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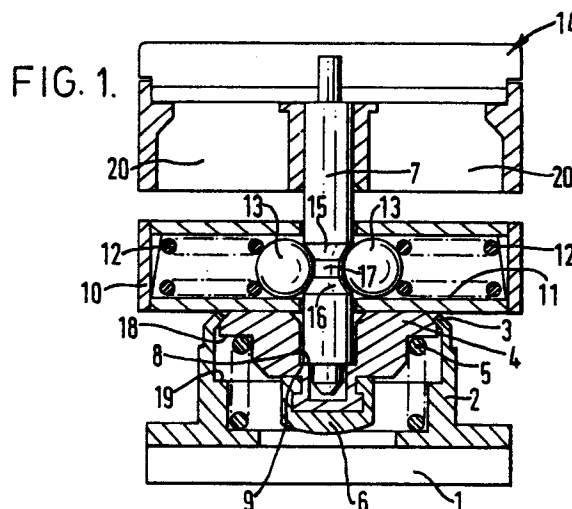
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Improvements relating to switches.

A push button kind of switch has an elongate stem (7) mounting a cap member (14) and engaged at its lower end in a member (4) retained in a housing (2) and biased upwardly by a spring (5). A switch member (1) comprising a diaphragm and contacts is operated upon downward movement of the elongate stem (7) by a cushion member (6).

Tactile indication of switch operation is given by a profiled portion (15) of the stem (7) co-operating with spring biased balls (13) in bores (11) in a housing (10). The springs (12), balls (13) and profiled portion (15) provide a high initial resistance to axial movement of the stem (7) followed by rapid collapse and virtually no resistance.



IMPROVEMENTS RELATING TO SWITCHES

The invention relates to switches and in particular to switches of the push button kind.

It may be desirable for a push button switch to have a high actuation force requirement and give an unmistakeable tactile indication to the operator that the switch has been actuated.

According to the invention there is provided a switch of the push button kind comprising an elongate member of circular section movable in the direction of its longitudinal axis to operate switch contacts, the elongate member including a profiled portion of frusto conical form, and a plurality of balls provided in respective transverse bores in a member through a further bore in which the elongate member passes, the transverse bores being provided in a radial array and the balls each being biased by a respective spring into engagement with the profiled portion and moved against the bias of the spring by the profiled portion upon movement of the elongate member to operate the switch contacts, characterised in that the switch is combined together with a plurality of other similar switches to form the keys of a keyboard and the elongate member is provided with a cap member to which force can be applied to cause movement of the elongate member, the cap member bearing indicia for illumination by at least one lamp.

Preferably the elongate member operates the switch contacts through the intermediary of a further member which is engaged on the elongate member and is spring biased to cause return movement of the elongate member. The further member may carry a cushion member thereon to provide for over-travel after actuation of the switch contacts. Preferably the further member and the spring are encapsulated in a housing and the travel of the further member against the bias of the spring and with respect to the housing is limited by stops to prevent excess force applied to the elongate member causing damage to the switch.

Preferably the cap and elongate member are removable together from the member in which the ball and spring are mounted to permit access to the lamp or lamps and the elongate member and cap are retained in said member against inadvertent removal by a reverse angled further frusto-conical portion of the elongate member which co-operates with the ball and is normally located on the opposite side of the ball to the cap. The angles of said frusto-conical portion and said further frusto-conical portion may be chosen to set the force required to operate the switch and the force required to remove the cap and elongate member respectively.

Advantageously the cap member is formed by an upper portion and a lower portion, the lower portion is divided into individual cells each of which can overlie a respective lamp and the upper portion is divided up into a plurality of discrete areas each of which overlies a respective one of the lamps.

Preferably said member comprises a plate mounting the balls and springs, the plate having apertures therein for the lamps and lugs whereby the plate can be secured in a respective recess in the underside of a skeleton member having a plurality of the recesses therein.

Advantageously each of the recesses of the skeleton member receives a respective one of the switches, a lamp printed circuit board is provided beneath the skeleton member and a spacer and location plate is provided beneath the lamp printed circuit board, the spacer and location plate including bores to receive support and connection pins for the lamps after they have passed through the lamp printed circuit board and also including bores to receive the switch contacts of the switches of the keyboard.

Preferably each cap member has a lug thereon to engage in a respective recess in the edge of the recess in the skeleton member in which it is mounted to prevent the cap member from rotating about the axis of the respective elongate member.

The invention is diagrammatically illustrated by way of example in the accompanying drawings in which:-

Figure 1 is a sectional view through one embodiment of a switch according to the invention;

Figure 2 is a plan view corresponding to Figure 1;

Figure 3 is a sectional view through another embodiment of a switch according to the invention;

Figure 4 shows an elongate member of the switch of Figure 3;

Figure 5 shows a spring and ball mounting plate of the switch of Figure 3;

Figures 6 and 7 show respectively a plan view and a side view of an upper portion of a cap member of the switch of Figure 3;

Figures 8 and 9 show respectively an underneath plan view and a sectional view of a spacer and location plate for a keyboard incorporating the switch of Figure 3;

Figures 10, 11 and 12 show respectively a plan view of a member for forming a keyboard incorporating the switch of Figure 3, a sectional view on line XI-XI of Figure 10 and an underneath plan view corresponding to Figure 10;

Figure 13 shows an underneath plan view of a lower portion of a cap member of the switch of Figure 1;

Figure 14 is an underneath plan view corresponding to Figure 13; and

Figures 15 to 17 are sectional views taken respectively on lines XV-XV : XVI-XVI and XVII-XVII of Figure 14.

Referring to Figure 1, a push button switch has a switch member 1 which, in known manner, incorporates a diaphragm and electrical contacts such that the contacts are closed when a compression force is provided between the upper and lower faces. The switch 1 is secured to the underside of a housing 2 which has an inwardly peened peripheral upper edge 3 which retains a circular member 4 in the housing 2, the circular member 4 being biased upwardly by a coil spring 5. A silicon cushion 6 is mounted at the lower end of the member 4 such that downward movement of the member 4 against the force of the spring 5 will cause the cushion 6, after a determined amount of pre-travel, to operate the switch 1.

An elongate stem 7 has its lower end engaged in the member 4 with a shoulder 8 on the stem 7 engaged against a shoulder 9 of the member 4. Mounted above the housing 4 is a housing 10 with a transverse bore 11 therein, the bore 11 containing two springs 12 and two steel balls 13.

A cap member 14 is mounted at the upper end of the stem 7. In the position shown the switch arrangement of Figure 1 is in a rest position and the balls 13 are accommodated in a circumferential groove in the elongate stem 7, which circumferential groove comprises an upper frusto-conical portion 15, a lower frusto-conical portion 16 and an intermediate cylindrical portion 17. It will be seen that if force is applied to the cap member 14 in a downward direction, downward movement of the elongate stem 7 will be resisted by the balls 13 engaging the frusto-conical surface 15 and that only after sufficient force has been applied to move the balls 13 radially outwardly against the force of the springs, will the elongate stem 7 be able to move downwardly. Once the balls have ridden up the frusto-conical portion 15 of the elongate stem 7 onto the upper cylindrical portion thereof, further downward movement will not be resisted by the springs 12 and balls 13 so that there will be, for the switch arrangement, an initial high resistance to actuation and, once this resistance has been overcome, a collapse of resistance and consequently very little resistance to further travel. Further travel will be resisted to some extent by the return spring 5 but the force chosen for the return spring 5 will be such that it applies a much lower resistance to movement of the elongate stem 7 than does the arrangement of the springs 12 and balls 13. The

cap 14, elongate stem 7 and member 4 will move downwardly to enable the cushion 6 to operate the switch 1 and downward movement will be stopped when a face 18 of the member 4 abuts a peripheral shoulder 19 of the housing 2, the peripheral shoulder 19 being so positioned that downward movement will be stopped before the cushion 6 can apply to the switch 1 a force which would cause damage thereto.

When the downward force applied to the cap member 14 is removed, the spring 5 will cause return movement to the position shown in Figure 1. By pulling outwardly on the cap member 14 the elongate member can be removed from the member 4 and the housing 10, thereby permitting access to bulbs (not shown) which illuminate the cap 14 and are received in recesses 20 in the underside of the cap 14. The force necessary to remove the cap and elongate stem 7 from the member 4 and housing 10 will depend upon the angle chosen for the further frusto-conical surface 16 which can be steeper or shallower or at the same angle as the frusto-conical surface 15.

Figure 2 shows that the cover 14 can be divided up into four discrete areas, each of which overlies a respective one of the lamps 20 which can illuminate it and indicia provided thereon.

Figure 3 shows another embodiment, Figures 3 does not show a housing corresponding to the housing 10 and mounting the springs 12 and balls 13, but these are provided in this embodiment as in the embodiment of Figure 1.

Figure 3 shows that a bottom part of the switch comprises a switch printed circuit board 21 on which a diaphragm switch 22 is mounted. A housing 23 is provided above the switch 22 with the inter-position of an annular washer 24 of electrically insulating material. A switch actuating member 25 is located in the housing 23 and biased upwardly by a spring 26, the housing 23 having an inner flange 27 which co-operates with a shoulder 28 on the member 25 to form a stop. A soft silicon rubber end piece 30 is provided on the lower end of the actuating member 25 and can be projected through the central aperture in the washer 24 to operate the switch 22. An elongate member 31 has its lower end engaged in a recess in the actuating member 25 and has at an intermediate position in its length although not shown in Figure 3, a double frusto-conical arrangement similar to the arrangement 15,16,17 of the embodiment of Figure 1 to co-operate with spring loaded balls.

A cap member comprises a lower portion 32 with a central aperture therein in which an upper portion 33 of the elongate member 31 is engaged, the lower portion 32 locating against a shoulder 34 on the elongate member 31. The lower portion 32 is divided into four cells 35 each of which can

overlie and receive a bulb as indicated by the curved lines. Preferably the lower portion 32 is formed of an opaque material. A cup-shaped upper end of the portion 33 of the elongate member 31 is peened outwardly to form a rim 36 which retains the lower portion 32 of the cap member on the elongate member 31 to form them into an integral unit. An upper portion 37 of the cap member is a press fit into the lower portion 32. Areas of the upper portion 37 which overlie the individual cells 35 of the lower portion 32 are provided to be suitably transparent to form suitable indicia for giving indications of the functions controlled by the switch. The combined upper portion 37 and lower portion 32 are mounted in a recess 39 in a skeleton member 40 which has a plurality of the recesses 39 and thereby forms a keyboard of which the cap members formed by the upper portions 37 and the lower portions 32 form the keys. Below the keyboard 40 is a mounting plate 41, a lamp printed circuit board 42 is provided below the plate 41 and a spacer and location plate 43 has recesses 44 and 45 therein which respectively receive the housing 23 and the diaphragm disc switch 22.

Figure 4 shows that the frusto-conical portion 15 of the elongate member 31 can have an angle of 45° but that the frusto-conical portion 16 can have an angle of 25° such that the force required to pull the elongate member 31 outwardly is considerably less than the force required to press it inwardly.

Figure 5 shows the ball and spring mounting plate 41 for each of the keys of the keyboard 40, each plate 41 having an aperture 46 at each of two diagonally opposite corners provided in lugs 47 to receive clamping bolts 48 Figure 3 which engage in threaded holes 49, Figure 3 and Figure 12, provided in the keyboard 40. Four bores 50 are provided each with a spring and a ball therein and the central cut-away portion of the Figure shows that the bores 50 are drilled individually each from the outside and are stopped a distance short of the middle position such that opposite bores while aligned are not through bores and the respective balls are retained therein and cannot move across the middle position. The plates 41 are recessed into the keyboard 40 as can be seen in Figure 11, portions 51 of the keyboard 40 closing the outer ends of the bores 50. Each plate 41 has four apertures 52 therein to provide passage for mounting and connection pins of the lamps of the key.

Figures 6 and 7 show that the upper portion 37 of the cap member of the key can have four discrete and different areas 53, 54, 55 and 56 which can be independently illuminated, preferably the top portion 37 is made from black perspex, a central divider of opaque material can be provided in a slot 57.

Figures 8 and 9 show the spacer and location plate 43 for the keyboard having the bores 44, 45 for each key and, in the flanges formed between the bores 44 and 45, apertures 58 in which are engaged support and connection pins 59, Figure 3, two for each lamp, such pins extending from the lamp, in sliding electrical contact with the printed circuit board 42 and being supported in the bores 58.

It will be seen that by pulling outwardly on a cap member of a key, the upper 37 and lower 32 portions of the cap member can be removed together with the elongate member 31, thereby exposing the four lamps which can then be changed if necessary, for example to replace a bulb which has burned out, merely by pulling outwardly on the bulb to disengage the pins 59 from the printed circuit board 42 and the bores 58 in the spacer and location plate 43, a new bulb then being inserted. The facility to replace burnt out bulbs readily is important, particularly in keyboards in aeroplanes where it may be necessary to replace burnt out bulbs in flight.

Figures 13 to 17 show various views of the lower portion 32 of the cap member of the key, particularly the four cells 35 and a slot 60 which co-operates with the slot 57 of Figures 6 and 7 to receive a central divider. Each lower member 32 of the cap member has a lug 61 thereon to engage in a respective recess 62 in the edge of the main respective recess 39 in the keyboard 40 so that the cap member is only insertable in one orientation and cannot rotate about the axis of the elongate member 31 after insertion.

If desired although not shown in the drawings, the actuation member 25 can be bifurcated and mounted to co-operate with two diaphragm switches 22 instead of only one as shown to form a two pole switch.

Claims

1. A switch of the push button kind comprising an elongate member (7, 31) of circular section movable in the direction of its longitudinal axis to operate switch contacts (1, 22), the elongate member (7, 31) including a profiled portion (15) of frusto conical form, and a plurality of balls (13) provided in respective transverse bores (11, 50) in a member (10, 41) through a further bore in which the elongate member passes, the transverse bores (11, 50) being provided in a radial array and the balls (13) each being biased by a respective spring (12) into engagement with the profiled portion (15) and moved against the bias of the spring (12) by the profiled portion (15) upon movement of the elongate member (31) to operate the switch con-

tacts (1, 22), characterised in that the switch is combined together with a plurality of other similar switches to form the keys of a keyboard and the elongate member (7, 31) is provided with a cap member (14, 32, 37) to which force can be applied to cause movement of the elongate member (7, 31), the cap member (14, 32, 37) bearing indicia for illumination by at least one lamp (20).

2. A switch according to claim 1, in which the elongate member (7, 31) operates the switch contacts (1, 22) through the intermediary of a further member (4, 25) which is engaged on the elongate member (7, 31) and is biased by a spring (5, 26) to cause return movement of the elongate member (7, 31).

3. A switch according to claim 2, in which the further member (4, 25) carries a cushion member - (6, 30) thereon to provide for over-travel after actuation of the switch contacts (1, 22).

4. A switch according to claim 2 or claim 3, in which the further member (4, 25) and the spring (5, 26) are encapsulated in a housing (2, 23) and the travel of the further member (4, 25) against the bias of the spring (5, 26) and with respect to the housing (2, 23) is limited by stops (18, 19, 27, 28) to prevent excess force applied to the elongate member (7, 31) causing damage to the switch contacts - (1, 22).

5. A switch according to any one of claims 1 to 4, in which the cap member (14, 32, 37) and the elongate member (7, 31) are removable together from said member (10, 41) to permit access to the lamp or lamps (20).

6. A switch according to any one of claims 1 to 5, in which the elongate member (7, 31) and the cap member (14, 32, 37) are retained in said member (10, 41) against inadvertent removal by a reverse angled further frusto-conical portion (10, 41) of the elongate member (7, 31) which co-operates

with the balls (13) and is normally located on the opposite side of the balls (13) to the cap member - (14, 32, 37).

7. A switch according to any one of claims 1 to 6, in which the cap member is formed by an upper portion (37) and a lower portion (32), the lower portion (32) is divided into individual cells (35) each of which can overlie a respective lamp (20) and the upper portion (37) is divided up into a plurality of discrete areas (53, 54, 55, 56) each of which overlies a respective one of the lamps (20).

8. A switch according to claim 7, in which said member (10, 41) comprises a plate (41) mounting the balls (13) and springs (13), the plate (41) having apertures (52) therein for the lamps (20) and lugs (47) whereby the plate (41) can be secured in a respective recess in the underside of a skeleton member (40) having a plurality of the recesses therein.

9. A switch according to claim 8, in which each of the recesses of the skeleton member (40) receives a respective one of the switches (1, 22), a lamp printed circuit board (42) is provided beneath the skeleton member (40) and a spacer and location plate (43) is provided beneath the lamp printed circuit board (42), the spacer and location plate - (43) including bores (58) to receive support and connection pins (59) for the lamps (20) after they have passed through the lamp printed circuit board (42) and also including bores (45) to receive the switch contacts of the switches of the keyboard.

10. A switch according to claim 8 or claim 9, in which each cap member (32, 37) has a lug thereon (61) to engage in a respective recess in the edge of the recess in the skeleton member (40) in which it is mounted to prevent the cap member (32, 37) from rotating about the axis of the respective elongate member (7, 31).

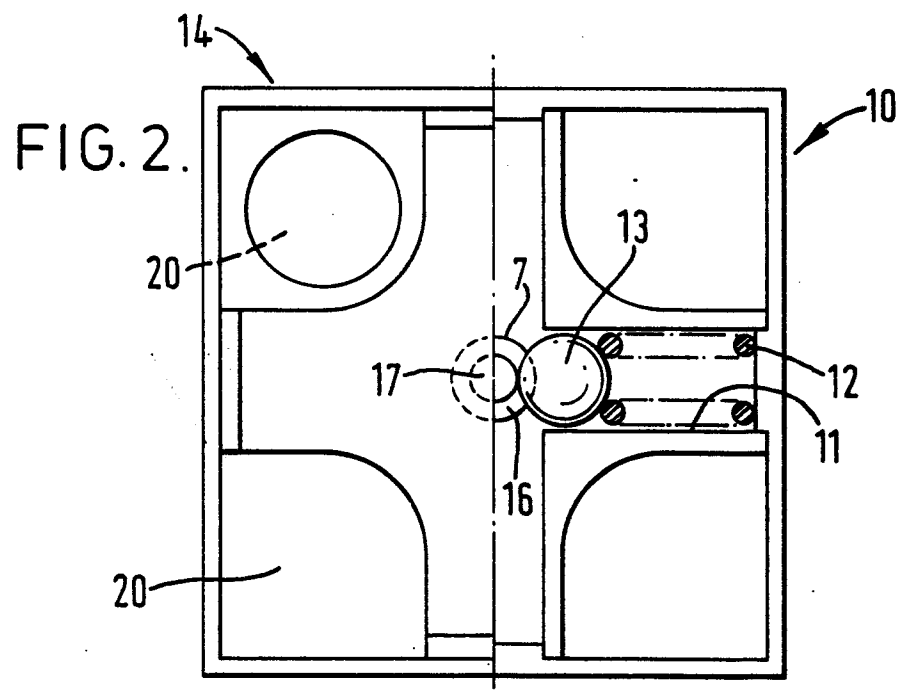
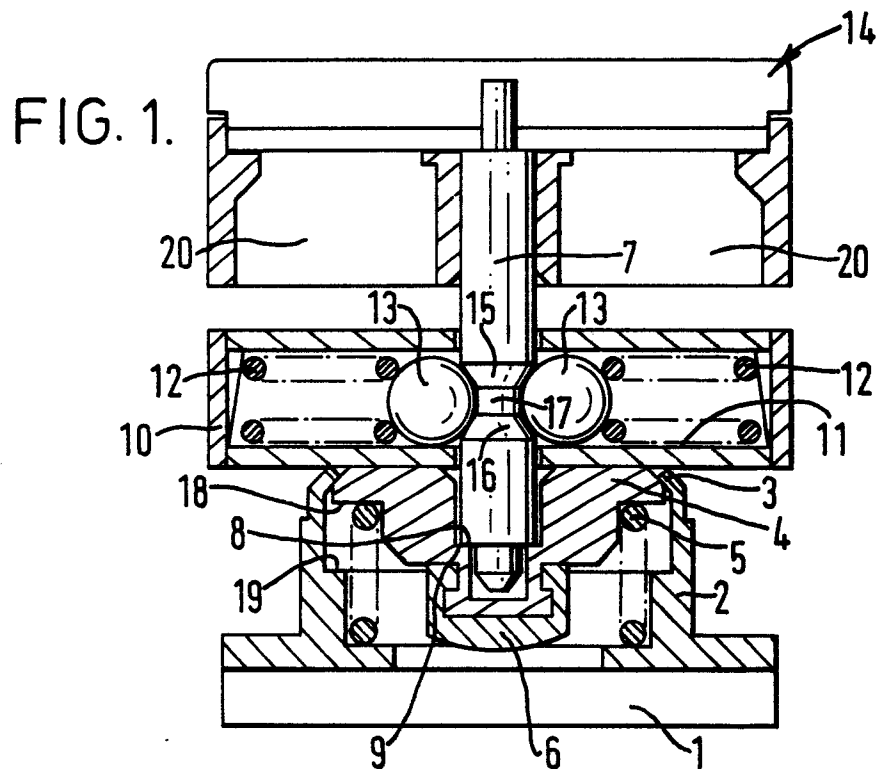
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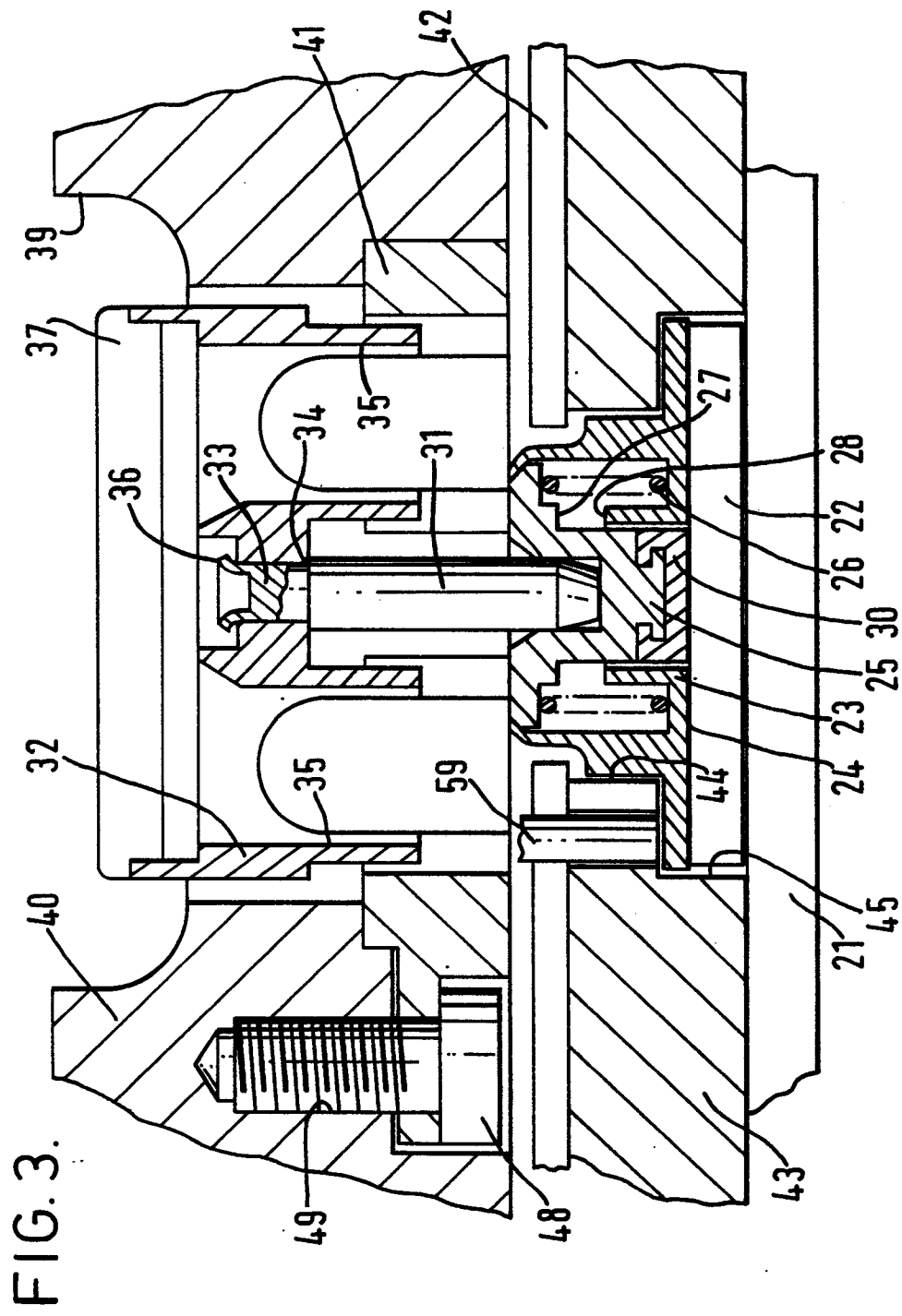
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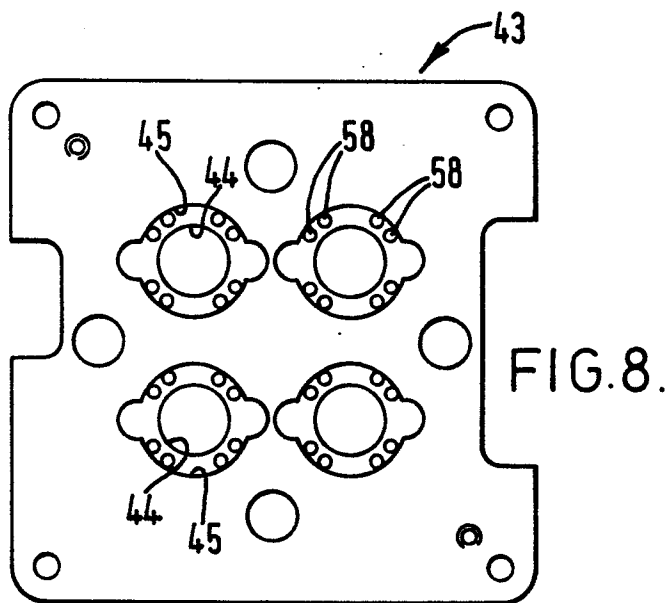
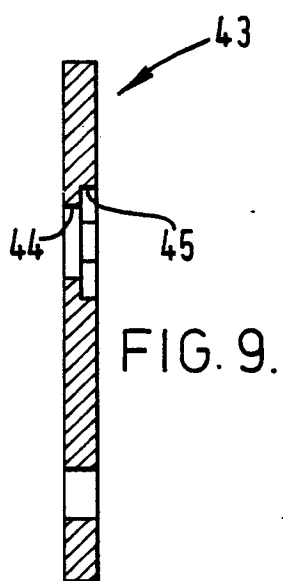
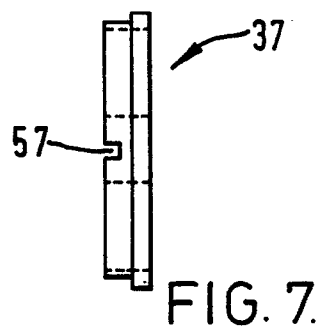
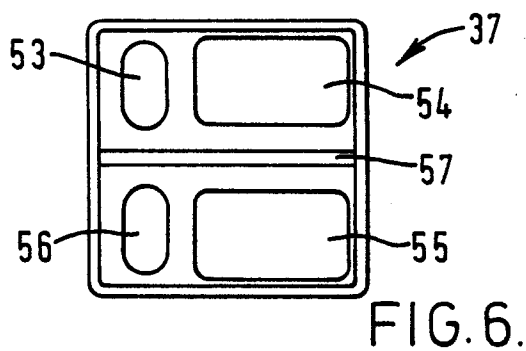
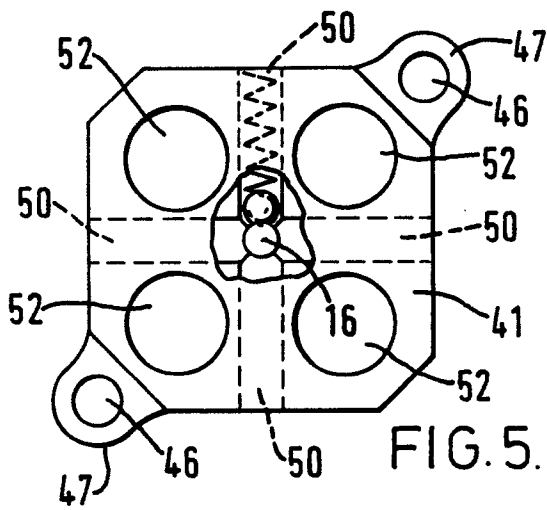
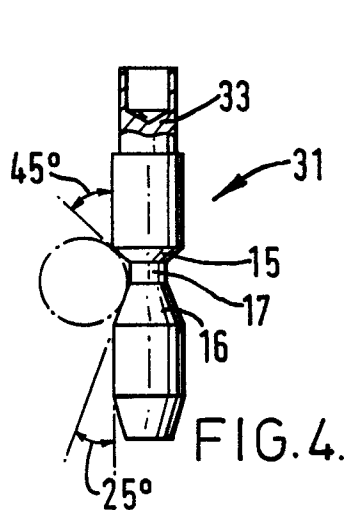
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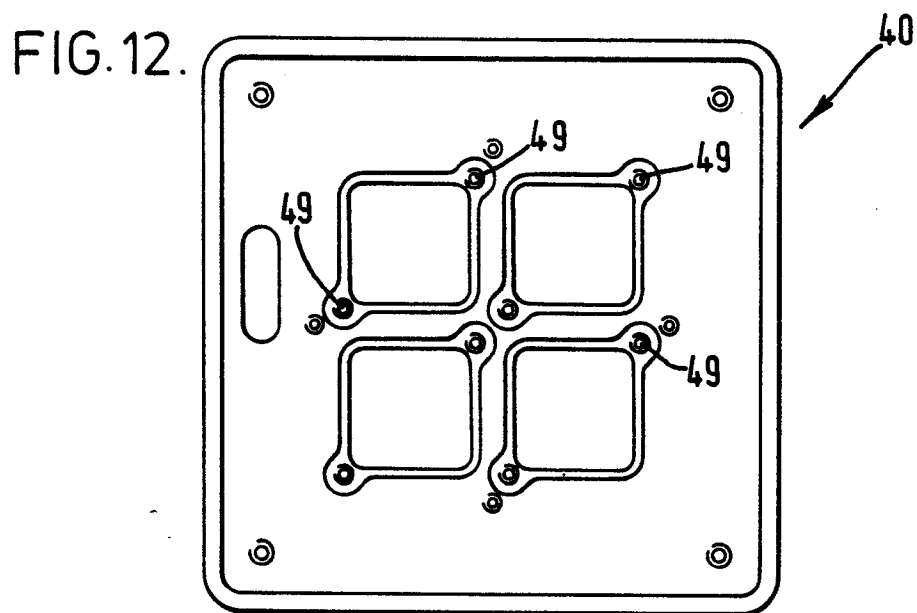
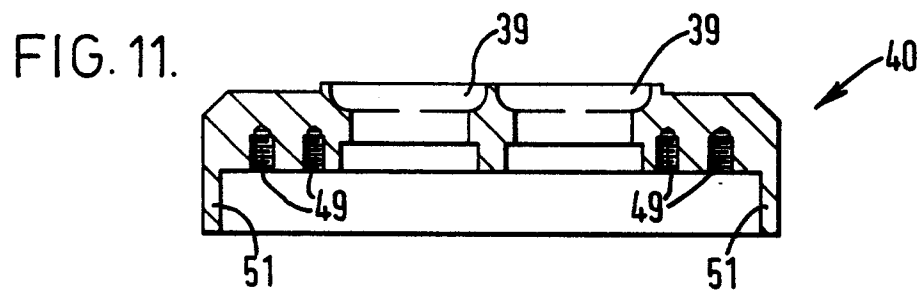
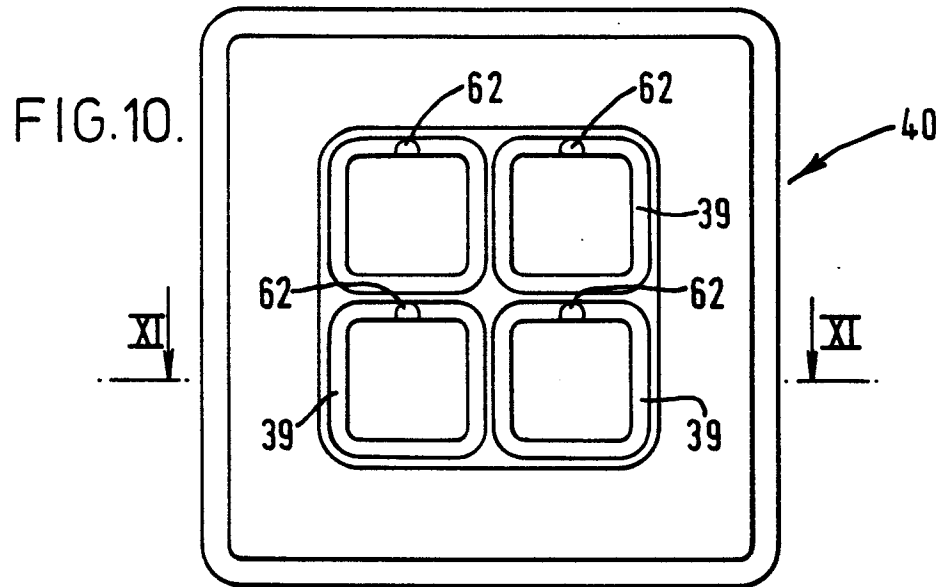
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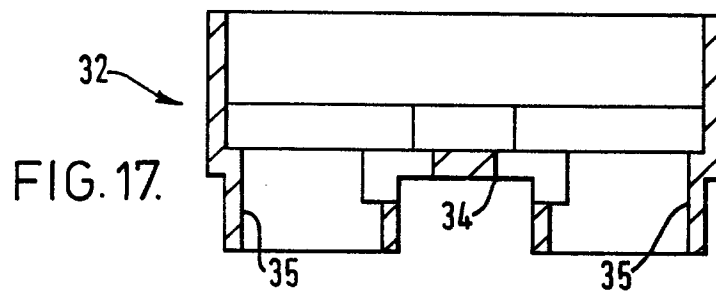
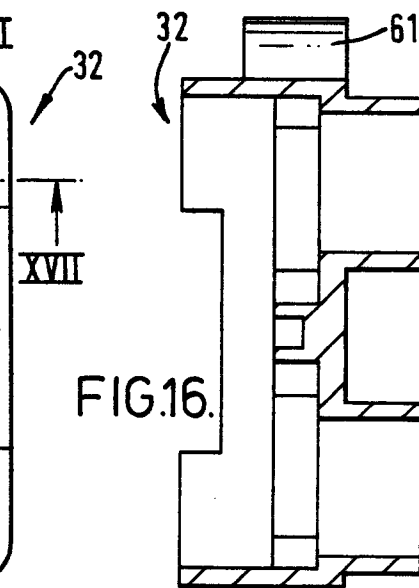
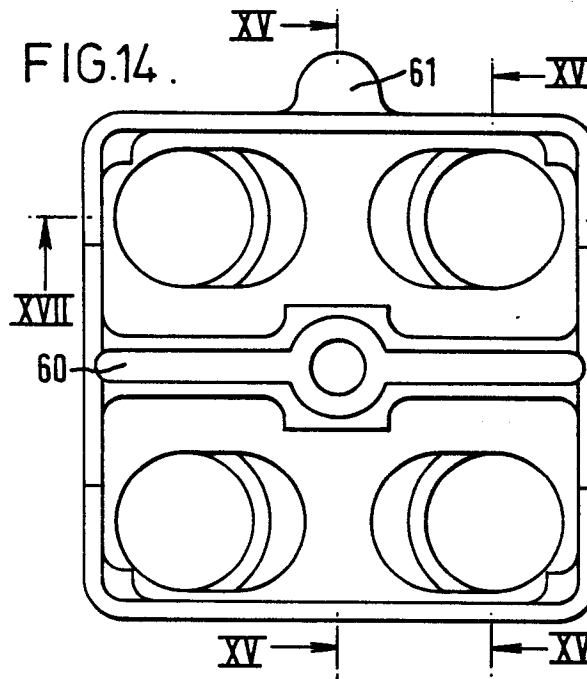
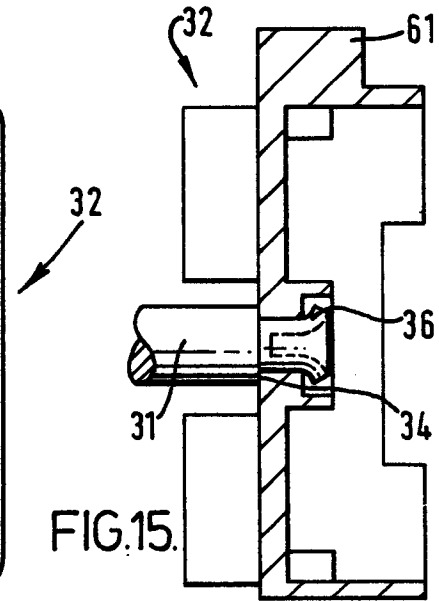
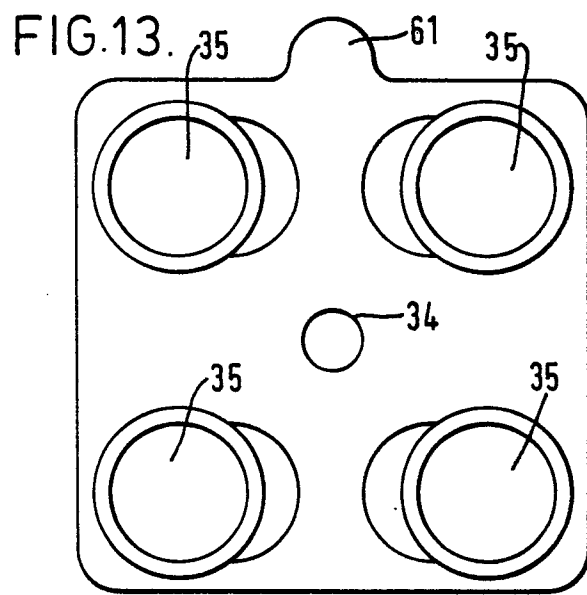
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-3 197 598 (J.H. ANDERSEN et al.) * figures 1-5; column 3, lines 8-12; column 4, lines 19-42 *	1,2,5-8	H 01 H 13/14 H 01 H 13/22
Y	US-A-3 764 762 (J.O. ROESER) * figure 4; column 5, lines 49-65 *	1,2,5-8	
A	EP-A-0 004 544 (MANNESMANN DEMAG AG) * figures 4-5; page 7, lines 5-19 *	1	
E	GB-A-2 154 797 (LRE RELAYS & ELECTRONICS LTD.) * whole document *	1-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			H 01 H 3/00 H 01 H 9/00 H 01 H 13/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 06-03-1986	Examiner LEOUFFRE M.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	