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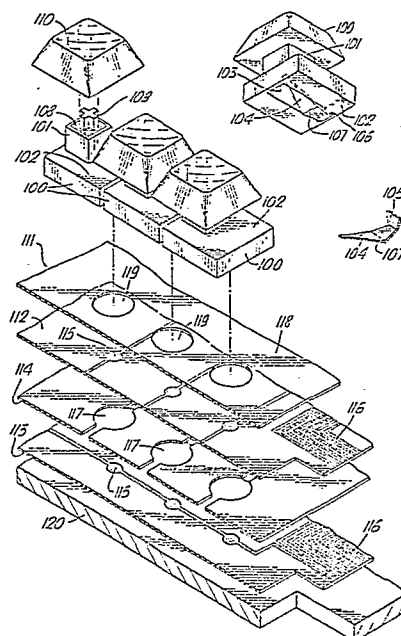
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54 Mechanical keyboard with membrane switch array.

57 A key actuated membrane switch comprises a key operated switch actuating member 101 in the form of a key module and a membrane switch panel 111.

The switch panel consists essentially of three membranes (112, 113, 114), one on top of the other, sealed together with adhesives. The upper and the bottom membranes (112, 113) are each continuous and each has at least one contact (115) and a respective conductor formed on its interior surface. The middle membrane (114) has at least one aperture (117) which defines a switch cell. The two contacts (115) are coaxially aligned with the aperture so that pressure on the upper membrane (112) along the axis of the aperture, causes the two contacts to come together and make a circuit. The membrane package is mounted, preferably by an adhesive, on a rigid base 120.

Pressure is selectively applied to the upper membrane by means of the key operated switch actuating member (101) via the agency of a cantilevered single-arm spring (104) which acts to apply leverage on the upper membrane (112) when the actuating member (101) is operated. The spring has a first portion which extends from the supported end of the spring in a plane parallel to the plane of the upper membrane to the vertical axis of the said contacts, and a



(Continuation next page)

second portion which extends upwards, at an angle, to the actuating plunger (108) of the actuating member. When the latter is actuated the spring (104) is flexed downwards and hinges during the first part of its movement about its supported end, thereby displacing the bend or "knee" (107) intermediate the two portions of the spring arm. The knee therefore applies pressure, with mechanical advantage, on the upper membrane (112). When the contacts come together, no further displacement of the knee (107) is possible and any further displacement of the free end of the spring causes flexing to take place at the knee and in the second portion of the spring.

In a preferred arrangement the said spring (104) is supported by means of a dog-leg portion (105) which is entered into a vertical slot (106) provided on the base of the actuating member (101). The slot contains facing ribs (121, 122) which cause the dog-leg portion to flex as it is pushed into the slot. This flexing results in a frictional force being exerted by the dog-leg portion on the ribs which serves to prevent the spring from falling out of the slot. Any tendency for this to happen is also counteracted by the leverage exerted by the spring (104) as it attempts to rock about its "knee" during overtravel of the spring.

Also in the preferred arrangement the actuating member (101) is fastened onto the upper membrane (112) by an adhesive.

The above arrangement is particularly intended as a keyboard switch.

"MECHANICAL KEYBOARD WITH MEMBRANE SWITCH ARRAY"

This invention relates to mechanical key-actuated membrane switches and also to keyboards, formed from said switches, for generating binary coded electrical signals, the keyboard having a data input through the agency of mechanically depressible keys.

5 The conventional electrical keyboard, for an electronic typewriter or for a data-entry station, comprises a set of "key-modules" arranged in a suitable matrix very often chosen to satisfy the requirements of the application. Each key module comprises at least one part of a switch and supports an inter-
10 changeable cap which bears the required "legend" for that key. Actuation of a key changes the electrical properties of a respective circuit either directly or indirectly, hence creating a perceptible signal. Such changes may be brought about through opening or closing electrical contacts, capacitative effects,
15 magnetic effects (i.e. inductive, Hall effect, etc.) or by optical effects. Desired characteristics for such keyboards, arising from the practice of touch-typing are key operating pressures of between 50 and 100 gms force, and a full travel of about 4 mm for each key. Some overtravel in the key operation
20 is a requirement in order to ensure positive operation, generally of the order of 1.5 mm, but this effect should not be perceptible to the operator and the aforesaid 4 mm travel includes this overtravel.

 Such key modules are usually inserted into a supporting
25 apertured plate for positioning above a printed circuit board

which carries the electronic components associated with encoding the key signals for onward transmission and the inter-module wiring into which the key modules are soldered.

Membrane switch arrays (touch or pressure sensitive panels) are also used to provide data-entry stations having a visually similar arrangement to that of conventional keyboards, but these have not been found suitable for high speed typing because the mode of operation, e.g. absence of key travel, etc., eliminates or reduces mechanical feedback of information to the operator during operation. This shortcoming of such arrays has been ameliorated to some extent by, for example, interposing a collapsible element between each "key" and the associated membrane switch contacts so as to provide for a greater travel of the "key". By interposing a second compressible element a degree of switch overtravel has been introduced without greatly complicating the structure, but only at the expense of an increase in the operating force when the overtravel operation is brought into effect. Hence the overtravel characteristic is perceptible to the operator. Moreover, difficulty has been found in providing a tactile response with such elements which corresponds with normal, acceptable, key operation, and the actuating force is often very much higher than the optimum force referred to above.

One object of the present invention is to provide an actuating mechanism which can be interposed between a conventional key-cap of a membrane key switch and the corresponding switch element in the membrane switch panel so as to provide the

operating characteristics of a normal full-travel key.

It is a further object of the present invention to provide an electronic keyboard with discrete mechanically-depressible keys, at relatively low cost, and having a sealed membrane switch array
5 panel to prevent ingress of contaminants.

In its broadest aspect the invention provides a key-actuated membrane switch comprising a key operated switch actuating member mounted on a displacement sensing means in the form of a sealed package, said package consisting of first and second
10 insulative membranes respectively positioned on either side of a further membrane comprising an apertured spacing member, the switch actuating member being mounted on the first of said membranes and said first and second membranes each bearing a respective one of an opposed pair of coaxially disposed contacts
15 associated with the switch actuating member, each contact consisting of a conductive film deposited on the internal surface of the respective membrane and comprising part of a normally open circuit which is closed when the said first membrane is flexed into a space normally between the membranes provided by
20 a corresponding one of the apertures in the spacing member so as to contact the said second membrane, the said conductive films thereby touching and said switch actuating member applying pressure on said first membrane along the actuating axis of said contacts through the intermedium of an electrically isolated
25 spring formed as a flat strip having a bend at an intermediate position along its length so as to define a lever having first

and second elongate portions which are distinguished by the discontinuity of direction at the said bend, said spring having a free end and a supported end, said bend being aligned with the actuating axis of the contacts, said first elongate portion
5 extending from said supported end of the spring to the bend along a plane which is substantially parallel to the plane of the said first membrane, and said second elongate portion extending from the bend to the free end of the spring generally in the same direction as said first portion and in a plane disposed
10 at an angle intermediate the plane of said first membrane and the plane perpendicular to said first membrane, the free end of the spring being arranged so as to be displaced by the switch actuating member when the latter is actuated, and the bend in the spring forming a knee which is pressed by said actuation
15 against the adjacent said first membrane so as to displace it into contact with the said second membrane. The free end of the spring is arranged directly beneath the respective key. When the key is depressed the spring is hinged substantially bodily about its supported end until the said knee by contact-
20 ing the membrane surface, causes actuation of the respective switch. Further travel, i.e. overtravel, of the key arises as a result of a flexing of the second portion of the spring relative to the first said portion.

In one embodiment of the invention a series of tongues
25 arranged along a common axis and each comprising one such cantilevered spring are formed in, or are struck out of, the web of a channel sectioned strip formed from a resilient material,

said strip providing the support for the springs and being mounted, preferably by means of an adhesive, on the membrane surface of a member switch panel. In another embodiment each spring is a separate member and each is supported by the body housing of the switch actuating member. In the preferred arrangement of this embodiment the said body is permanently affixed to the said membrane surface by an adhesive. Moreover the membrane panel itself is similarly affixed to a rigid panel which forms its only support.

10 Hereinafter the invention is further described by way of example and with reference to the accompanying drawings, wherein:

Figure 1 shows a membrane switch panel keyboard having a plurality of key modules mounted on a membrane switch panel and an associated electronic signal encoder board;

15 Figure 2 shows a blank ready for forming a key module mounting strip for mounting key modules on the keyboard panel of Figure 1 and having a row of actuating springs;

Figure 3 shows a further stage of manufacture in which the blank has been formed as an elongate channel and the springs have been struck out of the blank but are cantilevered thereto, the figure being a longitudinal section along the plane B-B;

Figure 4 is a cross-section of the mounting strip along the plane C-C;

25 Figure 5 shows a section through the keyboard of Figure 1 using the key module mounted strip illustrated in Figures 2 to 4;

Figure 6 shows an enlarged fragmentary sectional view of the keyboard of Figure 5, but with the key modules removed.

Figure 7a shows a second embodiment of the invention in an exploded view;

5 Figures 7b and 7c show features of the switch actuating members of Figure 7a;

 Figures 8a and 8b show an enlarged and sectioned portion of the assembly illustrated in Figure 7a and a section through the wall of the foot of a switch actuating member along
10 plane D-D;

 Figures 9a to 9c show a second form of the switch actuating member used in the second embodiment.

 Referring to the drawings, membrane switch panels for the keyboard as shown in Figure 1 are known to comprise first and
15 second sheets of which at least the upper one is flexible, which are positioned on either side of a third sheet. The mutually facing surfaces of the first and second sheets carry positionally-corresponding arrays of contacts and the third sheet which acts as a spacing member has an array of apertures
20 which positionally correspond with the arrays of contacts on the said first and second sheets. Each said aperture defines a switch cell containing a pair of opposed contacts. Pressure on the upper one of said first and second sheets brings the two contacts of the switch cell together within the space defined
25 by the respective aperture in the third sheet so as to make an electrical circuit. The upper sheet normally is resilient so as

to obviate any necessity for additional biasing means to restore the upper sheet to its normal planar condition after each actuation. The bottom sheet may be rigid, in which case the switch panel consisting of the three sheets may be mounted directly into a console, the bottom sheet providing all the necessary support. In the present arrangement, all said sheets are flexible and are adhesively held together. The bottom sheet is adhesively mounted on a rigid backing plate. In the first embodiment of the invention described hereinafter the switch actuating members, forming the actuating part of the key modules, are mounted by being clipped into C channel strips in which actuating levers, called herein springs, are integrally formed. In a second embodiment, also described hereinafter, there is a separate spring for each key module, mounted on the switch actuator member body, and the latter is secured directly on the upper surface of the membrane switch panel by means of adhesives.

In respect of the aforesaid first embodiment, a blank 2 as shown in Figure 2 is prepared from a suitable material, e.g. plastics, sheet spring steel, sheet beryllium-copper, etc. The blank is in the form of an elongate strip and may be of any convenient length depending on the number of key modules to be mounted on the strip. Along one side there are a series of regularly spaced notches 3 and along each side there is a row of rectangularly shaped apertures 4, the apertures on one side being in registration with the apertures on the other so as to form a longitudinal sequence of equally spaced pairs of

apertures alternating with the notches 3. Along the central axis 12 there is provided a row of U-shaped slots 6 which terminate at each end in larger diameter apertures 7, thus defining a weakened zone 8 at the neck of each U-shaped slot. The slots
5 correspond in number with the pairs of rectangular apertures. Two rows of holes 9, spaced on each side of the U-shaped slots, enable the strip to be riveted to a base.

A key module mounting strip is formed by bending up the sides of the strip along fold lines indicated by the dash lines
10 10 so as to provide a channel of the shape indicated in Figures 3 and 4. The tongues defined by the U-shaped slots are deformed about fold lines 11 normal to the axis 12 out of the plane of the floor of the strip and into the channel interior as shown in Figures 3 and 4, so as to provide a row of springs 13.
15 Each spring is cantilevered to the floor of the channel and is precisely bent so that its free end is a precise prescribed distance above the floor. The notches 3 define a series of coplanar flanges 14 on one side of the channel which may be individually sprung aside to enable a respective key module 15
20 to be inserted into the channel as shown in Figure 5, or easily removed, the apertures 4 receiving locating lugs or bosses 16 provided on the lateral sides of the key modules 15.

In the keyboard the channel is mounted, in a parallel array with others to give a keyboard layout required by the
25 particular application, for example as shown in Figure 1, one switch element of which is shown in the enlarged sectional view in Figure 6.

As shown in Figure 6, the membrane switch panel comprises

a pair of flexible sheets 18, formed of plastics material, separated by the spacer 19 of plastics material. An array of apertures 20 (only one of which is shown) registers with metallic, opposed, contacts 21 deposited with associated inter-
5 element printed circuitry (not shown), on the internal facing surfaces of the pair of sheets 18. The upper and lower surfaces of the spacer 19 are uniformly covered with an adhesive layer of acrylic material, thus bonding the two sheets 18 and the spacer 19 together. The arrangement forms a sealed
10 assembly, imperviously to moisture from, say, accidental spillage of liquids.

A further layer of adhesive 22 secures the switch membrane assembly to a substructure 26, e.g. a rigid aluminium plate.

The channel strips are mounted directly onto the switch
15 membrane so that the fold line 11 of each spring 13 coincides with the central axis of the pair of opposed contacts 21 in a respective one of a row of switch elements and so that the pair of holes 7, defining the aforesaid weakened zones 8, correspond with respective internal walls 23 of the spacer. The
20 respective key module (not shown in Figure 6) is mounted to the appropriate apertures 4 in the flanges of the channel (on the left, as shown in Figure 6) so that its actuating axis is in line generally with the free end of the spring 13. The actuating axis of the key module is therefore displaced from
25 the corresponding switch axis by a distance equal to the length

from the bend to the free end of the spring. Rivets 24 (only one shown) are used at appropriate intervals to secure the channel strips to the assembly; however, other forms of attachment of the strip may be used, including suitable adhesives.

5 The function of the weakened zones 8 of the springs 13 defined by the pairs of holes 7, is to create a line of easy flexure, that is a form of hinge. When the associated key is depressed the relevant spring 13 hinges about the weakened zone; hence the "knee" 25 of the spring, formed at the fold line 11, 10 forces together the respective pair of contacts 21 disposed underneath the "knee" so as to make a circuit. The spring 13 is therefore acting initially as a lever providing a mechanical advantage to actuate the switch of about 4:1. When the contacts 21 are abutting further displacement of the knee is prevented. 15 Additional pressure on the spring causes overtravel, i.e. flexure of the spring about the fold line 11 so that, in its ultimately depressed condition, the spring takes up the disposition shown in dashed outline in Figure 6. The upper sheet and the contact 21 thereon will naturally be displaced downwardly in 20 this condition, but as an aid to clarity, this detail is not shown in Figure 6. When the key is released the spring and the related part of the membrane switch return to their pre-actuated condition.

 The increase of pressure, necessary to cause the 25 "overtravel" of the spring and key, is slight and not objectionable to the operator.

 With reference to Figures 7a to c to Figures 9a to c, in

the second embodiment of the invention the body 101 of each of the switch actuating members of the key modules 100 is provided with a foot 102 which extends asymmetrically with respect to the actuating axis of the member so as to abut an adjacent key module when

5 assembled in a keyboard with other similar key modules. The foot provides a large planar base area to facilitate attachment of the respective key module to the upper membrane of the membrane switch panel solely by means of an adhesive. An elongate recess 103 in the foot houses actuating spring 104. Spring 104 has the same function as the
10 springs 13 of the aforesaid first embodiment. Each spring is provided with an upstanding dog-leg portion 105 which is lodged in a vertical slot 106 in the side wall of the foot 102 of the respective switch actuating member body and a free arm, comprising first and second portions. The first portion, adjacent the dog-leg portion,
15 extends substantially in the plane of the base of the said foot and the second portion extends upwardly from a knee 107 into contact with the lower end of a plunger 108 housed in the said body. Plunger 108 has an extension 109 of cruciform section on which the respective key cap 110 mounts in the conventional manner.

20 The membrane switch shown in Figs. 7a to c is represented in an exploded view, as a membrane switch panel 111 forming part of a keyboard, which part has three key modules and three switch cells. The membrane switch panel 111 comprises essentially an upper membrane 112, a lower membrane 113 and a spacing sheet 114 between
25 them. On the facing surfaces of the upper and lower membranes there are deposited in mutual-----

registration respective arrays of metallic contacts 115 and a matrix of conductors which interconnect the rows and columns of the said contacts in orthogonal directions in the conventional manner for keyboard switch circuits. These conductors are terminated together
5 (at 116) on one side of the board for connection to an auxiliary circuit board shown, for example, in Figure 1 for encoding the signals which are generated when the respective key switches are activated. An array of apertures 117 in the spacing sheet 114, arranged in mutual correspondence with the contacts 115 on each
10 of the membranes 112 and 113, define spaces comprising respective switch cells into which when the respective key is depressed the upper membrane is deflected by the respective spring 104, thus forcing the two metallic contacts together with a mechanical advantage of 4:1 and thereby completing a circuit.

15 Prior to assembly both surfaces of the spacing sheet 114 are coated with an acrylic adhesive material. The three flexible sheets are then pressed together to form a sealed package which is impervious to moisture.

So as to avoid problems caused by a compression of the air
20 trapped in the cells during operation, or as a consequence of changes in atmospheric pressure, the rows of apertures in sheet 114 are linked by slots. These slots may extend to pneumatic terminals (not shown) and be coupled thereby to air inlet filters, etc., or one or more pneumatic pressure compensators (not shown) by means of
25 which large changes in ambient pressure may be compensated, such as may be experienced, for example, in aviation use.

Between the upper membrane 112 and the assembly of key modules 100 there is provided a further apertured spacing sheet 118 having an array of apertures 119 in mutual correspondence with the switch cells and the respective key modules. Sheet 118 is also coated on both sides with an adhesive material before assembly so that it forms an adherent member for adhesively mounting the key modules on the membrane switch panel 111. The apertures 119 are made large enough to accommodate the entire operative length of the spring and the sheet thickness is chosen to provide the specified pre-contact free travel of the spring upon actuation. For the example quoted hereinafter the thickness of the sheet was 5 thousandths of an inch (.125 mm). The apertures 119 may be of any convenient shape, e.g. circular, elliptical, oblong, etc., and need not be linked by slots as they are open to the atmosphere via the interior of the switch actuating member bodies. A further, usually non-apertured membrane (not shown) coated on both sides with adhesive material may be used to adhesively mount the assembled membrane switch panel 111 on a rigid base plate 120.

The precise arrangement of the switch actuating members 101 on the membrane switch panel 111 is shown in the enlarged section detail of Figure 8a. For the convenience of this illustration, only a part of one key module and one switch cell is shown. As seen, the foot 102 of the switch actuating member body is arranged so that it slightly overlaps the edge of the aperture 119 in the top spacing sheet 118. In this position the "knee" 107 (not shown) of the spring 104 precisely aligns with the actuating axis of the two-----

contacts 115 of the respective cell. Also there is shown in this section the detail of the slot 106 in the side wall of the foot 102. This slot is provided with three internal facing ribs which extend towards the central plane of the slot and are spaced only sufficiently far apart to receive the dog-leg portion 105 of the spring 104 when it is bowed about a vertical axis. This is seen particularly in Fig. 8b which shows a section through the slot 106 along the plane D-D. The two ribs 121 on the actuation axis side are cambered at the bottom of the slot so that the dog-leg portion can be easily inserted. As the dog-leg portion is pushed up into the slot, the camber on the said ribs 121 forces it progressively into the bowed shape. Being a resilient member, the dog-leg portion exerts a frictional force on the ribs 121, 122 which maintains it in position in the slot. The third rib 122 extends substantially to the base of the slot so as to prevent flexing of the dog-leg portion when the arm of the spring is depressed during normal functioning.

On actuation of the respective key module the free end of the arm of the spring is engaged and depressed by the plunger 108, the spring flexing bodily substantially about the right-angle bend at the base of the dog-leg portion until the knee 107, by engaging the upper membrane 112 through the aperture 119 and displacing it into the aperture 117, is arrested by the coming together of the contacts 115. Overtravel of the spring occurs thereafter, but the flexing now takes place at the knee 107 and in the said second portion of the spring. In the fully depressed condition of the spring its free end

will be lodged within the aperture 119.

One of the features of the form of mounting used for the spring in the second embodiment is that any tendency for the spring to come out of the slot in the foot (which is unlikely because of the bowing of the dog leg portion) is overcome when the key is fully actuated because the spring tries to pivot about its knee 107 during the overtravel portion of movement and thereby force the dog-leg portion fully into the slot if it is not so disposed already. By this means permanent fixing of the spring onto or in the body of the switch actuating member becomes totally unnecessary, thereby greatly simplifying manufacture and reducing the parts required in this form of the switch actuating member to four, namely the body 101, the spring 104, the plunger 108 and the key cap 110.

Figures 9a to c illustrate an alternative form of the key module, used in the second embodiment, mainly intended to provide special functions in keyboards used for word processors and the like. A keyboard may therefore contain both types of module or adaptations containing some of their features. The key module of Figures 9a to c has the same basic parts as the key modules illustrated in Figures 7a to c and operates in exactly the same manner. These basic parts are therefore given the same reference numerals in both sets of figures.

The key module of Figure 9 is provided with two horizontal elongate recesses 121, 122, and two vertical elongate recesses 123, 124 in the external upper surfaces of the body 101. These recesses are intended to house a light emitting diode 125 and

allow a choice of locations, the location being dependent upon the type of key cap which is fitted to the module. In use, the diode is, of course, energised, so as to provide under-illumination of the key cap, whenever the respective key is
5 operated. A plurality of slots and passages through the foot of the body which communicate with the aforesaid recesses are provided to enable the terminal wires 126 of the diode to be taken through the foot of the module and through the membrane switch panel and be wired up to switches on the electronic
10 encoding circuit board.

The said body 101 also has a passage 127 on its upper part through the respective side wall which exposes the lower part (not seen in the drawing) of the plunger 108. The latter has a recess in its side, which is aligned with the said aperture
15 127, which is adapted to receive the cranked end of an optionally fitted double-cranked bar 128, the latter when fitted being pivotally supported and retained within a threequarter-circular-shaped recess 129 provided in a web 130 formed on the side of the body and being similarly supported by identical
20 arrangements on adjacent key modules. A similarly recessed web 131 is provided on the same body alongside the first said web on the near side of the aperture 127, as shown, for the purpose of supporting the double-cranked bar from that side.

The function of the bar is to provide a mechanical linkage
25 which transmits a key displacement from one key module to another key module situated in the same row. Such provision is required, for example, when two spaced apart switch actuating members are

employed to support a space bar, or when one lengthened key cap is fitted to two adjacent key modules.

Example

In pre-production models of the second embodiment of the key actuated membrane switches described herein which have successfully completed more than 5000,000 key depressions, the salient dimensions were:-

	Key pitch	19 mm (in both directions)
	Key travel	4 mm
10	Membrane travel	0.2 mm
	Actuating force	40 - 80 gms force
	Spring material	Stainless Steel
	Spring thickness	0.125 mm
	Switching distance	About 2.0 mm

CLAIMS

1. A key actuated membrane switch comprising a key operated switch actuating member mounted on a displacement sensing means in the form of a sealed package, said package consisting of first and second insulative membranes respectively positioned on either
5 side of a further membrane comprising an apertured spacing member, the switch actuating member being mounted on the first of said membranes and said first and second membranes each bearing a respective one of an opposed pair of coaxially disposed contacts associated with the switch actuating member, each contact consist-
10 ing of a conductive film deposited on the internal surface of the respective membrane and comprising part of a normally open circuit which is closed when the said first membrane is flexed into a space normally between the membranes provided by a corresponding one of the apertures in the spacing member so as to con-
15 tact the said second membrane, the said conductive films thereby touching and said switch actuating member applying pressure on said first membrane along the actuating axis of said contacts through the intermedium of an electrically isolated spring formed as a flat strip having a bend at an intermediate position along its
20 length so as to define a lever having first and second elongate portions which are distinguished by the discontinuity of direction at the said bend, said spring having a free end and a supported end, said bend being aligned with the actuating axis of the contacts, said first elongate portion extending from said supported
25 end of the spring to the bend along a plane which is substantially

parallel to the plane of the said first membrane, and said second elongate portion extending from the bend to the free end of the spring generally in the same direction as said first portion and in a plane disposed at an angle intermediate the plane of said first membrane and the plane perpendicular to said first membrane, the free end of the spring being arranged so as to be displaced by the switch actuating member when the latter is actuated, and the bend in the spring forming a knee which is pressed by said actuation against the adjacent said first membrane so as to displace it into contact with the said second membrane.

2. A key actuated membrane switch according to Claim 1 wherein the spring forms part of a channel-section member which is mounted by means of its interconnected web on the said first membrane, said spring being defined by means of a U-shaped slot in the said interconnecting web and said second portion thereof being struck out of the plane of the web along a line intersecting the arms of the U-shaped slot at a position intermediate of the two ends of the spring.

3. A key actuated membrane switch according to Claim 2 in which the switch actuating member is supported on the channel-section member by means of lugs which enter into corresponding apertures in the flange members of the channel-section member.

4. A membrane keyboard having a plurality of switches, each according to Claim 2 or Claim 3 wherein a plurality of springs are formed in the interconnecting web of the channel-section

member along and coaxially with a longitudinal axis thereof, each spring being associated with a respective switch actuating member.

5 5. A key actuated membrane switch according to Claim 1 wherein the switch actuating member comprises a plunger and a housing in which the plunger slides, the said housing having a substantially planar base which incorporates an asymmetric foot, the said spring being attached to the outer end of the foot at its supported end and the said base being held fast by means of an
10 adhesive on the said first membrane or on an apertured membrane which is intermediate said switch actuating member and said first membrane.

15 6. A key actuated membrane switch according to Claim 5 wherein the outer end of the foot incorporates a vertical slot which extends from its underside and said spring has a dog leg portion arranged substantially at right angles to the said first part of the cantilevered portion at its supported end which is entered into this slot, the walls of the latter serving to retain the spring in the housing by virtue of an interference fit by the
20 said dog leg portion between the walls of the slot.

7. A key actuated membrane switch according to Claim 6 wherein said slot is provided with ribs on its internal walls, whereby the said dog leg portion of the spring is bowed on its insertion into the slot about a vertical axis.

25 8. A membrane keyboard having a plurality of switches each according to any of Claims 5 to 7.

9. A membrane keyboard according to any preceding claim, wherein said first-----

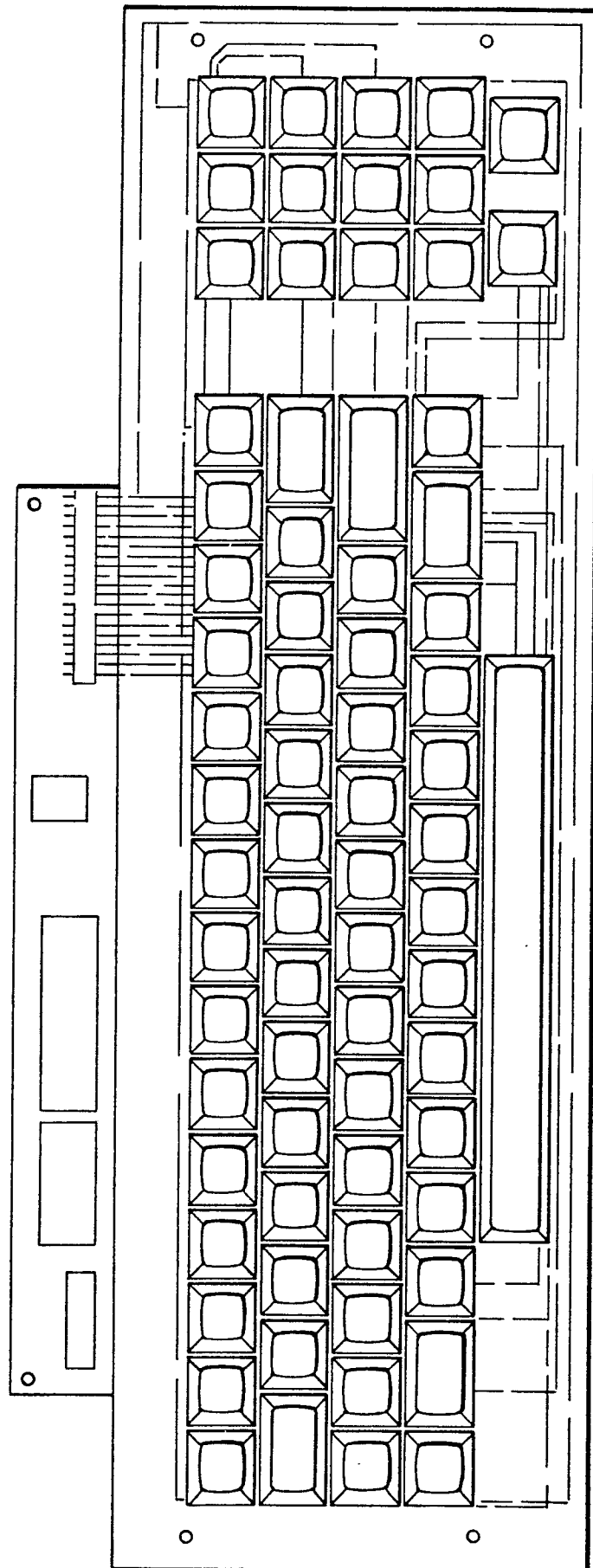
and second membranes are separated by an adhesively coated apertured spacing sheet of prescribed thickness whereby the normal separation of the contacts of said pairs of contacts is assured, there being an array of apertures in said spacing sheet each of
5 which respectively coincides with the pairs of contacts appertaining to a respective switch actuating member, said first and second membranes being bonded to said spacing sheet by the adhesive coating so as to provide said sealed package.

10. A membrane keyboard according to Claim 9 wherein said
10 spacing sheet has a plurality of slots which respectively link the apertures of respective rows of apertures.

11. A membrane keyboard according to Claim 10 wherein the said slots communicate with pneumatic terminals whereby air may be admitted to or exhausted from the spaces defined by said rows
15 of apertures in the spacing sheet.

12. A key actuated membrane switch according to Claim 1 or any claim appendant thereto wherein the said spring is dimensioned so as to provide a mechanical advantage of approximately 4:1 during the initial operation of the switch.

20 13. A membrane keyboard according to any of Claims 9 to 11 wherein the spring of each switch actuating member is dimensioned so as to provide a mechanical advantage of approximately 4:1 during the initial operation of the switch.

Fig. 1.

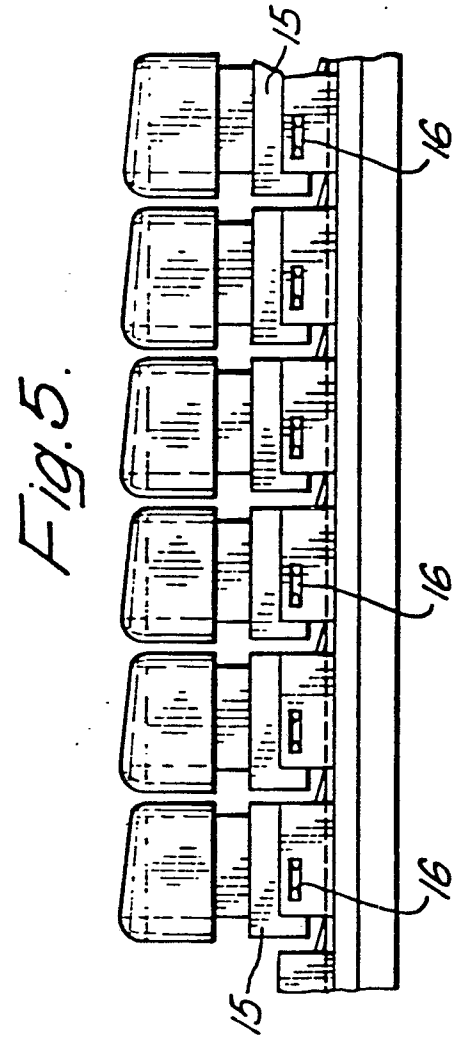
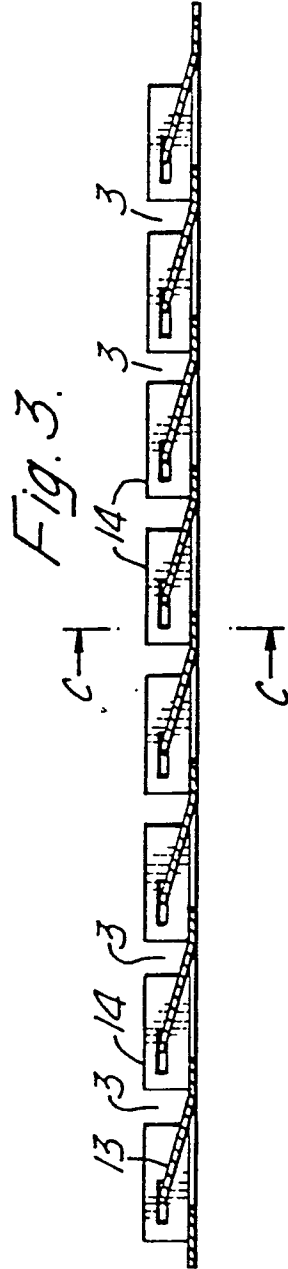
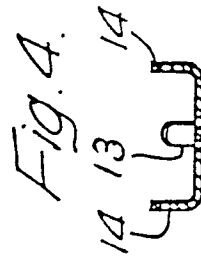
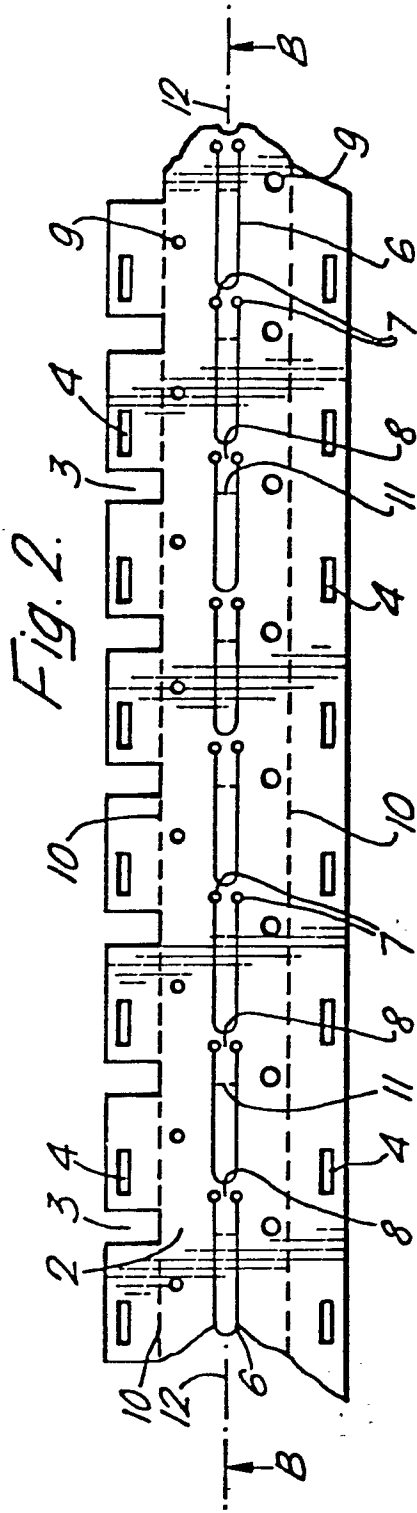
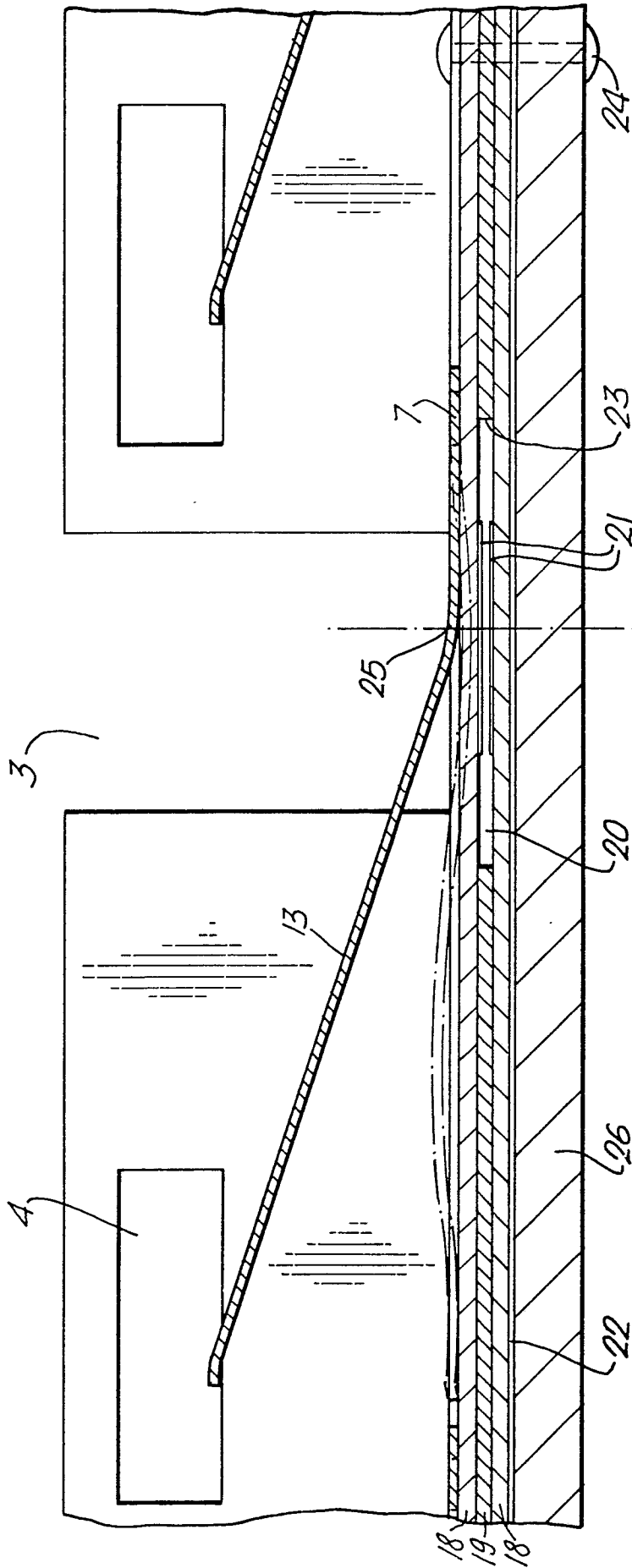
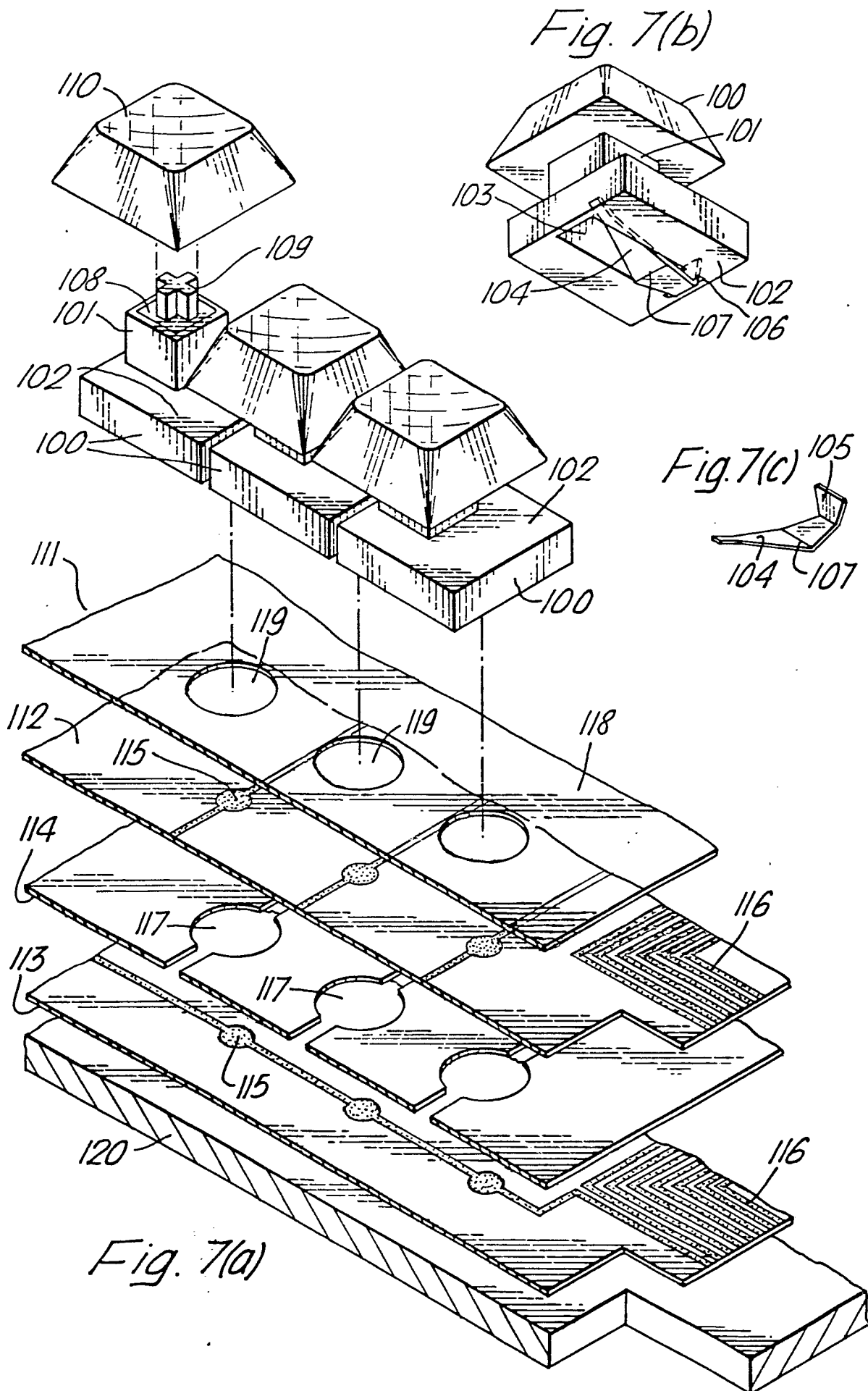
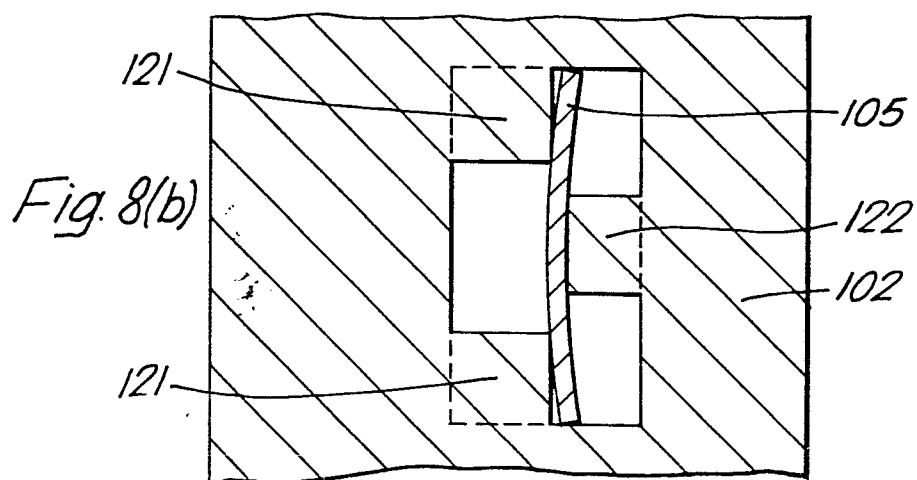
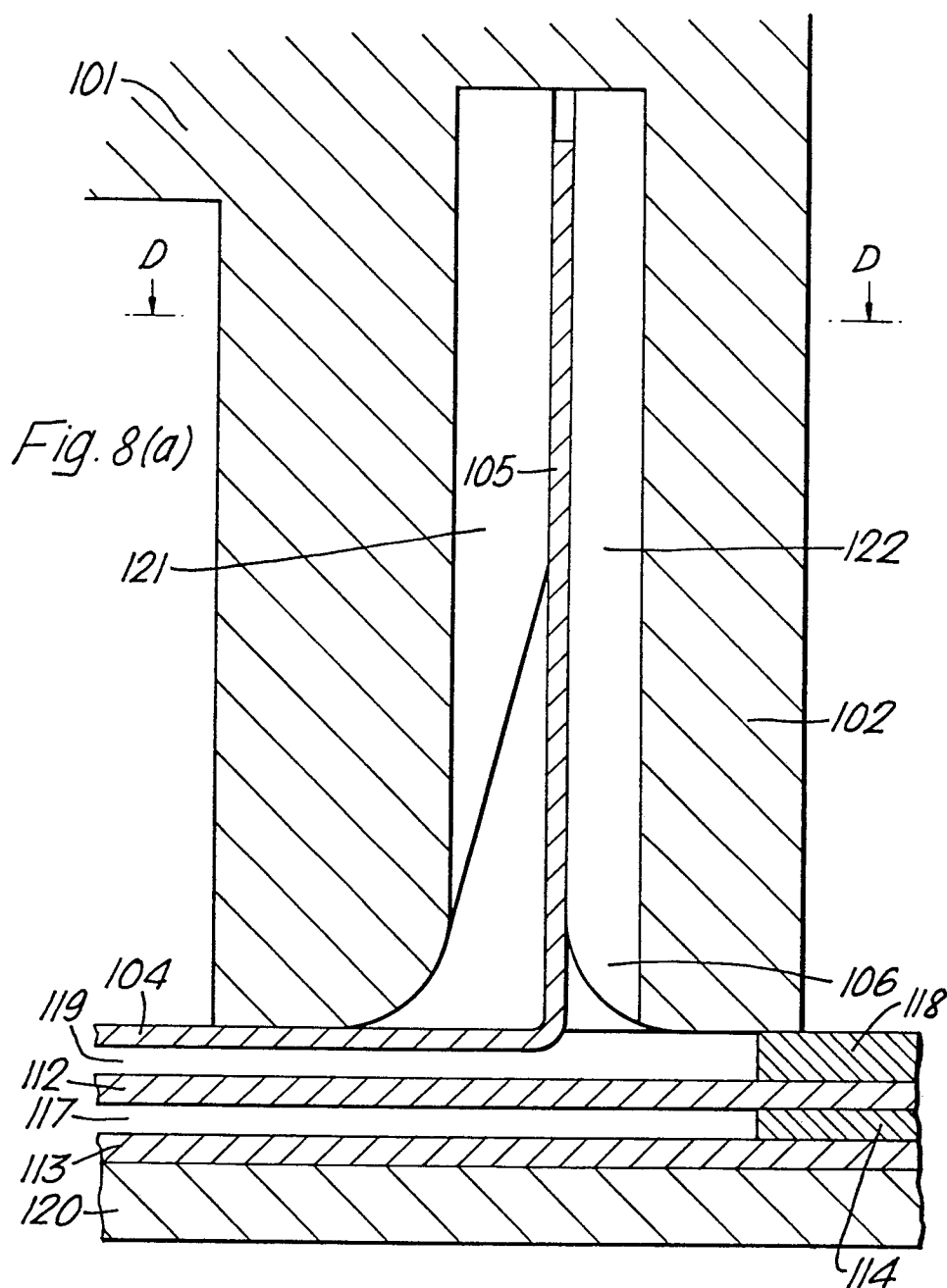
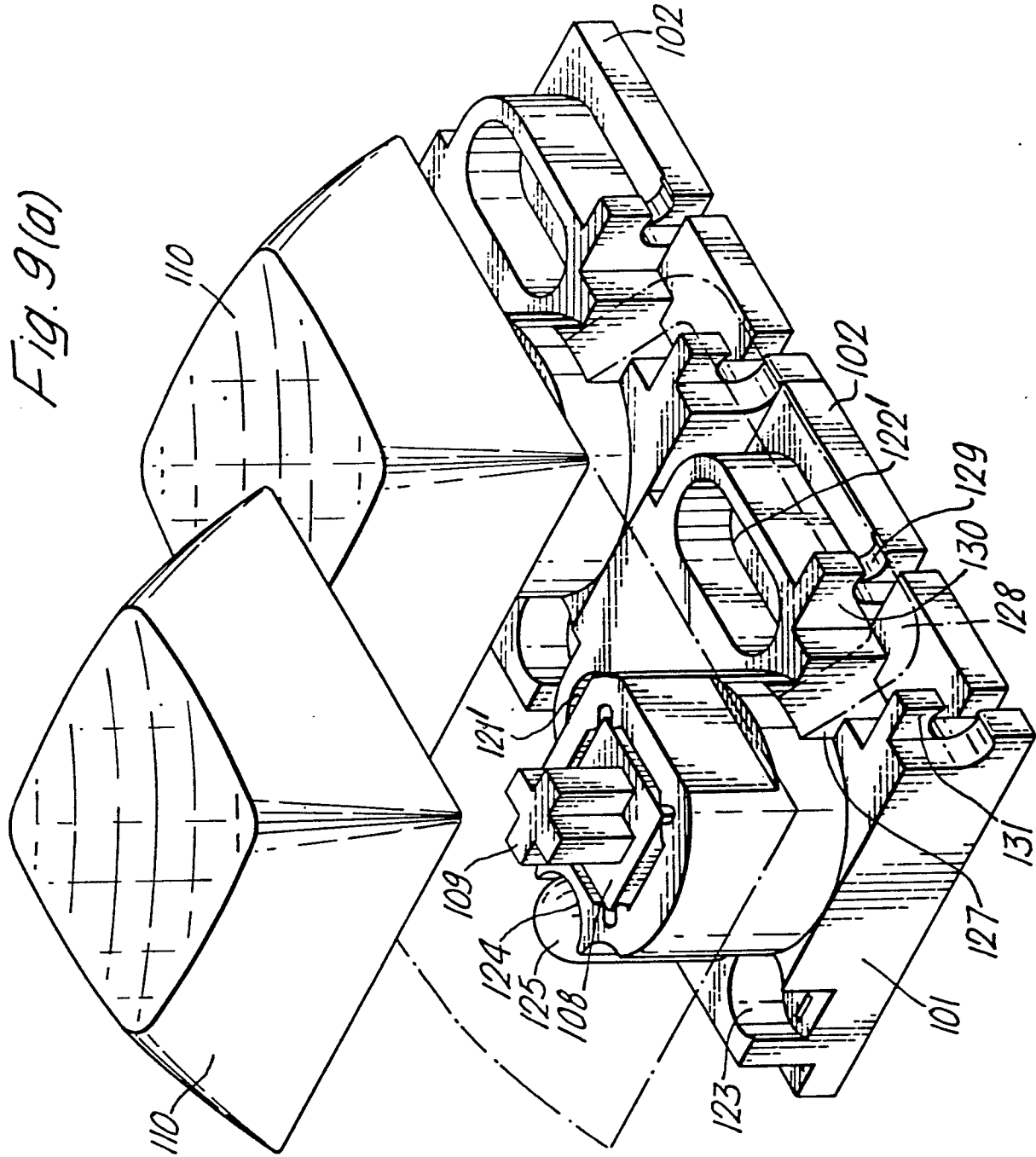


Fig. 6.

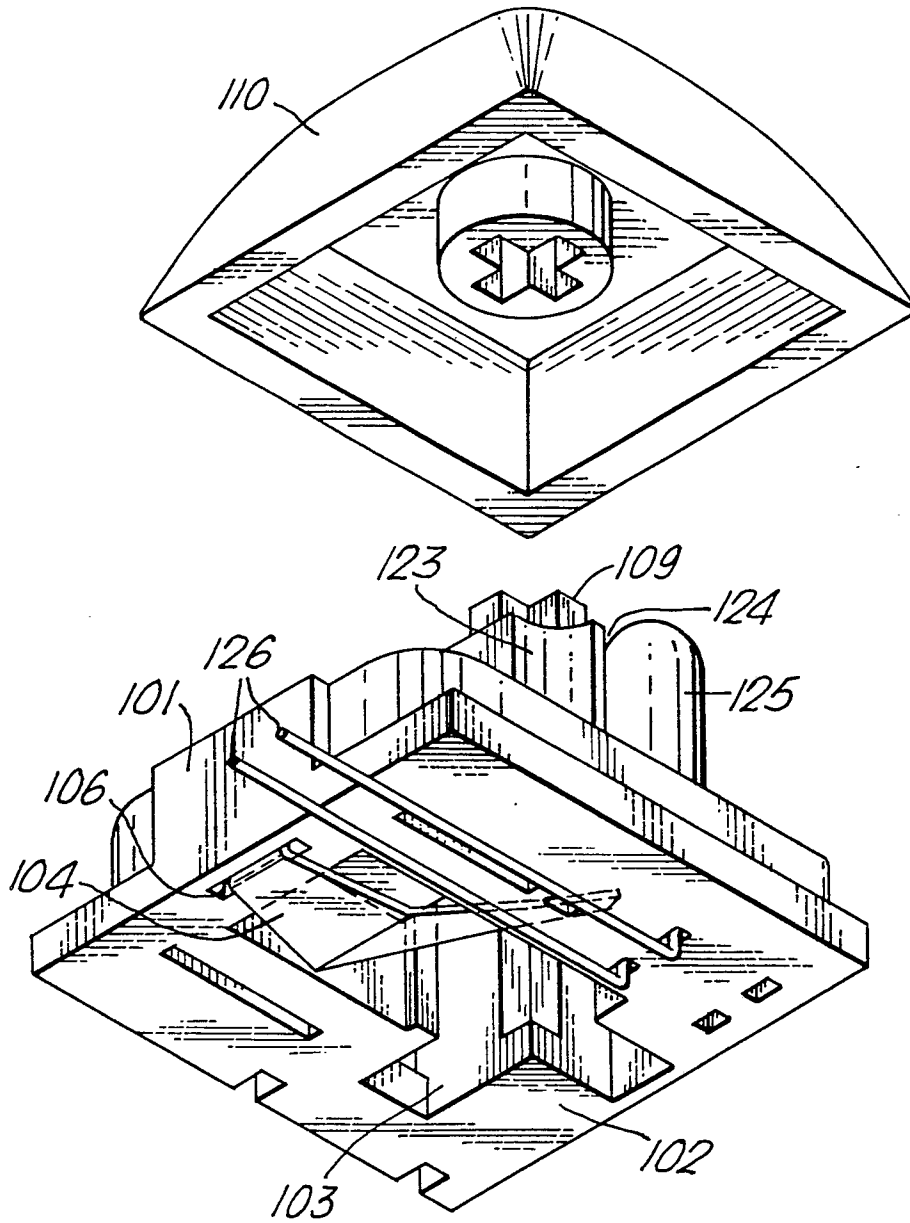








7/7

Fig. 9(b)*Fig. 9(c)*