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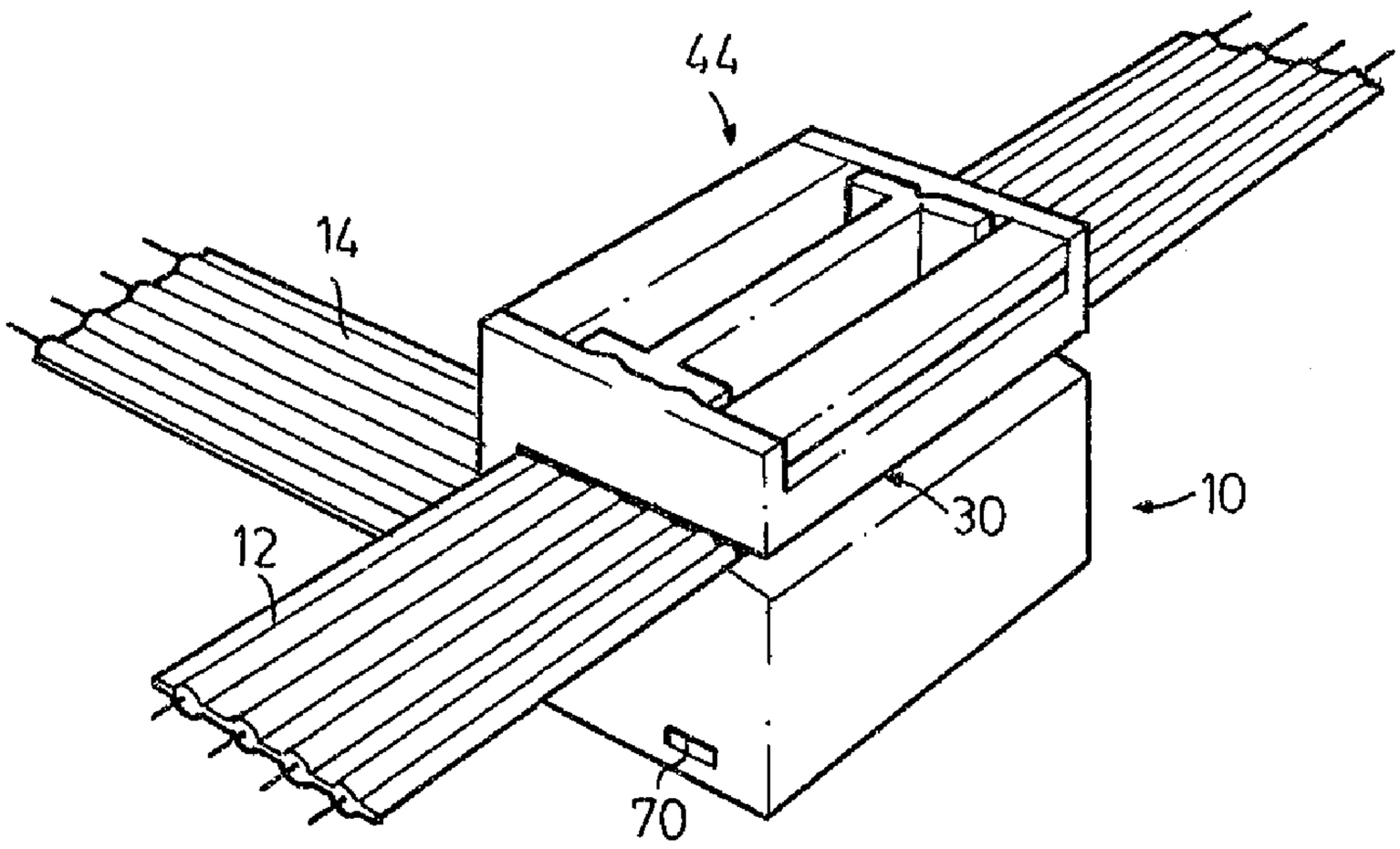
(54) **CONNECTEUR DE CABLE ELECTRIQUE MULTICONDUCTEUR**

(54) **MULTI CONDUCTOR ELECTRICAL CABLE CONNECTOR**




(57) This invention relates to an electrical conductor cable connector which includes a housing made from an electrical insulating material, having side walls which between them define an enclosure, a floor which extends between the side walls to define an open topped compartment in the housing on one side of the floor, a plurality of suitably spaced conductor engaging elements in and extending from the floor into the compartment with each element including a formation in the floor of the housing for electrically connecting an electrical conductor in a cable in the floor to the conductor engaging element, a press member which is made from an electrical insulating material, for pressing a conductor ribbon tape cable into the compartment and the conductors which are carried by the tape into electrical engagement with the conductor engaging elements, mans for clamping the ribbon tape in the compartment between the conductor engaging elements and each tape exit from the housing and a catch arrangement for locking the press member in the compartment to hold the tape clamped in the housing.

## ABSTRACT OF THE DISCLOSURE

This invention relates to an electrical conductor cable connector which includes a housing made from an electrical insulating material, having side walls which between them define an enclosure, a floor which extends between the side walls to define an open topped compartment in the housing on one side of the floor, a plurality of suitably spaced conductor engaging elements in and extending from the floor into the compartment with each element including a formation in the floor of the housing for electrically connecting an electrical conductor in a cable in the floor to the conductor engaging element, a press member which is made from an electrical insulating material, for pressing a conductor ribbon tape cable into the compartment and the conductors which are carried by the tape into electrical engagement with the conductor engaging elements, means for clamping the ribbon tape in the compartment between the conductor engaging elements and each tape exit from the housing and a catch arrangement for locking the press member in the compartment to hold the tape clamped in the housing.

## FIELD OF THE INVENTION

This invention relates to an electrical conductor connector for connecting the conductors of electrical cables to each other and more particularly to so connecting the conductors of multi-strand ribbon tape cables.

## BACKGROUND TO THE INVENTION

Electrical conductor connectors of the type with which this invention is concerned are well known. Many of the known connectors such as those disclosed in U.S. patent No.4,552,429, European patent No.0150593 and Canadian patent No.1070403 all to AMP Incorporated include terminal carriers which have a removable cover which is, in one way or another, engaged with the terminal carrier to hold conductors in the connector in engagement with the terminals of the terminal carrier. Problems that frequently arise with conductor connectors of the above type are that the conductors, whether single conductors or contained in ribbon tapes, may easily be torn from the terminals in the connectors by stress applied to the conductors on the outside of the connector with which they are engaged to cause electrical disconnection of the conductors with the terminals and more often than not irreparable damage to the terminals themselves. A second problem with the known conductor connectors is that the covers for holding the conductors on the terminal carriers are components which are separate from the carriers and so easily become misplaced and prior to location over conductors engaged with the carrier terminals permit, in hostile environmental conditions such as in mines and in

many industrial applications, the ingress of particulate matter and other dirt on to or into the terminal carriers with the possible consequence that the covers may be improperly located and in time become dislodged from the terminal carriers and further that the dirt may interfere with the proper electrical connection of the conductors with the terminals on those connectors in which the covers press the conductors into electrical engagement with the terminals on the terminal carriers.

## OBJECT OF THE INVENTION

It is the object of this invention to provide an electrical conductor connector which will at least minimize the problems discussed above with known conductor connectors.

## SUMMARY OF THE INVENTION

An electrical conductor cable connector according to the invention includes a housing, made from an electrical insulating material, having side walls which between them define an enclosure, a floor which extends between the side walls to define an open topped compartment in the housing on one side of the floor, a plurality of suitably spaced conductor engaging elements in and extending from the floor into the compartment with each element including a formation in the floor of the housing for electrically connecting an electrical conductor in a cable in the floor to the conductor engaging element, a press member which is made from an electrical insulating material, for pressing a conductor ribbon tape cable into the compartment, and

the conductors which are carried by the tape, into electrical engagement with the conductor engaging elements, means for clamping the ribbon tape in the compartment between the conductor engaging elements and the/or each tape exit from the housing and a catch arrangement for locking the press member in the compartment to hold the tape clamped in the housing.

Further according to the invention each conductor engaging element includes a first blade which extends perpendicularly from the housing floor into the compartment with the connecting formation on each conductor element being a second oppositely directed blade which is located in the floor with each blade of each conductor engaging element including a cutting edge for cutting the ribbon tape insulation on a conductor when pressed onto the blade and a slot for electrically engaging a conductor in the insulation when cut by the blade with the press member including slots for receiving the blades which project from the housing floor when the ribbon tape is pressed by the press member into the compartment over the blades.

In one form of the invention the housing floor includes, on its side opposite to that in the compartment, a recess defining a second compartment into which the second blades of the conductor engaging elements project with the connector including a second press member, having blade slots, for pressing a second conductor ribbon tape into the second compartment and the tape conductors, through the cut tape insulation, into electrical engagement with the blade slots and a catch arrangement for locking the second press member in the second compartment.

Conveniently the second compartment includes clamping means for clamping the ribbon tape in the floor in a position between the conductor element blades in the

second compartment and the/or each tape exit from the compartment.

The ribbon tape clamping means may be mating tape direction changing formations between the housing in the/or each compartment and the/or each press member between which the/or each ribbon tape is clamped in use.

Still further according to the invention the catch arrangement for holding the/or each press member in the/or each compartment is a resiliently deformable male formation on a surface of one of the components and a recess in an adjacent surface of the other into which the male formation is pressed to lock the components together when the/or each press member is fully pressed into the/or each compartment.

In a preferred form of the invention the housing includes a ribbon tape entry slot which extends through the wall of at least the first compartment above the conductor engaging elements and the cable connector includes in the/or each compartment, a first catch arrangement for holding the press member in the compartment clear of the tape entry slot and a second catch arrangement for holding the press member in pressure contact with the tape when pressed into clamping contact with the tape.

Conveniently the/or each housing compartment is filled with a flowable liquid sealant.

In many electrical circuit applications in which the cable connector will find application it will be convenient to open a conductor in the connector and the housing may, for this purpose, include a cutting blade which extends from the floor or press member into the/or each compartment for cutting and so open circuiting a pre-selected cable

conductor when pressed by the press member into the compartment with a conductor engaging element on at least one side of the cutting blade in the path of the cut conductor through the housing for electrically engaging the conductor on one side of the blade. Preferably, the base of the press member and the floor in the/or each compartment which carries a cutting blade includes mating formations in the cut conductor path through the housing on one side of the cutting blade for deforming the cut conductor to shorten it out of electrical contact with the cutting blade.

## DETAILED DESCRIPTION OF THE DRAWINGS

The invention is now described by way of example only with reference to the drawings in which:

FIGURE 1 is a perspective view of the electrical conductor cable connector of the invention shown connecting two ribbon tape cables at right angles to each other,

FIGURE 2 is a sectioned side elevation of the connector housing shown sectioned on the line 2 -2 in Figure 3,

FIGURE 3 is a plan view of the Figure 2 housing shown sectioned on the line 3 - 3 in Figure 2,

FIGURE 4 is a partially ghosted perspective view of a single conductor connecting element of the connector of the invention shown connected to two insulated electrical conductors,

FIGURE 5 is a fragmentary end elevation of the upper portion of one of the conductor connecting element blades

of Figure 4,

FIGURE 6 is a sectioned side elevation of one of the press members for use with the housing of Figures 2 and 3,

FIGURE 7 is an end elevation of the press member of Figure 6,

FIGURE 8 is a side elevation of a second press member for use with the Figure 2 and 3 housing,

FIGURE 9 is a sectioned end elevation of the cable connector of the invention in use,

FIGURE 10 is a fragmentary sectioned side elevation illustrating the first stage of engagement of the Figure 6 press member with the Figure 2 housing,

FIGURE 11 is a schematic electrical diagram illustrating the function of the cable connector of the invention,

FIGURE 12 is a fragmetary sectioned end elevation of a cable cutting blade arrangement in the connector housing.

FIGURE 13 is a perspective view of a second embodiment of the conductor connecting element of the invention, and

FIGURE 14 is a fragmentary sectional side elevation of the Figure 13 connecting element shown located in the floor of the connector housing.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The cable connector 10 of the invention is shown in Figure

1 to be connecting two multi-conductor ribbon tape cables 12 and 14 at right angles to each other.

The housing of the connector 10 of Figure 1 is shown in Figures 2 and 3 to include side walls 16 and 18, opposite end walls 20 with a compartment 22 defined between the four walls and a floor portion indicated generally at 24. The floor portion of the housing is recessed to provide a second compartment 26 which is located below and separated from the first compartment by a floor 28.

The walls 18 and 20 of the housing compartment 22 are slotted to provide an entry slot 30 for the ribbon tape 12.

A plurality of conductor engaging elements 32, which are more clearly seen in Figure 4 each include two oppositely directed blades 34 which are joined at right angles to each other by a connector strip. The connector elements 32 are punched from a common strip of electrically conductive sheet metal such as a suitable copper or brass alloy. As is more clearly seen in Figure 5, the upper edge of each of the blades 34 includes spaced points for piercing the insulation of a ribbon tape on either side of one of the conductors of the tape, a V-shaped formation for guiding the conductor into a slot 36 while at the same time slicing through the insulation on either side of the conductor. The width of the slot 36 is very slightly narrower than the diameter of the conductor so that the conductor in the cut insulation is in firm physical engagement with the blade 34 when fully pressed into the slot 36. The edges of the cable locating V could include small ripper teeth 38 to facilitate cutting of the ribbon tape insulation as a conductor is pressed into the slot 36 of the blades 34.

The central portion of the conductor engaging elements 32 including the connector strip between the blades is embedded in the material of the floor 28 with only the slotted portion of the blades 34 projecting from above and below the floor into the compartments 22 and 26 as shown in Figure 2.

The conductor engaging elements 32, in the compartment 22, are each located across a groove in the floor which extends, up and over a rounded formation 40 in the end walls 20 to the slot 30. The grooves serve as locators for the conductor carrying portions of the ribbon tapes which are to be used with the connector. The floor of the compartment 26 is similarly grooved with the grooves running down and over a formation 42 which forms a side wall of the compartment to a tape outlet from the compartment.

Figures 6 and 7 illustrate a press member 44 for use in pressing the ribbon tape 12 into the compartment 22 and into engagement with the conductor engaging elements 32 in the compartment. The press member is shown in the drawings to include side walls 46 and 48, opposite end walls 50 which are joined by a central rib 52 and a base portion 54.

The base 54 of the press member 44 is solid material and carries on its underside and its side walls grooves which, when the press member is located in the compartment 22 of the connector housing are in register with the locating grooves on the floor of the compartment and the formations 40 and slots 56 which are in register with the conductor engaging elements 32 on the floor of the compartment 22 and in which the blades of the elements are fully located when the press member is fully pressed into the compartment to clamp the ribbon tape 12 in the

compartment. The side walls 46 and 48 of the press member are separated from the walls 50 by slots 58 which, together with the resilience of the plastics material from which the press member is made, enable the walls to be flexed inwardly towards the vertical edges of the walls 50 when the walls are pressed inwardly in the direction of the arrows in Figure 6. Catch formations 60 and 62 are positioned on the outer surfaces of the side walls 46 and 48 as shown in Figure 7. The inner surfaces of the side walls 16 and 18 of the connector housing are recessed at 64, as shown in Figure 2, to receive the catches 60 and 62 of the press member.

Figure 8 shows a second press member 66 for location in the compartment 26 of the floor portion 24 of the Figure 2 housing. As is the case with the press member 44 of Figure 6 conductor locating grooves extend over the upper surface of the press member 66 and over onto its left hand vertical edge in Figure 8 and slots for receiving the blades 34 of the conductor engaging elements 32 in the compartment 26. The grooves in the press member are located to be in register with grooves on the underside of the floor 28 and the inner surface of the formation 42 in the compartment 26. The compartment 26 grooves, as with those on the upper surface of the floor, are in register with the slots in the blades 34 of the conductor engaging elements in the compartment. The end walls of the press member 66 include outwardly projecting catch formations 68 which, when the press member is fully pressed into the compartment 26 engage in slots 70 in the end walls of the compartment 26 to lock the press member in the compartment. This press member, as is the case with that of Figures 6 and 7, includes on one end wall two vertical grooves 72 and on the opposite end wall a single centrally located groove, not shown. The purpose of the grooves on the two press members is to ensure that the press members

and the slots 56 in them for receiving the conductor engaging blades 34 are correctly oriented by keying with inwardly projecting ribs 74 on the inner surfaces of the end walls of the compartments 22 and 26.

In use, the compartments 22 and 26 of the connector 10 are at least partially filled with a water resistant highly viscous grease. The ribbon tape 14 is located in the compartment 26 with its free end up against the wall on the right hand side of the compartment. The width of the compartment 26 conveniently corresponds to that of the ribbon tape 14 so that the raised conductor carrying portions of the ribbon tape insulation are located over the grooves and conductor engaging element blades 32 in the compartment. Alternatively, the compartment could be wider than the tape 14 but would then include one or more stops on the underside of the floor 28 accurately to locate the tape 14. The press member 66 is now located over the mouth of the recess 26 with the grooves 72 engaged with the locating ribs 74 on the inner surfaces of the end walls of the compartment. The press member is now pressed, conveniently by a suitable tool, into the compartment to press the ribbon tape 14 down over the blades 34 which cut through the insulation on the sides of the conductors in the tape and press the conductors into the slots 36 in the blades. The catch formations 68 on the end walls of the press member are pressed, by resilient deformation of the catch formations and/or deformation of the walls 20 over the inner surfaces of the recess end walls until they clip into the slots 70 with the upper surface of the press member bearing on the ribbon tape 14. The raised conductor insulation of the tape 14 is now firmly located in the grooves in the compartment floor and in the press member. The formation 42 is dimensioned to be almost a friction fit with the left hand vertical side wall of the press member so that

the ribbon tape is firmly pressure clamped in the compartment between the vertical side of the press member and the formation 42 to lock the ribbon tape in the compartment against any stress applied to the ribbon tape on the outside of the cable connector 10.

With the ribbon tape 14 now located in the compartment 26 and its conductors in electrical contact with the conductor engaging element blades 34 in that compartment the press member 44 is pressed into the recess 22 of the housing until its catches 60, again by resilient deformation of the material of the press member, engage in the recesses 64 in the walls 16 and 18 of the housing. With the catches 60 so engaged in the recesses the underside of the base 54 of the press member is situated above the upper edge of the slot 30 in the housing walls as shown in Figure 10.

At its place of use the ribbon tape 12, to which one or more of the connectors 10 are to be connected, is slid sideways into the slot 30 until its leading edge abuts the end of the slot 30 in the compartment 22. The entrance to the compartment could, as shown in Figure 2, include a flared mouth which terminates in a very slightly raised projection 76 over which the ribbon tape 12 is frictionally moved into the slot 32 and which, once in the slot, engages the outer edge of the tape 12 accurately to locate the tape in the slot 30 with its raised conductor insulation over the grooves in the floor of the compartment and on the underside of the base 54 of the press member. As has been mentioned previously, the grooves 72 in the press member which are keyed with the ribs 74 on the end walls 20 of the compartment ensure that the slots 56 in the base of the press member are located directly over the blades of the conductor engaging elements 32 in the compartment. The press member 44 is

now pressed downwardly into the compartment 22 with the side walls 46 and 48 hinging inwardly to permit the catches 62 to engage in the recesses 64 in the side walls of the housing to lock the press member in the housing in pressure contact with the ribbon tape 12. The ribbon tape conductors, as described with reference to the compartment 26, are now firmly located in the slots 36 of the blades 34 in the compartment 22. As will be seen from Figures 7 and 9 the side walls of the base 54 of the press member are rounded complementally to the formations 40 in the compartment 22. The side walls of the press member base are dimensioned, as is the case with the formation 42 of the compartment 26, to clamp the ribbon tape firmly between the press member and the vertical portions of the formations 40 against movement in the compartment by stress imposed on the ribbon tape 12 on the outside of the connector. This is illustrated in Figure 9 which more clearly illustrates the direction changing clamping formations on both the housing and press member 44.

To release the cable connector of the invention from the ribbon tape 12 the side walls of the press member 44 are pressed inwardly in the direction of the arrows in Figure 6 to clear the catches 62 of the recesses 64 in the walls 16 and 18 of the housing and, when cleared, the press member is merely lifted in the compartment 22 until the catches 60 abut the upper edges of the recesses 64. The ribbon tape 12 may then merely be tensioned to lift it from the conductor engaging element blades 34 and, when straightened, is merely slid from the slot 30 in the connector housing.

In some applications, it may be desirable to open circuit one of the ribbon tape conductors in the connector as illustrated in Figure 11. To achieve this, as shown in Figures 2, 3 and 12, a blade 78 is embedded in the floor

28 of the housing to project into one of the compartments, in this case compartment 22, with its sharpened upper edge projecting into the compartment. The press member 44 includes a recess for receiving the sharpened edge of the blade in use as illustrated in Figure 12. The blade 78 is located in the conductor path between two blades 34 of linearly spaced conductor engaging elements 32 with a raised formation 80 on the floor 28 extending across the conductor insulation groove between the blade 78 and one of the blades 34. The underside of the press member 44 includes a complementally shaped female formation 82, as shown in Figures 2 and 6, in which the formation 80 is located in use. As the press member 44 now presses the ribbon tape 12 down onto the floor of the compartment 22 the blade 78 severs the conductor in whose path it lies with the conductor being deformed and so shortened by the formations 80 and 82 out of electrical contact with the blade 78 to ensure a clean open circuit 84 as shown in Figure 11. The open conductor on either side of the break is now connected, through the blades 34 on either side of the cutting blade 78, to conductors on the ribbon tape 14. It will be noticed from Figure 11 that the ribbon tape 14 in this drawing includes five conductors whereas the connector, as shown in the remaining drawings, has provision only for four. This is not amiss as the connector of the invention could be designed for any reasonable width of ribbon tape having however many electrical conductors are required for a specific application.

The invention is not limited to the precise details as herein described. For example as an alternative to the conductor engaging elements 32 being moulded into the floor 28 of the housing, the floor could include, as shown in Figure 14, an L-shaped recess into which the elements 32 are pressed on completion of the plastics moulding

process. One of the legs of the L extends through the floor 28 and is shaped as shown in the drawing to include a step 86. The portion of the recess defining the outer leg of the L extends from the underside of the floor to terminate at 88 below the upper surface of the floor. The press in conductor engaging elements 32 in this application are modified from that of Figure 4 in that they include a locking tang 90 which extends downwardly and inwardly from the base of one of the blades 34, as shown in Figure 13, and a dimple 92 on the remaining blade 34. With the conductor engaging elements 32 held as shown in Figure 13 they are pressed into the L-shaped recesses in the underside of the housing floor 28 until the upper blade 34 projects from the upper surface of the floor 28 and the lower edge of the locking tang engages over the recess step 86, as shown in Figure 14, to lock the element 32 in the recess. The dimple 92 serves firmly to locate the other blade 34 in its recess against flexing in the recess.

Additionally, the conductor cutting blade 78 described with reference to Figures 11 and 12 could be fixed to the press member 44 in place of the floor 28 with the blade receiving recess located in the upper surface of the floor 28.

CLAIMS

1. An electrical conductor cable connector including a housing made from an electrical insulating material, having side walls which between them define an enclosure, a floor which extends between the side walls to define an open topped compartment in the housing on one side of the floor, a plurality of suitably spaced conductor engaging elements in and extending from the floor into the compartment with each element including a formation in the floor of the housing for electrically connecting an electrical conductor in a cable in the floor to the conductor engaging element, a press member which is made from an electrical insulating material, for pressing a conductor ribbon tape cable into the compartment and the conductors which are carried by the tape into electrical engagement with the conductor engaging elements, means for clamping the ribbon tape in the compartment between the conductor engaging elements and each tape exit from the housing and a catch arrangement for locking the press member in the compartment to hold the tape clamped in the housing.

2. An electrical conductor cable connector as claimed in claim 1 in which each conductor engaging element includes a first blade which extends perpendicularly from the housing floor into the compartment with the connecting formation on each conductor element being a second oppositely directed blade which is located in the floor with each blade including a cutting edge for cutting the ribbon tape insulation on a conductor when pressed onto the blade and a slot for electrically engaging a conductor in the insulation when cut by the blade with the press member including slots for receiving the blades which project from the housing floor when the ribbon tape is pressed by the press member into the compartment over the

blades.

3. An electrical conductor cable connector as claimed in claim 2 in which the housing floor includes, on its face opposite to that in the compartment, a recess defining a second compartment into which the second blades of the conductor engaging elements project with the connector including a second press member, having blade slots, for pressing a second conductor ribbon tape into the second compartment and the tape conductors, through the cut tape insulation, into electrical engagement with the blade slots and a catch arrangement for locking the second press member in the second compartment.

4. An electrical conductor cable connector as claimed in claim 3 in which the housing floor includes slots in which the conductor engaging elements are located with each slot including in its length through the floor a catch formation and each conductor engaging element a tang which is located on one of its blades and engaged with catch formation in the slot to lock the element in the slot with its blades projecting from opposite faces of the housing floor.

5. An electrical conductor cable connector as claimed in claim 4 including clamping means between the housing in the second compartment and the second press member for clamping the ribbon tape in the floor between the conductor element blades in the second compartment and the tape exit from the compartment.

6. An electrical conductor cable connector as claimed in any one of the above claims in which the ribbon tape clamping means are tape direction changing formations between the housing in each compartment and the press members between which the ribbon tapes are clamped in use.

7. An electrical conductor cable connector as claimed in claim 4 in which the catch arrangement for holding each press member in each compartment is a resiliently deformable male formation on one of the components and a recess in the other into which the male formation is pressed to lock the components together.

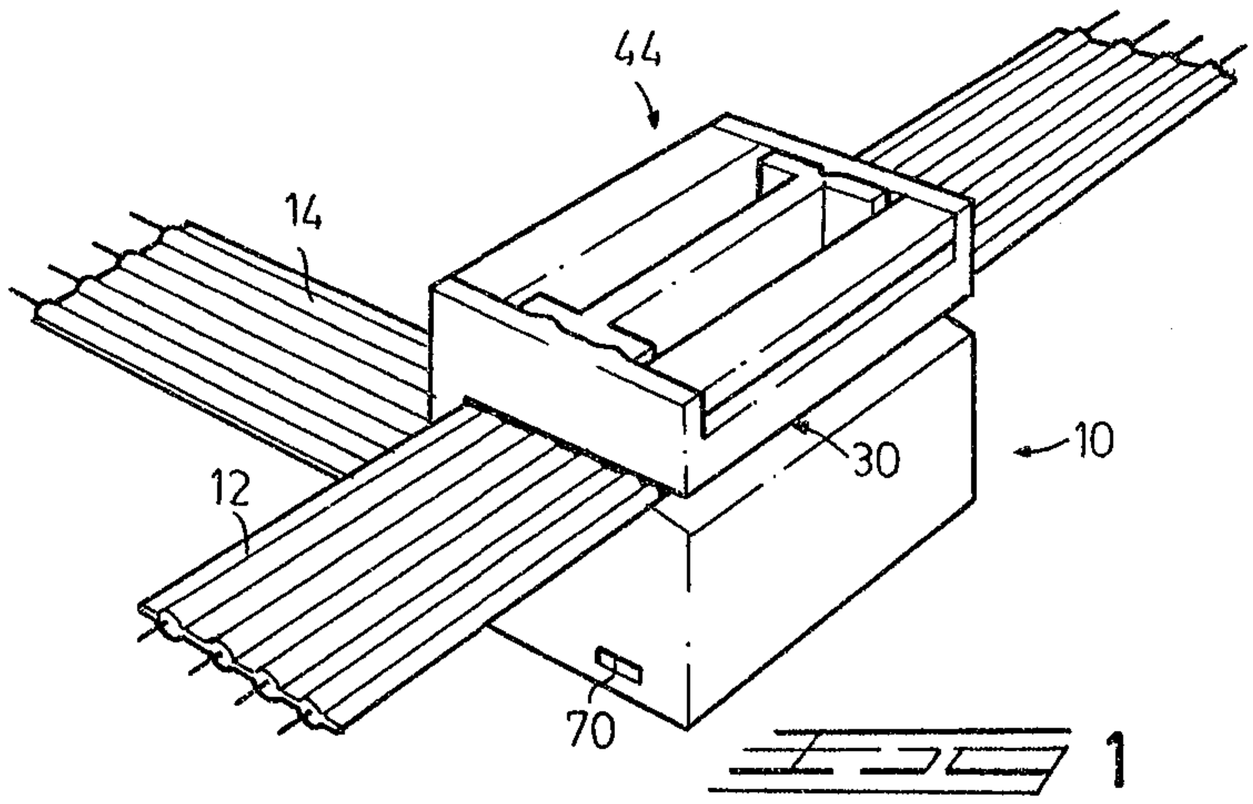
8. An electrical conductor cable connector as claimed in claim 1 in which the housing includes a ribbon tape entry slot which extends from one side of the housing through the walls of the compartment above the conductor engaging elements, and the cable connector in the compartment, includes a second catch arrangement for holding the press member in the compartment for movement between a first position in which it is clear of the tape entry slot and a second position in which the press member is locked by the first catch arrangement in the compartment into clamping contact with the tape on the housing floor.

9. An electrical conductor cable connector as claimed in claim 1 in which the housing compartment is filled with a flowable liquid sealant.

10. An electrical conductor cable connector as claimed in claim 1 including a cutting blade which extends from the floor into the compartment for cutting and so open circuiting a pre-selected cable conductor when pressed by the press member into the compartment with a conductor engaging element on at least one side of the cutting blade in the path of the cut conductor through the housing for electrically engaging the conductor on one side of the blade.

11. An electrical conductor cable connector as claimed

in claim 10 in which the base of the press member and the floor in the compartment include mating formations in the cut conductor path through the housing on one side of the cutting blade for deforming the cut conductor to shorten it out of electrical contact with the cutting blade in use.

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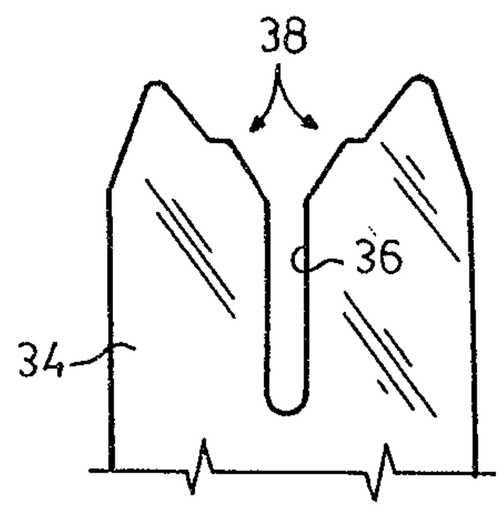


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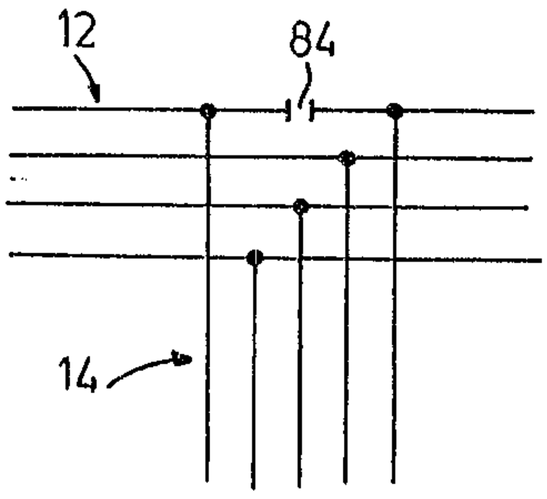


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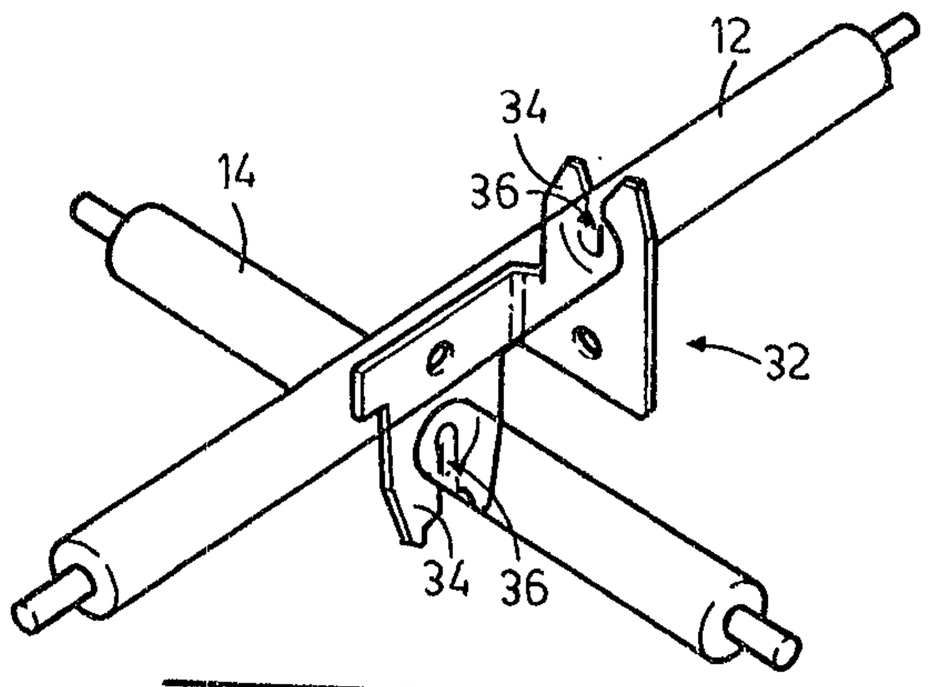


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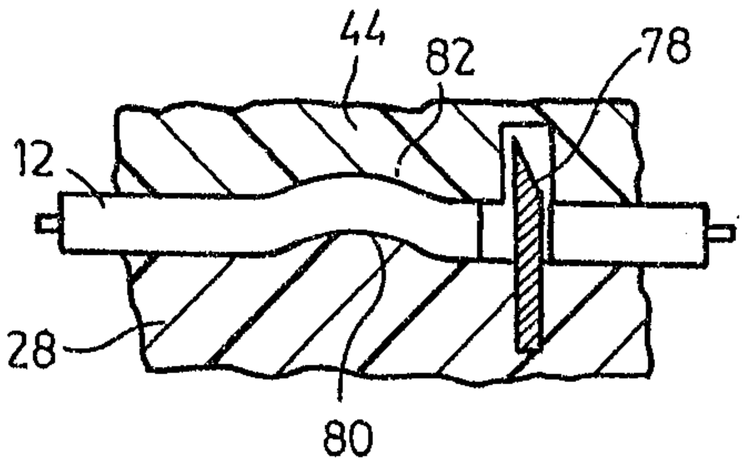


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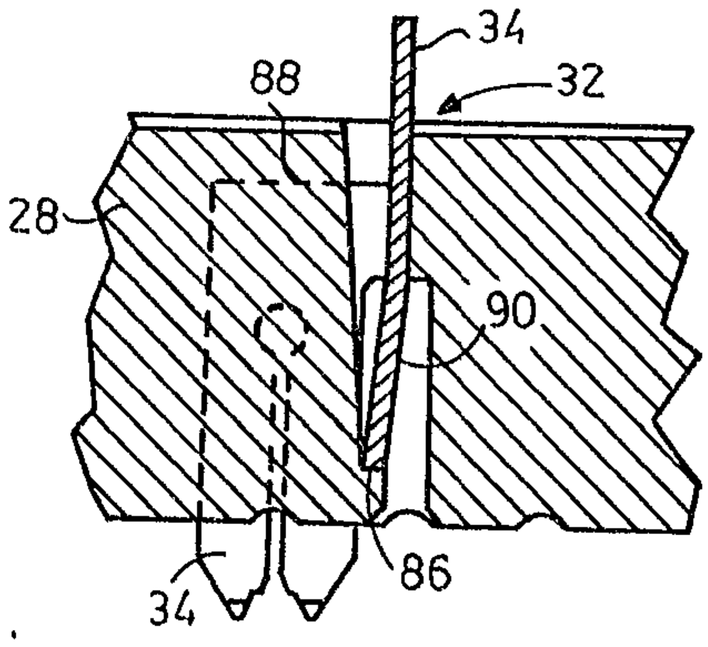


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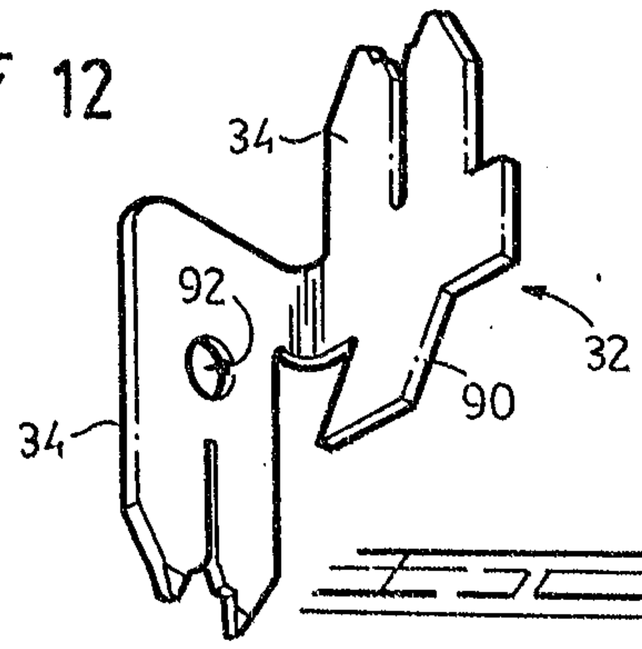


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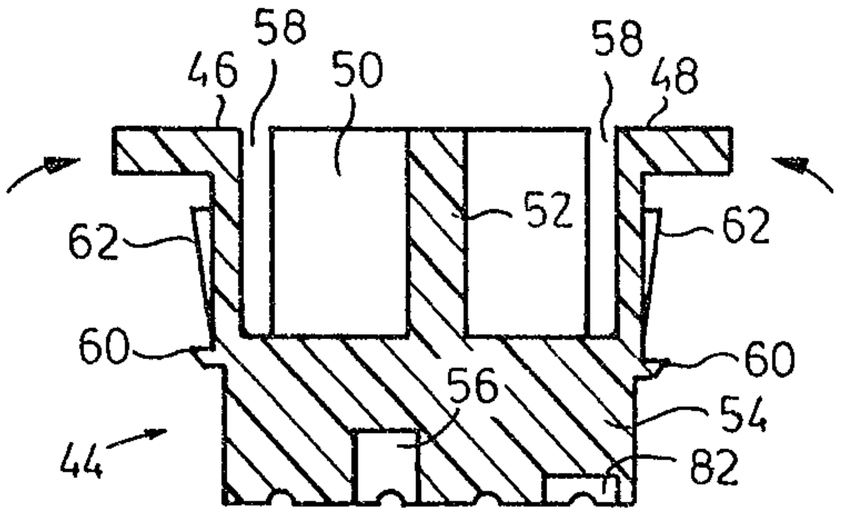



Fig 6

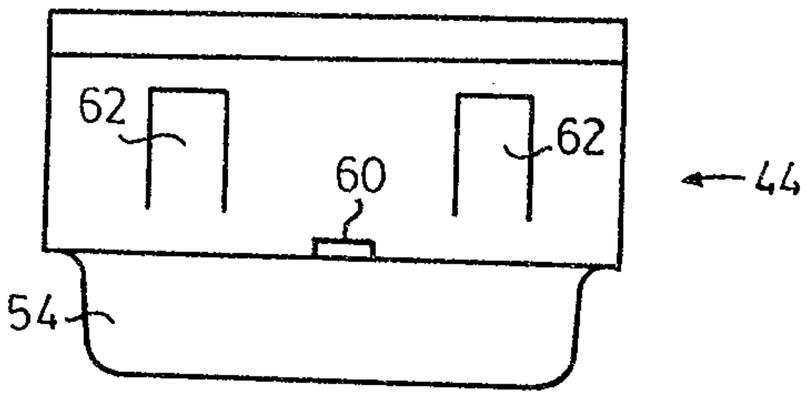



Fig 7

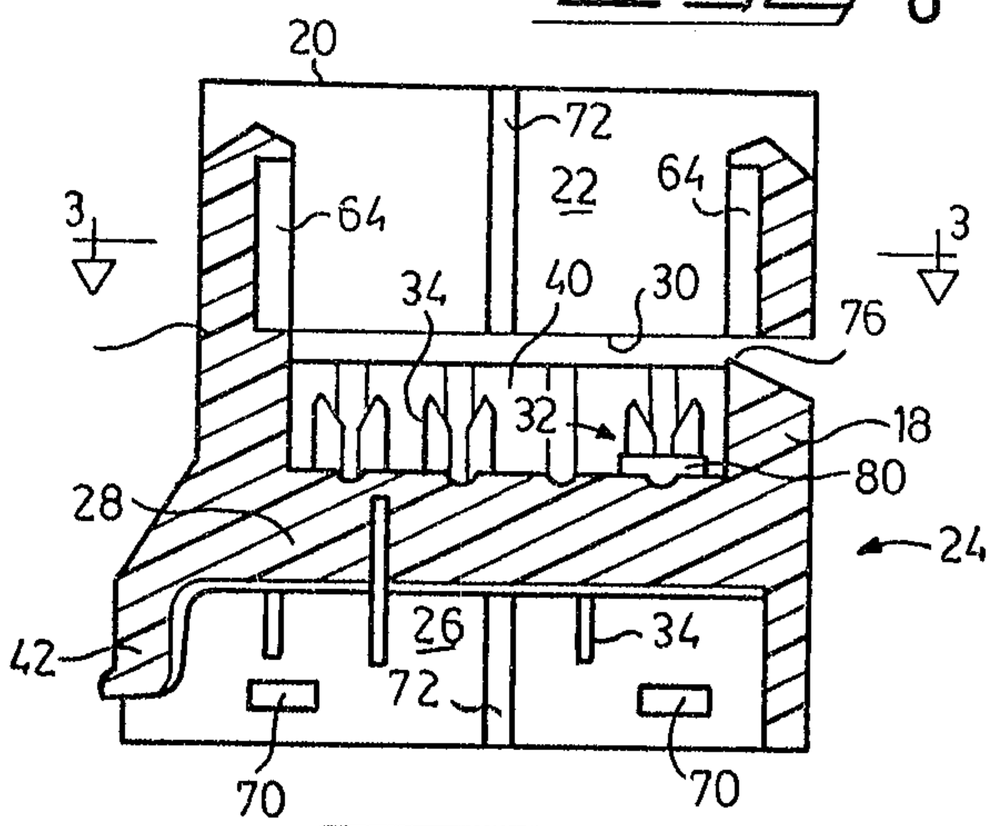



Fig 2

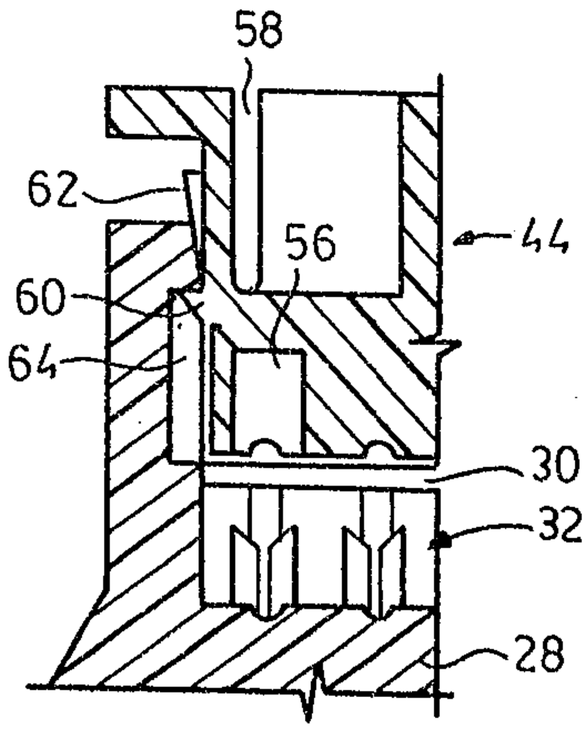



Fig 10

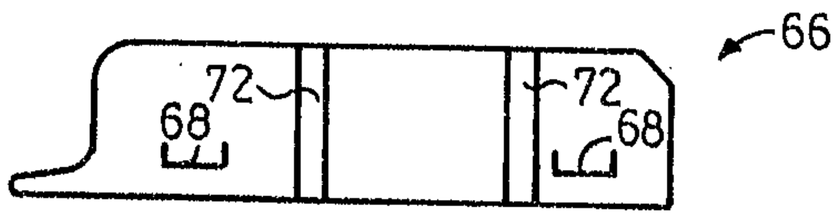
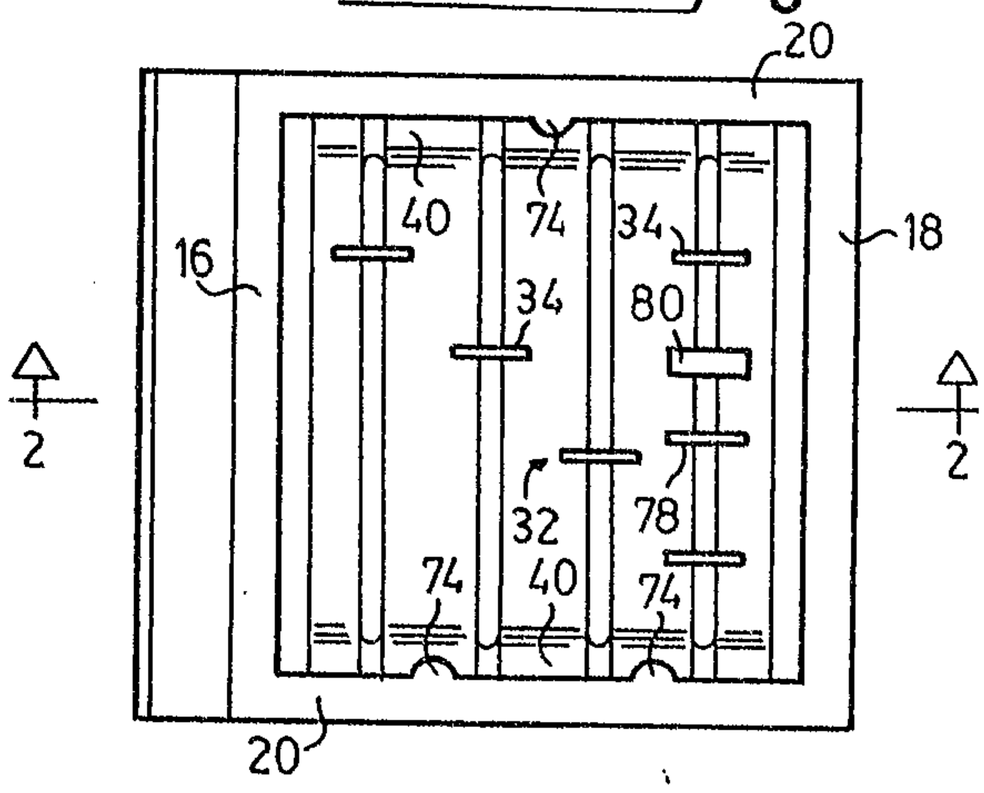



Fig 8



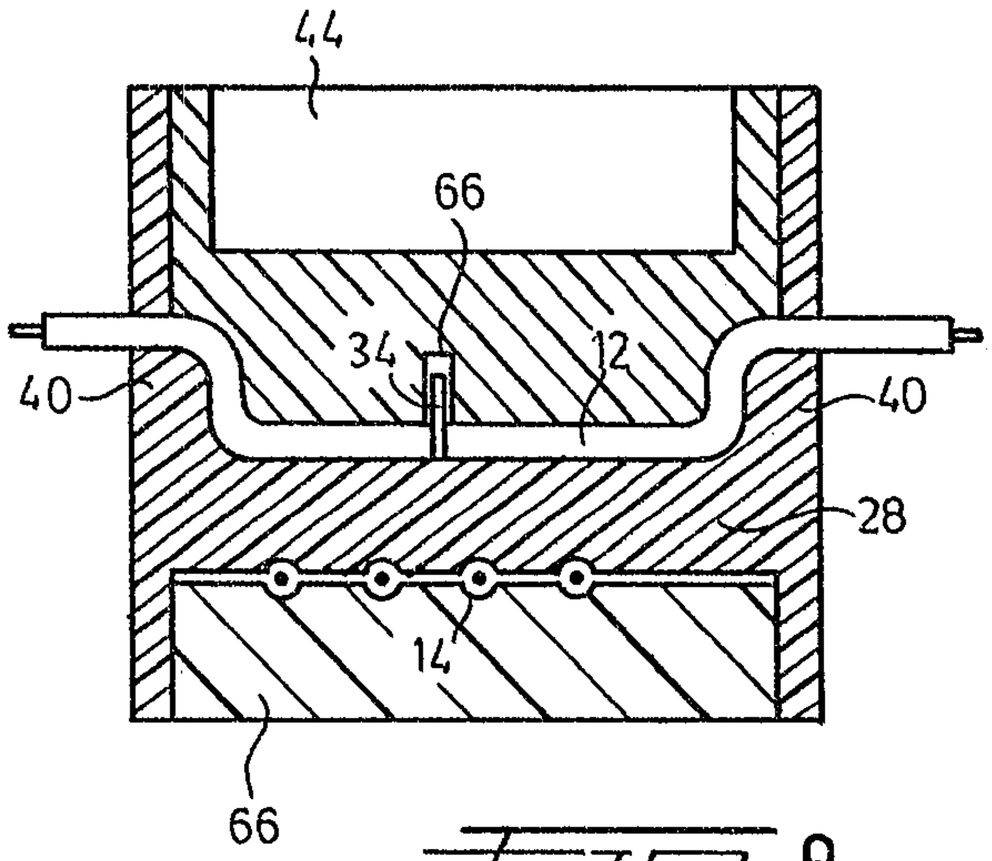




Fig 9

Fig 3

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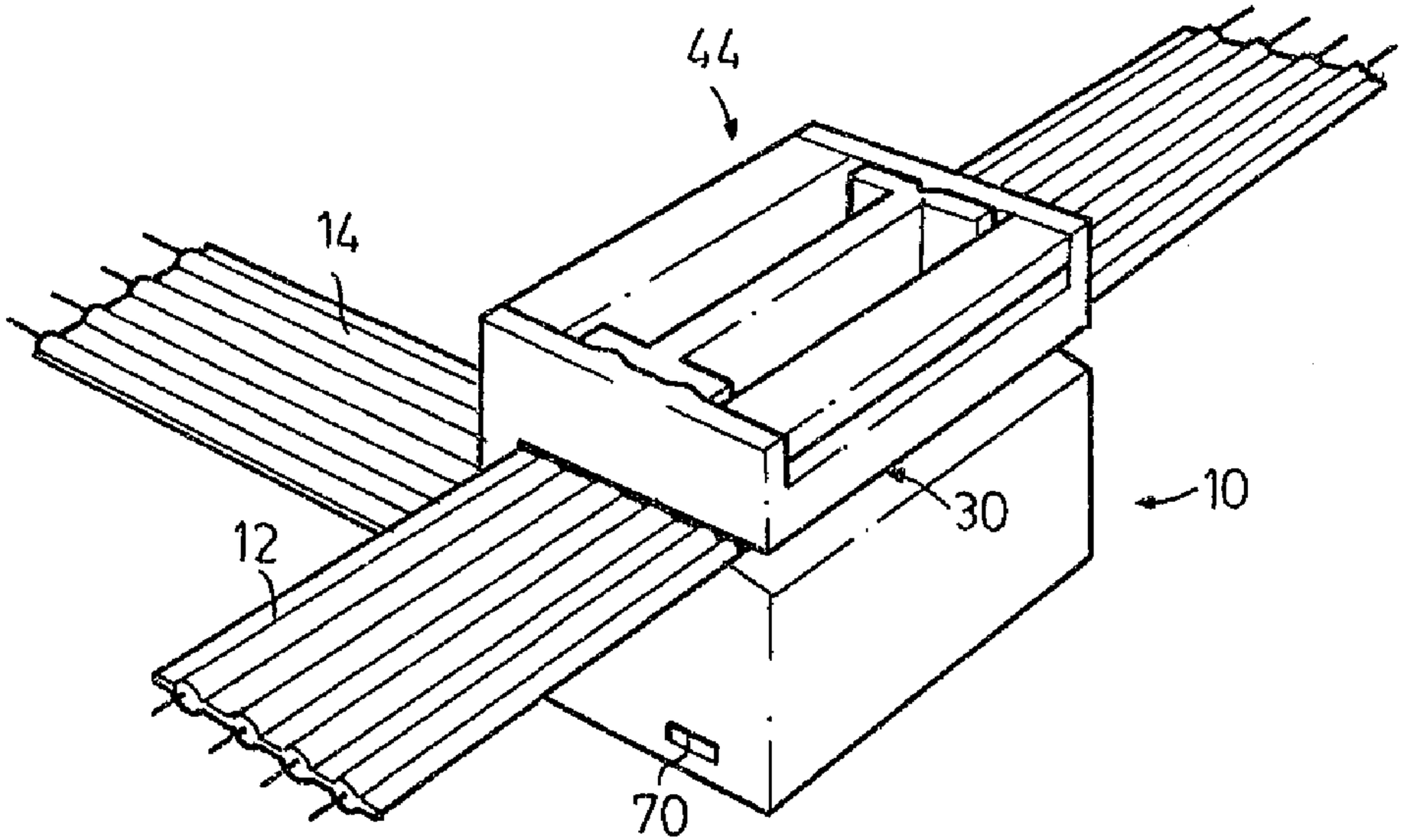
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