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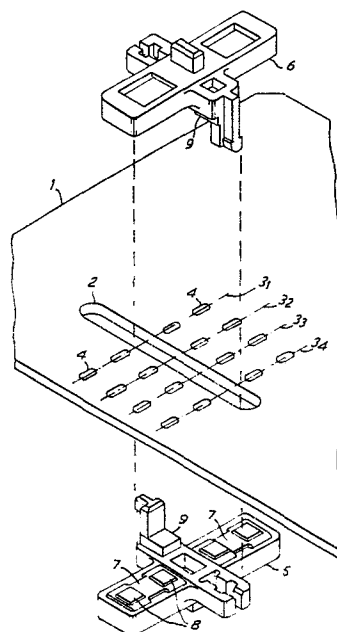
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⑤④ **Switch contact assembly.**

⑤⑦ The invention provides a switch, which may be either a linear sliding switch or a rotary switch, having two complementary contact carriers (5, 6) disposed on opposite sides of a circuit board (1) having contact surfaces (4) connected to circuits on the board. The contact carriers engage each other through an aperture (2) in the board and contacts (7) resiliently mounted in the carriers oppose each other. They then bridge different contact surfaces (4) as the contact carriers are moved. The contact carriers may have at least some dummy contacts, especially if one side of the board has no circuits, but at least the resilient contacts, dummy or not, will oppose each other providing a fully floating contact arrangement in which forces acting as opposite sides of the board are substantially balanced. A beneficial and easily inserted form of a resilient contact 7 is disclosed.



: 1 :

SWITCH CONTACT ASSEMBLY

The present invention relates to an electrical switch. It is particularly applicable to a switch, either a linear sliding switch or a rotary switch in which a sliding motion is about an axis, incorporated directly in a printed circuit board. In
5 such an application the contact assembly is movable in a slot or aperture in the printed circuit board and contact members carried thereon are slid across the surface of the printed circuit board to bridge contacts in circuits formed on the board and thereby to select or modify the circuit layout in use.

10 Such a switch may have many different applications for circuits employing such circuit boards and may then be operated by a switch activator mechanism which can be mounted directly on the printed circuit board or on a mounting assembly or housing associated therewith.

15 A particularly beneficial form of switch activator mechanism for use with such a contact assembly is that disclosed in co-pending patent application No.81 21934. As disclosed in that application, the arrangement is particularly applicable to a digital multimeter in which such switches may be used to
20 select different modes or ranges or as an on-off switch or for two or more of such purposes.

Electrical switches for use in association with printed circuit-boards have been proposed, for example in published British Patent Application 2050696A which shows a rotary switch
25 in which a spring, biasing the contact carrier, serves also as a contact. A linear version is also envisaged therein. British Patents Nos.1506371 and 1252096 also show sliding

switches with spring contacts bridging conductors on a printed circuit board. It is believed, however, that these arrangements do not provide a sufficiently free movement in switching and that other alternatives similarly do not provide a satisfactory movement and moreover are generally not convenient, for example requiring special tools or equipment for assembly.

It is, therefore, an object of the invention to provide an improved switch and contact carrier for such a switch, which may be readily assembled without the use of special equipment.

According to one aspect of the invention there is provided an electrical switch including: a circuit board having an aperture formed therein and a plurality of contacts adjacent the aperture and connected to circuits on the board; at least one pair of complementary contact carriers disposed on opposite sides of the board; and at least one contact member mounted in one of said carriers and having contact surfaces adapted to contact and connect two or more of said contacts on the circuit board; wherein the complementary contact carriers of said pair are interengaged through said aperture to provide opposing and substantially balanced forces on the board and are jointly movable relative to the board to connect or disconnect two or more contacts.

According to another aspect of the invention there is provided a contact carrier including: at least one aperture; a contact member situated in the aperture with contact surfaces disposed externally thereof, the contact member being formed with openings therein and the apertures with projections at the side thereof to engage the openings; and a resilient member situated in the aperture, restrained by the contact member and biasing the contact member to retain said projections engaged with said openings.

The invention also embraces a method of assembling a contact carrier according to the preceding paragraph, the method including the steps of inserting the resilient member into the aperture, inserting the contact member into the aperture to pass under the projections against the resilience of the resilient

member and allowing the said resilience to urge the said openings into engagement with the projections.

In order that the invention may be clearly understood and readily be carried into effect it will now be described by way
5 of example with reference to the accompanying drawings of which

Figure 1 shows a part of a circuit board with a sliding switch disassembled,

Figure 2 shows a similar switch to that of Figure 1 partly assembled,

10 Figure 3 shows a single contact carrier in accordance with the invention,

Figure 4a, 4b and 4c show plan, sectional side elevation and end elevation respectively of a contact for the carrier of Figure 3,

15 Figure 5a, 5b and 5c show plan, sectional side and end elevation respectively of an alternative form of contact,

Figure 6 shows the carrier of Figure 3 in perspective to illustrate the method of insertion of the contact,

Figure 7 is a plan view of a rotary switch contact carrier
20 in accordance with the invention,

Figure 8 is an underplan view of the carrier of Figure 7,

Figure 9 is a section on A-A of Figure 7,

Figure 10 is a section on B-B of Figure 7,

Figure 11 is a section on C-C of Figure 7,

25 Figure 12 is an elevational view of the carrier of Figure 7,

Figure 13 shows two carriers as that of Figure 7 interlocked, the carriers being shown in the sectional views of Figure 11, and

Figure 14 shows in part the assembled contact carriers of
30 Figure 13 with contacts in position therein.

In Figure 1 there is shown a part of a circuit board 1 which includes a sliding switch together with connections and other components which may take any suitable form and which have not been shown for the sake of clarity. For the purposes of
35 the switch, the board 1 includes an aperture in the form of a slot 2 flanked by a plurality of rows 3 of contacts 4.

Contacts 4 are connected by conductors, not shown, to the circuits on board 2 in a pattern which is determined by the functions to be performed. In this example four rows of contacts 3₁ to 3₄ are provided and the sliding switch is
5 intended to connect contacts in one row, bridging the two to one side of slot 2 and the two to the other side, and to be slid from one row to another. The circuit board 1 is also in this example a double sided circuit board carrying further connections and rows of contacts on the underside, not visible
10 in Figure 1, so that each row of contacts comprises four pairs, the contacts of each pair being bridged for one row 3.

To achieve the bridging of the contacts the switch further includes two plastic contact carriers 5 and 6 disposed on opposite sides of the board 1. Each contact carrier carries
15 two conducting contacts 7 having raised contact surfaces in the form of pads 8, which in operation press against the contact 4 by virtue of suitable resilient means. Thus each contact 7 bridges two contacts 4 against which its pads 8 press at any time.

20 Each contact carrier also has a portion 9 which is complementary to slot 2 to slide within as can be better seen from Figure 2. That Figure shows a similar sliding switch on board 1 in which the lower carrier 5 has been fitted to the slot 2. Raised on part 9 is a male part in the form of a member 10
25 which fits a complementary female part formed as an aperture 11 on the other contact carrier. When fully assembled the carriers are on opposite sides of the board 1, both having their parts 9 within slot 2 and their members 10 and apertures 11 inter-engaged to hold the contact pads 8 against contacts 4 and
30 to be slidably movable in slot 2 as indicated by arrows 12. To ensure a positive fitting and firm retention members 10 are formed with projections 13 and apertures 11 have slots 14 cut therein to be resilient.

Contact carriers 5 and 6 further include a projecting
35 member 15 whose purpose is to engage an activator mechanism, such as that disclosed in the said Patent Application

No.8121934, by which the carriers are moved in slot 2. The contact carriers may of course be moved without the intermediary of an activator mechanism but that is not preferred.

As illustrated contact carriers 5 and 6 are identical, each carrying a portion 9, member 10 and aperture 11. This is advantageous since it reduces the number of parts required. It is not, however, necessary and one carrier may for example carry two members 10, the other having two complementary apertures 11. Furthermore if it is desired to use a single sided circuit board, a single carrier such as 5 may be mated with a dummy carrier or other suitable part entirely for the purpose of being retained thereby.

A contact carrier 5 is shown in cross-section in Figure 3 to show the fitting of the contacts 7. Similarly suitable contacts are shown in plan, sectional side elevation and end elevation in Figures 4a, 4b and 4c respectively and in another form in Figures 5a, 5b and 5c respectively.

The contacts 7, which are formed of copper with a precious metal contact face, have the two contact pads referred to hereinbefore and two sidewalls 16 and on the bends between the top surface and each sidewall 16 have an opening or cut-out 17 between the two pads 8.

The contact carriers 5 and 6 are formed with apertures 18 in which the contacts 7 may be inserted. They are also formed with projections 19 facing inwardly of the apertures 18 to engage cut-outs 17 on the contact 7 and thereby retain the contacts. The contacts are placed in apertures 18 with contact pads 8 facing outwards and a resilient metal member 20 is placed within aperture 18 to urge contacts 7 outwardly. This serves partly to retain the contact, pressing the sidewall edges of cut-outs 17 against projections 19 and also serves to provide the resilience referred to hereinbefore to maintain pads 8 in firm contact with contact 4 on the circuit board.

This form of construction allows the assembly to be readily assembled without the use of special tools as can be seen in the perspective view of Figure 5 in which one contact 7 is partly

inserted.

The first step in assembly is to insert the resilient member 20 into the aperture 18, as is shown to the right hand side in Figure 5. Subsequently the contact 7 is inserted in the direction shown by the arrow 21 on the left hand side in Figure 5. It is pressed against the resilience of member 20 under the projections 19 and when in place allowed to rise with the projections 19 engaged in cut-out 17. Member 20 is shaped to facilitate this insertion but clearly need not be exactly as illustrated.

It will be apparent that the insertion of member 20 and contact 7 comprises two simple actions and yet provides positive positioning and resilience of contact. Furthermore the subsequent positioning of carriers 5 and 6 on opposite sides of board 1, as shown in Figure 1 with parts 9 in slot 2 and members 10 and apertures 11 inter-engaged is also a simple and yet positive procedure.

The provision of opposed contacts on opposite side of the circuit board, each resiliently mounted, contributes to the advantageous fully floating nature of the contact assembly. In this arrangement all of the forces tend to oppose each other and there is substantially equal pressure on each pair of contacts. It should be appreciated, however, that it is not necessary for these all to be fully operational contacts to achieve this effect. Any of the apertures 18 may include a dummy contact, perhaps of insulating material. Conveniently the active contacts may be on one side of the circuit board with all contacts on the other side being dummy ones.

Furthermore although it is preferred that the two contact carriers are identical, it is not necessary that they should be so provided they are complementary to the extent of being interlocking and providing opposing contacts when interlocked. Other interlocking arrangements than those illustrated may be used.

In the preferred example the contact carriers are moulded of 10% glass filled polycarbonate although many other materials

may be used.

The embodiment particularly described hereinbefore is for a switch in which the sliding motion is a linear one so that a linear switch is obtained. The invention, however, is suitable
5 for application to switches using other motions of which a rotary motion is particularly convenient. In that case the aperture through which the complementary contact carriers interengage is generally circular.

In Figure 7 there is shown a rotary contact carrier 1 in
10 plan and in Figure 8 the same contact carrier in underplan. These Figures should be viewed with Figures 9, 10 and 11 which show respectively sections on A-A, B-B and C-C of Figure 7. Figure 12 also shows a side elevation of the carrier.

The carriers include apertures 18 which correspond to the
15 similarly numbered apertures in the carriers described hereinbefore.

By means of similar projections 19 and resilient members (which are not shown in Figures 7 - 13 but which may be the same as those identified by reference numeral 20 in Figures 3 and 6)
20 there are mounted in a resilient manner contacts which may be the contacts 7 shown in Figure 4 or Figure 5. The contact carrier in this example has four arms 21 disposed symmetrically about a hub part 22, each arm having a respective aperture 18.

Different numbers of arms 21 may be provided according to
25 the purpose required. Two or more arms, evenly spaced would achieve the balance required although too many arms may become unwieldy so that four is a preferred number.

The hub part 22 has a central concavity 23 in the upperside with an aperture 24 axially therein. To one side is a
30 projection 25 and the concavity has a rim 26 extending over slightly greater than 270° leaving a part 27 of less than 90° having no rim 26.

For assembly, two identical contact carriers are disposed on opposite sides of a circuit board having an aperture
35 sufficient to accommodate the locking parts 25 and 26. The contact carriers are axially aligned and offered to the aperture

at relative rotational positions so that the projections 25 of each, approach the part of the other at which there is the gap 27 in rim 26. When each projection 25 is sufficiently introduced the two contact carriers are rotated relative to the
5 other so that each part 25 is engaged under the rim 26 of the other. The rotation is continued until the projections 25 are on opposite sides of the axis and the arms 21 of each are aligned on opposite sides of the circuit board.

For a better illustration of the locking arrangement Figure
10 13 shows two contact carriers, each in the section view of Figure 11, fully engaged on opposite sides of a circuit board 27. The circuit board has an aperture 28 through which the interlocking parts 25 and 26 engage.

The arrangement allows of firm, but not permanent,
15 interlocking of the two parts so that the two carriers may be rotated about their common axis 29 to effect the switching action.

Figure 14 shows in part an assembled pair of contact carriers as in Figure 13 but with the contacts 7 in position as
20 in the fully assembled switch.

CLAIMS

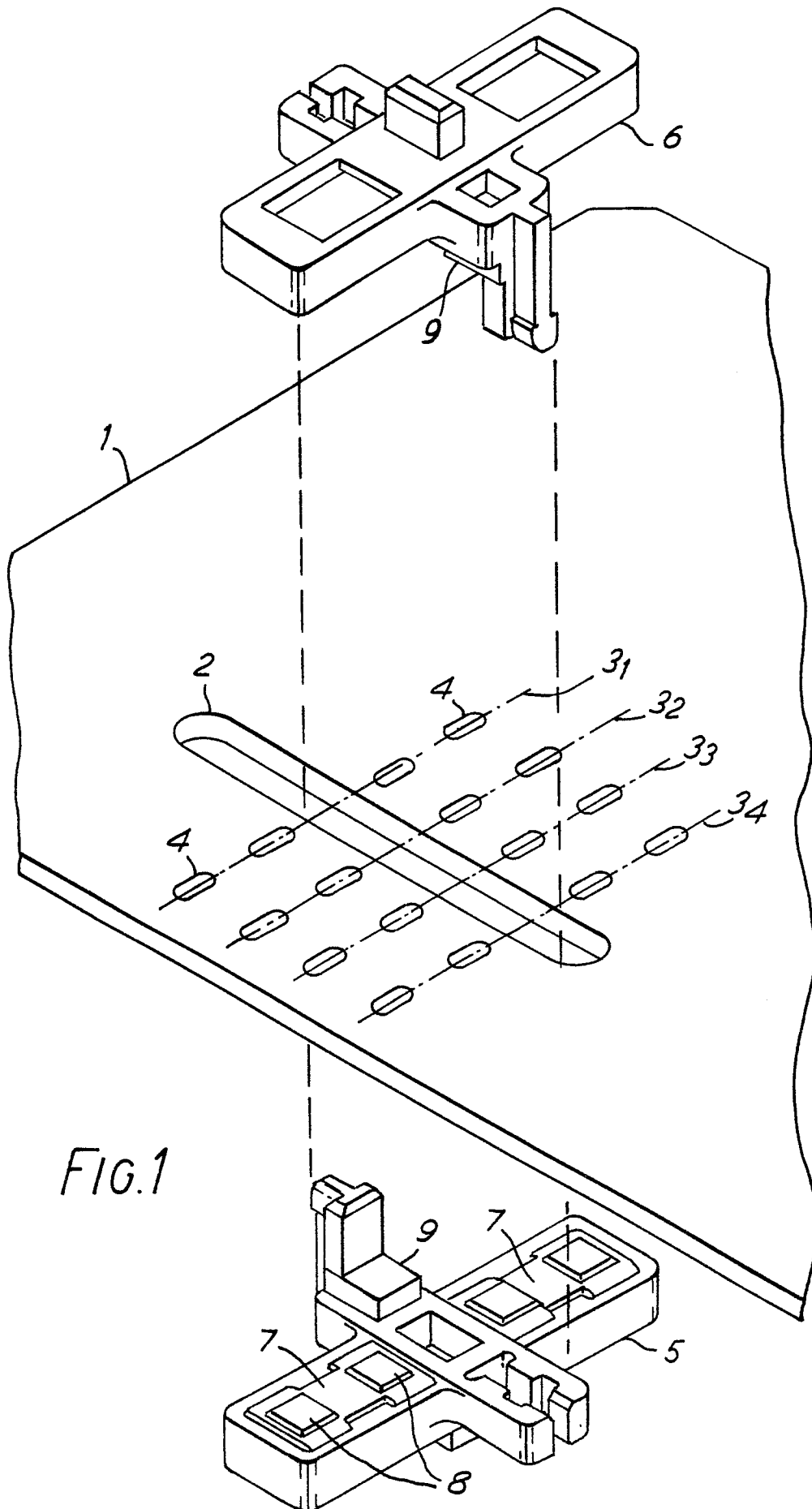
1. An electrical switch including: a circuit board having an aperture formed therein and a plurality of contacts adjacent the aperture and connected to circuits on the board; at least one pair of complementary contact carriers disposed on opposite sides of the board; and at least one contact member mounted in one of said carriers and having contact surfaces adapted to contact and connect two or more of said contacts on the circuit board; wherein the complementary contact carriers of said pair are interengaged through said aperture to provide opposing and substantially balanced forces on the board and are jointly movable relative to the board to connect or disconnect two or more contacts.
2. A switch according to Claim 1 in which said aperture is a slot and the pair of contact carriers are mated therewith to be capable of a linear sliding action on the board to connect or disconnect said contact.
3. A switch according to Claim 1 in which said aperture is generally circular and the pair of contact carriers are mated therewith to be capable of a rotary action on the board to connect or disconnect said contacts.
4. A switch according to Claim 3 in which each contact comprises a hub part adapted to engage the other contact carrier through said aperture and a plurality of arms, at least some of which carry at least one contact member, radiating from the hub so that, when the contact carriers are interengaged, contact carrying arms of one contact carrier oppose contact carrying arms of the other contact carrier.
5. A switch according to any preceding claim in which the circuit board has contacts on both sides and both of the pair of complementary contact carriers have at least one contact member adapted to contact and connect two or more of said contacts on a respective side of the board.
6. A switch according to any of claims 1 to 4 in which one of said pair of complementary contact carriers has at least one dummy contact member adapted to substantially balance forces on the circuit board from an opposing contact member of the other carrier without itself connecting contacts.

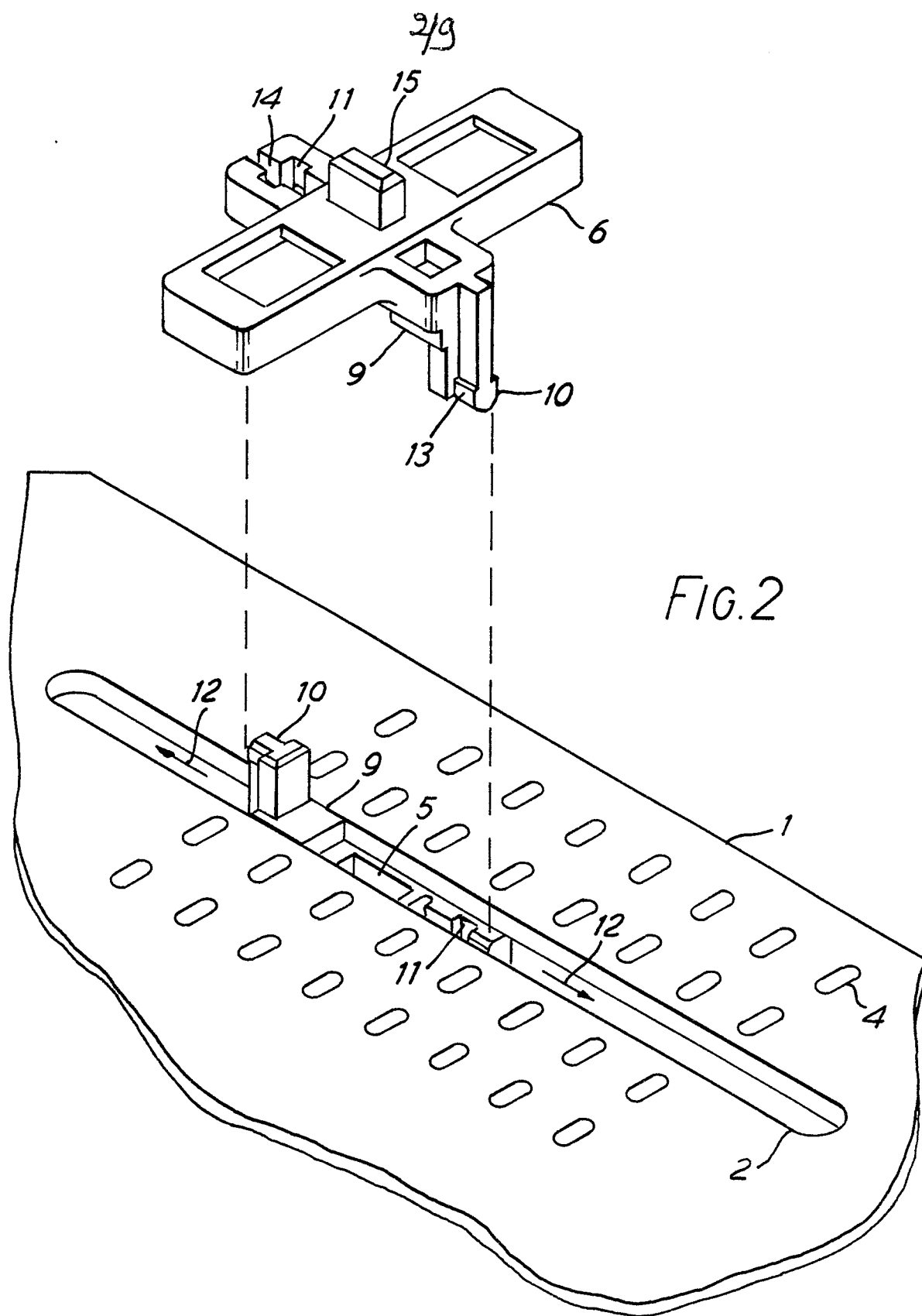
7. A switch according to any preceding claim in which each contact carrier includes means engaging the at least one contact member and resilient means urging the contact member against the means for engaging.

8. A contact carrier including: at least one aperture; a contact member situated in the aperture with contact surfaces disposed externally thereof, the contact member being formed with openings therein and the apertures with projections at the side thereof to engage the openings; and a resilient member situated in the aperture, restrained by the contact member and biasing the contact member to retain said projections engaged with said openings.

9. A contact carrier according to Claim 14 having complementary male and female members to engage complementary members on a similar contact carrier.

10. A method of assembling a contact carrier according to either of claims 14 and 15, the method including the steps of inserting the resilient member into the aperture, inserting the contact member into the aperture to pass under the projections against the resilience of the resilient member and allowing the said resilience to urge the said openings into engagement with the projections.





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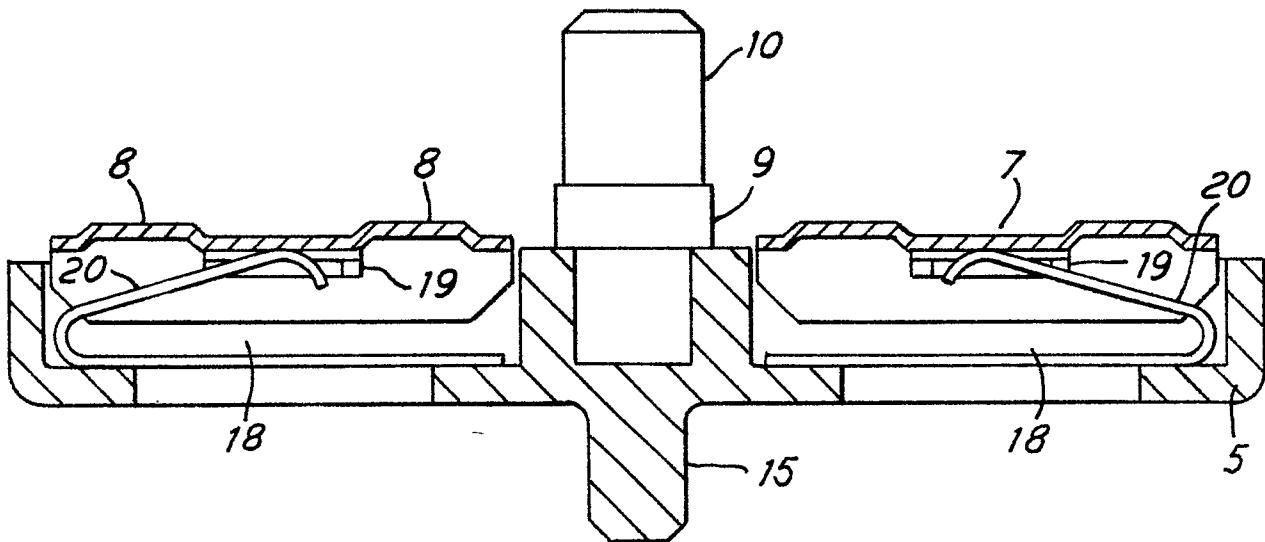


FIG. 3

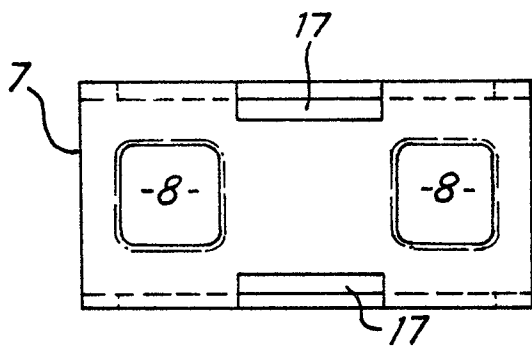


FIG. 4a

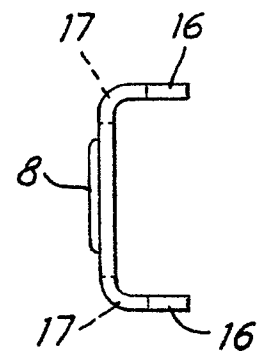


FIG. 4c

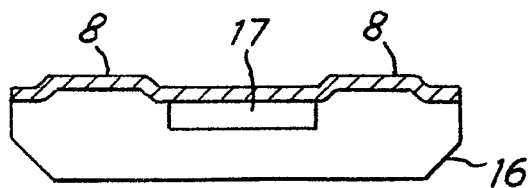


FIG. 4b

Fig

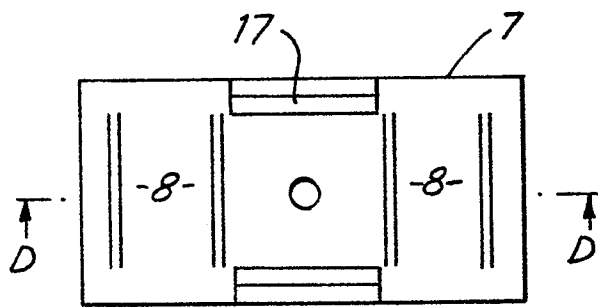


FIG. 5a

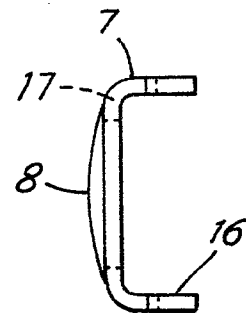


FIG. 5c

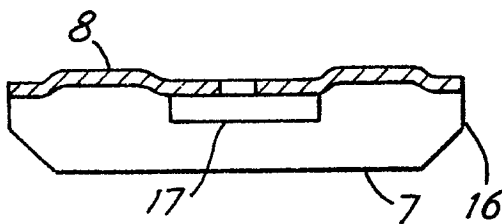
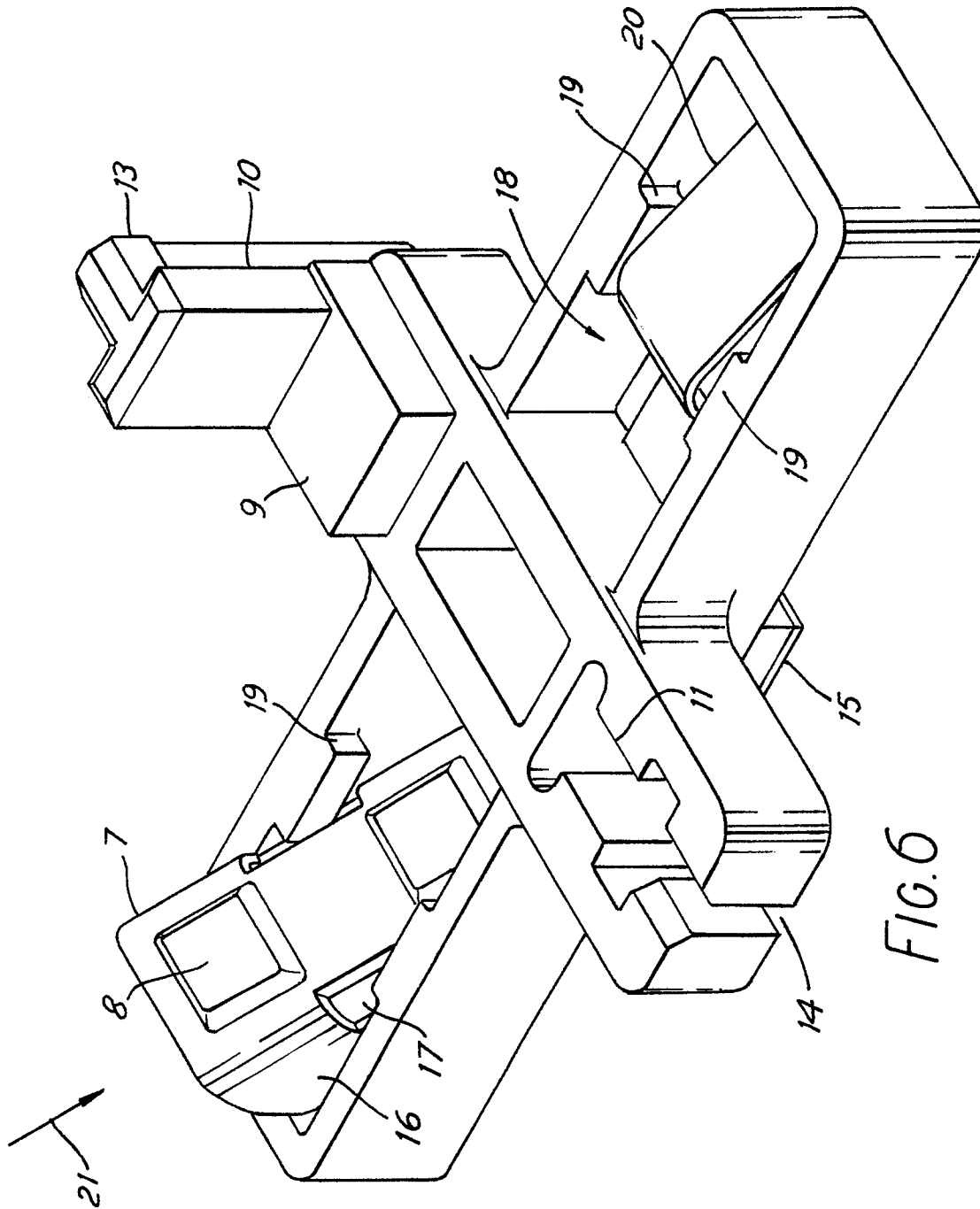


FIG. 5b



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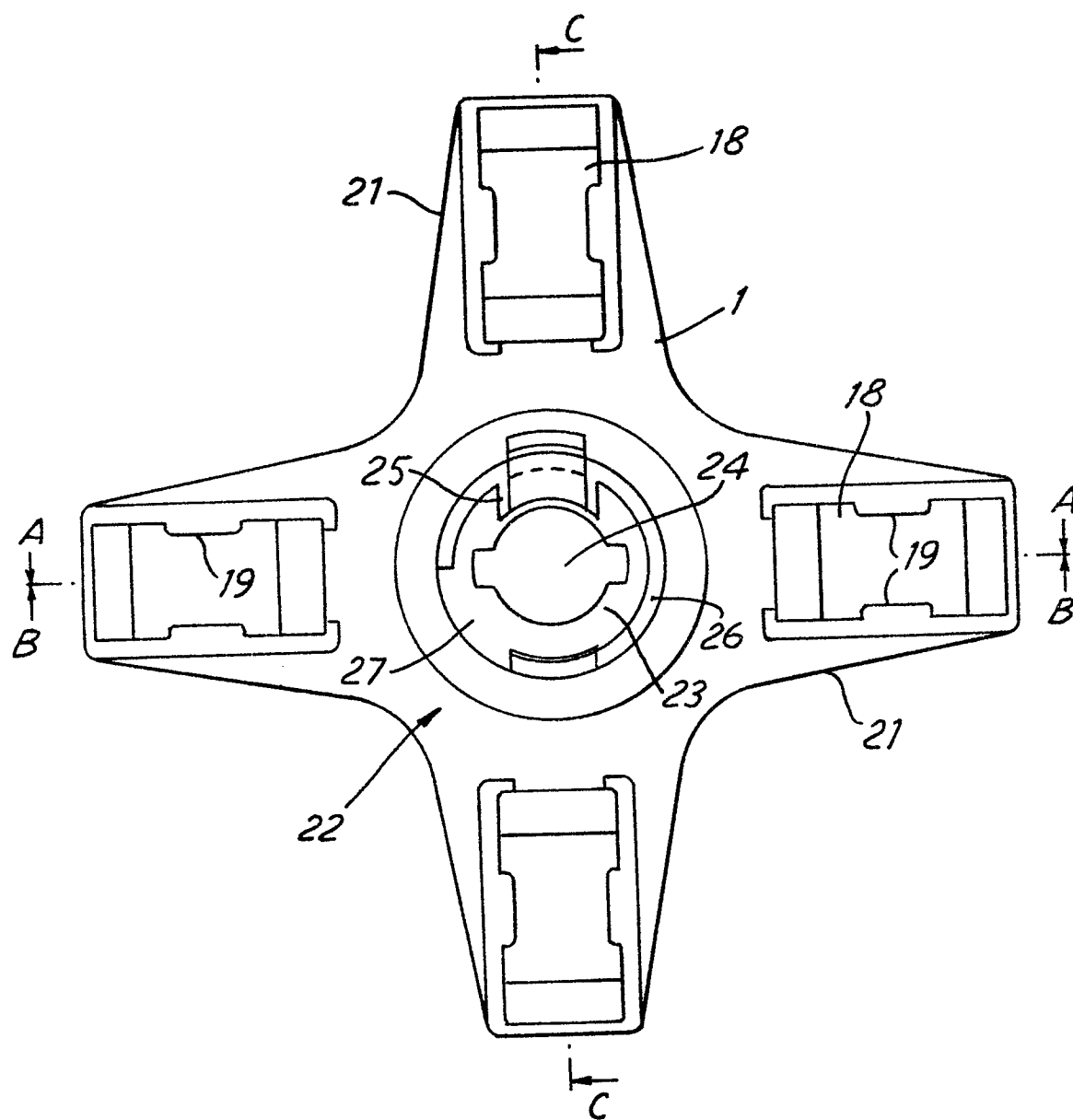


FIG. 7

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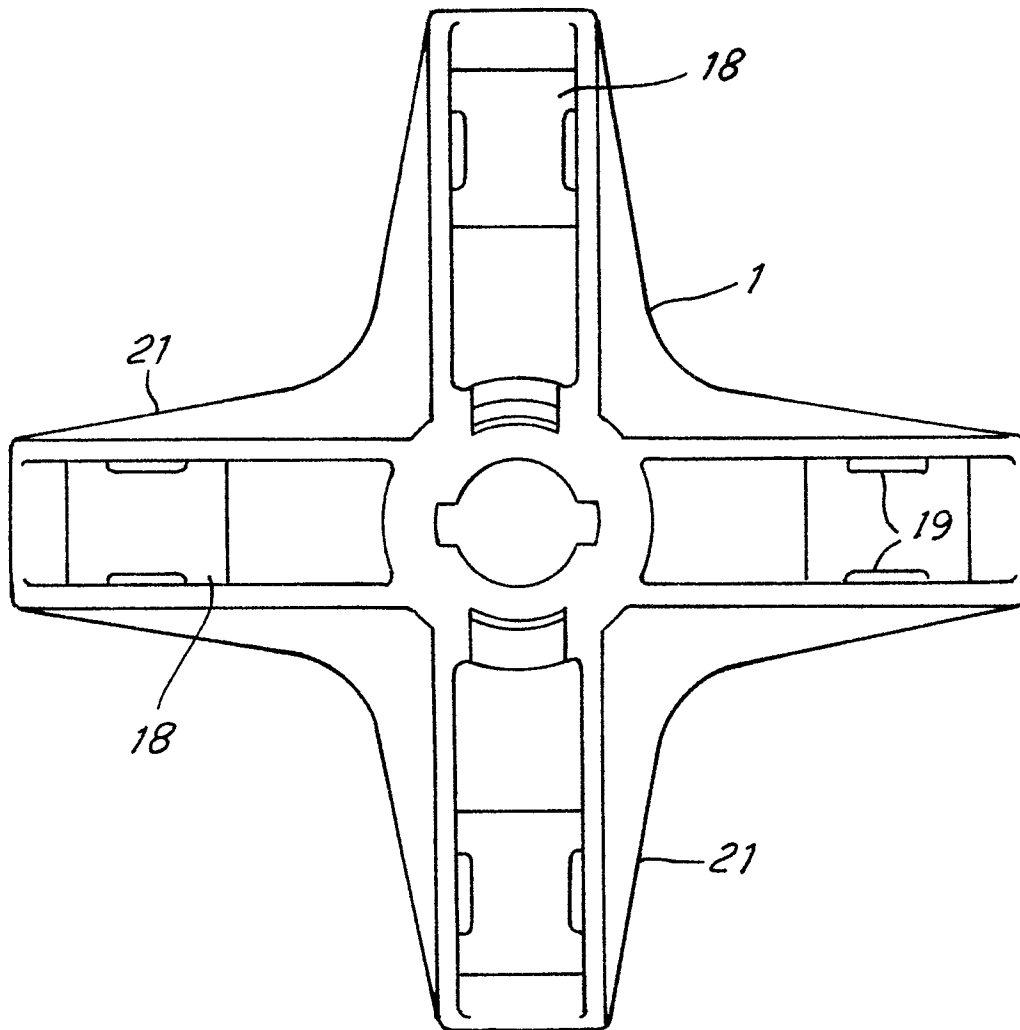
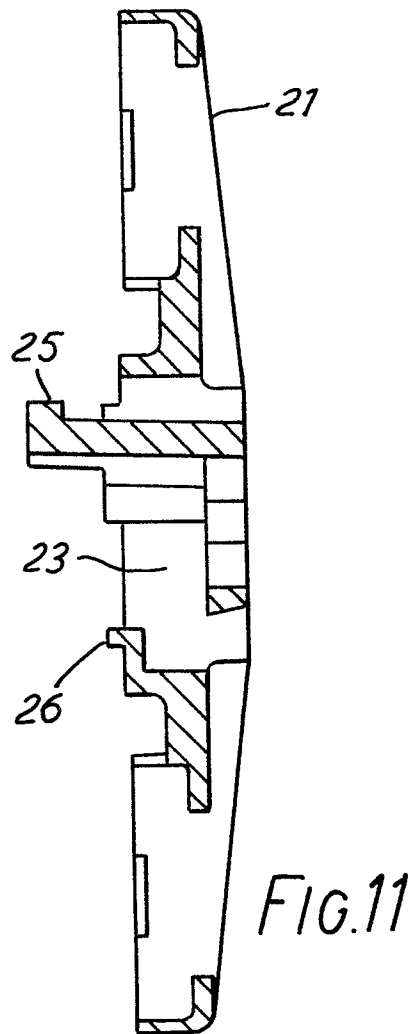
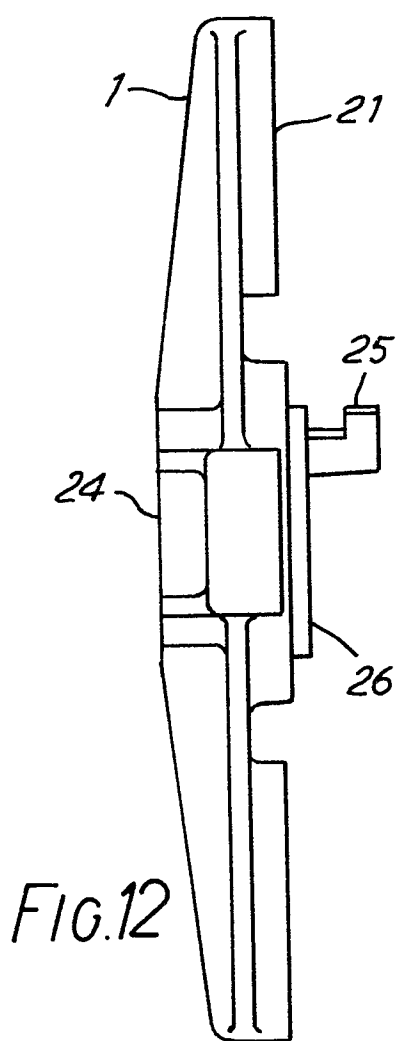
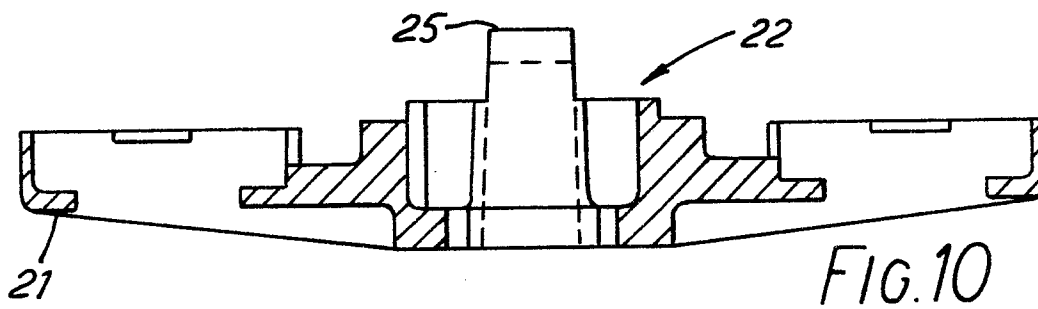
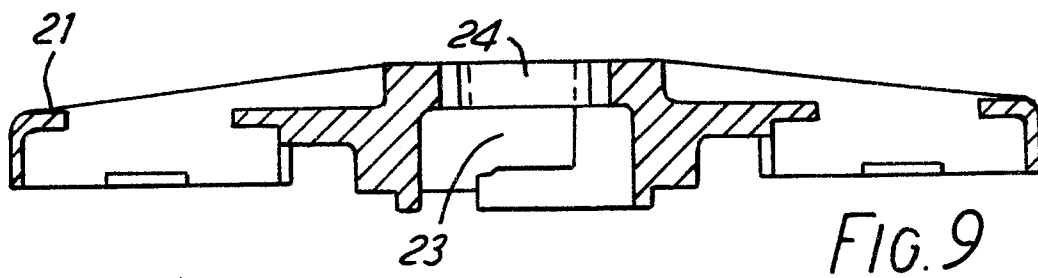


FIG. 8



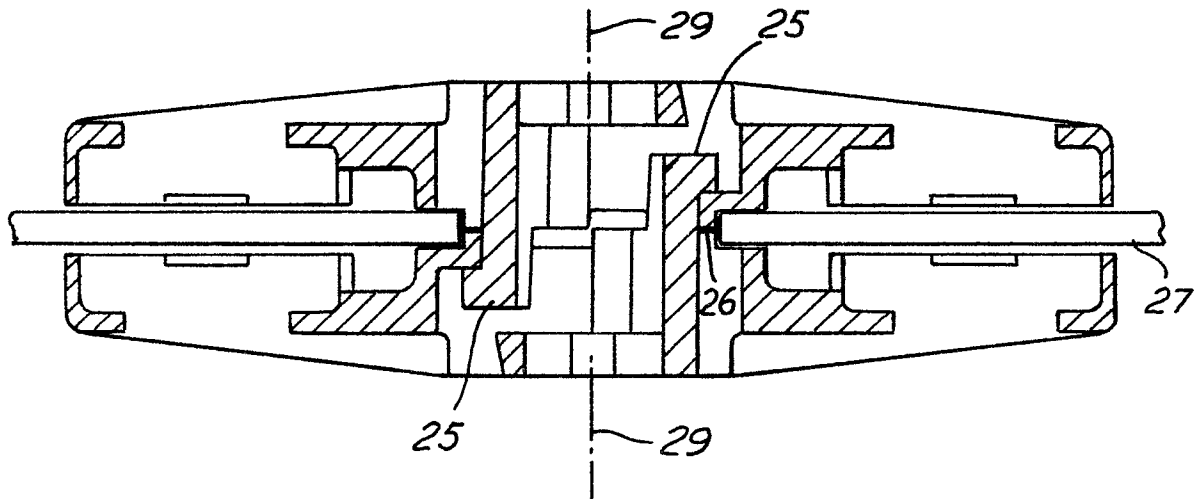


FIG. 13

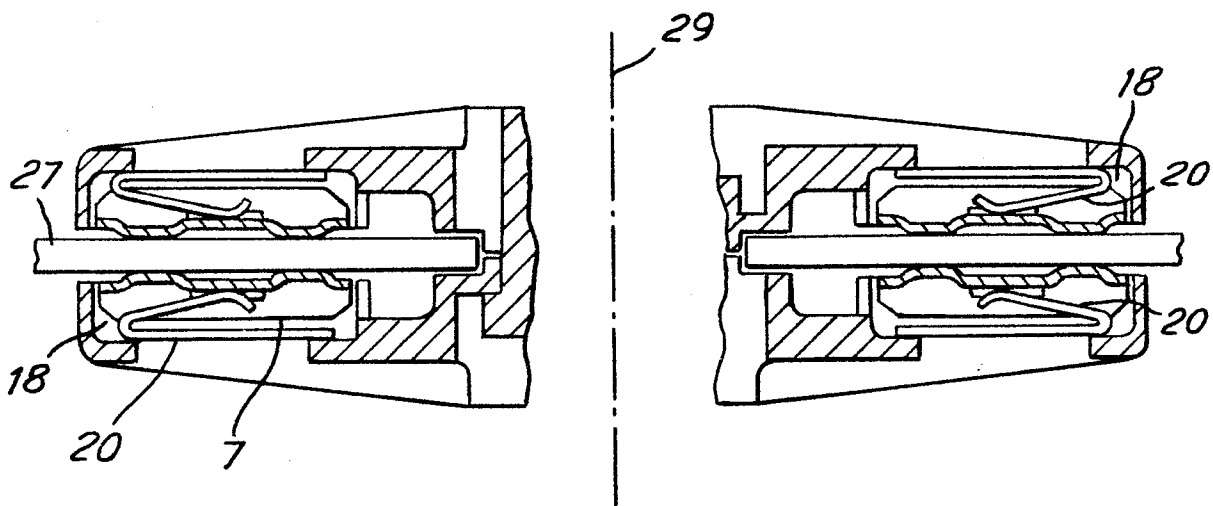


FIG. 14