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(12) # EUROPEAN PATENT APPLICATION

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(54) **Connector plug having shielding enclosure.**

(57) Connector plug (2) installed on the end of a shielded cable (4) has a shielding enclosure (26) in surrounding relationship to the plug housing (14). The shielding enclosure (26) has an internal cable ferrule (36, 38) into which the cable (4) extends. The shielding material (8), which is a metallized film, is reversely folded (48) and has a first section (52) which extends away from the plug housing (14) and is between the internal surface of the cable ferrule (36, 38) and the surface of the sheath (10) on the cable (4). At the outer end of the cable ferrule, the shielding (8) is reversely folded (54) and has a second section (56) which extends over the external surface of the cable ferrule (36, 38). A crimped sleeve (58) is provided in surrounding relationship to the cable ferrule (36, 38) and clamps the shielding (8) to the cable ferrule to secure an electrical connection. The sleeve (58) extends beyond the cable ferrule and is also crimped onto the cable (4) to provide a strain relief.

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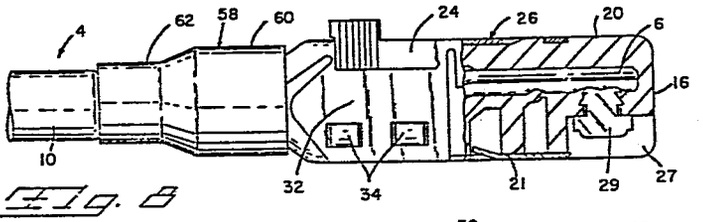
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Fig. 8

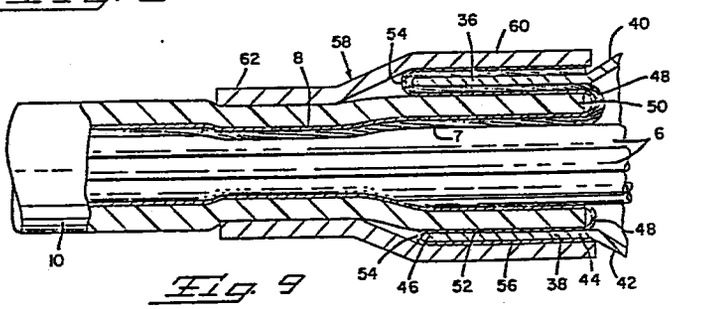
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Fig. 9

CONNECTOR PLUG HAVING SHIELDING ENCLOSURE

This invention relates to multicontact electrical connectors which are provided with sheet metal shielding enclosures and particularly to the achievement of electrical connections between the shielding film in a cable and the shielding enclosure of the connector.

A widely used type of multiconductor cable comprises a plurality of insulated wires having a thin metallized film of shielding material in surrounding relationship to the wires. A cable sheath of relatively durable insulating material in turn surrounds the shielding film. When a connector having a shielding enclosure assembled to the connector housing is intalled on the end of the cable, it is necessary to form an electrical connection between the metallized film shielding material and the metallic shielding enclosure on the connector housing.

The metallized film shielding material, which is usually of a polyester having a thickness of approximately .05 mm, is electrically effective as a shielding medium but it is relatively flimsy. Previously known methods of connecting braided shielding material, of a type commonly provided for shielding cables, are not satisfactory if the shielding material is of the metallized film type. Braided shielding materials are relatively durable and the methods of forming connections of these braided materials to a shielding enclosure tend to require that the shielding material be capable of withstanding physical abuse of a type to which film shielding cannot be subjected. The present invention is directed to the achievement of an electrical connector installed on the end of a cable with the shielding film electrically connected to the sheet metal shielding enclosure on the connector housing, the connections being achieved in a manner such that the film is physically protected and a secure and reliable connection results.

A preferred embodiment of the invention comprises an electrical connector plug installed on one end of a cable. The connector plug comprises an insulating housing having a leading

end, a conductor-receiving end which faces oppositely with respect to the leading end, oppositely facing housing sidewalls and oppositely facing housing endwalls extending from the leading end to the conductor-receiving end. A conductor-receiving opening extends into the housing from the conductor-receiving end. The cable comprises a plurality of insulated conductors, a shielding foil in surrounding relationship to the conductors, and a cable sheath in surrounding relationship to the shielding foil. The connector housing has a metallic shielding enclosure in surrounding assembled relationship thereto which extends at least from the conductor-receiving end partially towards the leading end and the conductors extend into the conductor-receiving opening and are connected to terminals in the housing. The shielding foil is electrically connected to the shielding enclosure. The connector plug and cable is characterized in that the shielding enclosure has an integral cable ferrule, the cable ferrule having a first end which is proximate to the conductor-receiving end of the housing and having a second end which is remote from the conductor-receiving end of the housing. The cable extends into the cable ferrule, the cable sheath being removed from the end portion of the cable so that the cable sheath extends only to the vicinity of the first end of the cable ferrule. The shielding foil has a first reverse fold adjacent to the first end of the cable ferrule and has a first section which extends from the first fold over the surface of the cable sheath and between the cable sheath and the internal surface of the cable ferrule. The shielding foil has a second reverse fold adjacent to the second end of the cable ferrule and has a second section which extends over the external surface of the cable ferrule and towards the first end of the cable ferrule. A crimped ferrule is provided in surrounding relationship to the second section of the shielding foil and the cable ferrule. The crimped ferrule serves to clamp the second section of the cable ferrule thereby to connect the shielding foil to the shielding enclosure.

In accordance with a further embodiment, the cable has a circular cross section and the cable ferrule and the crimped ferrule are cylindrical. The shielding enclosure is formed of two enclosure parts, each of the parts extending across one of the housing sidewalls past the conductor-receiving end of the housing and the cable ferrule comprising semicylindrical extensions on the enclosure parts.

In accordance with a further embodiment, the crimped ferrule extends past the second end of the cable ferrule and has a strain relief crimp portion which is crimped directly onto the cable.

FIGURE 1 is a perspective view of a connector installed on one end of a cable in accordance with the invention.

FIGURE 2 is a perspective view showing a section of the cable with the shielding material and the outer sheath of the cable partially removed.

FIGURE 3 is a view of the end of a cable which has been prepared for assembly to a multicontact electrical connector.

FIGURES 4-6 are a series of views which illustrate the installation of the connector on the end of the cable, the assembly of the sheet metal shielding enclosure to the connector housing, and the steps involved in forming an electrical connection between the shielding enclosure and the shielding film of the cable.

FIGURE 7 is a perspective view of the connector installed on the cable looking towards the rearward end of the connector.

FIGURE 8 is a view looking in the direction of the arrows 8-8 of Figure 7 and showing portions of the connector housing in cross section.

FIGURE 9 is an enlarged cross-sectional view of the rearward portion of the assembly shown in Figure 7 and showing the manner in which the shielding film is connected to the shielding enclosure of the connector.

Figure 1 shows a plug connector 2 installed on one end of a cable 4. The cable, Figure 2, comprises a plurality of insulated

wires 6 which are bunched so that the cable has a substantially circular cross section. The bunched wires are surrounded by a film 8 to provide continuous shielding along the length of the cable. The film may be polyester or other suitable, is metallized on at least one surface, and will usually have a thickness of approximately 0.05 mm. The film is relatively flimsy as compared with braided type shielding materials which are also commonly used. Ordinarily, a drain wire 7 is provided which extends parallel to the insulated wires 6 and which is also used under some circumstances for making connections between the shielding 8 and a further conductor. The shielding material 8 of the cable is in turn surrounded by a relatively heavy insulating sheath 10 which protects the shielding and maintains it in surrounding relationship to the bunched wires 6 despite the relatively flimsyness of the film.

The plug connector 2 may be of the type shown and described in U.S. Patent Application Serial No. 420,762, filed September 21, 1982. The connector comprises an insulating housing 14 having a leading end 16, a conductor-receiving end 18, upper and lower housing sidewalls 20, 21, and oppositely facing housing endwalls 22. Integral latch arms 24 extend from the endwalls and have latching shoulders thereon which engage complementary latching shoulders in the receptacle for which the plug connector 2 is intended.

The housing has a conductor-receiving opening 25 extending inwardly from its conductor-receiving end 18 and a plurality of contact-receiving cavities 27 extend inwardly from the leading end 16 and from the lower sidewall 21 as shown in Figure 8. Flat stamped contact members 29 are positioned in these cavities 27 and when the connector is installed on the cable, these contacts 29 are pushed into the individual wires so that they establish electrical contact with the conducting cores of the wires.

A sheet metal shielding enclosure 26 is provided on the housing 14 and extends from a location intermediate the housing

ends to, and beyond, the conductor-receiving end 18 of the housing. The shielding enclosure in the embodiment shown comprises upper and lower parts 28, 30 which extend over the upper and lower sidewalls 20, 21 and which have flanges 32 that extend over the housing endwalls. The enclosure is retained on the connector housing by means of suitable locking ears on the housing which are received in openings in the flanges as shown at 34.

The two parts of the shielding enclosure have semicylindrical extensions 36, 38 which are connected to the main body of each part by transition sections 40, 42. These semicylindrical extensions form a cable ferrule when the two parts are assembled to the housing as shown in Figure 5 and Figure 6, the ferrule having an internal diameter such that it will receive the cable 6 in a manner described below. The ferrule has a first end 44 which is adjacent to the rearward or conductor-receiving end of the housing 18 and a second end 46 which is remote from the conductor-receiving end 18.

The principles of the invention can best be understood from a description of the manner in which the connector is installed on the end of the cable as illustrated in Figures 3 through 6. Initially, a crimping sleeve 58 is moved over the end of the cable and away from the cable end to permit preparation as shown in Figure 3. The cable sheath 10 is removed from a portion from the end of the cable to expose the conductors 6 which may be taped in side-by-side relationship as shown to facilitate the installation of the connector housing 14. The drain wire 7, if provided, is folded rearwardly as shown in Figure 3 and the shielding material, which is not removed when the sheath is removed, is also folded rearwardly so that it extends over the surface of the sheath 10.

The conductors 6 are then inserted into the conductor-receiving opening 25 and the contact members 29 are driven into the ends of the wires as shown in Figure 8. The two parts 28, 30 of the shielding enclosure are then assembled to

the housing as shown in Figures 5 and 6. The shielding film 8 will then extend beyond the second end 46 of the cable ferrule and it can be folded forwardly as shown at 48 in Figure 6 so as to extend over the outside surface of the cable ferrule. The drain wire is similarly folded as indicated. The cable ferrule advantageously has circumferential grooves 35 therein which assists in obtaining a good electrical connection with the shielding film.

After the drain wire 7 and the shielding film have been folded forwardly at 54, the crimping sleeve 58 is moved along the cable until it surrounds the cable ferrule 36, 38 and it is then crimped at two locations. The portion 60 of the crimping sleeve 58 which surrounds the cable ferrule is crimped as shown in Figure 9 so that it is in constricting embracing relationship with the cable ferrule. The drain wire 7 and the shielding film will then be securely clamped between the internal surface of the crimped sleeve 58 and the external surface of the cable ferrule. The sleeve is also crimped more securely as shown at 62 so that it tightly clamps and surrounds a portion of the cable immediately adjacent to the cable ferrule.

Referring to Figure 9, in the completed assembly, the shielding film has a first reverse fold 48 at which it extends around the end 50 of the cable sheath 10. A first section 52 of the shielding film extends from this first fold leftwardly in Figure 9 and is between the internal surface of the cable ferrule and the external surface of the cable sheath 10. At the second end 46 of the cable ferrule, the shielding film has a second reverse fold 54 and a second section 56 of the film extends rightwardly in Figure 9 between the opposed surfaces of the crimped sleeve 58 and the cable ferrule. As shown in Figure 9, the drain wire 7 follows the shielding film and provides added assurance that a good electrical connection of the shielding enclosure of the connector is obtained.

It will be seen from the foregoing description that the invention does not require an undue number of added parts in

the assembly to obtain the connection of the shielding film to the sheet metal shielding enclosure. The procedure outlined above is relatively simple and straight-forward and can be carried out by a technician with a minimum amount of training. In the finished assembly, the end portion of the cable and the shielding film is entirely protected as shown in Figure 9 so that deterioration of the electrical connection will not take place. The reverse folds 48, 54 in the shielding film and the portions 52, 56 of the shielding film are entirely contained within the crimped portion 60 of the sleeve and are thereby protected. The provision of the strain relief crimp 62 in the sleeve 58 insures that any flexure or handling of the cable during use will not result in the transmission of any forces to the zone 60 in which the film is connected to the shielding enclosure 26.

CLAIMS:

1. An electrical connector plug (2) installed on one end of a cable (4), the connector plug (2) comprising an insulating housing (14) having a leading end (16) and a conductor-receiving end (18) which faces oppositely with respect to the leading end, oppositely facing housing sidewalls (20, 21) and oppositely facing housing endwalls (22) extending from the leading end (16) to the conductor-receiving end (18), a conductor-receiving opening (25) extending into the housing (14) from the conductor-receiving end (18), the cable (4) comprising a plurality of insulated conductors (6), a shielding foil (8) in surrounding relationship to the conductors (6), and a cable sheath (10) in surrounding relationship to the shielding foil (8), the housing (14) having a metallic shielding enclosure (26) in surrounding assembled relationship thereto which extends at least from the conductor-receiving end (18) partially towards the leading end (16), the conductors (6) extending into the conductor-receiving opening (25) and being connected to terminals (29) in the housing (14), the shielding foil (8) being electrically connected to the shielding enclosure (26), the connector plug (2) and cable (4) being characterized in that:

the shielding enclosure (26) has an integral cable ferrule (36, 38), the cable ferrule having a first end (44) which is proximate to the conductor-receiving end (18) of the housing (14) and having a second end (46) which is remote from the conductor-receiving end (18) of the housing (14), the cable (4) extending into the cable ferrule, the cable sheath (10) being removed from the end portion of the cable so that the cable sheath extends only to the vicinity of the first end (44) of the cable ferrule (36, 38),

the shielding foil (8) has a first reverse fold (48) adjacent to the first end (44) of the cable ferrule (36, 38) and has a first section (52) which extends from the first fold (48) over the surface of the cable sheath (10) and

between the cable sheath and the internal surface of the cable ferrule (36, 38), the shielding foil (8) having a second reverse fold (54) adjacent to the second end (46) of the cable ferrule (36, 38) and having a second section (56) which extends over the external surface of the cable ferrule (36, 38) and towards the first end (44) of the cable ferrule, and

a crimped ferrule (58) is in surrounding relationship to the second section (56) of the shielding foil (8) and the cable ferrule (36, 38), the crimped ferrule (58) serving to clamp the second section (56) of the shielding foil (8) against the external surface of the cable ferrule (36, 38) thereby to connect the shielding foil (8) to the shielding enclosure (26).

2. An electrical connector plug (2) installed on one end of a cable (4) as set forth in claim 1 characterized in that the cable (4) has a circular cross section, the cable ferrule (36, 38) and the crimped ferrule (58) being cylindrical.

3. An electrical connector plug (2) installed on one end of a cable (4) as set forth in claim 1 characterized in that the shielding enclosure (26) is formed of two enclosure parts (28, 30), each of the parts extending across one of the housing sidewalls (20, 21) past the conductor-receiving end (18) of the housing (14).

4. An electrical connector plug (2) installed on one end of a cable (4) as set forth in claim 1 characterized in that the crimped ferrule (58) extends past the second end (46) of the cable ferrule, the crimped ferrule (58) having a strain relief crimp portion (62) which is crimped directly onto the cable (4).

5. An electrical connector plug (2) installed on one end of a cable (4) as set forth in claim 1 characterized in that the cable has a circular cross section and the cable ferrule (36, 38) and the crimped ferrule (58) are cylindrical, the shielding enclosure (26) being formed of two enclosure parts (28, 30), each of the parts extending across one of the housing sidewalls

(20, 21) past the conductor-receiving end (18) of the housing (14), the cable ferrule (36, 38) comprising semicylindrical extensions on the enclosure parts.

6. An electrical connector plug (2) installed on one end of a cable (4) as set forth in claim 5 characterized in that the crimped ferrule (58) extends past the second end (46) of the cable ferrule (36, 38), the crimped ferrule (58) having a strain relief crimp portion (62) which is crimped directly onto the cable (4).

7. An electrical connector plug (2) installed on one end of a cable (4) as set forth in claim 6 characterized in that a drain wire (7) extends parallel to the shielding foil (8).

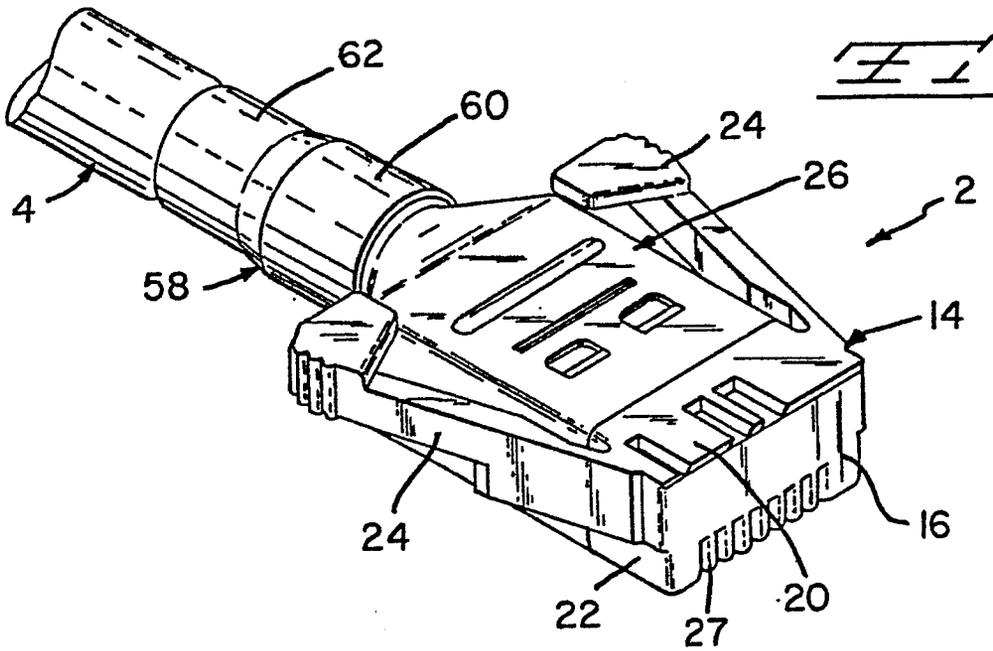


Fig. 1

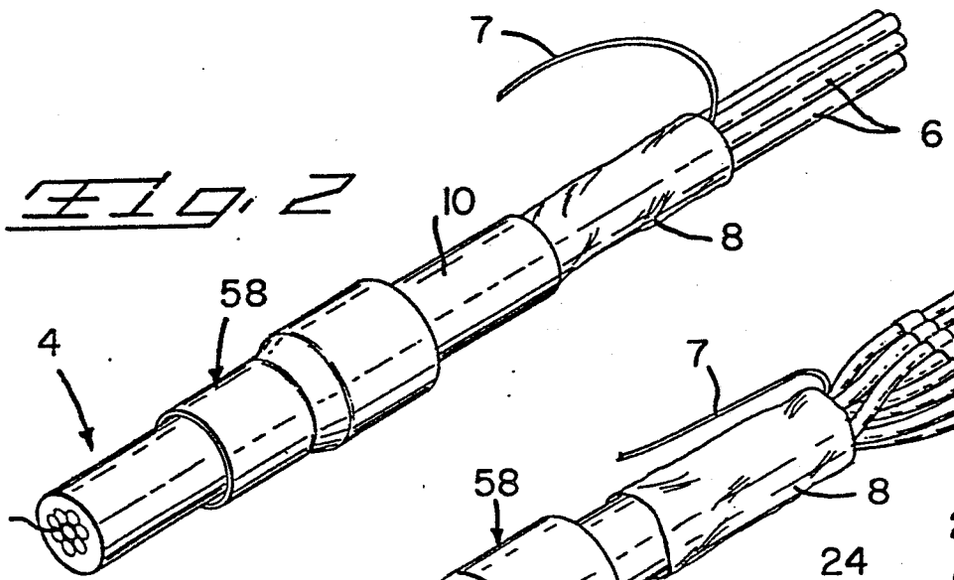
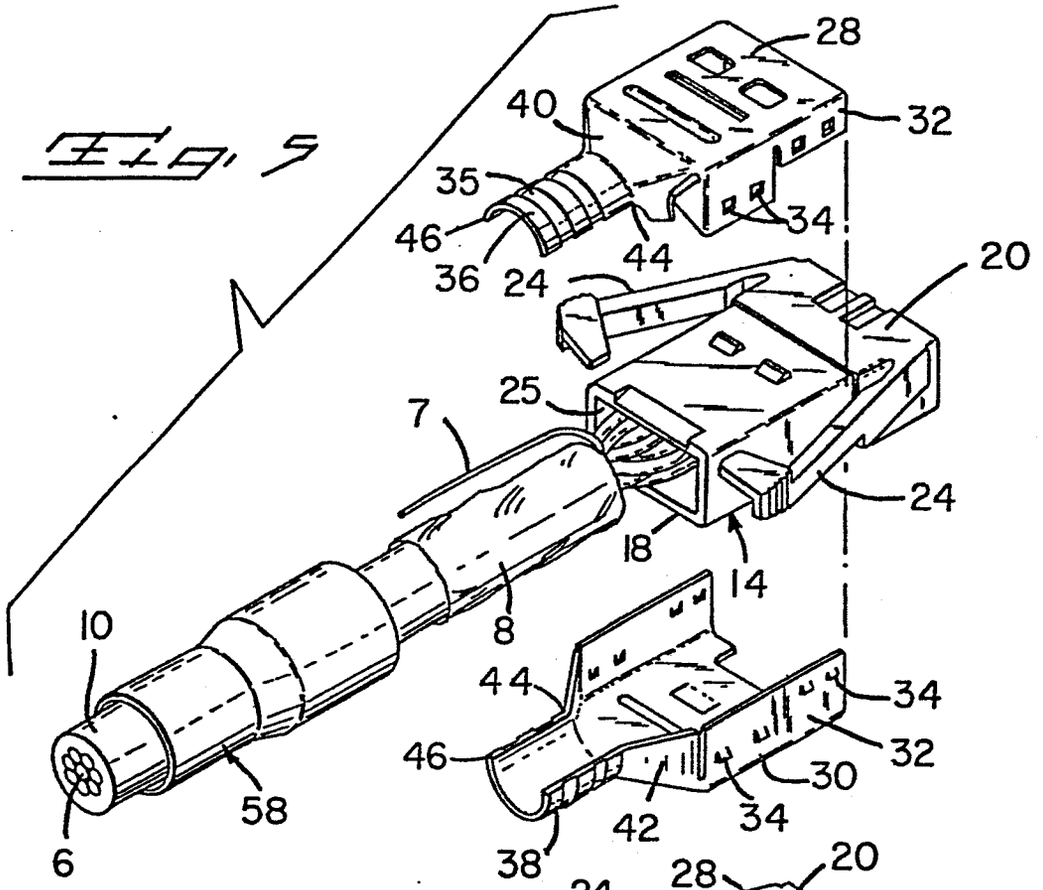


Fig. 2

Fig. 3

Fig. 4

Fig. 5



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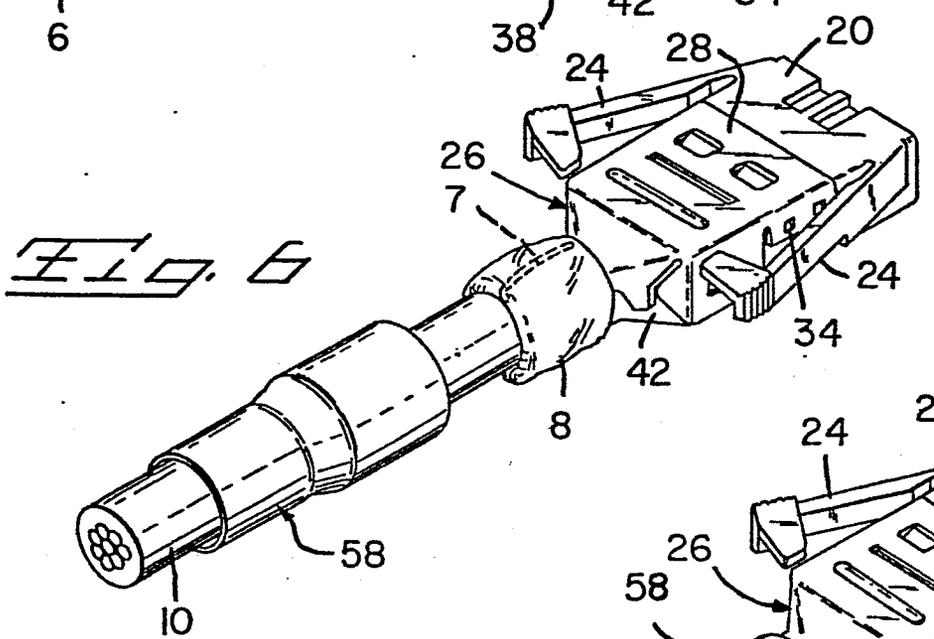
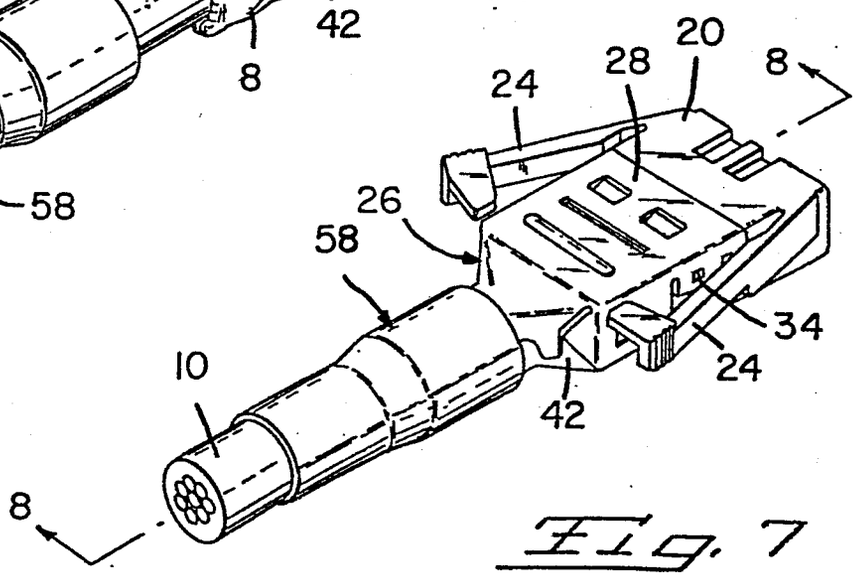


Fig. 7



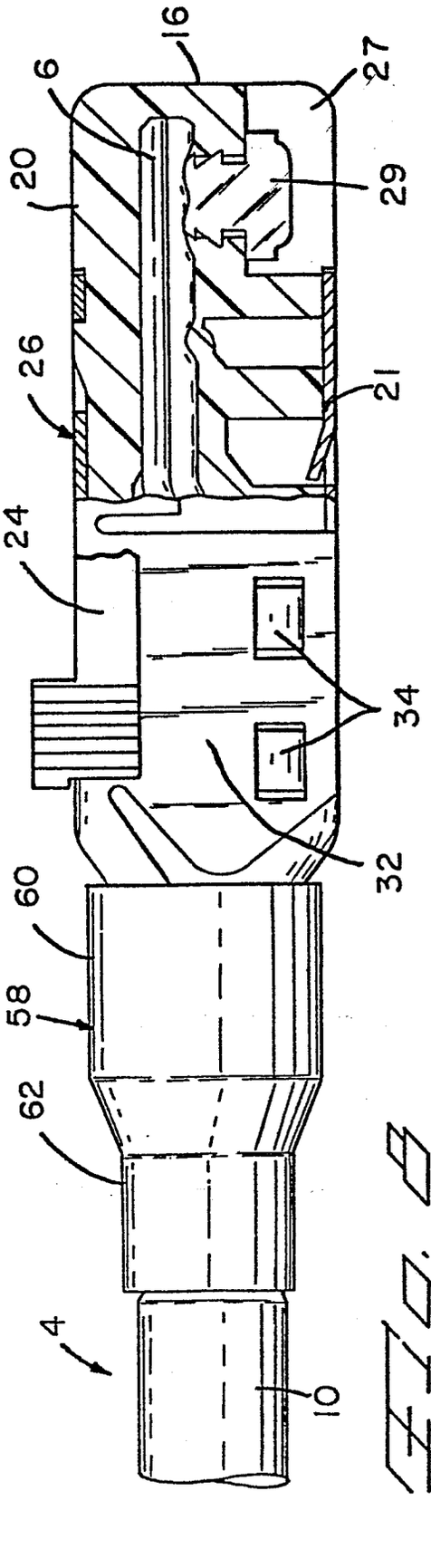

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FIG. 8

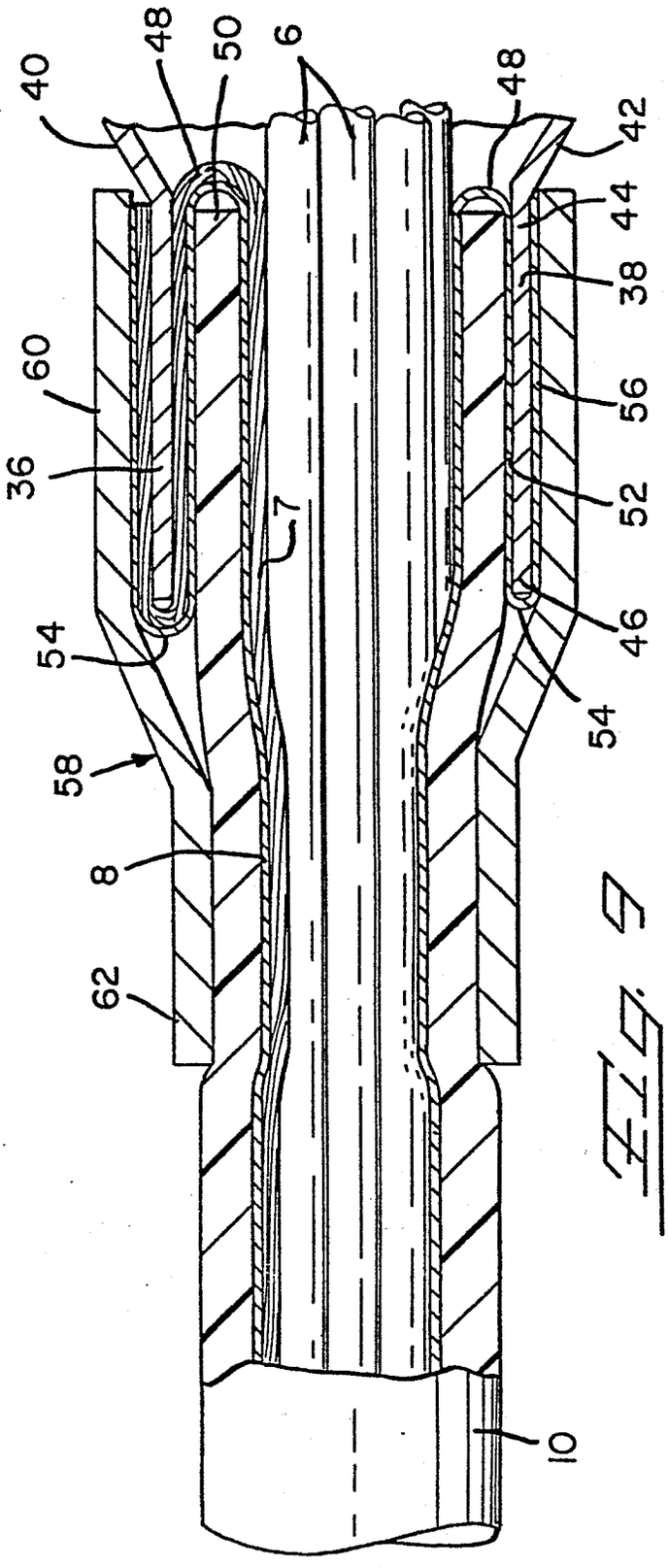
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FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

0125760
Application number

EP 84 30 1809

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. ³)
X	US-A-3 992 773 (DUFFNER et al.) * Column 2, line 1 - column 4, line 42; figures 1-8 *	1,2,4, 6	H 01 R 13/658
A	EP-A-0 040 941 (AMP) * Page 3, line 6 - page 5, line 31; figures 1-8 *	1-6	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

H 01 R 13/648
H 01 R 13/658
H 01 R 13/516

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	16-07-1984	HAHN G

CATEGORY OF CITED DOCUMENTS

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