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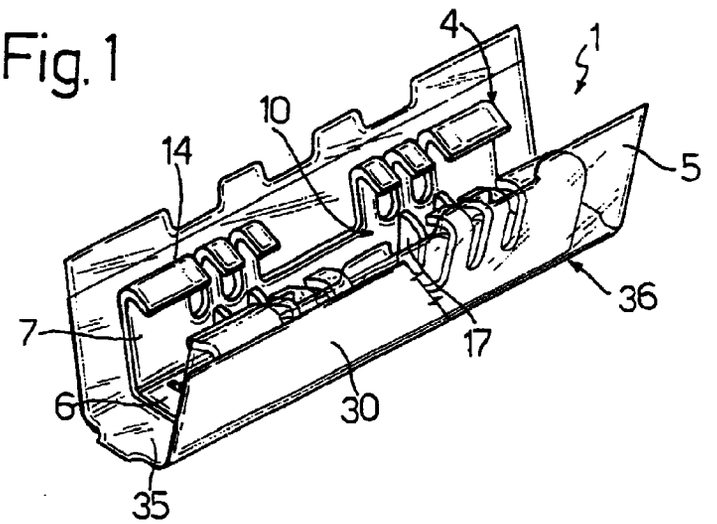
(54) Electric connector

(57) An electric connector (1) for connecting cables (2, 3), and which includes a connecting element (4) made of conductive sheet metal and connectable electrically to the cables (2, 3); and an enclosure (36) defined by an insulating covering (5) applied to an outer surface of the connecting element (4), and by a shielding cover (30) applied to the insulating covering (5).

Fig. 1



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Description

[0001] The present invention relates to an electric connector.

[0002] More specifically, the present invention relates to an electric connector comprising a substantially channel-shaped connecting element made of conducting sheet metal and which is designed to receive end portions of insulated electric cables, is crimped onto the cables, and in turn comprises insulation-piercing contact elements for piercing the insulating sheath of the cables when the connecting element is crimped, to establish electric connection between the element and the wires of the cables.

[0003] The connector also comprises an insulating covering generally formed by applying a layer of polymeric material to an outer surface of the contact element.

[0004] Connectors of the type briefly described above are illustrated, for example, in US-A-3 320 354 and US-A-5 110 387.

[0005] As the above connectors are normally used in telephone systems for permanently connecting bundles comprising tens of cables, reference is made to this particular application in the following description, though purely by way of example.

[0006] At junctions, the connectors of different lines are located close together and normally contacting one another. The insulating covering of the connectors, however, provides for electrically insulating the connectors of different lines and, in conventional telephone applications, is normally sufficient to prevent any noticeable crosstalk between the lines.

[0007] Transmitting multimedia data (e.g. relative to cable television programs or telematic applications in general) over telephone lines, however, calls for a very high transmission frequency, and, in such applications, conventional connectors of the type described may result in inductive crosstalk between the lines.

[0008] It is an object of the present invention to provide an electric connector of the type briefly described above, designed to eliminate the aforementioned drawbacks.

[0009] According to the present invention, there is provided an electric connector as claimed in Claim 1.

[0010] The present invention also relates to a method of fabricating the connector, as claimed in Claim 9.

[0011] A preferred non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a view in perspective of an electric connector in the as-made configuration;

Figure 2 shows a side view of the connector in the Figure 1 configuration;

Figure 3 shows a section along line III-III in Figure 2 together with an enlarged detail;

Figure 4 shows a view in perspective of the Figure 1 connector in the as-used configuration to join two electric cables;

Figure 5 shows a cross section of the connector in the Figure 4 configuration;

Figure 6 shows a partial diagram of a system for producing electric connectors in accordance with the invention;

Figures 7 and 8 show a semifinished part, from which to produce the connectors, at two different stages in the fabrication method;

Figure 9 shows a view in perspective of a number of connectors according to the invention at the end of the fabrication method.

[0012] Number 1 in Figures 1 to 5 indicates as a whole an electric connector for connecting two electric cables 2, 3 (Figure 4).

[0013] Connector 1 substantially comprises a connecting element 4 made of conducting sheet metal; and an insulating covering 5 applied to the outside of connecting element 4.

[0014] When undeformed as shown in Figures 1 and 3, connecting element 4 is elongated and substantially channel-shaped with a substantially U-shaped section, and comprises a flat bottom wall 6, and two lateral walls 7, 8 extending integrally and in diverging directions from respective lateral edges of bottom wall 6, and defining with the bottom wall a cavity 10.

[0015] A number of deformable retaining elements 14 extend from the free edges of lateral walls 7,8, comprise respective end portions 15 bent inwards of cavity 10, and, in use, are deformed inwards of cavity 10 to retain insulating covering 5 as described later on.

[0016] Connecting element 4 also comprises two pairs of insulation-displacement contact (IDC) elements, each comprising a blade 17 cut from bottom wall 6 and bent 90° inwards of cavity 10 in a plane perpendicular to the longitudinal dimension of the connector.

[0017] Each blade 17 (Figure 3) comprises along the top edge a known substantially funnel-shaped slot 18 in turn having a lead-in portion 19, and a bottom portion 20 defined by a pair of edges 23 separated by a distance slightly less than the diameter of the conducting core of cables 2, 3.

[0018] Insulating covering 5 conveniently comprises a dielectric layer 24 of dielectric polymeric material, e.g. polyester, which covers the entire outer surface of connecting element 4 and has a pair of lateral portions 25 extending beyond retaining elements 14 of connecting element 4 so as to be "gripped" between the retaining elements and held in place when the connector is fitted to the cables.

[0019] Lateral portions 25 of insulating covering 5 comprise recesses 34 at contact elements 17 for the purpose explained later on.

[0020] Covering 5 is longer than connecting element 4 so that axial edges 35 of the covering project from the connecting element (Figure 1).

[0021] Covering 5 is applied to connecting element 4 by means of adhesive conveniently comprising a second layer 26 of low-temperature-softening thermoplastic material, e.g. polyethylene, which forms part of covering 5 and by which dielectric layer 24 is heat-sealed to connecting element 4.

[0022] Covering 5 is conveniently formed from a known continuous rolled strip 27 (Figure 6) comprising layers 24, 26.

[0023] According to the present invention, connector 1 also comprises a shielding cover 30, which is applied to the outer surface of covering 5 and in turn conveniently comprises a conductive metal shielding layer 31 defined by a thin plate, e.g. of aluminium or copper alloy of a thickness measurable in hundredths of a millimeter. Shielding layer 31 covers the outside of the whole of insulating covering 5 except for respective free edges 25a of lateral portions 25, to prevent any electrical contact with connecting element 4 when connector 1 is fitted (Figure 3). Layer 31 is also heat sealed to insulating covering 5, for which purpose, layer 30 conveniently comprises a thin film 32 of thermoplastic material, e.g. polyethylene, having a lower softening temperature than dielectric layer 24.

[0024] Shielding cover 30 is conveniently formed from a continuous strip 33 (Figure 6) comprising shielding layer 31 and polymeric film 32.

[0025] Insulating cover 5 and shielding cover 30 together define an insulating enclosure 36 of connector 1.

[0026] Connector 1 is fitted in known manner using special tools not shown (hand pliers or semiautomatic tools); and the ends of cables 2, 3 are first placed inside respective end portions of cavity 10 of connecting element 4 so that each cable end is superimposed on a respective pair of blades 17.

[0027] Connector 1 is then deformed using said tool, so that lateral walls 7, 8 are positioned perpendicular to bottom wall 6, retaining elements 14 are bent inwards of cavity 10, cables 2, 3 are forced inside slots 18 of blades 17, and the insulation of cables 2, 3 is cut by the lateral edges of slot 18 to establish an electrical connection between the conducting cores of the cables and connecting element 4 (Figure 5).

[0028] When fitting connector 1, the tool, by means of a rolling operation, guides lateral portions 25 of insulating covering 5 between retaining elements 14 and into slots 18 of blades 17 to assist in retaining cables 2, 3; and recesses 34 are so sized as to prevent any unwanted interference between the material of covering 5 and the cables inside slots 18.

[0029] Figure 4 shows connector 1 as fitted to cables 2, 3. Connecting element 4 is substantially entirely enclosed by shielding cover 30, and is insulated electrically from the shielding cover by covering 5. As shown clearly in Figure 5, edges 25a of covering 5 projecting from shield 30 provide for electrically insulating the shield and connecting element 4.

[0030] In the event connector 1 is located, in use, contacting another similar connector, electric insulation is therefore ensured to eliminate any problems arising from inductive crosstalk.

[0031] Figure 6 shows schematically a method of producing a rolled strip 40 by superimposing and heat sealing strips 27 and 33 at a hot-rolling station 44.

[0032] Strip 33, unwound off a reel 41, is first fed through a preblanking station 42 where transverse strips shorter than the width of strip 33 are removed to define equally spaced slots 43 (Figure 7) at the regions eventually defining, in use, edges 25a of insulating covering 5. The spacing of slots 43 equals the width of the blank of covering 5 of connector 1.

[0033] Strip 27 is unwound off a reel 45 and fed to rolling station 44 along a plane α.

[0034] Station 44 comprises a pair of rotary cylinders 46, 47 symmetrical with and tangent to plane α so as to compress strips 27, 33.

[0035] Cylinder 46 is cold and cooperates with the face of strip 27 defined by dielectric layer 24; and cylinder 47 also provides for guiding strip 33, which, on leaving preblanking station 42, is fed around cylinder 47 and onto strip 27 along plane α. Cylinder 47 is heated and cooperates with the face of strip 33 defined by shielding layer 31 to heat strip 33 to a temperature higher than the softening temperature of polyethylene film 32.

[0036] On leaving rolling station 44, the rolled strip 40 so formed is fed to a step-operated stamping station 50 where cutting and forming operations are performed successively with reference to slots 43 formed in strip 33.

[0037] A first operation A (Figure 8) comprises forming, with reference to slots 43, sprocket holes 51 along the longitudinal edges 52 of rolled strip 40; and a second operation B comprises simultaneously forming longitudinal slots 53 at opposite ends of slots 43, and a number of spaced openings 54 along slots 43.

[0038] A third operation C comprises forming a transverse cut 55 along the center line of each slot 43 to define, at each step, a portion 56 of rolled strip 40 defined lengthwise of the strip by two successive cuts 55, and widthwise of the strip by cuts 53, and which defines the blank of enclosure 36 of a respective connector 1.

[0039] A fourth and last operation D comprises preforming enclosure 36, whereby lateral portions 57 of portions 56 are bent upwards to form the lateral walls of the enclosure.

[0040] A continuous semifinished part 60 is therefore obtained at the output of stamping station 50, and is defined by a succession of preformed insulating enclosures 36 connected to one another by a pair of lateral traction bands defined by longitudinal edges 52 of the original rolled strip 40.

[0041] At a known follow-up station (not shown), metal connecting elements 4 are supplied and hot fitted to respective insulating enclosures 36 to form the finished

connectors 1.

[0042] Figure 9 shows the end result of the method, which comprises a continuous strip of successive connectors 1 joined to one another by lateral bands 52.

[0043] The advantages of connector 1 according to the present invention will be clear from the foregoing description.

[0044] In particular, shielding cover 30 provides for eliminating any inductive crosstalk between adjacent high-frequency transmission lines.

[0045] Moreover, the shielding cover is formed using a particularly straightforward, low-cost method simply requiring, as compared with conventional methods of producing known nonshielded connectors, an additional preblanking operation of strip 33 and an additional rolling operation at station 44.

Claims

1. An electric connector (1) for connecting cables (2, 3), comprising a connecting element (4) made of conductive sheet metal and electrically connectable to said cables (2, 3); and an insulating covering (5) in turn comprising at least a layer of dielectric polymeric material (24) applied to an outer surface of said connecting element (4); characterized by comprising a shielding cover (30) applied to said insulating covering (5).

2. A connector as claimed in Claim 1, characterized in that said shielding cover (30) comprises a shielding layer (31) of conductive metal material; and an adhesive layer (32) for securing said shielding layer (31) to said insulating covering (5).

3. A connector as claimed in Claim 1 or 2, characterized in that said insulating covering (5) comprises an adhesive layer (26) for securing said layer of dielectric polymeric material (24) to said connecting element (4).

4. A connector as claimed in Claim 3, characterized in that said adhesive layer (32) of said shielding cover (30) comprises a film of thermoplastic material having a softening temperature lower than that of said dielectric polymeric material.

5. A connector as claimed in Claim 3 or 4, characterized in that said adhesive layer of said insulating covering (5) comprises a film (26) of thermoplastic material having a softening temperature lower than that of said dielectric polymeric material.

6. A connector as claimed in any one of the foregoing Claims, characterized in that said connecting element (4) is substantially channel-shaped, and defines a longitudinal cavity (10) for housing end portions of the cables (2, 3) to be connected; said connecting element (4) comprising contact means (17) housed inside said cavity (10) and for establishing an insulation-displacement electrical connection with the cables (2, 3).

7. A connector as claimed in Claim 6, characterized in that said connecting element (4) comprises a bottom wall (6) and a pair of lateral walls (7, 8) defining said cavity (10); and a number of deformable portions (14) extending from said lateral walls (7, 8) and deformable, in use, inwards of said cavity (10) to retain said insulating covering (5).

8. A connector as claimed in Claim 6 or 7, characterized in that said shielding cover (30) covers the outside of said insulating covering (5) with the exception of lateral edges (25a) of the insulating covering eventually interacting with said contact means (17) of said connecting element (4).

9. A method of fabricating an insulating enclosure of an electric connector (1) for connecting electric cables (2, 3); said connector (1) comprising a connecting element (4) made of conductive sheet metal, and an insulating covering (5) in turn comprising at least a layer of dielectric polymeric material (24) applied to an outer surface of said connecting element (4); and said method being characterized by comprising the step of applying a shielding cover (30) to said insulating covering (5).

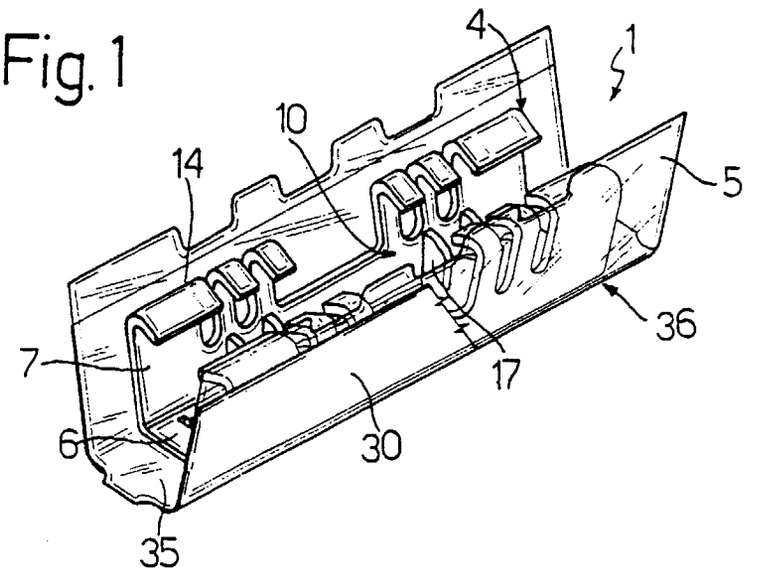
10. A method as claimed in Claim 9, characterized in that said shielding cover (30) comprises a shielding layer (31) of conductive metal material; and an adhesive layer (32) for securing said shielding layer (31) to said insulating covering (5) and defined by a film of thermoplastic material having a softening temperature lower than that of said dielectric polymeric material; said step of applying said shielding cover (30) to said insulating covering (5) being performed by means of a hot rolling operation.

11. A method as claimed in Claim 10, characterized by comprising the step of forming, by means of said hot rolling operation, a continuous rolled strip (40) from a continuous first strip (27) forming said insulating covering (5), and from a continuous second strip (33) forming said shielding cover (30); and the step of forming from said continuous rolled strip (40) a succession of enclosures (36) by means of blanking and stamping operations.

12. A method as claimed in Claim 11, characterized by comprising the step of removing portions of material from said second strip (33) at regions corresponding to portions of said enclosure (36) in which said insulating covering (5) is devoid of said shielding cover (30); said removing step being performed

upstream from said hot rolling operation.

Fig. 1



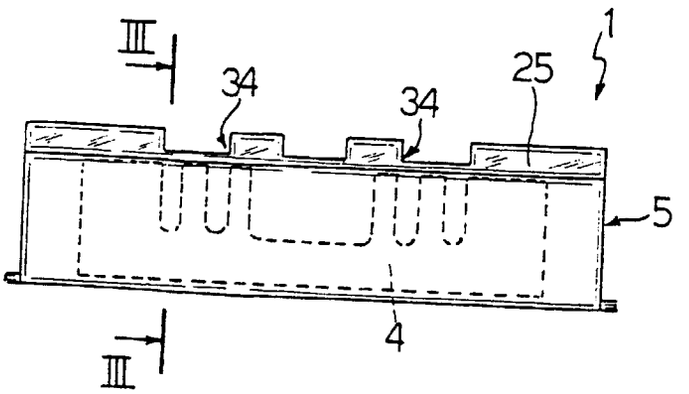


Fig. 2

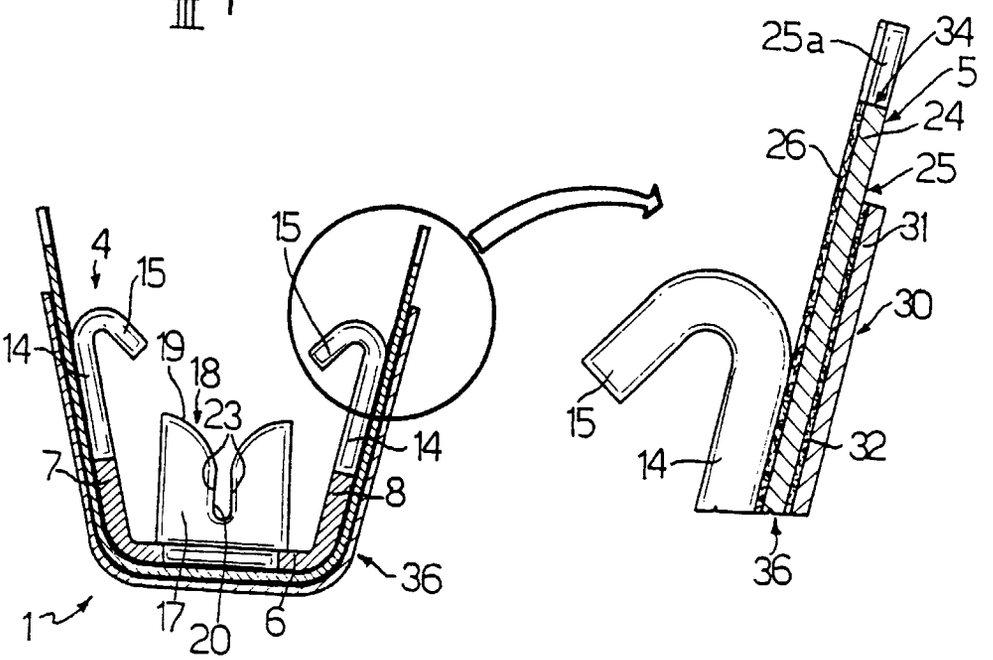


Fig. 3

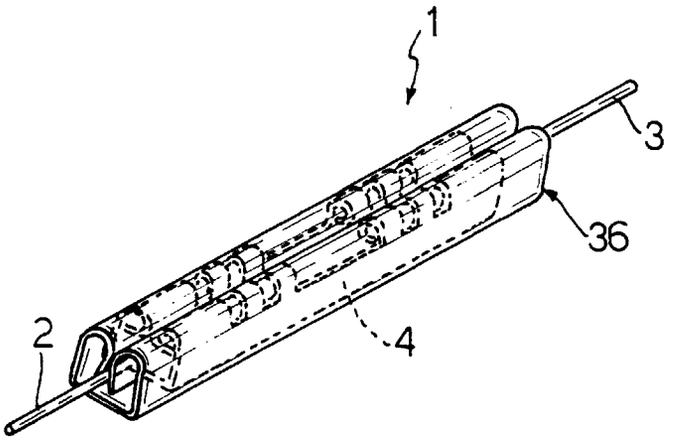


Fig. 4

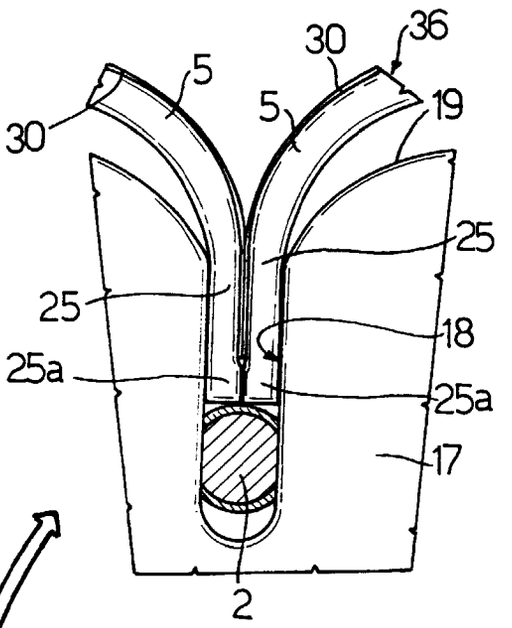
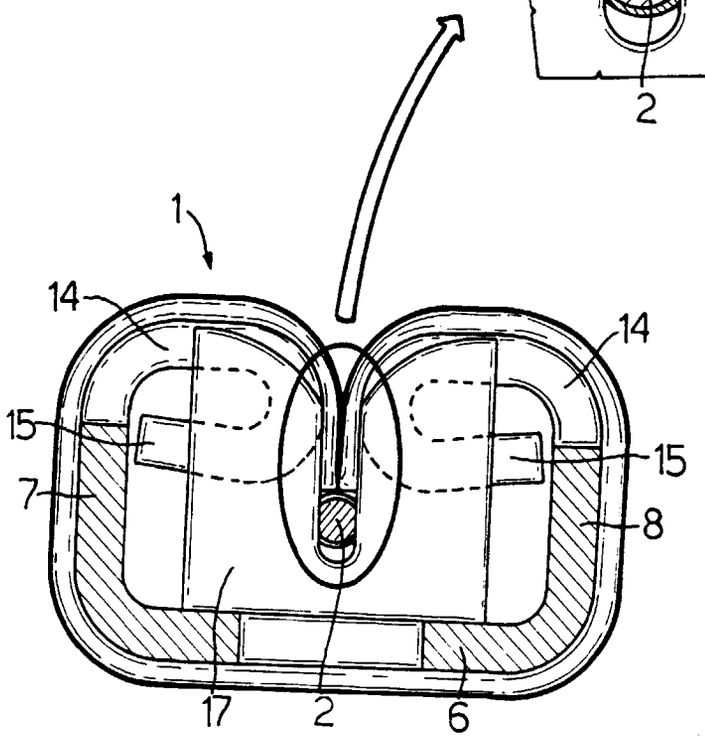


Fig. 5



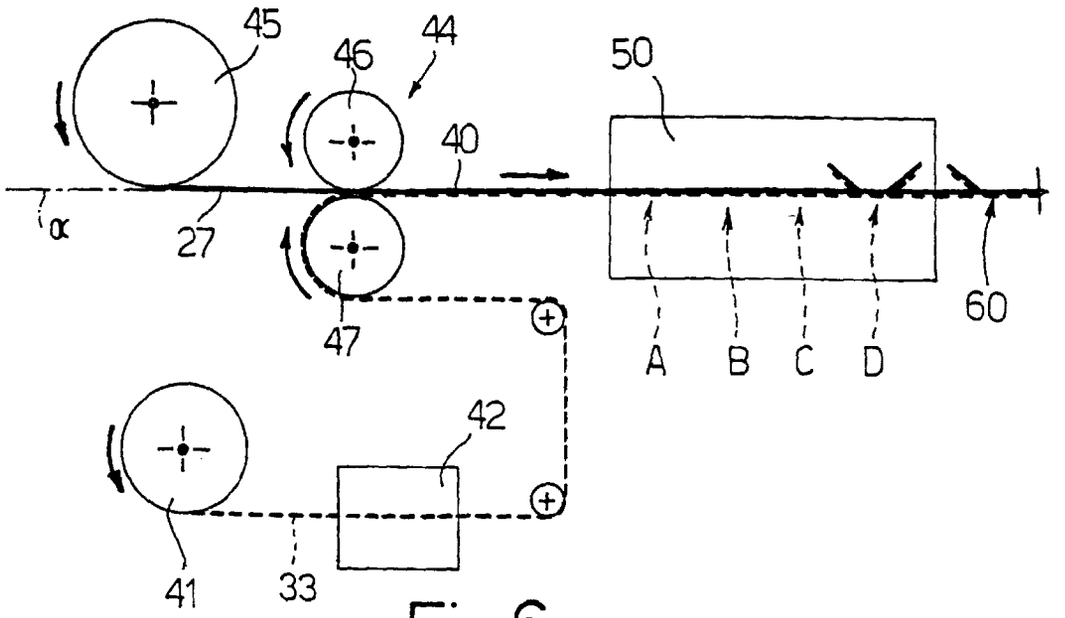


Fig.6

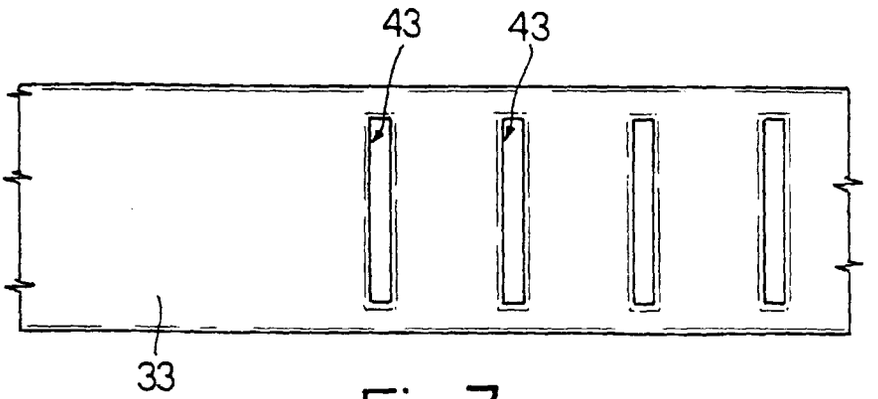


Fig.7

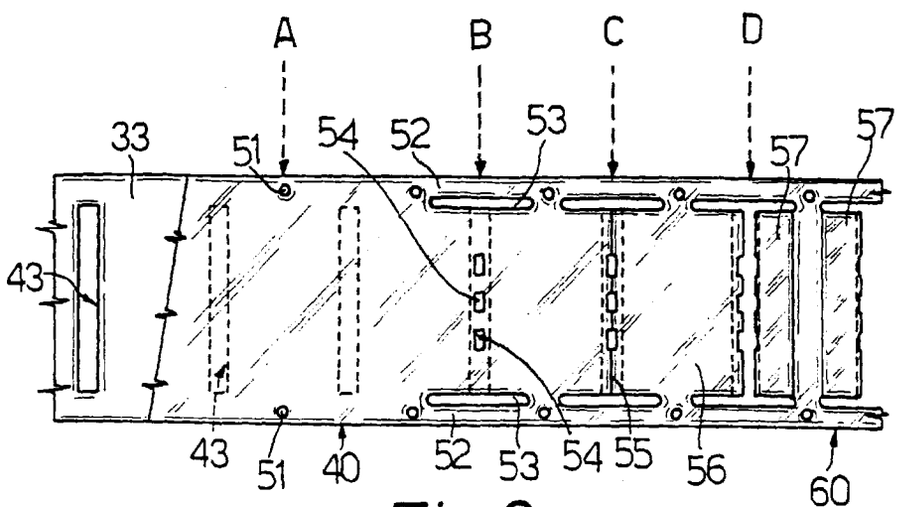


Fig.8

Fig.9