 5, releasing the control member of the switch 30 and hence switching the latter and activating an associated alarm.

When the closure panel is subsequently reapplied, this causes a stroke of the rod exactly sufficient to operate the switch.

It should be noted that, in this application, the length of the push-button actuator according to the invention is adjusted automatically which therefore makes it extremely useful in all applications in which it is neither possible nor convenient to determine the exact position of the switch beforehand.

A further advantage of the push-button actuator according to the invention is that it may easily be fitted to any support structure as long as it has a wall or plate with an aperture adapted to couple with the bush 16. Naturally, the means for fixing the bush 16 to the plate may differ from those illustrated and described, for example, a different type of housing coupling, or a screw coupling may be envisaged.

Although only one embodiment of the invention has been illustrated and described, it is clear that numerous variants are possible within the ambit of the same inventive concept. For example, there may be two or four resilient tongues 12 rather than three, the mutual positioning of the resilient tongues 12 and the coupling element 14 may be changed, that is, the rod may be provided with resilient tongues with associated teeth, and the coupling element with the annular grooves may be formed as an integral extension of the actuator element. Furthermore the resilient tongues may be disposed so as to form a resilient expansion grip rather than a compression grip so as to engage annular grooves in an inner surface of a bush which replaces the coupling element 14. In this case also, the positioning of the tongues and the coupling element may be interchanged. Instead of the annular grooves, further variants may provide a thread or a series of notches in correspondence with the engagement teeth of the resilient tongues.

Claims

1. A push-button actuator of adjustable length comprising:
 - a rod-like element (10),
 - an actuator element (11),
 - means (12, 13) for coupling the rod-like element (10) with the actuator element (11) comprising a plurality of resilient tongues (12), each having a coupling tooth (13) and together forming resilient gripper means and a coupling ele-

ment (14) which is elongate in the axial direction of the rod-like element (10) and provided with recesses (15) adapted to receive the teeth (13) of the resilient tongues (12), the resilient gripper means and the coupling element (14) being, respectively, part of one or the other of the said rod-like element (10) and the actuator element (11) and

- a guide member (16) which supports the actuator element (11), with the rod-like element (10) coupled thereto, for axial sliding movement in the said axial direction, and which is provided with means (20, 21) for fixing it to the edges of a hole (25) in a wall (24) of an external structure (24, 31, 35).

2. A push-button actuator according to Claim 1, in which means (17, 18, 19) are provided for limiting the axial sliding movement of the actuator element (11) relative to the guide member (16).
3. A push-button actuator according to Claim 2, in which the guide member (16) is a bush, the actuator element (11) has a part that is axially slidable in the bush (16), and the means for limiting the axial sliding comprise, for limitation in one direction, at least a first stop tooth (18) fixed to the actuator element (11) and at least one cavity (19) which extends axially within the bush and forms an abutment for the first stop tooth (18) and, for limitation in the opposite direction, at least a second stop tooth (17) fixed to the actuator element (11) in a position spaced axially from the first stop tooth (18) and an edge of the bush (16) which forms an abutment for the second stop tooth (17).
4. A push-button actuator according to Claim 3, in which the second stop tooth or teeth (17) is or are formed on a resilient appendage or appendages (9) of the actuator element (11), which extends or extend axially, the second stop tooth or teeth (17) being formed as saw teeth.
5. A push-button actuator according to Claim 3 or 4, in which the guide member in the form of a bush (16) has an annular flange (20) and at least one lateral projection (21) which together form part of the said means for fixing it to the edges of a hole (25) in a wall (24) of an external structure (24, 31, 35).
6. A push-button actuator according to any preceding claim, in which the rod-like element (10) has at least one annular notch (28) for predetermined fracturing.
7. A push-button actuator according to any preceding claim, in which the rod-like element (10) has a channel (22) which extends along its entire length

apart from a portion (23) close to one of its ends,
and in which the actuator element (11) has a pro-
jection (23) which engages the aforesaid channel
(22).

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8. A switch assembly including

- a support structure (24, 31, 35),
- a switch device (30) fixed to the support struc-
ture (24, 31, 35) and having a control member, 10
and
- an adjustable-length push-button actuator (8)
according to any preceding claim,
the support structure having a wall (24) with an
opening opposite the control member of the 15
switch device, this wall (24) being the said wall
of an external structure.

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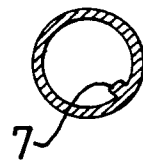
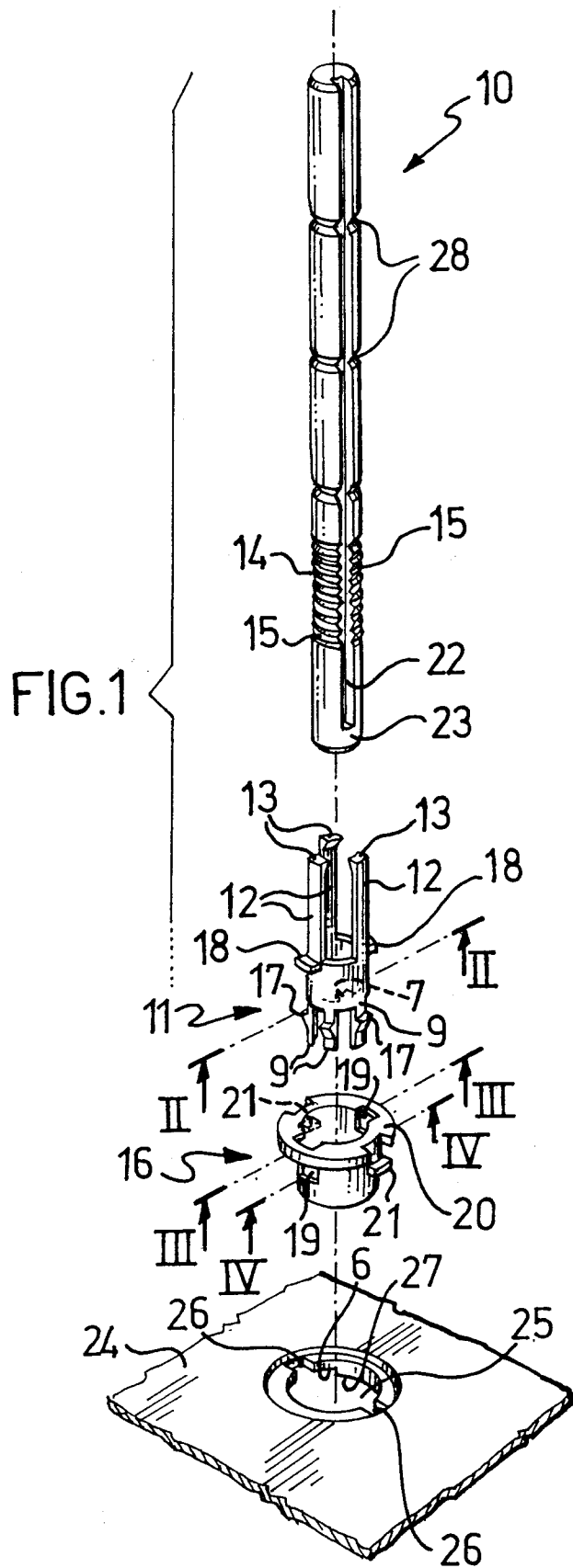


FIG.2

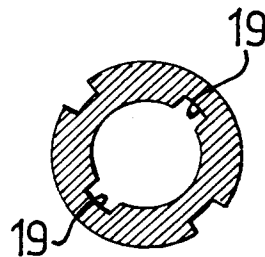


FIG.3

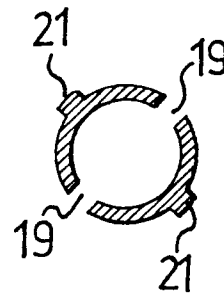


FIG.4

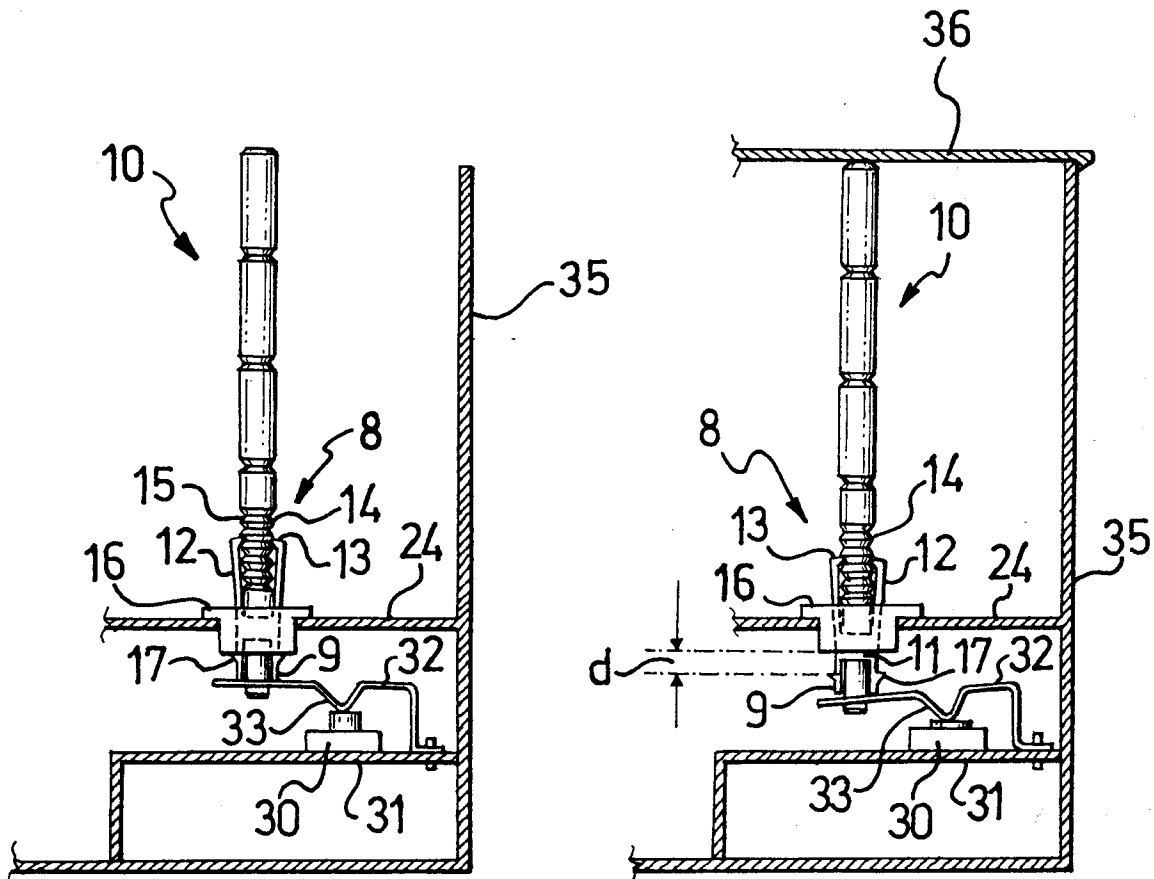


FIG.5

FIG.6



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EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0522

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 349 367 A (BENDIX FRANCE) 3 January 1990 * abstract; figures * ---	1	H01H1/00 H01H3/16
A	DE 42 15 515 C (MERIT-ELEKTRIK) 5 August 1993 * abstract; figure 5 * ---	1	
A	DE 34 39 695 A (SCHULTE ELEKTROTECH) 7 May 1986 -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H01H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 March 1997	Examiner Janssens De Vroom, P
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