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(11) Publication number:

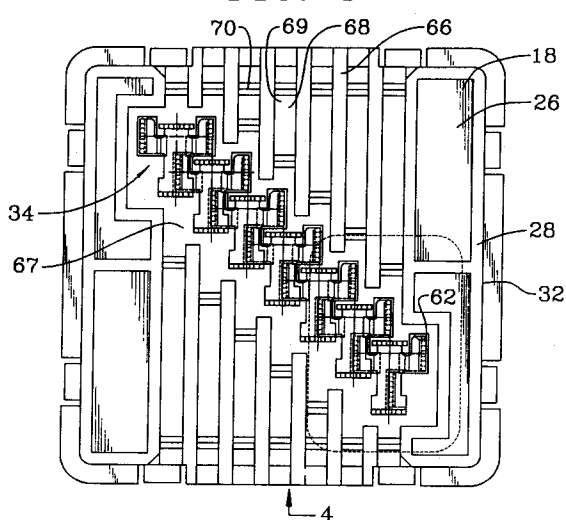
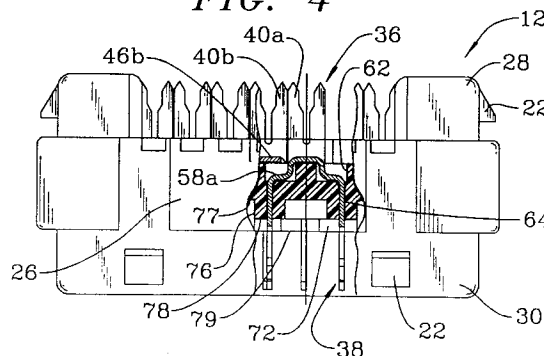
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EUROPEAN PATENT APPLICATION(21) Application number: **95102344.9**(51) Int. Cl.⁶: **H01R 4/24**(22) Date of filing: **20.02.95**(30) Priority: **21.02.94 GB 9403262**(43) Date of publication of application:
23.08.95 Bulletin 95/34(84) Designated Contracting States:
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D-80797 München (DE)(54) **IDC branch connector for flat flexible cable.**

(57) A branch connector (2) for interconnection of orthogonally disposed flat flexible cables (4, 6) comprises a plurality of IDC terminals (34) having pairs of IDC slots (42, 52) for good electrical connection. The terminals (34) are mounted on an intermediate housing (12) such that they overlap in order to provide for a compact design. Contact between adja-

cent terminals is avoided by stepping a base portion (58) of a second IDC section (38) down from a base portion (46) of a first IDC section (36). Advantageously therefore, cables with small pitches can be interconnected whilst providing a pair of IDC slots per connection to each cable for good conductivity therebetween.

FIG. 3**FIG. 4****EP 0 668 629 A2**

This invention relates to an electrical insulation displacement contact (IDC) branch connector for connecting wires of a first cable to orthogonally disposed wires of a second cable, especially wires of flat flexible electrical cables.

Such a connector is disclosed in US 5,049,088 according to which an electrical connector housing assembly comprises an insulating housing and first and second insulating covers for mating with the housing, the housing having a plurality of through cavities, each for accommodating an electrical terminal with IDC portions thereof projecting from opposite surfaces of the housing, each cover having a corresponding plurality of recesses for receiving the IDC portions, recesses bounded by wire stuffer surfaces for stuffing the wires into the IDC slots.

Another such connector is disclosed in US 5,199,899, similar in concept to US 5,049,088 except that the IDC portions each comprise a pair of IDC slots having the effect of increasing the contact surface between the wire and terminal and thereby the current carrying capability thereof. The disadvantage of the latter concept however, is the increase in spacing requirements i.e. the single IDC contacts shown in US 5,049,088 can be spaced closer together and therefore accept a smaller pitch between conducting wires of the cable, than the double IDC contacts shown in US 5,199,899.

There is a requirement, however, for more compact connectors with higher current carrying capabilities. There is also a requirement, for certain applications, to branch a flat flexible cable off another flat flexible cable in an orthogonal direction in order to adapt optimally to a crowded environment, especially considering those cables extending to other electrical components in substantially orthogonal directions.

It is therefore an object of this invention to provide an electrical branch connector for electrically connecting orthogonally disposed cables having a plurality of juxtaposed conducting wires arranged with a small pitch and whereby the connector is able to carry relatively high currents.

It is a further object of this invention to provide an electrical branch connector for connecting two orthogonally disposed cables, the connector being cost-effective to produce and assemble, whilst remaining compact and reliable.

The objects of this invention have been achieved by providing an electrical branch connector for electrically connecting conducting wires of a first cable to orthogonally disposed conducting wires of a second cable, the branch connector comprising an intermediate housing sandwiched between first and second covers, the connector further comprising a plurality of IDC terminals having a first IDC section protruding from one side of

the intermediate housing facing the first cover, and a second IDC section protruding from an opposite side of the intermediate housing facing the second cover whereby the first IDC section of a terminal overlaps the second IDC section of the preceding adjacent terminal such that the terminals can be compactly arranged together.

The preferred embodiment of this invention will now be described in more detail with reference to the drawing figures, whereby;

Figure 1 is a plan view of a branch connector assembled to orthogonally disposed first and second cables;

Figure 2 is a view of the connector shown in Figure 1 in the direction of arrow 2;

Figure 3 is a plan view of a first side of the intermediate housing with terminals mounted therein;

Figure 4 is a view in the direction of arrow 4 of Figure 3, with a partial cross-section through one of the terminals;

Figure 5 is a view of the intermediate housing from an opposite side to that shown in Figure 3;

Figure 6 is a plan view of the inside surface of one of the covers;

Figures 7 and 8 are partial cross-sectional views through, respectively, line 7-7 and line 8-8 of Figure 6;

Figure 9 is a detailed top view of a terminal;

Figures 10 and 11 are views taken in the direction of arrows 10 and 11 respectively of Figure 9; and

Figure 12 is a detailed view of part of the intermediate housing shown in Figure 3.

Referring to Figures 1 and 2, a branch connector generally shown at 2 is connected to a first cable 4 and a second cable 6 disposed orthogonally thereto, both cables 4, 6 comprising a plurality of juxtaposed conducting wires 8 separated by webs 10 of insulating material. The branch connector 2 comprises an intermediate housing 12 sandwiched between a first cover 14 and a second cover 16 mounted contiguous a first side 18 and an opposing second side 20 respectively of the intermediate housing 12. Latch protrusions 22 are provided around the intermediate housing 12 for securely fixing the covers 14, 16 thereto by cooperation with latching recesses 24 thereof. The first cable 4 is mounted contiguous the first side 18 and the second cable 6 is mounted contiguous the second side 20 of the intermediate housing 12.

Referring now to Figures 3, 4 and 5, the intermediate housing 12 is shown comprising a square shaped base 26 extending between the first and second sides 18, 20 and bounded laterally by upstanding walls 28 protruding from the first side 18 and upstanding walls 30 protruding from the second side 20. The upstanding walls 28, 30 pro-

vide outer surfaces 32 for snugly receiving and positioning the covers 14, 16 with respect to the intermediate housing 12 whereby the latches 22 protrude outwardly from the outer surfaces 32. A plurality of terminals 34 stamped and formed from sheet metal, are assembled in a juxtaposed diagonal manner across the first side 18 of the intermediate housing and have a first insulation displacement contact (IDC) section 36 upstanding therefrom and a second IDC section 38 projecting through the base 26 so as to project in a similar manner from the second side 20.

Referring now to Figures 9-10, the terminal 34 will be described in more detail. The first IDC section 36 comprises a pair of spaced apart parallel walls 40 each having an IDC slot 42 and pointed insulation piercing tips 44, the IDC slots 42 being aligned for receiving a single conducting wire 8. The pair of walls 40 are joined at an end opposite the tips 44, by a base portion 46 having lateral edges 48, the lateral edge 48 comprising an indented edge portion 50. The second IDC section 38 also comprises a pair of spaced apart and parallel walls 52 comprising aligned IDC slots 54 and knife shaped tips 56, whereby the IDC slots 54 are aligned in a direction orthogonal to the first IDC slots 42. The wall portions 52 of the second IDC section 38 are integrally attached to the indented edge portion 50 of the first base portion 46 via a second base portion 58 substantially parallel but perpendicularly offset to the plane of the first base portion 46, and a joining portion 60 extending between the first and second base portions 46, 58 respectively.

Referring back to Figures 3-5 and 12, the intermediate housing 12 is shown comprising recesses 62 flanking the first IDC sections 36 for receiving the offset base portions 58 of the second IDC sections 38, and extending from the recesses 62 to the second side 20, are through cavities 64 for receiving the second IDC section wall portions 52. Protruding from the first side 18 are a plurality of juxtaposed ridges 66 parallel to the aligned pair of IDC slots 42 of the first IDC section 36 which are also parallel to the conducting wires 8 of the first cable 4 when connected thereto. Between the ridges 66, are recesses 68 in alignment with the first IDC slots 42, and chisel shaped strain relief members 70 upstanding from a bottom 64 of the recesses 68 and extending across from ridge to ridge. A diagonally disposed surface 67 spans across the first side 18, intersecting the terminals 34 and providing an area free of ridges 66 for receiving the terminals thereon.

Similarly, the second side 20 has a plurality of ridges 72, strain relief members 74 and recesses 76, whereby the ridges 72 are parallel to the second IDC section slots 54 and therefore perpendicu-

lar to the first side ridges 66. The second side 20 also comprises a diagonally disposed surface 78 intersecting the second IDC section wall portions 52, the surface 78 positioned intermediate a bottom 77 of the recess 76 and a top 79 of the ridges 72 (see Figure 4). Further recesses 80 extending from the surface 78 are provided to reduce material usage.

Referring now to Figures 6, 7 and 8, one of the covers 14, 16 is shown comprising a base plate 82 partially surrounded by an upstanding edge 84 having an inner surface 86 profiled to fit snugly over the outer surface 32 of the intermediate housing upstanding lateral walls 28, 30. Upstanding from the base plate 82, are a plurality of juxtaposed ridges 88 and a plurality of strain relief members 90, both the ridges 88 and strain relief members 90 arranged so as to be positioned in opposition and aligned to the ridges 72 and strain relief members 74, or ridges 66 and strain relief members 70 of the intermediate housing 12, depending on whether the cover 14, 16 is assembled to the first or second side of the intermediate housing 12, whereby the covers 14, 16 are identical but simply orientated in perpendicular directions when mounted to the intermediate housing 12. Having identical covers 14, 16 for either side of the intermediate housing, reduces manufacturing costs thereof as only one set of tooling is required therefor. The cover 14, 16 further comprises a diagonally disposed surface 92 intermediate the base plate 82 and outer surface of the ridges 88, whereby a plurality of terminal receiving cavities 94 having tapered inlet sections 96 extend from the intermediate surface 92 towards the base plate 82. The terminal receiving cavities 94 are positioned to fit over the upstanding walls 40 or 52 of the terminals 34, whereby the surface 92 acts as a means for stuffing the conducting wires 8 into the corresponding IDC slots of the terminals 34. Recesses 97 between the cavities 94 serve to reduce material usage.

Assembly of the connector and cables will now be explained. The terminals 34 are successively mounted to the intermediate housing 12 by inserting the second IDC section wall portions 52 into the terminal receiving cavity 64 until the second IDC base portions 58 abut the bottom of the recess 62 whereby the successive adjacent terminal can then be mounted in a similar manner resulting in the first base section 46b of the successive terminal overlapping one of the second base portions 58a of the preceding adjacent terminal 34a (see especially Figures 4 and 12). Due to the perpendicularly offset second base portion 58 with respect to the first base portion 46, contact is avoided between adjacent terminals 34a, 34b whilst enabling the terminals to be placed closely together, whereby the indented edge 50b allows the first IDC upstanding

walls 40a of the adjacent preceding terminal 34a to be positioned yet closer to the successive terminal 34b. The upstanding IDC wall portions 40a require a certain width to not only accommodate the IDC slot 42 but also provide sufficient mechanical strength and spring force, the terminal spacing therefore being reduced by positioning the second IDC sections 38b of a successive terminal 34b beyond the first IDC section 46a of the preceding adjacent terminal 34a such that the first wall portion 40a thereof can be approached to the indented edge 50b of the successive terminal 34b. By viewing the terminals in the direction of the first cable 4 (see Figure 4), the first wall portions 40a, 40b of adjacent terminals 34a, 34b almost or even slightly overlap each other. Similarly to the latter, when looking in the direction of the second cable 6, the second wall portions 52 of adjacent terminals almost or slightly overlap each other.

The first cable 4 can then be connected to the terminals 34 by positioning the conducting wires 8 of the cable 4 over and aligned with the corresponding IDC slots 42, and such that the interconnecting insulative webs 10 of the cable 4 are positioned over the ridges 66 and the conducting wires 8 oppositioned over the recesses 68 and strain relief members 70. The first cover 14 can then be positioned over the intermediate housing 12 and pressed thereagainst (by a special clamping tool) such that the pointed tips 44 of the terminals 34 pierce through the cable webs 10 and the conductors 8 forced into their respective IDC slots 42 for making electrical contact therewith. Once the tips 44 pierce through the cable webs 10, they subsequently enter corresponding terminal receiving cavities 94 of the cover, which not only provides stability therefor, but the surface 92 from which they extend also acts as a stuffer member to force the conducting wires 8 into their corresponding IDC slots 42. The cover ridges 88 and intermediate housing ridges 66 are brought together against the cable webs 10 for clamping thereof, whilst the opposing strain relief members 90, 70 dig into the insulation of the conducting wires 8 for clamping thereof, thereby securely holding the first cable 4 to the connector 2. Engagement of the intermediate housing latch protrusions 22 with the latch recesses 24 of the cover 14, ensure that the cover is securely and tightly locked thereto. The second cable 6 is assembled to the intermediate housing 12 in a similar manner, and possibly simultaneously, to that described above, except that the conducting wires thereof are positioned over the second side 20 of the intermediate housing and in alignment with the IDC slots 54 of the second IDC section 38.

Advantageously therefore, overlapping base portions of successive terminals allows them to be

closely spaced together and adapted for connection with flat flexible cable having juxtaposed conducting wires on a relatively small pitch, whilst providing two IDC connections per wire to ensure good electrical conductivity therebetween. Additionally, the design is cost-effective to produce and assemble due to the relatively simple stamped and formed terminals, and few housing parts whereby the cover members for both sides are identical. Termination of the cables through the connector is also simple and rapid due to the use of the covers to press the conductors onto their corresponding IDC contacts while providing strain relief means and latching onto the housing in the same procedure.

Claims

1. An electrical branch connector (2) for electrically connecting conducting wires (8) of a first cable (4) to substantially orthogonally arranged conducting wires (8) of a second cable (6), the branch connector comprising an intermediate housing (12) sandwiched between opposed first and second covers (14, 16), further comprising a plurality of terminals (34) having a first insulation displacement contact (IDC) section (36) for contacting the first cable (4), the first IDC section (36) protruding from a first side (18) of the intermediate housing and facing the first cover (14), and a second IDC section (38) for contacting the second cable (6), the second IDC section (38) protruding from a second side (20) facing the second cover (16), characterized in that the first IDC section (36b) of a successive adjacent terminal (34b) overlaps the second IDC section (38a) of the preceding terminal (34a) when viewing in a direction substantially perpendicular to the conducting wires (8) of the first and second cables (4, 6).
2. The branch connector of claim 1 characterized in that the first (36) and second (38) IDC sections each comprising a pair of spaced apart and aligned IDC slots (42, 52).
3. The branch connector of claim 1 characterized in that the first IDC sections (36) comprise IDC slots (42) formed in wall portions (40), whereby one of the wall portions (40a) of one of the preceding terminals (34a) almost or slightly overlaps one of the wall portions (40b) of the successive adjacent terminal (34b), with respect to a viewing direction parallel to the wires (8) of the first cable (4).

4. The branch connector of claim 3 characterized in that the terminals (34) comprise a first base portion (46) extending between the wall portions (40) and having lateral edges (48) with indented edge portions (50 for allowing wall portions (40a, 40b) of adjacent terminals (34a, 34b) to be positioned proximate to the indented edge portions (50) for compact spacing of the terminals.
5. The branch connector of any preceding claim characterized in that the second IDC sections (38) comprise IDC slots (52) wall portions (52), whereby one of the wall portions (52) of one of the preceding terminals (34a) almost or slightly overlaps one of the wall portions (52) of the successive adjacent terminal (34b), with respect to a viewing direction parallel to the wires (8) of the second cable (6).
6. The branch connector of any preceding claim characterized in that the first IDC section (36) comprises a first base portion (46), extending between first upstanding wall portions (40) comprising IDC slots (42), and the second IDC section (38) comprises a second base portion (58) extending between the first base portion (46) and second wall portions (52) comprising IDC slots (54), whereby the second base portion (58) is stepped with respect to the first base portion (46) such that the second base portion (58a) of a preceding terminal (34a) is positioned below the first base portion (46b) of a successive adjacent terminal (34b) without contact therebetween.
7. The branch connector of claim 6 characterized in that the first wall portions (40) are substantially orthogonal to the first base portion (46).
8. The branch connector of claims 6 or 7 characterized in that the second wall portions (52) are substantially orthogonal to the first base portion (46).
9. The branch connector of any preceding claim characterized in that the first and second covers (14, 16) are identical.

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FIG. 1

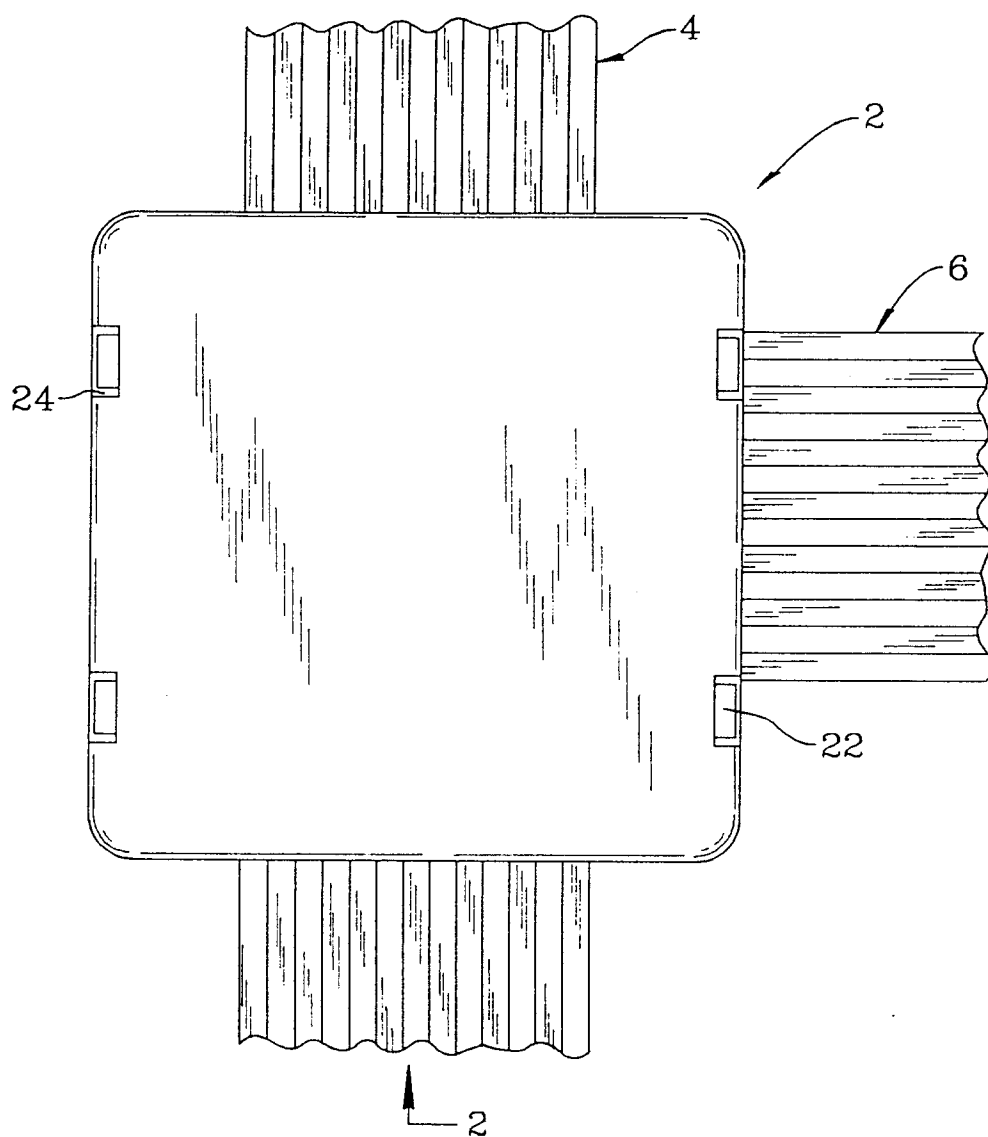


FIG. 2

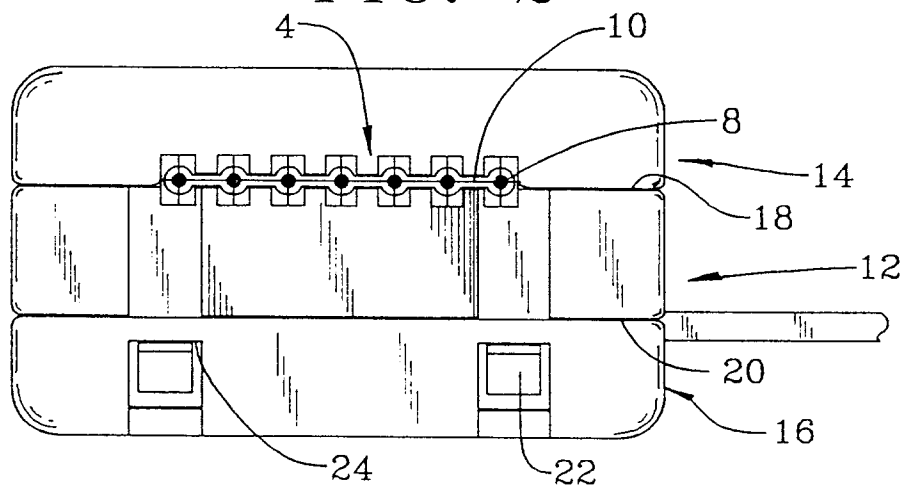


FIG. 3

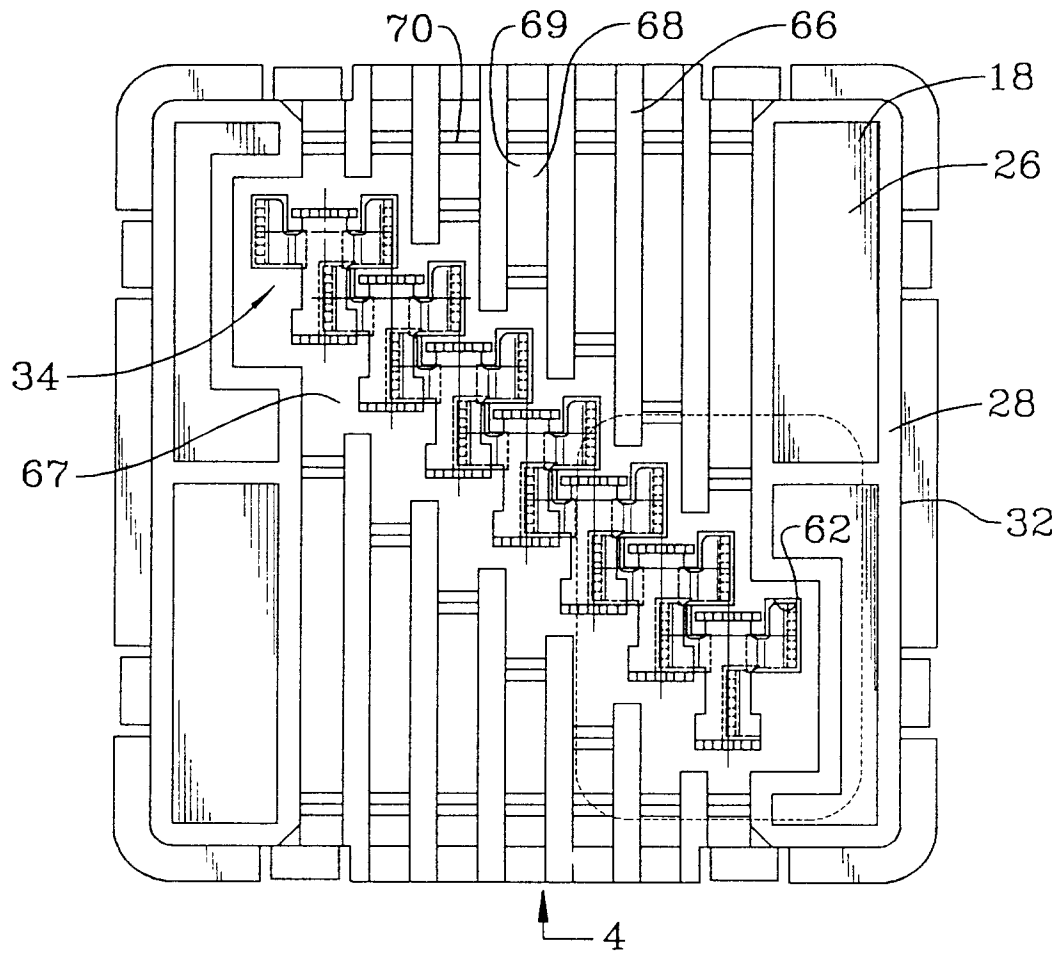


FIG. 4

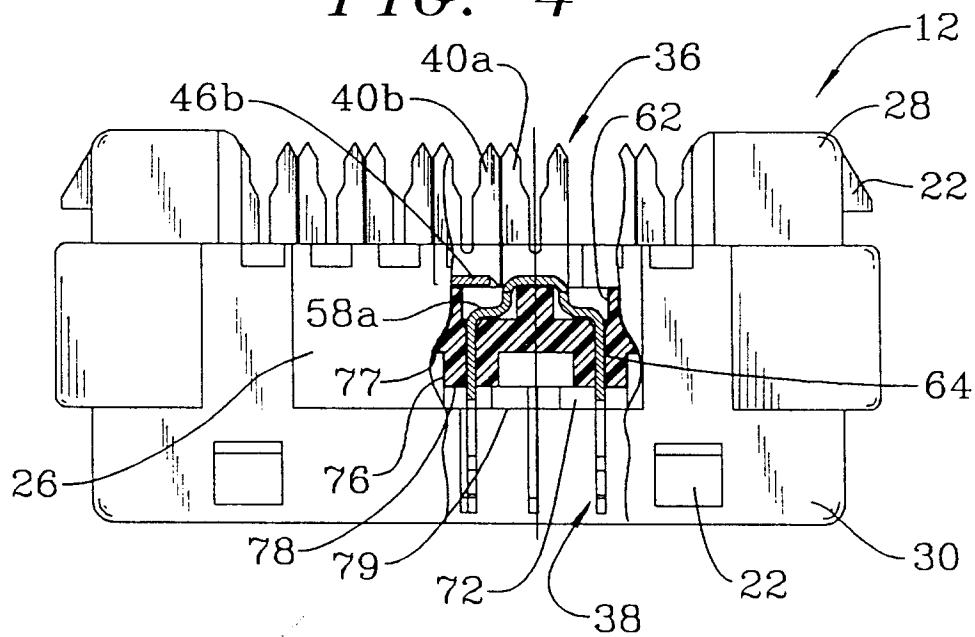


FIG. 5

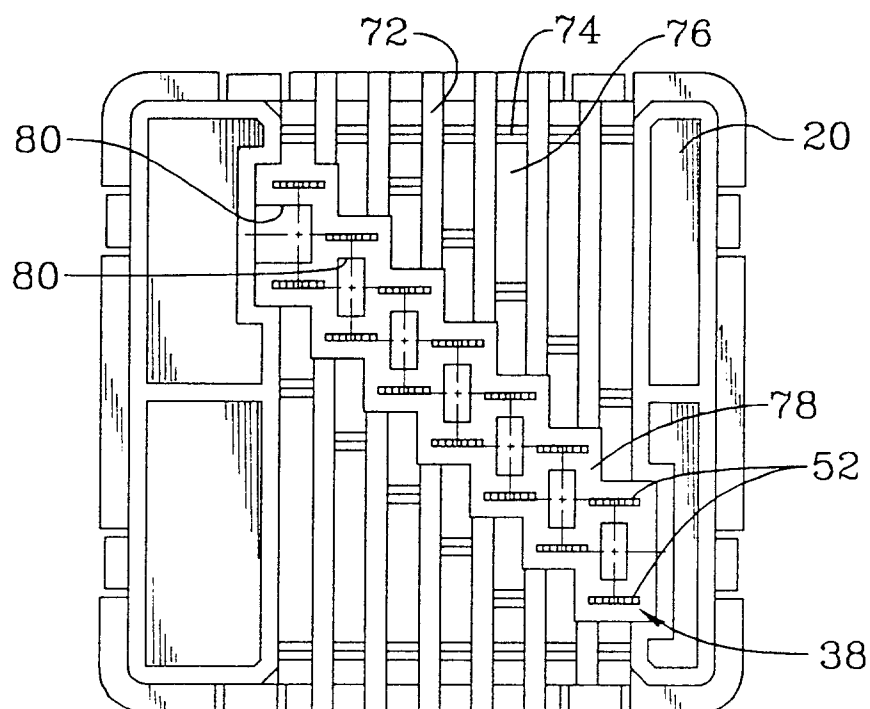


FIG. 6

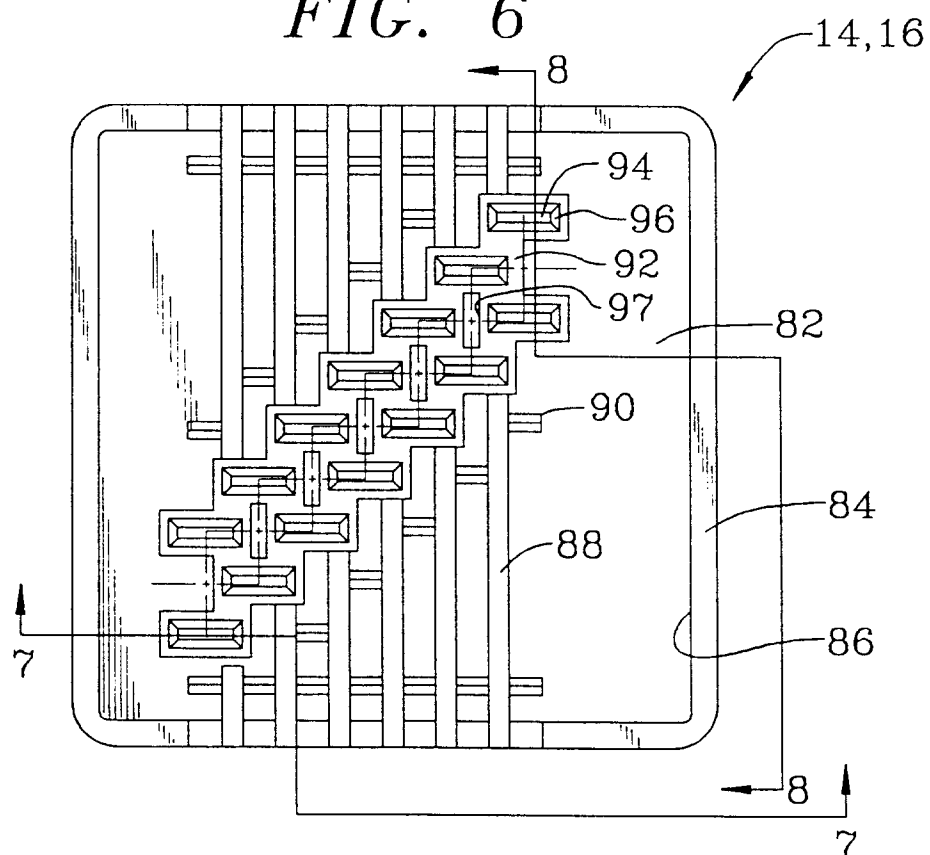


FIG. 7

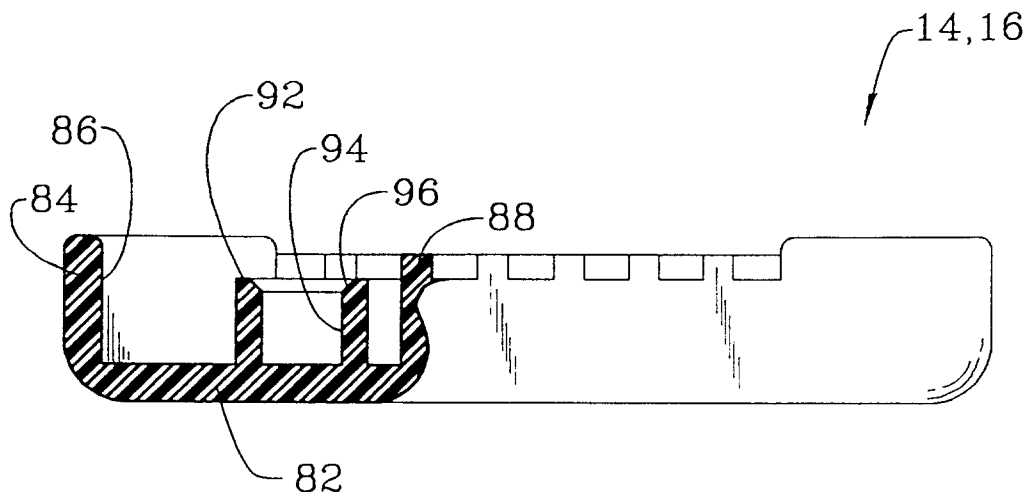


FIG. 8

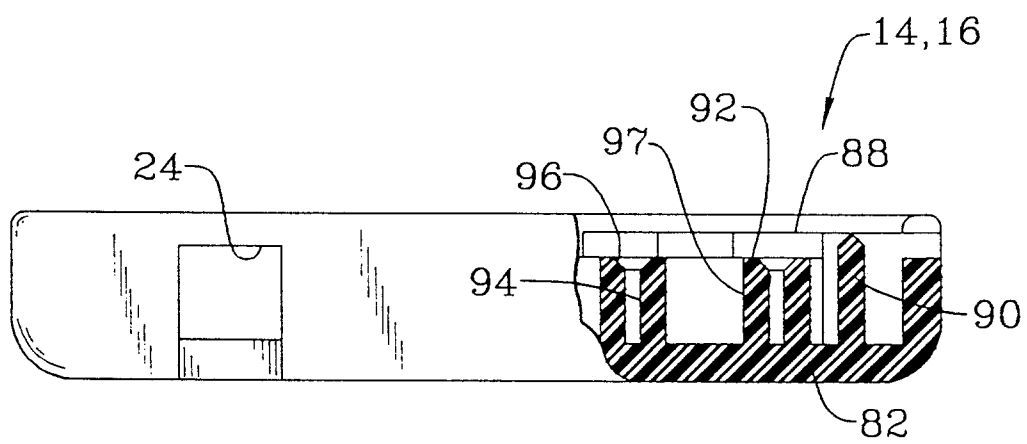


FIG. 9

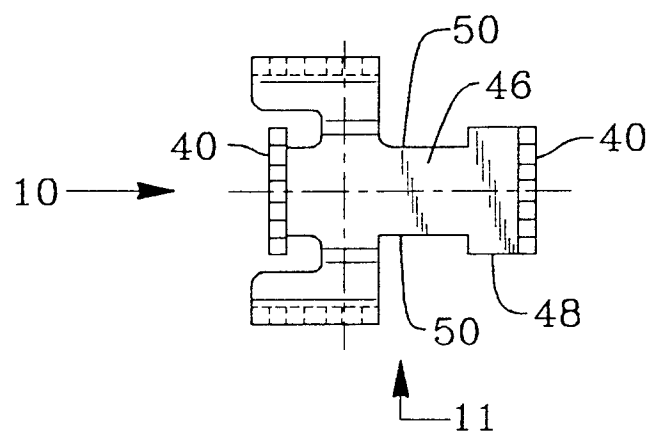


FIG. 10

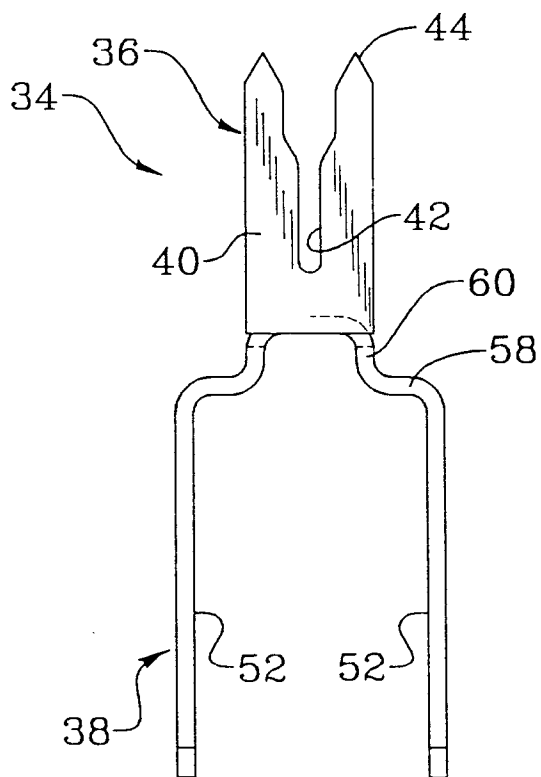


FIG. 11

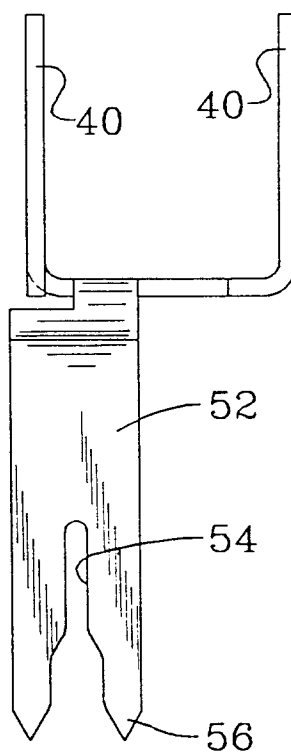


FIG. 12

