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**EP-A- 0 021 550**  
**EP-A- 0 124 695**  
**EP-A- 0 174 165**

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## Description

This invention relates to a connector, and particularly, though not exclusively, to a branch-off connector, for an electric cable, especially a power cable. Although the invention finds application primarily with low voltage cables, that is to say cables operating at voltages less than about 1kV, it is also applicable to higher voltage cables.

In a branch joint, a branch cable takes electricity from a main cable to supply equipment on a spur. In some instances, there is the requirement that the core conductors of the main cable are not cut at the branch connection. The main cable has its outer jacket and any other common outer components of the cable cut back so as to expose the individual, insulated cores of the cable, defining a branch-off region. Conventionally, a branch-off connector is mounted on the exposed cores in the branch-off region and has one set of contacts, which may be screw contacts, for connecting to respective ones of the core conductors of the main cable, and another set of contacts for receiving the core conductors of the branch cable. Electrical connection between the branch cable and the main cable is made. Subsequently, electrical insulation and environmental protection is applied to the branch-off region.

One known method of insulating and protecting the branch-off region involves the positioning of a two-part rigid plastic box around the region, being sealed at each end on to the cable jacket. Epoxy resin is poured in to fill the box and to exclude air from around the connector and between the cores. The resin is allowed to cool and cure. This method, however, has the disadvantages of using potentially toxic materials, and of having to mix two components together, and then pour them into the box before any appreciable curing takes place. Consequently, adequate ventilation has to be ensured, thus precluding use of the method in confined areas, care has to be taken with the viscous resin, and the jointer has to wait until the resin has cooled and fully cured before power can be re-supplied to the main cable. The curing period can be as long as ten to fifteen hours, and if power is applied too soon, gas bubbles may be evolved from the resin, giving rise to voids in the insulation and thus the risk of poor electrical performance of the branch joint. Furthermore, the potting that is involved with this method in practice precludes re-entry of the joint without its destruction.

Another known method of insulating and protecting a branch-off region, and one that mainly overcomes the disadvantages of cast resin joints, is to use a heat-recoverable polymeric insulating wraparound sleeve. Such a sleeve, available from Raychem with its rail and channel closure system, is wrapped around the branch-off region and extends at each end over the cable jacket. The longitudinal sleeve edges, each having a rail formed therealong, are brought into abutment and the channel member slid over them to secure them together. Heat, for example from a gas torch, is then applied to the sleeve to cause it to shrink into conformity with the underlying components. The sleeve is internally coated so as to provide a seal along its closure region and on to the cable. Power may be restored immediately to the main cable, and the shrinking technique is quick, relatively safe, and involves little skill. The joint may be re-entered by cutting away the sleeve, and the required action to the connector or cable carried out. Insulation and protection may be re-applied to the branch-off region using a fresh recoverable sleeve.

Other branch-off connectors are shown in EP-A- 0 021 550 and EP-A- 0 124 695, in which the main cable and branch-off cable are secured together in a housing enclosing the cables and filled with insulating protective material.

In the known methods, however, access to the branch connector, for replacing a branch cable, for adding a further branch cable, or for taking one away for example, involves disturbing the joint at least to the extent that the environmental sealing of the branch-off region is destroyed. Furthermore, the joint has subsequently to be re-built, to a greater or less degree depending on the particular method used.

It is one object of the present invention to provide an electrical connector and a method of forming an electrical connection that overcomes the above-mentioned disadvantages associated with branch-off connections, and that also allows connections to be made to a cable in an in-line manner. An in-line joint involves the connection of two cables end-to-end.

In accordance with one aspect of the present invention, there is provided an electrical connector for an electric cable, comprising: first and second body members arranged to be secured together to form a housing enclosing the cable at a region of the cable at which the or each core of the cable is exposed, the housing comprising a first electrically conductive member that provides at least one electrical contact for connection to a further cable, and a first electrical connection member mounted within the housing to effect connection between the first conductive member and a core conductor of said cable within the housing, the housing containing insulating material for sealing the electrical connection, the connector being characterised in that said at least one electrical contact is exposed to an outer surface of the housing; in that the first electrical connection member is operable from outside the housing; in that the insulating material is cross-linked and seals against ingress of moisture into the housing; and in that a third body member is arranged to receive and terminate the

further cable, the third body member comprising a second electrically conductive member that is arranged to extend from a core conductor of the further cable so as to provide an electrical contact exposed to an outer surface of the third member, and the third body member being arranged to be mounted on the housing such that the first and second conductive members are interconnected, thereby to interconnect the core conductors of the said cable and the core conductors of said further cable.

In accordance with another aspect of the present invention, there is provided a method of forming an electrical connection to an electric cable, comprising the steps of connecting together first and second body members so as to form a housing around a region of the cable at which the or each core of the cable is exposed, the housing containing insulating material, characterised in that a first electrically conductive member is mounted in the housing so as to expose at least one electrical contact thereof to an outer surface of the housing for connection to a core conductor of a further cable; in that an electrical connection member that is mounted in the sealed housing is operated from outside thereof so as to contact a core conductor of said cable, thereby to effect electrical connection between said electrical contact and said core conductor; in that the insulating material is cross linked and seals against ingress of moisture into the housing; in that a third body member is mounted at an end of the further cable such that a second electrically-conductive member mounted within the third body member extends from a core conductor of the further cable so as to provide an electrical contact exposed to an outer surface of the third body member; in that the third body member is mounted on the housing; and in that the contact of the second conductive member is electrically connected to said at least one contact of the first conductive member.

The invention is particularly, though not exclusively, concerned with the provision of a branch-off connector and branch-off connecting method, thus dealing with a branch-off region of a cable (the main cable) that is partway along its length and at which outer components of the cable (such as outer jacket and insulation) have been removed to expose the individually insulated cores so that they may be correctly identified for subsequent connection. The further cable is then the branch cable. Furthermore, the branch-off connector may be applied to a single core cable, in which case removal of the cable jacket is not usually required. However, the invention is also applicable to an in-line joint, whereby a sealed connection can be provided at an end of a cable for subsequent connection to an end of another cable. Thus, a cable may have a region at its end at which the core or cores (usually individually insulated) are exposed, and the connector of the invention may be sealingly connected thereto. Electrical connection to a further cable can then be made either at the same time or subsequently, with the original cable having voltage supplied thereto. It will be appreciated that the further cable may itself have a connector in accordance with the invention mounted at one end, so that the interconnection of the two cables involves only the interconnecting of the two connectors.

It will further be appreciated that when the connector of the present invention is applied to the end of a cable, it can be used in place of a conventional end cap. An end cap is a sealing component mounted on an exposed end of the cable, for example being heat shrunk thereon, to provide temporary protection until the circuit of which the cable forms part is completed. The end cap however, has to be removed, and thereby destroyed, when electrical connection is required to be made to the cable. The connector of the invention when used in this way may also be utilised to provide a supply of power from the cable, for example while the cable is temporarily unconnected at a work site.

A branch-off region of a cable, for example, needs to be sealed against ingress of moisture, so that no electrically conductive path is thereby formed between a live conductor and earth, or, in the case of a multi-conductor cable only, between one live conductor (i.e. phase) of the cable and another. It is known that in operation of a cable in a damp environment, moisture may penetrate a damaged outer cable jacket and travel along the cable along a core or between the cores. Thus, where the core insulation is broken, e.g. pierced, at a branch-off region, it is necessary to ensure that insulation is re-applied. The sealed housing of the connector of the present invention ensures this.

The sealant material used in the present invention is cross-linked so as to enhance its performance at higher temperatures, for example at temperatures of 50°C, up to around 95°C and higher, at which power cables can operate under load. A non cross-linked material, such as a grease, would melt and flow away at high temperature, thus negating its sealing.

For convenience only, and not by way of limitation, the following description will refer mainly to a branch-off joint of a multi-core cable, with the cable (the main cable) extending continuously through the connector housing. It is understood that, with suitable modification where necessary, the invention is also applicable to an in-line joint or end cap, and to connection to a single core cable.

The housing may contain, for example by having moulded therein, a plurality of first conductive members to be associated with respective ones of the cores of a multi-core main cable.

A plurality of electrical connection members, such as insulation piercing screws for example, are preferably mounted in the housing so as to be accessible from an outer surface thereof. The connection members are

arranged to contact respective ones of the first conductive members, and to pierce the insulation of respective core conductors of the main cable so as to effect electrical contact therewith. The electrical connection members may either be permanently retained within the housing, or may be introduced therein at any time when it is required to energise the branch cable. It will be appreciated that the connection members should be sealingly engaged with the housing, and may, after insertion, be covered by insulating plugs, of the cross-linked, insulation, moisture sealant material for example.

It will be appreciated that the connection and disconnection of a third body member does not disturb the sealing of the branch-off region, since the mounting of the first and second body members on the main cable is not disturbed. Furthermore, when each of the first conductive members is arranged to expose two or more contacts, the third body member may be mounted on the housing in a plurality of different orientations with respect to the main cable. Thus, the branch cable may be arranged to extend to one or the other side of the main cable, parallel therewith in one or the other direction, or perpendicularly thereto. Additionally, two or more branch cables may be connected to the main cable independently of each other.

Thus, the connector and method of the invention overcomes the destruction of the sealing that is associated with re-entry using known connectors and methods.

Other pieces of electrical equipment, such as a switch, a fuse, or a surge arrestor for example, may also be connected electrically in series with the branch cable, interposed between it and the main cable, and may be so connected without disturbing the sealing of the branch-off region of the main cable.

It will be noted that using the present invention, there is no need to interrupt the power supply to the main cable, since electrical connection thereto by means of the electrical connecting members may be made whilst the cable is live. Furthermore, this connection need not be made at the time the sealing of the branch-off region is effected. Indeed, the attachment of the branch cable to the housing need not be made at the time of sealing the branch-off region. Thus, the main cable could be put into position, possibly with a plurality of (sealed) branch-off housings mounted at desired positions therealong, and branch-off connections conveniently made at any subsequent time. Also, the branch cables could be mechanically connected to the main cable at one time, left without power supplied thereto (even though the main cable is live), and electrically connected to the main cable at a later time. All of this can be done using the connector and method of the present invention without disturbing the sealing of the branch-off region.

At a branch-off region, sealing is required primarily to prevent ingress of water and water vapour into the housing. Such moisture may have entered the cable away from the branch-off region, through a breach in the cable jacket for example, and may pass along the inside thereof between the cores. It is essential then to ensure that at the branch-off region, where the core conductor insulation has been interrupted, no moisture can form a conductive path between any of the cores (whether at phase voltage or at earth potential). The sealing may also conveniently be required to replace the electrical insulation of the removed cable jacket, in the case of a multi-core cable. The sealing may conveniently be achieved by having a quantity of the electrically insulating and water resistant cross-linked sealant material, such as gel for example, in one or both of the first and second body members before they are secured together around the branch-off region to form the housing. The quantity of gel, or other sealant material, is chosen such that all of the air spaces around the conductor cores and within the body members are filled when the housing is formed. In general, the following materials when cross-linked are suitable for providing an electrically insulating and water resistant seal of the branch-off region: gels, greases, mastic, unvulcanised soft rubbers, or a water curable material such as silicone. When the material is a gel, this is preferably a suitable material as described in Patent Application Publication No. WO 86/01634.

The or each of the body members may be made, for example by moulding, from rigid plastics insulating material. In general, the body members of the branch-off connector of the invention may be formed from rigid thermoplastics or thermosetting materials, epoxy resins, or polyester materials, that are capable of mechanically withstanding the temperatures to which they are subjected during normal and test operation of the cable. One or more mechanical reinforcing members may be embedded in or applied to the body members if required so as to withstand the mechanical stresses, particularly under thermal cycling that occurs with operation of power cable. Such member or members may be of metal, electrically insulated from the other conductive components of the connector.

Embodiments of a connector and method, for forming a branch-off with a four-core cable, 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 perspective view showing one embodiment of the connector connecting a branch cable to a main cable;

Figure 2 is a plan view of the connector of Figure 1;

Figure 3 is a side elevation of a housing part of the connector of Figure 1;

Figure 4 is a section along the line I-J of Figure 3;

Figure 5 is a section along the line G-H of Figure 3;  
 Figure 6 is an elevation along the line C-D of Figure 3;  
 Figure 7 is an elevation along the line E-F of Figure 3;  
 Figure 8 is a side elevation of a termination part of the connector of Figure 1, with a cover removed; and  
 Figure 9 is side elevation of another embodiment of the connector.

Referring to Figures 1 to 3, a 1kV main power cable 2 has four cores 4, one for each of the three phases of the supply and an earth core. Each core 4 comprises a sectored conductor enclosed within an individual, colour-coded layer of insulation. The four cores 4 are all enclosed within a further layer of insulation and an outer insulating and abrasive-resistant cable jacket. A branch cable 6 that has four cores 8 is to be connected to the main cable 2. To this end, two electrically insulating, half-shells 12,14 of plastics material are clamped together around the cable 2 at a branch-off region to form a housing 10 that is sealed on to the cable 2. The branch-off region is formed by removing the outer jacket and common insulating layer of the cable 2 for a length that is less than that of the housing 10, so as to expose the cores 4, whose individual insulation is left in position. Such preparation of the cable 2 can be carried out with power still being carried by the cable 2. The branch cable 6 is cut back at one end thereof to expose the conductors of the cores 8, and a two-part electrically insulating termination block 16 of plastics material is mounted on that end of the cable 6. The block 16 is then mounted on the housing 10 for effecting electrical connection between the conductors of the cores 8 of the branch cable 6 and respective ones of the conductors of the cores 4 of the main cable 2.

The construction of the housing 10 and its connection on to the main cable 2 will now be described in further detail with reference additionally to Figures 3 to 7.

The half shells 12 and 14 mechanically interlock with each other along their length, are secured together by four bolts 18, and are sealed at each end on to the outer jacket of the continuous cable 2 by foam members 9 (Figure 5) contained therewithin. The housing 10 is thus mechanically retained on the main cable 2 at its branch-off region. In order to distribute the mechanical load, arising from the clamping action of the bolts 18, over a larger area of the housing 10, rigid strips 19 extend between pairs of the bolts 18 over the faces of the half-shells 12,14. The half-shells 12 and 14 are substantially identical, and each is arranged to provide for electrical connection with two of the four cores of the cables 2 and 6.

Referring to Figures 6 and 7, prior to mounting the half-shells on the branch-off region of the cable 2, the cores 4 are manually separated and a pair of rigid planar dividers 20 introduced there between in opposing fashion. Each half shell 12,14 has a further inwardly-projecting rigid divider 22 integrally formed therewith that, on bringing the half shells together, separates the remaining adjacent cable cores. Thus, as can be seen from Figure 6, the cable cores 4 are located in individual compartments, insulated from each other, and restrained against inward movement, which could otherwise compress and thus reduce in thickness their insulation.

Referring to Figures 4,6 and 7, each half-shell 12,14 has two connecting members 24 moulded thereinto. Each member 24 extends from one side to the other of the housing 10 and exposes an internally threaded contact portion 26 at each of two outer faces thereof. The four exposed contacts at each outer face are located at the corners of a square. Within the housing, each connection member 24 extends towards a longitudinally central area of the branch-off region, and has an internally threaded portion 28 directed radially towards a respective one of the compartments containing the cores 4. Insulation-piercing electrically conductive screws 30 engage the portions 28, and are accessible from outside the housing 10 (Figures 1,2 and 3) so as to be screwed in through the insulation of the cores 4 to contact respective ones of the core conductors. In this way, electrical connection is established between each core conductor and the two contact portions 26 at the outer surfaces of the housing 10. In order to ensure low contact-resistance engagement between the screws 30 and the conductors of the cores 4 over the lifetime of the connector, it may be found necessary to enhance the rigidity of at least this part of the housing 10 and to maintain the inwards pressure on the screws 30 by a reinforcing arrangement (not shown), which may extend peripherally around the housing and mechanically engage each of the screws 30.

The mounting of the termination block 16 on to the branch cable 6 will now be described in more detail with reference to Figures 1,2 and 8. The block 16 has a base 40 and a screw fitted, interlocking cover 42, that provide a water-resistant foam seal 44 around the outer jacket of the entering branch cable 6. The common outer jacket of the cable 6 is removed, and the conductors exposed at the ends of the individual insulated cores 8. The core conductors are retained within respective moulded-in screw terminals 46 in the base 40 of the block 16. Connection members 48 are moulded into the base 40, and extend from respective ones of the terminals 46 to threaded apertures 50 that extend right through the base 40. The apertures 50 are located at the corners of a square that is of the same dimension at that of each set of contact portions 26 of the conductive members 24 at opposing outer surfaces of the housing 10.

The termination block 16 is mounted on the housing 10 (Figure 1 and 2) by four conductive bolts 52 that engage the threaded apertures 50 from one side of the block 16, extend therethrough and engage respective

ones of the threaded contact portions 26 at an outer surface of the housing 10. In this way, electrical paths are established between respective ones of the conductors of the cores 4 of the main cable 2 and of the cores 8 of the branch cable 6. Each path extends through an insulation piercing screw 30, housing conductive member 24 and contact 26, retaining bolt 52, termination connecting member 48 and screw terminal 46. The exposed heads of the bolts 52 and screw terminals 46 may be covered by insulating plugs.

An electrically-insulating and water-resistant gel, which is cross-linked, is arranged to fill any voids within the housing 10 and within the termination block 16, and this is achieved by locating the gel in spaces in each of the four components 12, 14, 40, 42 such that on bringing the respective components together, the gel is forced into any voids that would otherwise occur, such as for example in the interstices between the cores of the cables 2 and 6, and around the insulation-piercing screws 30.

It will be appreciated that the housing 10 may be formed around the branch-off region of the main cable 2 without necessitating cutting the conductors of the main cable and without interrupting the supply of power along the main cable. The branch-off connection may thus be left sealed and insulated at this stage of its construction, if required, and completed at a later time. The termination block 16 may be fitted to the branch cable 6 without any power being supplied to the branch cable. The termination block 16 may be mechanically mounted on the housing 10, by means of the bolts 52, and may still not have power supplied thereto, the branch cable thus being non-activated but sealed and insulated, if required, awaiting energisation at a later time.

The supply of power to the branch cable does not take place until the screws 30 are screwed in to pierce the insulation of the cores 4 of the main cable 2, and this is arranged so that it may be carried out after the branch-off region has been sealed, and can be carried out after the branch cable has been mechanically secured to the main cable. This energising operation can thus be carried out almost as the last stage of forming the branch-off connection, since the screws 30 are accessible from outside the sealed housing 10, even after the branch cable termination block 16 has been mounted thereon. All that remains is to fit insulating plugs over the exposed heads of the screws 30.

Since the termination block mounting bolts 52 are located at corners of a square that is of the same dimension as that of the location of the contacts 26 of the housing connecting members 24, it will be appreciated that the lock 16 may be mounted on the housing 10 not only in the orientation shown in Figure 1, whereby the branch cable 6 extends to the left of the housing 10 and parallel to the main cable 2, but may also be mounted with the branch cable 2 extending in the opposite direction, or extending at right angles, in one direction or the other, to the main cable 2. In addition, each of these orientations is possible with the termination block 16 mounted on the opposing face of the housing, with the branch cable on the other side of the main cable, electrical connection then being made with the other set of contacts 26 of the connecting members 24 (Figure 4). It will also be appreciated that coding, for example colour coding, may be employed to ensure that whatever the chosen orientation of the branch cable, the cores of the branch and main cables will always be correctly matched to each other.

Figure 9 shows a side elevation, corresponding to the side elevation of Figure 3, of another embodiment of a branch-off connector 60 for use with a four-core cable. The connector 60 comprises two identical half-shells that interengage with each other and that are mounted around a main cable 64. The shells 62 are made from rigid insulating plastics material and are secured together by two bolts 66 (only one of which is shown) that interengage metal semi-cylindrical inlays 68 in the shells 62. The inlays 68 form a metal band around the closed connector 60 that provides mechanical support.

Four insulating plugs 70 in each pair of opposing faces of the connector 60 seal the ends of four connecting members (not shown) embedded within the connector, which correspond to the connecting members 24 of the embodiment of the connector described with respect to the earlier Figures. Four screws 72 (only two of which are shown) corresponding to the screws 30 of the previous embodiment, are operable from outside the connector and are arranged to pierce the insulation of respective cores of the cable 64. The screws 72 are insulated from the metal band 68 through which they pass.

The internal construction of the connector 60, and in particular the arrangement of conducting components and the gel filling, the operation of the connector, including the interconnection with a branch cable, and other features, correspond to the construction and operation of the connector already described with respect to Figures 1 to 8.

If required, the core separators of the connector of the invention, for example the separators 20 of the first described embodiment, may be spring-loaded to enhance their separation of the cores. The springs may be put under compression by biasing screws (not shown) operable from outside the connector 60.

The present invention allows for more than one branch cable to be attached to the main cable at one branch-off region. As can be seen from Figures 1 and 2, for example, with one branch cable attached, not only is an opposing set of contacts 26 still available on the other side of the main cable 2, but also, with suitable modification of the retaining bolts 52, one or more, further termination blocks may be mounted on top of the

existing one. Furthermore, additional branch cable may be added, or existing ones removed, at any time without disturbing the sealing and insulation of the main cable or any existing branch cables, and without interrupting the supply of power to the main cable or to an existing branch cable.

5 Other pieces of electrical equipment, such as a switch, a fuse, or a surge arrestor may be connected in series with the branch cable, and may be arranged to be interposed between the housing and the termination block. Furthermore, the connector may be used as a means of supply of power from the cable to operate other equipment.

10 It will be appreciated that when the connector of the invention is mounted at the end of a cable, either to act as an end cap, which may be a permanent attachment to the cable, or as part of an in-line joint, it will be desirable to modify the housing, for example to seal one end thereof. It is envisaged that this may most simply be achieved by fitting a disc into the housing formed by the two body members so as to close the opening that in a branch connection would otherwise allow exit of the continuing main cable from the housing. As an alternative, the body members may themselves be specifically formed in a different shape for use in such application so as to allow (a) entrance of a single cable, or (b) entrance of two cables with means for electrical interconnection therebetween.

## Claims

- 20 1. An electrical connector for an electric cable (2), comprising: first and second body members (12, 14) arranged to be secured together to form a housing (10) enclosing the cable (2) at a region of the cable (2) at which the or each core (4) of the cable (2) is exposed, the housing (10) comprising a first electrically conductive member (24) that provides at least one electrical contact (26) for connection to a further cable (6), and a first electrical connection member (28, 30) mounted within the housing to effect connection between the first conductive member (24) and a core conductor (4) of said cable (2) within the housing (10), the housing (10) containing insulating material for sealing the electrical connection, the connector being characterised in that said at least one electrical contact (26) is exposed to an outer surface of the housing (10); in that the first electrical connection member (28, 30) is operable from outside the housing (10); in that the insulating material is cross-linked and seals against ingress of moisture into the housing (10); and in that a third body member (16) is arranged to receive and terminate the further cable (6), the third body member (16) comprising a second electrically conductive member (48) that is arranged to extend from a core conductor (8) of the further cable (6) so as to provide an electrical contact (46) exposed to an outer surface of the third member (16), and the third body member (16) being arranged to be mounted on the housing (10) such that the first (24) and second (48) conductive members are interconnected, thereby to interconnect the core conductors (4) of the said cable (2) and the core conductors (8) of said further cable (6).
2. A connector according to claim 1 comprising a plurality of said first conductive members (24), a like plurality of said first connection members (28,30), and a like plurality of said second conductive members (48), one of each of said members being arranged, on mounting of said third body member (16) on the housing (10), to provide electrical interconnection between respective ones of the core conductors (4,8) of the said cable (2) and of said further cable (6).
3. A connector according to claim 2, wherein the housing (10) and the third body member (16) are arranged such that said first electrical connection members (28,30) are operable from outside the housing (10) after the third body member (16) has been mounted on the housing (10), to effect said electrical interconnection between said respective cable cores (4,8).
4. A connector according to any preceding claim, wherein each of said first conductive members (24) provides at least two of said electrical contacts (26), and wherein the housing (10) and the third body member (16) are arranged such that electrical interconnection between the or each core (4) of the said cable (2) and the or a respective core (8) of the further cable (6) can be arranged by mounting the third body member (16) on the housing (10) in a selected one of at least two orientations with respect thereto.
5. A connector according to any preceding claim wherein the sealant material is retained within at least one of said first and second body members (12,14) prior to its mounting on the said cable (2).
6. A connector according to any preceding claim, wherein the sealant material comprises a gel.

7. The use of a connector in accordance with any preceding claim for forming a connection to an electric cable.
8. A method of forming an electrical connection to an electric cable (2), comprising the steps of connecting together first and second body members (12,14) so as to form a housing (10) around a region of the cable (2) at which the or each core (4) of the cable (2) is exposed, the housing (10) containing insulating material, characterised in that a first electrically conductive member (24) is mounted in the housing (10) so as to expose at least one electrical contact (26) thereof to an outer surface of the housing (10) for connection to a core conductor (8) of a further cable (6); in that an electrical connection member (28,30) that is mounted in the sealed housing (10) is operated from outside thereof so as to contact a core conductor (4) of said cable (2), thereby to effect electrical connection between said electrical contact (26) and said core conductor (4); in that the insulating material is cross linked and seals against ingress of moisture into the housing (10); in that a third body member (16) is mounted at an end of the further cable (6) such that a second electrically-conductive member (48) mounted within the third body member (16) extends from a core conductor (8) of the further cable (6) so as to provide an electrical contact (46) exposed to an outer surface of the third body member (16); in that the third body member (16) is mounted on the housing (10); and in that the contact of the second conductive member (48) is electrically connected to said at least one contact (26) of the first conductive member (24).
9. A method according to claim 8, wherein the electrical connection member (28,30) is operated to connect the first conductive member (24) to the core conductor (4) of the said cable (2) after the second conductive member (48) has been connected to the first conductive member (24).
10. A method according to claim 8 or 9, wherein the said cable (2) and the further cable (6) each have the same number of conductor cores (4,8), wherein the housing (10) comprises a like number of said first conductive members (24) and a like number of said connection members (28,30), wherein the third body member (16) comprises a like number of said second conductive members (48), and wherein the or each of said first conductive members (24) is arranged to expose at least two of said electrical contacts (26) thereof to an outer surface of the housing (10), and wherein the third body member (16) is mounted on the housing (10) such that the further cable (6) extends in a selected one of a plurality of orientations with respect to the said cable (2) with the electrical contact of the or each second conductive member (48) being engaged with a selected one or other of the electrical contacts (26) of the or each first conductive member (24).

## Patentansprüche

1. Elektrischer Verbinder für ein elektrisches Kabel (2), der folgendes aufweist: ein erstes und ein zweites Körperelement (12, 14), die so angeordnet sind, daß sie aneinander befestigt werden, um ein Gehäuse (10) zu bilden, das das Kabel (2) in einem Bereich des Kabels (2) umschließt, an dem die oder jede Seele (4) des Kabels (2) freiliegt, wobei das Gehäuse (10) ein erstes elektrisch leitfähiges Element (24), das mindestens einen elektrischen Kontakt (26) zur Verbindung mit einem weiteren Kabel (6) vorsieht, und ein erstes elektrisches Verbindungselement (28, 30) aufweist, das in dem Gehäuse angebracht ist, um eine Verbindung zwischen dem ersten leitfähigen Element (24) und einem Seelenleiter (4) des Kabels (2) in dem Gehäuse (10) zu bewirken, wobei das Gehäuse (10) Isoliermaterial enthält, um die elektrische Verbindung abzudichten, wobei der Verbinder dadurch gekennzeichnet ist,
- daß der mindestens eine elektrische Kontakt (26) zu einer Außenfläche des Gehäuses (10) freiliegt;
  - daß das erste elektrische Verbindungselement (28, 30) von der Außenseite des Gehäuses (10) betätigbar ist;
  - daß das Isoliermaterial vernetzt ist und gegen das Eindringen von Feuchtigkeit in das Gehäuse (10) abdichtet;
  - und daß ein drittes Körperelement (16) angeordnet ist, um das weitere Kabel (6) aufzunehmen und abzuschließen, wobei das dritte Körperelement (16) ein zweites elektrisch leitfähiges Element (48) aufweist, das so angeordnet ist, daß es sich von einem Seelenleiter (8) des weiteren Kabels (6) aus erstreckt, um einen elektrischen Kontakt (46) zu bilden, der zu einer Außenfläche des dritten Elements (16) freiliegt,
- und wobei das dritte Körperelement (16) so angeordnet ist, daß es an dem Gehäuse (10) der-

art angebracht wird, daß das erste (24) und das zweite (48) leitfähige Element miteinander verbunden werden, um dadurch die Seelenleiter (4) des einen Kabels (2) und die Seelenleiter (8) des weiteren Kabels (6) miteinander zu verbinden.

- 5     **2.**    Verbinder nach Anspruch 1,  
der eine Vielzahl von den ersten leitfähigen Elementen (24), eine gleiche Vielzahl von den ersten Verbindungselementen (28, 30) und eine gleiche Vielzahl von den zweiten leitfähigen Elementen (48) aufweist, wobei das eine von jedem der Elemente beim Anbringen des dritten Körperelements (16) an dem Gehäuse (10) so angeordnet ist, daß eine elektrische Verbindung zwischen den jeweiligen der Seelenleiter (4, 8) des einen Kabels (2) und denen des weiteren Kabels (6) hergestellt wird.
- 10     **3.**    Verbinder nach Anspruch 2,  
wobei das Gehäuse (10) und das dritte Körperelement (16) derart angeordnet sind, daß die ersten elektrischen Verbindungselemente (28, 30) von der Außenseite des Gehäuses (10) betätigbar sind, nachdem das dritte Körperelement (16) an dem Gehäuse (10) angebracht worden ist, um die elektrische Verbindung zwischen den jeweiligen Kabelseelen (4, 8) herzustellen.
- 15     **4.**    Verbinder nach einem der vorhergehenden Ansprüche,  
wobei jedes der ersten leitfähigen Elemente (24) mindestens zwei der elektrischen Kontakte (26) vorsieht und wobei das Gehäuse (10) und das dritte Körperelement (16) derart angeordnet sind, daß eine elektrische Verbindung zwischen der oder jeder Seele (4) des genannten Kabels (2) und der oder einer jeweiligen Seele (8) des weiteren Kabels (6) gebildet werden kann, indem das dritte Körperelement (16) an dem Gehäuse (10) in einer gewählten Orientierung von mindestens zwei Orientierungen in bezug zu diesem angebracht wird.
- 20     **5.**    Verbinder nach einem der vorhergehenden Ansprüche,  
wobei das Abdichtmaterial zumindest entweder in dem ersten oder in dem zweiten Körperelement (12, 14) vor dessen Anbringung an dem genannten Kabel (2) zurückgehalten wird.
- 25     **6.**    Verbinder nach einem der vorhergehenden Ansprüche,  
wobei das Abdichtmaterial ein Gel aufweist.
- 30     **7.**    Verwendung eines Verbinders nach einem der vorhergehenden Ansprüche, um eine Verbindung mit einem elektrischen Kabel zu bilden.
- 35     **8.**    Verfahren, um eine elektrische Verbindung mit einem elektrischen Kabel (2) zu bilden, wobei das Verfahren die folgenden Schritte aufweist:  
Verbinden eines ersten und eines zweiten Körperelements (12, 14) miteinander, um ein Gehäuse (10) um einen Bereich des Kabels (2) herum zu bilden, an dem die oder jede Seele (4) des Kabels (2) freiliegt, wobei das Gehäuse (10) Isoliermaterial enthält,  
40     dadurch gekennzeichnet,  
daß ein erstes elektrisch leitfähiges Element (24) in dem Gehäuse (10) angebracht wird, um mindestens einen elektrischen Kontakt (26) davon zu einer Außenfläche des Gehäuses (10) zur Verbindung mit einem Seelenleiter (8) eines weiteren Kabels (6) freizulegen;  
daß ein elektrisches Verbindungselement (28, 30), das in dem abgedichteten Gehäuse (10) angebracht ist, von der Außenseite des Gehäuses betätigt wird, um mit einem Seelenleiter (4) des Kabels (2) in Kontakt zu gelangen, um dadurch eine elektrische Verbindung zwischen dem elektrischen Kontakt (26) und dem Seelenleiter (4) herzustellen;  
45     daß das Isoliermaterial vernetzt ist und gegen das Eindringen von Feuchtigkeit in das Gehäuse (10) abdichtet;  
50     daß ein drittes Körperelement (16) an einem Ende des weiteren Kabels (6) derart angebracht wird, daß ein zweites elektrisch leitfähiges Element (48), das in dem dritten Körperelement (16) angebracht ist, sich von einem Seelenleiter (8) des weiteren Kabels (6) aus erstreckt, um einen elektrischen Kontakt (46) zu bilden, der zu einer Außenfläche des dritten Körperelements (16) freiliegt;  
daß das dritte Körperelement (16) an dem Gehäuse (10) angebracht wird;  
55     und daß der Kontakt des zweiten leitfähigen Elements (48) mit dem mindestens einen Kontakt (26) des ersten leitfähigen Elements (24) elektrisch verbunden wird.
- 9.**    Verfahren nach Anspruch 8,

wobei das elektrische Verbindungselement (28, 30) betätigt wird, um das erste leitfähige Element (24) mit dem Seelenleiter (4) des genannten Kabels (2) zu verbinden, nachdem das zweite leitfähige Element (48) mit dem ersten leitfähigen Element (24) verbunden worden ist.

- 5     **10.** Verfahren nach Anspruch 8 oder 9,  
wobei das eine Kabel (2) und das weitere Kabel (6) jeweils die gleiche Anzahl von Leiterseelen (4, 8) ha-  
ben, wobei das Gehäuse (10) eine gleiche Anzahl von den ersten leitfähigen Elementen (24) und eine  
gleiche Anzahl von den Verbindungselementen (28, 30) aufweist,  
wobei das dritte Körperelement (16) eine gleiche Anzahl von den zweiten leitfähigen Elementen (48) auf-  
weist und wobei das oder jedes der ersten leitfähigen Elemente (24) so angeordnet wird, daß mindestens  
zwei der elektrischen Kontakte (26) davon zu einer Außenfläche des Gehäuses (10) freiliegen,  
und wobei das dritte Körperelement (16) an dem Gehäuse (10) derart angebracht wird, daß das weitere  
Kabel (6) sich in einer gewählten Orientierung von einer Vielzahl von Orientierungen in bezug auf das  
genannte Kabel (2) erstreckt, wobei der elektrische Kontakt des oder jedes zweiten leitfähigen Elements  
(48) mit dem einen oder anderen gewählten Kontakt der elektrischen Kontakte (26) des oder jedes ersten  
leitfähigen Elements (24) in Eingriff ist.

## Revendications

- 20     **1.** Connecteur électrique pour un câble électrique (2), comportant : des premier et deuxième éléments de  
corps (12, 14) disposés de façon à être fixés l'un à l'autre pour former un boîtier (10) renfermant le câble  
(2) dans une zone du câble (2) où la ou chaque âme (4) du câble (2) est à nu, le boîtier (10) comportant  
un premier élément électriquement conducteur (24) qui présente au moins un contact électrique (26) pour  
une connexion sur un autre câble (6), et un premier élément (28, 30) de connexion électrique monté à  
l'intérieur du boîtier pour effectuer une connexion entre le premier élément conducteur (24) et un conduc-  
teur d'âme (4) dudit câble (2) à l'intérieur du boîtier (10), le boîtier (10) contenant une matière isolante  
pour l'étanchéité de la connexion électrique, le connecteur étant caractérisé en ce que ledit, au moins un,  
contact électrique (26) est à découvert à une surface extérieure du boîtier (10), en ce que le premier élé-  
ment (28, 30) de connexion électrique peut être manoeuvré depuis l'extérieur du boîtier (10) ; en ce que  
la matière isolante est réticulée et s'oppose de manière étanche à l'entrée d'humidité dans le boîtier (10) ;  
et en ce qu'un troisième élément (16) de corps est agencé de façon à recevoir et terminer l'autre câble  
(6), le troisième élément (16) de corps comportant un second élément électriquement conducteur (48)  
qui est agencé de façon à s'étendre depuis un conducteur d'âme (8) de l'autre câble (6) pour former un  
contact électrique (46) à découvert à une surface extérieure du troisième élément (16), et le troisième  
élément (16) de corps étant agencé pour être monté sur le boîtier (10) afin que les premier (24) et second  
(48) éléments conducteurs soient interconnectés, pour interconnecter ainsi les conducteurs d'âmes (4)  
dudit câble (2) et les conducteurs d'âmes (8) dudit autre câble (6).
- 40     **2.** Connecteur selon la revendication 1, comportant plusieurs desdits premiers éléments conducteurs (24),  
un nombre égal desdits premiers éléments de connexion (28, 30) et un nombre égal desdits seconds élé-  
ments conducteurs (48), l'un de chacun desdits éléments étant agencé, lors d'un montage dudit troisième  
élément de corps (16) sur le boîtier (10), pour établir une interconnexion électrique entre certains, res-  
pectifs, des conducteurs d'âmes (4, 8) dudit câble (2) et dudit autre câble (6).
- 45     **3.** Connecteur selon la revendication 2, dans lequel le boîtier (10) et le troisième élément de corps (16) sont  
agencés de manière que lesdits premiers éléments (28, 30) de connexion électrique puissent être ma-  
noeuvrés depuis l'extérieur du boîtier (10) après que le troisième élément de corps (16) a été monté sur  
le boîtier (10), pour effectuer ladite interconnexion électrique entre lesdites âmes respectives (4, 8) des  
câbles.
- 50     **4.** Connecteur selon l'une quelconque des revendications précédentes, dans lequel chacun desdits premiers  
éléments conducteurs (24) présente au moins deux desdits contacts électriques (26), et dans lequel le  
boîtier (10) et le troisième élément de corps (16) sont agencés de manière qu'une interconnexion électri-  
que entre la ou chaque âme (4) dudit câble (2) et la ou une âme respective (8) de l'autre câble (6) puisse  
être établie par un montage du troisième élément de corps (16) sur le boîtier (10) dans l'une, choisie, d'au  
moins deux orientations par rapport à lui.

5. Connecteur selon l'une quelconque des revendications précédentes, dans lequel la matière d'étanchéité est retenue à l'intérieur d'au moins l'un desdits premier et deuxième éléments de corps (12, 14) avant son montage sur ledit câble (2).
- 5 6. Connecteur selon l'une quelconque des revendications précédentes, dans lequel la matière d'étanchéité comprend un gel.
7. Utilisation d'un connecteur selon l'une quelconque des revendications précédentes pour former une connexion sur un câble électrique.
- 10 8. Procédé de formation d'une connexion électrique sur un câble électrique (2), comprenant les étapes qui consistent à connecter entre eux des premier et deuxième éléments de corps (12, 14) pour former un boîtier (10) autour d'une zone du câble (2) dans laquelle la ou chaque âme (4) du câble (2) est à nu, le boîtier (10) contenant une matière isolante, caractérisé en ce qu'un premier élément électriquement conducteur (24) est monté dans le boîtier (10) afin qu'au moins un contact électrique (26) de cet élément soit à découvert à une surface extérieure du boîtier (10) pour une connexion sur un conducteur d'âme (8) d'un autre câble (6) ; en ce qu'un élément (28, 30) de connexion électrique, qui est monté dans le boîtier (10) fermé de façon étanche, est manoeuvré depuis l'extérieur de ce dernier afin d'entrer en contact avec un conducteur d'âme (4) dudit câble (2), pour effectuer ainsi une connexion électrique entre ledit contact électrique (26) et ledit conducteur d'âme (4) ; en ce que la matière isolante est réticulée et s'oppose de façon étanche à l'entrée d'humidité dans le boîtier (10); en ce qu'un troisième élément (16) de corps est monté à une extrémité de l'autre câble (6) de manière qu'un second élément électriquement conducteur (48) monté à l'intérieur du troisième élément (16) de corps s'étende depuis un conducteur d'âme (8) de l'autre câble (6) pour former un contact électrique (46) à découvert à une surface extérieure du troisième élément de corps (16) ; en ce que le troisième élément de corps (16) est monté sur le boîtier (6) ; et en ce que le contact du second élément conducteur (48) est connecté électriquement audit, au moins un, contact (26) du premier élément conducteur (24).
- 15 20 25 30 9. Procédé selon la revendication 8, dans lequel l'élément (28, 30) de connexion électrique est manoeuvré de façon à connecter le premier élément conducteur (24) au conducteur d'âme (4) dudit câble (2) après que le second élément conducteur (48) a été connecté au premier élément conducteur (24).
- 35 40 45 50 55 10. Procédé selon la revendication 8 ou 9, dans lequel ledit câble (2) et l'autre câble (6) ont chacun le même nombre d'âmes conductrices (4, 8), dans lequel le boîtier (10) comporte un nombre égal desdits premiers éléments conducteurs (24) et un nombre égal desdits éléments (28, 30) de connexion, dans lequel le troisième élément de corps (16) comporte un nombre égal desdits seconds éléments conducteurs (48), et dans lequel ledit ou chacun desdits premiers éléments conducteurs (24) est agencé de façon à mettre à découvert au moins deux desdits contacts électriques (26) de cet élément à une surface extérieure du boîtier (10), et dans lequel le troisième élément de corps (16) est monté sur le boîtier (10) de manière que l'autre câble (6) s'étende dans une, choisie, de plusieurs orientations par rapport audit câble (2), le contact électrique du ou de chaque second élément conducteur (48) étant engagé avec l'un ou l'autre, choisi, des contacts électriques (26) du ou de chaque premier élément conducteur (24).

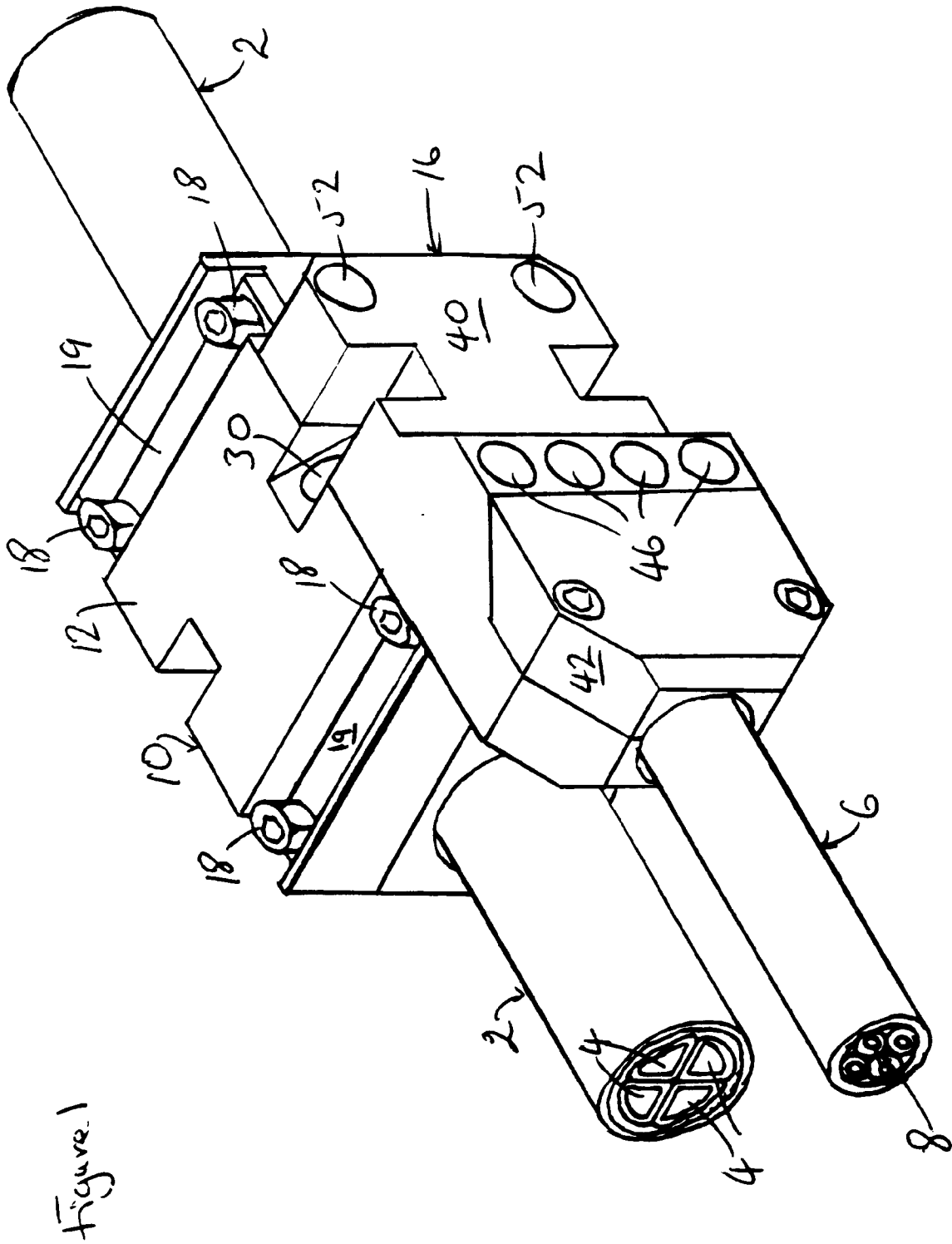


Figure 1

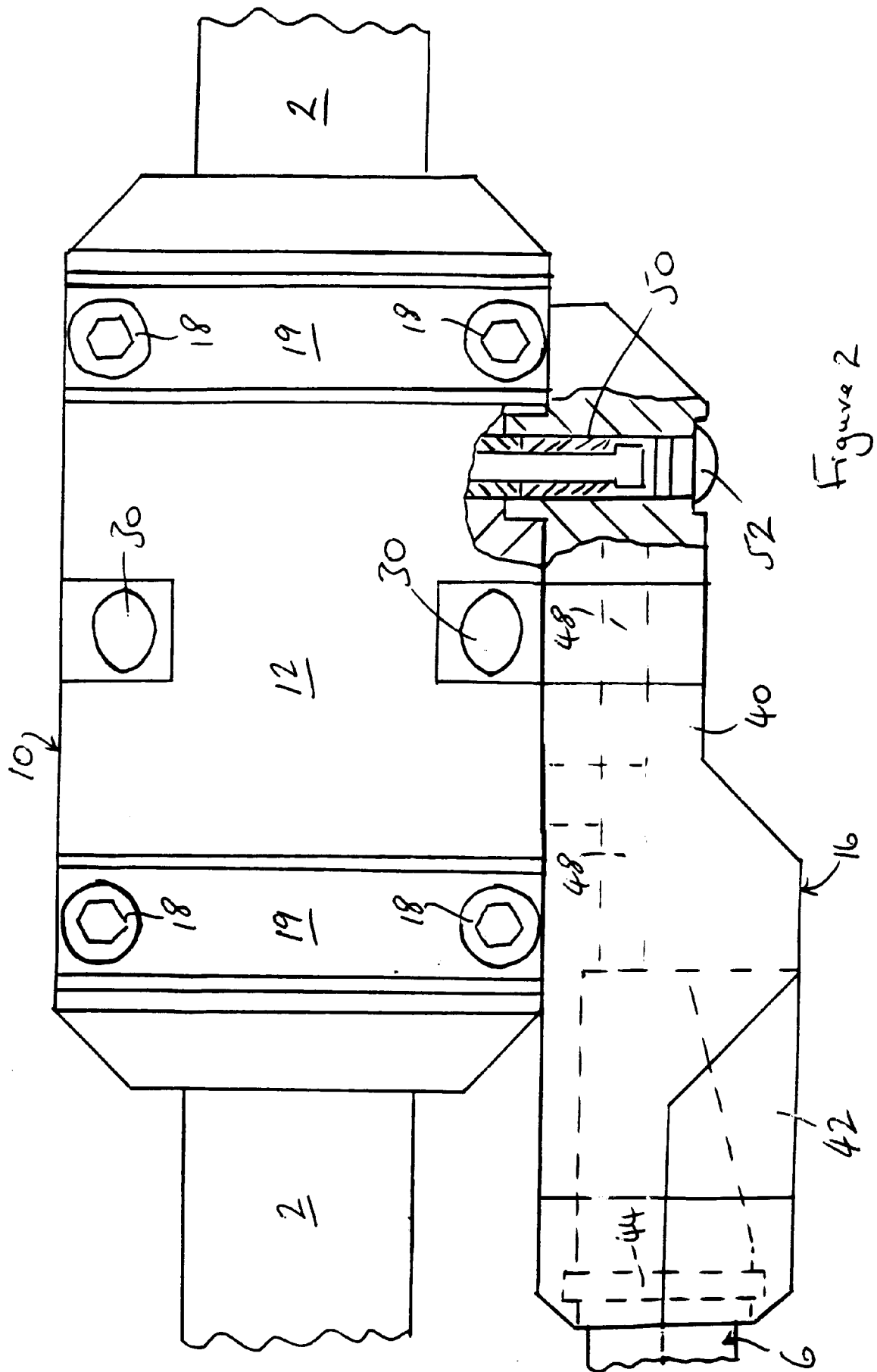
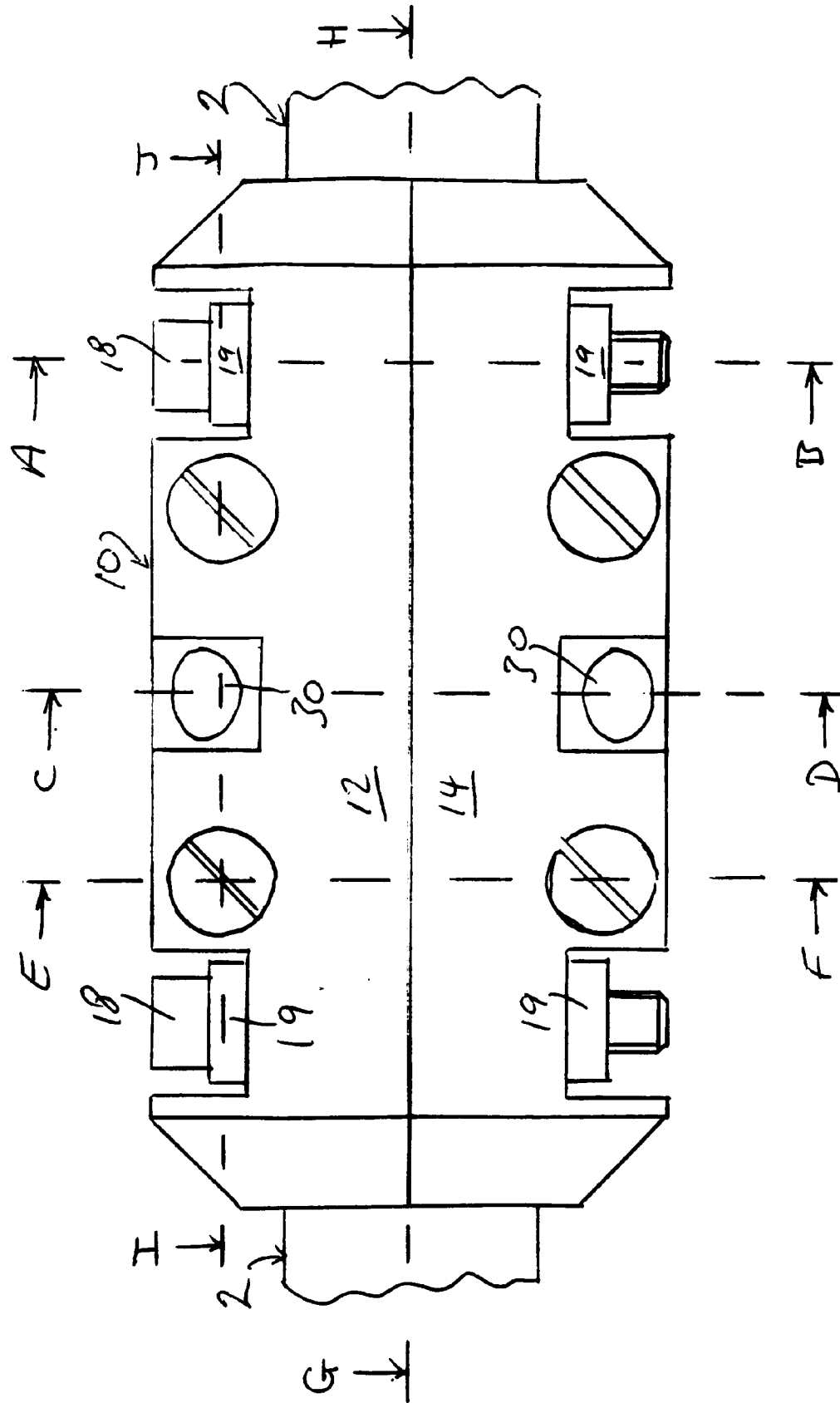


Figure 2

Figure 3



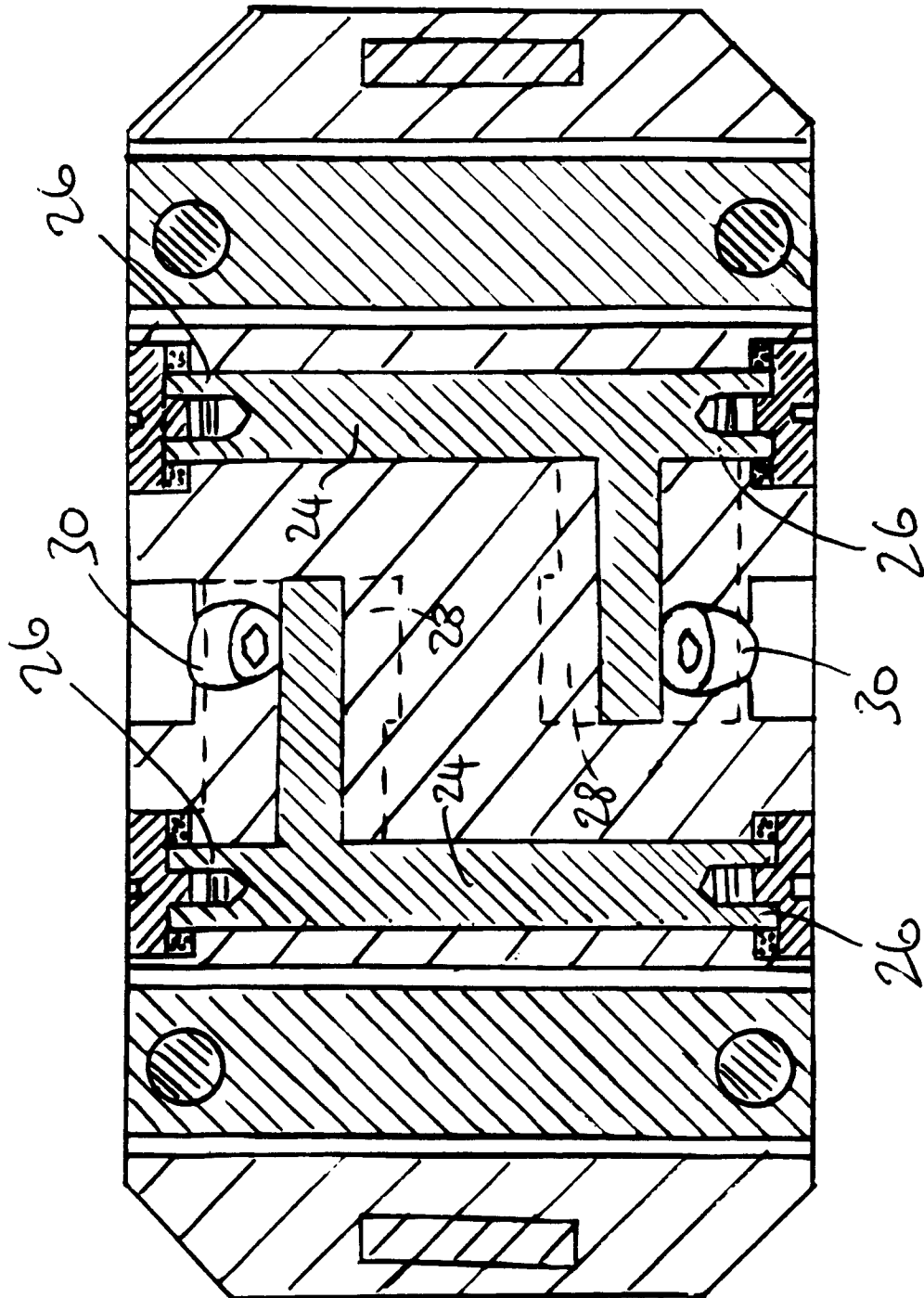
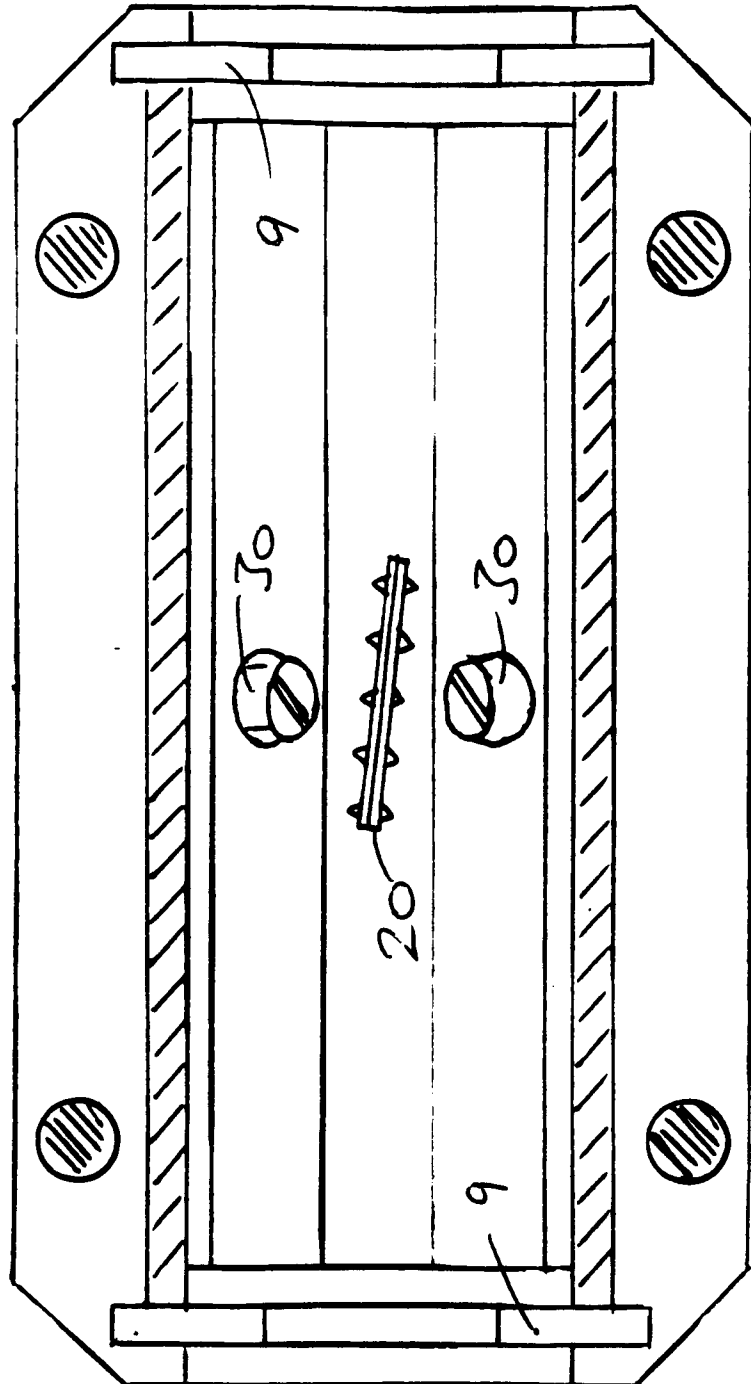


Figure 4

Figure 5



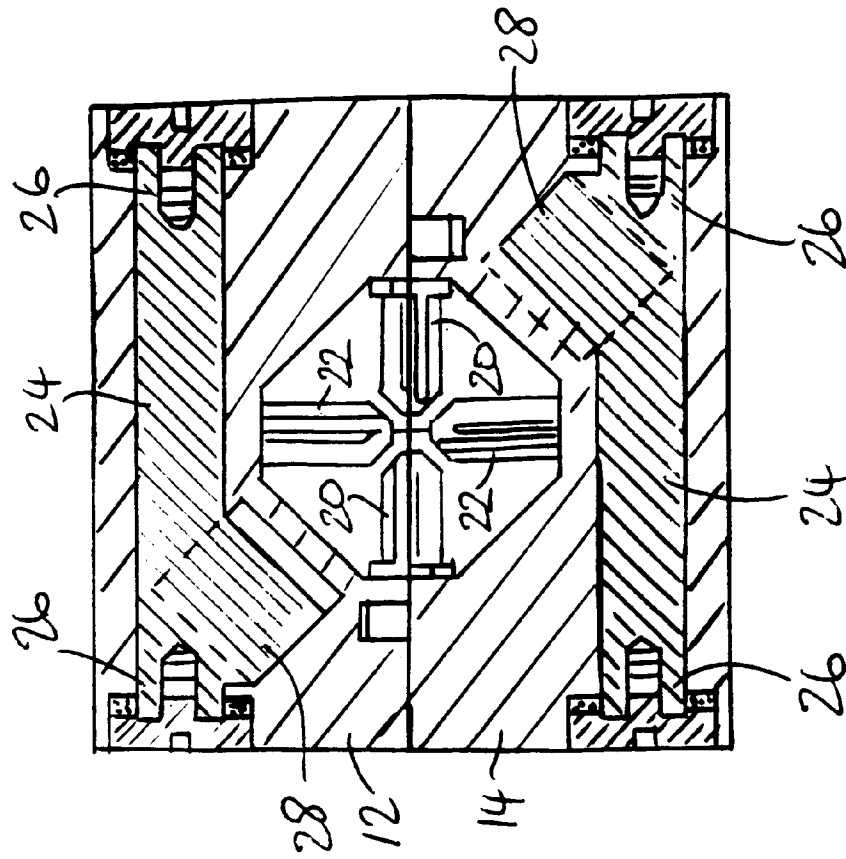


Figure 7

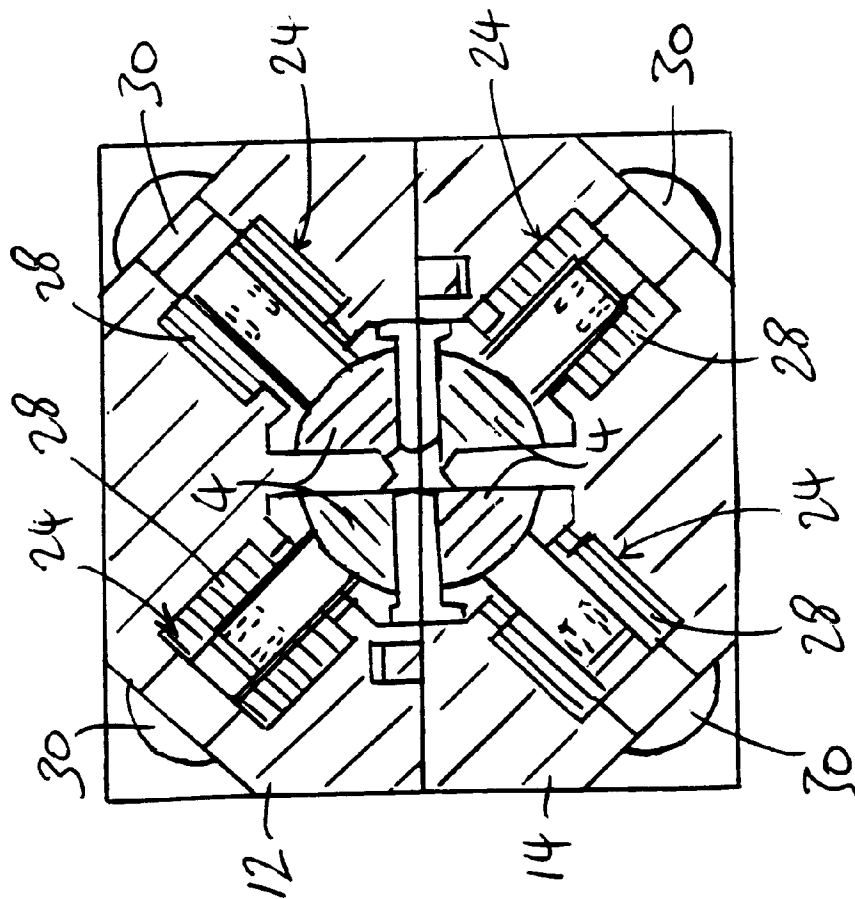


Figure 6

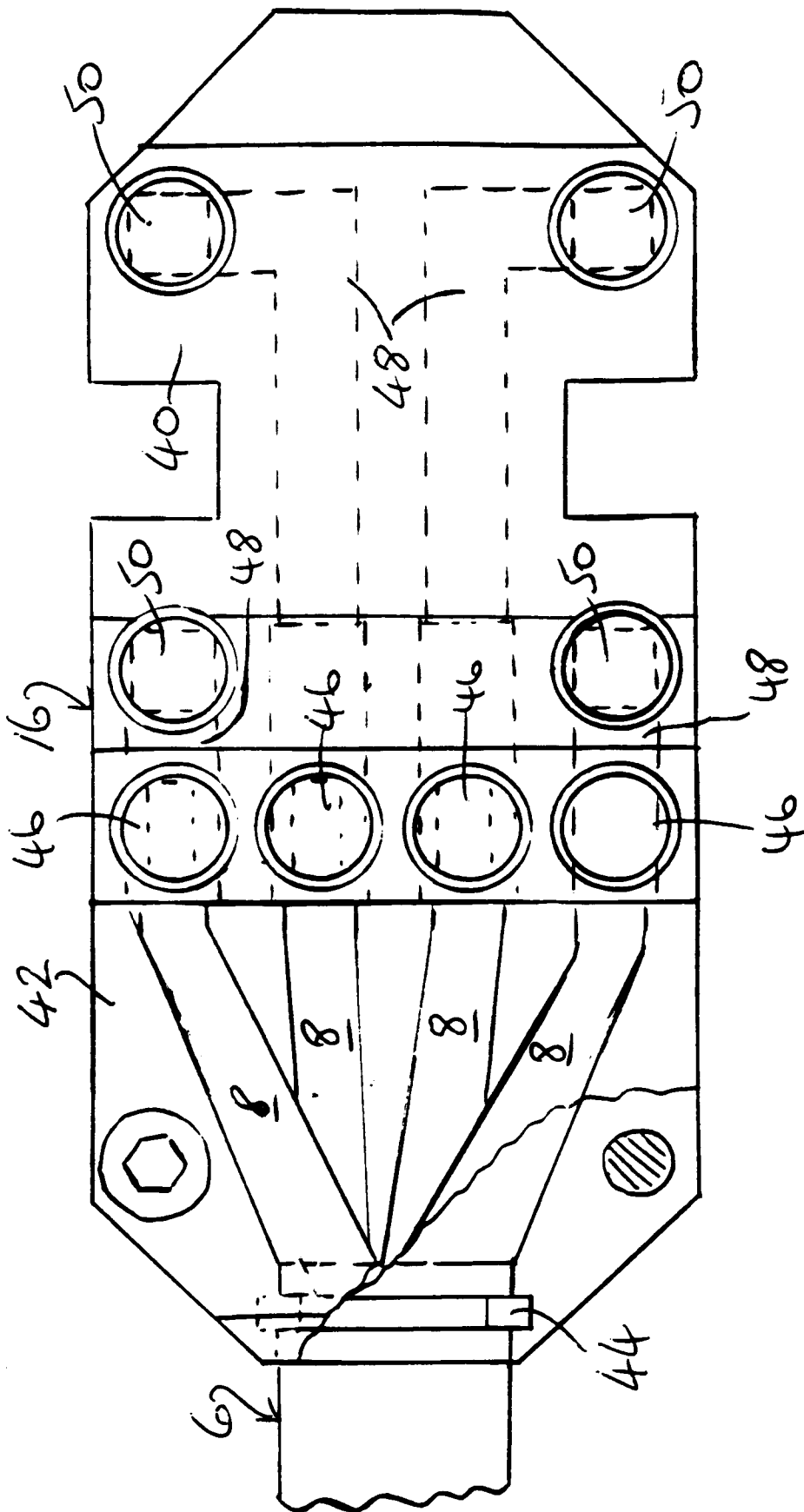


Figure 8

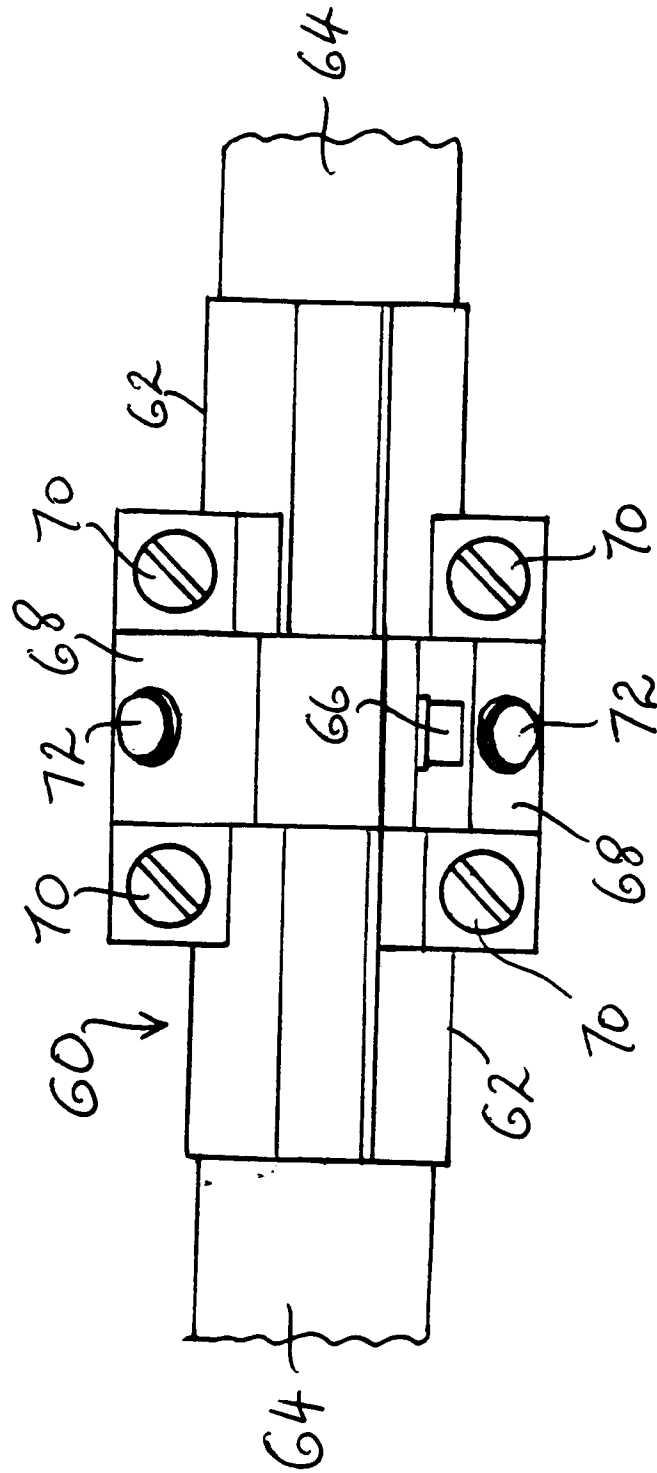


Figure 9