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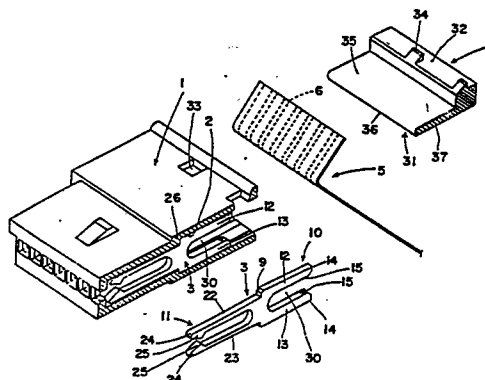
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### Electrical connector for flexible flat cable.

The connector includes a housing (1) having a terminal mounting space (2) formed therein, a plurality of terminals (3) mounted in said space and arranged in parallel relation with pitches corresponding to pitches of flat conductors (6) formed in the flexible flat cable (5) and an inserting and holding member (4) for inserting and holding the flexible flat cable into the terminals (3) to connect the respective flat conductors (6) to the respective terminals (3). Each terminal (3) is fork-shaped and comprises upper and lower terminal pieces (12, 13) each having a projecting contact (15) projecting inwardly from an inside of a free end thereof, and said inserting and holding member (4) comprises a wedging portion having an upper surface (35), a front surface (36) and a lower surface (37) to be inserted into a receiving space (30) formed between the fork-like terminal pieces (12, 13) of said terminal and a locking projection (34) to be engaged with a locking groove (33) formed in said housing. The flexible flat cable is positioned in flat state at an opening (38) formed at the front side of said housing and is pressed and inserted by the wedging portion (31) of the inserting and holding member (4) into the receiving space (30) between the fork-shaped terminal pieces (12, 13) while said flexible flat cable is bent into U-shape along the upper, front and lower surfaces (35, 36, 37) of said wedging portion (31) under the co-operating action of said wedging portion with the contacts (15) of the

respective terminal pieces (12, 13) positioned in confronting relation to the upper and lower surfaces of said wedging portion, and when the locking projection (34) of the inserting and holding member has completely come into locking engagement with said locking groove (33) of the housing, the contacts (15) of the fork-like terminal pieces (12, 13) elastically contact with each flat conductor (6) of the flexible flat cable (5) at upper and lower points thereof under the elastic restoring force of the fork-shaped terminal pieces (12, 13) which are slightly opened outwardly by the wedging portion (31).



- 1 -

ELECTRICAL CONNECTOR FOR FLEXIBLE FLAT CABLEBACKGROUND OF THE INVENTIONFIELD OF THE INVENTION

The present invention relates to an electrical connector for an electrical cable and, more particularly, it relates to a connector for connecting an electrical cable of the type so-called flexible flat cable (FFC) or flexible printing cable (FPC).

DESCRIPTION OF THE PRIOR ART

The flexible flat cable is now widely used in various fields and various arts. Often, the flexible flat cable is connected to a terminal.

One of the methods or measures for connecting the flexible flat cable with a terminal in a so-called pressure or piercing connection. According to this type of connection, the terminal has sharp projections formed thereon, which pierce into the flexible flat cable to make electrical contact with the respective flat conductors in the cable. More specifically, each of the sharp projections pierces from one side of a covering insulation of the flexible flat cable into said insulation, passes through an inner conductor and then projects through the other side of the insulation to the outside. The end projecting to the

- 2 -

outside of the cable is bent. Thus, the terminal is mechanically fixed to the flexible flat cable, while the former is electrically connected with the inner conductor of the latter. Such connection is disclosed, for example, in Japanese Patent Publication

5 No. 7475/1982, and Japanese Patent Publication No. 61789/1985.

Another one of the methods heretofore proposed is a so-called plug-in connection. According to this method, a connector includes a connector housing having a terminal receiving cavity formed therein. Terminals are mounted in the cavity of said

10 connector housing. An inserting and holding member is provided for inserting and holding the flexible flat cable in the housing. The electrical connection between inner conductors of the flexible flat cable and the terminals is made by firstly stripping a covering insulation of the cable at its end to expose the inner

15 conductors, inserting the exposed inner conductors in flat state into the terminal receiving cavity and then inserting and locking said inserting and holding member into said cavity, thereby elastically holding the conductors between the inserting and holding member and the terminals. Such a connector is disclosed,

20 for example in Japanese Laid-Open Patent Application No. 101886/1985.

The above two types of the prior art have been actually used for a long time, with satisfactory results in the various fields. However, there remain some problems to be solved in

25 practice.

Firstly, the pressure-connection method has the advantage of not requiring the pre-treatment to expose the inner conductors at the end portion of the cable. The length of the cable can be selected as desired and once the cable is connected to the terminal it is very difficult to cause a disconnection. The disadvantages of the pressure-connection method is that a special tool is required to make the connection between the terminals and the inner conductors of the cable, the efficiency of connecting operation is low, and a high precision of electrical connection cannot be always attained.

As compared with the pressure-connection, the plug-in connection has the advantages that the efficiency of connecting operation is high since it is only necessary to insert the end portion of the flexible flat cable into the terminal cavity of the housing in order to effect connection of the cable with the terminals. In addition, a high precision of electrical connection can be attained since the terminal and the conductor of the cable are elastically held in contacting state with a predetermined contact pressure. The disadvantages of the plug-in connection is that the treatment of exposing the inner conductors at the end portion of the flexible flat cable is always required and the cable is relatively easily disconnected from the terminals when an external force is accidentally applied thereto since the cable is connected by simply inserting the cable in flat state into the terminals and it is held in the terminals by pressure contact



- 4 -

between the terminal and the conductor at one point at a predetermined pressure.

SUMMARY OF THE INVENTION

It is a general object of the present invention  
5 to provide an improved connector for a flexible flat cable.

The present invention provides a connector for a flexible flat cable including a connector housing, a plurality of terminals mounted in said housing and an inserting and holding member for  
10 connecting respective flat conductors of the cable to respective terminals of the connector, in which said terminal comprises fork-shaped upper and lower terminal pieces each having a contact projecting inwardly from an inside of a free end thereof, while said inserting  
15 and holding member comprises a wedging portion to be inserted into a receiving space between said upper and lower terminal pieces, the arrangement being such that when the inserting and holding member has been completely inserted into the housing, the end portion  
20 of the flexible flat cable portioned between the wedging portion and the contacts is bent into U-shape along the upper, front and lower surfaces of said wedging portion and the contacts of the terminal pieces elastically contact with the respective conductors  
25 of the flexible flat cable.

Some ways of carrying out the present invention

will now be described in detail by way of example with reference to drawings which show specific embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

5           FIGS. 1 to 8 illustrate a first embodiment of the present invention in which:

          FIG. 1 is an exploded perspective view, partly broken, of the connector,

          FIG. 2 is a perspective view, partly broken,  
10       showing the assembled state of the connector.

          FIG. 3 is a plan view showing the relation between the pitches of the terminals and the pitches of the conductors of the flexible flat cable placed in front of the housing,

15           FIG. 4 is a partly enlarged section showing the ends of the contacts,

          FIG. 5 is an enlarged front view of the contacts,

          FIGS. 6, 7 and 8 illustrate the process of inserting the cable into the terminal,

20           FIGS. 9 to 13 illustrate a second embodiment of the present invention, in which:

          FIG. 9 is a partly enlarged side view of the ends of the contacts,

          FIG. 10 is an enlarged front view of the  
25       contacts, and

          FIGS. 11, 12 and 13 illustrate the process

of inserting the cable into the terminal;

FIG. 14 is a sectional view showing a modified form of the inserting and holding member; and

FIGS. 15 and 16 are perspective views, partly broken, showing the actual application modes of the connector.

#### DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Firstly, the first embodiment will be described with reference to Figs. 1 to 8.

The connector includes a connector housing 1 having a terminal mounting space 2 formed therein, a plurality of terminals 3 mounted in said space 2 and arranged in parallel relation with pitches corresponding to pitches of flat conductors 6 formed in the flexible flat cable 5 and an inserting and holding member 4 for connecting the respective conductors 6 of the flexible flat cable 5 to the respective terminals 3; said terminal 3 comprising fork-shaped upper and lower terminal pieces 12, 13, each having a projecting contact 15 projecting inwardly from an inside of a free end thereof, said inserting and holding member 4 comprising a wedging portion 31 having an upper surface 35, a front surface 36 and a lower surface 37 to be

- 7 -


inserted into a receiving space 30 formed between the  
fork-shaped terminal pieces 12, 13 of said terminal  
3 and a locking projection 34 to be engaged with a  
locking groove 33 formed in said housing, in which  
5 the flexible flat cable 5 positioned in flat state  
at an opening 38 formed at the front side of said housing  
is pressed and inserted by the wedging portion 31 of  
the inserting and holding member 4 into the receiving  
space 30 between the fork-shaped terminal pieces 12,  
10 13 while said flexible flat cable 5 is bent into U-shape  
along the upper, front and lower surfaces 35, 36, 37  
of said wedging portion under the co-operating action  
of said wedging portion 31 with the contacts 15 of  
the respective terminal pieces positioned in confronting  
15 relation to the upper and lower surfaces of said wedging  
portion, and when the locking projection 34 of the  
inserting and holding member 4 has completely come  
into locking engagement with said locking groove 33  
of the housing, the contacts 15 of the fork-shaped  
20 terminal pieces 12, 13 elastically contact with each  
flat conductor 6 of the flexible flat cable 5 at upper  
and lower points thereof under the elastic restoring  
force of the fork-shaped terminal pieces 12, 13 which  
are slightly opened outwardly by the wedging portion  
25 31.



In FIGS. 1 to 8, the connector includes a connector housing 1 having a terminal receiving cavity 2 formed therein, terminals 3 mounted in said cavity 2, and an inserting and holding member 4. A cable 5 has a plurality of flat conductors 6 arranged in parallel with predetermined pitches and covering insulation layers 7 and 8 arranged on upper and lower sides of the conductors, respectively. This cable 5 is generally called as a flexible flat cable (FFC) or a flexible printed cable (FPC). The terminals 3 are mounted in said terminal receiving cavity 2 with pitches corresponding to the pitches of the flat conductors 6.

Referring to each of the terminals, the terminal 3 includes one terminal side portion 10 and the other terminal side portion 11, with step portions 9 positioned between said one and the other terminal side portions. The one terminal side portion 10 is a part to be connected to the conductor 6 of the flexible flat cable 5 and includes fork-shaped upper and lower terminal pieces 12 and 13, each having a contact 15 formed at inside of the free end thereof.

In the embodiment as shown in FIGS. 1 to 8, the contacts 15 have sharp ends 16, respectively, which can strip the upper and lower covering insulation layer 7. That is, the end 16 of the contact 15 has a bottom surface 17, a front surface 18 and a rear surface 19, in which the bottom surface 17 and the front surface 18 and the bottom surface 17 and the rear surface 19 are crossed




at substantially right angles respectively, to form sharp edges 20 and 21, as shown in FIGS. 4 and 5.

The other terminal side portion 11 also includes fork-shaped upper and lower terminal pieces 22 and 23, each having a  
5 contact 25 at the inner side of the free end thereof.

The terminal 3, which is arranged to be set in the terminal receiving cavity 2 of the connector housing 1 as described above, is so mounted in the housing that the step portions 9 of the terminal 3 are set at the setting step portions  
10 26 of the housing. Gaps 29 are formed between the inside walls 28 and the upper surfaces 27 of the terminal pieces 12, 13 and 22, 23 of the one and other side portions 10 and 11 to allow slight outward deformation of the pairs of terminal pieces 12, 13 and 22, 23 at the time of mounting of the terminal in the housing.

15 The inserting and holding member 4 consists of a plate-shaped wedging portion 31 having such thickness that it can enter into a receiving space 30 formed between the pair of the terminal 3, and a base portion 32 integrally formed at the rear portion of said wedging portion. The base portion 32 has a locking  
20 projection 34 formed thereon, which can engage with a locking groove 33 formed in the connector housing 1.

The wedging portion 31 has an upper surface 35, a front surface 36 and lower surface 37, and the thickness of this wedging



portion to so determined that the pair of terminal pieces 12, 13 are slightly expanded outwardly when the flexible flat cable 5 is positioned between the surfaces 35, 36 and 37 and the pair of contacts 15 and the wedging portion is pressed into the receiving space 30.

The operation of this embodiment will be explained, with reference to FIGS. 4 to 8.

Firstly, the flexible flat cable 6 is positioned in its flat state in front of the opening 38 formed at the front of the housing 1, as shown in FIG. 6.

Then, the wedging portion 31 of the inserting and holding member 4 is inserted, by means of a suitable tool 39, toward the terminal mounting space 2, more particularly into the space between the pair of contacts 15, as shown by the arrow A in FIG. 7. During the time when the front surface 36 of the wedging portion 31 moves into contact with the pair of contacts 15, the flexible flat cable 5 is forcibly bent by an edge 40 defining an entrance 38 and a guide 41. The front surface 36 of the wedging portion 31 comes into contact with the pair of contacts 15 when the flexible flat cable 5 positioned on the front surface 36 of the wedging portion 31 has contacted with the ends 16 of the pair of contacts 15. After this occurs, the pair of terminal pieces 12 and 13 are slightly expanded outwardly by the continued insertion of the wedging portion 31, while the contacts pierce into the

- 11 -

flexible flat cable by the elastical restoring force thereof. Accordingly, the covering insulation 7 is stripped at the upper and lower portions corresponding to the conductors of the flexible flat cable, as shown in FIG. 4, and the covering insulation is


5 progressively stripped by the bottom surface 17, the front surface 18 and the edge 20 of the sharp end 16 of the contact.

FIG. 8 shows the state of the inserting and holding member 4 which has been completely inserted to the position where the locking projection 34 has come into engagement with the

10 locking groove 33. As the position, the flexible flat cable 5 has been bent into U-shape along the surfaces 35, 36 and 37 of the wedging portion 31 and the pair of contacts 15 of the terminal 3 have come into electrical contact at two upper and lower positions with the stripped conductor 6 at a predetermined contact pressure.

15 Accordingly, the high precision of electrical contact is assured and the disconnection of the cable is avoided. It is not necessary to apply pre-treatment of exposing the conductor at the end portion of the flexible flat cable 5. The insertion of the inserting and holding member 4 can be easily effected.

20 FIG. 2 is a perspective view showing the state where the connection has been completed. As shown in FIG. 2, conductors 42 connected to a printed circuit (not shown) may be connected to the other side portion 11 of the terminal 3. When it is desired to disconnect the cable from the connector, it is only necessary to



- 12 -

unlock the inserting and holding member 4 and effect successive operations in the reverse order as that described above.

Now the second embodiment of the present invention will be described, with reference to FIGS. 9 to 13.

5           According to this embodiment, the conductor 6 at the end portion of the flexible flat cable 5 is previously exposed and connected to the terminal.

          The end 16 of the contact 15 is totally formed in a continuous curved surface 43 which enables easy sliding on the  
10 conductor 6. The order of inserting the inserting and holding member into the terminal and the operation of connection are shown in FIGS. 11, 12 and 13 and effected in substantially the same way as described with reference to the first embodiment. In the state as shown in FIG. 13, the pair of contacts 15 make contact with the  
15 previously exposed conductor 6 at upper and lower points at a predetermined contact pressure under the elastically restoring force of the pair of outwardly expanded contact pieces 12 and 13.

          In the embodiments as described above, the inserting and holding member is shown as the one having a wedging portion 31 and  
20 a base portion 32 in which said wedging portion projects from the lower part of said base portion 32 forwardly. However, as shown in Fig. 14, this member may have a wedging portion 31 and a base portion 32 in which said wedging portion projects forwardly

from the central part of said base portion, and a step portion is formed between the bottom 44 of the base portion 32 and the lower surface 37 of the wedging portion 31. According to this modified form, the flexible cable 5 is bent and held in U-shape along the upper surface 35, the front surface 6 and the lower surface 37 and then it passes through the space between the step forming bottom 44 and the inside wall of the housing and extends outwardly of the housing.

FIG. 15 illustrates an example in which at the other end a conductor 45 connected to the above-mentioned other side portion 11 of the terminal 3 is formed as a terminal 46 which is same as the terminal 3 having terminal pieces 12, 13 to which another flexible flat cable 47 can be connected.

FIG. 16 illustrates another example of the invention.

In the exemplary embodiments described, each of the conductors of the flexible flat cable is securely held between the contact as of the upper and lower terminal pieces and the wedging portion pressed into the space between said contacts. That is, the conductor is curved into U-shape along the upper, front and lower surfaces of the wedging portion and firmly held by the contacts which elastically contact with the upper and lower points of the conductor at a predetermined pressure. This arrangement provides several advantages over the prior art. For example, high precision of



electrical contact is ensured and it is very unlikely that the flexible flat cable may come out of the connector even if an external force is accidentally applied thereto. It is possible to select a shape of the end of the contact, sharp end or rounded end, as desired. If the sharp end which can strip the covering insulation of the cable is selected, it is not necessary to apply pre-treatment of exposing the conductor at the end portion of the cable. The inserting operation for the connection can be easily effected without using a special tool.

CLAIMS:

1. A connector for an insulated flexible flat cable (5) having flat conductors (6) covered by insulation, said connector including a housing (1) having a terminal receiving cavity (2) formed therein, a plurality of terminals (3) mounted in said  
5 cavity (2) and arranged in parallel relation with pitches corresponding to pitches of flat conductors (6) and an inserting and holding member (4) for inserting and holding the flexible flat cable (5) into the terminals to connect the respective flat conductors (6) to the respective terminals (3), characterized  
10 by:

said terminal (3) comprising fork-shaped upper and lower terminal pieces (12, 13), each having a projecting contact (15) projecting inwardly from an inside of a free end thereof and adapted to contact the conductors (6),

15 said inserting and holding member (4) including a wedging portion (31) having an upper surface (35), a front surface (36) and a lower surface (37) to be inserted into a receiving space (30) formed between the fork-like terminal pieces (12, 13) of said terminal (3) and a locking projection (34) to be engaged  
20 with a locking groove (33) formed in said housing,

whereby the flexible flat cable (5) positioned in flat state at an opening (38) formed at the front side of said housing





is pressed and inserted by the wedging portion (31) of the inserting and holding member (4) into the receiving space (30) between the fork-shaped terminal pieces (12, 13) causing said flexible flat cable (5) to be bent into a U-shape along the upper, front and lower surfaces (35, 36, 37) of said wedging portion under the cooperating action of said wedging portion (31) with the contacts (15) of the respective terminal pieces positioned in confronting relation to the upper and lower surfaces of said wedging portion, and when the locking projection (34) of the inserting and holding member (4) has completely come into locking engagement with said locking groove (33) of the housing, the contacts (15) of the fork-like terminal pieces (12, 13) elastically contact with each flat conductor (6) of the flexible flat cable (5) at upper and lower points thereof under the elastic restoring force of the fork-shaped terminal pieces (12, 13) which are slightly opened outwardly by the wedging portion (31).

2. A connector for a flexible flat cable according to Claim 1, wherein the projecting contact (5) formed at the inside of the free end of each of the fork-shaped terminal pieces (12, 13) has a sharp end (16) which can pierce into a covering insulation 7 of the flexible flat cable and while the flexible flat cable (5) positioned in flat state at the opening (38) formed at the front side of the housing is pressed and inserted by the wedging portion (31) of the inserting and holding member (4) into the receiving space (30) between the fork-shaped terminal pieces

(12, 13), the flexible flat cable (5) is bent into U-shape along the upper, front and lower surfaces (35, 36, 37) under the cooperating action of said wedging portion (31) with the contacts (15) of the respective terminal pieces positioned in confronting relation to the upper and lower surfaces of said wedging portion (31), and at the same time said sharp ends (16) serve to strip the covering insulation (7) of the flexible flat cable positioned on the respective flat conductors, and when the locking projection (34) of the inserting and holding member (4) has completely come into locking engagement with said locking groove (33) of the housing, the contacts (15) elastically contact and electrically connect with each of the exposed flat cables (6) of the flexible flat cable (5) at upper and lower points thereof under the elastic restoring force of the fork-shaped terminal pieces (12, 13) which are slightly opened outwardly by the wedging portion (31).

3. A connector for a flexible flat cable according to Claim 1, wherein the projecting contact (5) formed at the inside of the free end of each of the fork-shaped terminal pieces (12, 13) has an end 16 which is formed in such shape that it can easily slide on a previously exposed terminal conductor (6) of the flexible flat cable, and while the flexible flat cable (5) positioned in flat state at the opening (38) formed at the front side of the housing is pressed and inserted by the wedging portion (31) of the inserting and holding member (4) into the receiving space (30) between the fork-shaped terminal pieces (12, 13), the

previously exposed conductors (6) of the flexible flat cable are bent into U-shape along the upper, front and lower surfaces (35, 36, 37) under the cooperating action of said wedging portion (31) with the contacts (15) of the respective terminal pieces

5 positioned in confronting relation to the upper and lower surfaces of said wedging portion (31), and when the locking projection (34) of the inserting and holding member (4) has completely come into locking engagement with said locking groove (33) of the housing, the contacts (15) elastically contact with each of the previously

10 exposed flat cables (6) of the flexible flat cable (5) at upper and lower points thereof under the elastic restoring force of the fork-like terminal pieces (12, 13) which are slightly opened outwardly by the wedging portion (31).




Fig 1

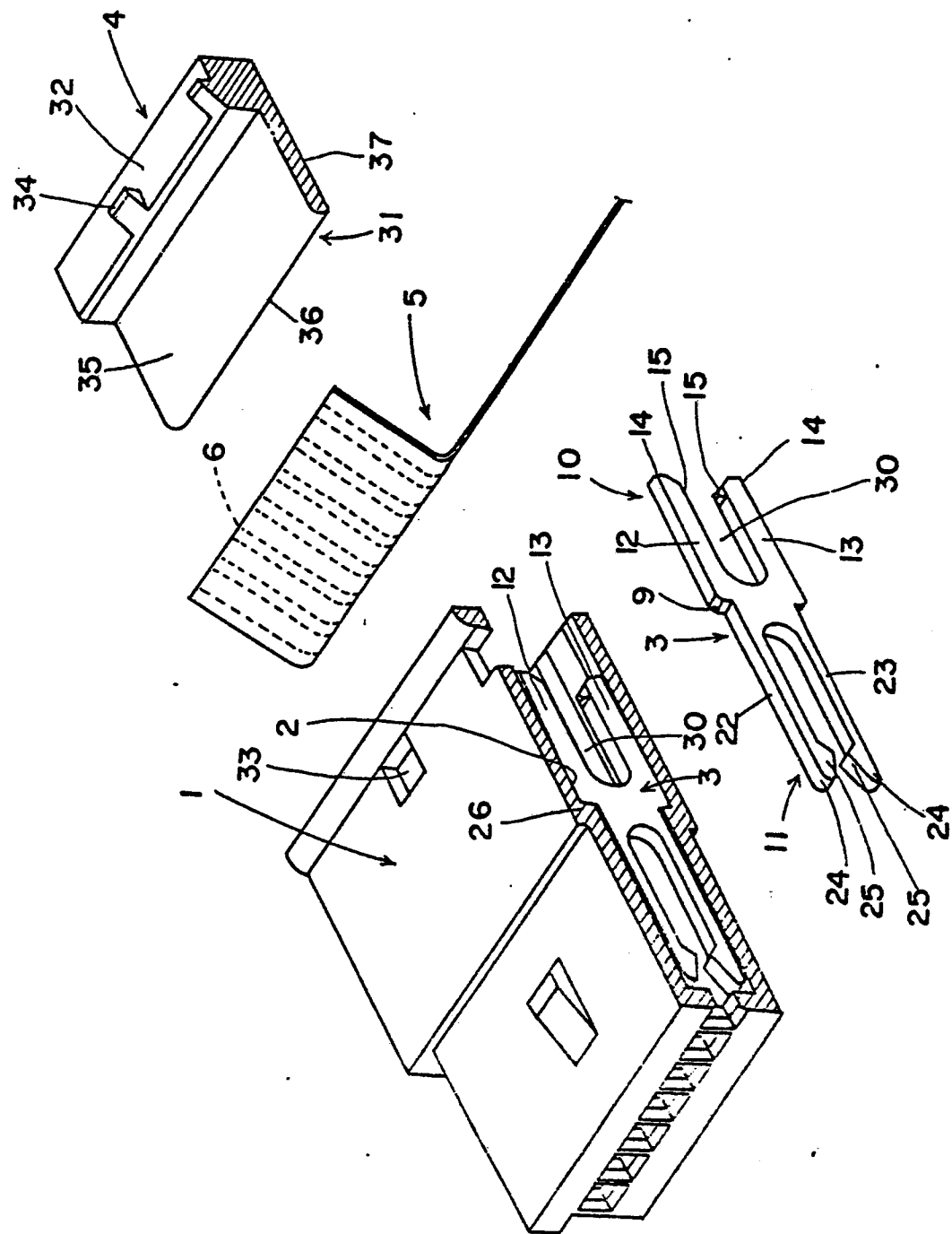


Fig 2

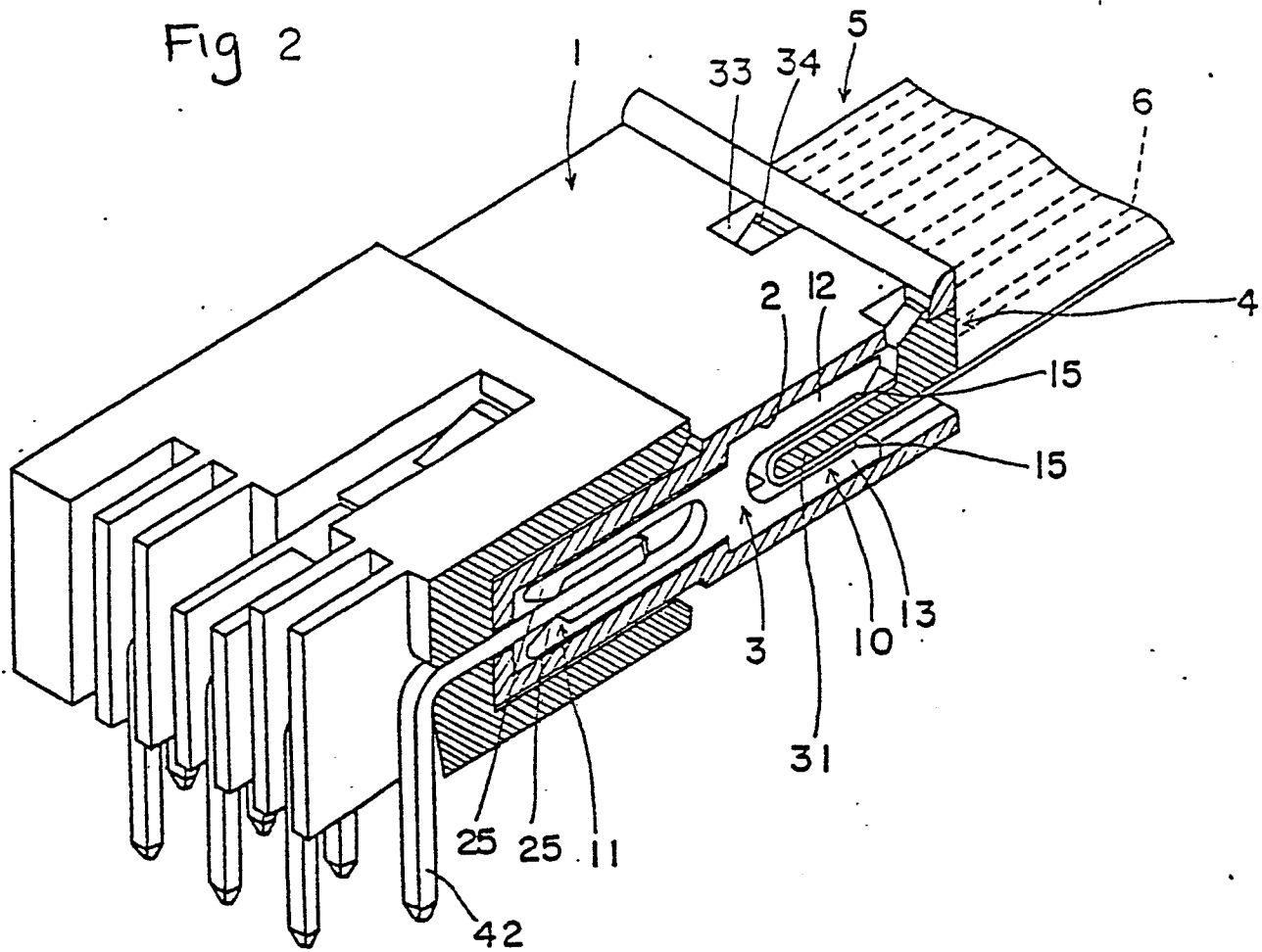


Fig 3

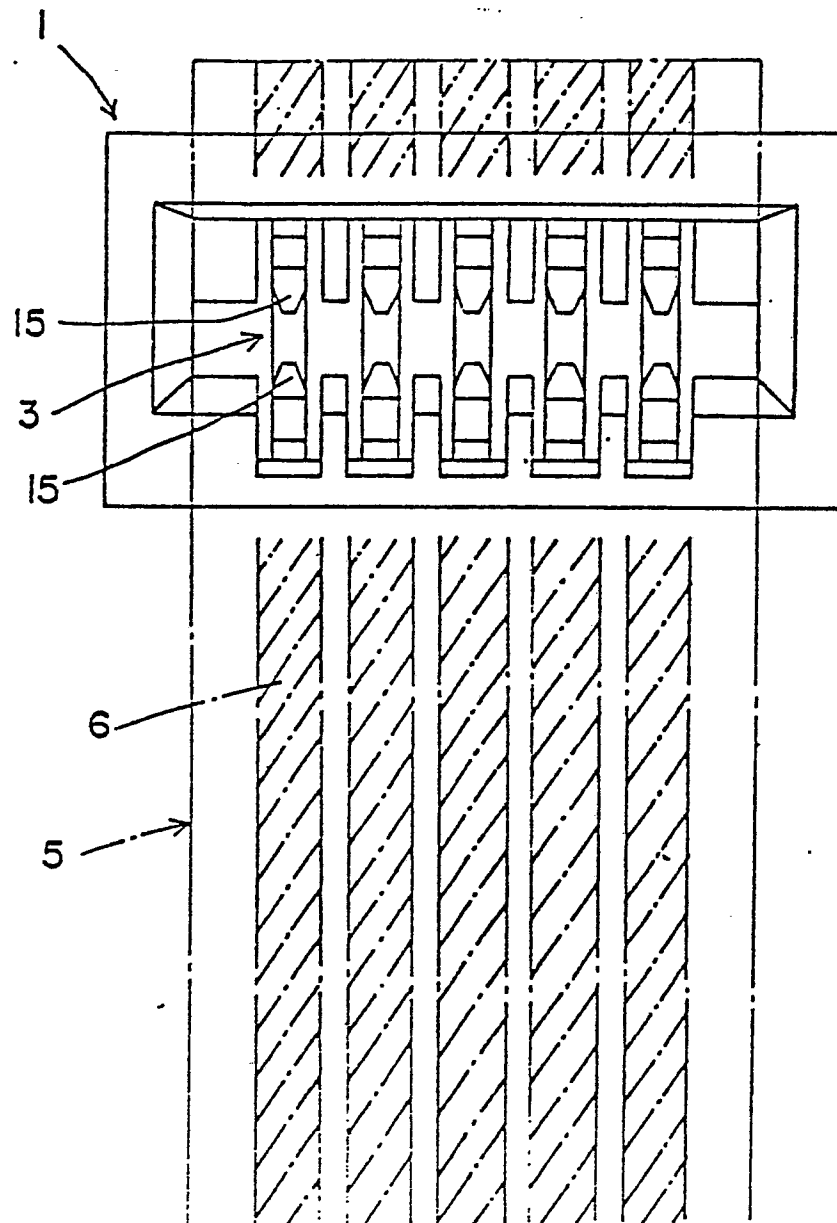


Fig 4

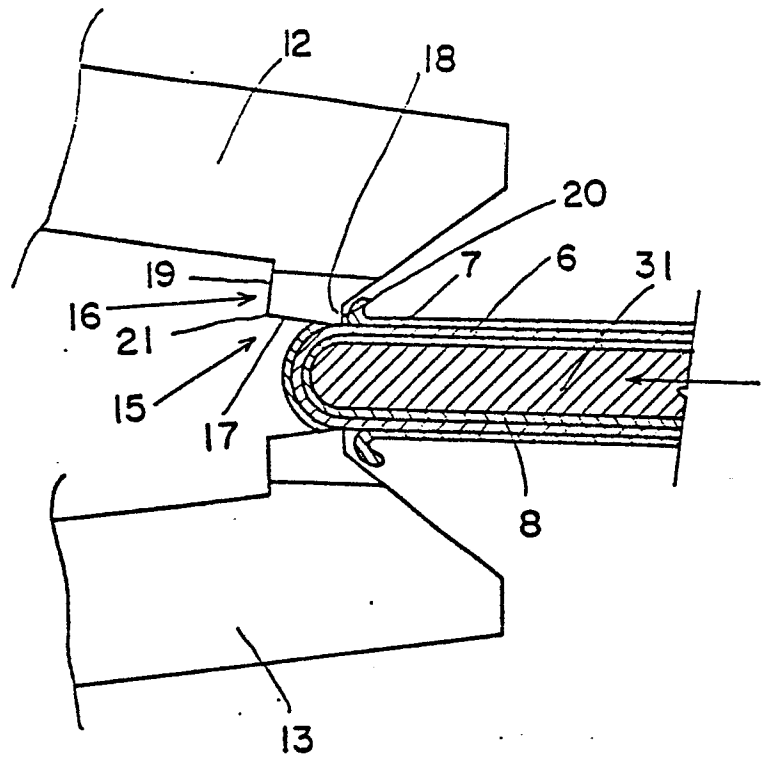
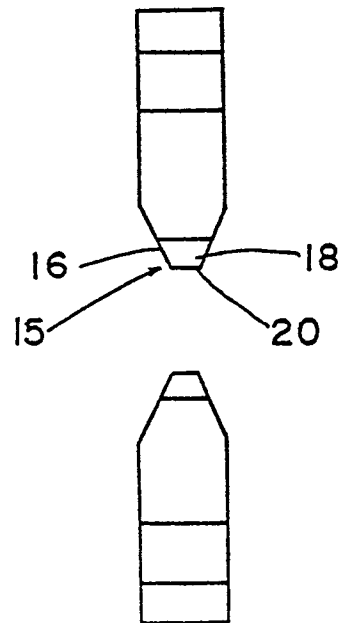


Fig 5



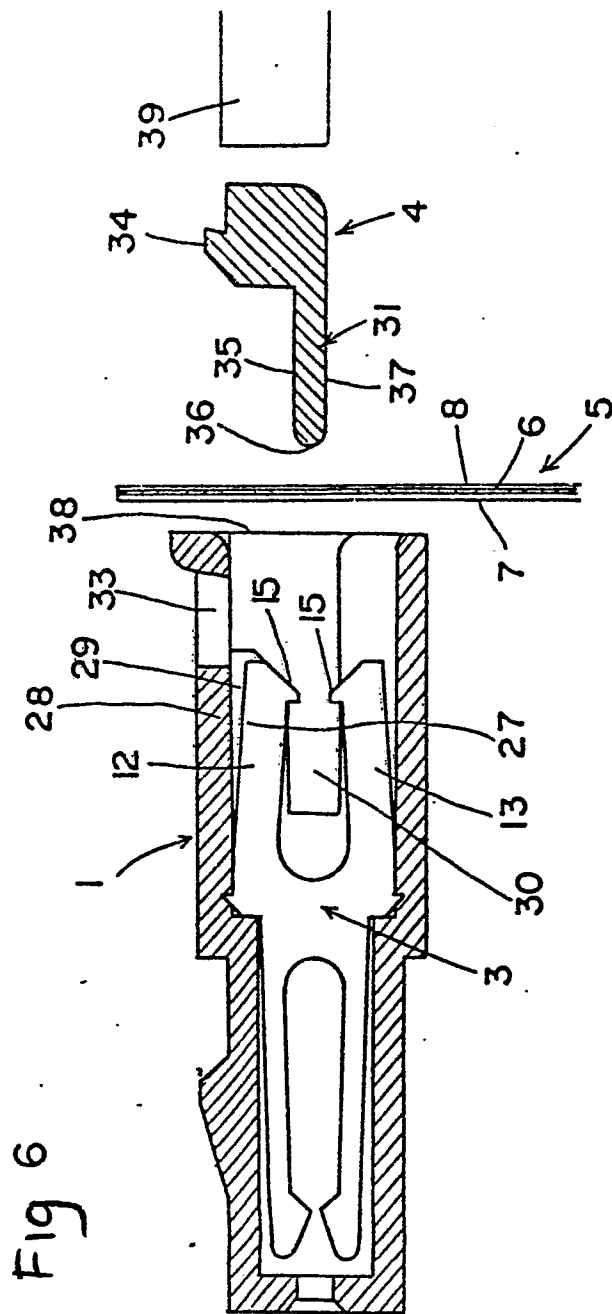




Fig 7

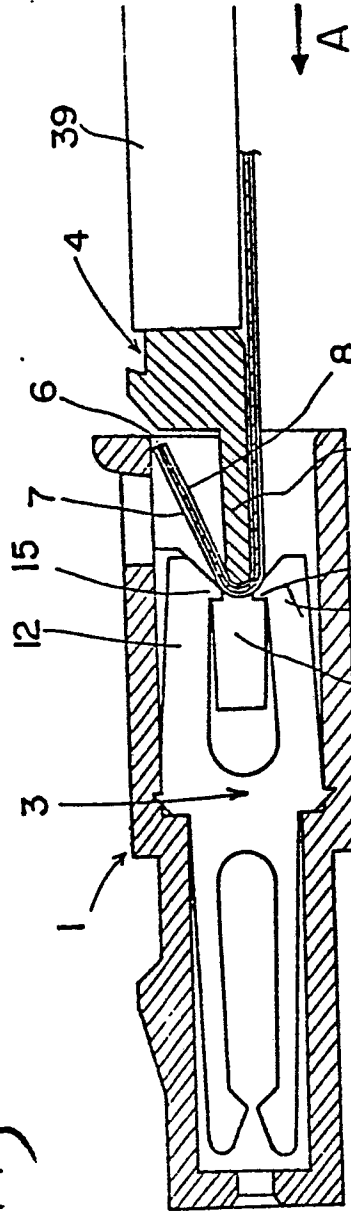


Fig 8

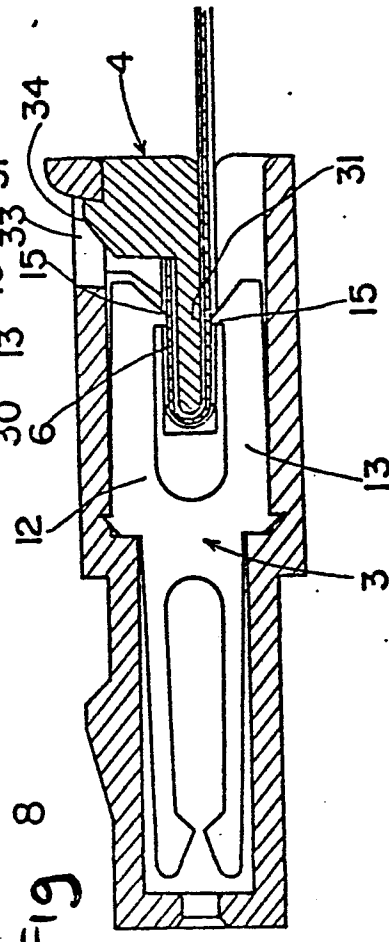
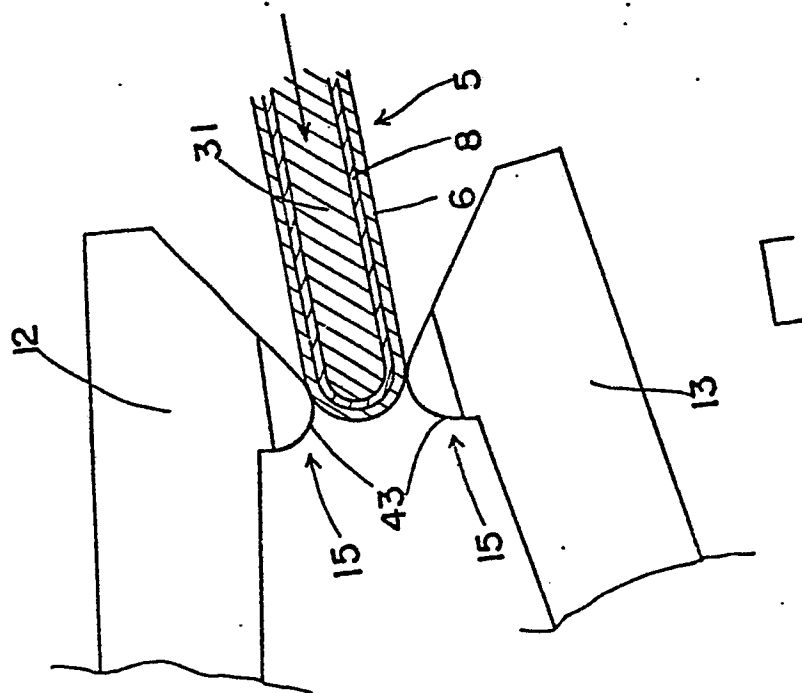


Fig. 9



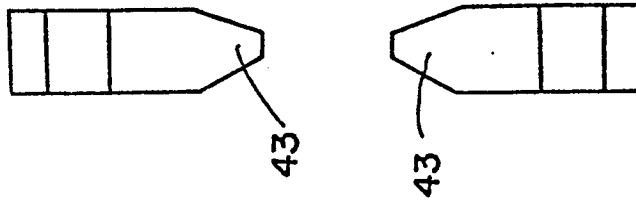


Fig 10

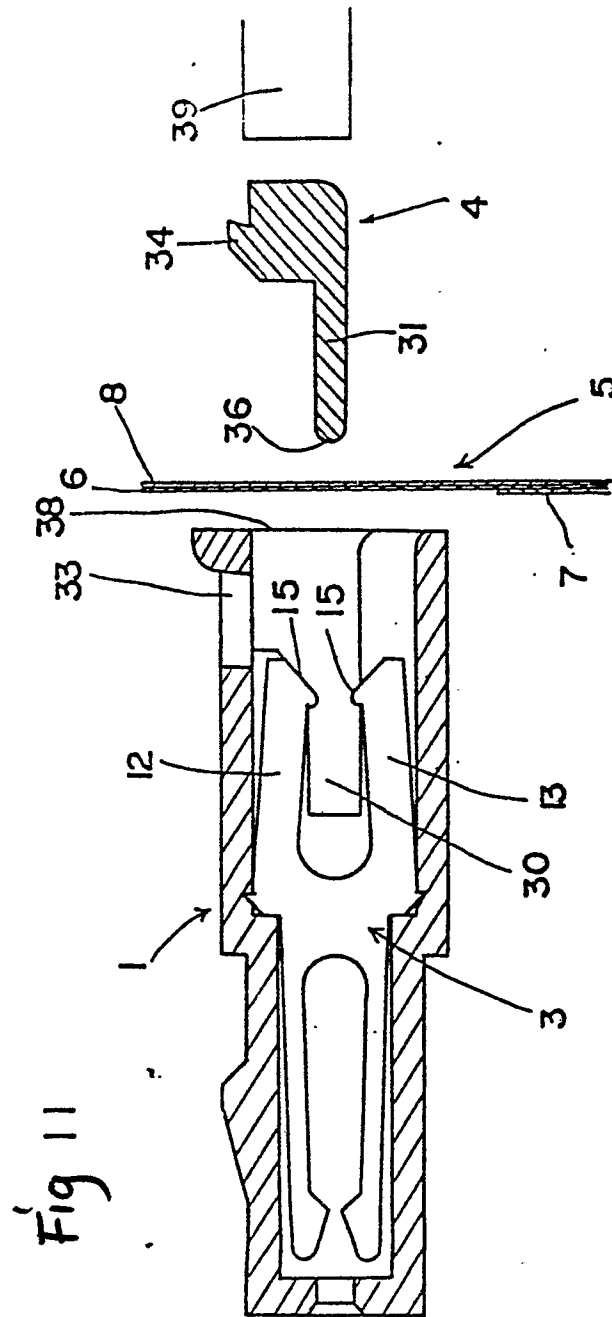


Fig 12

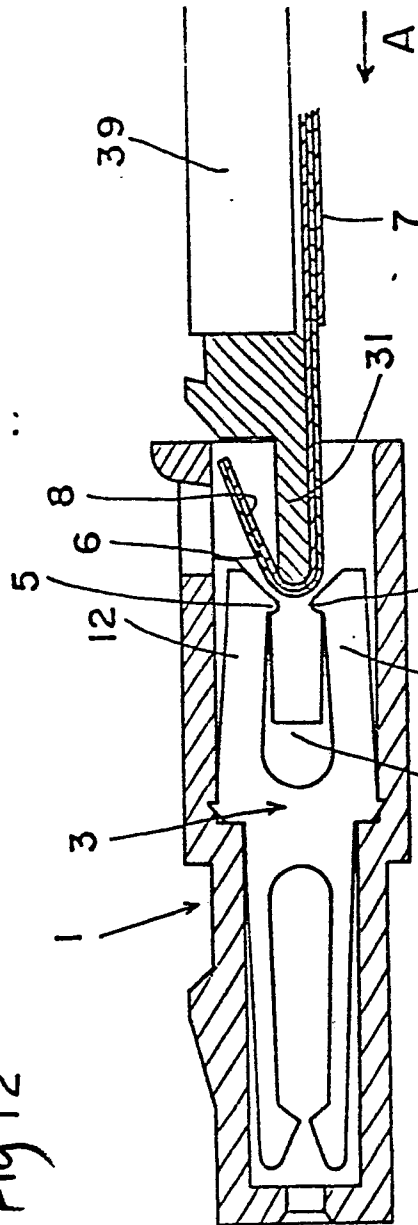
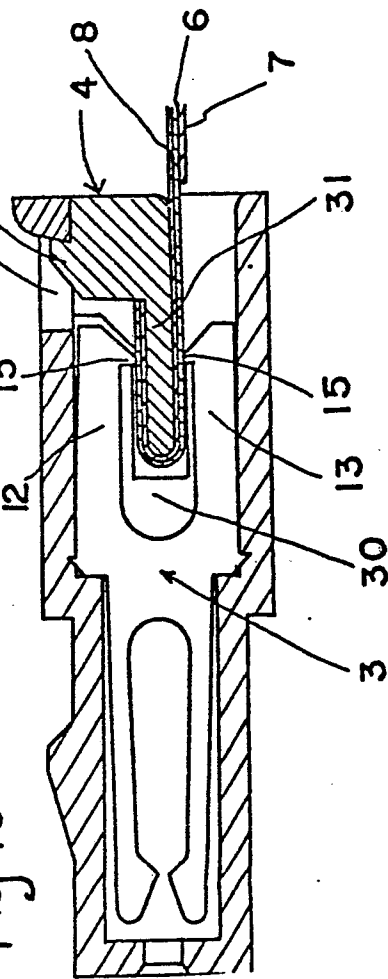
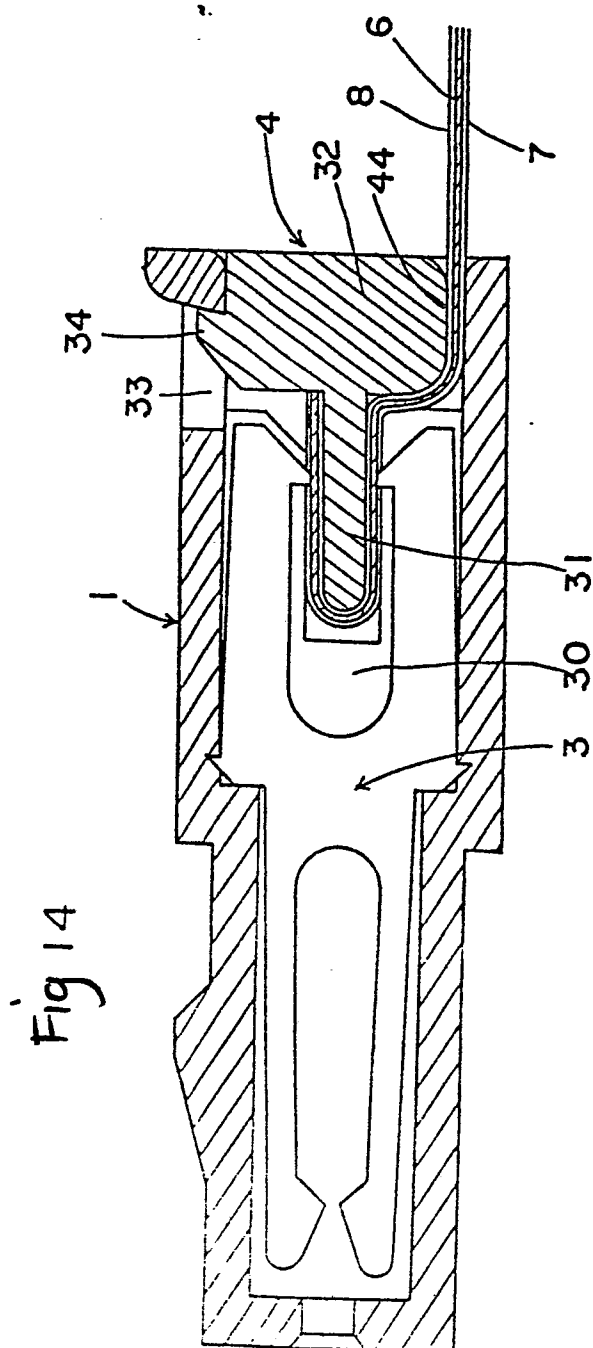


Fig 13





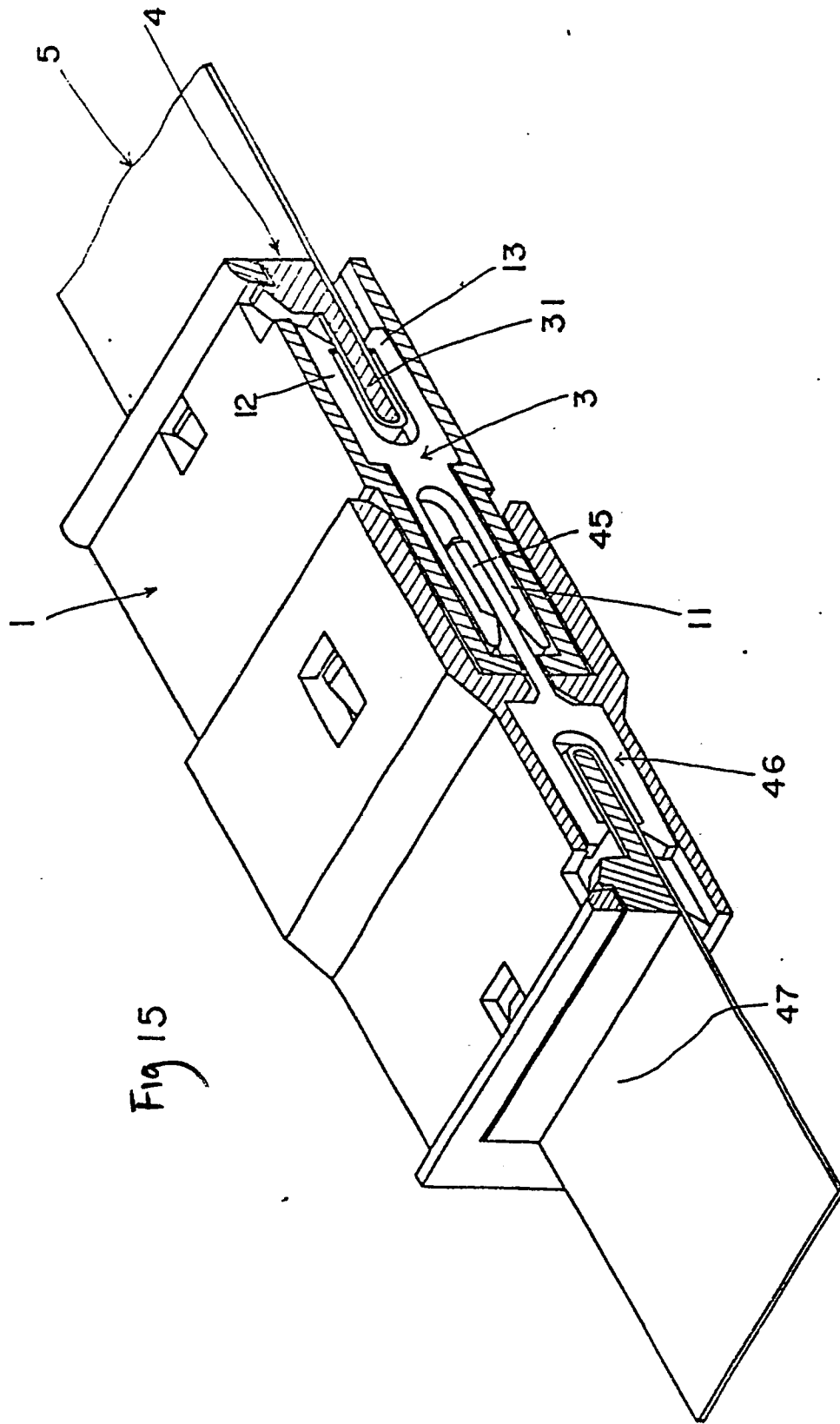
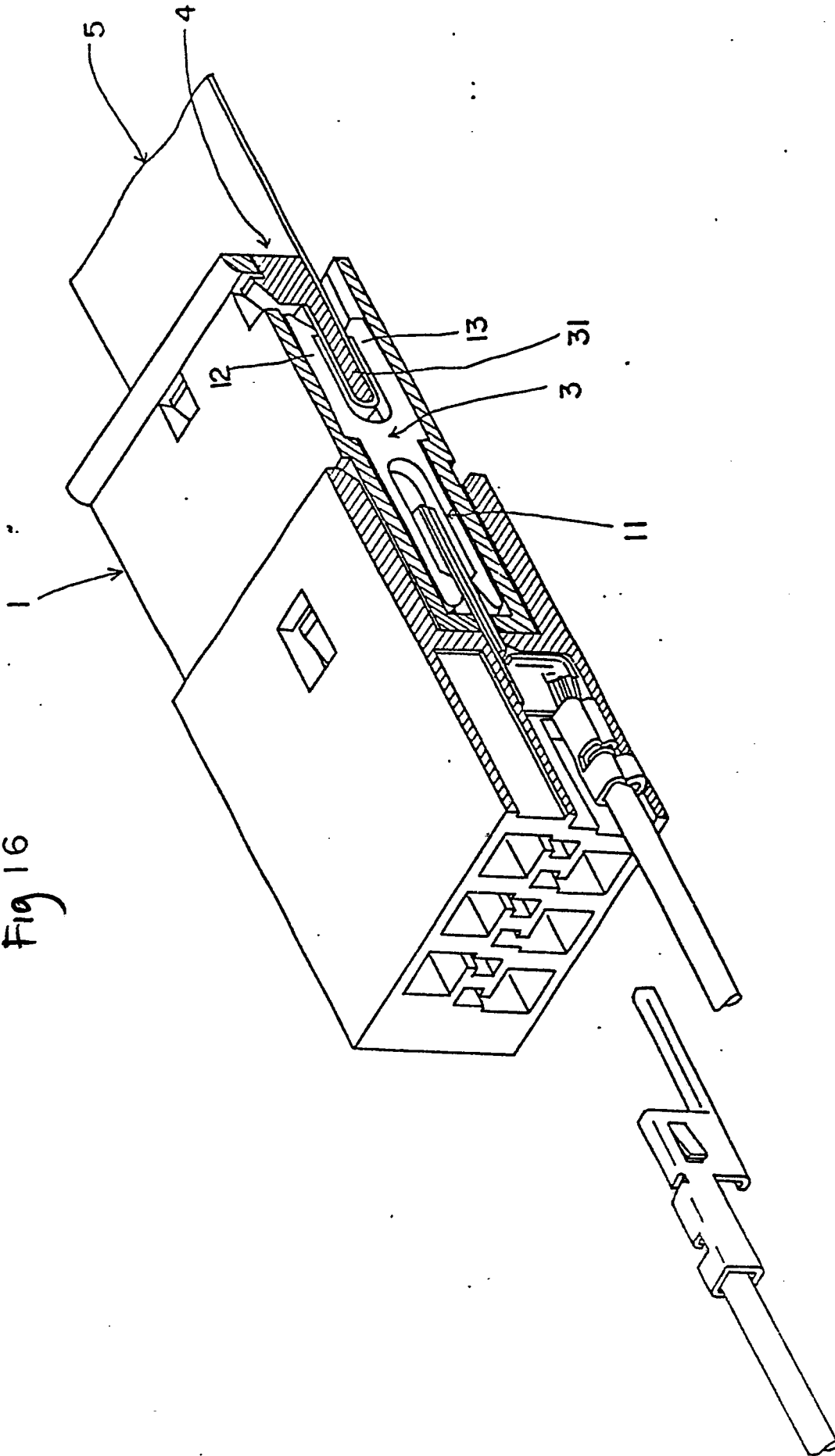


Fig 16







European Patent  
Office

# EUROPEAN SEARCH REPORT

0239422

Application number

EP 87 30 2704

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)
X	CH-A- 512 833 (W. KELLER) * column 2, line 23 - column 3, line 35; figures 1,2,5,6 *	1,3	H 01 R 9/07
A	--- US-A-3 414 867 (L.R. TRAVIS) * column 4, lines 17-41; figure 6 *	1,2	
A	--- DE-B-1 161 609 (BURNDY CORP.) * column 4, lines 21-40; column 7, lines 6-14; figures 17-18 *	1,2	
A	--- US-A-3 696 319 (B.E. OLSSON) * figure 2 *	1,3	
A	--- DE-A-1 640 464 (INTERNATIONAL STANDARD ELECTRIC CORP.) * figures 5-6 *	1,2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			H 01 R 9/00 H 01 R 23/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 25-06-1987	Examiner LEOUFFRE M.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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 &amp; : member of the same patent family, corresponding document</p>			