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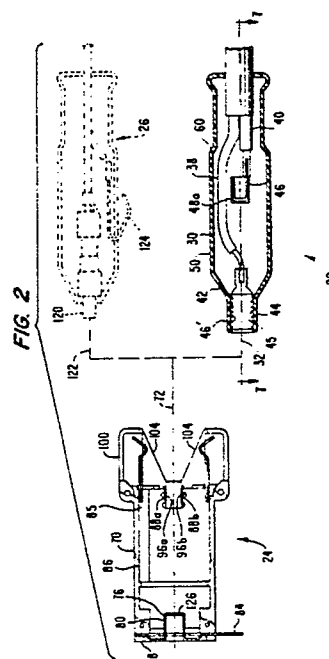
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(54) **Socket and plug therefor.**

(57) A socket (24) can accommodate a conventional cigar lighter socket-compatible plug (26), which can handle low currents, and a plug (22) which can handle lighter currents. The socket (24) comprises abutment surfaces (126) and (86) for transmitting power to spring loaded contacts (120, 124) on conventional cigar lighter socket-compatible plug (26). In addition, the socket (24) has first and second wiping contacts (76; 88a, b) which co-operate with first and second wiping contacts (44; 56a, b) of plug (22). The socket (24) is provided with a boss (148) which prevents a standard cigar lighter plug being actuated if it is inserted in the socket (24). The end of the plug (22) is provided with a layer of insulation which prevents electricity being supplied to the plug (22) on insertion of the plug (22) in a conventional cigar lighter socket (130).



SOCKET AND PLUG THEREFOR

This invention relates to a socket and a plug therefor.

In recent years, low-voltage direct current, for example 12VDC, hand-held appliances and tools have proliferated for use in the car and around the home. Some appliances, such as hand-held car vacuum cleaners and car polishers are intended for operation using power supplies from the car battery. These appliances, which are relatively low current devices, for example, 2-6 amps, typically employ a plug compatible with the socket of a conventional, dash-mounted automotive cigar lighter. The necessity for use of these appliances in close proximity to a vehicle having a cigar lighter socket has restricted the utilization of the same appliances around the home.

In contrast, many low voltage tools used around the home require relatively high current levels, for example, 8-20 amps. These high current appliances include hedge trimmers and grass trimmers which can seriously tax the capacity of self-contained battery packs which typically are of the NiCd variety.

In our co-pending European Patent Application No. 87 of even date we describe a portable lead-acid battery pack as offering increased power capacity and longer operation times between charging. The battery pack is designed to be carried by the user separate from the device and is capable of supplying low voltage power to both low current and high current devices.

Because of the substantial number of appliances having cigar lighter socket-compatible plugs it is clearly desirable that the battery pack should be able to accommodate such plugs. However, such plugs are not capable of handling relatively high current levels. In particular, cigar lighter sockets generally comprise a circular cylindrical metal wall forming the negative electrode and an end wall which forms the positive electrode and is insulated from the circular cylindrical metal wall. The plugs generally comprise a tubular body having a spring loaded electrode projecting axially forward and a spring wire extending radially. In use the spring loaded electrode and the spring wire merely abut the positive and negative electrodes. The current carrying ability of these plugs is strictly limited, particularly if the electrodes become corroded.

An aim of at least preferred embodiments of the present invention is to provide a socket which can accommodate a conventional cigar lighter socket-compatible plug and a plug which can handle a higher current.

According to the present invention there is

provided a socket for accommodating a low voltage cigar lighter socket-compatible plug and a plug having a higher current handling ability, which socket comprises:

- 5 a generally cylindrical socket housing;
- a first wiping contact at or adjacent one end of said generally cylindrical socket housing on or adjacent the longitudinal axis thereof;
- 10 a second wiping contact at or adjacent the cylindrical wall of said socket housing;
- a first abutment surface at or adjacent said one end of said generally cylindrical socket housing on or adjacent the longitudinal axis thereof; and
- 15 a second abutment surface on or adjacent the cylindrical wall of said socket housing,
- wherein said first and second wiping contacts are intended to co-operate with respective first and second wiping contacts on said plug having said higher current handling ability and said first and second abutment surfaces are intended to bear
- 20 respective first and second spring biased abutment contacts on said low voltage cigar lighter socket-compatible plug.

By the term "wiping contact" it is meant that the contact has a significant contiguous contact surface area which comes into sliding contact with an opposing contact also having a significant contiguous contacting surface during the course of establishing the electrical connection between the two contacts. The "wiping" engagement acts to rejuvenate the metal contact surface by removing, at least in part, any oxide or other non-conductive layer that may have built up on the contact surface. The completed contact is characterized by electrical conduction across the mating contacting areas thereby affording high current capacity and reducing ohmic heating due to contact imperfections and contamination.

Preferably, said first wiping contact comprises the side of a pin and said first abutment surface comprises an end of said pin.

Advantageously, said second wiping contact comprises at least one ear which extends substantially radially of said generally cylindrical socket housing.

Preferably, said second wiping contact comprises at least one pair of ears which are adjacent one another and which extend substantially radially of said generally cylindrical socket housing.

Advantageously, said second abutment surface comprises a barrel-shaped portion.

Preferably, said at least one ear is integral with said barrel-shaped portion.

Advantageously, resilient spring means are provided to retain a plug in said socket.

Preferably, said socket is provided with one or more notches to, in use, guide the second wiping contacts of a plug into alignment with the second wiping contacts of said socket.

Preferably, means are provided to inhibit said socket actuating a cigar lighter. Such means may comprise, for example, a boss which inhibits the end of a cigar lighter coming into contact with said first abutment surface. Alternatively, or in addition, a flange may be provided at or adjacent the opening to said socket to inhibit insertion of a cigar lighter fully in the socket.

The present invention also provides a plug for use with a socket according to the invention, said plug comprising a generally cylindrical plug housing having a leading end, a first wiping contact at or adjacent said leading end on or adjacent the longitudinal axis of said generally cylindrical plug housing, and a second wiping contact extending generally radially outwardly from said generally cylindrical plug housing.

Preferably, said second wiping contact extends generally radially outwardly from diametrically opposed portions of said generally cylindrical plug housing.

Advantageously, said second wiping contact comprises a U-shape member disposed with the base of the 'U' facing the leading end of said generally cylindrical plug housing and the outer surfaces of the sides of the 'U' forming the second wiping contact.

Preferably, means are provided to inhibit said plug being actuated in a conventional cigar lighter socket. Such means may comprise, for example, a layer of insulating material on the leading end of the first wiping contact.

The present invention also provides a coupling comprising a socket in accordance with the present invention and a plug in accordance with the present invention.

Viewed more broadly, the present invention also provides a socket for a low-voltage, high direct current connector of the plug and socket type comprising:

a generally cylindrical housing having an axis and a plug-receiving axial end;

a first wiping electrical contact element positioned within said housing at the other housing axial end proximate said axis;

a second wiping electrical contact element electrically isolated from said first element and proximate the outer housing periphery of said housing at a preselected circumferential position, said second wiping contact element having at least one wiping contact surface generally parallel to said axis and substantially perpendicular to said housing outer periphery at said circumferential position, wherein said first and second wiping contact ele-

ments are configured for mating with complementary wiping contact members carried by a high current plug on plug insertion in said socket.

For a better understanding of the invention reference will now be made, by way of example, to the accompanying drawings, in which:-

Fig. 1 is a schematic side view of a plug and a socket in accordance with the invention with a conventional cigar lighter-compatible plug being shown in chain lines;

Fig. 2 is a cut-away view of the parts shown in Fig. 1;

Fig. 3 is a cut-away view of the socket shown in Fig. 1;

Fig. 4 is a cut-away view of the socket of Fig. 1 showing the conventional cigar lighter socket-compatible plug inserted therein;

Fig. 5 is a cut-away view of the socket of Fig. 1 showing the plug in accordance with the invention inserted therein;

Fig. 6 is a view taken along line 6-6 of Fig. 3;

Fig. 7 is a sectional view taken along line 7-7 of Fig. 2;

Figs. 8 and 9 are sectional side views of the socket of Fig. 1 showing details of structure for preventing electrical contact during insertion of a conventional cigar lighter plug;

Fig. 10 is a sectional view showing, in chain lines, a conventional cigar lighter inserted in a conventional cigar lighter socket, and, in full lines, the plug in accordance with the invention inserted in the conventional cigar lighter socket (shown in chain lines);

Figs. 11 and 12 are top and side views, respectively, of the pin used in the socket of Fig. 1;

Figs. 13 and 14 are side and top detail views of the barrel contact used in the socket of Fig. 1;

Fig. 15 is a side view of a U-shape member of the plug in accordance with the invention;

Fig. 16 is a view taken along line 16-16 of Fig. 15; and

Fig. 17 is a view taken along line 17-17 of Fig. 15

Referring to Figure 1 there is shown a connector assembly which is generally identified by reference numeral 20. Connector assembly 20 comprises a plug 22, and a socket 24. Also shown in Figure 1, in chain lines, is a conventional cigar lighter socket-compatible plug 26 of the type used to connect low-voltage, low current appliances to a cigar lighter socket.

The plug 22 is capable of connecting low-voltage, high direct current appliances to a power source via socket 24. The plug 22 comprises a plug housing 30 which is generally cylindrical. The plug 22 has an axis 32 and a leading end 34 which can be inserted into the socket 24. The plug 22

also has a trailing end 36 which is configured for gripping by a user and from which power cord 37 having plug leads 38, 40 extends for connection to a suitable appliance or power tool (not shown). Plug housing 30 preferably is formed from a non-conductive mouldable, impact-resistant plastic and can be formed in two mating halves, for permitting "clamshell" type assembly or moulded as one piece around internal parts ("insert moulded").

The leading end 34 of the plug 22 comprises a cylindrical portion 46 and a frusto-conical portion 42 formed from a non-conductive material. The leading end 34 can be formed integrally with plug housing 30.

As better shown in Figure 2, the plug 22 comprises a first wiping contact in the form of a sleeve 44 positioned in the cylindrical portion 46 of the plug housing 30.

Sleeve 44, which is coaxially mounted with respect to axis 32, can be made of brass or similar conductive, resilient material and is crimped on plug lead 38.

The plug 22 is also provided with a second wiping contact in the form of a U-shape member 46. The U-shape member 46 is electrically isolated from the sleeve 44, extends transverse to axis 32, and projects radially outward from the outer surface 50 of the plug housing 30 through apertures 48a, b formed at diametrically opposed positions in housing 30 (see Figure 7). A tab portion 47 of the U-shape member 46 is crimped to plug lead 40.

As best seen in Figure 7 and Figures 15-17, the U-shape member 46 is economically formed from a single piece of sheet metal, such as brass or other resilient material, and includes appropriate reliefs to permit captive assembly into plug housing 30 if a "clamshell" construction is utilized.

As shown in Figure 7, portions 52 and 54 of the U-shape member 46 project outside of plug housing 30 in a "wing"-like configuration and provides two pairs of planar wiping contacts for engagement by a suitable mating wiping contact in socket 24. Specifically, and as best seen in Figure 15, portion 52 includes a first pair of planar wiping contact surfaces 56a, b while portion 54 provides a second pair of planar wiping contact surfaces 58a, b. Also, as best seen in Figure 2, the U-shape member 46 is disposed with the bottom of the U orientated in the direction of insertion to provide a "lead in" to the mating wiping contact element of socket 24. Although not shown in the drawings, the balance of the internal configuration of plug component 22 can include suitable structure for providing strain relief for plug leads 38, 40, as well as appropriate support structure to provide internal rigidity to plug housing 30.

Plug 22 includes a shoulder 60 on plug housing 30 to provide an engagement surface for resil-

ient spring fingers 106, 108 provided with socket 24. The fingers 106, 108 serve to restrain movement of plug 22 counter to the insertion direction whenever plug 22 has been inserted to a predetermined axial insertion depth.

As best seen in Figure 7, plug housing 30 has a pair of flanges 62, 64 integrally formed with plug housing 30 at an axial location between the portions 52, 54 of U-shape member 46 and the gripping location 66 on plug housing 30. Flanges 62, 64 are sized to shield portions 52, 54 to protect the user's hand during the insertion of the plug 22 in the socket 24.

The socket 24 comprises a socket housing 70 which is non-conductive, and generally cylindrical. The socket housing 70 has an axis 72, an open end 74 configured for receiving plug 22 and a closed end 78.

Socket housing 70 is made from an impact-resistant, mouldable plastic material and can be made in two joinable halves in a "clamshell" like construction.

The socket 24 comprises a first wiping contact in the form of a pin 76 positioned adjacent the closed end 78 of the socket housing 74 on the axis 72.

Pin 76 is generally cylindrical and has a diameter such that outer surface 80 forms an interference fit with the cylindrical surface 45 of sleeve 44 when plug 22 is inserted into socket 24 as shown in Figure 5.

As best seen in Figures 11 and 12, pin 76 is formed from a single piece of sheet metal to provide an integral base support 82 which can be captured within the "clamshell" construction of socket housing 70. Also, a tab portion 84 is formed on the same piece of sheet metal and extends radially outwardly to provide a lead to connect pin 76 electrically to one terminal of an external power source (not shown).

The socket 24 also comprises a second wiping contact electrically isolated from the pin 76 and positioned proximate the outer periphery of the socket housing 70 at a preselected circumferential position.

With reference to Figure 2, socket 24 includes a second contact element 85 comprising a barrel-shaped portion 86 positioned within the socket housing 70 proximate the open end 74. Two pairs of ears 88a, b and 90a, b (Figure 6) are integrally formed from, and extend substantially radially outward from, barrel-shaped portion 86 and are received in corresponding slots 92, 94 formed in socket housing 70. The inwardly facing surfaces 96a, b and 98a, b of opposing ears 88a, b and 90a, b provide the complementary mating wiping contact surfaces for engagement with the first and second pairs of planar wiping contact surfaces 56a,

b and 58a, b of U-shape member 46 carried by plug 22.

When plug 22 is inserted into socket 24 as shown in Figure 5, the respective complementary mating surfaces of the contact elements associated with socket 24 engage the corresponding surfaces in the contact members associated with plug 22. Thus, the outer surface 80 of pin 76 engages the cylindrical surface 45 of sleeve 44 while inwardly facing surfaces 96a, b of ears 88a, b engage the second pair of planar wiping contact surfaces 58a, b of protruding portion 54 of U-shape member 46.

The portions 52, 54 of the U-shape member 46 in plug 22 in conjunction with the slots 92, 94 in socket housing 70 orient plug 22 circumferentially with respect to socket 24. Additionally, socket housing 70 includes cylindrical extension 100 at open end 74. The cylindrical extension 100 includes a pair of "V"-shaped notches 102, 104 (see Figures 2 and 6) for guiding protruding portions 52, 54 into engagement with ears 88a, b and 90a, b of second contact element 85.

With reference to Figure 3, socket 24 includes a pair of resilient spring fingers 106, 108 resiliently mounted in socket housing 70. Resilient spring fingers 106, 108 have radially inwardly depending portions 110, 112 which co-operate with shoulder 60 on plug 22 to retain plug 22 in socket 24 at the predetermined axial insertion position as shown in Figure 5. Cylindrical extension 100 of socket 24 is enlarged to accommodate the radially outward flexing of resilient spring fingers 106, 108 during the insertion process. Also, and with reference to Figures 13 and 14 of the drawings, resilient spring fingers 106, 108 are conveniently integrally formed from the same piece of sheet metal used to form barrel-shaped portion 86 and ears 88a, b and 90a, b.

As best seen in Figure 14, a tab portion 114 is formed integrally with barrel-shaped portion 86 and used as a second electrical lead.

The socket 24 can also receive a conventional low current cigar lighter socket-compatible plug 26. The cigar lighter socket-compatible plug 26 shown in chain lines in Figures 1 and 2, has a spring loaded contact pin 120, disposed on the axis 122 of the plug 26. The plug 26 also has a bent wire spring contact 124, located at the periphery of the plug 26.

Pin 76 of socket 24 specifically includes a closed pin face 126 sized and positioned for providing abutting engagement with spring loaded contact pin 120 upon insertion of cigar lighter socket-compatible plug 26 into socket 24 (Figure 4). Additionally, barrel-shaped portion 86 of second contact element 85 which is conductive and electrically connected to tab portion 114 extends axially toward the closed end 78 of socket 24 a distance

sufficient to provide engagement with bent wire spring contact 124 when plug 26 is inserted. Further, to ensure compatibility with car appliances having plug connectors like plug 26, pin 76 preferably has a positive polarity and second contact element 85 a negative polarity.

As stated previously, the socket 24 is intended to be utilized in the power pack described in our co-pending European Patent Application 87 of even date. Because of the compatibility of the socket 24 with conventional cigar lighter socket-compatible plugs used with automotive appliances, there is the potential for inadvertent operation of the high current plug 22 in a standard cigar lighter socket in an automobile. Because the fusing system of an automobile often is set for low current cigar lighter operation (e.g., 6 amps), if a user attempts to operate a high current power tool or appliance from the car battery utilizing plug 22 there is a possibility of blowing the fuse or possibly causing damage to the automobile's electrical wiring system.

Consequently, it is preferred that safeguard means be included in the construction of plug 22 for preventing electrical connection to at least one of sleeve 44 and U-shape member 46 during inadvertent insertion of plug 22 into a conventional automotive cigar lighter socket.

With reference to Figure 10, a conventional cigar lighter socket 130 (shown in chain lines) is mounted in a dashboard 132. The cigar lighter socket 130 has an electrical contact face 134 contactable with end 152 of a cigar lighter 138.

As shown in Fig. 10, the free extremity of cylindrical portion 46 has an inwardly extending insulating flange 144 which extends an axial distance "d2" sufficient to preclude contact between sleeve 44 and electrical contact face 134 following inadvertent insertion of plug 22 into cigar lighter socket 130.

It is also possible that a user may attempt to activate the cigar lighter 138 by inserting it into socket 24. Although socket 24 is capable of handling the current load imposed by the cigar lighter 138 if electrically activated, the internal heat generated could damage socket housing 70. Therefore, socket 24 includes lockout means for preventing electrical connection to at least one of pin 76 and second contact element 85.

With reference to Figure 8, socket 24 is provided with boss 148 formed on the inside periphery of socket housing 70 circumjacent pin 76. Boss 148 is made of a non-conductive material, preferably formed integrally with socket housing 70, and extends axially toward the open end 74 of the socket 24 a distance greater than the axial extent of pin 76, the difference in axial extent being designated by "d1" in Figure 8. Also, the inner diameter 150 of boss 148 is sized to be less than the

outer diameter of the end 152 of cigar lighter 138 to preclude electrical contact between pin 76 and heating element 146.

For cigar lighters 138' having a flange 154 (Figure 9), the inwardly turned lip portion 156 of cylindrical extension 100 is sized to have a minimum inner diameter 158 less than the outer diameter of the flange 154. Moreover, the axial extent of cylindrical extension 100 is sized so that lip portion 156 is spaced from pin 76 by a distance greater than the distance between flange 154 and heating element 146, thus precluding electrical contact between pin 76 and heating element 146.

Claims

1. A socket (24) for accommodating a low voltage cigar lighter socket-compatible plug (26) and a plug (22) having a higher current handling ability, which socket (24) comprises:
a generally cylindrical socket housing (70);
a first wiping contact (76) at or adjacent one end (78) of said generally cylindrical socket housing (70) on or adjacent the longitudinal axis (72) thereof;
a second wiping contact (88a, b; 90a, b) at or adjacent the cylindrical wall of said socket housing (70);
a first abutment surface (126) at or adjacent said one end of said generally cylindrical socket housing (70) on or adjacent the longitudinal axis (72) thereof; and
a second abutment surface (86) on or adjacent the cylindrical wall of said socket housing (70);
wherein said first and second wiping contacts (76; 88a, b; 90a, b) are intended to co-operate with respective first and second wiping contacts (44; 56a, b; 58a, b) on said plug (22) having said higher current handling ability and said first and second abutment surfaces (128, 86) are intended to bear respective first and second spring biased abutment contacts (120, 124) on said low voltage cigar lighter socket-compatible plug (26).

2. A socket according to Claim 1, characterized in that said first wiping contact (76) comprises the side (80) of a pin (76) and said first abutment surface (126) comprises an end of said pin (76).

3. A socket according to Claims 1 or 2, characterized in that said second wiping socket comprises at least one ear (88a, b; 90a, b) which extends substantially radially of said generally cylindrical socket housing (70).

4. A socket according to Claim 3, characterized in that said second wiping contact comprises at least one pair of ears (88a, b) which are adjacent one another and which extend substantially radially of said generally cylindrical socket housing (70).

5. A socket according to any preceding Claim, characterized in that said second abutment surface comprises a barrel-shaped portion (86).

6. A socket according to Claim 5 when appended to Claim 3 or 4, characterized in that at least one ear is integral with said barrel-shaped portion (86).

7. A socket according to any preceding Claim, characterized in that resilient spring means (106, 108) are provided to retain a plug (22, 26) in said socket (24).

8. A socket according to any preceding Claim, provided with one or more notches (102, 104) to, in use, guide the second wiping contacts (52, 54) of a plug (22) into alignment with the second wiping contacts (88a, b; 90a, b) of said socket (24).

9. A socket according to any preceding Claim, characterized in that it includes means (148) to inhibit said socket (24) actuating a cigar lighter.

10. A socket according to Claim 9, characterized in that said means comprise a boss (148) which, when a cigar lighter (138) is inserted into said socket (24) engages the end (152) of said cigar lighter (138) and prevents it contacting said first wiping contact (76) and said first abutment surface (126).

11. A plug (22) for use with a socket according to any preceding Claim, characterized in that said plug (22) comprises a generally cylindrical plug housing (30) having a leading end (34), a first wiping contact (44) at or adjacent said leading end (34) on or adjacent the longitudinal axis (32) of said generally cylindrical plug housing (30), and a second wiping contact (56a, b; 58a, b) extending generally radially outwardly from said generally cylindrical plug housing (30).

12. A plug according to Claim 11, characterized in that said second wiping contact extends generally radially outwardly from diametrically opposed portions of said generally cylindrical plug housing (30).

13. A plug according to Claim 11 or 12, characterized in that said second wiping contact comprises a U-shape member (46) disposed with the base of the 'U' facing the leading end (34) of said generally cylindrical plug housing (30) and the outer surfaces (56a, b; 58a, b) of the sides of the 'U' forming the second wiping contact.

14. A plug according to Claim 11, 12 or 13, characterized in that means (144) are provided to inhibit said plug (22) being actuated in a conventional cigar lighter socket (130).

15. A coupling comprising a socket according to any of Claims 1 to 10 and a plug in accordance with any of Claims 11 to 14.

FIG. 1

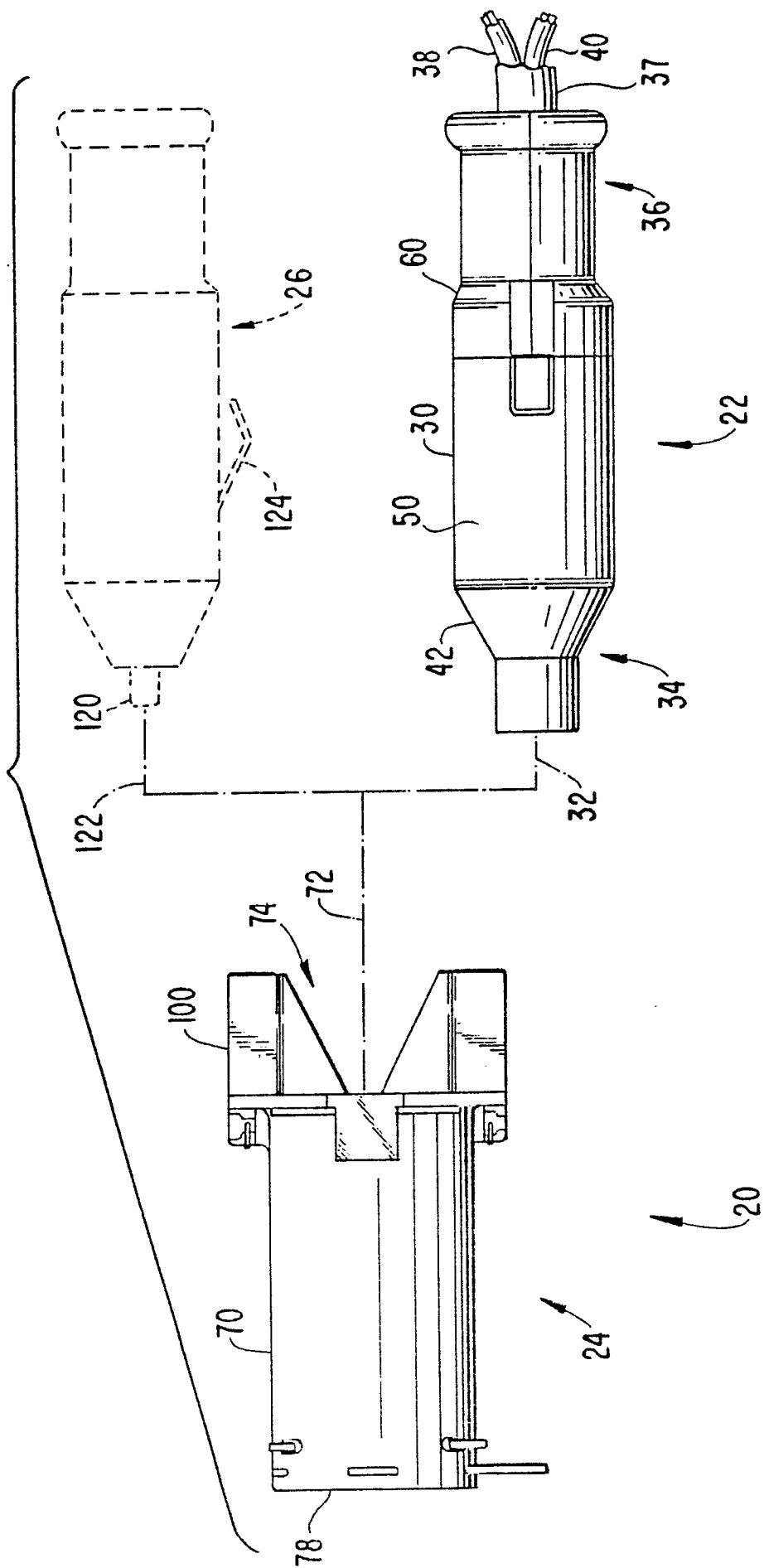


FIG. 2

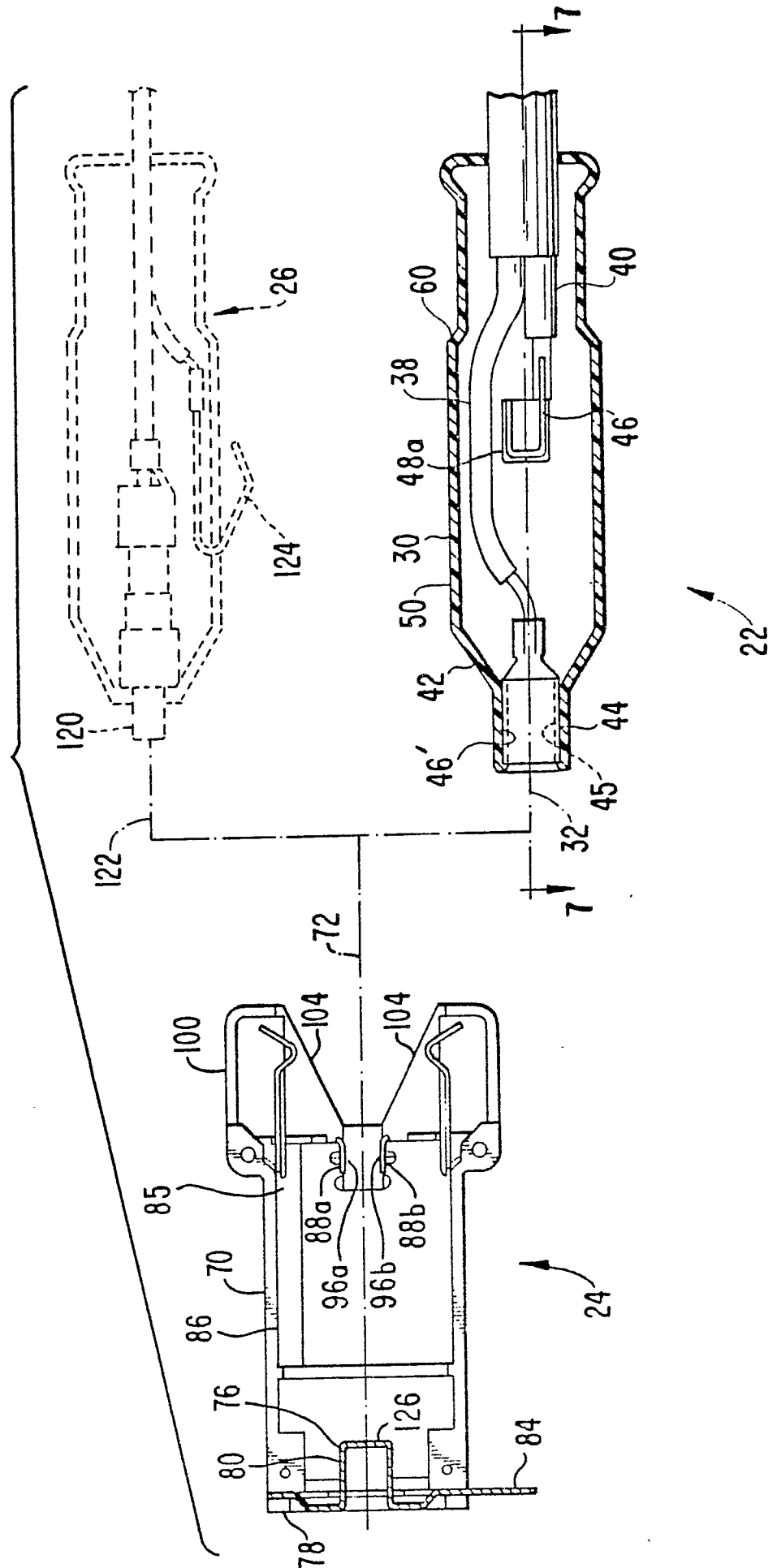


FIG. 3

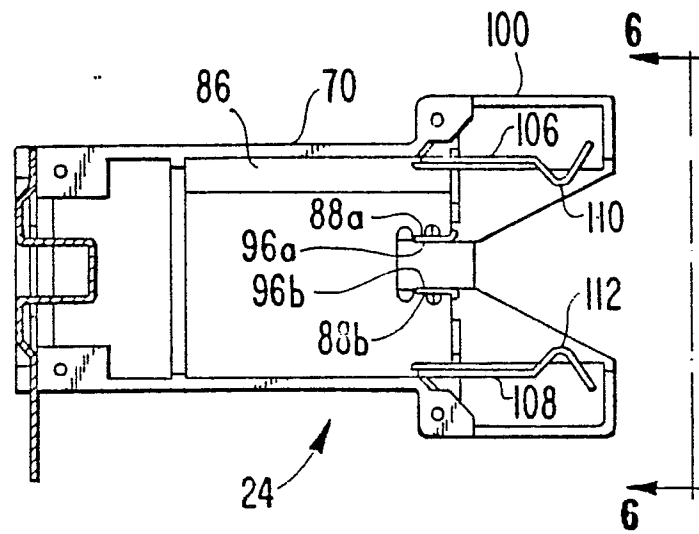


FIG. 4

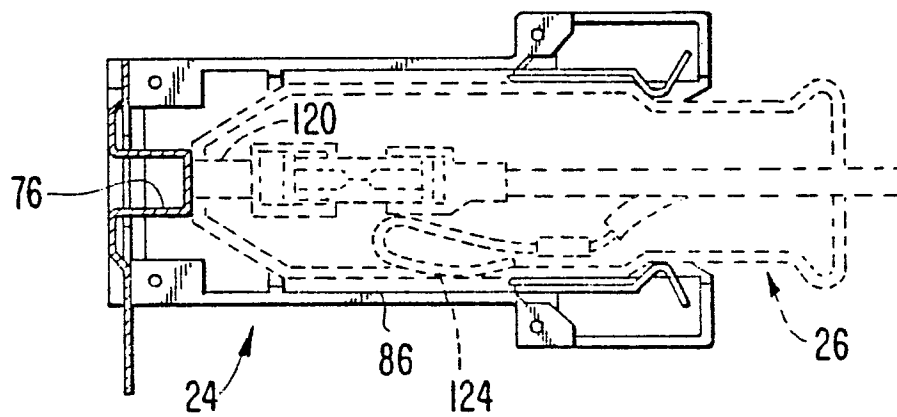


FIG. 5

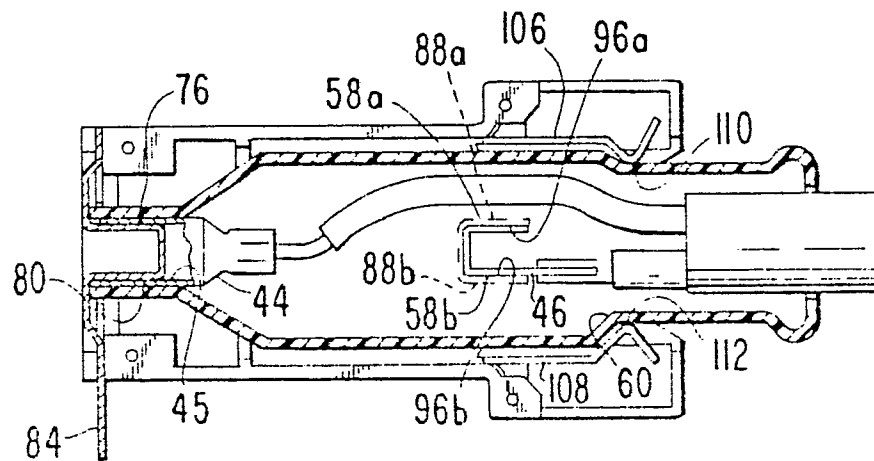


FIG. 6

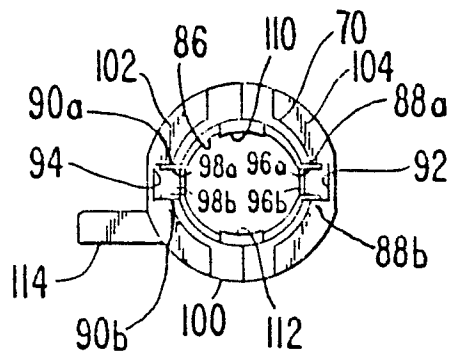


FIG. 7

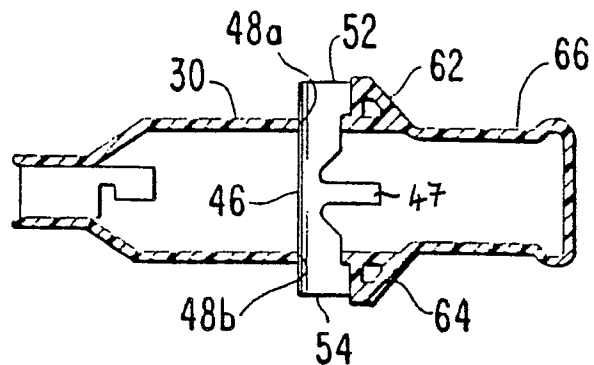


FIG. 8

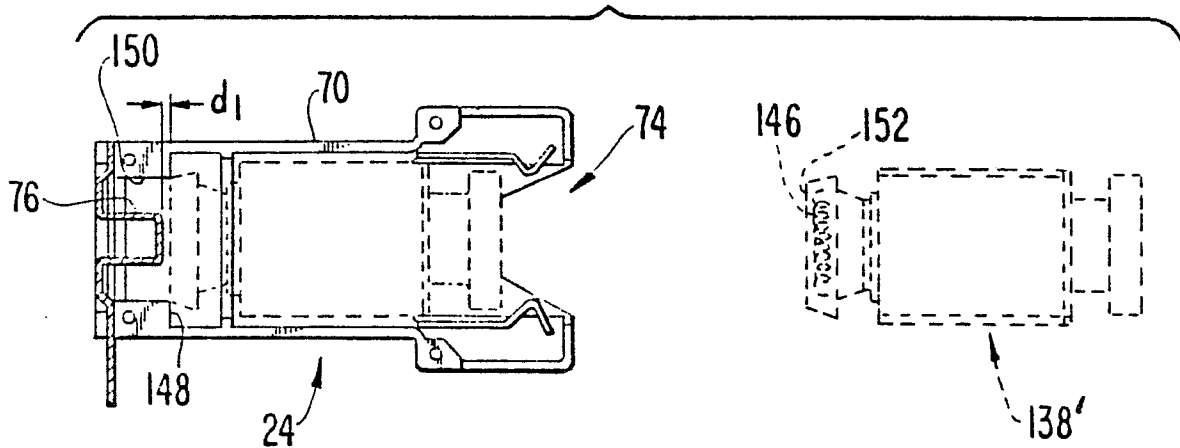


FIG. 9

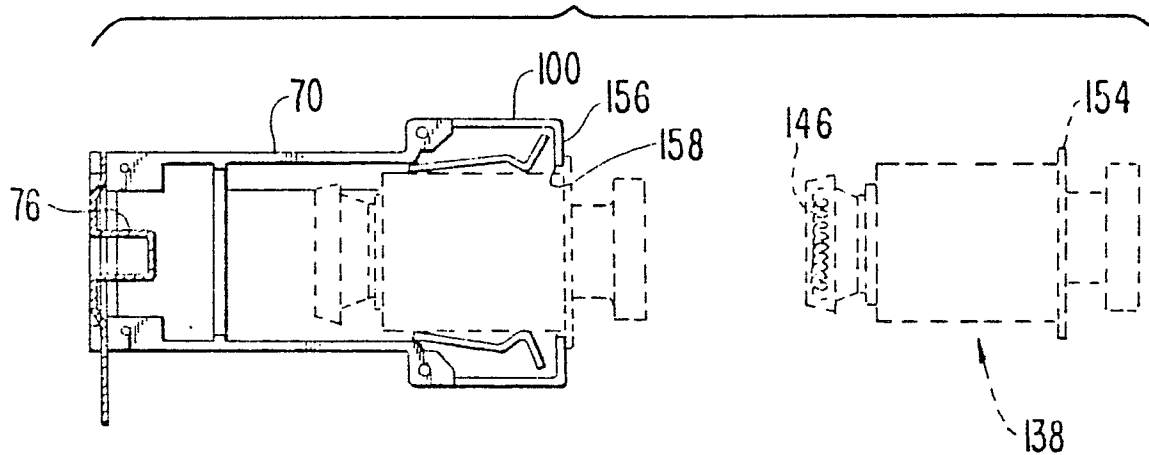


FIG. 10

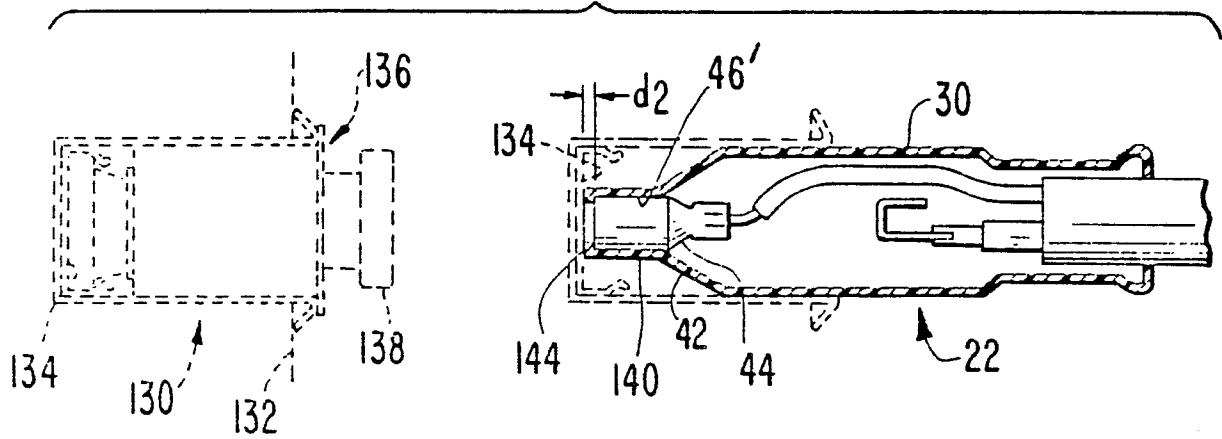


FIG. 11

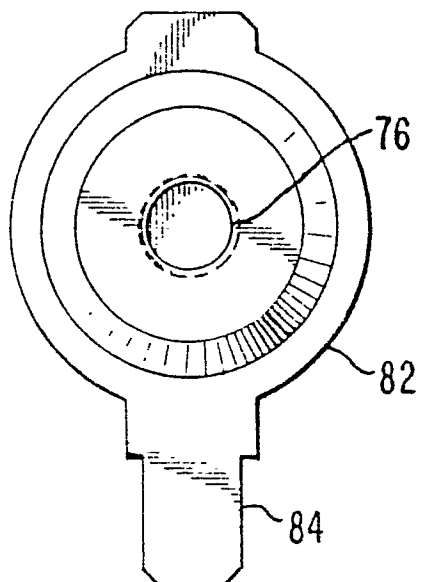


FIG. 12

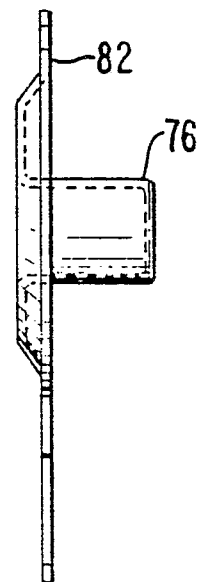


FIG. 13

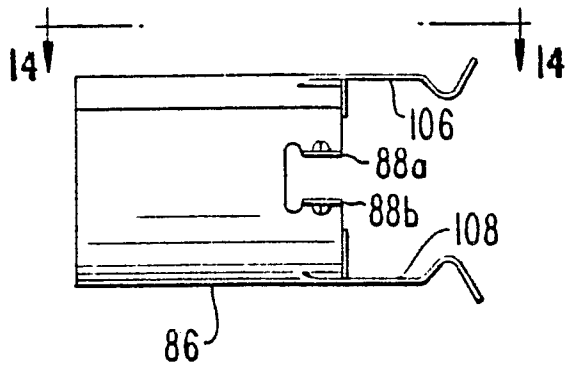


FIG. 14

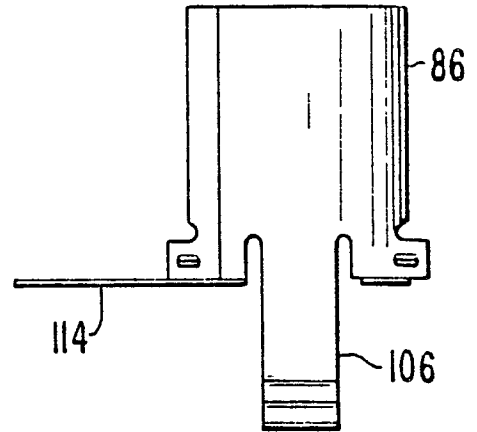


FIG. 15

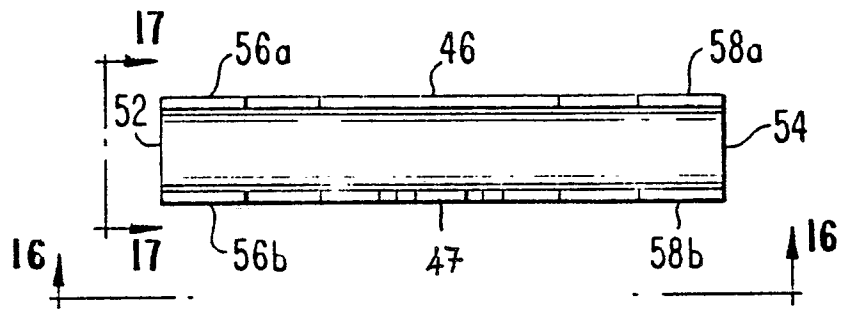


FIG. 16

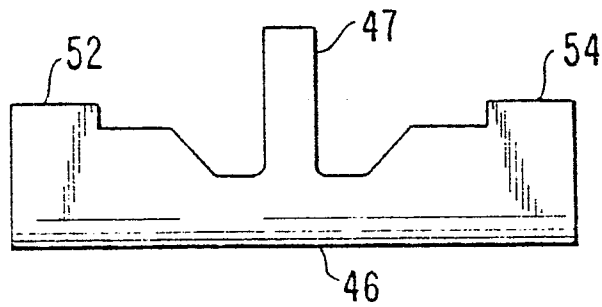
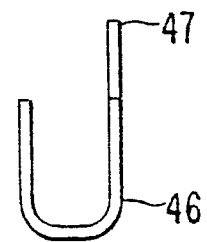


FIG. 17





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
A	FR-A-1 423 103 (AXO) * figure * ---	1	H 01 R 13/64 H 01 R 17/04
A	US-A-3 932 020 (GILBERT) * column 1, lines 5-25; abstract; figure 1 * ---	1	
A	US-A-3 453 578 (FERNALD et al.) * column 1, lines 43-51; column 4, lines 4-19, 38-50; figure 3 * ---	11	
A	DE-U-7 733 921 (PATENT-TREUHAND-GESELLSCHAFT FÜR ELEKTRISCHE GLÜHLAMPEN) * page 5, lines 1-5; figure 2 * -----	11-12	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			H 01 R 17/00 H 01 R 13/00 H 01 R 29/00 H 01 R 11/00 B 60 R 16/00 F 23 Q 7/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 15-06-1988	Examiner LEOUFFRE M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			