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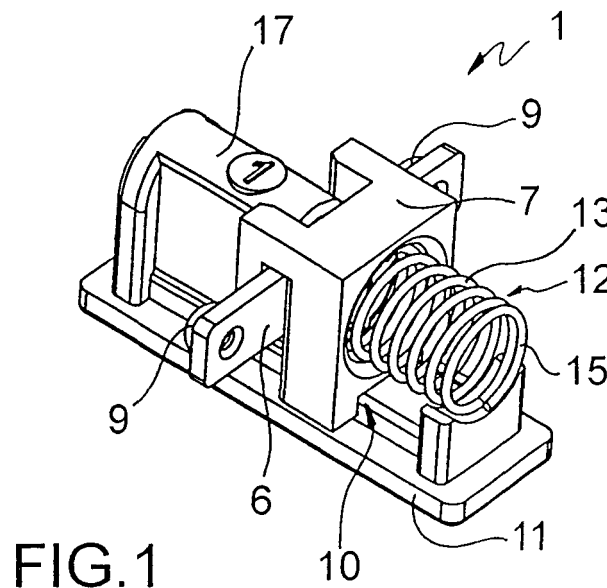
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(54) **Modular contact element and multiple contact switch having such element**

(57) A modular contact element, designed to be mounted on a multiple contact switch (2), of the type that has a slider moving relative to a plurality of stationary electric contacts (4). The modular element (1) has one or more movable electric contacts (6) for selectively interacting with corresponding stationary contacts (4) to cause their respective external electric circuits to open

and close in response to the motion of the slider (3). More in detail, at least one of the movable electric contacts (6) is associated to a support (7) which may be removably connected to the slider (3) by suitable connection means (8) to allow one or more movable contacts (6) to be mounted on and removed from the slider (3), to thereby change the opening and/or closing pattern of the electric circuits associated thereto.



Description

Field of the Invention

[0001] This invention generally finds application in the field of electric devices and particularly relates to a modular contact element and a multiple contact switch according to the preambles of claims 1 and 8 respectively, particularly for safety devices and apparatuses.

State of the Art

[0002] Many multiple contact switches for safety devices are currently known. These multiple contact switches may specifically be used to close or open specific circuits in potentially dangerous situations, such as when an operator enters an operating area of a machine or system.

[0003] EP-A-1239498 discloses a switch which has a box-like body with a plurality of stationary contacts mounted therein, and a movable element slideably connected in the box-like body and comprising a plurality of movable contacts. These are designed to selectively close certain electric circuits by contact with the corresponding stationary contacts. The movable element is arranged to be displaceable from a inoperative position to an operative position, which are characterized by the different electric circuits being closed and/or opened respectively.

[0004] Several stationary contacts are connected to the box-like body by a pivotal support, which allows the corresponding electric circuits to be set as normally closed or normally open. Thus, some electric circuits may be selected to be closed or open when the movable element is in the inoperative or operative position.

[0005] An apparent drawback of this arrangement is that it does not allow selection of the opening and closing states of all electric circuits. Therefore, a very small number of possible patterns is allowed.

[0006] EP-A-1276124 discloses a multiple contact switch which has a slider slideably mounted to a box-like body along a longitudinal axis. The slider comprises a first pair of movable contacts and a second pair of movable contacts which are situated at an axial distance from the first pair. Each pair of movable contacts is designed to selectively come in contact with a corresponding pair of stationary contacts connected with the box-like body, to selectively close two separate electric circuits. Each pair of movable contacts and each pair of stationary contacts may be removed and mounted in an axially offset position to change the opened and closed states of the two electric circuits with the slider in the same position.

[0007] One drawback of this arrangement is that two electric circuits only may be associated to the electric contacts and that customization of contact positions is limited.

[0008] A further drawback lies in that the steps for changing the pattern of movable and stationary contacts

may be laborious and relatively complicated. Each movable and stationary contact has to be removed manually, and due to its relatively small size handling requires particular care.

[0009] Furthermore, the movable contacts are held in position by the bias exerted by respective springs. Therefore, the position of the movable contacts may be only changed by first releasing them from the spring bias and then assuring a proper connection between each spring and the corresponding movable contact in the new position.

Summary of the invention

[0010] A primary object of this invention is to obviate the above drawbacks, by providing a modular contact element and a multiple contact switch that is cost-effective.

[0011] A particular object is to provide a modular element that is easily adapted to various configuration needs.

[0012] Another object of the invention is to provide a highly customizable switch which is made of a small number of components.

[0013] Yet another particular object is to provide a switch that has a sturdy construction and a reliable operation.

[0014] These objects, as well as other objects that will be apparent hereinafter, are achieved, according to claim 1, by a modular contact element, designed to be mounted on a multiple contact switch, of the type that has a slider moving relative to a plurality of stationary electric contacts, wherein the modular element comprises one or more movable electric contacts designed to selectively interact with corresponding stationary contacts, to cause their respective external electric circuits to open and close in response to the motion of the slider, characterized in that at least one of the movable electric contacts is associated to a support which may be removably connected to the slider by suitable connection means to allow one or more movable contacts to be mounted on and removed from the slider, to thereby change the opening and/or closing pattern of the electric circuits associated thereto.

[0015] Thanks to this particular arrangement, the opening and/or closing pattern of the external electric circuits may be changed in a very simple and fast manner, to adapt it to various operation needs.

Brief Description of the Drawings

[0016] Further features and advantages of the invention will be more apparent from the detailed description of a few preferred, non-exclusive embodiments of a modular contact element and a multiple contact switch according to the invention, which are described as non limiting examples with the help of the annexed drawings, in which:

FIG.1 is a perspective view of a first embodiment of a modular element according to the invention;
 FIG.2 is a perspective view of a second embodiment of a modular element according to the invention;
 FIG.3 is a broken away side view of the element of FIG. 1;
 FIG.4 is a broken away side view of the element of FIG. 2;
 FIG.5 is a bottom view of the element of FIG. 1;
 FIG.6 is a bottom view of the element of FIG. 2;
 FIG.7 is a perspective view of a first embodiment of a switch according to the invention;
 FIG.8 is a top view of the switch of FIG. 7;
 FIG.9 is a broken away side view of the switch of FIG. 7;
 FIG.10 is a side view of the switch of FIG. 7;
 Figures 11 to 16 are broken away views of the switch of FIG. 7 in three different patterns;
 Figures 17 to 22 are broken away views of a second embodiment of a switch of the invention, in three different patterns;
 FIG. 23 is a perspective view of a safety device containing a switch of the invention;
 FIG.24 is a perspective view of a detail of FIG. 1;
 FIG.25 is a perspective view of a detail of FIG. 2.

Detailed description of a preferred embodiment

[0017] Particularly referring to the above figures, a modular contact element according to the invention is described, which is generally designated with numeral 1, which element is designed to be mounted on a multiple contact switch 2. This switch comprises a slider 3, moving relative to a plurality of stationary electric contacts 4, preferably along a longitudinal axis L of the slider. External electric circuits (not shown) may be further electrically connected to the stationary contacts 4 by means of suitable terminal clips 5.

[0018] More in detail, the modular element 1 comprises one or more movable electric contacts 6, which may be associated to the slider 3 and are designed to selectively interact with corresponding stationary contacts 4. When the movable contacts 6 interact with the corresponding stationary contacts 4, electric connection is established therebetween to close the corresponding external electric circuits. Conversely, when the movable contacts 6 do not interact with the corresponding stationary contacts 4 no current flow may occur therebetween, and the corresponding electric circuits will be in an open state. Therefore, these circuits may be opened and closed by displacing the slider 3.

[0019] A peculiar feature of the invention is that at least one of the movable electric contacts 6 is associated to a support 7 that may be removably connected to the slider 3 by means of appropriate connection means 8. Thus, by operating on the modular element 1, one or more movable contacts 6 may be easily mounted on and removed from the slider 3, to change the opening and/or closing

pattern of the electric circuits associated thereto.

[0020] As shown in the annexed drawings, each modular element 1 may have one transversely elongate movable contact 6 associated thereto, having two ends 9 designed to interact with two corresponding stationary contacts 4 to close and open a corresponding external electric circuit.

[0021] More in detail, the connection means 8 may include guide means 10 to allow displacement of the support 7 along a direction L', L" substantially parallel to the longitudinal axis L. Furthermore, the modular element 1 may include a substantially flat base 11 with which the guide means 10 may be integrally formed. The connection means 8 of the modular element 1 may also include elastic means 12, acting on the movable contact 6 to promote interaction and selective electric connection with the stationary contacts 4.

[0022] Particularly, the elastic means 12 may include a compression spring 13 having one end 14 connected to the support 7 and the other end 15 abutting against a corresponding abutment surface 16 of the slider 3.

[0023] As shown in FIG. 3 and FIG. 4, the connection means 8 may include a stop member 17, which is adapted to limit the displacement of the movable contact 6 toward the stationary contacts 4. Particularly, the stop member 17 may be formed integrally with the substantially flat base 11 and may have an abutment surface 18 adapted to interact with the movable contact 6.

[0024] The above modular element 1 may be advantageously used as a component of a multiple contact switch 2 of the type that is used for safety devices S and apparatuses.

[0025] The switch 2 may include one or more stationary electric contacts 4, one slider 3 that defines a longitudinal axis L and is axially movable relative to the stationary electric contacts 4, at least one movable electric contact 6 which is designed to electrically interact with corresponding stationary electric contacts 4 to open and close corresponding external electric circuits (not shown) associated thereto.

[0026] A peculiar feature of the invention consists in that the slider 3 has at least one receptacle 19, 19' for holding at least one corresponding modular element 1 as described above. This will facilitate mounting and removal of each movable electric contact 6, associated to a corresponding modular element 1, on and from the slider 3, whereby the pattern of the switch 1 for opening and/or closing the external electric circuit/s may be easily changed.

[0027] As shown in FIG. 7, the slider 3 may include a first set of receptacles 19 aligned along a first direction L' substantially parallel to the longitudinal axis L, and a second set of receptacles 19', aligned along a second direction L", substantially parallel to and transversely offset from the first direction L'. The first and second sets of receptacles 19, 19' may be placed on the slider 3 symmetrically to its longitudinal axis L.

[0028] In certain preferred embodiments, the slider 3

may be displaceable between two longitudinal end positions relative to a main body 20, on which the stationary contacts 4 and the clips 5 may be mounted. Furthermore, the slider 3 may have at least one intermediate longitudinal position. The end positions and the intermediate position may correspond to opening and/or closing states of the external electric circuits. Particularly, different positions of the slider 3 may correspond to different opening and/or closing states of the external electric circuits and the displacement of the slider 3 between two adjacent positions may cause at least one electric circuit to open or close.

[0029] Each receptacle 19, 19' may only hold one corresponding modular element and all the receptacles 19, 19' may be substantially identical. Furthermore, the connection surfaces of the receptacles 19, 19' and the modular elements 1 may be substantially identical and complementary to each other, to provide full interchangeability. Thus, each modular element 1 may be mounted in any receptacle 19, 19'. This feature may be very useful in case of replacement of a modular element 1.

[0030] In addition to this advantage, the use of the modular elements 1 provides the important advantage of allowing an extensive customization of the switch 2, by changing the opening and/or closing states of the external electric circuits for the same position of the slider 3. This is mainly possible thanks to the fact that the modular elements 1 may have different characteristics and/or may be mounted on the slider 3 in different positions.

[0031] More in detail, the stop members 17 of the modular elements 1 may have abutment surfaces 18 with at least two different longitudinal positions. By this arrangement, the admitted displacement of the support 7 and the corresponding movable contact 6 relative to the substantially flat base 11 and the wiper 3 may differ depending on the longitudinal position of the abutment surface 18. Also, various admitted displacements of the movable contacts 6 relative to the slider 3 allow contact with the corresponding stationary contacts 4 in different positions of the slider 3.

[0032] Particularly, a first type of modular elements, denoted by numeral 1 in the annexed drawings, may have a shorter admitted displacement between the support 7 and the substantially flat base 11 than in a second type of modular elements, denoted by numeral 1' in the annexed drawings. Thus, in the first type of modular elements 1, the movable contact 6 may only interact with the corresponding stationary contacts 4 at one of the two end positions of the slider 3. Alternatively, in the second type of modular elements 1', the movable contact 6 may interact with the corresponding stationary contacts 4 both at one of the two end positions of the slider 3 and at the intermediate position of the slider.

[0033] Furthermore, each receptacle 19, 19' may be arranged to hold a corresponding modular element 1 in either orientation along the longitudinal directions L', L". This provides a further possibility to change the opening/closing state of the electric circuit corresponding to each

modular element 1, 1'. Particularly, by selecting the orientation of each modular element 1, 1', the corresponding electric circuit may be selected to be closed in either of the end positions of the slider 3. The two selectable orientations of the modular element 1 will allow the spring 13 to push the corresponding movable contact 6 in either of two opposite directions, thereby changing the opening/closing state of the associated electric circuit at the end positions of the slider 3. Particularly, the electric circuit associated to a modular element 1 of the first type may be always open when the slider 3 is in the intermediate position, regardless of the direction of insertion of the modular element. Conversely, the electric circuit associated to a modular element 1' of the second type may be always closed when the slider 3 is in the intermediate position.

[0034] By changing the orientation of a modular element 1, the biasing direction of the compression spring also changes. For this feature to be allowed, the stationary electric contacts 4 may be mounted on the main body 20 in two longitudinally offset positions depending on the orientation of the corresponding modular element 1.

[0035] As is apparent from the above disclosure, the modular element and the switch of this invention fulfill the proposed objects, and particularly allow easy mounting and removal of movable contacts, and provide a large number of combinations and customization possibilities. Considering an embodiment with four receptacles and two different types of modular elements in either of the two opposite orientations, the total number of possible combinations, determined by combinatorial analysis, is $4^4 = 4 \times 4 \times 4 \times 4 = 256$.

[0036] The modular element and the switch of this invention are susceptible to a numerous modifications and changes all falling 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.

[0037] While the modular element and the switch have 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 modular contact element, designed to be mounted on a multiple contact switch (2), of the type that has a slider (3) moving relative to a plurality of stationary electric contacts (4), wherein the modular element (1) comprises one or more movable electric contacts (6) designed to selectively interact with corresponding stationary contacts (4), to cause their respective external electric circuits to open and close in response to the motion of the slider (3), **characterized**

- in that at least one of said movable electric contacts (6) is associated to a support (7) which may be removably connected to the wiper (3) by suitable connection means (8) to allow one or more movable contacts (6) to be mounted on and removed from the slider (3), to thereby change the opening and/or closing pattern of the electric circuits associated thereto.
2. A modular element as claimed in claim 1, wherein the slider (3) is movable along its own longitudinal axis (L), **characterized in that** said connection means (8) include guide means (10) which allow displacement of said support (7) along a direction (L', L'') substantially parallel to said longitudinal axis (L).
 3. A modular element as claimed in claim 2, **characterized in that** said guide means (10) are formed integrally with a substantially flat base (11).
 4. A modular element as claimed in claim 3, **characterized in that** said connection means (8) include elastic means (12), acting on said at least one movable contact (6) to promote interaction and selective electric connection with said stationary contacts (4).
 5. A modular element as claimed in claim 4, **characterized in that** said elastic means (12) include a compression spring (13) having one end (14) connected to said support (7) and the other end (15) abutting against a corresponding abutment surface (16) of the wiper (3).
 6. A modular element as claimed in claim 5, **characterized in that** said connection means (8) include one stop member (17) for said at least one movable contact (6), said stop member (17) being formed integrally with said substantially flat base (11).
 7. A modular element as claimed in claim 6, **characterized in that** said stop member (17) has an abutment surface (18), which is adapted to limit the displacement of said at least one movable contact (6) toward said stationary contacts (4).
 8. A multiple contact switch, particularly for safety devices and apparatuses, comprising one or more stationary electric contacts (4), one slider (3) defining a longitudinal axis (L), which is movable relative to said stationary electric contacts (4), at least one movable electric contact (6), which is designed to electrically interact with corresponding stationary electric contacts (4) to open and close corresponding external electric circuits associated thereto, **characterized in that** said wiper (3) has at least one receptacle (19, 19') for holding a corresponding modular element (1) as claimed in any of claims 1 to 7, to facilitate mounting and removal thereof on and from the slider (3), to thereby change the opening and/or closing pattern of the switch (2) to open and/or close the external electric circuit/s.
 9. A switch as claimed in claim 8, **characterized in that** said slider (3) has a first set of receptacles (19) aligned along a first direction (L') substantially parallel to said axis (L).
 10. A switch as claimed in claim 9, **characterized in that** said slider (3) has a second set of receptacles (19') aligned along a second direction (L'') substantially parallel to and transversely offset from the first direction (L').
 11. A switch as claimed in claim 10, **characterized in that** said first and second sets of receptacles (19, 19') are placed on said wiper (3) symmetrically to its longitudinal axis (L).
 12. A switch as claimed in claim 8, **characterized in that** said wiper (3) has two longitudinal end positions and at least one longitudinal intermediate position, corresponding to opening and/or closing states of the circuits.
 13. A switch as claimed in claims 10 and 12, **characterized in that** each of said receptacles (19, 19') is arranged to hold a corresponding modular element (1) in either orientation along said longitudinal directions (L', L''), to change the opening/closing state of the corresponding electric circuit at said longitudinal end positions of the wiper (3).
 14. A switch as claimed in claim 13, **characterized in that** it comprises a main body (20) where to said stationary electric contacts (4) are associated in two longitudinally offset positions depending on the orientation of the corresponding modular element (1).
 15. A switch as claimed in claim 10, **characterized in that** said receptacles (19, 19') and said modular elements (1) have substantially identical and complementary connection surfaces, to provide full interchangeability.
 16. A switch as claimed in claim 8, **characterized in that** said stop members (17) of the modular elements (1) have abutment surfaces (18) with at least two different longitudinal positions, corresponding to different opening/closing conditions of the electric circuits.

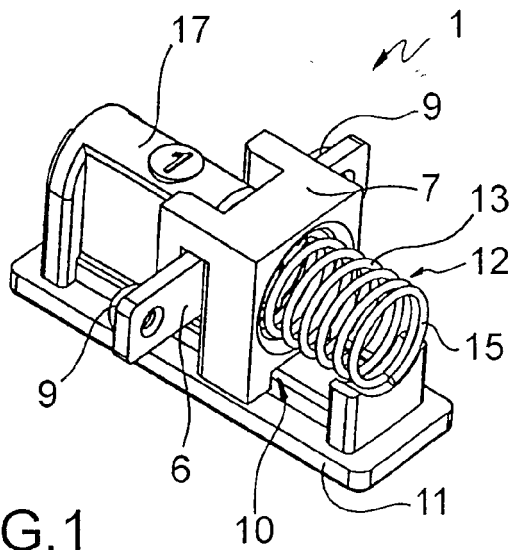


FIG. 1

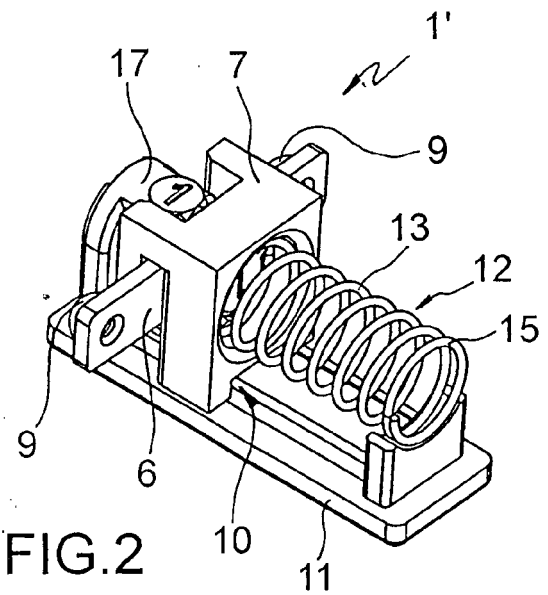


FIG. 2

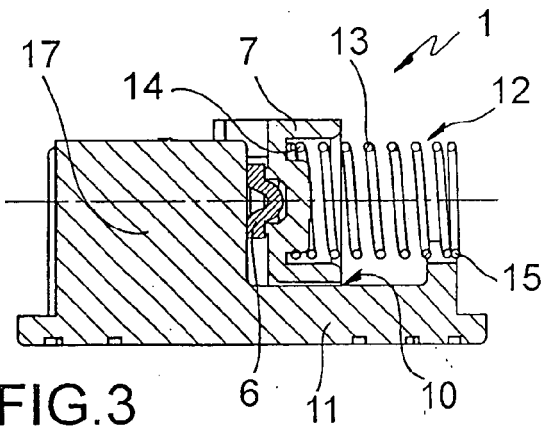


FIG. 3

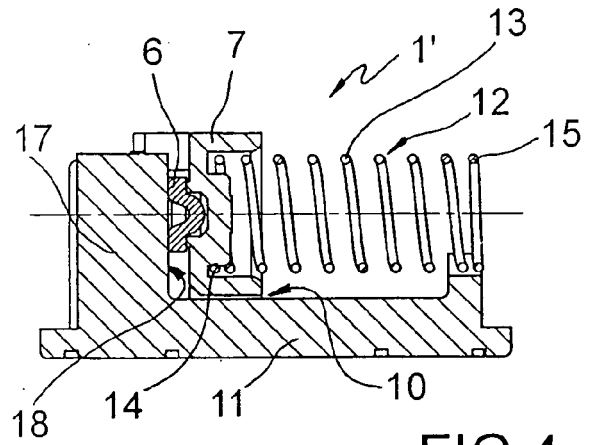


FIG. 4

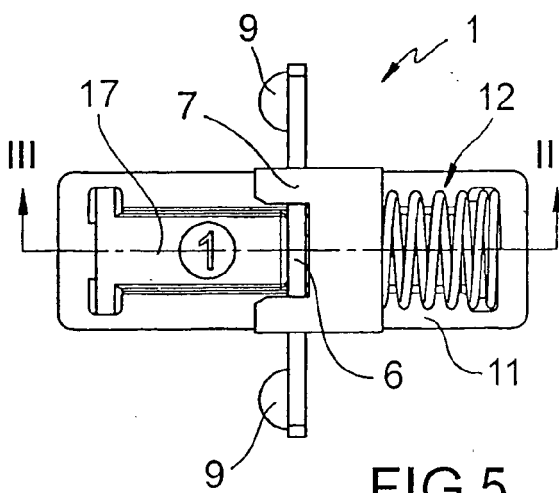


FIG. 5

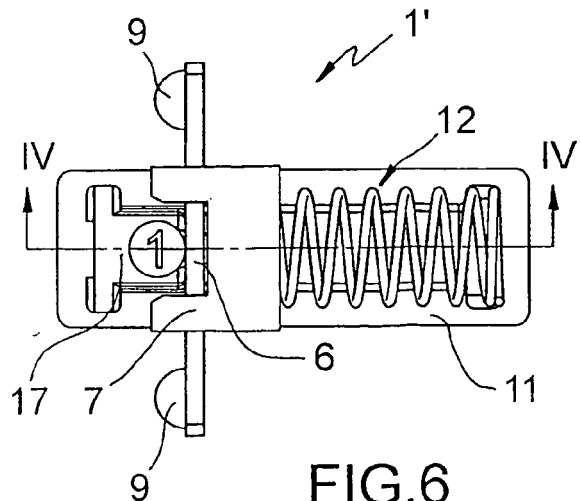
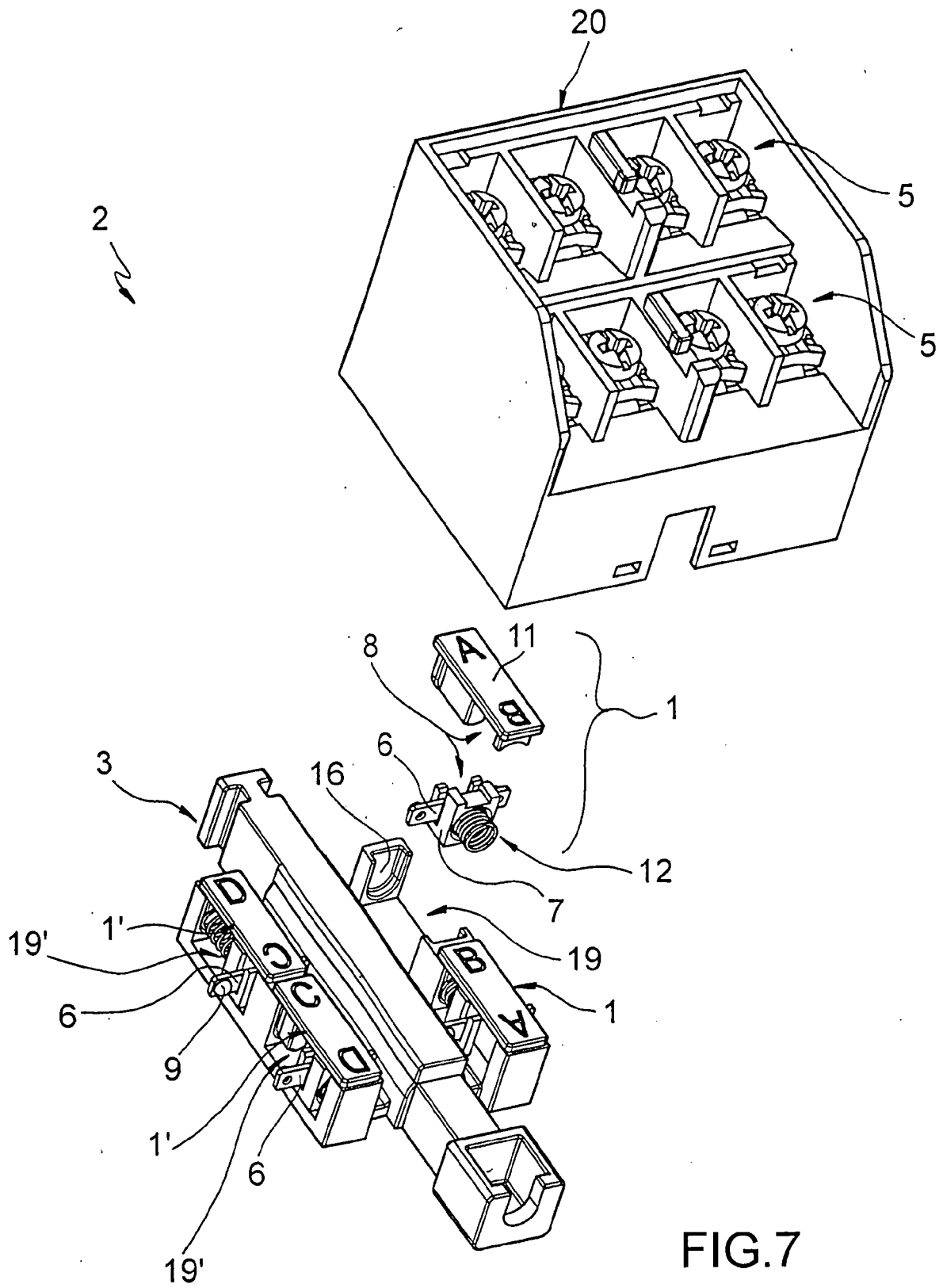


FIG. 6



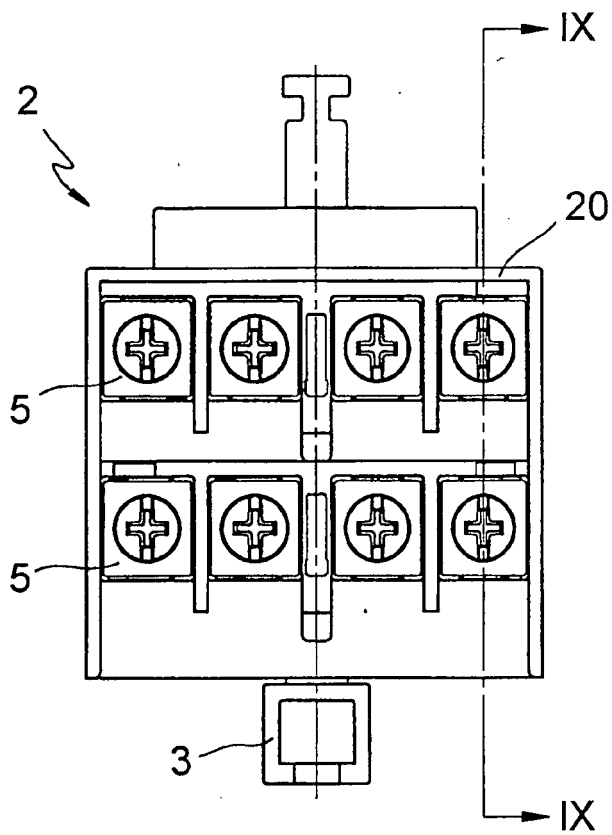


FIG. 8

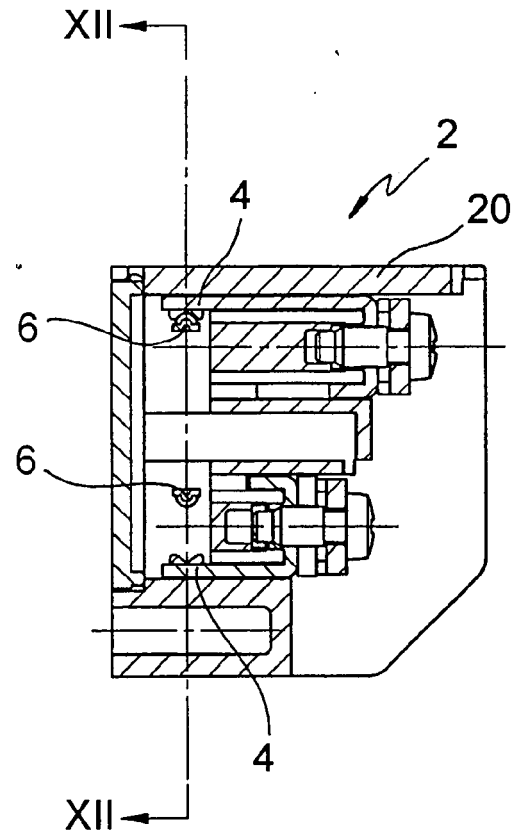


FIG. 9

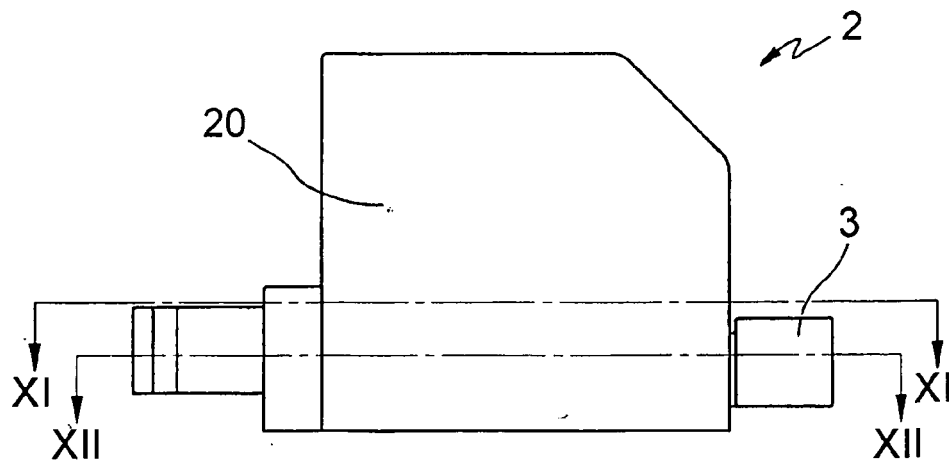
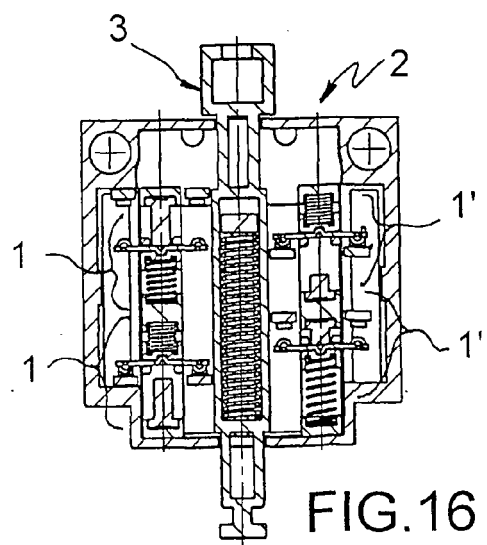
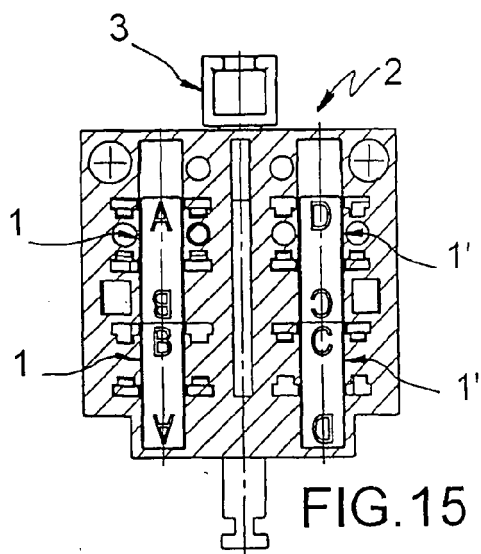
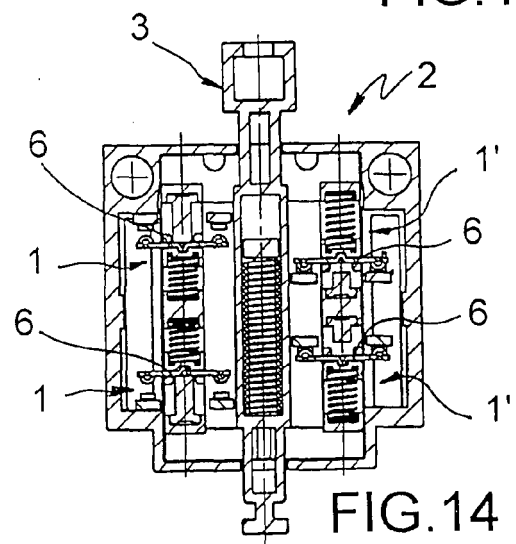
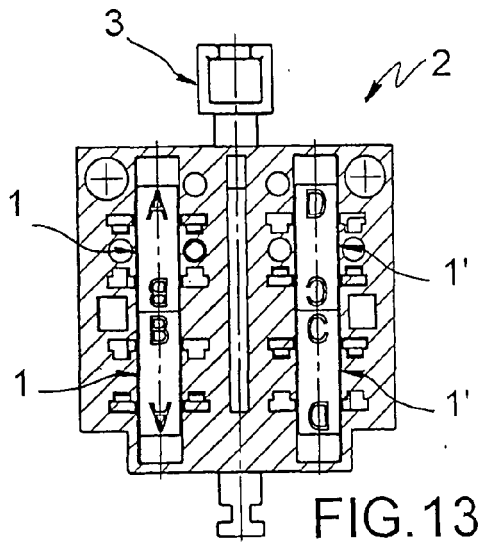
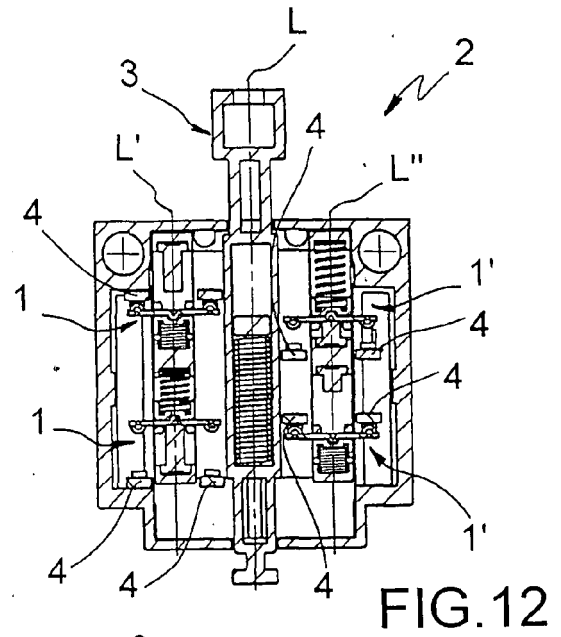
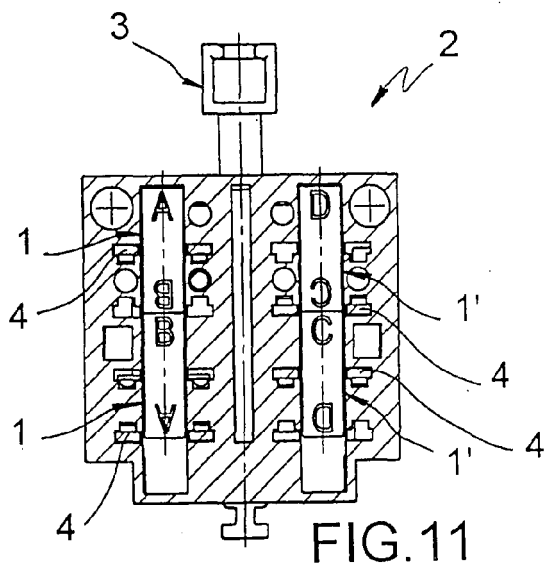


FIG. 10



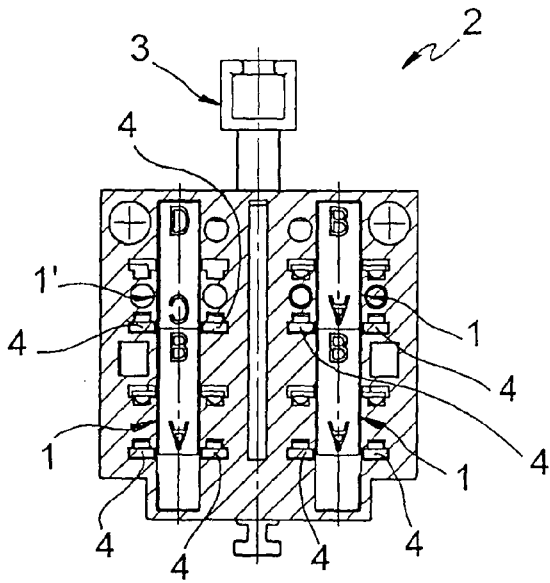


FIG. 17

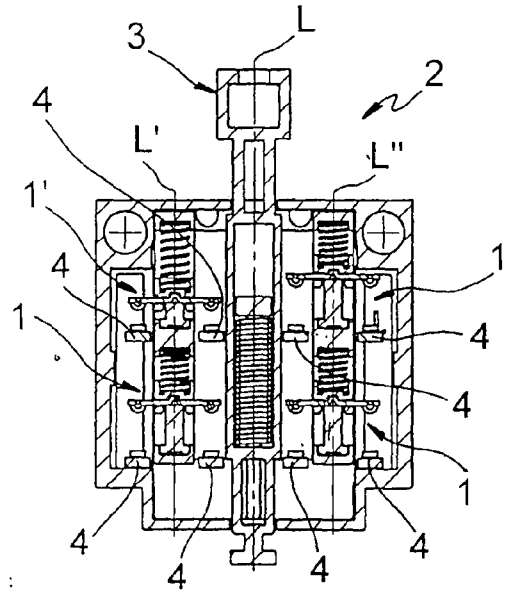


FIG. 18

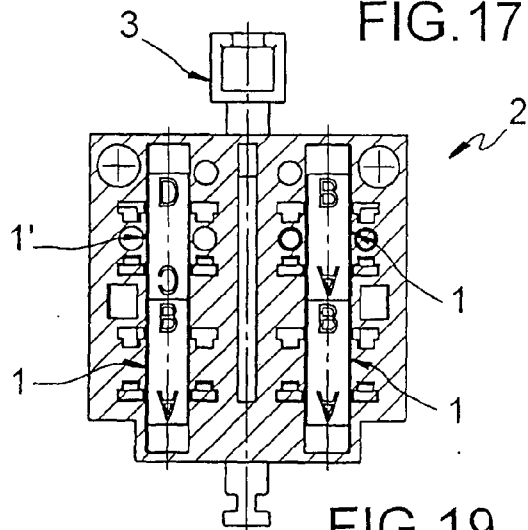


FIG. 19

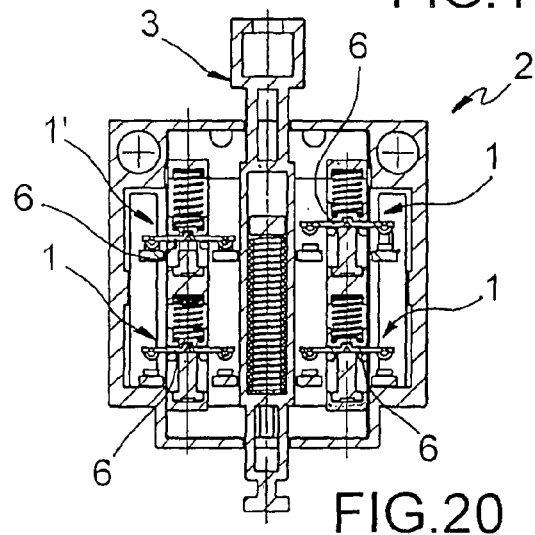


FIG. 20

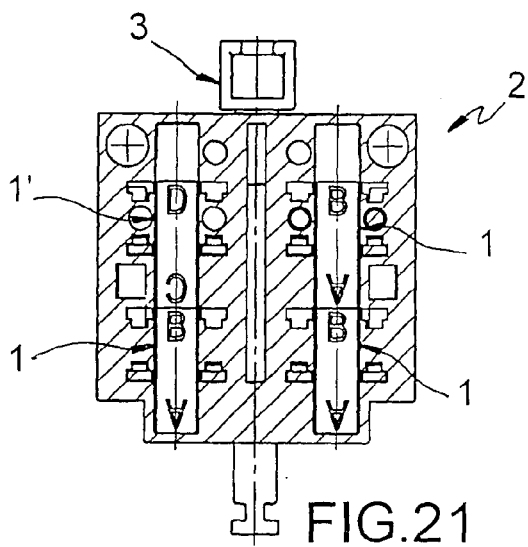


FIG. 21

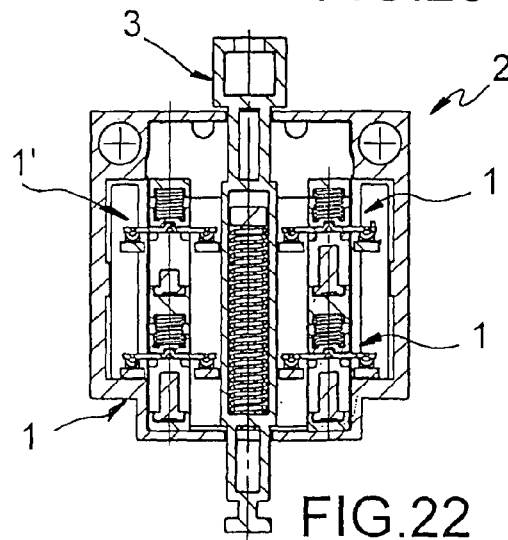


FIG. 22

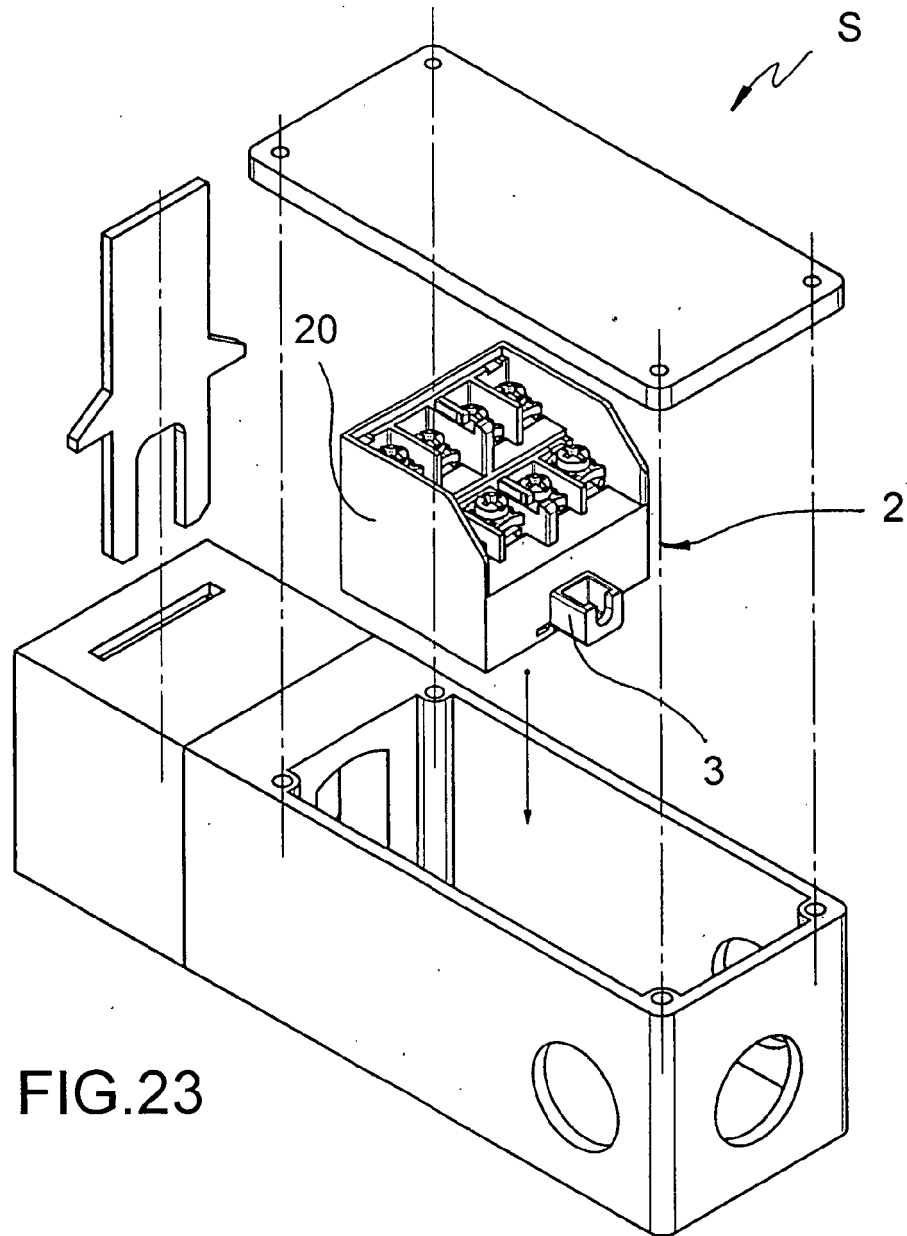


FIG. 23

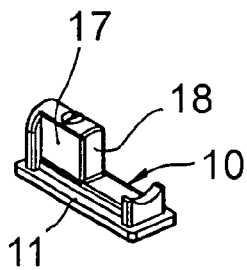


FIG. 24

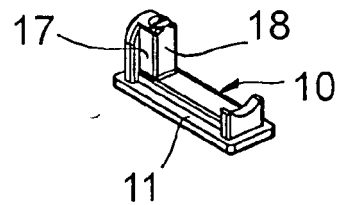


FIG. 25



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 05 02 1765

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 January 2006	Examiner Simonini, S
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 05 02 1765

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