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(54) Rope bistable commutation device

(57) A rope-operated bistable commutation device, comprises a box-like body (2) for housing at least one switch (3) connectable to a corresponding electric circuit, a bistable commutation unit (4) operably associated to the switch (3) to promote commutation thereof between a closed circuit condition and an open circuit condition, wherein the unit (4) comprises an actuator (5) designed to be associated with an actuating rope (F) and guide means (6) for guiding the actuator (5) between a first stable operative position (A) and a second stable operative position (B) corresponding to open and closed switch (3) conditions respectively. The unit (4) is removably connected to the box-like body (2), locking means (7) being provided for holding it constantly joined with the actuator (5) set in either the first (A) or the second (B) stable operating position to allow one-piece removal thereof from the box-like body (2).

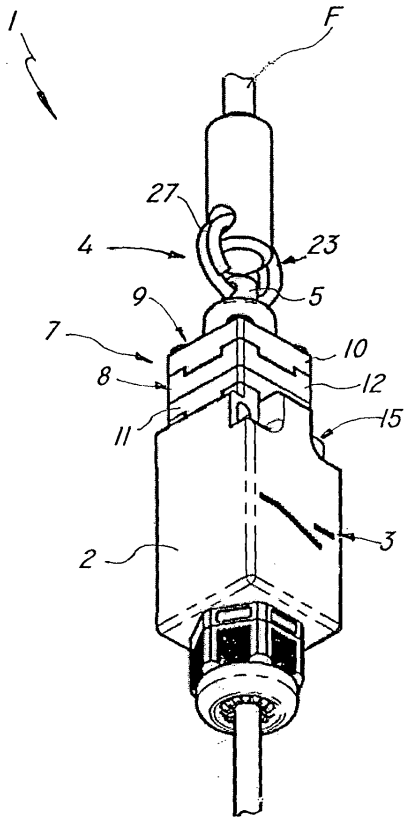

FIG. 1

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Description

Field of the invention

[0001] The present invention generally finds application in the field of safety electric devices and particularly relates to a rope-operated commutation device having bistable operation for use with safety or emergency electric circuits.

Background art

[0002] Devices used for bistable switching of electric contacts by rope or pull cord operation are known to comprise a manual switch associated with a bistable relay.

[0003] Typically, an electric load is switched into open/closed circuit conditions by controlling a switch via appropriate mechanisms, whereas the relay is used to hold the switch in an intermediate electrically switched contact position, to allow or bypass circuit operation.

[0004] Other devices, one of which is disclosed in patent GB2330195, have a mechanically operable actuator in lieu of the relay, for bistable operation.

[0005] These devices are used, for instance, to turn on and off emergency lights in a hoistway, during inspection and/or maintenance.

[0006] A well-known drawback of these prior art solutions is that the presence of two separate devices, such as the switch and the relay or similar device, requires laborious and complex installation and operation steps.

[0007] These devices are found to be composed of a relatively large number of components, and involve difficult assembly operations, frequent maintenance and high manufacturing costs.

[0008] In an attempt to obviate these drawbacks, bistable commutation devices have been devised, such as those disclosed in GB87969 and GB2176940, in which the electric load is switched and the condition of electric contacts is maintained by the use of a commutation unit consisting of a single control mechanism, such as a lever system or relatively rotating cylindrical bodies.

[0009] Nevertheless, these solutions require the provision of switches having a single box-like body for containing both the switch unit and the bistable commutation unit.

[0010] As a result, all the components of the device have to be specially designed, and proprietary switches are obtained therefrom.

[0011] Therefore, any replacement of one or more of these components would involve the replacement of the whole device, which will apparently increase the overall costs.

Disclosure of the invention

[0012] The object of the present invention is to overcome the above drawbacks, by providing a rope-operated bistable commutation device that is highly efficient and relatively cost-effective.

[0013] A particular object is to provide a rope-operated bistable commutation device that allows simple replacement of one or more of its components, without requiring the replacement of the whole switch if only some of its components need to be replaced.

[0014] A further object is to provide a commutation device that allows simple and quick installation and requires no wiring or other premilinary complex operations.

[0015] Yet another object is to provide a commutation device that is composed of a relatively small number of components for simple and inexpensive production.

[0016] These and other objects, as more clearly explained hereafter, are fulfilled by a rope-operated bistable commutation device as defined in claim 1, comprising a box-like body for housing at least one switch designed for connection to an electric circuit for selective opening/closing thereof, a commutation unit operably associated with said at least one switch to promote commutation thereof between a first closed circuit condition and a second open circuit condition.

[0017] The commutation unit comprises an actuator designed to be associated with an actuating rope and means for guiding said actuator between a first stable operative position and a second stable operative position corresponding to said first and second circuit conditions respectively.

[0018] According to a peculiar characteristic of the invention, the commutation unit is removably connected to the box-like body, locking means being provided for holding said commutation unit constantly assembled with said actuator set in either said first or said second stable operating position to allow one-piece removal thereof from said box-like body.

[0019] Thus, the whole commutation unit may be removed as a one piece from the first box-like body that houses the switch, while maintaining it assembled and ready for use.

[0020] With this feature, the commutation unit may be used in any switch-housing body thereby affording bistable operation of the whole device, even when the switch body has not been specially designed for the special commutation unit.

[0021] As used herein, the term "bistable operation" concerning the commutation unit is clearly intended to indicate the possibility for the unit to switch or commutate between a first operating condition and a second operating condition, and be locked in the set condition until the next actuation by a user.

[0022] Advantageous embodiments of the invention are defined by the dependent claims.

Brief description of the drawings

[0023] Further characteristics and advantages of the invention will be more apparent from the detailed description of a preferred, non-exclusive embodiment of a rope-operated commutation device of the invention, which is

described as a non-limiting example with the help of the annexed drawings, in which:

FIG. 1 is a perspective view of a commutation device of the invention in a particular application;
FIG. 2 is a sectional front view of the device of Fig. 1;
FIG. 3 is a front view of a commutation unit and three different box-like bodies 2, adapted to be selectively combined with the former to obtain a device of the invention;
FIG. 4 is an exploded perspective view of the device of Fig. 1;
FIG. 5 is an exploded perspective view of a detail of the device of Fig. 1;
FIG. 6 is a sectional front view of the detail of Fig. 5;
FIGS. 7a to 7e are pairs of front and cross sectional views of the device of Fig. 1 during a typical operating cycle;
FIG. 8 shows a plan development of the helical surfaces belonging to the detail of Fig. 5.

Detailed description of a preferred embodiment

[0024] Referring to the above figures, a commutation device of the invention, generally designated by numeral 1, may be used in all the systems that require bistable switching of an electric circuit.

[0025] For instance, the device 1 may be used in an industrial or service system, for instance a lift car control system, for actuating the lighting system located in the hoistway.

[0026] The device 1 is designed to be connected to a rope F, a pull cord or any other similar member, for manual or automatic actuation, possibly from a remote location, as exemplified in Fig. 1.

[0027] As shown in Fig. 1 and Fig. 2, a rope-operated commutation device 1 comprises a first box-like body 2, with at least one switch, diagrammatically shown in the figures and designated by numeral 3, which is designed to be connected to at least one electric circuit, not shown.

[0028] The switch 3 will not be disclosed herein in detail, as it may be designed with typical configurations. As a rule, at least one movable contact will be provided, for interaction with at least one stationary contact designed to be connected to the electric circuit for commutating an electric load.

[0029] Therefore, the switch 3 may be switched between a first condition, in which the electric circuit is closed and a second reversed open circuit condition.

[0030] In an alternative application, not shown, the device 1 may be used for bistable circuit commutation between two distinct electric circuits, e.g. a primary circuit and an auxiliary circuit of the electric system being served.

[0031] Here, the switch 3 may include at least one pair of stationary contacts designed to be connected to the terminals of the main circuit and the secondary circuit respectively, and at least one movable contact that may be selectively and alternately moved to contact with one of the stationary contacts of the pair.

[0032] Thus, the switch 3 may be switched between a first condition, in which the main circuit is closed and the secondary circuit is open, and a second reversed condition.

[0033] The device 1 of the invention further comprises a bistable commutation unit, generally designated by numeral 4, which is operably associated with the switch 3 to promote commutation thereof between the open and closed circuit conditions.

[0034] The commutation unit 4 essentially comprises an actuator 5 designed to be associated with an actuating rope F and means 6 for guiding the actuator 5 between a first stable operating position A and a second stable operating position B in which the switch is held in the open and closed conditions respectively.

[0035] According to a peculiar characteristic of the invention, the switching unit 4 is removably connected to the box-like body 2. Locking means 7 are further provided for locking the switching unit 4, which are susceptible of holding it constantly assembled in the first A or second B position.

[0036] Thus, the whole switching unit 4 may be removed from the box-like body 2 as a one piece, while holding it assembled and ready for installation, possibly to a box-like body 2', 2" other than the first body 2, as schematically shown in Fig. 3.

[0037] The box-like bodies 2, 2', 2" may have respective switches 3, 3', 3", not necessarily of identical types.

[0038] The locking means 7 may include a hollow head 8 in which the bistable commutation unit 4 is accommodated, having a portion 9 for removable attachment thereof to the box-like body 2.

[0039] As shown in Fig. 4, the head 8 may have a substantially prismatic or cylindrical shape, with upper and lower end portions 10, 11 and a central portion 12, separable from each other for simpler assembly of the commutation unit 4.

[0040] The head 8 may be also equipped with seals, not shown, to prevent the ingress of water or other particles therein.

[0041] The various portions 10, 11 and 12 of the head 8 may be held in assembled relation by any kind of coupling arrangement.

[0042] Like in the preferred, non exclusive embodiment of the invention, as shown herein, the head 8 may have a first series of peripheral through holes 13, four in the illustrated embodiment, which extend throughout the head 8 in an axial direction at its peripheral attachment portion 9.

[0043] Upon attachment of the commutation unit 4 to the box-like body 2, the holes 13 of the first series may be aligned with corresponding axial holes 14 of a second series, that are formed on the top face 15 of the box-like body 2.

[0044] Removable attachment of the bistable commutation unit 4, which is held assembled with the head 2,

may be obtained by screws 16, pins or similar means.

[0045] However, it will be appreciated by those of ordinary skill in the art that both shapes of the body 2 and the head 8 may be also considerably different from those of the figures, without departure from the scope of the present invention.

[0046] The cavity 17 defined within the head 8 may have a substantially cylindrical shape with a side surface 18 defining a longitudinal axis L.

[0047] The cavity 17 may be configured and appropriately sized to accommodate and radially retained the whole commutation unit 4, as shown in Fig. 2.

[0048] The guide means 6 may operate in a substantially axial direction, i.e. be designed to guide the actuator 5 between the first A and the second B stable positions along the longitudinal axis L.

[0049] Thus, each time that the rope F is pulled, the actuator 5 will run a first axial stroke c_1 from bottom to top and then a second stroke c_2 from top to bottom.

[0050] Preferably, the guide means 6 may be designed for the commutation unit 4 to always switch from the first A to the second B stable positions during the first axial stroke c_1 of the actuator 5.

[0051] Figs. 5 and 6 show a preferred, non limiting configuration of the guide means 6 that are part of the switching unit 4.

[0052] In this configuration, the guide means 6 include a substantially cylindrical and tubular slider 19 disposed within the cavity 17.

[0053] The slider 19 may be rotatably mounted to the actuator 5 and be able to axially slide within the cavity 17. Preferably, the actuator 5 will be integrated with the slider 19 during axial translation by special radial flanges 20, 21 of the actuator 5 or equivalent means, such as O-rings or similar joints.

[0054] The actuator 5 may have a substantially cylindrical shape and include a lower portion 22 designed for interaction with the switch 3, and an upper portion 23 designed for attachment to the actuation rope F as is known in the art.

[0055] By way of example, the lower portion 22 of the actuator 5 may have such a size as to fit into a passage 24 formed in the box-like body 2, for interaction with the switch 3.

[0056] The upper portion 23 may have a radially enlarged end 25 defining a step 26 that projects radially from the rest of the body of the cylindrical actuator 5 and has an eyelet 27 for attachment of one end of the actuation rope F.

[0057] As used herein, the terms "upper" and "lower" and "top" and "bottom" are only used to define relative positions of the various parts of the device 1 of the invention and are not to be intended as absolute concepts.

[0058] Thus, the device 1 may have any orientation in space, without departure from the scope of the present invention.

[0059] One or more radial projections 29, preferably directed outwards, may be provided on the lateral surface 28 of the slider 19.

[0060] In the example of the annexed figures, the slider 19 has four identical and equally angularly spaced projections 29, that may be located at the bottom of the slider 19, to ensure balanced orientation and smooth motion of the actuator 5.

[0061] The guide means 6 may include at least a pair of axially offset helical surfaces, to define an upper helical surface 30 and a lower helical surface 31.

[0062] Such helical surfaces 30, 31 may define a substantially helical guide path therein, for the radial projections 29 of the slider 19.

[0063] Particularly, one or more substantially similar and equally angularly spaced peripheral tooth-like formations 32 may be provided in the cavity 17 of the head 8, at its lower portion 11, to define a plurality of substantially axial peripheral grooves 33.

[0064] Each tooth-like formation 32 may have a pair of lower helical surfaces 31, 31' with a predetermined pitch. The lower helical surfaces 31, 31' may face towards respective upper helical surfaces 30, 30' associated with the median portion 12 of the head 8.

[0065] The locking means 7 may include one or more substantially transverse lower abutment surfaces 34 which end with respective lower helical surfaces 31.

[0066] The lower abutment surfaces 34 may be interposed between two lower helical guide surfaces 31, 31', which are connected to the other helical surface 31' by an axial section 35, thereby forming a concavity adapted to receive the projections 29 of the slider 19 and stop the downward axial sliding motion thereof.

[0067] The upper guide surfaces 30, 30' may be connected together by axial sections 36, defining additional concavities adapted to stop upward axial translation of the slider 19, and the actuator 5 that translates integral therewith.

[0068] The pitches of the helices defined by the guide surfaces 30, 30'; 31, 31' of one pair may be different each other and selected according to the axial and angular stroke to be imparted to the slider 19 for any single actuation.

[0069] The provision of four tooth-like formations 32 allows the commutation unit 4 to perform four full work cycles in a 360° rotation by the slider 19.

[0070] As used herein, the term "full work cycle" is intended to indicate the passage of the commutation unit 4 from the first to the second operating positions and back.

[0071] The locking means 7 may further have a substantially transverse upper abutment surface 37, which is adapted to interact with the enlarged end 25 of the upper portion 23 of the actuator 5 to stop its downward axial translation.

[0072] The upper abutment surface 37 may have a substantially annular shape and define the top face of the head 8.

[0073] In this case, as shown in the figures, it may have a central opening 38 of a diameter large enough to allow

the cylindrical actuator 5 to partially fit therein, but smaller than the diameter of the enlarged end 25.

[0074] An elastic return element 39 with a first end 40 operating on the upper abutment surface 37 and a second end 41 operating on the projections 29 of the slider 19, may be fitted on the periphery of the actuator 5, at its central portion 12.

[0075] The elastic element 39 will displace the projections 29 of the slider 19 from one of the upper helical surfaces 30, 30' to the corresponding lower helical surface 31, 31' or into one of the axial grooves 33, according to the starting position A, B, as the actuator 5 is pulled by the rope F. Furthermore, its elastic action will counteract the pulling action exerted by the rope F.

[0076] The elastic element 39 may be a helical spring, whose end turns are engaged in respective bushings 42, 43, and may be preloaded with a predetermined load.

[0077] Figs. 7a-e show a device 1 of the invention, with the commutation unit 4 engaged in a typical work cycle.

[0078] Particularly, Fig. 7a shows the commutation unit 4 in the first position A, which may correspond to a particular operating condition of the switch 3, e.g. the open circuit condition.

[0079] Fig. 7b shows the same commutation unit 4 in an intermediate unstable position, following a first pull exerted on the actuator by the rope F, and then switches to the second stable position B, as shown in Fig. 7c, which will correspond to another operating condition of the switch 3, e.g. the closed circuit condition.

[0080] Fig. 7d also shows the commutation unit 4 in another intermediate unstable position, following a second pull exerted by the rope F to switch the commutation unit 4 back into the first stable position of Fig. 7e.

[0081] The cross sections associated with each of the front sections show the rotation of the individual projections 29 of the slider 19 after each pull exerted on the actuator 5.

[0082] Fig. 8 shows the plan development of the helical guide surfaces 30, 30'; 31, 31'. In the same figure broken lines outline the helical guide path followed by a single projection 29 during a typical work cycle.

[0083] For the description of a typical work cycle, reference will be made hereinafter to a single projection 29 of the slider 19, although it shall be intended that any other radial projection 29 will have a substantially similar behavior.

[0084] Figs. 7 and 8 show that, as a result of the first pull exerted on the rope F, the slider 19 will axially slide integrally with the rope F and, at the same time, the projection 29, initially housed in the axial groove 33, will slide on a corresponding inclined surface defined by one of the upper helical surfaces 30 until the stop point defined by the upper concavity between the axial section 36 and the upper guide surface 30.

[0085] Thus, the slider 19 will be forced to rotate by a given angle α, defined by the rotation of the transverse axes X, Y, as shown by the comparison of the cross sections of Figs. 7a and 7b.

[0086] As the rope F is released, the slider 19 will slide in the opposite direction, due to the elastic return force of the spring 39 thereon, and will cause the projection 29 to slide on one of the lower helical surfaces 31 to the stop point defined by one of the lower abutment surfaces 34, with the slider 19 being further guided in its rotation by an additional angle β-α, as shown in the cross section of Fig. 7c.

[0087] Following a new pull, the projection 29 will slide upon another upper helical surface 30', adjacent to the former to the next stop point defined by one of the upper concavities. This will result in a further rotation γ-β of the slider 19.

[0088] Then, as the rope F is further released, the slider 19 will be axially displaced under the action of the spring 39 and its radial projection 29 will slide upon the lower helical guide surface 31', adjacent to the former, and enter another axial groove 33', with the slider 19 being free to slide until the enlarged head 25 of the actuator 5 contacts the upper abutment surface 37 of the head 8.

[0089] In the embodiment as shown herein, during this full closing-opening cycle, the slider 19 will run a total rotation angle δ of 90°, and reach a position that will allow a next cycle to start.

[0090] Then, the cycle may be repeated any time that the electric circuit needs to be closed or opened, such as for turning on or off the emergency lights of a hoistway.

[0091] The above description clearly shows that the invention achieves the intended objects and particularly fulfils the requirement of providing a rope-operated commutation device that can be obtained by modular fabrication, by simply replacing one or more of its components, without requiring the replacement of the whole device if only some of its components need to be replaced.

[0092] The device of this invention is susceptible to a number of changes and variants, within the inventive concept disclosed in the appended claims. All the details thereof may be replaced by other technically equivalent parts, and the materials may vary depending on different needs, without departure from the scope of the invention.

[0093] While the device has been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

Claims

1. A rope operated bistable commutation device comprising:

   - a box-like body (2) designed to house at least one switch (3) connectable to a corresponding electric circuit,
   - a bistable commutation unit (4) operatively associated to said at least one switch (3) to pro-

mote the commutation thereof between a closed condition and an opened condition of said electric circuit,

wherein said unit (4) comprises an actuator (5) operable with an actuating rope (F) and guide means (6) for guiding said actuator (5) between a first stable operative positions (A) and a second stable operative position (B) corresponding to said opened and said closed condition of said at least one switch (3), respectively;
characterized in that said unit (4) is removably connected to said box-like body (2), locking means (7) being provided for holding constantly assembled said unit (4) with said actuator (5) into either said first (A) or said second (B) stable operative position to allow the unitary removal thereof from said box-like body (2).

2. Device as claimed in claim 1, **characterized in that** said blocking means (7) comprise a hollow cylindrical head (8) housing said commutation unit (4) and having a portion (9) for removably anchoring this latter to said box-like body (2).

3. Device as claimed in claim 2, **characterized in that** said head (8) has a substantially cylindrical cavity (17) with an inner side surface (18) defining a longitudinal axis (L) and shaped for housing and radially holding said commutation unit (4).

4. Device as claimed in claim 2 or 3, **characterized in that** said guide means (6) are substantially axial and are shaped to guide said commutation unit (4) from said first position (A) to said second position (B) and viceversa in response to an unidirectional axial translation of said actuator (5).

5. Device as claimed in any of the preceding claims, **characterized in that** said guide means (6) comprise a slider (19) rotatably mounted on said actuator (5) and axially sliding into said cavity (17), said slider (19) being provided on its outer side surface (28) with at least one radial projection (29).

6. Device as claimed in claim 5, **characterized in that** said guide means (6) comprise at least one pair of helical guide surfaces (30, 31) in axially offset relationship to define a substantially helical guide path for said at least one radial projection (29).

7. Device as claimed in claim 6, **characterized in that** said locking means (7) comprise at least a substantially transverse lower abutment surface (34) joined with the lower helical surface (30) of said at least one pair to stop the axial downward sliding of said slider (19).

8. Device as claimed in claim 7, **characterized in that** said guide means (6) have a plurality of said pairs of helical surfaces (30, 31; 30', 31') which are mutually angularly spaced, said locking means (7) having a plurality of said lower abutment surfaces (34) joined with corresponding lower helical guide surfaces (31).

9. Device as claimed in any of the preceding claims, **characterized in that** said actuator (5) is substantially cylindrical and has a lower portion (22) designed to interact with said at least one switch (3) and an upper portion (23) anchorable to said rope (F).

10. Device as claimed in claim 9, **characterized in that** said tubular cavity (17) has an substantially transverse upper abutment surface (37) designed to interact with said upper portion (23) of said actuator (5) to limit its axial downward translation.

11. Device as claimed in claim 10, **characterized by** comprising an elastic return member (39) having a first end (40) acting against said upper abutment surface (37) and a second end (41) acting against said slider (19) to force said at least one radial projection (29) to move from one of said upper helical surfaces (30, 30') to the corresponding lower helical surface (31, 31') in response to the pulling of said actuator (5) operated by said rope (F).

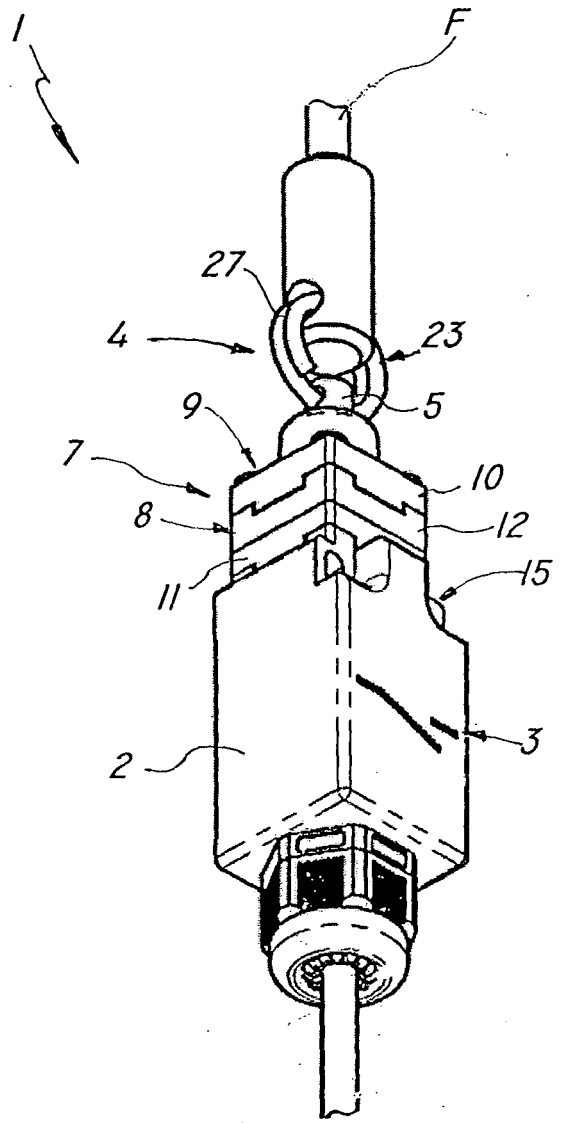
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FIG. 1

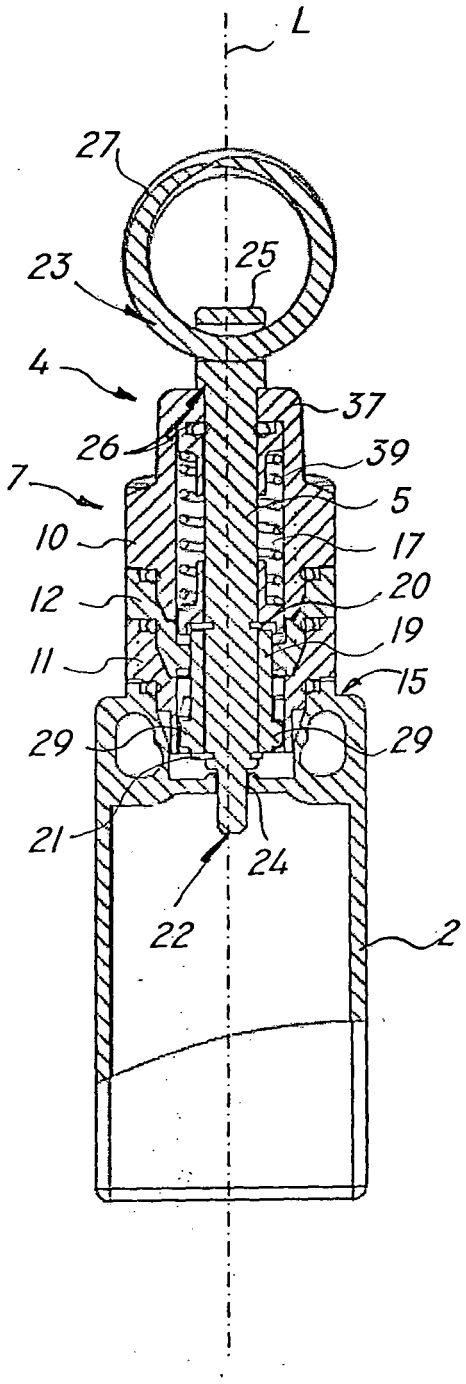
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FIG. 2

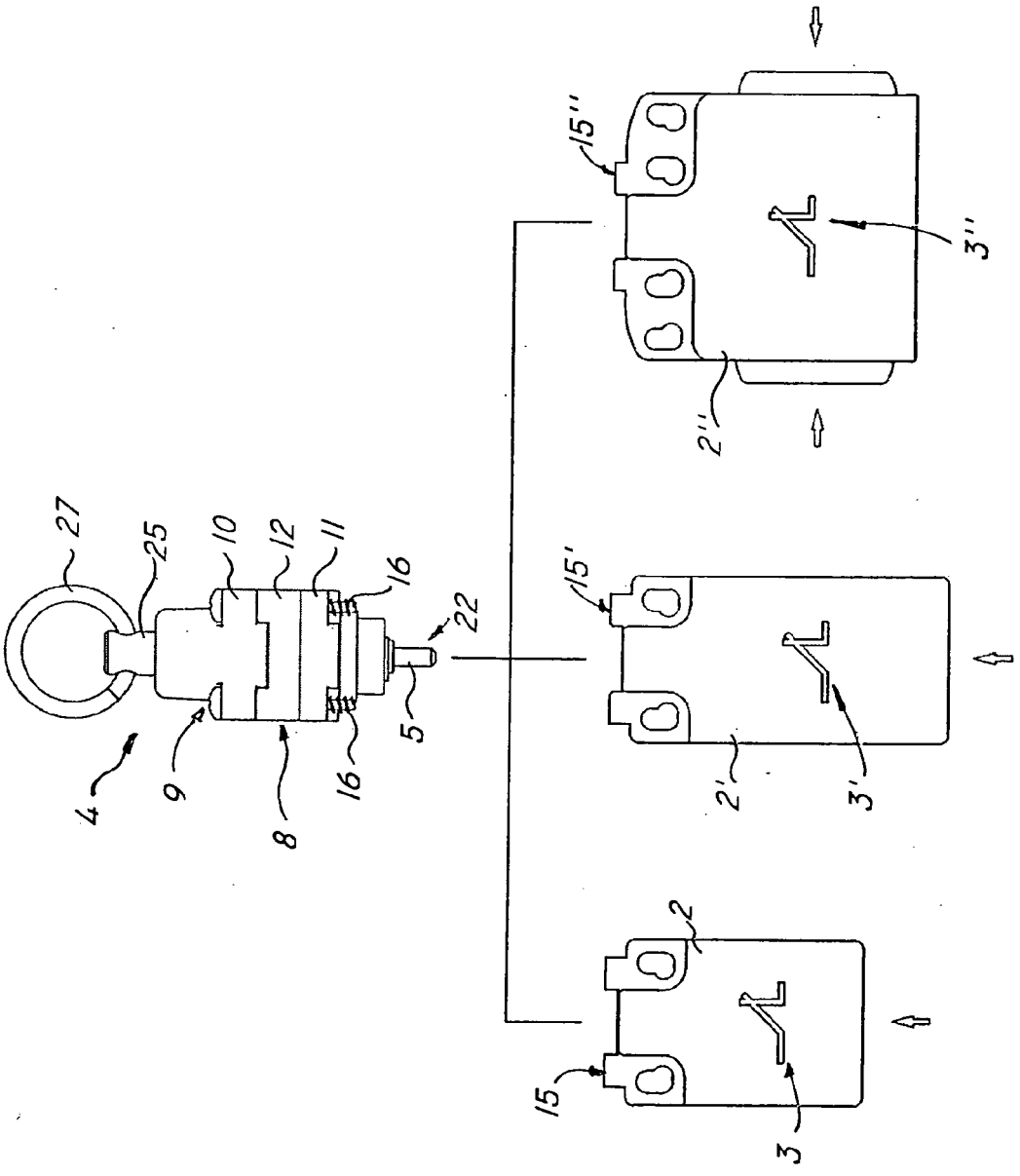

FIG. 3

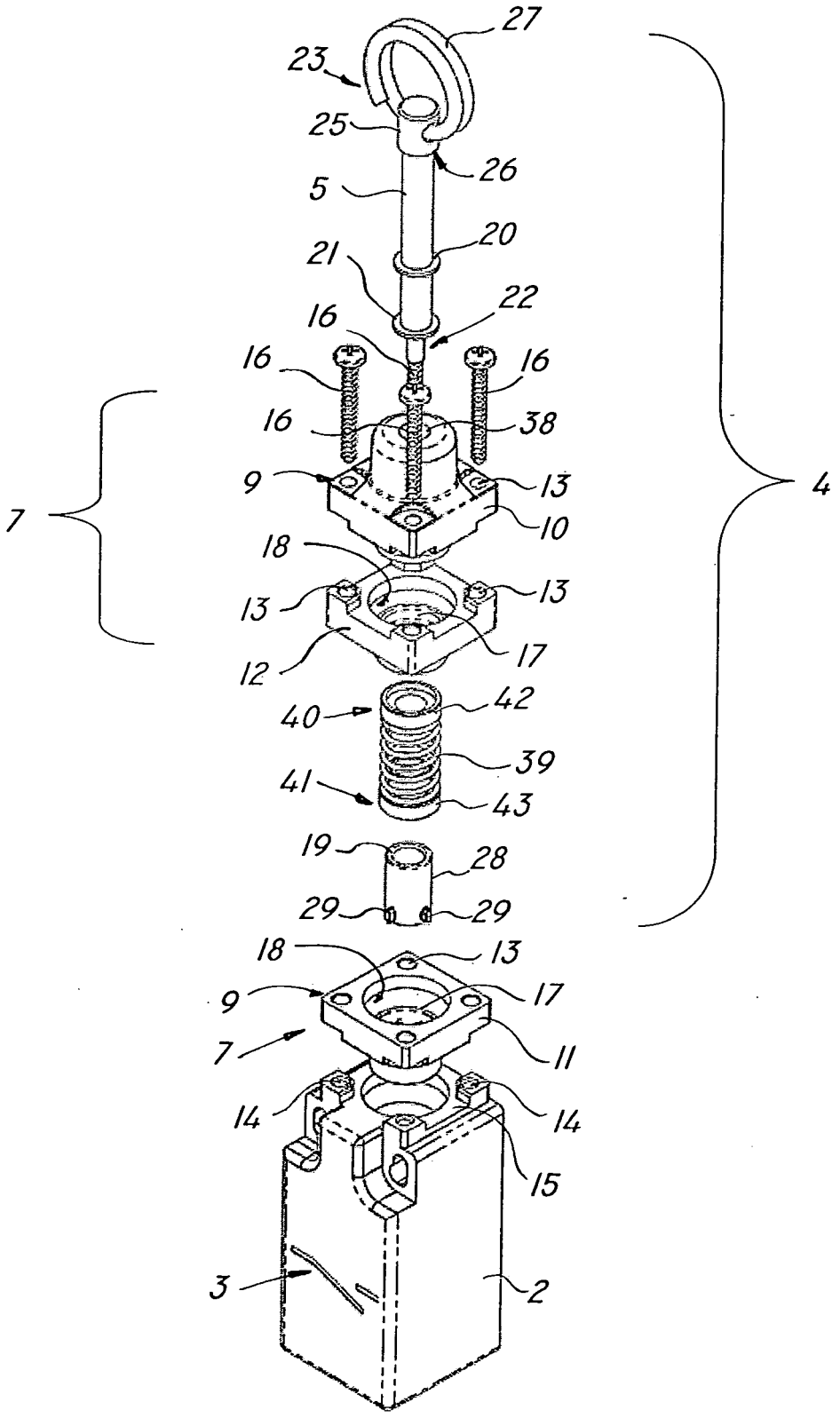
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FIG. 4

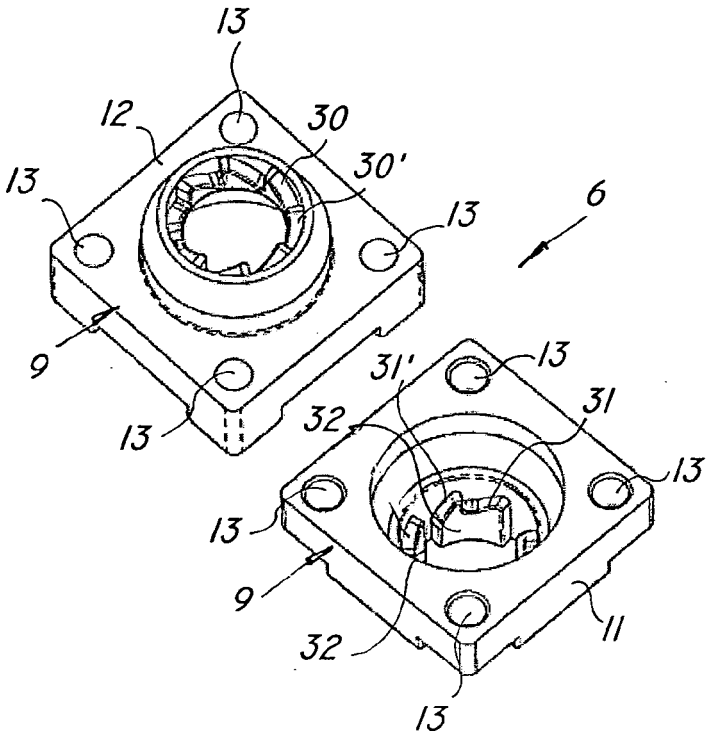

FIG. 5

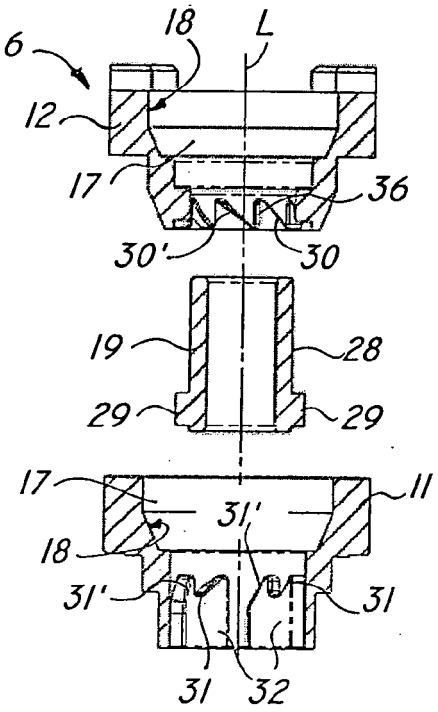

FIG. 6

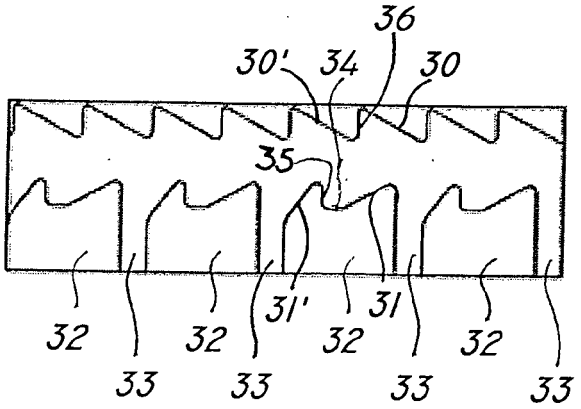

FIG. 8

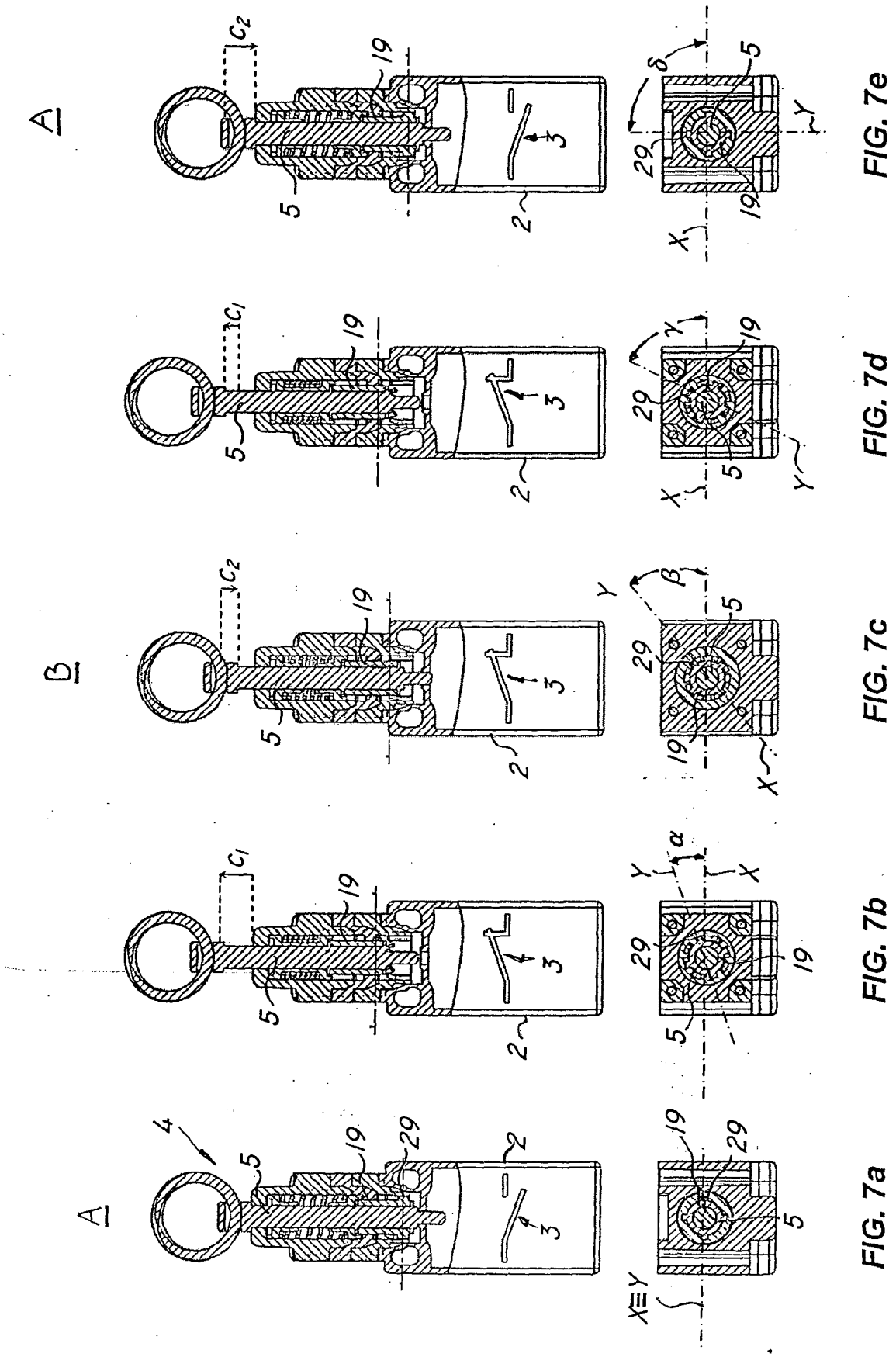

FIG. 7a

FIG. 7b

FIG. 7c

FIG. 7d

FIG. 7e

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 09 00 7766

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 2 154 369 A (GIBBON JEFFREY) 4 September 1985 (1985-09-04) * the whole document *	1-5,9-11	INV. H01H17/16 ADD. H01H13/58
X	GB 2 300 757 A (WONG BUN [HK]) 13 November 1996 (1996-11-13) * the whole document *	1-5	
X	FR 2 714 999 A (LEGRAND SA [FR]) 13 July 1995 (1995-07-13) * the whole document *	1-5	
D,A	GB 876 969 A (HANS WERNHARD SCHNEIDER) 6 September 1961 (1961-09-06) * figure 5 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 October 2009	Ruppert, Christopher

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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