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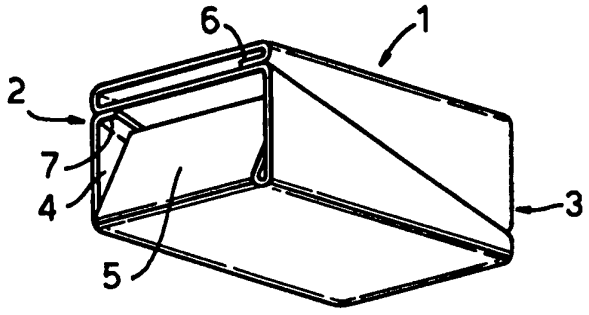
(57) Abstract

An in-line heat-shrinkable solder connector has a metal insert (1) with overlapping chambers (2, 3) for receiving respective conductors from each side. Solder (35) is located at the overlap. Insert (1) is formed from a single sheet.



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Electrical Connector

The present invention relates to a wire connector in the form of a heat shrinkable sleeve containing a solder insert.

It is known to join wires end to end by inserting them into opposed ends of a sleeve of heat shrinkable material containing a solder insert. The insulation is stripped from the ends of the wires so that the conductors can make contact. The heat shrinkable sleeve is heated to cause the sleeve to shrink and grip the wires and to melt the solder insert so that the solder establishes electrical contact with the exposed conductors. Connectors for this purpose are available from Raychem under its trademark SOLDERSLEEVE.

Connectors in which the wires enter from opposed ends are sometimes known as in-line connectors. WO93/16505 discloses such a connector comprising a heat shrinkable sleeve and a solder insert for joining wires end to end. The heat shrinkable sleeve also contains a metal insert in the form of a tube, which in turn contains the solder insert. The tube has two openings formed by depressing portions of the tube wall on the same side of the wall to form tabs which project into the tube. These tabs grip the exposed conductors of wires inserted into the sleeve but because they are formed on the same side of the tube the conductors are constrained to meet end to end.

There is a need for improved in-line connectors, particularly for connecting bundles of cables as is sometimes necessary in connecting wiring harnessing for electrical circuits in the production of automobiles.

It is also sometimes desirable to be able to test the electrical continuity of wires before they are finally soldered into place.

It is also desirable to provide better and more reliable electrical contact than is obtained by simply aligning individual conductor ends.

It is desirable for each wire to be inserted and held temporarily independently without the need to insert two wires simultaneously into opposed ends of the connector. It is also desirable to avoid the need for twisting either the wire or the connector to hold the wire in the connector, as this can be difficult when one wire has already been connected.

It is also desirable for metal inserts used in such connectors to be as cheap and as simple as possible.

According to one aspect of the present invention there is provided a wire connector for making in-line connections between wires, said wire connector comprising:

(a) a heat shrinkable sleeve,

(b) a metal insert within said sleeve for receiving the conductors of wires to be connected,

(c) a quantity of solder within said sleeve disposed so as to flow, when melted, into contact with the metal insert and conductors when said conductors are received within the metal insert, wherein

(i) the metal insert comprises first and second conductor receiving means for receiving at least one first and at least one second conductor of at least one first and at least one second wire inserted from first and second ends of the sleeves respectively,

(ii) said first and second receiving means define openings which decrease in the direction of insertion of the first and second conductors respectively,

(iii) said first and second receiving means being so disposed that parts of the first and second conductors overlap within the sleeve; and

(iv) the first and second conductor receiving means are formed by deforming a single sheet metal blank.

Preferably the whole metal insert is formed from a single sheet metal blank. In some instances, however, a two-part construction is envisaged, in which the conductors are received and retained in one part which is itself located within an outer housing.

Advantageously, the solder is disposed around the outside of the insert, which is suitably apertured to allow the solder to flow therethrough. This is particularly advantageous when, as envisaged, heating of the connector is effected, at least in part, by induction. With the solder initially disposed outside the metal enclosure, the heating time and heating power can be minimised since it is not necessary to raise the temperature of the insert to the melting temperature of the solder. Furthermore, the removal of a bulge in the polymeric sleeve that occurs when the underlying solder melts is an indication that sufficient heating of the solder has taken place.

The metal blank may be formed to provide the first and second conductor receiving means by bending to form curved surfaces. The metal blank may be bent along fold lines to give first and second conductor receiving means with substantially planar panels.

Each receiving means is preferably so formed that the conductors of a wire inserted into it by axial movement are retained (at least temporarily) without the need for any rotation of the wire or the connector.

The receiving means may be regarded as having an entrance, which is the outermost part of the receiving means which defines the opening into which the wire is inserted. It is preferred for conductor retaining means to extend from the entrance

of the receiving means. Alternatively, other retaining means for temporarily retaining conductors may be provided within the receiving means.

The retaining means at the entrance of the receiving means may be a flap of sheet metal formed by bending the sheet metal blank at a free edge.

The flap may be provided with teeth or other conductor retaining features at its free edge, where it engages with the conductors. These teeth may be formed in the blank before it is bent to form the receiving means. This simplifies the production process compared with receiving means in which it is necessary to form barbs in the body of a receiving means. Alternatively the free edge of the flap contacting the conductor may be pleated or corrugated to improve contact with, and retention of, the conductor.

In a preformed form of the connector of the present invention, the metal insert including receiving means is formed by folding a flat blank having fold lines defining a plurality of rectangular and triangular panels. Preferably the panels are so disposed that the metal insert is formed by folding in a direction transverse to the axis of the metal insert. The axis of the metal insert is the direction along which wires are inserted onto it. The panels described as triangular may be completely triangular or may be frusto-triangular with portions of one angle cut off. Additional flaps may be provided at the ends of the blank to assist in holding the panels in position when the blank is folded to form the insert.

Advantageously, the insert is made of resilient material so as to be deformed upon insertion of the wires, thereby to assist in their retention.

The rectangular panels may each have a rectangular flap at the edge of the panel adjacent the broadest free edge of the flanking triangle.

In an alternative embodiment, connector of the present invention may be formed by folding a blank into substantially flat panels in a direction substantially parallel to the axis of the insert along to fold lines to give a pair of receiving means constituted by a folded sheet having a substantially Z-shaped cross-section, taken parallel to the axis of the connector. The two substantially parallel panels which form the top of one receiving means and the bottom of the other are preferably provided at their outermost edges with flaps which are folded back into the receiving means and may be provided at their innermost free edge with teeth, or may be connected or pleated, to help grip the conductors.

In this embodiment of the invention the Z-shaped element constituting the two receiving means may be inserted inside a metal housing to complete the metal insert.

In general it is preferable for the solder insert to be outside the receiving sections so as not to obstruct the insertion of the conductors. Preferably the solder insert is positioned outside the metal insert and it will be desirable to provide openings in the metal insert to allow solder to flow into the interior of the receiving means.

In a still further embodiment of the present invention the receiving means is formed by a step which includes rolling the blank to give a curved panel, as opposed to folding it into substantially planar panels. In this embodiment, the receiving means may be formed by rolling the blank into two substantially frusto-conical shapes lying one above the other in opposite senses. Barbs may be formed by partially cutting out and bending portions of the body of the receiving means.

Alternatively only the outer surfaces of the metal insert, which will be adjacent the sleeve, are curved, and the insert will have a generally planar portion forming part of both receiving means.

Advantageously the entire insert of the connector of the present invention is resilient such that it can receive inserted conductors in a manner to grip them, to hold them temporarily in position, and to allow a temporary electrical connection to be made between them. The latter feature is important in that when an electrical harness for an automobile, for example, is being assembled, many connections are involved, and the electrical continuity of the entire harness can then be tested before permanent connections, involving melting the solder and shrinking the heat shrinkable sleeves, have to be made.

The insert may be made of any suitable metal, but copper or brass or bronze are preferred.

When induction heating is employed to form electrical connections with connectors of the present invention, the solder is advantageously disposed between the metal insert and the enclosing sleeve and is preferably made of a material that is more resistive than that of the insert. In these circumstances, the solder preferentially absorbs the heat, thus reducing the heating time. Then, by providing apertures in the outer surface of the insert, the molten solder can flow into the conductor-receiving means and form the electrical connection.

There is a further advantage in disposing the solder externally of the insert, in that in its solid state its presence can be discerned through the heat recoverable polymeric sleeve as a prominent portion which disappears on melting and thus acts as an indicator that sufficient heat has been applied to the connector.

Connectors in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings in which;

Figure 1, is a first perspective view of one form of metal insert for use in the present invention;

Figure 2, is an end elevation of the metal insert of Figure 1;

Figure 3, is a further perspective view of the metal insert of Figure 1 showing the other end thereof;

Figure 4, is a plan of a sheet metal blank with fold lines for folding to give the insert of Figures 1 to 3;

Figure 5 is a perspective view of a modified form of the insert of Figure 1;

Figure 6, is a perspective view of the insert of Figure 5 surrounded by a quantity of solder;

Figure 7 is a diagrammatic cross-section of a complete connector having a metal insert of the type shown in Figures 5 and 6;

Figure 8, is a side elevation of a folded metal blank consisting of two receiving means;

Figure 9, is an end elevation of the folded blank of Figure 8 looking in the direction of arrow A;

Figure 10, is a cross-sectional side view of a housing for receiving the folded blank of Figures 8 and 9;

Figure 11, is a cross-section along the line XI-XI of Figure 10;

Figure 12, is a perspective view of another form of metal insert for use in the present invention; and

Figure 13, is a perspective view of part of a modified form of the metal insert of Figure 10.

In the embodiment shown in Figures 1 to 3 a metal insert 1, suitable for use in an electrical connector, is constituted by a single piece of folded sheet metal. It has receiving means 2 and 3 for receiving conductors of wires (not shown) inserted into the insert 1 from opposed directions. Each receiving means 2, 3 is defined between substantially planar panels and decreases in depth from an entrance 4. A flap 5 projects rearwardly into each receiving means from its entrance 4 to help to retain conductors inserted into the receiving means. Narrow folded portions 6, 7 define weld regions to hold in place the panels of the insert to which they are attached.

Figure 4 shows a sheet metal blank 8 with fold lines suitable for use in producing the insert 1 of Figures 1 to 3. The blank has two rectangular panels corresponding to the folded portions 6, 7 of Figure 1, and two rectangular panels that correspond to the retaining flaps 5. The rest of the blank 8 comprises alternating triangular panels 9 and rectangular panels 10 separated by fold lines 11. The fold lines may be pre-scored on the blank but the skilled person will understand that the substantially planar panels of Figure 1, may be obtained by bending at the boundaries of the panels and flaps to give small radii of curvature, as indicated in Figure 1.

It will be appreciated that by suitable folding of the panels 9 and 10 about the fold lines 11, the blank 8 may be formed into the insert 1 of Figures 1 to 3 so as to define the two receiving means 2, 3 with their entrance apertures 4 closed by a respective flap 5.

Figure 5 shows a metal insert 1A similar to the insert 1 but having an opening 30 in each longitudinal edge 31 thereof. A flap 32 extending rearwardly from entrance of the receiving means has a plurality of parallel folds or pleats 33 extending

to its free edge 34, which help to grip conductors inserted into the receiving means. Alternatively, each flap may contain a plurality of parallel slits so as to define resilient fingers for gripping inserted conductors.

Figure 6 shows the metal insert 1A with a band of solder 35 extending around it covering, and advantageously retained by, the apertures 30.

Figure 7 is a diagrammatic cross-section showing a connector 41 containing an insert 1A of the type shown in Figure 6. The connector includes a heat shrinkable polymeric sleeve 42 surrounding the insert 1A with its solder band 35. The sleeve 42 also contains an annular insert of hot melt adhesive 43 at each of its extremities beyond the insert 1A. In use, a wire with exposed conductors is inserted into one of the receiving means 2 or 3 of the insert 1 or 1A. The conductor is pushed past the rearwardly extending flap 5 at the entrance 4 to the receiving means 2, which retains it and forms a temporary electrical contact. A similar procedure is then carried out with another wire and the other receiving means 3.

A permanent electrical connection between the conductors, is subsequently produced by heating the heat-shrinkable sleeve 42 to melt the solder 35 and the adhesive rings 43 and to shrink the sleeve 42 to seal around the internal components. Shrinkage of the sleeve 42 helps to force solder 35 through the apertures 30 in the metal insert 1A to give good electrical contact with conductors in the receiving means 2, 3. The hot melt adhesive 43 together with the sleeve 42 provides good environmental protection to the connection and also prevents any flow of solder out of the sleeve 42.

In an alternative embodiment, the two sealing rings 43 are replaced by a continuous layer of hot melt adhesive disposed along the inner surface of the sleeve 42.

Heating of the connector to form and to seal the electrical connection between the conductors may be effected in any suitable manner, for example using a gas torch an infra-red heater of a hot air gun. However, a preferred method is to use induction heating. In this case, one or more induction coils are located around the metal insert 1A and solder ring 35 and power is applied thereto until melting occurs. The solder 35 is advantageously made of a material that is more resistive than the material of the insert 1A, which may be copper, brass or bronze for example, so that it preferentially heats up and thus melts in a relatively short time. Heating of the polymeric sleeve 42 and of the hot melt adhesive inserts 43 then takes place by thermal conduction through the metal insert 1A.

Figure 8, is a side view of one part 50 of an insert having a pair of receiving means formed from a single sheet metal blank, and, apart from two projections 51, 52, the main surfaces are substantially planar and seen end on (as in Figure 9) have a rectangular cross-section. Receiving means 3 has a downwardly and inwardly extending flap 5 and receiving means 2 has an upwardly and inwardly extending flap 5. As in the previous embodiments disclosed the flaps help to retain conductors forced past them.

Figures 10 and 11 show the other part of the insert, comprising a housing 53 within which the open-sided part 50 of Figures 8 and 9 fits. The housing 53 has apertures 54 and 55 extending across the middle thereof in opposing rectangular surfaces to receive the projections 51 and 52. The insert part 50 shown in Figure 8 is sufficiently resilient that it can be forced into the housing 53 and the projections 51 and 52 spring up and lock it into place when they coincide with the openings 54 and 55, and so form the complete metal insert.

The flaps 5 of the insert 50, 53 may be made with pleats, corrugations, slits or with indentations at the face edge to improve the grip on conductors inserted into the receiving means.

A further embodiment of the present invention is shown in Figure 12 in which a metal insert 61 has receiving means 62, 63 formed by opposed frusto-conical portions 64, 65 which are rolled from a single sheet of metal. The metal is partially cut away and bent inwardly to form rearwardly facing barbs 66 for retaining and making electrical contact with conductors inserted into the receiving means 62, 63.

Figure 13 shows a modification of the metal insert of Figure 12 in which the portion 67 of the sheet metal which divides the first and second receiving means 2, 3 is made substantially planar.

It is to be understood that the various metal inserts described are each intended to be disposed inside a heat-shrinkable polymeric sleeve and associated with solder arranged, on melting, to provide electrical interconnection between conductors inserted therein.

Claims

1. A connector for making in-line connections between wires, said wire connector comprising:

(a) a heat shrinkable sleeve,

(b) a metal insert within said sleeve for receiving the conductors of wires to be connected,

(c) a quantity of solder within said sleeve disposed so as to flow, when melted, into contact with the metal insert and conductors when said conductors are received within the metal insert, wherein

(i) the metal insert comprises first and second conductor receiving means for receiving at least one first and at least one second conductor of at least one first and at least one second wire inserted from first and second ends of the sleeves respectively,

(ii) said first and second receiving means define openings which decrease in the direction of insertion of the first and second conductors respectively,

(iii) said first and second receiving means being so disposed that parts of the first and second conductors overlap within the sleeve; and

(iv) the first and second conductor receiving means are formed by deforming a single sheet metal blank.

2. A connector according to claim 1, wherein the receiving means have substantially planar surfaces.

3. A connector according to claim 1 or claim 2, wherein a conductor retaining means extends rearwardly from the entrance of each receiving means into each receiving means.

4. A connector according to claim 3 wherein the retaining means comprises a flap of metal formed by bending a sheet metal blank at a free edge.

5. A connector according to claim 4 wherein the flap is provided with teeth.

6. A connector according to any one of the preceding claims, wherein the metal insert is formed by folding a flat blank having fold lines defining a plurality of rectangular and triangular panels.

7. A connector according to any one of the preceding claims, wherein the two receiving means comprise an element having a substantially Z-shaped cross-section, taken parallel to the connector, and formed by folding a blank into substantially flat panels.

8. A connector according to claim 7, wherein the Z-shaped element is inserted inside a metal housing.

9. A connector according to any one of the preceding claims, wherein the metal insert is provided with apertures partway along its length and wherein the solder is disposed extorialy of the insert in the region of the apertures.

10. A connector according to any one of the preceding claims, wherein the conductor receiving means forms a first part of the insert and an enclosing housing forms a second part, and wherein the two parts are mechanically interlinked.

11. A wire connector according to Claim 1, wherein the metal insert is formed from a single sheet metal blank.

12. A flat sheet metal blank suitable for making a metal insert for receiving opposed electrical wires comprising three rectangular and four triangular panels, and first and second rectangular panels are each flanked by two triangular panels in the same sense, and the third rectangular panel is flanked by triangles in opposite senses, and the panels are so disposed that the metal insert is produced by folding generally transversely to the axis of the metal insert.

Fig.1.

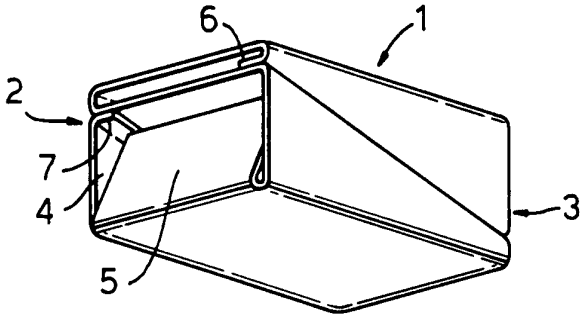


Fig.2.

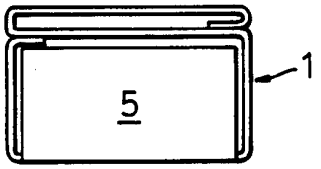


Fig.3.

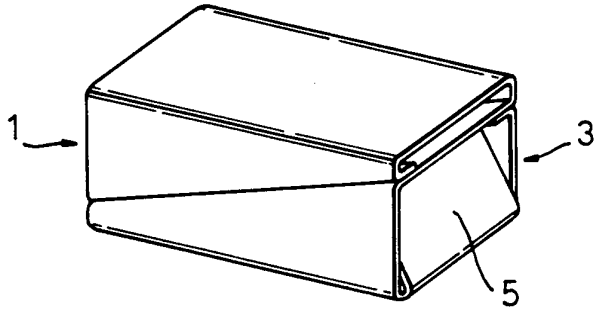


Fig.4.

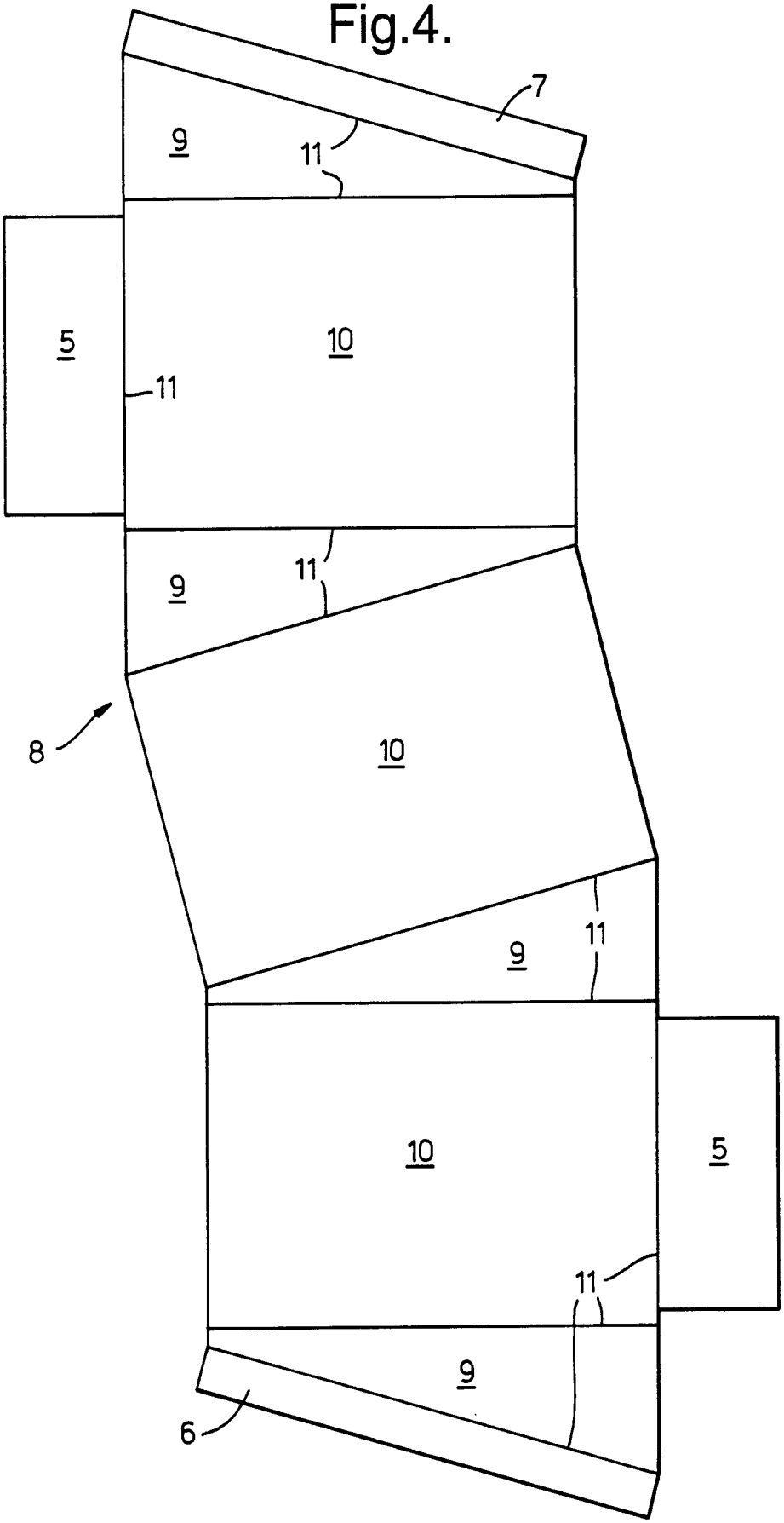


Fig.5.

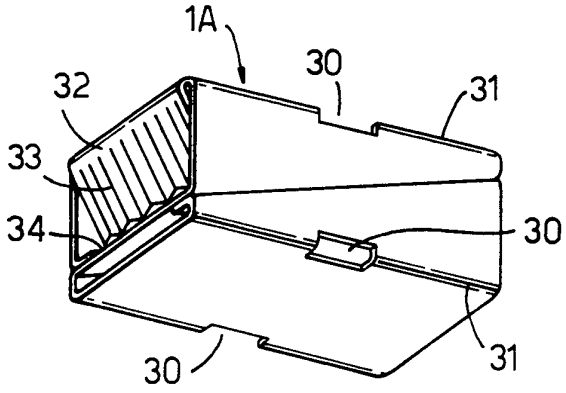


Fig.6.

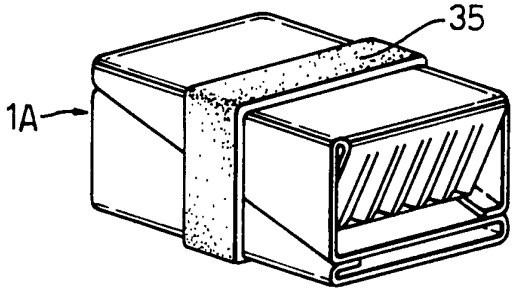


Fig.7.

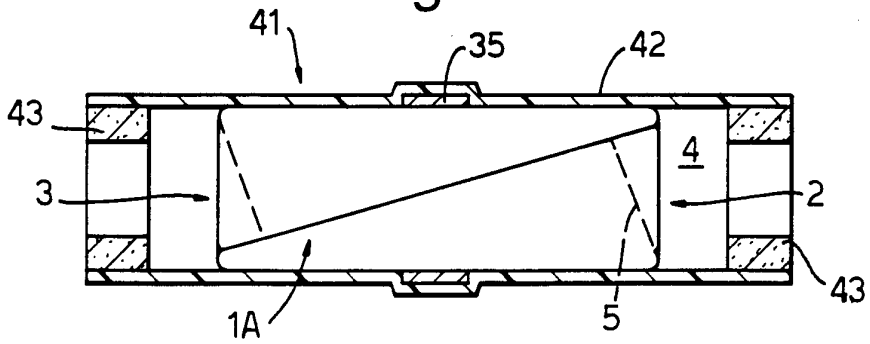


Fig.8.

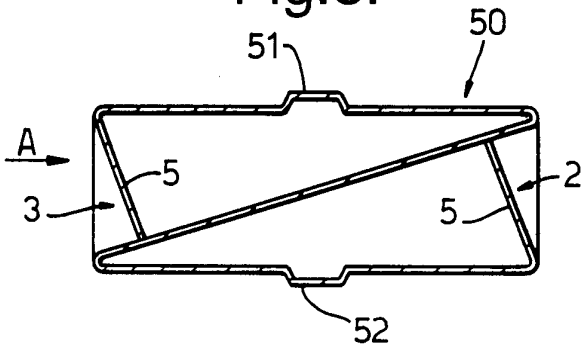


Fig.9.

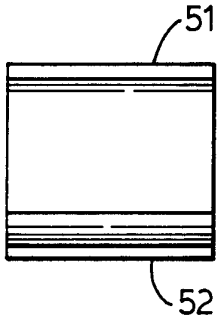


Fig.10.

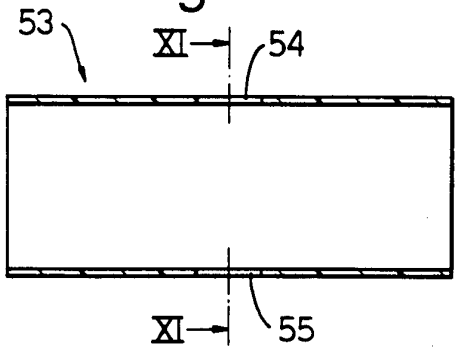


Fig.11.

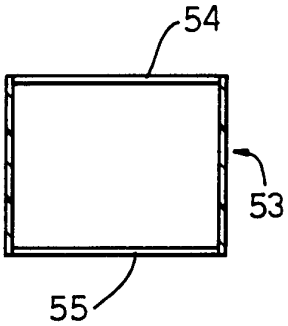


Fig.12.

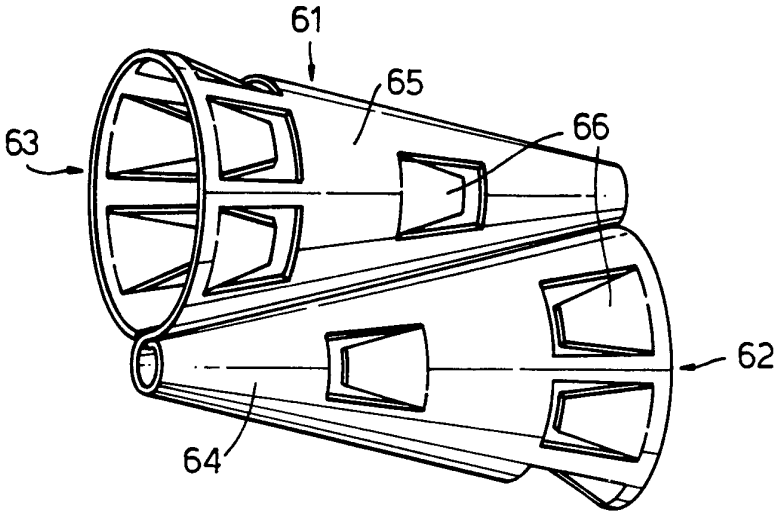
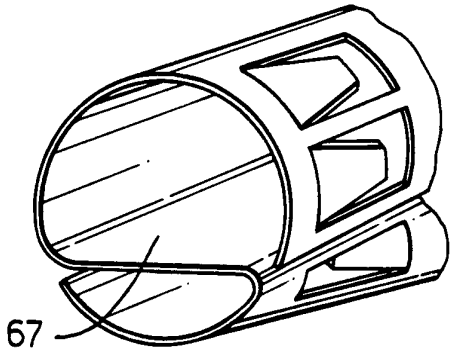


Fig.13.



INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/GB 96/01493

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01R4/72

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO,A,93 16505 (MINNESOTA MINING & MFG) 19 August 1993	1
A	see the whole document	2,4,8-10
Y	EP,A,0 270 283 (RAYCHEM CORP) 8 June 1988 see column 6, line 27 - column 7, line 16; figures 1A-1C	1
A	US,A,4 199 211 (KIDDER KENT A) 22 April 1980 see column 4, line 4 - line 29	1,4,5
A	EP,A,0 643 453 (CONNECTEURS CINCH SOCIETE ANON) 15 March 1995 see column 2, line 42 - column 4, line 31	6,7

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☒ Patent family members are listed in annex.

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