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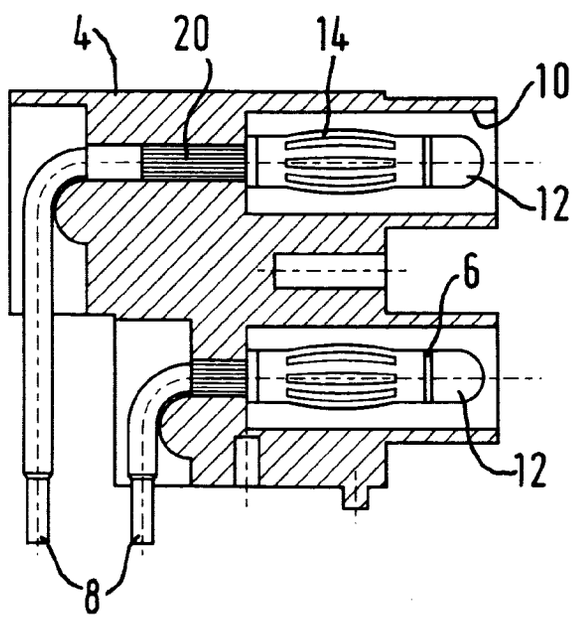
(54) Electrical connectors and connecting parts therefor

(57) A plug (2) has an insulating housing (4) and two elongate, conductive, connecting pins (6) which each extend within a tubular bore (10). Each pin (6) is wholly within, and does not project relative to, its respective bore (10). Each pin (6) carries a resilient, conductive lantern spring (14) to enable good electrical contact between the pin (6) and a socket (22). The socket (22) has a housing (24) of insulating material defining a tubular sheath which extends around and insulates a substantially cylindrical, tubular, conductive socket (30). This socket (30), with its insulating sheath (26), is receivable within the corresponding bore (10) in the plug (2). In the connected position, the pin (6) is received within the socket (30), and the socket (30) is insulated both by its sheath (26) and by the housing (4) of the plug (2) such that the electrically conductive parts are completely inaccessible from the outside.

FIG. 2.



EP 0 849 835 A2

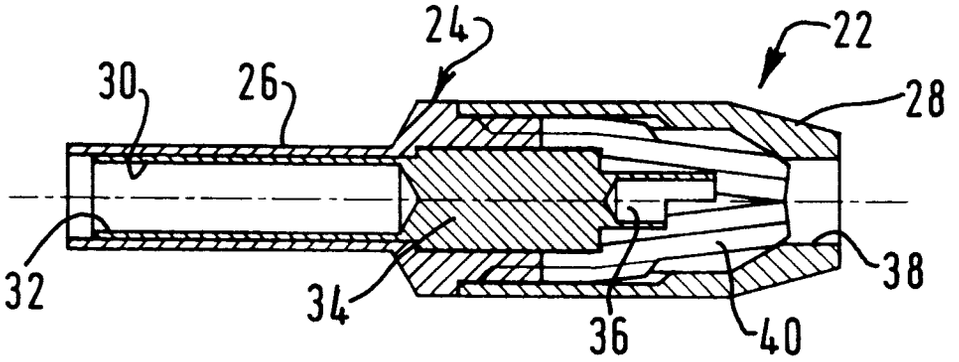


FIG. 4.

Description

The present invention relates to an electrical connector, and to connecting parts therefor.

There is a requirement to make electrical connectors, for example, for use in audio systems, touch proof in order to enhance their safety.

The present invention seeks to provide a new electrical connector which is touch proof.

According to a first aspect of the present invention there is provided an electrical connector comprising first and second, interengagable, connecting parts, said first connecting part having a conductive socket arranged to receive a conductive pin of said second connecting part, wherein said socket of said first connecting part is provided in an insulating sheath, and the conductive pin of said second connecting part extends within an insulating housing, and wherein, when said first and second connecting parts are engaged, said socket and its sheath of the first connecting part extend within said insulating housing of the second connecting part whereby said pin is engaged within, and in electrical contact with, said socket.

In an embodiment of an electrical connector of the invention the first and second connecting parts are "transsexual". Thus, the second connecting part can be considered to be a plug as it has a conductive pin engagable within the conductive socket of the first connecting part. However, in its turn, the first connecting part, which can be considered to be the socket, is engaged, when connected, within the housing of said plug. This enhances the safety of the connector as, when it is in its connected condition, the engaged conductive pin and socket are within both the insulating sheath of the socket and the insulating housing of the plug.

In an embodiment, the second connecting part, that is, the plug, is fixed on equipment, such as an amplifier or a speaker. A cable to be connected to the equipment is terminated with a first connecting part, or socket. This also enhances safety as compared to conventional arrangements in which it is the plug which is connected to the end of a cable. With an electrical connector of an embodiment of the invention, no conductive pin is fixed to the end of the cable so that there is less risk when handling the cable, even if the cable is live.

Preferably, conductive resilient means are provided to enhance the connection between the conductive pin and the conductive socket. These resilient means may be provided, for example, within the socket for receiving and engaging the conductive pin.

In a preferred embodiment, the conductive pin carries conductive resilient means protruding relative to the periphery thereof. When the pin is engaged in the socket, the resilient means are arranged to be compressed against a restoring force thereof, and are thereby maintained in contact with the internal periphery of the socket.

The resilient means carried by the pin may be configured as required. For example, the resilient means may comprise lantern contacts and/or may comprise a bowed spring, for example, of the type known as a banana plug.

The conductive pin of the second connecting part extends within an insulating housing. Furthermore, it is preferred that the free end of the conductive pin carries an insulating cap or tip. This cap or tip is provided to further enhance the touch proof characteristics of the second connecting part and also of the connector.

In a preferred embodiment, the free end of the conductive pin remains within the insulating housing, that is, the free end does not project relative to the insulating housing.

Preferably, the insulating sheath for the conductive socket of the first connecting part projects beyond an open end of the socket. This is a further measure to enhance the touch proof characteristics not only of the connector, but of the first and second connecting parts individually.

The socket may be provided with means enabling the connection of the socket to one or more electrical cables.

According to a further aspect of the present invention there is provided a connecting part for an electrical connector, said connecting part comprising an insert of conductive material defining an elongate tubular socket having a first open end, and connecting means for connection to at least one electrical cable spaced from said open end, said socket being received within, and insulated by, a housing of insulating material, wherein said insulating housing comprises a tubular sheath of insulating material which extends along at least part of the longitudinal extent of said socket and projects with respect to said first, open, end thereof.

In an embodiment, said connecting means for connection to at least one electrical cable comprises a cable grip associated with a second, connecting, end of the socket.

Additionally and/or alternatively, said connecting means for connection to electrical cable may comprise, for example, one or more solder buckets, and/or grub screw fixings and/or binding post fixings, and/or one or more bores.

In one embodiment, the connecting means is configured such that the tubular socket and an electrical cable connected thereto are substantially in-line. Additionally and/or alternatively the connecting means may be configured such that the electrical cable(s) generally extend at an angle to the extent of said tubular socket. For example, the cable(s) and the socket may be substantially perpendicular.

In an embodiment, the connecting means of said tubular socket is within the insulating housing, but at least part of the housing is selectively removable to provide access to the connecting means.

A connecting part, configured as a socket as defined above, may comprise the first connecting part of

an electrical connector as defined above.

The present invention also extends to a connecting part for an electrical connector, said connecting part comprising an insulating housing in which an elongate bore extends, and an elongate, conductive pin extending within said bore, a first end of said pin being within said bore, and a second end of said pin forming, or being coupled to, an electrical contact.

An electrical connecting part comprising a conductive pin as defined forms a plug for connection to a socket. In an embodiment, the conductive pin has a first end on which an insulating tip or cap is provided.

A second, opposed end, of the conductive pin is coupled to, or defines, a contact pin for direct connection to a circuit board.

In an embodiment, the conductive pin and the contact pin are in-line. Additionally and/or altematively, the conductive pin and the contact pin extend at an angle relative to one another. In one embodiment, the contact pin and the conductive pin extend substantially perpendicularly to each other.

To enhance the connection between the conductive pin and a socket in which it is received, resilient means protruding substantially transversely relative to the conductive pin may be provided. These resilient means are arranged to be conductive. For example, the resilient means may comprise lantern contacts and/or may comprise a bowed spring, for example of the type known as a banana plug.

In a particularly useful embodiment, the insulating housing of the connecting part comprises a number of elongate bores in each of which an elongate conductive pin extends. In this manner, the connecting part is configured as a multi-pin plug.

A connecting part as defined above comprises a plug which may comprise the second connecting part of an electrical connector as defined above.

Embodiments of the present invention will hereinafter be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a perspective view of a two-pin plug of the present invention,

Figure 2 shows a section through the two-pin plug of Figure 1,

Figure 3 shows an alternative configuration for a plug of the invention,

Figure 4 shows a first embodiment of a socket of the present invention,

Figures 5a, 5b and 5c show alternative embodiments of sockets of the invention, and

Figures 6a and 6b show a perspective view and a section of a further embodiment of a socket of the invention.

The plugs and sockets illustrated in the drawings have been specifically designed for use in audio applications, with the plugs fixed to equipment such as amplifiers and speakers, and the sockets provided on cables therefor. However, the connectors may be used in other environments as required. Furthermore, if preferred, the plugs may be provided on cable, and the sockets on equipment.

The terms "plug" and "socket" are used for simplicity in the following description. The term "plug" is used to refer to a connecting part having one or more pins, and the term "socket" is used to refer to a connecting part having at least one socket for receipt of a pin. However, it will be appreciated that the connecting parts of the invention are "transsexual".

Figure 1 shows a perspective view of a plug 2. In the embodiment of Figure 1, the plug 2 has two connecting pins 6. However, it will be appreciated that single pin plugs may be provided as may plugs with differing numbers of pins. The relative arrangement of the pins when more than one is provided may also be chosen as required to meet the particular circumstances.

In the embodiment illustrated in Figure 1, the two-pin plug 2 has an insulating housing 4 and two elongate, conductive, connecting pins 6. As will become apparent, each connecting pin 6 is electrically coupled to a corresponding contact pin 8, for example, for receipt in a circuit board of the equipment on which the plug 2 is to be carried.

As can be seen in Figure 2, each elongate conductive pin 6 extends within a respective elongate, tubular bore 10 which is provided therefor in the housing 4. It will also be seen that each conductive pin 6 is wholly within its bore 10 and does not project relative thereto. This is to make access to the conductive pin 6, for example, by a finger, difficult. In addition, an insulating cap 12 is provided on the free end of each conductive pin 6. Both of these measures enhance the touch proof characteristics of the plug 2.

In the embodiment illustrated in Figure 2, each conductive pin 6 carries a resilient, conductive, member 14. As can be seen, this resilient member 14 comprises a lantern spring 14 held between the housing 4 and the insulating cap. This lantern spring 14 is formed from a generally cylindrical length of conductive spring material which has been provided with a number of spaced, elongate slots therein whereby a plurality of individual bowed springs extending longitudinally of the conductive pin 6, and protruding substantially radially with respect thereto, are defined. It will be appreciated that if substantially radially directed forces are applied to the lantern spring 14 to compress it, it will exert force substantially radially outwardly. This configuration, therefore, enables good electrical contact to be maintained between the conductive pin 6 and a socket in which it is received.

At its end remote from the cap 12, each conductive pin is knurled, as indicated at 20, and is press fitted into its bore 10 for retention therein. Knurling may additionally and/or alternatively be provided in the bore 10 whereby the pin is retained, and rotation thereof is prevented. The knurled end of the conductive pin 6 is also

connected to the contact pin 8.

An alternative embodiment of a two pin plug 2 is shown in Figure 3. It will be seen that the embodiment of Figure 3 is substantially the same as that of Figure 2 except that the lantern spring 14 is replaced by an elongate resilient member forming a bowed spring 14'. As can be seen, this resilient member 14' comprises a length of conductive spring material fixed at one of its ends in a groove 16 in the conductive pin 6 and held at the other of its ends by the insulating cap 12. The elongate resilient member 14' is bowed to provide spring tension and thus forms a bowed spring protruding substantially transversely relative to the longitudinal extent of the pin 6. It will be appreciated that if substantially radially directed forces are applied to the resilient member 14' to compress it, it will exert force substantially radially outwardly. This configuration, therefore, enables good electrical contact to be maintained between the conductive pin 6 and a socket in which it is received.

At its end remote from the cap 12, each conductive pin 6 of the embodiment of Figure 3, is threaded to receive a nut 20' by means of which the conductive pin 6 is retained within its bore 10. The threaded end of the conductive pin 6 is also connected to the contact pin 8.

Figure 4 shows one example of a socket 22 arranged to be connected with one conductive pin 6 of a plug as 2. In the embodiment shown in Figure 4, the socket 22 is also arranged to be connected to an electrical cable (not shown).

In the embodiment illustrated, the socket 22 comprises a housing 24 of insulating material which comprises a first part 26 on which a cover 28 is removably engaged. In the embodiment illustrated, the connection between the two housing parts 26 and 28 is a threaded connection. The first housing part 26 defines a tubular sheath of insulating material which extends around and insulates a substantially cylindrical, tubular, conductive socket 30. In this respect, it will be seen that the socket 30 has a first open end 32 within the sheath 26, and a second, spaced, connecting end 34 to which an electrical cable can be connected. In the embodiment illustrated in Figure 4, the connecting end 34 has a solder bucket 36 in which the cable is received and connected. In this respect, it will be appreciated that the cable will extend through an opening 38 within the cover 28. In the embodiment illustrated, the socket 22 is also provided with a collapsible collet 40 to act as a cable grip.

In use, the cable connected to the socket 22 in Figure 4 extends substantially in line with the socket 30 thereof. It will be appreciated that the socket 30, with its insulating sheath 26, is receivable within a corresponding bore 10 in a plug as 2. The socket 30 is positioned to extend along the bore 10 such that the conductive pin 6 extends into, and along the socket 30. The resilient member 14 of the conductive pin 6 is compressed radially and thus contacts the socket 30 along its extent. In this way, reliable electrical contact between the socket 30 and the pin 6 occurs whereby the electrical cable is connected to the contact pins 8 as is required.

In the connected position of a socket 22 with a plug 2, the electrically conductive parts are completely inaccessible from the outside. Thus, the pin 6 is received within the socket 30, and the socket 30 is insulated both by its sheath 26 and by the housing 4 of the plug 2.

With audio systems in particular, there can be advantage to having the cable extending substantially perpendicularly to the socket 30 rather than being in line as in Figure 4. Figures 5a, 5b and 5c show various configurations of sockets 22 where the cable is substantially at right angles to the socket 30. In Figure 5a, for example, an electrical cable 42 is connected to the connecting end 34 of the socket 30 by way of a grub screw fixing incorporating a grub screw 44. In Figure 5b, the fixing of the cable 42 to the connecting end 34 is by way of a binding post fixing indicated at 46. Figure 5c shows the connection of a three wire cable 48 to the connecting end 34 by way of three solder buckets 50.

If required, alternative fixing means for the cable may be provided either alone or in conjunction with any of the fixing means illustrated. Additionally and/or alternatively any of the fixing means described may be combined in a single socket.

In the version of the socket 22 shown in Figure 4, the insulating housing 24 has a cover 28 which can be screwed onto and off the housing part 26 whereby access to the solder bucket 36 is made available for connection purposes. In the embodiments of the socket 22 shown in Figures 5a to 5c, the insulating housing 24 is similarly made in two parts, the first part 26 defining the sheath for the socket 30, and the second part 28 being removable to provide access to the fixing means for the electrical cable. In this respect, it is generally preferred that the two part housing of Figures 5a to 5c be arranged to securely clip together such that access can only be had by prising the two parts apart using a suitable tool, such as a screwdriver.

Figure 6a shows a perspective view, and Figure 6b a section, of an alternative embodiment of a socket 122 to which one cable may be connected in an in line configuration, or to which one, two or three cables may be connected to extend at right angles thereto. The socket 122 is formed from two plastics mouldings 126 and 128. The first moulding 126 receives a conductive insert having a substantially cylindrical, tubular, elongate, conductive socket 130 formed in one piece with a conductive body 134. The socket 130 extends along, and is insulated by, a tubular sheath defined by said first moulding 126. In the embodiment illustrated, the conductive body 134 has a hexagonal outer periphery to prevent rotation thereof. A threaded bore 136 is provided in the end of the body 134 remote from the socket 130, and three, substantially parallel, threaded bores, as 138, extend transversely of the body 134.

The first moulding 126 is configured to provide access to the longitudinal bore 136 and to the transverse bores 138. Thus, an end of the moulding 126 is substan-

tially aligned with the one end of the body 134 in which the longitudinal bore 136 opens. Furthermore, an elongate slot 140 extends longitudinally of the first moulding 126 to provide access to all three transverse bores 138.

The second plastics moulding 128 is arranged to be clipped onto the first moulding 126. For example, projections (not shown) of the first moulding 126 may be arranged to engage in slots (not visible) of the second moulding 128. The arrangement is such that a tool, such as a screwdriver, has to be employed in order to prise the two mouldings 126, 128 apart.

In its initial condition, the second moulding 128 is in the form of a substantially cylindrical, hollow cap having an elongate tongue 142 which extends longitudinally from a periphery of the cap 128. The tongue 142 is arranged, when the cap 128 is clipped onto the first moulding 126, to extend within the elongate slot 140 of the first moulding 126, to prevent access to the conductive insert. In a preferred embodiment, a flange (not shown) may extend around the periphery of the slot 140 to support and guide peripheral edges of the tongue 142.

Similarly, the cap 128 has a circular line of weakness 144 provided in its end to define a detachable, substantially circular, protective cap 146.

The configuration of the cap 128 enables the socket 122 of Figures 6a and 6b to be "customised" to the cables to be connected thereto without compromising the "touchproof' criteria thereof. Thus, if it is required to connect the socket 122 to a single in line cable, the protective cap 146 of the cap 128 is removed, for example, by pushing the cap 146 to detach it along the line of weakness 144. If then the cap 128 is clipped into place on the first moulding 126, the single cable can be fed into the longitudinal bore 136 and secured by a grub screw 150 engaged in the central one of the transverse bores 138. The tongue 142 is cut to a suitable length to provide access to the central bore 138.

Alternatively, if one or more cables are to be secured to the transverse bores 138, the tongue 142 is cut to a suitable length to reveal the appropriate number of transverse bores 138. The cap 128 is then clipped in place on the first moulding 126, and the cable or cables can then be secured in respective bores 138 by soldering. In this arrangement, the protective cap 146 can be left in place. Alternatively, the protective cap 146 may be removed and a grub screw 148 used to retain the cable in the adjacent transverse bore 138. In this arrangement, a grub screw as 148 is preferably only employed if a single cable is to be secured to the conductive body 134.

In all of the embodiments illustrated, the housings of insulating material are preferably constructed of substantially flameproof plastics material. Furthermore, the insulating material can be appropriately coloured to provide polarity indications.

It will be appreciated that other variations in and modifications to the embodiments of the present invention as described and illustrated may be made within the scope of the present invention as defined by the appended claims.

Claims

1. An electrical connector comprising first and second, interengagable, connecting parts (2; 22, 122), said first connecting part (22, 122) having a conductive socket (30, 130) arranged to receive a conductive pin (6) of said second connecting part (2), wherein said socket of said first connecting part is provided in an insulating sheath, and the conductive pin (6) of said second connecting part extends within an insulating housing (4), and wherein, when said first and second connecting parts are engaged, said socket and its sheath of the first connecting part extend within said insulating housing of the second connecting part whereby said pin is engaged within, and in electrical contact with, said socket.

2. An electrical connector as claimed in Claim 1, wherein one or more cables are terminated by said first connecting part, or socket (22, 122).

3. An electrical connector as claimed in Claim 1 or Claim 2, wherein conductive resilient means (14, 14') are provided to enhance the connection between the conductive pin (6) and the conductive socket (30, 130).

4. An electrical connector as claimed in Claim 3, wherein the conductive pin (6) carries conductive resilient means (14, 14') protruding relative to the periphery thereof and arranged to be compressed against a restoring force thereof.

5. An electrical connector as claimed in any preceding claim, wherein the free end of the conductive pin (6) of the second connecting part (2) carries an insulating cap or tip (12).

6. A connecting part (22, 122) for an electrical connector, said connecting part comprising an insert of conductive material defining an elongate tubular socket (30, 130) having a first open end, and connecting means for connection to at least one electrical cable spaced from said open end, said socket being received within, and insulated by, a housing (24; 126, 128) of insulating material, wherein said insulating housing comprises a tubular sheath of insulating material which extends along at least part of the longitudinal extent of said socket (30, 130) and projects with respect to said first, open, end thereof.

7. A connecting part (2) for an electrical connector, said connecting part comprising an insulating hous-

ing (4) in which an elongate bore (10) extends, and an elongate, conductive pin (6) extending within said bore, a first end of said pin being within said bore, and a second end of said pin forming, or being coupled to, an electrical contact.

8. A connecting part as claimed in Claim 7, wherein resilient means (14, 14') protruding substantially transversely relative to the conductive pin (6) are provided.

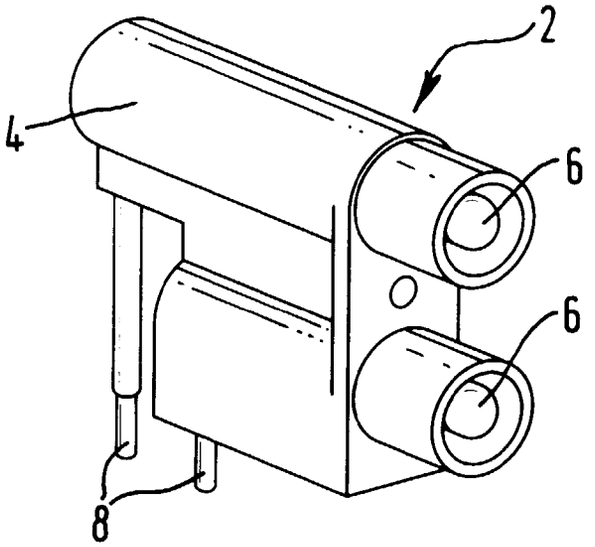
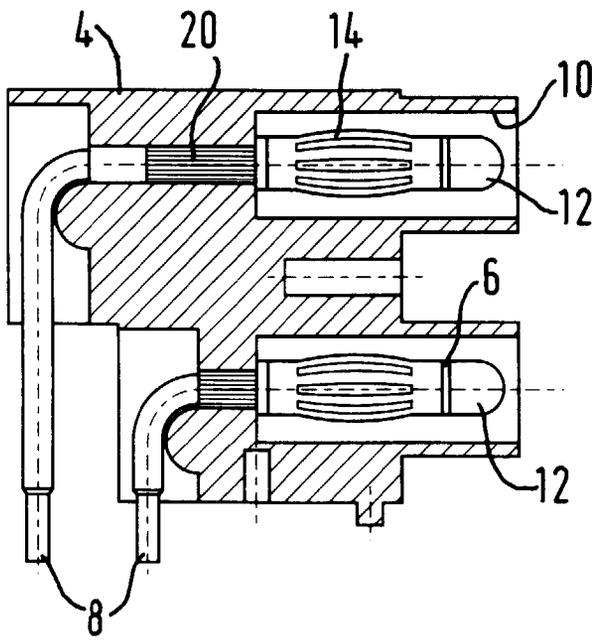


FIG. 1.

FIG. 2.



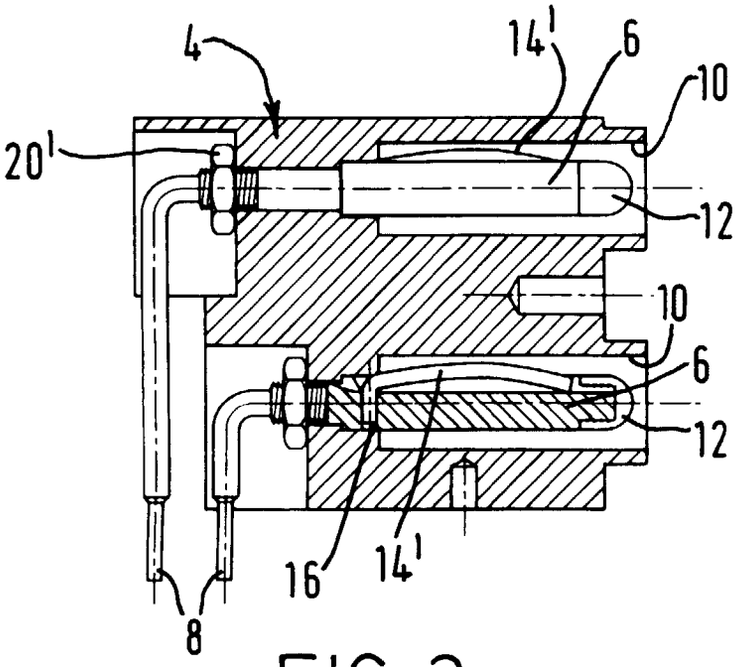


FIG. 3.

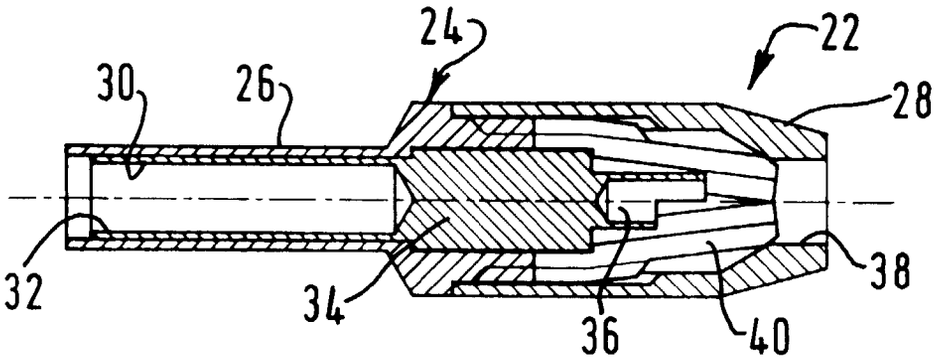


FIG. 4.

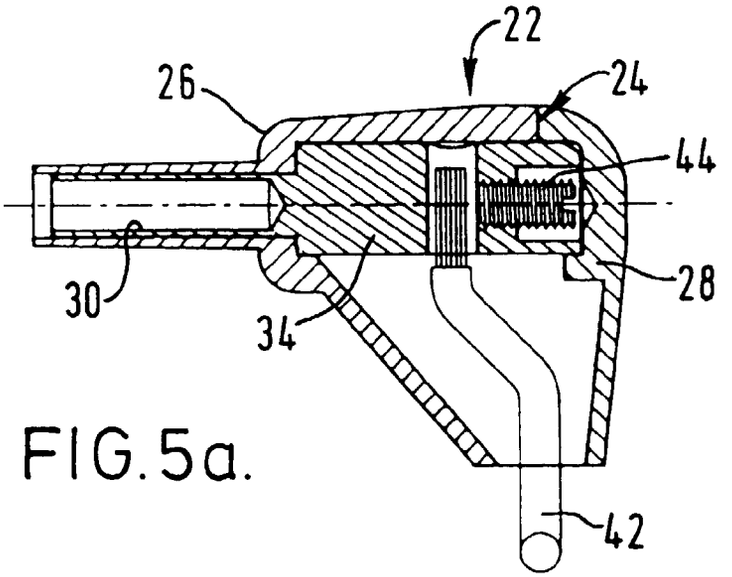


FIG.5a.

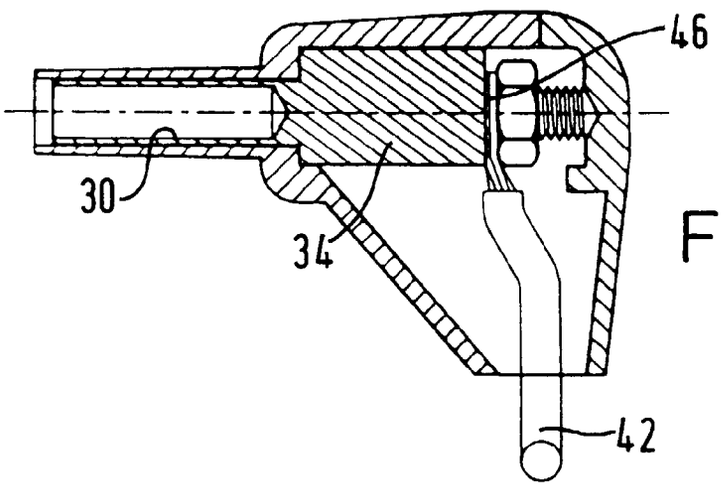


FIG.5b.

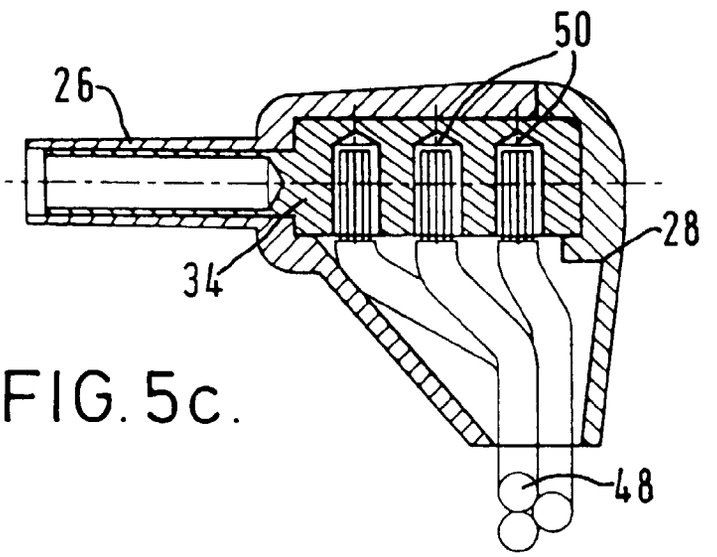


FIG.5c.

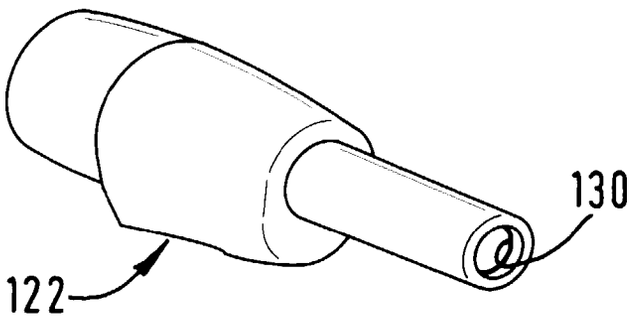


FIG. 6a.

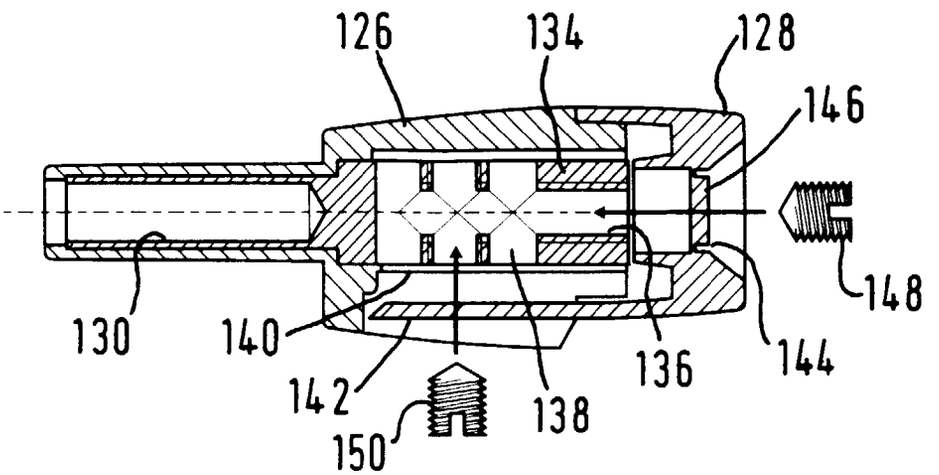


FIG. 6b.