(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 101 290**
**A2**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: 83304591.7

(51) Int. Cl.³: H 01 R 4/24

(22) Date of filing: 09.08.83

(30) Priority: 09.08.82 GB 8222892

(43) Date of publication of application:
22.02.84 Bulletin 84/8

(84) Designated Contracting States:
DE FR IT

(71) Applicant: MOLEX INCORPORATED
2222 Wellington Court
Lisle Illinois 60532(US)

(72) Inventor: Dechelette, Helen
219 Earl's Court Road
London, S.W.5(GB)

(74) Representative: Slight, Geoffrey Charles et al,
Graham Watt & Co. Riverhead
Sevenoaks Kent TN13 2BN(GB)

## (54) Multigauge insulation displacement connector and contacts therefor.

(57) The connector comprises an insulated housing (50) (see Figure 5) and contact members (15) housed in recesses (52) therein. Each contact member (15) is formed by U-bending a slotted blank (10) (see Figure 1) and has aligned insulation displacement slots (13) (see Figure 1) and a spade terminal receiving slot (14) in its bend. The insulation displacement slots (13) are relatively wide mouthed (as at 17) and taper to a narrow section (23). Tooth-like projections (21) are provided on opposite sides of the entrance to the narrow sections (23) of the slots (13) for piercing the insulation (35*a* or 35*b*) (see Figures 3 and 4) of a conductor introduced into these slots. The contact members have protrusions (25) adjacent the narrowed sections (23) of the slots (13) to slightly widen and strengthen the slots (13) and to act to separate the insulation (35*a* or 35*b*).

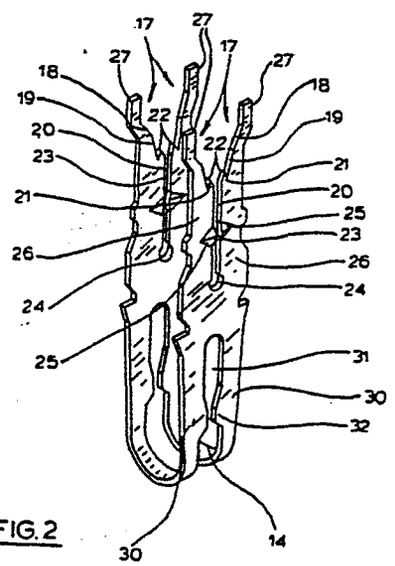


FIG. 2

EP 0 101 290 A2

# MULTIGAUGE INSULATION DISPLACEMENT CONNECTOR AND CONTACTS THEREFOR

This invention concerns a multigauge insulation displacement connector and contacts therefor, and particularly concerns such a connector and contacts adapted for use with multistranded conductors.

Insulation displacement connectors do not require the stripping of insulation from a section of an insulated conductor preparatory to insertion of the conductor into the connector. Rather, they rely upon displacement of the insulation of the conductor by the sides of a slot in a contact or terminal member into which the conductor is introduced.

Many different forms of insulation displacement connectors have been successfully marketed in recent years. A need still exists for such a connector which not only is usable with multistranded conductors, but also is usable with a range of conductor sizes or gauges. The difficulties which arise in the application of insulation displacement technology to connectors for use with multistranded conductors are known and are discussed in U.S. Patent No. 4,317,608. Generally, these difficulties result from undesirable rearrangement of the conductor strands upon their insertion into the connector contact member. As a consequence of such rearrangement, a reliable electrical connection

between the conductor and contact member cannot be assured, particularly if the connector is to be used with varying conductor sizes.

It is, therefore, a principal object of the present invention to provide an improved contact member for an electrical connector having the capability of establishing a reliable electrical connection with a stranded wire.

A further object is to provide a contact member which is equally suitable for use with both small and large gauge wires.

The present invention provides a contact member for an electrical connector having an insulation displacement slot therein defining opposed edge surfaces for providing electrical connection to an insulated conductor, the slot having a mouth leading to a relatively narrow section, there being at least one tooth projecting into the slot for piercing the insulation of a conductor introduced therein.

The contact member may be formed with a protrusion projecting outwardly from a major surface of the contact member adjacent the narrow section of the slot thereby increasing the width of the narrow section of the slot in the region of the protrusion. The protrusion then serves to separate the insulation displaced by the slot.

The slot may define a pair of limb portions and the limb portions may be deformable away from each other upon introduction of a conductor therebetween. Accordingly, stresses are not transferred to a housing for the contact member in concentration.

The contact member may be reversely bent to define a bight portion and the bight portion may be formed with a slot therein for receiving and making an electrical connection with a terminal member introduced therewithin.

An insulation displacement connector according to the present invention comprises an electrically insulating connector housing having one or more recesses therein for receiving a contact or terminal member constructed according to the teachings of the present invention. The said recesses will be open at least at one end corresponding to the mouth end of the contact member, and preferably will be formed for directing and guiding a conductor wire inserted therein into the mouth of the associated contact member and will include strain relief formations such as resilient displaceable strain relief fingers which are displaced by a conductor wire inserted into the connector and then resile to hinder or prevent withdrawal of the conductor. The recess of the connector housing can advantageously be open at both ends, for example in the case of

a connector employing reversely bent contact members as above described wherein the bight portion is slotted to provide access for a spade terminal to engage in the slot of the contact member.

In order that the invention might be clearly understood, a number of embodiments thereof will hereinafter be described by way of example only with reference to the accompanying drawings wherein :-

FIG. 1 shows a portion of a sheet metal stamping used for manufacturing contact members according to one embodiment of the invention;

FIG. 2 shows in enlarged perspective view a contact member formed from the sheet metal stamping of Fig. 1;

FIG. 3 shows stages in the insertion of a small gauge multistranded conductor into the contact member of Fig. 2;

FIG. 4 shows corresponding stages in the insertion of a relatively large gauge multistranded conductor into the same contact member of Fig. 2;

FIG. 5 shows, in perspective view, a four circuit connector in accordance with the invention which employs a contact member according to the preceding figures, and

FIG. 6 shows a sectional view on taken generally along the line 5-5 of Fig. 5.

With reference to the accompanying drawings and first to Fig. 1, there is shown a blank, designated generally by the reference numeral 10, formed by stamping suitable metal of selected thickness in sheet or strip form. The blank 10 includes a plurality of plate-like elongated contact blanks 11, each connected at one end to a carrier strip 12. Each blank 11 comprises an insulation displacement slot formation 13 at both ends thereof, defining edge surfaces 13' which are of suitable sharpness to sever the insulation of a conductor. Intermediate the said ends is an elongate slot 14 of predetermined shape, which will be described in greater detail hereafter. Each blank 11 is generally symmetrical, both longitudinally and transversely and is designed to be folded end-to-end into a generally U-shape as shown in Fig. 2.

Folding of a blank 11 defines a double-ended insulation displacement contact 15 with the insulation displacement slot-formations 13 in alignment with one another. At the bend or bight of the U-shape, the elongate slot 14 defines a bifurcated contact formation suitable to engage a spade terminal or the like.

Looking at Fig. 2, the contact 15 is seen to include a relatively wide mouth 17 which narrows inwardly in a stepped and tapering fashion through three stages, designated generally by the reference numerals 18, 19 and 20, respectively. A pair of teeth 21 of sharp triangular shape and juxtaposed on opposite sides of the slot 13 project from the regions defined between stepped portions 19 and 20 with their apices pointed generally inwardly of the slot 13 towards the open mouth 17. Opposed edges 22 of the teeth 21 taper inwardly towards each other in a direction away from the mouth 17. Stepped portions 20 define a generally parallel section 23 of relatively long length which terminates in an enlarged hole 24. About midway along the length of the parallel section 23, each side of the insulation displacement slot 13 has a slight protrusion 25 projecting from one surface of the blank 11, formed therein as, for example, by coining of the blank 11.

The insulation displacement slot 13 thus defined lies between two limbs 26 which taper so as to be to a degree resiliently flexible. Free ends 27 of the limbs 26 adjacent the open mouth 17 of the slot 13 are sufficiently narrow such that the limbs 26 are bendable along their entire length.

The elongate slot 14 formed in the blank 11 results in bifurcation of the bight of the contact member 15 to define two opposed limbs 30 which form therebetween a female contact receptacle 31 adapted for receiving a male contact member (shown

in Fig. 6). The slot 14 is further adapted with lugs 32 projecting into the female contact receptacle 31.

Figure 3 shows various steps in the insertion of a relatively small gauge, multistranded, insulated conductor 33a into the insulation displacement slot 13 of three contact members as just described, designated 15a, 15b and 15c. The contact members 15a, 15b, and 15c are each identical in their construction and accordingly, like reference numberals will be used, hereinafter to describe the operation of their various features.

The conductor 33a comprises multiple strands of conductive wire 34a coated with a layer of insulation 35a. Each contact member 15a, 15b and 15c is schematically shown engaged in an accommodating recess 36 in an illustrative connector housing 37. Contact 15a is shown with the conductor 33a being guided by wall formations 38 in the housing 37 towards the mouth 17 of the insulation displacement slot 13. Contact 15b is shown with the conductor 33a just engaged with the insulation piercing teeth 21 of slot 13 and with the teeth 21 just beginning to penetrate and to pare off a section of the conductor insulation 35a. Contact 15c is shown with the conductor strands 34a lodged well down into the generally parallel section 23 of the insulation displacement slot 13 in the region of the coined protrusions 25, where the protrusions 25 slightly widen and strengthen the slot 13.

A further advantage of the protrusions 25 is that they cooperate to separate the insulation 35a longitudinally of the

wire 33a inasmuch as they protrude from the blank 10 in oppositely directed pairs (Fig. 2). This separation of the insulation 35a allows for greater exposure of the conductor strands 34a to the contact slot 13. A plug of insulation 40c remains above and below the conductor strands 34a in the slot 13 of the contact member 15c and remnants 41c of pared off insulation remain on the teeth 21. The teeth 21 thus serve, when the conductor core gauge is small relative to the insulation thickness, to positively pare away part of the insulation and thereby reduce the insulation displacement task of the parallel section 23 of the slot 13.

The limbs 26 of contact 15c is slightly opened as the conductor core 34a is forced into the slot 13. This brings the free ends 27 of the said limbs 26 into abutting engagement with the housing 37.

Fig. 4 is similar to Fig. 3 but shows the insertion of a considerably larger gauge conductor 33b into contacts 15d, 15e and 15f. For purposes of clarity, contacts 15d, 15e and 15f have been shown with reference numerals corresponding to like elements of the contact 15 illustrated in Fig. 2.

Notable in Fig. 4 as compared to Fig. 3 is the earlier deformation of the conductor cross-section as the conductor 33b is forced into the mouth 17 of the contact 15e, and the increased deformation of the limbs 26 which bow as the larger conductor 33b is inserted. The additional strains involved are at to a great extent accommodated within the contact member 15f itself, rather

than being transferred to the connector housing 37. This has the desirable effect of minimizing the risk of housing distortion.

Referring now to Figs. 5 and 6, there is shown therein a four circuit connector 50 for use with a contact member 15 as above described. The connector 50 comprises a one piece housing 51 of glass filled Nylon, for example, having a plurality of open ended recesses or channels 52 therein for receiving the contacts 15. Access is provided at the top and bottom ends of the housing 51 to the insulation displacement slot 13 and the female receptor 31, respectively, of each contact 15.

As shown most clearly in Fig. 6, the housing 51 and the recess 52 therein have upper and lower portions 53 and 54, respectively, which provide accommodation for the (upper) insulation displacement portion 13 of the contact member 15 and the (lower) female receptor 31, respectively. The upper portion 53 has formed therein opposed pairs of grooves 55 into which the edges of the two insulation displacement portions 13 of the contact member 15 engage when the contact member 15 is received in the housing recess 52. The upper portion 53 also has a pair of ribs 56 of triangular cross-section disposed one on either side of the pairs of grooves 55, the ribs 56 being tapered at their upper ends, as best seen in Fig. 5, to provide guidance to a conductor 33 introduced into the recess 52. Not only do the ribs 56 provide the guidance aforementioned, but also they serve to strengthen the housing and to retain a conductor 33 once it has been engaged with the connector.

As best seen in Fig. 6, the lower part 54 of the housing recess 52 is of simpler form and comprises a major portion 57 which accommodates the female receptor 31 of the contact member 15 and slotted portions 58 extending at right angles off of the major portion 57. The slotted portions 58 serve to guide and retain a tab terminal 59 inserted into contact with the female receptor 31 of the contact member 15. Although not shown, slotted portions 58 may be configured such that tab terminal 59 is offset laterally with respect to the female receptor 31, allowing an aperture 60 of the tab terminal 59 to be engaged by the lugs 32 of the female receptor 31, thereby effecting a locking function.

The housing 51 further comprises entry ports 60 which are provded with a variety of strain relief formations 61 enabling a conductor 33 received in the connector 50 to be bent substantially through 90 degrees so as to extend from the connector 50 generally parallel to the longitudinal axes of the terminals 15, as illustrated in Fig. 6. A pair of opposed, resilient strain relief fingers 62 depend from the housing walls within the entry port 60 and are such as to be resiliently deformable out of the path of a conductor 33 introduced into the connector 50 by contact with the conductor 33. Once the conductor 33 has been fully positioned, the strain relief fingers 62 resume their original disposition and prevent withdrawal of the conductor 33. Also provided is a member 63 of generally triangular cross-section which performs a function similar to that of the ribs 56, and opposed members 64 which serve

as conductor guiding and retaining means particularly when, as aforementioned, the conductor is bent through 90 degrees to exit from the connector 50.

The connector 50 described is particularly, though not exclusively, useful in consumer and automotive applications where it lends itself to automatic assembly of wiring harnesses and can reliably mate with standard terminal tabs. As an example of the gauge range which might be accommodated, a connector according to the invention might be designed for use with multistranded conductors ranging from 0.5 mm (16 strands each of 0.2 mm diameter) to 1.5 mm (30 strands each of 0.25 mm diameter) core area with insulation thicknesses of the order of 0.6 mm to 0.7 mm providing an overall conductor diameter range of 2.2 mm to 3.2 mm. Although the illustrative embodiment is of a four circuit connector, any number of circuits may be terminated in accordance with the principles of the invention, within the ordinary skill in the art.

CLAIMS:

1. A contact member for an electrical connector having an insulation displacement slot (13) therein defining opposed edge surfaces (13') for providing electrical connection to an insulated conductor (33a or 33b), the slot having a mouth (17) leading to a relatively narrow section (23) characterised by at least one tooth (21) projecting into the slot (13) for piercing the insulation (35a or 35b) of a conductor (33a or 33b) introduced therein.

2. The contact member of claim 1 wherein the tooth (21) is positioned intermediately between the mouth (17) and the narrow section (23) of the slot (13).

3. The contact member of claim 1 or 2 having two teeth (21) projecting into the slot and wherein the teeth are positioned in juxtaposed relationship on opposite sides of the slot.

4. The contact member of claim 1, 2 or 3 wherein the contact member adjacent the narrow section of the slot is formed with a protrusion (25) projecting outwardly from a major surface of the contact member thereby increasing the width of the narrow section (23) of the slot in the region of the protrusion.

5. The contact member of claim 4 having a

second protrusion (25) and wherein the protrusions are positioned in juxtaposed relationship on opposite sides of the slot.

6. The contact member of any preceding claim wherein the slot defines a pair of limb portions (26) and the limb portions are deformable away from each other upon introduction of a conductor therebetween.

7. The contact member of claim 6 wherein the limb portions are each formed with a free end (27) and taper to a relatively narrow width at their free ends (27) thereby enabling the limb portions to deform along substantially their entire length upon introduction of a conductor therebetween.

8. The contact member as claimed in any preceding claim in which the contact member has spaced apart first and second ones of said insulation displacement slots (13) such that contact is made with a conductor inserted into the contact member at two slightly spaced apart points therealong.

9. The contact member as claimed in claim 8 of generally U-shape.

10. The contact member as claimed in claim 9 formed by bending a metal blank (10) having said first and second insulation displacement slots (13) at opposite ends thereof such that the two ends with their respective slots adjoin one another in the

final U-shape.

11. The contact member as claimed in claim 9 or 10 in which an elongate slot (14) is provided generally in line with the two slotted ends of the contact member in the region of the bight or U-bend of the contact member such that the bight or U-bend of the contact member is effectively divided or bifurcated to receive a spade or other compatible terminal member (59).

12. An insulation displacement connector comprising an electrically insulating connector housing (50) having one or more recesses (52) therein and each receiving a contact member as claimed in any preceding claim, each such recess being open at its end corresponding to the mouth end of the contact member.

13. An insulation displacement connector as claimed in claim 12 in which the open end of the or each recess corresponding to the mouth end of the connector member is formed for directing and guiding a conductor inserted therein into the mouth of the associated contact member.

14. An insulation displacement connector as claimed in claim 13 in which the or each recess includes strain relief formations (62) which are displaced by a conductor (33) inserted into the

connector and then resile to hinder or prevent withdrawal of the conductor.

15. An insulation displacement connector as claimed in claim 13 or 14 in which the or each recess receives a contact member as claimed in claim 8, 9, 10 or 11 and the open end of the or each recess is formed with opposed pairs of grooves (55) into which the edges of the two insulation displacement parts of the contact member engage and a pair of ribs (56) of triangular cross-section disposed one on either side of the pairs of grooves the ribs being tapered at their upper ends to provide guidance for a conductor introduced into the recess.

16. An insulation displacement connector as claimed in claim 13, 14 or 15 in which the or each recess is open at both ends and receives a contact member as claimed in claim 11 the open end of the recess at its end opposite its open end corresponding to the mouth end of the contact member providing access for a spade or other compatible terminal member (59) to engage the bifurcated part of the contact member.

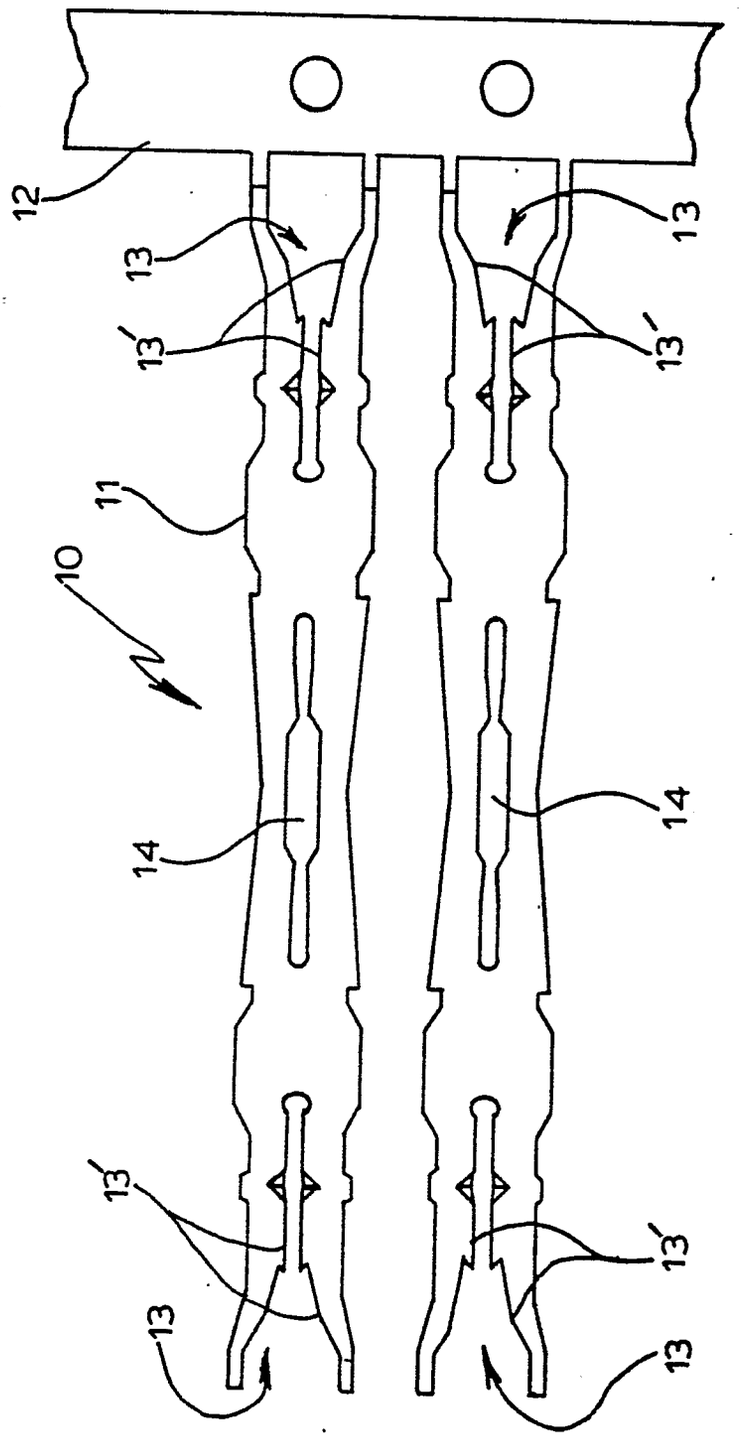


FIG.1

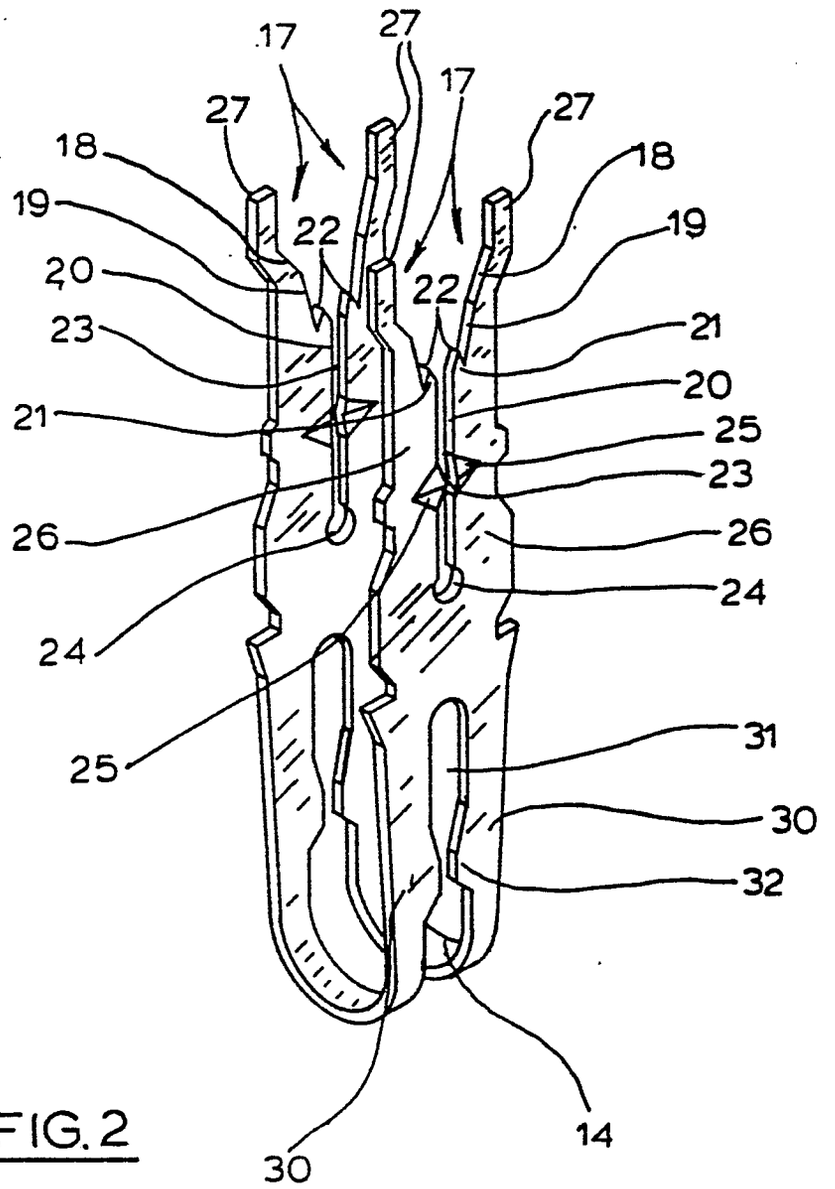
17
27
17
27
27
18
18
19
19
22
22
20
23
21
21
20
25
23
26
26
24
24
25
31
30
32
30
14

FIG. 2

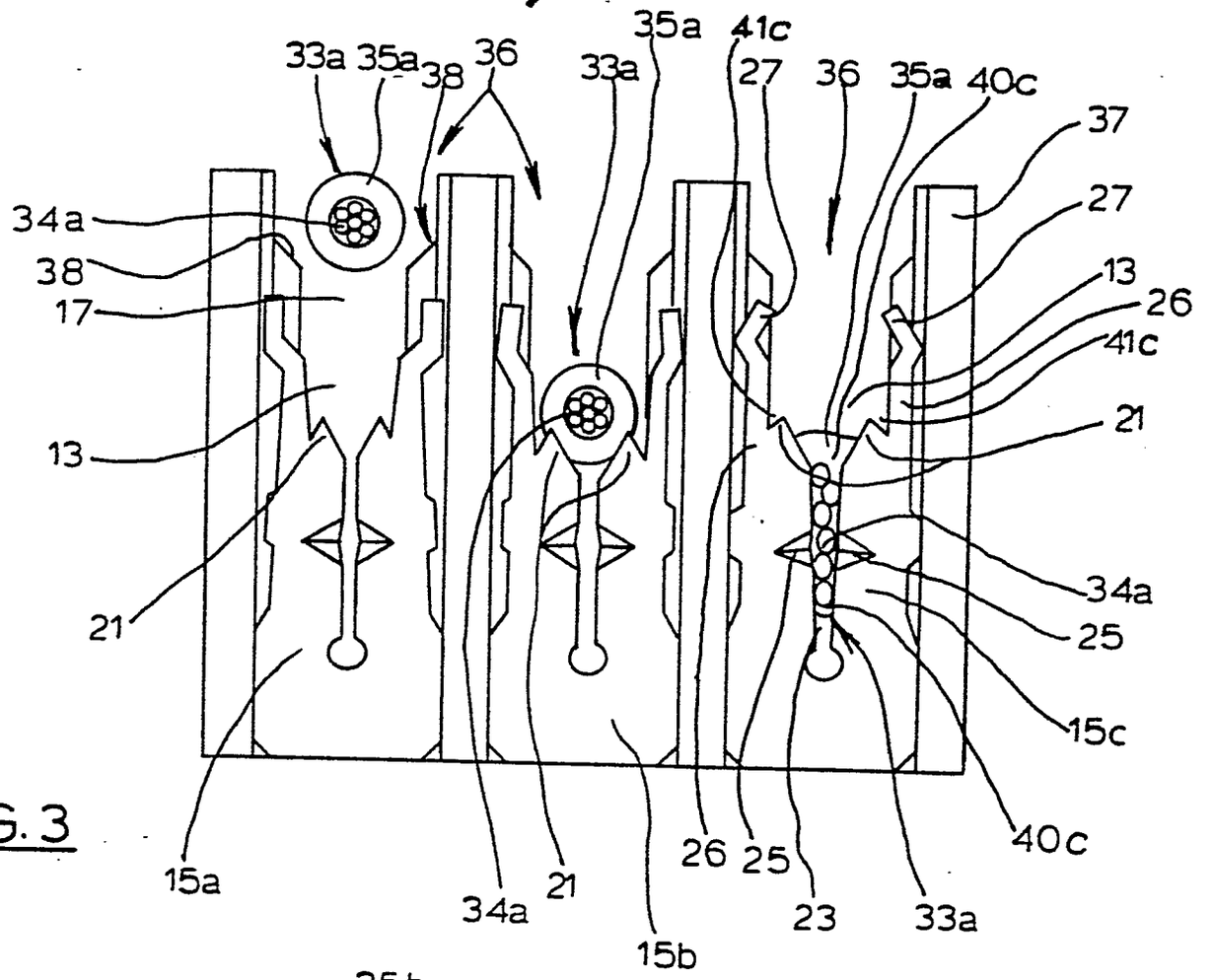
33a
35a
38
36
33a
35a
41c
27
36
35a
40c
37
34a
38
17
27
13
26
41c
13
21
21
34a
25
15c
40c
15a
34a
21
26
25
23
33a
15b

FIG. 3

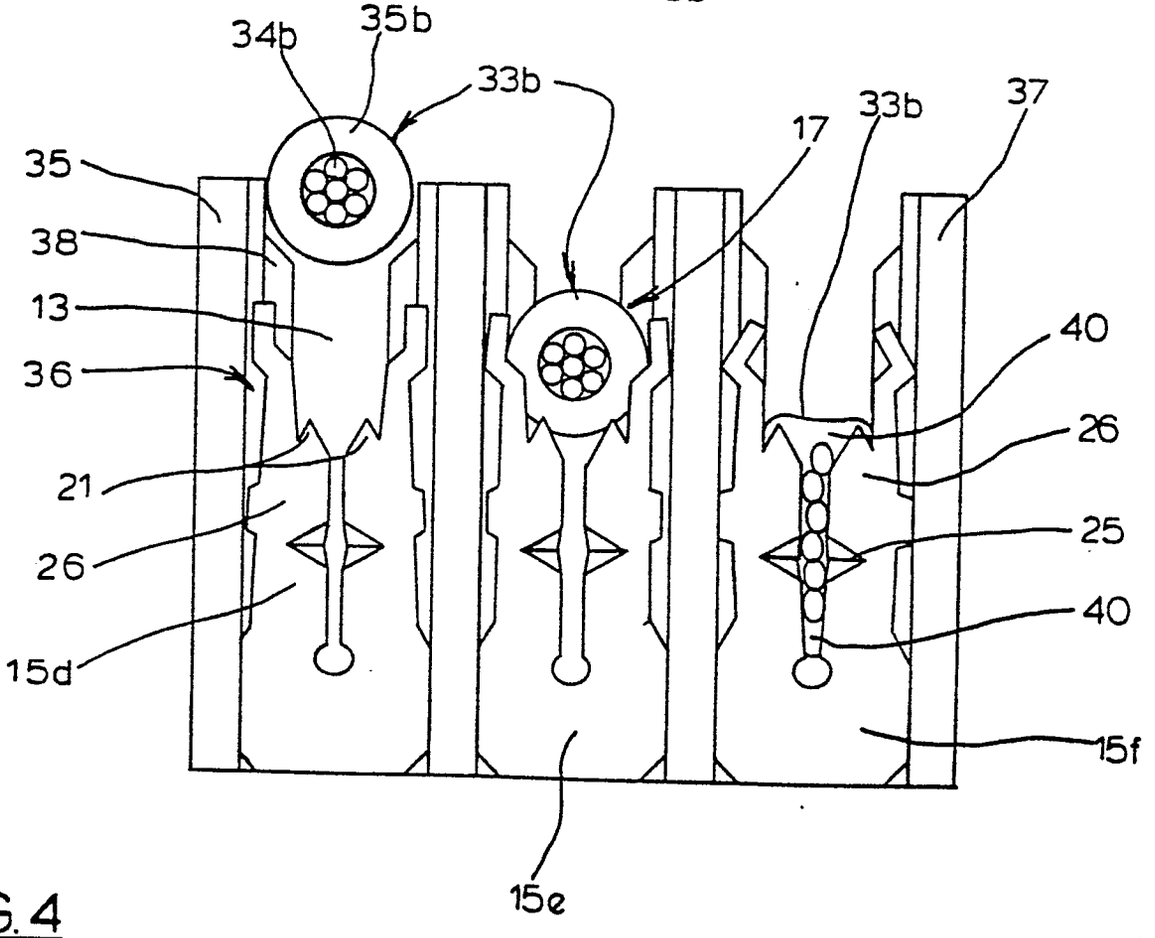
34b
35b
33b
33b
37
17
35
38
13
36
40
26
21
25
26
40
15d
15f
15e

FIG. 4

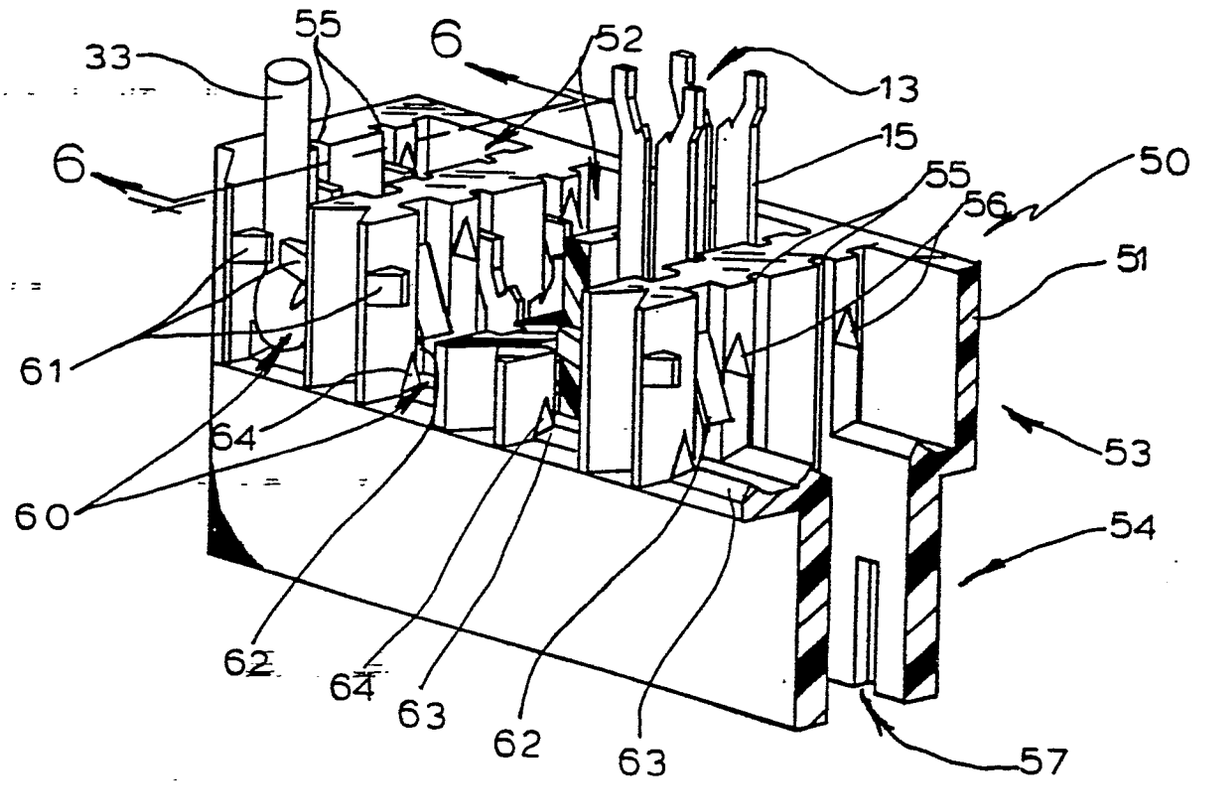


FIG 5

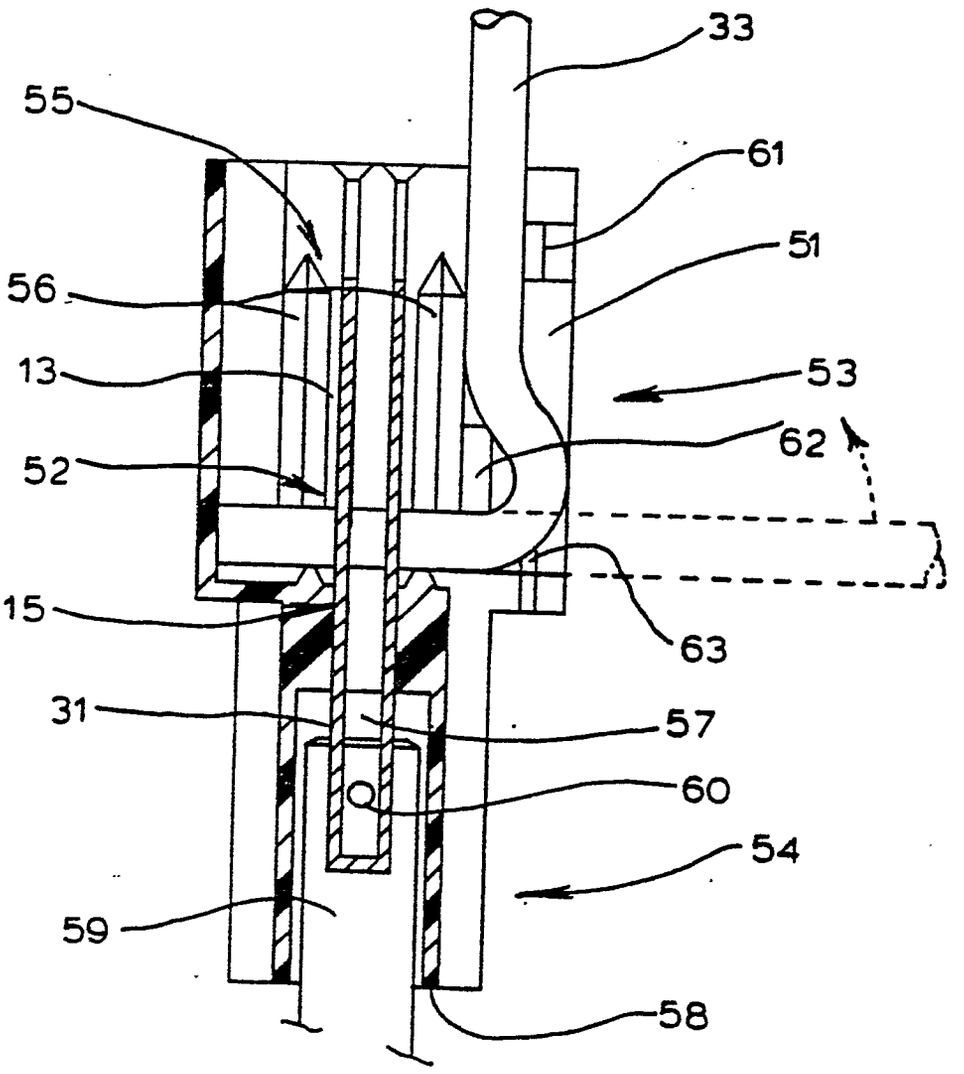


FIG.6